DOCTOR OF ECONOMICS AND BUSINESS MANAGEMENT

Essays in development economics

On Agents' prosocial and financial behaviours

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Award date:
2020

Awarding institution:
University of Namur

University of Namur

Ph.D Thesis:
Essays in development economics

On Agents' prosocial and financial behaviours

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A thesis submitted by Modeste Dayé in fulfillment of the requirements for the degree of Doctor of philosophy in Economics and Management.

November 2020

 Imprimé en Belgique ISBN : 978-2-39029-127-5 Dépôt légal: D/2020/1881/24

À Evelyne, Catherine et...à toi qui arrive!

Contents

Acknowledgments

My journey as a PhD student in Namur started in october 2014 after completing a research master at the Toulouse School of Economics (France) and an advanced master in international and development economics in 2013.

In 2014, Romain Houssa offered me a contract to work, as a PhD student, on a project called Acropolis and funded by the Belgian Development Cooperation. After a year working on that project, together with Paul Reding and Romain Houssa, we have written a working paper from which we published a policy paper (not part of this thesis). Working with both Romain and Paul in that year was challenging as expectations were high about deliverables and I felt the need to do some teaching along with my research activities. The ideal position to do that is what is commonly called "Assistant". I was lucky enough to have among my first generation friends, François Libois with whom I used to play football and discuss plans. François generously encouraged me to apply for an "Assistant" position opened for the academic year 2014-2015. I have decided to seize that opportunity and talked to Romain who was really supportive of the idea. I have therefore pursued my PhD as an "Assistant". Along my way during these six years, I have intensively interacted with various professors, PhD students fellows and numerous students both as regards my teaching activities and my research. Each these interactions has helped me a lot and has contributed to shape my thesis and my profile.

I want to specifically acknowledge the tremendous support from Romain Houssa, my main supervisor and the key role played by Paul Reding in guiding

me, and providing feedback on my work whenever I ask. Romain Houssa has given much of his time reacting quickly to my questions and providing close guidance and insight. Even at the moment I am writing this acknowledgment, we have been spending time on my work.

I am grateful to my jury members for their patience and the different comments on my work that have helped to significantly improve my thesis. Likewise, I am grateful to Philippe Lemay-Boucher with whom I have collaborated on a project that has led to Chapter 2. This collaboration has been key in my PhD path, in particular, because it has allowed me to conduct a field work on a Randomized Controlled Trial project. I have also had the opportunity to visit the university of Oxford for 2 months in 2018, thanks to Stefan Dercon, who generously hosted me and with whom I have had an interesting discussion on Chapter 2. More recently, Chapter 3 has benefited a lot from insightful discussions with Benoît Decerf, and a great help from my supervisor Romain Houssa.

I thank Pierrette who has been a key person and very helpful in the course of my years of PhD and in particular for administrative matters. I also have to mention that I had very positive interactions with colleagues and friends including: Mattéo, Oliver, Jolan, Nicolas, François W., Doux, Pierre, Camille, Auguste, Joey, Lhorie, Françoise, Pierre, Marie, Stéphanie, Ludovic, Jérôme, Christian, Sébastien, Clarice, Luca Natalie, Coline, François-Xavier, Henri, Victor, Eli, and many others.

Last, but not least I am grateful to my parents Marie and René.

Marcq-en-Baroeul, le 21 novembre 2020.

Introductory chapter

This thesis is composed of three self-contained chapters analyzing two main topics: (i) an analysis of labour supply in the form of volunteering in various sectors (chapter 1), and (ii) the effects of financial inclusion policies both from the perspective of access to savings devices (chapter 2) and access to credit including some related behavioral issues (chapter 3). The two topics are discussed in developing countries context.

Occupation in the form of wage work or of entrepreneurship, and access to formal financial services (e.g. savings, credit) are key ingredients for agents' connection to economic activities. Jobs ensure income generation while financial services facilitate the management of the generated liquidity, including day-to-day transactions, and plans for the future (e.g. investment).

On occupational choices, there is evidence of limited wage work opportunities in developing countries, making many people to resort to self-employment or to microentrepreneurship, and to operate most often in the informal sector. In Benin,[1] for instance, data from a nationally representative household survey (EMiCOV, 2015) show that, 81% of workers are self-employed (Table 1) and 91% of all workers run their activities in the informal sector (Table 2).

[1] Benin is a West African country of about 11 millions inhabitants. Benin used to be categorized as a Low Income Country but have been upgraded in 2020 as a Lower Middle Income Country.

Table 1: **Socio-professional categories**

Categories	#	%
Senior manager, engineer	24,913	1
Middle-grade manager, Agent-control	82,807	3
Employee, skilled worker	120,779	4
Employee, semi-skilled worker	89,048	3
Laborer	68,953	2
Boss/Employer (has at least 1 employee)	48,460	2
Self-employed worker	2,419,720	81
Apprentice	129,771	4
Total	2,984,451	100

Source: EMiCOV (2015)

Table 2: **Count of workers in formal or informal sectors**

Item	Number	%
Informal	2,719,290	91
formal	265,161	9
Total	2,984,451	100

Source:EMiCOV (2015)

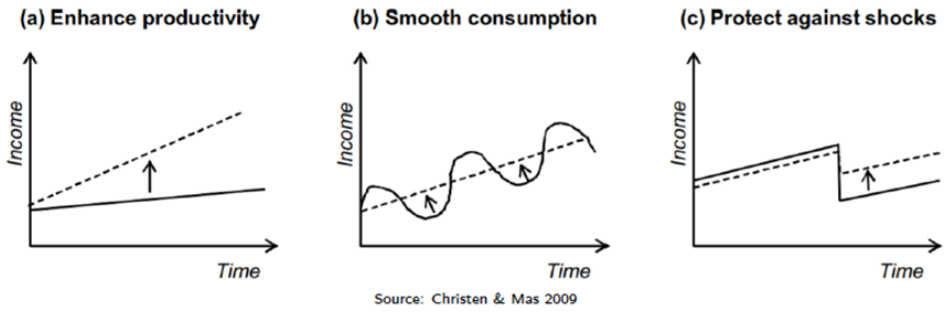
It is well known that years of experience positively correlate with the likelihood of getting wage work. Besides, social capital and network positively affect the probability of finding a job (Hällsten et al., 2017). In a context where decent jobs are scanty, some people may choose volunteering as a strategy to get either first hand experience and to build a network likely to be used when looking for a job. Volunteering mainly led by such purposes is referred to as extrinsic or investment motive volunteering. Alternatively other people might rather want to volunteer simply because they enjoy it or because they like to

reaching out to others needing help, irrespective of their own labor market outcomes. Such volunteers are said to be intrinsically motivated. Considering the major sectors attracting volunteers in developing countries, I study the predominant motive (intrinsic versus extrinsic) for volunteering and discuss potential implications in terms of policies aiming at incentivizing volunteers.

On the second topic of this thesis, financial inclusion, I discuss both access to savings and access to credit and their respective implications in terms of economic activities.

Access to financial services (savings, credit) can help poor deal with three important needs: the need to have higher productivity, the ability to smooth consumption and the ability to protect themselves against various shocks, as described in Figure 1 (Christen and Mas, 2009).

Figure 1: How financial services can improve the lives of the poor



These needs are of particular importance to the poor since they are often faced with volatile income, in particular for unskilled wage work (see, for instance, Flodman-Becker, 2004, for more details on the riskiness of informal wage work) and may also lack resources if they urgently need to face an unexpected event (illness for instance). To that extent, having a secure savings account (formal bank account or mobile money, for instance), at least for precaution (e.g. Paxton and Young, 2011) could be very useful to the poor.
A limited access to formal financial services[2] may therefore further exclude

[2] Services such as deposit accounts, loan facilities, etc. offered by banks and registered

the poor, limiting their economic participation and well-being (Banerjee and Duflo, 2007). While financial services are important, they also need to be easy to understand, accessible, secure and available at decent costs for people to adopt and benefit from using them. However, this does not seem to be the case in the developing world, and in particular in Sub-Saharan Africa where the penetration of formal accounts is low compared to developed countries, 30% against 90% (GFDR, 2017; Chaia et al., 2009).[3] As a result, people partially or totally unconnected to the formal financial system resort to informal financial mechanisms. For instance, investments and savings may be financed by relying on networks, friends (Turvey and Kong, 2010), organized informal settings such as ROSCAs (Anderson and Baland, 2002; Lelart, 2005),[4] moneylenders and insurance groups (Banerjee and Duflo, 2007) or rather on *Tontinier* (Elven and LeMay-Boucher, 2016). Although these informal financial channels are useful, they come with relatively higher risks and costs compared to the formal alternatives (Karlan et al., 2019; Gugerty, 2007). To that extent, one way to help unconnected and poor people to have access to finance is via public interventions initiatives, consisting in offering formal accounts and credit facilities. While such policies have expanded during the last two decades, there is no consensus as regards how effective these intervention are, both in terms of the types of financial products which should be offered, their impacts and in terms of the targeting of beneficiaries. (e.g. Ozili, 2020; Callen et al., 2019; Somville and Vandewalle, 2019; Dupas et al., 2018; Deshpande, 2006).

The second Chapter of this thesis discusses the impact of an intervention consisting in providing in the same context (Benin), two formal savings devices: a microfinance institution standard savings account and a mobile money account to initially unconnected people. Moreover, the extent to which these formal savings devices provided interact with existing informal savings channels such

microfinance institutions.

[3] The World Bank's Global Financial Development Report.

[4] Rotating savings and credit association.

as ROSCAs and *tontinier* are scrutinized.

As part of financial inclusion, access to credit for investment purposes is key. A limited or no access to credit may in fact reduce scope for microentrepreneurship and growth, but also would maintain income and consumption at very low levels. At the same time, it is not clear that public interventions aiming at expanding access to credit are enough to spur investment. In fact, apart from standard reasons nurturing credit constraints such as limited growth prospects, lack of collateral, liquidity constraints, etc., there agent's specific factors such as time-inconsistency due to present-bias and risk-aversion which might also play an important role regarding whether an agent will actually invest, once credit is obtained. There is also evidence that not only present-bias, but also beliefs agents might have on their own time-inconsistency (naiveté versus sophistication) and their risk-aversion are to be considered to fully understand the outcome of agents' decision-making regarding borrowing and investment (Bauer et al., 2012; De Quidt and Ghatak, 2018). In Chapter 3, I discuss how a behavioral and resource-constrained microentrepreneur forms her borrowing and investment decisions based on the extensive margin of sophistication and the extent to which aversion to risk might play a role in enforcing her choices or not.

The rest of the thesis proceeds as follows. In Chapter 1, I study the predominant motive (intrinsic vs extrinsic) for volunteering in the main organizations or sectors attracting this seemingly free labor force.[5] In chapter 2, I evaluate, in the framework of a randomized control trial (RCT), the impacts of expanding access to formal savings and liquidity devices to poor households on their total savings and well-being in Benin. Chapter 3 is a theoretical behavioral model to rationalize poor microentrepreneurs' borrowing and investment choices in a context of an uncertain outside option.

[5] The paper has been published in *Annals of Economics and Statistics*, No. 131 (September 2018), pp. 117-136.

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Chapter 1

Volunteering at the extensive margin: intrinsic or extrinsic motive?[1]

[1] This paper is single authored and published in ***Annals of Economis and Statistics***, **N. 131, september 2018.**

Abstract

This paper identifies the nature of the predominant motive (consumption versus investment) moving people to offer labour for free by considering the major beneficiary sectors involved. Using basic consumption and investment models, some hypotheses are derived and tested to identify the salient motivation for volunteering in each sector. The analysis results in two main findings: (a) in peace movements and in womens groups and associations, volunteers seem to be mainly intrinsically motivated and (b) in sectors concerned with social welfare for the elderly people or in religious and health organizations, the key motivation for volunteering is investment (extrinsic returns).

1.1 Introduction

People face two main types of incentive while entering volunteering: some are categorized as intrinsic motivation and others as extrinsic motivation. An individual is intrinsically motivated to volunteer if it is internally rewarding for her to do so. In that vein, volunteering is undertaken for the sheer joy arising from performing the underlying activities ("warm-glow" utility, Andreoni (1989)) or for some purely altruistic purposes. Conversely, if volunteering is mainly driven by some external expected rewards, the motivation to volunteer is referred to as extrinsic.

The aim of this paper is to analyze the nature of the main incentives moving people to volunteer by considering different beneficiary sectors. More specifically, the paper attempts to find out in which major volunteering sectors (political parties, religious organizations, social welfare for the elderly, women's groups or associations, etc.), motivation is likely to be mainly intrinsically driven, and which sectors seem rather to attract on average, volunteers willing to invest in human and social capital (people motivated by the underlying returns).

Analyzing volunteering and the underlying motivations has a double interest. First, volunteering does not seem to be a market oriented behaviour in the sense that it is not directly priced, although the economic theory would suggest a return in terms of wage for a labour supply, given a corresponding demand. Second, the literature (Table 1.1) shows that under certain conditions, intrinsic and extrinsic motivations might be at odds (Lepper et al. (1973); Deci and Ryan (1985); Frey and Jegen (2001)) or complementary (Eisenberger et al. (1999); Gagné and Deci (2005)). Therefore, the nature of the interaction between the two types of motivation is important for any policy targeting better performance by using external rewards as incentive devices, in particular in sectors where the key motivation making people volunteer is intrinsic. The

cognitive evaluation theory for example (Deci and Ryan (1985), Table 1.1) which builds on people's psychological needs for autonomy and competence suggests that what matters for intrinsic motivation is the ability to express own competence and self-control over the outcomes of the performed tasks. Consequently any external incentive decreasing either the feeling of competence or self-control[2] crowds out intrinsic motivation and self-interest in the activity (Fang et al. (2013)). The Attribution or Overjustification theory (Lepper et al. (1973) applies in a similar way: when people are mainly intrinsically motivated for some tasks, external rewards might induce them to start focusing on the rewards *per se* at the expense of their intrinsic motivation or self interest in the activities. Based on these predictions, whenever intrinsic motivation is predominant in a sector which benefits from volunteering, a policy, targeting for instance better performance or self-interest improvement by providing external incentives, might be unproductive. In fact, such a policy would be perceived by workers or volunteers as controlling[3] rather than supportive (Eisenberger et al. (1999), Gagné and Deci (2005)).

The extent of volunteering can be illustrated both in terms of the money value of the labour services offered, and in terms of the number of people involved in the process, including beneficiaries. For example, around 13.1 millions active Red Cross and Red Crescent volunteers have donated about 6 billion US dollars worth of services that reached approximately 30 million people in 2009 (IFRC,[4] 2011). Another way of valuing the contribution and the value added of volunteers to communities and national societies takes into account the number of years of unpaid labour they provide yearly. More precisely it consists in mapping the time length and the different supports (in-kind and financial) allocated by volunteers to different beneficiaries (non-

[2] Task-contingent or performance contingent rewards such as monetary incentives.
[3] For instance, some threats of layoff if the assigned objectives are not met.
[4] International Federation of Red Cross and Red Crescent Societies Report, 2011.

Table 1.1: Motivation crowding-out and crowding-in theories

Theory	**Key Reference**	**Major Claims Concerning the Effects of Extrinsic Rewards**
	Crowding out effect	
Cognitive Evaluation Theory (CET)	Deci and Ryan (1985)	Under certain conditions, extrinsic rewards undermine intrinsic motivation
Attribution Theory/ The Overjustification Effect	Lepper et al. (1973)	Intrinsic motivation may be decreased by extrinsic incentives
Motivation Crowding Theory	Frey and Jegen (2001)	Intrinsic motivation can be crowded out by extrinsic motivation created by incentives
	Crowding in effect	
Self-Determination Theory (SDT)	Gagné and Deci (2005)	Under certain conditions, extrinsic rewards can enhance intrinsic motivation
General Interest Theory	Eisenberger et al. (1999)	Under certain conditions, extrinsic rewards can enhance intrinsic motivation

Source: Fang et al. (2013), P.19.

governmental organizations, faith-based and community-based organizations). A study conducted in a South African province (Jansenville, Eastern Cape, about 5612 people) for instance concluded that the before-mentioned indicator amounts to 19 years and 8 months of unpaid labour per year by 4343 people (not necessarily from the province) and across 278 beneficiary households (Wilkinson-Maposa (2009)).

Given these different facts, at first glance, volunteering might seem "irrational" if the immediate or expected benefits (including non-monetary benefits) likely to be enjoyed, and the underlying costs (opportunity cost of time) are not clearly evaluated. In this respect, volunteering can be rationalized only if its motivations (in particular non-monetary motives) and the related costs incurred are conveniently accounted for. No matter what drives it, volunteering is observed both in developing countries (which are poorer with more social ties) and developed countries (which are richer with less social ties), suggesting that both economic and non-economic motivations (moral satisfaction, networking, etc.) are involved in the process. In some cases however, one

motivation can be more relevant than the other, depending on what people volunteer for and what they care more about. People can in fact value more, a direct utility (internal satisfaction) from volunteering or rather be much more concerned with an accumulation of work experience and a level of social capital likely to help in relaxing some general constraints in the labour market. The most common constraint is the labour market tightness which consists in a significant discrepancy between demand and supply for labour, implying an excess labour supply (Brigden and Thomas (2013)). In the context of very tight labour market for instance, work experience and valuable networking could in fact improve a volunteer's employment prospects and income. If these external rewards are the key purpose for volunteering, extrinsic motivation would then be leading it. This paper builds on developing countries data for their contrasting environment: (a) higher unemployment, denser and stronger family ties to be maintained as compared to industrial societies (Alesina and Giuliano (2010)) and (b) relatively more risk-averse (Cardenas and Carpenter (2008)), more generous and altruistic people (Piff et al. (2012)). These two features are in fact conducive to the observation of volunteering in similar contexts, for different purposes with room for either motivation (consumption vs investment) to be predominant. The rest of the paper is structured as follows: section 2 describes some key results on different works related to the topic, section 3 shows the theoretical framework and the identification strategy used, sections 4 and 5 present respectively the data used and the estimation results.

1.2 Background

Motivation is anything that energizes someone's behaviour or moves people to behave in a specific way. The debate on volunteering motivations suggests different types of motive to rationalize it, both in economics and psychology. Most of the studies have in fact attempted to model choices volunteers make

regarding the time allocation and provide an analysis of the underlying returns (pecuniary or "inner satisfaction"). More specifically, while psychologists insist on motives that come from within a person (Fischhoff (1982); Hirst (1988)) as being more informative, economists find extrinsic motivation, mainly shaped by external incentives more relevant in explaining human behaviour and argue that people mainly respond to external incentives (in particular money). In parallel, other studies have emphasized on how intrinsic motivation could be altered by some external incentives or rewards and whether people perceive them as controlling or supportive (Frey et al. (1997); Frey and Jegen (2001); Fang et al. (2013)).

The literature on the motives for volunteering has been synthesized into two broad categories of motive by Hackl et al. (2007): (a) the intrinsic motive, accounting for internal satisfaction and considering volunteering as a consumption good and (b) the extrinsic motive, treating volunteering as an investment instrument whose returns are the expected external rewards.

Regarding these motives for volunteering, some papers have considered consumption motive and found that private wealth has a positive effect on voluntary hours and this in turn positively feeds in people's altruistic behaviour (Schram and Dunsing (1981); Unger (1991); Freeman (1997); Govekar and Govekar (2002)). More specifically, Meier and Stutzer (2008) compared volunteers and non-volunteers satisfaction with life and find a robust evidence that the formers feel more satisfied with their life than the latter using the German Socioeconomic Panel (1985-1999). Similarly, Binder and Freytag (2013) have concluded using the British Household Panel Survey (BHPS 2010), that volunteering has a positive impact on subjective well-being, and this tends to increase over time, the more people volunteer.

Only few studies discuss volunteering from the perspective of investment motive or by combining both the investment and the consumption motives in order to properly isolate the dominant category. The usual goal when consid-

ering the investment model for volunteering is to identify whether there is a wage premium for people who volunteer. For some authors there is a significant wage premium of about 4% attributable to volunteering (Day and Devlin (1997), Day and Devlin (1998); Devlin (2000)). However, after restricting the analysis to managerial tasks, Prouteau and Wolff (2006) find no significant wage premium using french cross-section data (1998-1999). All of these studies have though considered volunteering at the aggregate level, that is, regardless of the heterogeneity in volunteering beneficiary sectors.

The combination of the two motives (investment and consumption) is included in a couple of studies of which, one seems to be a synthesis. Hackl et al. (2007) analysis focuses on the two types of motive and finds some significant evidence of investment motive using an austrian survey data (collected in 2001) on volunteers in organizations, no matter what organization it is. They estimate a wage premium of 18.7 % due to volunteering and highlight the importance of the intensive margin of volunteering in explaining this premium. The study's framework is rich for having tested the two motives simultaneously, but failed to identify any sign of intrinsic motivation, probably due to heterogeneity in beneficiary sectors which is not accounted for. Moreover, nothing is said about the potential employability premium[5] likely to be associated with volunteering for investment purposes by unemployed people.

Following the previous discussion, it is important to emphasize the role of incentives since it complexifies the distinction between altruistic pro-social behaviours and the constrained ones. In that respect, Bénabou and Tirole (2003) and Bénabou and Tirole (2006) point out that when honor and/or stigma are the main reputational concern in a society, extrinsic incentives (rewards and punishment) might crowd out some altruistic pro-social behaviours. Elaborating more on the issue of incentives, Seabright (2009) identifies two types of discontinuity regarding an altruistic behaviour. The first type of discontinuity

[5] Difference in the probability to get employed between volunteers and non-volunteers.

relates to the fact that for an altruist, it is more worthwhile to offer the service for free than getting a payment as reward. The second arises from the fact people find it less worthwhile selling the services for a positive amount of money, although they are ready to provide the service for free. These different dynamics, in particular the latter, are accounted for in different theories exhibited in Table 1.1 and discussed in this paper's results. An empirical implementation of the effects of incentives is conducted by Carpenter and Myers (2010). They have implemented an experiment in a context where people could volunteer to be a firefighter. The authors conclude that altruism and reputational concerns are key in the decision to volunteer and are positively correlated with it. However, this effect seems to disappear when there are some variations in stipends incentives (external rewards). All of these models are designed to explain in a sense the main reasons why people volunteer. However, the literature lacks large scale studies involving an analysis on volunteering motives with a focus on the different beneficiary sectors of volunteering, considered separately. This is important since the dynamic of volunteering and its implications might differ from one volunteering sector to the other. Failing to take this into account may lead to spurious general conclusions, that is, conclusions not applicable to most sectors.

1.3 Theoretical framework and Identification

This section shows the theoretical setting for the analysis and describes the identification strategy. It does not provide a formal derivation of volunteering dynamics but induces some interesting insights and intuitions for the identification framework.

1.3.1 Theoretical framework

The framework describes two simple consumption and investment models and their implications in terms of volunteering.

1.3.1.1 Consumption model

Consider an individual whose preferences consist in a linear combination of selfishness and moral attitudes with the weight attributed to morality being the degree of morality.[6]

The typical individual solves the following problem:

$$\max_{\tau_l, \tau_v, G} U(\tau_l, \tau_v, G)$$
$$Subject \;\; to \;\; G = w(\Gamma - \tau_l - \tau_v)$$

where τ_v is the time devoted to voluntary activities, τ_l the time allocated to leisure, G the consumption of usual goods and services, Γ the total time endowment during a given period (with $\Gamma < \infty$) and w the wage per unit of time. The consumption model for volunteering is assumed here equivalent to the basic consumer's program. Volunteering is then included in the program like any normal consumption good as an argument of a utility function $U(\tau_l, \tau_v, G)$, assumed concave and strictly increasing in each argument ($U_x > 0$, for $x \in \{\tau_l, \tau_v, G\}$). This utility is maximized under the budget and time constraint $G = w(\Gamma - \tau_l - \tau_v)$. The key assumption here is that the consumer is not a pure *homo economicus* as regards her consumption of volunteering. This means that her degree of morality is non-zero and if intrinsic motivation is the main driver of volunteering, then τ_v should be non-zero too, irrespective of how much the opportunity cost of time amounts to. From this simple

[6] The extent to which she believes she has to do the right thing in a given situation, see Alger and Weibull (2013) for more details.

framework described, the following conjecture can be analyzed:

Claim: If intrinsic motivation is the main driver of volunteering, then volunteering should induce a welfare premium at the cost of less time available for paid activities. Moreover, the willingness to volunteer should not be decreasing in income nor should it vary across employment status (employed versus unemployed).

A volunteer in this case does not in fact expect any external benefit apart from the enjoyment of the activity she volunteers for. In that sense, becoming poorer or richer should not affect the willingness to volunteer if intrinsic motivation is the main reason for this behaviour. Moreover the welfare premium from volunteering if any, should not significantly differ by empoyment status. That is, being employed should not bring any bonus to the welfare premium derived from volunteering as compared to unemployed people. Conversely, the volunteer might mainly care about the external benefits she is likely to enjoy from volunteering. This case is treated in the investment model.

1.3.1.2 Investment model

The idea behind the investment model is that an individual volunteers because she expects an external rewards, mainly, an accumulation of human capital, some experience and an extension of her networkings in order to relax labour market tightness constraint. In other words, the volunteer anticipates that the experience and the network she could potentially build during the voluntary activities would allow her to get better job prospects (in particular if she previously has no job or has a precarious one).

The following simple dynamic investment model can illustrate the optimal trajectory of volunteering and serves as a baseline to test extrinsic motive (Cahuc et al. (2014), Hackl et al. (2007)). Volunteering for an individual in this context consists in behaving as a pure *homo economicus* agent caring mainly for her own payoffs.

Consider a basic optimization framework in which an individual maximizes her (lifetime working period) net present income:

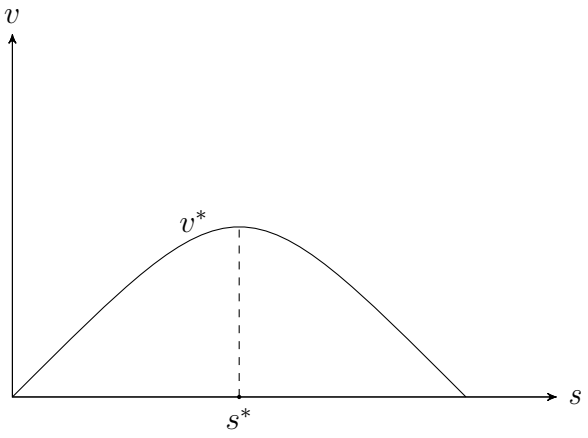
$$\begin{aligned} \max_{v(\tau),\ t(\tau)} & \int_0^{\Gamma} f(v(\tau), s(\tau), t(\tau)) e^{-r\tau}\, d\tau \\ \text{Subject to} \quad & \dot{s}(\tau) = g(v(\tau)) - \varsigma s(\tau) \\ & v(\tau) \leq \Gamma - t(\tau) - l(\tau) \\ \text{and} \quad & v(\tau) < \infty; \Gamma < \infty. \end{aligned}$$

with Γ the total amount of time endowment, $l(\tau)$ and $t(\tau)$ the time length allocated respectively to leisure and to paid jobs and ς the volunteer's depreciation rate for human and social capital (s) at period τ. The depreciation of human and social capital (s) at each period τ is mainly due to skill depletion and some social links (or ties) breaking off especially during inactive periods. In this framework $f(\cdot)$ is the individual production function which can be seen as an income generating process, $v(\tau)$ stands for volunteering amount of time at instant τ and g is the gross gain in terms of know-how, human capital and the networking thanks to volunteering. The income generating process f works as follows: volunteering at period τ decreases the contemporaneous marketable production or income from paid work ($f_v < 0$), it increases the unpaid labour services (v) and boosts thereby the stock of human and social capital ($g_v > 0$) which in turn induces a positive marginal return tomorrow ($f_s > 0$ at $\tau+1$ or at a subsequent optimal $\tau^* > \tau$). These external benefits are not only employment status improving (especially moving from unemployment to employment) but they also offer prospects for higher income and eventually less scope for volunteering. Thus a rational agent will engage in an optimal voluntary activity path if and only if the expected returns from volunteering outweigh the losses incurred in current income due to volunteering, else $v_\tau = 0$.

As shown in Hackl et al. (2007) the optimal trajectory of $v(\tau)$, the solution

to the previous dynamic problem is hump shaped (Figure 1.1).

Figure 1.1: Optimal trajectory v^*



In fact people with a low s and employment prospects would tend to volunteer more up to an optimal threshold, then they will be less likely to volunteer in particular because they would already have a significantly high s and probably a new or a better job. Since volunteering in this model is expected to increase human capital, networking and experience, it has to be the case that it increases the prospects for moving from unemployment to employment. In that respect, the following supposition could be consistently suggested about the investment motive identification.

Claim: Volunteering at time τ increases the likelihood of getting employed at time $\tau + 1$ or at a time $\tau^* > \tau$, and this impact tends to vanish when the individual becomes richer or switches from unemployment to employment.

1.3.2 Identification strategy

Following the previous discussion, the identification strategy is based on the two theoretical frameworks presented and the underlying suppositions. More specifically, the different hypotheses below are derived and serve as the basis of the identification of the key motive in each sector.

Hypothesis 1: *Intrinsic motivation for volunteering is salient*

Volunteering significantly increases people's well-being, and this welfare premium is independent from employment status.

Hypothesis 2: *Extrinsic motivation for volunteering is salient*

There is a welfare premium related to volunteering and this premium significantly varies by employment status. Moreover volunteering increases the likelihood of moving from unemployment to employment.

Hypothesis 3: *No salience identified*

There is no significant welfare premium from volunteering. That is, neither Hypothesis 1 nor Hypothesis 2 hold true. This might happen depending on how the two motives interact in the considered beneficiary sector (crowding-out versus crowding in effects as shown in Table 1.1).

Although testing these interactions is beyond the scope of this work, if none of the motives appears to be dominant, then there are two possible suggestions:

- First, a crowding-out effect from extrinsic motivation if any cannot be strong enough to outweigh intrinsic motivation in the considered sector. The volunteer is as concerned with inner satisfaction as she is with rewards and external returns on time invested.

- Second, one might suggest a crowding-in effect via a self-reinforcing mechanism from the two types of motive.

The different hypotheses are tested using the following estimations in a two-step framework :

Step 1: Is consumption motive salient?

$$
\begin{aligned}
Wellbeing_i = \quad & \beta_1 Volunteering_i + \beta_2 Education_i + \beta_3 Employment_i \\
& + \beta_4 Employment_i * Volunteering_i \\
& + \delta' controls_i + countryfe + \xi_i \qquad (1.1) \\
controls = \quad & \{education,\ gender,\ marital\ status, age, health\}
\end{aligned}
$$

As explained in the identification strategy the parameters of interest are β_1 and β_4. If the welfare premium (β_1) is non-zero and does not statistically differ between employed and unemployed, the consumption motive is key for volunteering in the considered sector. Conversely, when the welfare premium significantly differs between employed and unemployed, there is scope for investment motive salience. Then to confirm whether this is actually the case or not, a second step is required.

Step 2: Is investment motive dominant ?

$$
\begin{aligned}
Employment_{it+1} = & \theta_1 Volunteer_{it} + \theta_2 Age_{it+1} + \theta_3 Volunteer_{it} * Age_{it+1} \\
& + \theta_4 Education_{it+1} + \theta_7 Health_{it+1} + \theta_7 Gender_i \qquad (1.2) \\
& + countryfe + \varsigma_{it+1}
\end{aligned}
$$

Equation (1) is estimated by a generalized ordered logit to account for proportional odds or parallel regression assumption which is taken as given in the simple ordered logit but quite often violated. Equation (2) is estimated via a simple logit. In both cases the different predicted probabilities for each outcome are computed.

In practice, the identification of the predominant motive (consumption versus investment motive) in a given beneficiary sector of volunteering proceeds as follows in a joint hypotheses testing framework:

- From step 1, if $\beta_1 \neq 0$ and $\beta_4 = 0$, then consumption motive (or intrinsic motivation is dominant.
- If from steps 1 and 2 ($\beta_1 \neq 0$ & $\beta_4 \neq 0$) & ($\theta_1 \neq 0$ or $\theta_3 \neq 0$), then

investment motive is more likely to be dominant in the considered sector.

- else, one cannot conclude on a salience of either motive.

The different variables used and the database are described in next section.

1.4 Data

The empirical analysis of this study is based on the World Values Survey, hereafter (WVS) database.[7] It is an individual level survey conducted in about 100 developed and developing countries. This paper focuses on developing countries (Figure 1.2) and on the time period 1999-2003.

The main variables of interest include Volunteering in various forms (different beneficiary sectors), some subjective measures of Well-being (Satisfaction with one's life and Feeling of happiness) and other individual socio-economic characteristics: age, education level, gender, health status, marital status.

Regarding the variable Volunteering, data are collected in all of the beneficiary sectors (see Table 1.2 for the considered sectors) by asking respondents to evaluate a statement for which the possible responses are coded as *1=belongs to* and *0=no*. For instance, the following statement: "*Voluntary work: unpaid work, social welfare service for elderly, handicapped or deprived people*" is the one related to whether or not a respondent volunteers for social welfare services offered to the elderly people.

Furthermore, Table 1.2 provides the average proportion of volunteers by beneficiary sector for the considered period. Information on well-being is captured by the variables Feeling of happiness and Satisfaction with one's life. The statement facing the respondents in evaluating their level of Satisfaction is: *"All things considered, how satisfied are you with your life as a whole these days? Please use this card to help with your answer"*. The response card is

[7] Available at: http://www.worldvaluessurvey.org/wvs.jsp.

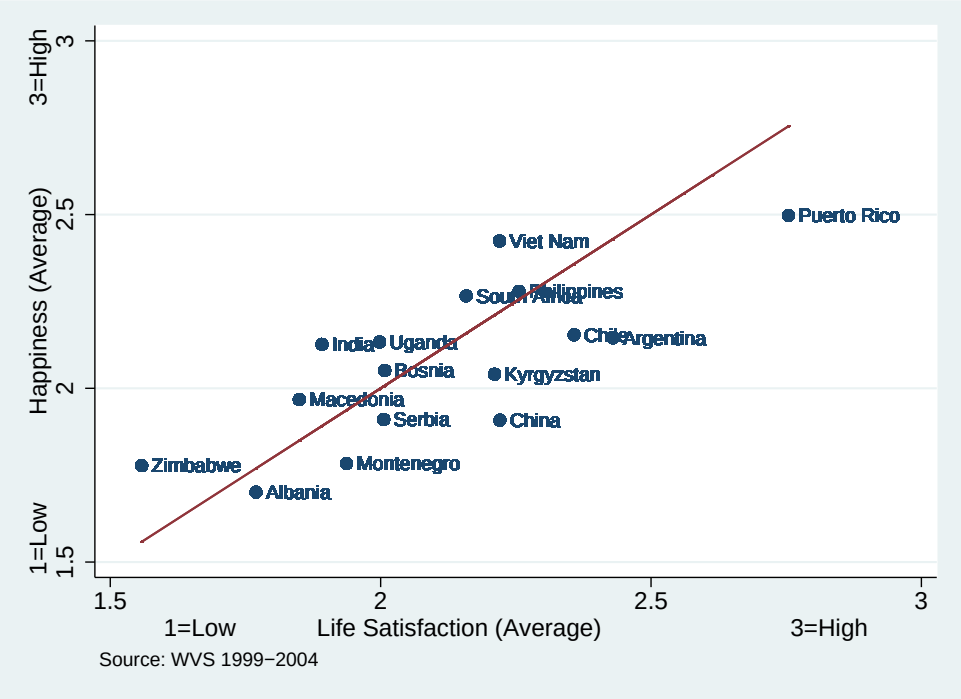
Table 1.2: Summary statistics on the key variables

	Mean	SD	Min	Max
Basic characteristics				
Age	39.5	15.1	15	96
Health Status (Very poor- Very good)	3.87	0.87	1	5
Happiness (Low-High)	2.08	0.69	1	3
Satisfaction (Low-High)	2.11	0.74	1	3
Education (Low-High)	1.89	0.72	1	3
Employed (No/Yes)	0.52	0.50	0	1
Volunteering types **(No/Yes)**				
Social welfare (Elderly/Disabled)	0.11	0.31	0	1
Religious or church organization	0.20	0.40	0	1
Education/arts/music/cultural activities	0.093	0.29	0	1
Political parties or groups	0.075	0.26	0	1
Youth work	0.063	0.24	0	1
Women's group	0.11	0.31	0	1
Peace movement	0.055	0.23	0	1
Health organization	0.073	0.26	0	1
N		16105		

Source: Author's calculations based on World Values Survey database.

a three scale choices ranging from *1=Dissatisfied (Lowest level)* to *3= Very satisfied (Highest level)*. Similarly, the same process is used to evaluate Happiness using the following statement: "Taking all things together, would you say you are: *1=Not at all happy (lowest level)* to *3 =Very happy (Highest level)?"*.

Figure 1.2: Measures of Well-being



The two proxies for well-being, happiness and satisfaction are positively associated and most of the countries considered are quite close to the 45 degree line (Figure 1.2). Although on average people tend to report slightly lower level of satisfaction, both measures should give consistent results regarding the question addressed in this paper. However, it is argued that in most cases, happiness should be preferred since it allows to capture people's ultimate objective or interest (Veenhoven (2012), Ng (2015)).

1.5 Results and discussion

The estimation results of equation (1) are reported in Tables 1.3 and 1.5. The results from equation (2) are reported in Table 1.7 (see the annexes).

Two types of information are used from those tables:

(i) The marginal effects on the probability to claim a given level of well-

being (mainly Happiness) conditional on volunteering summarized in Tables 1.3 and 1.5. Note that these tables also include the interaction effects of volunteering and employment status on well-being in order to evaluate whether there is scope for investment motive to be dominant.

(ii) The predicted probabilities to get a job during the time period 2000-2003 given volunteering at the start of the period (Table 1.7, Panel A). Moreover, the differential effects across age cohorts in terms of difference-in-differences (Diff-in-Diff hereafter) of the predicted probabilities are provided in Panel B, Table 1.7. They allow to evaluate the employability premium related to volunteering and how it varies across age cohorts and beneficiary sectors.
Using these two points combined with the identification strategy described in section 3, a conclusion is drawn on the type of motivation more likely to be salient in each considered beneficiary sector and the implications.

The following discussion starts with the beneficiary sectors where the consumption motive is more likely to be dominant, and proceeds with the investment motive sectors. The last point includes organizations where none of the motive is identified as dominant.

1.5.1 Consumption motive

From the results provided in Table 1.3, people seem relatively more likely to volunteer for consumption motive in two sectors: Women's groups and Peace movements (columns (6) and (7)). The former beneficiary sector consists in women's associations with the purpose of defending their own rights and fight for more equality between men and women. The latter includes organizations seeking to achieve ideals like ending wars and violence in the world. In both sectors, there is a welfare premium from volunteering and it does not vary with employment status (columns (6) and (7) of Table 1.3). In Women's groups for instance a volunteer is 3.3 percentage points more likely to evaluate her happiness as high and relatively less as low or medium than would do her

counterpart who does not volunteer there.[8] Similarly, in peace movements, a volunteer is on average more likely (6 percentage points) to rank her well-being as medium and relatively less likely to rank it as low. Given that in the two cases, these rankings hold no matter the volunteer's employment status (interaction effect not significant), it is sufficient to conclude that consumption motive is on average the key motivation for volunteering in the two sectors. In other words, people volunteering in Women's groups and Peace movements seem on average much more concerned about the sheer joy of being member of the groups and taking part to the activities (more intrinsically motivated) than seeking for experience and networking for better job prospects (investment motive). Note that these results are identical to the predictions using satisfaction as a measure of well-being (Table 1.5). In such a context and given the different theories shown in Table 1.1, two types of implication might arise in those sectors in the presence of extrinsic incentives for volunteering: either (a) an undermining of intrinsic motivation by any attempt to extrinsically motivate volunteers, for example by using money as reward (Cognitive evaluation, Over-justification, Motivation crowding theories) or on the contrary, (b) its enhancement (self determination theory, general interest theory). Everything will depend on the nature of the different specific conditions under which in each beneficiary sector, one or the other scenario occurs. However, an analysis of the different conditions conducive to a crowding-out or a crowding-in of intrinsic motivation in the different beneficiary sectors under study are out of the scope of this paper and left for future research.

There are three other beneficiary sectors where there is a welfare premium related to volunteering: Social Welfare for the elderly or deprived persons, Religious and Church Organizations and Health Organizations (Table 1.3, columns (1), (2) and (8)). Volunteers in those sectors are in fact on average relatively less likely to rank their level of happiness as low or even medium as compared

[8] These results hold at 10% significance level.

to non-volunteers. In religious and church organizations for example, people involved in volunteer activities are 10 percentage points more likely to feel strongly happier than their counterpart who are not. However this welfare premium related to volunteering significantly differs by employment status. For those three beneficiary sectors, people do not seem to engage in volunteering mainly for intrinsic motive or consumption purposes. People who are not employed tend in fact to report more often a relatively higher level of happiness (interaction terms in columns (1), (2) and (8), Table 1.3), that is, they would report a relatively higher welfare premium from volunteering than people who already have a job. Obviously there is scope for investment motive to be the leading reason for volunteering in the three cases since the opportunity cost of time that matters mainly for investment motive actually seems to translate into a relatively higher welfare cost for employed people as compared to the unemployed.

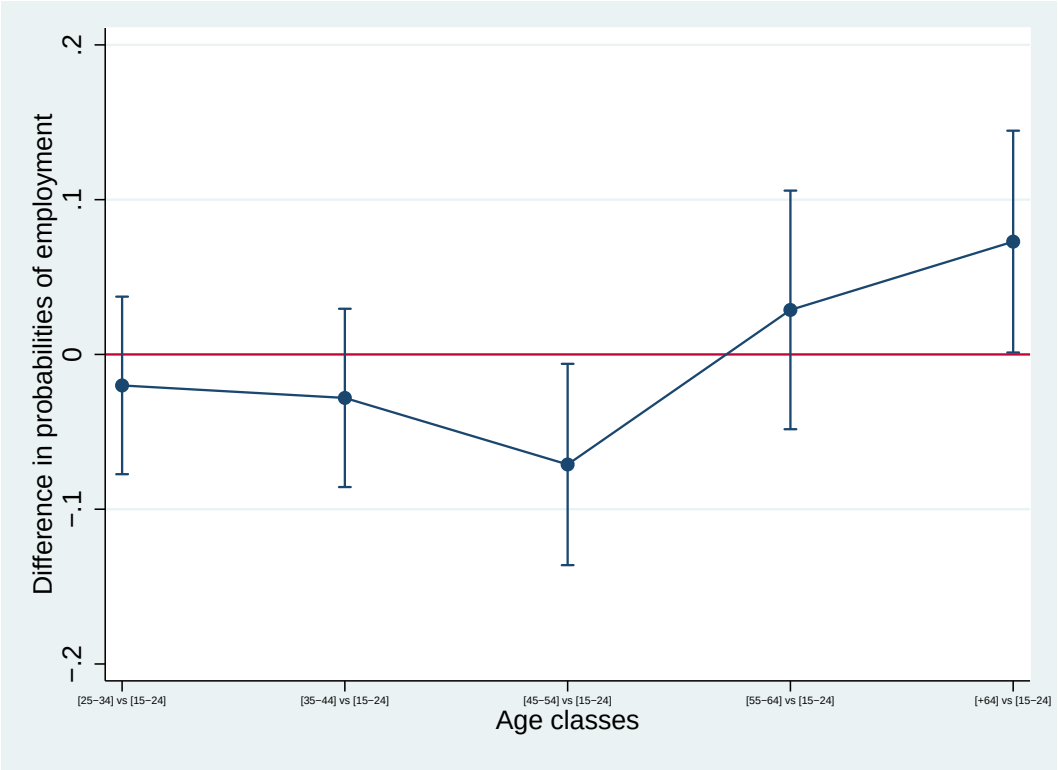
As presented in the identification strategy, further analysis is required for each of the three beneficiary sectors in order to figure out whether it is rewarding or not that volunteering is mainly led by investment motive.

1.5.2 Investment motive

As sketched in the previous section, the three beneficiary sectors where investment motive is more likely to be the leading motive are: social welfare for the elderly or deprived people, religious and church organizations and health organizations (Table 1.3). There are though two questions to be addressed in analyzing those beneficiary sectors from the perspective of investment motive: (a) does it on average make any difference in terms of job prospects to volunteer in either of the sectors and (b) how does it matter across age cohorts to volunteer for better job prospects? To the first question, the answer is yes for two beneficiary sectors: social welfare for the elderly or deprived people and health organizations (Table 1.7, Panel A, columns (1) and (8)). It is not

the case for religious and church organizations (column (2)) where there is on average no significant difference in terms of job prospects between volunteers and non-volunteers. However, regarding the second question, there are some significant differences by age classes not only in that beneficiary sector but also in health organizations (Table 1.7, Panel B, columns (2) and (8)). These differences can be observed in particular for people aged between 45-54 or above 65 years.

Figure 1.3: Diff-in-Diff across age cohorts for religious organizations



Source: Author's estimations based on World Values Survey database.

Figure 1.3 shows that for the elderly (+ 65 years old), the difference in probabilities to get a job between volunteers and non-volunteers in religious and church organizations is larger than in the youngest group (aged 15-24). In other words, for the +65 years old, volunteering in religious and church organiza-

tions for investment purposes seems relatively more rewarding as compared to the youngest group. This is mainly related to the fact that most of the people aged +65 years are retired, need to be active and to keep good connections with people in order not to feel useless to the society and these returns to volunteering significantly make them better off (Morrow-Howell et al. (2003)). In this respect, any sector likely to generate those returns are good candidate for them, except for the youngest. The +65 would thus tend to target sectors with less competition and requiring more life experience and general knowledge, in particular, if the experience accumulated over the course of their working period happens to be irrelevant. They are then relatively more attractive for such sectors compared to the youngest, and it is likely to be the case in religious and church organizations. On the youngest people side, the fact that there is a relative immobility of skills and workers across religious and church organizations, due to differences in religious practices, in faith and thereby, in the way the different tasks are executed, is deterrent. In fact, some valuable skills and capacity built in one religious organization might be useless or inappropriate in another organization (Bauder (2005), Michelle (2009), Kelly (2011)). The elderly people would be less concerned about this than would be the younger ones. Therefore, the younger someone is, the less likely she is to significantly benefit from an investment in religious and church organizations for better job prospects as compared to the elderly people.

The other significant result for religious and church organizations (Figure 1.3) simply reflects that it is relatively more costly for the 45-54 years old to volunteer in religious and church organizations for the sake of a new job or for better job perspectives than it is for the youngest people (15-24). As shown in Panel A of Table 1.7 (column (2)) the 45-54 years old people are significantly more able on average to find a job than the youngest group, regardless of volunteering. So for them in fact, it is relatively less valuable to volunteer in religious and church organization for investment purposes than it

would be for the 15-24 due to the characteristics of the sector exposed above (relative immobility of labor and skills for instance) which are more harmful (induce higher opportunity costs) for the 45-54 years old than for the 15-24 old.

There is no significant differences across age classes in terms of employability induced by volunteering for social welfare to the elderly persons. It might happen if for example volunteering is mainly directed to grandparents and takes the form of exchange for services where the volunteer (their child) provides them with some financial support or healthcare and in turn expects them to take care of some domestic chores, childcare, etc. (Wu and Li (2014)). The volunteer will in fact in such a context have relatively more time and energy at disposal for a new or a better job search. This holds irrespective of the volunteer's age. Similarly, in the case that extrinsic motive is exclusively guided by investment in know-how and networking, the returns in terms of employability do not significantly differ by age cohorts for social welfare to the elderly.

Finally, the results for health organizations (column (8)) and for religious and church organizations (column (8)) are similar except that the employability premium induced by volunteering in health organizations is significant only for the +65 years old people. The main explanation to this is work experience often required for health related activities.

The following section focuses on beneficiary sectors showing no salience of either motive.

1.5.3 Other beneficiary sectors

There are three sectors for which neither intrinsic motive nor investment motive is identified to be the predominant motive for volunteering in this paper. Those beneficiary sectors include art, music or cultural activities, political parties and human rights. Therefore, on average, people volunteering in those

sectors are as likely to be concerned with enjoying *per se* the tasks performed in the framework of their voluntary activities, as the experience or the better job prospects and opportunities volunteering provides them with. In this case, the two types of motive are likely to be self-reinforcing. However this observation needs further investigations.

1.6 Conclusion

This paper primarily contributes to the literature on volunteering and the underlying motives by considering the major beneficiary sectors separately and by identifying volunteers' predominant motivation (intrinsic versus extrinsic). The interest of this contribution is twofold: (a) it emphasizes the necessity to disaggregate volunteering in different beneficiary sectors for an analysis on the motives and (b) it implies that a knowledge on the leading motivation in each beneficiary sector is key for any policy aiming at improving productivity or the volunteers' endeavor, given the risk of a crowding-out of intrinsic motivation and self-interest.

The methodology is built on a simple model of consumption and investment and provides an empirical framework that compares volunteers and non-volunteers in different dimensions, controlling for their main socio economic-characteristics. These dimensions include well-being, employment and age cohorts.

The analysis results in two main findings. First, in peace movements and in women's groups and associations, volunteers seem mainly intrinsically motivated rather than seeking for investment in experience and networking for better job prospects. Therefore for those sectors, providing some extrinsic rewards (positive or negative) seeking for example for better performance or higher returns might not be worthwhile, in particular if these rewards are perceived as controlling or undermining autonomy. Second, for sectors concerned

with social welfare for the elderly people and in religious and health organizations, the key motivation for volunteering is investment and the underlying returns (extrinsic returns). In this case, volunteers are more likely to positively respond to extrinsic incentives. Future research projects on the topic might focus on the conditions under which, a crowding-out effect occurs in the presence of extrinsic incentives in sectors where people are mainly intrinsically motived to volunteer, and to which extent a crowding-in effect would happen in such sectors, accounting for the intensive margin of volunteering.

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1.8 ANNEXES

Table 1.3: First step analysis: Consumption motives and potential extrinsic motive using Happiness

Panel A of beneficiary sectors

	HAPPINESS[=Low-Medium-High]											
	(1) Social welfare: Elderly/Disabled			(2) Religious and church organization			(3) Education Art/Music			(4) Political parties or groups		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
employed	-0.0017	0.023**	-0.021**	-0.010	0.029***	-0.019*	-0.0015	0.030***	-0.028***	-0.0052	0.033***	-0.028***
volunteer	-0.066***	-0.019***	0.084***	-0.032***	-0.071***	0.10***	-0.019	-0.0054	0.024	-0.023	-0.0065	0.030
empl_vol	0.0078	0.085***	-0.093***	0.035**	0.0097**	-0.045**	-0.024	0.043*	-0.019	0.025	0.0070	-0.032
N	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105

Panel B of beneficiary sectors

	HAPPINESS[=Low-Medium-High]											
	(5) Human right			(6) Women groups			(7) Peace Movement			(8) Health Organization		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
employed	-0.0040	0.033***	-0.029***	-0.0042	0.033***	-0.029***	-0.0034	0.032***	-0.029***	-0.0031	0.028***	-0.024***
volunteer	-0.026	-0.0073	0.033	-0.026*	-0.0072*	0.033*	-0.083***	0.060**	0.023	-0.044***	-0.012***	0.057***
empl*vol	0.0043	0.0012	-0.0055	0.0053	0.0015	-0.0069	0.023	0.0065	-0.030	0.0047	0.078***	-0.083***
N	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105

Note: Data are from the World Values Survey. The coefficients reported in both panels are the marginal effects on the probability of having either level of Happiness conditional on volunteering and some controls. The dependent variable (Happiness) has three categories: ***Low, Medium*** *and* ***High***. In each column volunteering is characterized by the considered beneficiary sector (2^{nd} row in the heading). For example column (1) reports the effects of volunteering for ***Social welfare*** on the probability of being in either category of happiness, the effect of employment and the interaction effect of volunteering and employment status. The control variables used are: education level, health status, gender, marital status and age. Their effects are in the expected direction and not reported for presentation purposes. The country fixed effects are also controlled for and the significance levels considered are: *** p<0.01, ** p<0.05, * p<0.1.

Table 1.5: First step analysis: Consumption motives and potential extrinsic motive using Satisfaction

Panel A of beneficiary sectors

	SATISFACTION[=Low-Medium-High]											
	(1) Social welfare: Elderly/Disabled			(2) Religious and church organization			(3) Education Art/Music			(4) Political parties or groups		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
employed	-0.024***	0.019*	0.0049	-0.019***	-0.0054***	0.025***	-0.024***	0.012	0.012	-0.023***	0.012	0.012
volunter	-0.12***	0.097***	0.024	0.016	-0.052***	0.036**	-0.017	-0.0048	0.022	-0.014	0.042**	-0.028
empl_vol	0.035	-0.094***	0.059*	0.013	0.0038	-0.017	-0.014	-0.0040	0.018	-0.021	-0.0059	0.027
N	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105

Panel B of beneficiary sectors

	SATISFACTION[=Low-Medium-High]											
	(5) Human right			(6) Women groups			(7) Peace Movement			(8) Health Organization		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
employed	-0.016**	-0.0044**	0.020**	-0.027***	0.015	0.013	-0.026***	0.015	0.011	-0.018***	-0.0050***	0.023***
volunteer	-0.018	-0.0050	0.023	-0.046**	0.030*	0.017	-0.11***	0.10***	0.0091	-0.063***	0.043**	0.020
empl_vol	-0.050	0.048	0.0025	0.0041	0.0012	-0.0052	0.041	-0.084*	0.043	0.026	0.0072	-0.033
N	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105	16105

Note: Data are from the World Values Survey. The coefficients reported in both panels are the marginal effects on the probability of having either level of Satisfaction conditional on volunteering and some controls. The dependent variable (Satisfaction) has three categories: ***Low, Medium*** *and* ***High***. In each column volunteering is characterized by the considered beneficiary sector (2^{nd} row in the headings). For example column (1) reports the effects of volunteering for ***Social welfare*** on the probability of being in either category of Satisfaction, the effect of employment and the interaction effect of volunteering and employment status. The control variables used are: education level, health status, gender, marital status and age. Their effects are in the expected direction and not reported for presentation purposes. The country fixed effects are also controlled for and the significance levels considered are: *** p<0.01, ** p<0.05, * p<0.1.

Table 1.7: Second step analysis: Investment motive and comparative effects by age

Panel A: Effects of volunteering on employment by beneficiary sector

	Predicted Pr(Employed=1)							
	(1) Social welfare: Elderly Disabled	(2) Religious and church organization	(3) Education Art/Music	(4) Political parties or groups	(5) Human right	(6) Women groups	(7) Peace Mov.	(8) Health Organization
Volunteer	0.081**	0.007	0.010	-0.017	0.006	-0.012	0.034*	0.029*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
$[25-34] vs [15-24]$	0.308**	0.311**	0.308**	0.310**	0.306**	0.307**	0.310**	0.311**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$[35-44] vs [15-24]$	0.400**	0.404**	0.402**	0.405**	0.399**	0.400**	0.404**	0.404**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$[45-54] vs [15-24]$	0.373**	0.376**	0.374**	0.376**	0.371**	0.372**	0.376**	0.377**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$[55-64] vs [15-24]$	0.101**	0.105**	0.104**	0.104**	0.105**	0.104**	0.106**	0.105**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
[65 plus]$vs[15-24]$	-0.154**	-0.150**	-0.146**	-0.151**	-0.147**	-0.149**	-0.146**	-0.147**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Observations	13910	13910	13910	13910	13910	13910	13910	13910

Source: WVS database
**** p<0.01, * p<0.05**

Panel B: Differential effects of volunteering on employment by age categories

	Predicted Pr(Employed=1)							
	(1) Social welfare: Elderly Disabled	(2) Religious and church organization	(3) Education Art/Music	(4) Political parties or groups	(5) Human right	(6) Women groups	(7) Peace Mov.	(8) Health Organization
$[25-34] vs [15-24]$#Volunteer	-0.013	-0.020	0.056	-0.060	0.006	0.032	-0.010	0.045
	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)	(0.04)
$[35-44] vs [15-24]$#Volunteer	-0.051	-0.028	0.083*	-0.051	0.082	0.064	-0.015	0.063
	(0.04)	(0.03)	(0.04)	(0.04)	(0.05)	(0.03)	(0.05)	(0.04)
$[45-54] vs [15-24]$#Volunteer	-0.083	-0.071*	0.084	-0.041	0.086	0.075	-0.024	0.050
	(0.04)	(0.03)	(0.04)	(0.05)	(0.05)	(0.04)	(0.06)	(0.05)
$[55-64] vs [15-24]$#Volunteer	-0.045	0.029	0.139*	0.033	0.245**	0.141*	0.053	0.108
	(0.05)	(0.04)	(0.06)	(0.06)	(0.08)	(0.06)	(0.07)	(0.06)
[65 plus]$vs[15-24]$#Volunteer	0.019	0.073*	0.202**	0.012	0.259**	0.143*	0.127	0.143*
	(0.05)	(0.04)	(0.06)	(0.05)	(0.10)	(0.06)	(0.08)	(0.07)
Observations	13910	13910	13910	13910	13910	13910	13910	13910

Source: Author's estimations based on World Values Survey database.
Standard Errors in parenthesis.

Notes:
[1] In Panel A, the coefficients reported are the predicted probabilities of getting a job during the time period 2000-2003 given volunteering at the start of the period in a given beneficiary sector.
[2] Panel B reports the differences in the predicted probabilities of getting a job when one volunteers and compares it across age cohorts.
[3] In both panels the following variables are controlled for: education level, health status, gender, marital status, the different age classes and the country fixed effects. The significance levels considered are **** p<0.01, * p<0.05**.

Chapter 2

Contrasting the Impacts from two Formal Savings Devices: Evidence from a field experiment in Benin[1]

[1] We are grateful to Charlemagne Codjo Tomavo and Alexandre Zounmenou for outstanding field work coordination. Louise Grogan, Romain Houssa, Paul Reding, Jean-Marie Baland, Stefan Dercon, Denis Acclassato and Catherine Guirkinger for useful discussions and suggestions. We also thank seminar participants at the CSAE conference in economic development (Oxford), Africa Econometric Society Conference (Cotonou), International Development Economics Conference (Clermont-Ferrand) and CRED workshops (Namur). This study was funded by the Economic and Social Research Council United Kingdom (grant ES/N014642/1). The protocol for this study was approved by Heriot-Watt University. The trial is registered in the American Economic Associations registry for randomized controlled trials (ID AEARCTR-0002285).

Abstract

We conduct a field experiment to assess the impacts of access to two formal saving devices on saving behavior. Subgroups of our sample of around 3000 individuals, are offered either access to a mobile money account or an account at a microfinance institution (MFI). One year after opening these accounts, we find that access to a mobile money account substantially increases savings. Comparatively, using a standard saving account from an MFI provides no significant effects on savings. Our results suggest that the flexibility provided by mobile money accounts offers greater rewards to financially unconnected people. We also observe a complementarity between mobile money account and informal saving groups in the form of savings through ROSCAs.

2.1 Introduction

Savings can help poor face three fundamental needs: improving labour productivity, consumption smoothing, and shocks buffering (Christen and Mas, 2009). Depending on the nature of the financial institutions collecting savings (i.e., whether officially registered and subject to official regulations), one can distinguish formal and informal savings. Formal savings are money deposited in an account at a registered financial institution. Informal savings, on the contrary, consist in legally non-binding arrangements with relatives or peers, either in groups,[2] or based on an agreement with an individual who collects deposits.[3] In addition to these different informal savings options, people may also hold cash at home in the form of savings.[4]

Although informal financial mechanisms may contribute to saving mobilisation, these savings channels are known to be costlier and riskier, compared to their formal counterparts (e.g. Karlan et al., 2019; Gugerty, 2007). As a result, access to formal financial institutions is widely promoted in many developing countries. However, there is a debate about the effectiveness of this policy as regards their impact on savings (e.g. Ozili, 2020; Callen et al., 2019; Dupas et al., 2018; Prina, 2015; Kast and Pomeranz, 2014; Deshpande, 2006).

The purpose of the chapter is twofold. First, it studies the impacts of access to formal savings devices on savings. Second, the chapter investigates the interactions between formal and informal devices as regards savings behaviour.

The literature has not been able to provide conclusive answers to these questions (e.g. Dupas et al., 2018; Prina, 2015). For instance, Dupas et al.

[2] e.g. Rotating Savings and Credit associations (ROSCAs), Self-help groups. See Section 2.2 for more detail on these savings channels.

[3] Such an individual is called *Tontinier* or informal itinerant banker or mobile banker. It is the major informal savings mechanism in Benin (26% membership at baseline) after ROSCAs (30% membership).

[4] Home savings consist in keeping liquidity at home, for instance, under the mattress or in a pot. This money is in general not intended to be used to finance current expenses, but most often, unexpected ones.

(2018) study access to a standard savings account in a microfinance institution (MFI) in three countries (Uganda, Malawi and Chile) using a randomized control trial. Two years after the treatment, high take-up rates were observed in Malawi (69%) and Uganda (54%).[5] However, there was, on average, no significant effect on savings in any of the three countries.[6] The authors argue that poverty is a suggestive limiting factor preventing beneficiaries from using the accounts and from saving more. In a related study, Prina (2015) shows that in Nepal, with a relatively high take-up and usage rates (respectively 84% and 80%), access to an MFI account increases savings, one year following the treatment.[7] Regarding the interactions between MFI accounts and informal savings mechanisms, Dupas et al. (2018) find that formal MFI accounts tend to crowd out home savings. There was no significant effect on other informal savings channels (e.g. Somville and Vandewalle, 2017) also find a null effect of MFI accounts on Self-help groups savings (and on ROSCAs) in Indian context.

As for mobile money accounts, there is a growing literature pioneered by studies on M-PESA in Kenya (e.g. Mbiti and Weil, 2015; Ouma et al., 2017). These studies show positive impacts of access to mobile money accounts on savings in Kenya.[8] A Positive impact of mobile money accounts on savings is also found in other case studies. For example, Ouma et al. (2017) find positive effects of mobile money on savings in Uganda, Malawi and Zambia.

[5] The take-up rate in Chile was only 17%.

[6] The authors notice, however, that they cannot reject large and significant effects on savings for the subset of active users of the MFI account. An active user is defined in their framework as an agent having made at least five deposits on the account opened within two years.

[7] The relatively high take-up and impact found by Prina (2015) is mostly due to the fact that she controlled for travel costs to the MFIs branches. These branches were in fact operating within the slums where people live and had developed a close relationship with beneficiaries. In our study, we account for travel costs by controlling for distance to branches (see Section 2.3).

[8] There are other descriptive studies on mobile money development in Kenya: Morawczynski and Pickens (2009), Vaughan (2007). For a discussion related to the impact of mobile money on risk sharing (not accounted for in this study), see notably Jack and Suri (2014), Riley (2018).

Ky et al. (2018) find similar results in Burkina Faso. While access to mobile money accounts tend to significantly improve savings, there is no consensus as for whether its users will continue using informal savings services (ROSCA, *Tontinier*, home savings and self-help groups).

This study adds to this literature by providing a case study on Benin.[9] In particular, what makes this chapter distinctive is the fact that we look at both the impacts of access to an MFI account and a mobile money account in parallel in the same context. This specific setting allows us to better contrast the impacts of the two devices and discuss some policy implications. Moreover, Benin is characterized by a large and diverse informal financial sector, and as such, this case study offers an interesting opportunity to investigate the interaction between any of the two formal accounts and a wide range of informal financial devices (ROSCA, *Tontinier*, home savings, and self-help groups). To the best of our knowledge, the literature is very scant on this issue and available studies on mobile money have also concentrated on Kenya. Moreover, these studies focus on ROSCAs. For instance, Kiiti and Mutinda (2011) find that M-PESA (mobile money) is used for ROSCAs. In a related study, Mbiti and Weil (2015) report that intensive use of M-PESA lowers peoples propensity to use informal savings mechanisms such as ROSCAs. Moreover, users of mobile money accounts are also more likely to have a bank account.[11]

In our study, from a sample of 2894 eligible individuals,[12] we have randomized access to MFI accounts and mobile money accounts. After a year, we find relatively high take-up but low usage for the MFI accounts (52% opened accounts and 21% with at least one transaction), high take-up plus high rates of

[9] Benin, a West African country of 11 million inhabitants (in 2017, World Bank), has a mobile network penetration rate of 88% of adult population in the country.[10] While this mobile network penetration rate is high (compared to other countries in the region), Benin consistently ranks in the poorest countries with an income per capita of $820 in 2016 (World Bank). Since July 2020, Benin has moved to the lower-middle income country category, with an income per capita of $1,250 (World Bank).

[11] In our study, there was no effect of mobile money on bank accounts.

[12] See more detail on eligibility in Section 2.3.

active usage for the mobile money accounts (75% activated accounts and 66% with at least one transaction). More specifically, beneficiaries of mobile money accounts have increased their savings with ROSCAs, suggesting a complementarity between the two savings devices. In particular, mobile money accounts have, on average, induced a significant and positive impact on ROSCA savings (40% more deposits) and on total savings (140%). The positive impacts on total savings are in line with findings by Mbiti and Weil (2015) (for Kenya), Ouma et al. (2017) (for Kenya, Uganda, Malawi and Zambia). More specifically, the positive effect on ROSCA savings is also found in Kiiti and Mutinda (2011). On the contrary, there is no significant effect of mobile money on savings with the other three informal savings devices (*Tontinier*, home savings and self-help groups). In the same way, access to MFI accounts has no significant impact on savings in any of the four informal savings devices. Besides, MFI accounts have no significant effect on total savings. We briefly discuss these results below.

First, the complementarity between mobile money accounts and ROSCA savings is suggestive that mobile money accounts help minimize transport costs to ROSCA meetings (a simple mobile money transfer can, for instance, be used to contribute to the ROSCAs common pot). To that extent, mobile money accounts may introduce greater flexibility in ROSCA functioning by allowing for fewer meetings and yet, facilitating regular contributions to the ROSCAs common pot.[13] On the contrary, there is no other significant effects of mobile money accounts on remaining informal savings devices (Tontinier, Self-help group and home savings). In the case of Tontinier, one likely explanation of the null effect is that saving with a Tontinier does not incur any direct travel cost to the depositor, since the Tontinier usually goes directly to clients to collect savings. Moreover, there is a close interaction between the saver and the

[13] See more detail on the complementarity between mobile money and ROSCAs in Section 2.5.

Tontinier, and this contact facilitates anticipated repayment to the depositor if needed. As a consequence, having access to formal savings devices, such as mobile money accounts, which primarily help minimize transaction costs and safety issues is not expected, a priori, to make any fundamental change on Tontinier.

Second, the null effect of MFI accounts on total savings is also found in Dupas et al. (2018). A plausible explanation to this result is probably the short time length between treatment administration and the follow-up survey in our study. In fact, a key reason for using an MFI account is to facilitate access to loans. Nonetheless, access to loans with an MFI requires that the client saves steadily in an account at the MFI. This saving dynamic, in the case of our partner MFI, for instance, usually goes beyond a year. In this study, we evaluate the impacts of MFI accounts one year after treatment. An additional follow-up survey on a longer time span will probably help to better characterize MFI accounts effects and confirm or not the sustainability of the null result observed in the short run.

The rest of the paper is structured as follows. In Section 2.2, we provide the context of the study which includes the financial landscape (formal and informal financial institutions) and expected benefits from using a formal saving account. We then describe in Section 2.3 the experiment design and the data collected. Sections 2.4 and 2.5 show the results and the underlying mechanisms. Section 2.6 concludes.

2.2 Context

Benin has a dual financial system in which coexist a formal and an informal component (Verpoorten and Houssa, 2008; IMF, 2018). The formal financial sector is made of regular commercial banks, registered MFIs and mobile money system operated by mobile phone network companies. All of these in-

stitutions operate under the control of the Central Bank and the Ministry of Finance. Beside this, there is a tradition of savings and financing via informal mechanisms of which the two most common and important are: ROSCAs and itinerant bankers (*Tontiniers*).

2.2.1 Formal financial institutions

Benin's formal financial system is composed of commercial banks (15 banks as of 2016), the postal bank (*Caisse Nationale d'épargne, CNE*) and a decentralized financial system made mainly of MFIs (IMF, 2018). The traditional banks have a relatively low penetration rate, roughly 3.26 branches per 100,000 adults and barely reach rural areas.[14] Only 16.8% of the individuals aged 15 or more possess a bank account.[15] As a result, transaction costs to access these banks' services are comparatively costly for populations. However, banks dominate the whole financial system by holding 90% of the total assets (62% of the GDP in 2015, IMF).

Alongside, there is a decentralized financial system of around two hundreds authorized MFIs (data from 2016) with a penetration rate of roughly 60% of the adult population.[16] A rapid growth of MFIs has been observed in the last decade with new branches reaching rural areas. MFIs account for 5% of total assets of the financial system. They charge higher interest rates on loans than banks (between 24-70% for MFIs and 9-18% for banks annually) but tend to offer better access to poor people for their proximity and the relatively smaller size of loans supplied. There are few notable MFI networks in the country. One, FECECAM[17] with which we partner in this study, has

[14] The penetration rate is between 5 and 20 branches per 100,000 adults in Sub-Sahara Africa and 21 in Europe.
[15] According to the World bank's Financial Development indicators (2017).
[16] According to IMF (2018) it is estimated that around six hundreds MFIs are currently operating in the country illegally.
[17] Faîtière des Caisses d'Epargne et de Crédits agricoles Mutuel. FECECAM has been operating since the end of the 1980s.

succeeded in establishing distribution platforms outside of the main cities. Each of the FECECAM branch is called a CLCAM (Caisses dEpargne et de Crédit Agricole Mutuel).

A CLCAM account is a saving account which earns no interest but can facilitate access to credit schemes. These credit schemes become available to new members after three months of membership and upon regular savings in the account. Deposits and withdrawal are free but there are monthly account maintenance fees of 500 CFA for accounts with balance above 20,000 CFA. Opening a CLCAM account costs in total 8,500 CFA. This amount is composed of: 5000 CFA in the form of shares,[18] a 500 CFA operational fee and a 3000 CFA required initial deposit. Account ownership and membership to the FECECAM are forever starting from the date of opening.

Mobile money in Benin is relatively new[19] when compared to the industry's development in many East African countries and Kenya notably. The current Beninese market belongs to two well established mobile phone operators: MTN (with MoMo MTN) and Moov (with Moovmoney) which are also both partners in this study. There was no operational difference between mobile money accounts provided by these two operators. Mobile money services are based on Short Message Service (SMS) features on usual SIM cards in mobile phone devices. These services allow to store monetary value on a mobile phone with the possibility of transferring part of the available balance via text messages to other mobile money accounts holders. Currently, MoMo MTN and Moovmoney do not offer loans. Account holders can thus solely deposit, withdraw, send or receive transfers.[20] In Benin, there is no cost to activate a mobile money account as long as the new client has a mobile phone and a valid ID card. Deposits are free but cash withdrawals are charged fee ranging from

[18] FECECAM is operated as a cooperative and to that extent is owned by its subscribers.
[19] The very first operations started around 2010.
[20] See Suri and Jack (2016) for an overview of mobile money account functioning in the developing word.

100 CFA (for amount between 100 CFA and 5000 CFA), to 3500 CFA (for amounts between 400,001 and 500,000). Transfer fee between clients from the same mobile network provider are set to 100 CFA irrespective of the amount transferred.

2.2.2 Informal Financial Institutions

Agents with no access to formal financial services often resort to informal (legally non-binding) mechanisms. These mechanisms range from networks and friends Wang et al. (2010), deposit collectors also known locally as *Tontinier* (Elven and LeMay-Boucher, 2016) and saving groups known as rotating savings and credit association (ROSCAs; see Baland et al. (2011); Lelart (2005). Although these informal mechanisms may be useful, they may represent riskier and costlier alternatives to formal financial institutions (Gugerty, 2007; Karlan et al., 2019).

The first of the two most widely used informal institutions consist of the ROSCAs. A basic description of a ROSCA can be given as follows: a group of individuals gathers on a regular basis for a cycle of meetings. At each meeting, all members contribute a fixed amount of money to a common pot allocated to one of them. The latter is then excluded from the reception of the collective savings in subsequent meetings but is still obliged to bring her contributions for the rest of the cycle. This process repeats itself until each member has received the pot, which marks the end of a cycle. The ROSCA may then begin another cycle or decide to break up. Apart from this basic principle, groups vary widely in terms of amount of contributions, number of members, frequency of meetings and functioning. In our Beninese context, the pot is allocated either according to a random process (random ROSCAs) or through a decision imposed by the governing body of the group (decision ROSCAs).

The second important informal financial institutions are deposit collectors and locally called *Tontiniers*. The usual format is that clients pay a person

to collect their money every day (or every week, etc.) for usually a month.[21] Then, at the end of the prespecified time period, the clients recover these savings minus a collection fee once this period of time has passed. Because of this cost, saving with an itinerant banker (*Tontinier*) in Benin generally earns customers a negative nominal return of -3.3% per month on their savings.

The main difference between ROSCA and a *Tontinier* is then that the former operates in groups where savings are kept within the group, while the later acts as an itinerant banker, collecting deposit from clients. From these two informal options, no positive interest is earned by members or clients. They also bear the risk of losing their savings in case, for example, a deposit collector goes bankrupt or a member of a ROSCA defaults. Thus, one can speculate that access to more secure and reliable formal financial products could lead to improvement in peoples ability to save and invest.

Along with these two well-known informal savings devices, there is also a savings group called Self-help group which operates more as an insurance device. Self-help groups are mutual assistance groups aimed at assisting one another, both in good and adverse situations with the goal of improving their own lives (Gugerty et al., 2019). Unlike ROSCAs, amounts saved in Self-help groups in fact act as an insurance mechanism for members experiencing shocks (adverse or happy events) requiring liquidity. This often includes festivals, funerals, etc.

2.2.3 Intra-Household Decision Making

Investigating the impact of formal finance requires an understanding of how decisions related to finance are taken within households. In particular, it is crucial to our design to determine whether decisions related to savings are made by spouses jointly or not.

[21] These frequencies might vary depending on the type of activities the subscriber operates and the frequency of income generating process in these activities.

Survey questions related to financial decision making in households in Benin have been addressed to respondents aged older than 18 and in a couple (60% of the baseline sample).

To the question Can you estimate your spouses revenues? 89% answered no, 8% yes and 3% partially. Results were similar for Do you think your spouse knows your revenues? where 79% answered no, 15% yes and 6% partially. This means, for a large proportion of men and women living in couple that spouses are not precisely aware of one another's income generating activities and private consumption expenditures. Besides, some of respondents spoken to in a pilot survey regarding financial decision making anecdotally (irrespective of age or gender) stated the less he/she knows about my activities, the better it is or I dont want him/her to know my income otherwise he/she will ask me to meet the cost of such and such expenses. Spouses were overwhelmingly secretive, indeed it even seemed quite natural to divulge as little information as possible to ones partner. As a result, spouses rarely ask questions concerning their partners income or inquire about their activities. It is a kind of tacit convention allowing each member of the couple to keep their income more or less secret.

Studies have substantiated this dichotomy between the husband and wifes finances within Beninese couples (Falen, 2011; Somville et al., 2011; Lemay-Boucher and Dagnelie, 2014). They also document that social norms play an important role in determining the intra-household allocation of expenses by gender in Benin. Duflo and Udry (2004) also highlight similar dichotomy in Côte d'ivoire.

The result of such practice is that each individual has a lot of leverage in managing his or her personal income. Thus by acting in a secretive way, spouses avoid sharing their personal earnings or contributing to a common budget and retain the sole control over their personal expenditures. Being aware of this particular feature, we designed our survey to account for the fact

that the household is a collection of separate economic spheres. Therefore, in each randomly selected household we have randomly selected one adult (husband, wife or other adult member) whom we surveyed in isolation. This gives us data at the individual level on group membership, contributions, income, etc.

2.2.4 Expected Benefits from Formal Savings

Participation in ROSCAs can be costly and earns no interest. ROSCAs members bear their peer's default risk, and this can lead to financial loss and in worse cases, the breakdown of a group. ROSCA members have no flexibility regarding the size of their deposit in the common pot and in many cases the timing of reception of the pot (Gugerty, 2007). Despite these constraints, ROSCAs enjoy large popularity in developing countries. Part of the appeal comes from meeting other fellow members on a regular basis and the investment in social capital it represents.

From the anecdotal evidence we collected, many *Tontiniers* can offer to their customers a more flexible collection of deposits than what is initially set. They can thus accommodate, to a certain extent, clients who experience difficulties. Clients set for daily collection can switch to weekly payments after experiencing a negative shock or make several payments in smaller intervals of time than initially planned in case of a positive income shock. Nevertheless, the extent to which clients can rely on this flexibility remains limited. Using a *Tontinier* also bears risks as the *Tontinier's* business may fluctuate up to a point that they default on their clients. Anecdotal evidence of such cases are isolated and rare.

Therefore, there are mainly two advantages of using any of these accounts (CLCAM or mobile money). The first one relates to safety. These two devices offer a secure and relatively safe place for deposits which bear no risk compared to the informal options poor Beninese face. By that we do mean that they

provide safer places to save in relation to pressure to share (Anderson and Baland, 2002; Baland et al., 2011). This characteristic is, however, not specific to formal devices. ROSCAs are also known to be used as a social alibi for avoiding transfers and redistribution (Dagnelie and Lemay-Boucher, 2012).

The second one relates to flexibility. Clients of formal finance can decide when and how much they want to deposit or withdraw their money. Mobile money offers the highest level of flexibility possible. In urban settings, accredited mobile money agents can be found pretty much at every street corner and for long extended hours. This allows clients to transfer money, withdraw or deposit pretty much when desired. CLCAM clients have to make their transactions within opening hours and maybe have to travel longer distance.

Comparatively, ROSCAs are notoriously rigid and deposit collectors not as accommodating as other formal saving options. Flexibility may help better allocate savings and conveniently meet financial needs, specifically in relation to investment, insurance, lump sum expenditures and risk-sharing. Mobile money features greater flexibility in its use but with no possibility of direct access to credit. Mobile money providers in Benin had not, at the time of our survey, started to offer loans. CLCAM account holders have less flexibility but can be offered access to credit. This requires a soft commitment to save up to a critical amount which is about a third of loan amount asked to a CLCAM. Thus linked to that we could add a third advantage: formal saving can facilitate access to credit. Some agents may value interactions with formal financial institutions with the expectations of ultimately being granted access to credit. Comparatively, the offer of credit from ROSCAs and *Tontiniers* is sporadic, not guaranteed and of smaller magnitude (Lelart, 2005; Gugerty, 2007).

This helps us make simple predictions. If new users value potential access to credit we would expect CLCAM accounts holders to significantly raise their savings. In other words, if flexibility (including risk-sharing via transfers)

features are valued, we should observe individuals offered a mobile money account to become active users.[22]

Safety and flexibility can potentially allow new users of formal devices to better channel their liquidity towards investments in their own micro-enterprises or investment for the household consumption requiring lump sum payments such as children's education. In turn we can expect these investments to potentially impact revenue and other welfare measures positively. We intend to analyze impact on downstream outcomes following our treatment, in a separate follow-up study. We focus in this study on impact on various savings channels.

Our work also looks at one important topic: i.e. the interaction between access to formal finance and the continued or discontinued use of informal finance. Our data allow us to investigate to what extend formal finance can substitute informal savings.

2.3 Sampling, Experiment design and Data

In this section we describe the three study sites, a random assignment procedure to treatment and control groups of the study and the different nudges provided to the beneficiaries.

2.3.1 Sampling and experiment

Our baseline sample includes 12 neighborhoods[23] of three major cities covering the territory of Benin: Cotonou in the south, Parakou in the north and Abomey in the central region. The 12 neighborhoods have been selected in

[22] Note that the mobile money and a CLCAM account can also be combined by some agents. In our design only a small sub-sample of beneficiaries who initially hold a mobile money account were offered a CLCAM account and vice versa to test whether a combination of the two devices bring additional impact. We do not find evidence that holding both accounts bring any additional impact. We discuss that further below.

[23] 7 in Cotonou, 1 in Abomey and 4 in Parakou, based on the density of each city.

these three sites only from residential areas[24] where at least one branch of each of the two devices of our partners (CLCAM for MFI and Moov/MTN for mobile money) are present.

After the neighborhoods are defined, the baseline sampling follows a pseudo-random sampling procedure (Arnab, 2017; Dagnelie and Lemay-Boucher, 2012).[25] First, we start by selecting a MFI branch[26] and thereafter a radius of one kilometer is drawn around it. Five key infrastructure points, such as churches or schools,[27] within that radius are identified. Enumerators then start from one of these points at a time and move to a street. In a given street, enumerators select every fifth house on their left.[28] For houses, or compounds with multiple households, our enumerators used another pseudo-random rule to select only one in this context.[29] For selected households, surveys were conducted individually in order to get as precise and reliable information as possible.

The baseline sample is composed of 3908 individuals whose formal account

[24] In this sense our study does not include any area from the countryside. If we included people from the countryside together with those from residential areas, we would be very likely to have individuals who would have differed (at the mean) on various metrics from our treated groups (from urban environments). So, the fact that we are comparing comparable groups (and similar at the mean) is what gives us a solid ground.

[25] Arnab (2017) is a statistical book on sampling theory and applications. The pseudo-random procedure is exposed in the book. Dagnelie and Lemay-Boucher (2012) used this sampling procedure in their work on roscas participation as a commitment issue in Benin. The pseudo random procedure in this context was appropriate given there was no pattern in the data from the pilot. To that extent, the baseline sample is not fully random. However, the assignment of individuals to treatment and control groups was fully random and given insignificant contamination, and that we are computing Intent-To-Treat effects, the internal validity of the results cannot be rejected, but may not be extrapolated beyond the context considered (external validity).

[26] There was no constraint in finding Mobile Money branches as there was always one Mobile Money branch available within the 1km radius around the MFI branch. In each neighbourhood, there is only one CLCAM branch.

[27] This is to ensure that the sampling procedures structure allows to continuously find some households (residential neighbourhoods).

[28] In all cases, there was only one house found and surveyed each time.

[29] Enumerators selected one room (or apartment) per compound according to a clock-wise selection varying from compound to compound: for the first compound of the day they selected the first room clock-wise, for the second one the second room clockwise and so on.

ownership is shown in Table 2.1.

Table 2.1: Mobile money and other formal saving accounts ownership at baseline

Has Mobile Money account	**Has any formal deposit account**					
	NO		**YES**		**Total**	
	n	%	n	%	n	%
NO	2093	54	504	13	2597	66
YES	735	19	576	15	1311	34
Total	2828	72	1080	28	3908	100

Note: Proportions are calculated relative to the whole sample at baseline. Having no formal account means having none of with the following institutions: Bank, CLCAM (Partner MFI), Other formal MFIs, CNE (Postal bank).

From the baseline account ownership distribution (Table 2.1), different eligibility criteria have been applied to restrict the sample to eligible individuals by treatment (Table 2.2).

Table 2.2: Eligibility across treatments

Has Mobile Money Account	**Has any formal deposit account**					
	No		**Yes**		**Total**	
	n	%	n	%	n	%
NO	**1723**	60	**464**	16	2187	76
YES	**706**	24	0	0	706	24
Total	2429	84	464	16	2893	100

Note: Proportions are calculated relative to the whole sample at baseline. Having no formal account means having none of the following: Bank, CLCAM (Partner MFI), Other formal MFIs, CNE (Postal bank).

In the framework of the experiment, in fact, two treatments are offered to eligible individuals: either T1, a formal deposit account in the partner MFI (CLCAM), or T2, a Mobile Money account in the partner mobile network operators (MTN, MOOV). Eligibility to each treatment requires to have a valid ID card. T2 further requires a mobile phone device with a SIM card installed in it.[30] Besides, by design, individuals who already had any of the

[30] 90% of the baseline sample had a phone device with a SIM card and 88% have a valid

available formal deposit account (Bank, CLCAM account, Other formal MFIs account, Postal bank) were not eligible to T1 (MFI) but could be offered T2 (mobile money account) if they did not have it at baseline (E_2 eligible individuals in Figure 2.1; see also Table 2.2). Similarly, individuals with a valid ID card who owned a mobile money account at baseline but none of the formal accounts were eligible to treatment T1 (E_1 eligible individuals in Figure 2.1).

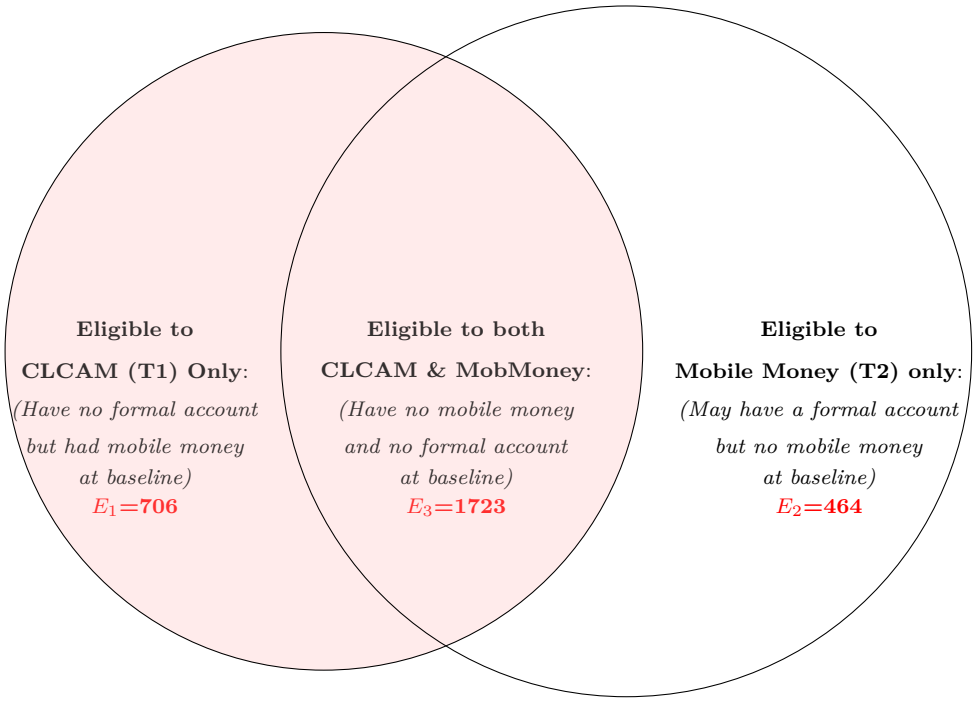


Figure 2.1: Eligibility to each treatment

Finally, people with no mobile money account and none of the formal accounts at baseline (E_3 in Figure 2.1) are eligible to both treatment but are randomly assigned to only one of the treatments. That is, part of E3 eligible individuals are randomly drawn to get T1, and another fraction is randomly

ID card (see Table 2.3). We did not offer mobile phone devices and SIM cards.

assigned to treatment T2, respectively according to equations 2.1 and 2.2.[31]

$$T_i = \frac{1}{2}E_i + \frac{3}{8}E_3, i \in \{1, 2\}. \tag{2.1}$$

$$C_i = \frac{1}{2}E_i + \frac{2}{8}E_3, i \in \{1, 2\}. \tag{2.2}$$

Overall, $\{T_1, C_1\}$ are both composed, in the specified proportions, of individuals having no formal account (no mobile money account, no MFI account and none of the other formal accounts available in the country) and some individuals having no MFI account (as this is treatment T_1 offered in the experiment) but who possibly have another formal account.

Similarly, $\{T_2, C_2\}$ are composed of individuals having no formal account and individuals with no mobile money account (as this is treatment T_2 offered in the experiment) but possibly have another formal account.
By design, $\frac{2}{8}E_3$ individuals are common to the two control groups. These individuals are in fact those using none of the formal accounts available. Tables A.1 and A.2 in appendices show the balance test for each treatment and the corresponding control group.

Randomly assigning E_1 and E_2 respectively to treatments T_1 and T_2, on top of the fully unconnected individuals (E_3) allows to measure potential heterogeneity effects, related to prior exposition to any formal financial account.

The pairs of randomly formed groups, i.e. $\{T_1, C_1\}$ and $\{T_2, C_2\}$, with C_1 and C_2 the respective control groups, are balanced in standard baselines socio-economic and demographic dimensions, suggesting a satisfactory random allocation of the different eligible individuals.

[31] The proportions are defined so as to ensure enough observations in each treatment arm. Different proportions could have been defined but need to ensure that power considerations are met.

Despite the satisfactory random assignment to treatment and control, there might be some potential peer effects and externalities likely to threaten identification of effects. There are two potential threats: (1) a prior exposition to the formal devices offered in the sense of being aware of the characteristics of the products and (2), a potential actual exposition of the control groups during the treatment in the sense that they might have had access to either account outside the project. On the first aspect, it is possible that some of the treated in our sample started to use or took the product we offered them due to interactions or social influence from other people in their neighborhood who were used to the devices. We cannot take this effect out of our estimates. Simply, we could say that on average all of the treated had been similarly exposed (due to knowing people who had been (or are) users, or simply walking by a branch). This effect is (again on the whole) potentially there for both treated and control due to our sampling within a 1 km radius of a branch. We control for previous use of other formal devices (or current other devices). And this effect is less likely to be tainted by the peer effect we mention above (the take-up maybe but less likely the impact from usage). On the second aspect, as we are estimating intent-to-treat (ITT) and not treatment effect on treated (TOT), potential contamination and non compliance should not be problematic. In any case, a potential contamination of control group would have biased down the effect identified. However, contamination was minimal (less than 3%).

In terms of treatment administration, in practice, we have covered the costs of opening accounts and provided an incentive balance. For the CLCAM account (T1), the usual total cost is 8,500 CFA, but we have negotiated and actually paid a discounted cost of 2500 which includes a 1000 CFA incentive deposit. Regarding the mobile money account (T2), an incentive deposit of 2,000 CFA has been provided on top of assisting in activating the account.

The treatments' administration was implemented separately for each type

of account offered. For treatment T1, the process goes from the offer, after explaining the features of the account, up to the account opening and proceeds as follows:

- A voucher is offered.
- If the voucher is accepted, it should be used by the beneficiary to shoot an ID picture with a specified and well known photograph in the neighborhood.
- Then, the beneficiary goes to MFI's branch with the ID picture, the voucher and the ID card to have the account opened.

In the case of T2, the process is implemented in one step and consists in activating the mobile money account for selected beneficiaries who have accepted the offer.

The overall timeline of the study ranges from October 2016 to October 2018 when the first follow-up has been completed. (see Figure 2.2).

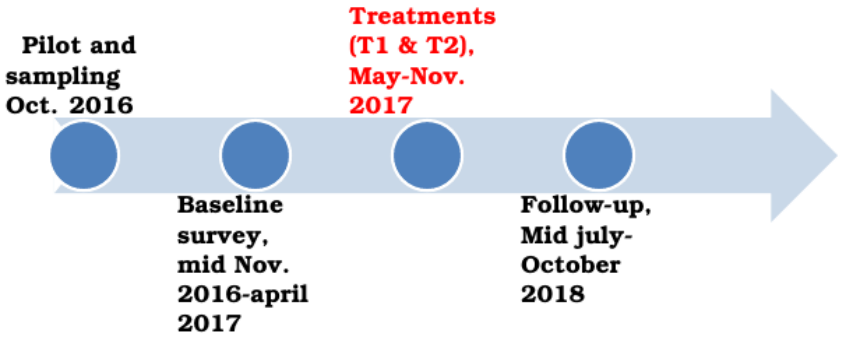


Figure 2.2: Timeline

2.3.2 Data

In this section we present the different sources of Data used and the main features of the baseline characteristics regarding households access to formal finance, their savings behavior and different expenditures ("normal" expenditures and expenditures in "temptation goods"). We use two main sources of

data: (1) Survey data from baseline and follow-up and (2) administrative data from the partner institutions. More details on the transactions data regarding each account are shown and discussed in the results section.

At baseline, in the population of interest (Cotonou, Parakou and Abomey), three types of agents could be identified regarding whether or not they have a formal account in any of the described formal and informal financial institutions in the country: we have (a) people fully unconnected to formal financial institutions, (b) people using exclusively informal financial mechanisms and (c) people combining both. As already explained, allocation to each treatment and control group is conducted considering individuals according to their financial inclusion. Our sample includes 60% of woman, people are aged roughly 40 years and a high proportion of people either married or engaged in a relationship and living in the same household (Table 2.3). The average monthly revenue from different activities amounts to 81,043 CFA with a median of 60,000 CFA (respectively $162 and $120). Note that 25% of the sample live with less than $2 a day.

It is worth mentioning that, most of the data collected are self-reported. To that extent, they are definitely subject to noise, in particular those related to monthly revenue, savings and consumption because no restriction was imposed on the relationship between the declared amount of savings, consumption and income during our surveys. There are two potential issues that might explain very marginal discrepancies when comparing income to the sum of savings and consumption. These issues are: (1) precision in measurement and (2) frequency or recall period of the information collected during the survey. Revenue and savings were in fact collected based on a month recall period while consumption and investment were based on a quarter recall period. Nonetheless, this frequency mismatch only generates marginal differences. For instance, when consumption is estimated monthly and added to monthly savings, the

sum corresponds to monthly revenue. [32]

(a) Formal and informal accounts distribution

As can be seen from Tables 2.4 and 2.7, 54% of our baseline sample have no savings account in a formal financial institution. Among them, 39% have no informal means for saving either (roughly 21% of people with no formal account in total at baseline). Besides, only few people have a formal account: for example 16% of the sample have an account in banks, 11% and 6% respectively in MFIs and in the local postal bank (Table 2.7).

[Insert Tables 2.4, 2.7 & 2.6 here]

The most common informal financial device attracting deposits are ROSCAs with almost 30% of respondent using it at baseline (Table 2.6). This saving mechanism is followed by savings in a box at home and informal deposit collectors (itinerant bankers). In order to test possible complementarity or substitution of formal and informal savings a particular focus shall be put on these informal savings devices.

(b) Savings patterns for financially unconnected at baseline

Despite being "unconnected" to the different formal devices to deposit money (bank, MFI, mobile money accounts, etc.), households find ways to save their money using informal mechanisms, irrespective of the costs and the underlying risks. At baseline, considering only individuals fully unconnected, people seem to be depositing larger amounts to the *Tontinier* with a monthly average of

[32] In figures ??, 2.6, referring to data on consumption and investment, for instance, the amounts are recorded for the past 3 months during the survey. Taking this fact into account allows to have consistency between the monthly revenue reported in the study and consumption+ gross total monthly savings.

22,000 CFA and a median of 16,000 CFA (see Figure 2.5).[33]

[Insert Figure 2.5 here]

(c) "Normal" expenditures and temptation goods at baseline

There are two main categories of expenditures identified at baseline: some usual expenditures and unusual or "temptation" expenditures incurred the past 3 months (from the date of the survey). The former category of spending is measured as the contribution to the households main spending, including rent, food, transport, electricity, water and health. The larger share of individual contribution to the household expenditures goes to rent and transport (Figure 2.6). Besides these expenditures, people also tend to spend on temptation goods by either eating outside, drinking alcohol, buying jewelries or some other goods that happen to be regretful ultimately but remain the more costly on average (Figure 2.7).

[Insert Figures 2.6 & 2.7 here]

2.4 Empirical Results

The results are presented in three main parts. First, we use administrative data both from mobile money and CLCAM partner institutions to visualize the extent to which the accounts are taken up and used. Second, basic Ordinary Least Squares (OLS) regressions are run to identify baseline characteristics that correlate with uptake and use of each account. The third part discusses the main results on causal impact of access to each of the account types.[34]

[33] The monthly net minimum wage in the country is set at 40,000 CFA ($80).

[34] We use indifferently the expressions CLCAM account and MFI account to mean the treatment T1 offered.

2.4.1 Accounts take-up and transactions

After the treatments administration, take-up was 52% (Table 2.8) for the MFI deposit accounts.[35] The mobile money account take-up was around 75%[36] (Table 2.9). Below we provide further details on the extent of the usage of different accounts over the first year after opening. These details cover the number of transactions and the money flows involved using administrative data collected from the partners, one year after the treatment.[37]

A MFI accounts

We need to define a metric to characterize usage of MFI accounts. As a standard account, any deposit counts as a basic usage. Active usage being defined as making at least 3 deposits or withdrawals during the first year of usage. This definition is based on Prina (2015) and Dupas et al. (2018) who define an active user as any beneficiary making at least 2 deposits within a year and 5 deposits in 2 years. We rather use a broader measure (number of transactions) taking withdrawals as well in account usage definition.

[Insert Figure 2.8, 2.9 & Table 2.8 here]

As can be seen from Figure 2.8 and Table 2.8, 21% of beneficiaries who opened the MFI account offered have actually used it (i.e. have made at least 1 deposit or 1 withdrawal) and 13% are active users (made at least 3 deposits or

[35] Take-up rate of the vouchers was about 76%, so 68% of these vouchers have actually been used to open the accounts. Note that analysis on administrative data are base on 572 individuals who accepted the MFI accounts vouchers. The total number of eligible individuals assigned to T1 is 992 (Table A.1); 762 were found at treatment phase, offered vouchers and roughly 76% accepted.

[36] This is based on a sample of 543. Note that the intended sample for mobile money treatment was 877 (Table A.2). At treatment phase, 543 were found and offered treatment.

[37] The accounts are opened at different dates, but in this analysis we consider what happened during the first 12 months since activation.

3 withdrawals). Besides, on average, beneficiaries have withdrawn less often than they had deposited (in the course of the twelve months) with the total average amount withdrawn being slightly higher than the total average amount deposited (Table 2.8 and Figure 2.9). This leaves room for very low level of savings. However, based on active users, withdrawals are less frequent than deposits which are here of higher amounts. This thereby is suggestive of for some higher balance on the MFI accounts on average for active users.

Another interesting feature can be observed in Table 2.8. While active users' transaction amounts tend to be relatively higher than the ones of basic users, the median amounts withdrawn or deposited are lower for active users compared to their counterpart on average, and their transactions are more frequent. We provide further details on the characteristics of each type of agent in the regression analysis section on the determinants of take-up and usage.

B Mobile money accounts

Similarly to the discussion for MFI accounts usage, we define basic and active usage for mobile money accounts. From Figures 2.10 and 2.11, one cannot directly infer the proportion of people who did not use the accounts at all[38] since at least two relevant dimensions of usage can be considered based on the different inflows and outflows of money: Deposits or withdrawals and Transfers received or transfers sent. In fact, basic and active usage in this case cannot be exclusively based on deposits made as is the case for bank accounts in previous studies (Prina, 2015; Dupas et al., 2018), since mobile money accounts are also used for transfers (both for sending and receiving money). For example, a mobile money account holder might have no deposit on her account but still be using it exclusively to receive and send transfers

[38] 15% of the mobile money accounts have recorded no transaction during the 12 months time span after treatment.

while keeping a positive balance as savings. However, data show that deposits and withdrawals are the most common transactions. To that extent, usage in terms of number of transactions made can be defined based on the two most usual actions: deposits and withdrawals. Similarly, active usage is defined accordingly so as to facilitate comparison with MFI accounts.

Unlike MFI accounts, users of mobile money accounts owners tend to deposit money less often than they withdraw. This positive wedge seems in a sense offset by the fact they also tend to receive more transfers than they send, both in terms of the frequency of transactions and in terms of the different amounts involved (Figure 2.11, Table 2.9).

[Insert Figures 2.11, 2.12 & Table 2.9 here]

Figure 2.12 summarizes this pattern and suggests room for positive but low balance on the accounts for people with at least one deposit or withdrawal.

2.4.2 Determinants of accounts take-up and use

In a regression framework, this section exposes some conditional correlations between respectively the probability to take up, the probability to use (considering different frequencies of use) and relevant baseline characteristics.

A MFI accounts

Very few baseline covariates significantly correlate with probabilities to take-up and to use MFI accounts (Table 2.10).

[Insert Table 2.10 here]

Unsurprisingly, there is a significant travel cost effect that shows up both for the probability to take up and the probability to use the accounts. This

effect is substantial for the take-up (41% less likely) although by design, every household randomly selected in the program is no far than 1km from the Partner MFI branch in their respective neighborhood. Besides, people having received a loan from a financial institution in the past 3 months are substantially more likely to take-up. However, this does not make any significant difference in terms of use. Regarding a potential complementary between MFI accounts and informal savings organizations, there is a negative correlation with participation in Roscas (Table 2.11).

B Mobile money accounts

Similarly to the results discussed for the MFI accounts, Tables 2.12 shows some conditional correlations between baseline covariates and respectively the probability to take-up and mobile money accounts.

[Insert Tables 2.12, 2.13, 2.14 here]

From Tables 2.12, 2.13, 2.14, five main relationships are worth emphasizing: (i) female seem more likely to use the accounts compared to males (ii) but gender related correlation is lower when in living in couple as compared to being single (probably due to pressure to share, spending in household public goods compared to males, etc.), (iii) using a *Tontiniers'* savings services and participation in ROSCAs at baseline are positively related to the probability to take up a mobile money, (iv) participation in ROSCAs at baseline increases the probability to use a mobile money account in particular for sending transfers and relatively less in terms of receiving (2.14) and finally, (v) people with a formal account at baseline tend to be more likely to open and use mobile money. These different features are tested in the causal impacts section.

2.4.3 Estimation of accounts' causal effects

In our framework, the causal impact is assessed using a randomized controlled trial. This allows to have a relevant counterfactual to estimate the effects of access to deposit accounts on the beneficiaries savings behaviors (formal versus informal savings). However in a context of attrition (see Appendix C for more details) and the impossibility to observe control groups' behavior in terms of usage of the accounts offered, we focus on the average effect of being assigned to each treatment arm or the intent-to-treat (ITT) effect. The estimations are based on the following Analysis of Covariance (ANCOVA) specification:[39] See further details on why in the context of our design, we preferred ANCOVA compared to Diff-in-Diffs (Appendix B).

$$\mathbf{Y_{it}} = \alpha + \beta \mathbf{Y_{i(t-1)}} + \gamma \mathbf{T_i} + \eta \mathbf{X'_{i(t-1)}} + \mathbf{S_i} + \mathbf{P_i} + \epsilon_{\mathbf{it}} \tag{2.3}$$

where, Y_{it} is the outcome of interest with observations from the follow-up survey, $Y_{(t-1)}$ its baseline value, T_i stands for treatment assignment status of eligible individuals and equals to 1 if randomly selected to receive the treatment (0 otherwise), S stands for slums fixed effect, P the monthly time dummies controlling for actual accounts opening dates, and ϵ_{it} represents the error term of individual i at time t. The ITT effect is measured by γ, based on the considered type of account offered. The outcomes of interest denoted by Y are respectively the different formal and informal savings in various institutions and some downstream outcomes.

Tables 2.15 and 2.16 provide the average intent-to-treat impacts respectively for MFI and mobile money accounts on the different formal and informal savings through different devices. As for CLCAM accounts, there is no

[39] In an experiment with a unique baseline and follow-up it is best to run an ANCOVA when the auto-correlation coefficients of the outcomes of interest are less than 0.5 as it increases power (McKenzie, 2012).

significant difference between treatment and control groups relative to savings.

Regarding the effects of mobile money accounts (Table 2.16), there is a positive and substantial impact on total savings, allowed mainly by an increase of savings in ROSCAs. This result is suggestive that mobile money device and ROSCAs savings are complement and is in line with Kiiti and Mutinda (2011).

[Insert Tables 2.15, 2.16 here]

Comparing effects of the two treatments, only the mobile money account significantly increase total savings (140%). This effect on savings is also found by Mbiti and Weil (2015) (for Kenya), Ouma et al. (2017) (for Kenya, Uganda, Malawi and Zambia) and Ky et al. (2018) (for Burkina Faso).

Unlike CLCAM accounts, mobile money accounts beneficiaries tend to continue saving significantly more in ROSCAs (39% more), probably valuing the social connection allowed by such groups and a willingness to introduce more flexibility in ROSCAs. This link between mobile money accounts and ROSCAs savings suggests that, mobile money accounts are being used to modernize ROSCAs functioning and savings. This can work, for instance, by labeling a mobile money account as the common ROSCAs' pot in which every member deposits their cyclical contribution mostly via a transfer. We provide a suggestive mechanism on this result below (Section 2.5).

Regarding the impacts of the two formal devices on the other informal savings mechanisms (*Tontinier*, Self-help groups, home savings), none of the formal devices offered show a significant link (complement or substitute). As for *Tontinier*, although the costs incurred (negative interest rate on savings), one likely explanation is that a *Tontinier* savings channel does not incur any direct travel cost for the saver, given that this itinerant banker goes to people to collect savings. Moreover, the Tontinier may offer some flexibility on the timing of savings collection. So it is not surprising that access to formal devices such as mobile money accounts which primarily help limit travel costs, do not make any significant change on the existing dynamic of *Tontinier*.

The null effect on home savings and self-help groups savings, both from the MFI account and the mobile money account is in line with the fact that poor people often need to hold some liquidity so as to be able to face unexpected expenses (Paxton and Young, 2011). Holding some cash is important for poor, particularly in the context of Benin where most transactions are still cash based and, neither mobile money branches, nor MFIs offer a 24/7 service to withdraw cash in the country. The same narrative holds for self-help groups, given that this informal savings group acts as an insurance device and there is a need to be liquid in the group any time. For MFI accounts in particular, the absence of significant effects on Self-help groups and ROSCAs is also found in Somville and Vandewalle (2017).

Overall, our results suggest that deposit accounts providing more flexibility in liquidity management (mobile money accounts) reward more the users, at least in the short run compared to less flexible devices (MFI accounts). Beneficiaries therefore tend to value more flexibility compared to committing to save in order to have access to credit[40] in a year after accounts opening. This finding may be seen as a relevant input to financial inclusion policies mainly targeting financially unconnected people.

2.4.4 Heterogeneous effects

In this section, we focus on heterogeneity in impacts along some baseline key characteristics. Based on our simple theory of change framework, are savings. The baseline characteristics analyzed include gender, education, microentrepreneurship, hiding money to spouse and the main baseline informal savings channels (ROSCAs and itinerant informal banker). Heterogeneous

[40] Overall, based on administrative data collected from the partner institutions, only 5 beneficiaries have applied and succeeded in getting loans from the MFI.

effects are captured by λ in Equation (2).

$$\mathbf{Y_{it}} = \alpha + \beta \mathbf{Y_{i(t-1)}} + \gamma \mathbf{T_i} + \eta \mathbf{X'_{i(t-1)}} + \lambda \mathbf{T_i} * \mathbf{X_{i(t-1)}} + \mathbf{S_i} + \mathbf{P_i} + \epsilon_{\mathbf{it}} \quad (2.4)$$

The different results from estimation of equation (2) show no heterogeneity in impacts from MFI accounts on savings (Table 2.17).

The differential impacts of mobile money accounts are provided in Tables 2.19, 2.20. There is a significantly higher impact on total savings for beneficiaries who had ROSCA at baseline (Table 2.19). This can be seen as a liquidity effect or a reallocation of savings between devices thanks to the mobile money account. Regarding this increase in total savings, one can note a higher impact on ROSCAs savings from people with secondary education or higher (Table 2.20). Moreover, being a ROSCA member increases impact of mobile money account on *Tontinier* savings (Table E.2). The differential impact on total deposits can thus be attributed to education and the complementarity between ROSCAs and mobile money. So while mobile money accounts can allow to undertake activities that are in general inherent to the use of a mobile phone (e.g., selling credits or airtime, transferring money, etc.) and that can be easily handled, it is likely that men go beyond this and invest more in other activities as compared to women. This might also be related to the fact that women are on average less educated than men and that education matters as for the benefits accrued to mobile money accounts. In terms of impacts on total savings thanks to access to mobile money, there is however no gender gap.

2.5 Mechanisms

We find evidence of complementarity between mobile money accounts and ROSCAs savings. We provide some suggestive evidence to support this. In

2019, after our baseline survey, one of our mobile network operator partner (MTN) introduced digital ROSCAs for the famous motorcycle taxis, locally known as Zémidjan. In this pilot scheme developed by MTN, ROSCAs common pots are mobile money accounts offered by the mobile network operator. In that scheme, all ROSCA members possess a mobile money account individually and can transfer their contributions directly to the common mobile money account (the ROSCAs pot). At the end of a ROSCA cycle, the member entitled to collect the money gets the equivalent of the amount of the pot via a transfer on her mobile money account. The process can be extremely useful for ROSCAs members who had to travel either temporally or permanently, since they will not have to drop out from the ROSCAs and can keep being active members.

Some anecdotal evidence from the subscribers of this modern ROSCAs[41] show that it introduces more transparency in the contributions tractability and provides more safety and efficiency in the payments. Due to this potentially higher efficiency in digitized ROSCAs, mobile money accounts beneficiaries might also have subscribed to more ROSCAs but we do not have data on the number of ROSCAs membership to further emphasize this point. Nonetheless, we do observe significantly higher ROSCAs' savings from mobile money account beneficiaries compared to their counterparts (Figure 2.3) while there is no significant difference in ROSCAs' membership between the two groups (Figure 2.4).[42]

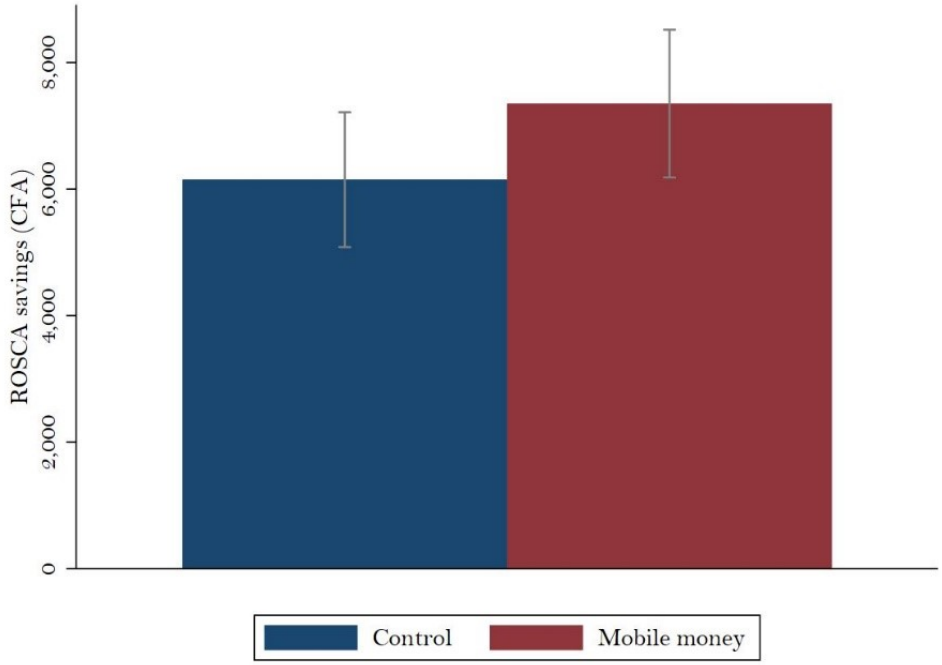
The complementarity between ROSCAs and mobile money accounts is contributing to increase formal finance via the digitalization of ROSCAs. This is probably a promising formal financial inclusion dynamic. However, it is

[41] http://www.integrallc.com/2012/02/23/mobile-money-and-roscas-the-intersection-of-technology-and-informal-financial-services/
http://finclusion.org/blog/fii-updates/mobile-wallets-a-way-to-bring-transparency-to-roscas.html

[42] During the baseline and the follow-up survey, we only ask whether the individual is member of a roscas. We did not ask questions about the extensive margin of roscas membership.

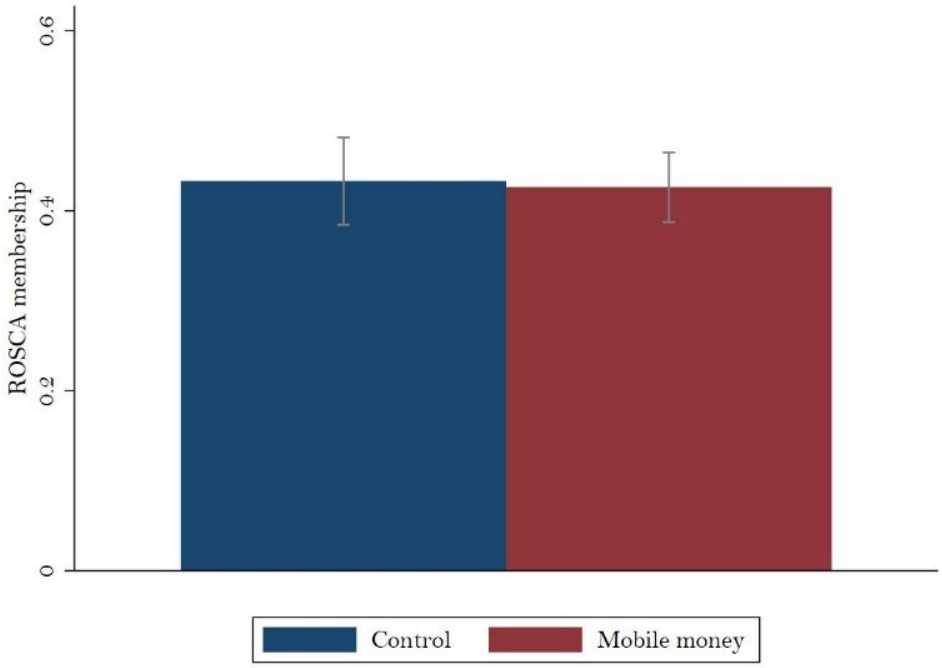
worth mentioning that the suggestive formalization of ROSCAs identified in this study is not sufficient to solve all issues inherent to ROSCAs. For instance, regarding potential defaults, doing ROSCA savings via mobile money accounts does not prevent a ROSCA member from not sending their contribution when time comes to do so. The key benefits that a complementarity between ROSCAs and mobile money accounts may bring are flexibility, safety[43] and tractability in the way contributions to the common pot are disbursed and collected (for instance, a simple transfer is enough to contribute to and to collect money from ROSCAs common pots).

Figure 2.3: ROSCAs savings by mobile money account treatment arms



[43] There is a limited risk of theft on the ROSCAs savings when savings are kept in a mobile money account compared to traditional cash handling (e.g. Rim et al., 2002).

Figure 2.4: ROSCAs membership by mobile money account treatment arms



Future research should, however, be conducted to further understand the dynamic of the complementarity between mobile money accounts and ROSCAs. This will require, for instance, a field experiment focusing on ROSCAs members only (all unconnected to mobile money accounts system). Some of these ROSCA members will be randomly assigned to benefit mobile money accounts and the others not. This way, one can provide richer mechanisms and different channels generating improved and higher savings via a formalized and digitized ROSCAs using mobile money accounts.

2.6 Conclusion

Within our intervention and context, two savings accounts have been randomly offered, predominantly to individuals who were not using formal finance at baseline. We find a relatively high take-up of 52% for CLCAM accounts

among which 20% of beneficiaries made at least one transaction (deposit or withdrawal) in the course of the year following treatment. Mobile money account show higher levels of take-up and use at respectively 75% and 55% (with at least one transaction during the last twelve months). We implicitly identify the extent to which flexibility offered by a formal savings account impacts beneficiaries' savings. Overall, one year after opening accounts, being offered a mobile money account substantially improves total savings. As for our second treatment, offering a CLCAM account, yield no positive and significant effects on savings.

The results are suggestive that a more flexible formal savings device seems to reward financially unconnected more, at least in the short run (1 year). To that extent, this result can be seen as a relevant input for financial inclusion policies. Finally, our results also show a null effect from the formal savings devices on savings via *Tontinier* Self-help groups, and home savings channels. Only ROSCAs' savings are positively impacted by that mobile money accounts, suggesting a complementarity between the two devices.

Further work is however needed to better understand the specific mechanisms and the dynamic driving this complementarity. Furthermore, an extension of the study's time span might help better apprehend the dynamics of the two devices in terms of their impacts on beneficiaries' savings, investment and welfare.

2.7 Bibliography

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Figures and Tables

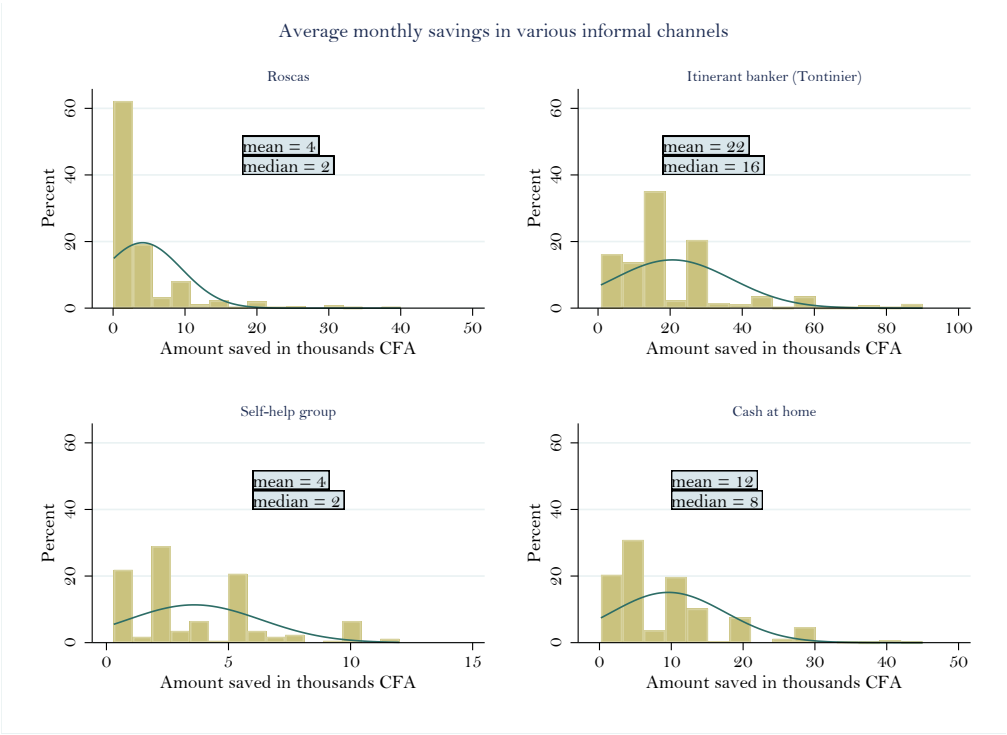


Figure 2.5: Monthly Informal savings from financially unconnected

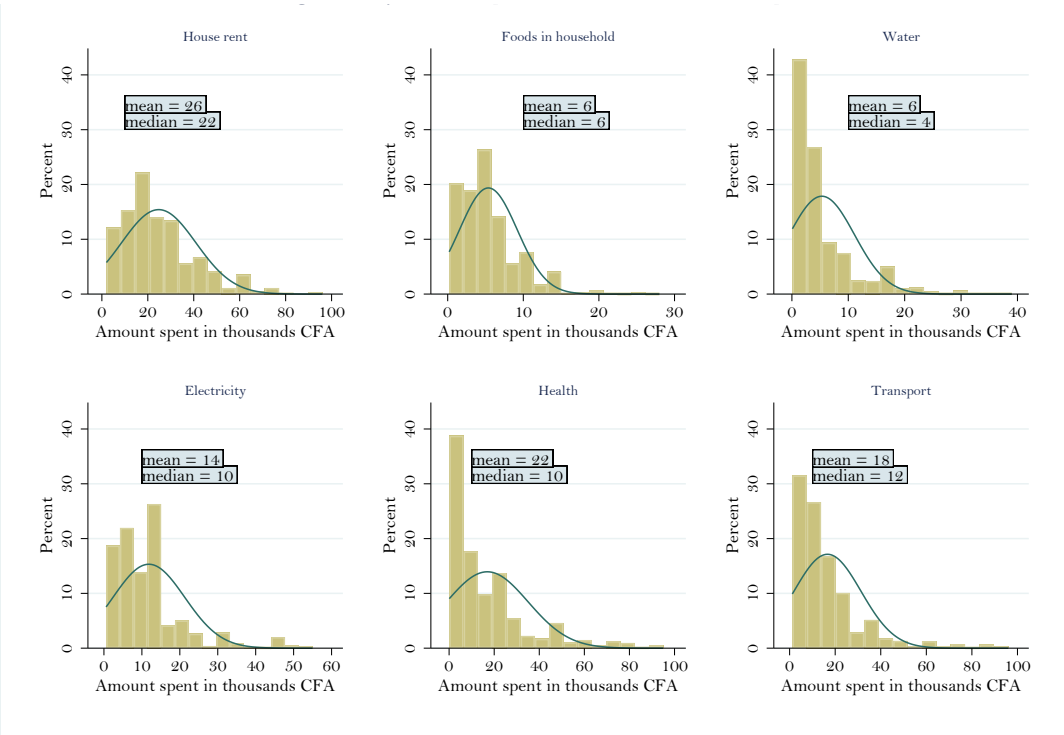


Figure 2.6: Households "Normal" expenditures (total in the past 3 months)

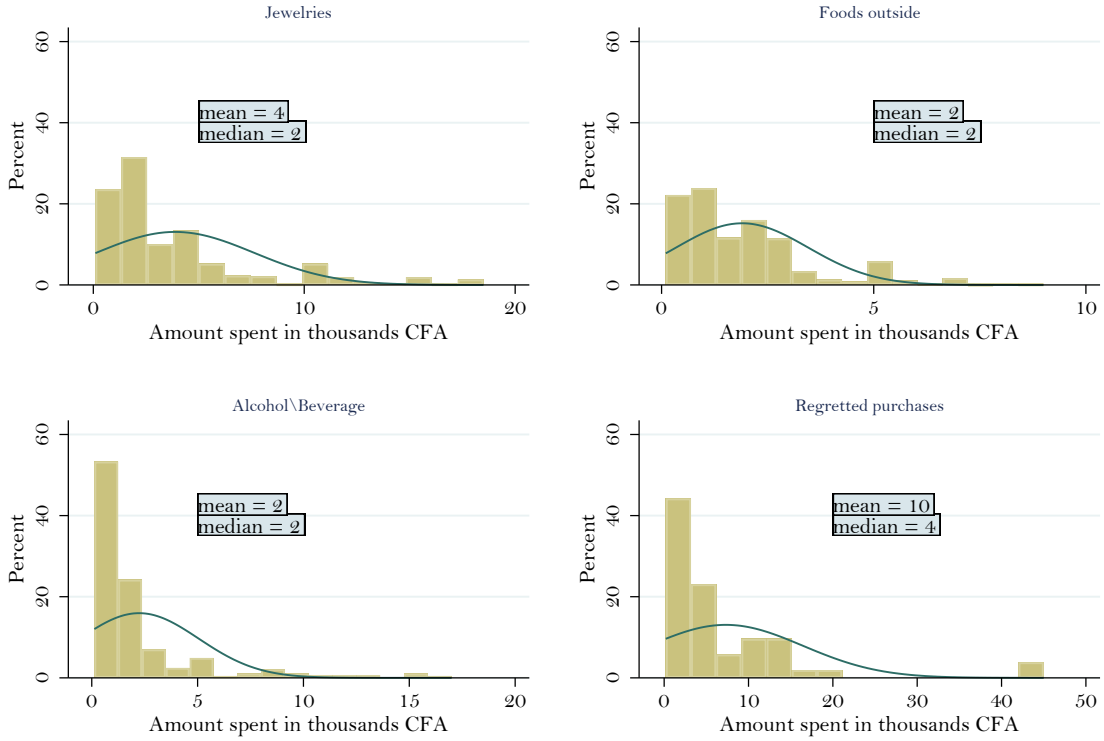


Figure 2.7: Households temptation expenditures (total in the past 3 months)

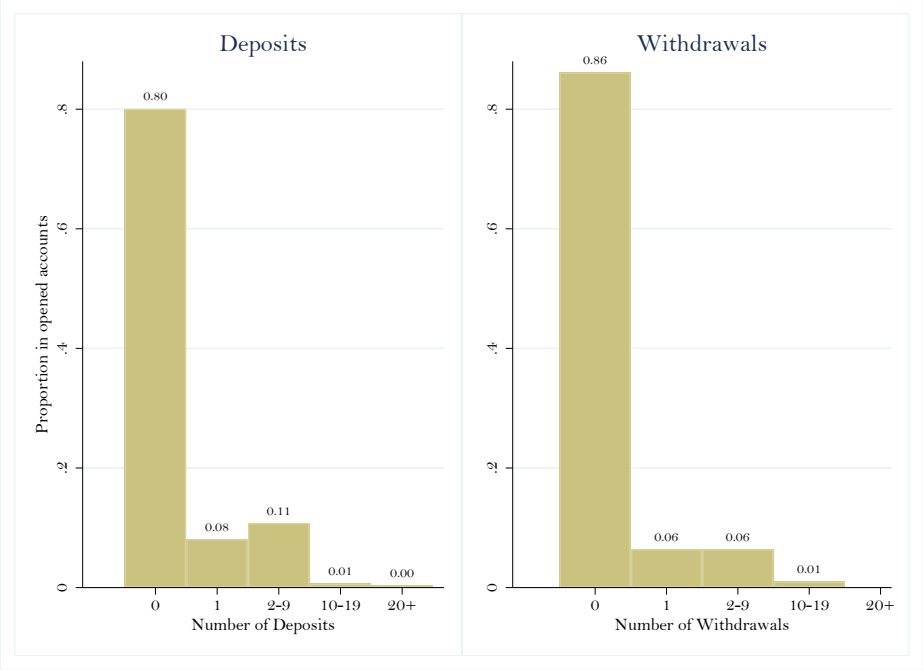


Figure 2.8: Distribution of MFI accounts' transactions

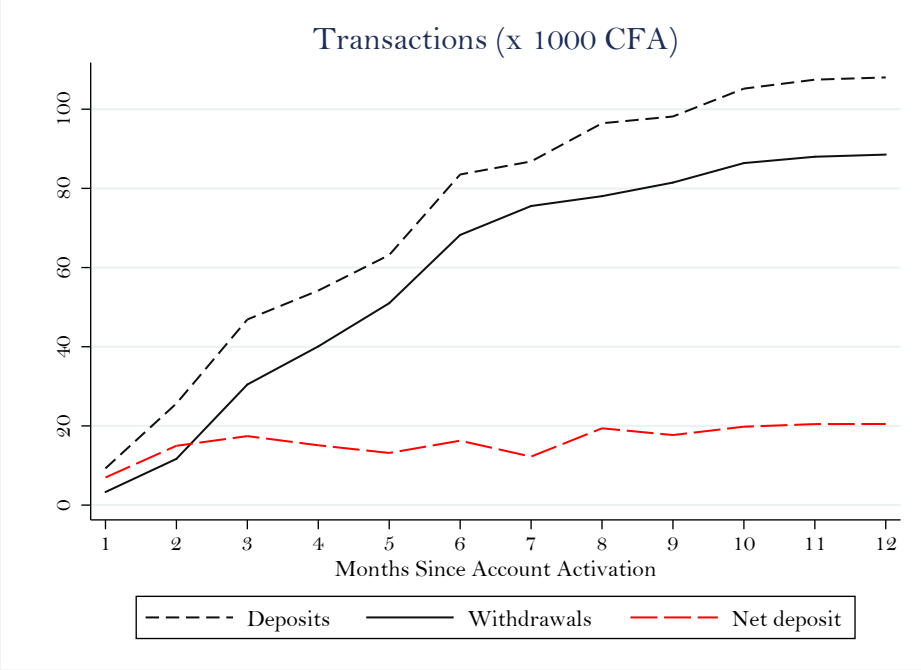


Figure 2.9: Average cumulative deposits and withdrawals amounts

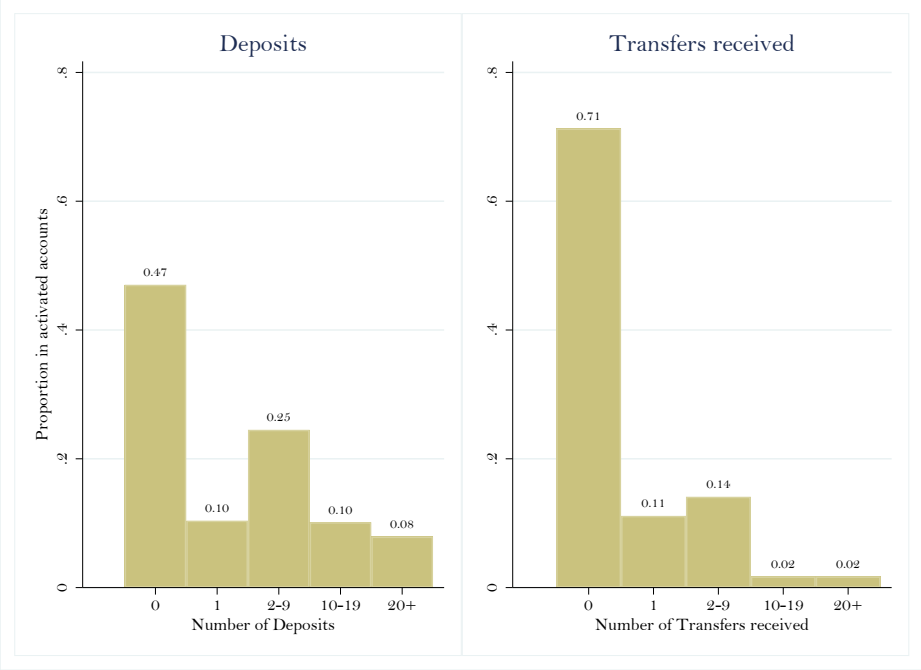


Figure 2.10: Distribution of Mobile money inflow transactions

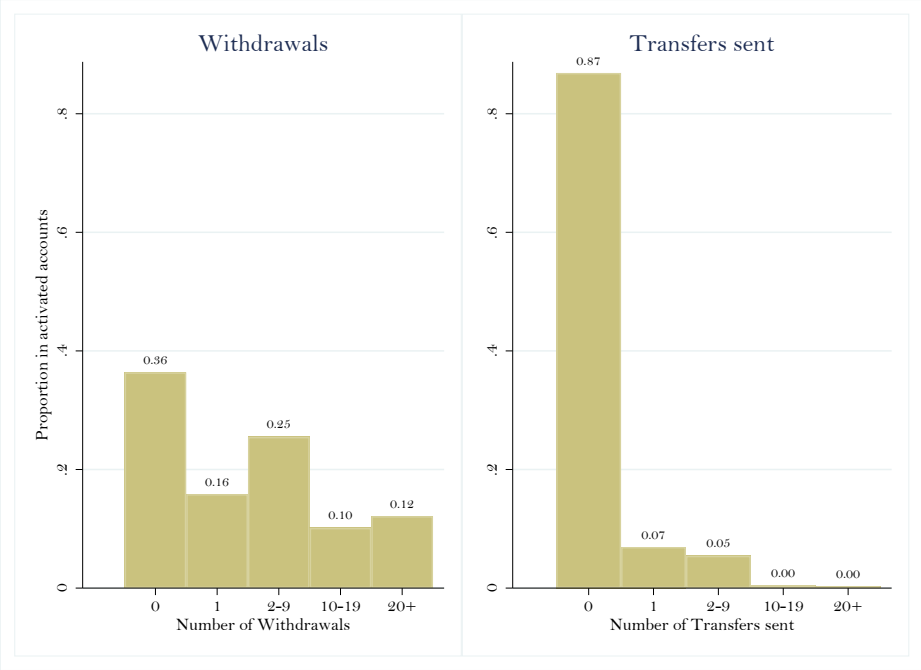


Figure 2.11: Distribution of Mobile money outflow transactions

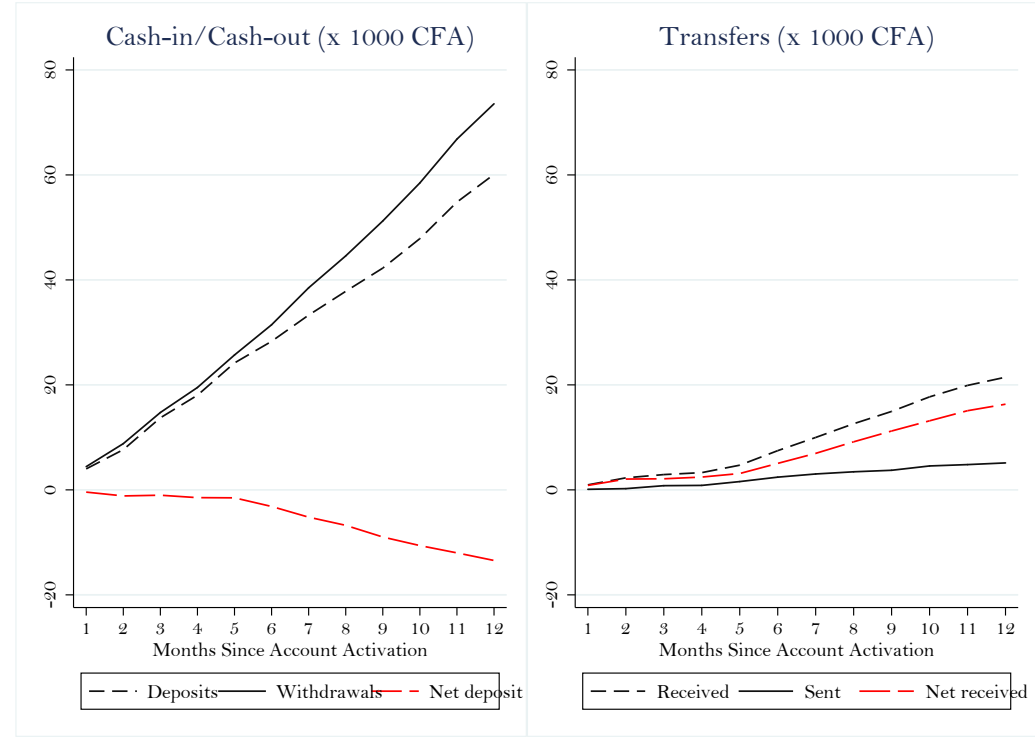


Figure 2.12: Average cumulative
mobile money inflows and outflows amounts

Table 2.3: Descriptive Statistics at Baseline (Whole sample)

Variable	Mean	Std. Dev.	Min.	Max.	N
Demographics & income					
Age	39.6	13.31	18	99	3908
Female	0.64	0.48	0	1	3908
Lives in couple	0.79	0.41	0	1	3908
Household size	4.92	2.78	1	22	3908
Number of Under 18 children in Hhld	2.79	1.85	0	15	3216
Number of Under 5 children in Hhld	0.86	0.85	0	5	3216
Education (Attended High school or beyond=1)[1]	0.41	0.49	0	1	3908
Valid ID Card	0.88	0.32	0	1	3908
Total Monthly Income	81043.45	72501.68	5000	500000	3908
Self-Assessed Financial situation (Very poor or difficult but acceptable=1)[2]	0.82	0.38	0	1	3908
Savings					
Save home as you wish	0.27	0.45	0	1	3908
Rosca member	0.3	0.46	0	1	3908
Monthly average contribution to Rosca	19592.53	25853.64	0	310000	1158
Has a formal MFI account	0.11	0.32	0	1	3908
Average monthly formal MFI deposit	1516.21	13467.57	0	500000	3908
Bank Account	0.16	0.36	0	1	3908
Monthly Bank deposit	17135.23	38978.98	0	400000	619
Has Mobile Money account	0.34	0.47	0	1	3908
Monthly Mobile money deposit	3910.41	14912.76	0	200000	1311
Use informal mobile banker services	0.26	0.44	0	1	3908
Monthly average contribution to the mobile banker	25328.2	27190.44	800	309000	1000
Savings at home in a Box	8643.38	15873.83	0	300000	3908
Own house	0.17	0.38	0	1	3908
Health & shocks?					
Experienced shock last month at or on the way to work	0.04	0.2	0	1	3908
Money spent for shock at work last month	113738.8	413955.21	0	5000000	165
Self-Assessment of Health (Good or very good=1)[3]	0.8	0.4	0	1	3908
Money you spent for health problems in your Hhd	14784.2	53517.37	0	2003000	3908
Job sector					
Works as an informal microentrepreneur	0.6	0.49	0	1	3908
Works as an informal sector employee	0.04	0.21	0	1	3908
Works in the public sector	0.04	0.2	0	1	3908
Works as a formal microentrepreneur	0.13	0.34	0	1	3908
Transfers					
Has sent a transfer the past 3 months, self-reported	0.51	0.5	0	1	3908
Total Amount received the past 3 months	37616.88	71202.15	0	1000000	1366
Has received a transfer the past 3 months, self-reported	0.56	0.5	0	1	3908
Total Amount sent the past 3 months	21276.99	35019.22	0	540000	1230
Loan demand pattern and usage					
Would you take a 2% monthly loan if accessible?	0.76	0.43	0	1	2616
Loan amount for 3 month repayment	97797.34	328923.34	0	10000000	1996
Loan amount for 12 months repayment	395357.46	949303.33	0	20000000	1996
Applied for loan the past 3 months?	0.1	0.3	0	1	3908
Has received a loan in the last 3 months(formal or informal)	0.77	0.42	0	1	398
Amount of loan got the past 3 months	90331.15	201611.31	0	3000000	305

Note: Amounts in the table are in CFA francs (**1 CFA=0.00152 €**).

[1] Coded as: 0= No education, attended primary School, 1= attended secondary school or beyond.

[2] Coded as: 0= Fair or comfortable, 1=Very poor or difficult but acceptable.

[3] Coded as: 0=poor, 1= Good or very good.

Table 2.4: Overview formal/informal savings devices distribution

Has an informal savings device	**Has a formal saving account**					
	NO		**YES**		**Total**	
	n	%	n	%	n	%
NO	783	20	749	19	1532	39
YES	1310	34	1066	27	2376	61
Total	2093	54	1815	46	3908	100

Note: Proportions are calculated relative to the whole sample at baseline. formal accounts here include all the available traditional accounts (bank accounts, MFI accounts) and mobile money accounts.

Table 2.5: Mobile money and traditional formal accounts

Other formal accounts	**Mobile Money Account**					
	NO		**YES**		**Total**	
	n	%	n	%	n	%
NO	2093	54	735	19	2828	72
YES	504	13	576	15	1080	28
Total	2597	66	1311	34	3908	100

Note: Proportions are calculated relative to the whole sample at baseline.

Table 2.6: **Formal-informal accounts distribution (a)**

	Has a formal saving account					
	NO		**YES**		**Total**	
	n	%	n	%	n	%
Participate in roscas						
NO	1523	39	1227	31	2750	70
YES	570	15	588	15	1158	30
Total	2093	54	1815	46	3908	100
Use a mobile banker services						
NO	1462	37	1446	37	2908	74
YES	631	16	369	9	1000	26
Total	2093	54	1815	46	3908	100
Save home as you wish						
NO	1491	38	1344	34	2835	73
YES	602	15	471	12	1073	27
Total	2093	54	1815	46	3908	100
Self-Help group member						
NO	1974	51	1633	42	3607	92
YES	119	3	182	5	301	8
Total	2093	54	1815	46	3908	100

Note: Proportions are calculated relative to the whole sample at baseline.

Table 2.7: **Formal-informal devices distribution (b)**

	Has an informal savings device					
	NO		**YES**		**Total**	
	n	%	n	%	n	%
CLCAM Account						
NO	1447	37	2175	56	3622	93
YES	85	2	201	5	286	7
Total	1532	39	2376	61	3908	100
Any Other MFI account						
NO	1502	38	2239	57	3741	96
YES	30	1	137	4	167	4
Total	1532	39	2376	61	3908	100
Mobile Money Account						
NO	960	25	1637	42	2597	66
YES	572	15	739	19	1311	34
Total	1532	39	2376	61	3908	100
Bank Account						
NO	1215	31	2075	53	3290	84
YES	317	8	301	8	618	16
Total	1532	39	2376	61	3908	100
Postal bank Account						
NO	1423	36	2270	58	3693	94
YES	109	3	106	3	215	6
Total	1532	39	2376	61	3908	100

Source: Baseline data

Note: Proportions are calculated relative to the whole sample at baseline.

Table 2.8: **Summary statistics on MFI accounts usage**

Variable	Mean	Std. Dev.	Min.	Max.	N
Vouchers uptake	0.76	0.43	0	1	762
Accounts uptake	0.52	0.5	0	1	572
Have made at least:					
1 transaction (deposits and/or withdrawals)	0.21	0.41	0	1	296
2 transactions (deposits and/or withdrawals)	0.16	0.36	0	1	296
Active use:					
3 transactions (deposits and/or withdrawals)	0.13	0.33	0	1	296
4 transactions (deposits and/or withdrawals)	0.1	0.3	0	1	296
5 transactions (deposits and/or withdrawals)	0.07	0.25	0	1	296
Account use: All users:					
Number of deposits	3.29	3.96	1	25	59
Number of withdrawals	3.17	3.9	1	16	41
Total deposits	111688.59	215394.59	2000	1202500	59
Total withdrawals	131719.51	231640.65	1000	1175000	41
Median deposit	34691.31	95701.29	2000	700000	59
Median withdrawals	52076.83	121612.76	1000	699000	41
Account use: Active users					
Number of deposits	4.62	4.51	1	25	37
Number of withdrawals	3.87	4.27	1	16	31
Total deposits	154692.62	238561.86	7000	1202500	37
Total withdrawals	145709.68	238046.08	4000	1175000	31
Median deposit	31967.22	44644.92	3500	178987.02	37
Median withdrawal	40375.81	71354.45	4000	360000	31

Note: The different figures (number of transactions and total amount per type of transaction) of this table are averages across the different opened accounts for the 12 months after the treatment. For example Total deposits is equivalent to an average total amounts deposited in an account during this period. Median for each type of transaction is an average of median transactions amounts across accounts.

Table 2.9: Summary statistics on mobile money accounts use

Variable	Mean	Std. Dev.	Min.	Max.	N
Account uptake	0.75	0.43	0	1	543
Have made at least:					
1 transaction (deposits and/or withdrawals)	0.66	0.47	0	1	404
2 transactions (deposits and/or withdrawals)	0.52	0.5	0	1	404
Active use:					
3 transactions (deposits and/or withdrawals)	0.48	0.5	0	1	404
4 transactions (deposits and/or withdrawals)	0.44	0.5	0	1	404
5 transactions (deposits and/or withdrawals)	0.42	0.49	0	1	404
Account use: All users:					
Number of deposits	11.08	17.16	1	136	214
Number of withdrawals	11.91	18.24	1	145	257
Number of transfer sent	3.6	5.82	1	39	50
Number of transfer received	5.48	8.04	1	42	113
Total deposits	97181.07	166084.08	200	1563650	214
Total withdrawals	99014.2	279187.99	500	3930300	257
Total transfers sent	35479.72	81681.38	100	554900	50
Total transfers received	65605.19	277778.89	500	2932500	113
Median deposit	8482.24	18105.86	200	190000	214
Median withdrawal	6556.81	16294.01	500	169500	257
Median transfer sent	8130.1	12687.64	100	65000	50
Median transfer received	11817.82	31801.59	5	278000	113
Account use: Active users					
Number of deposits	12.23	17.77	1	136	192
Number of withdrawals	15.73	19.86	1	145	190
Number of transfers sent	3.77	5.97	1	39	47
Number of transfers received	5.72	8.19	1	42	107
Total deposits	106796.35	172399.59	500	1563650	192
Total withdrawals	131352.37	318039.21	2000	3930300	190
Total transfers sent	37480.55	83895.09	100	554900	47
Total transfers received	66219.97	284524.95	500	2932500	107
Median deposit	7945.05	15068.56	500	190000	192
Median withdrawals	7068.16	16037.53	1000	169500	190
Median transfers sent	8385.21	13036.77	100	65000	47
Median transfers received	9491.25	19805.4	5	152000	107

Note: The different figures (number of transactions and total amount per type of transaction) of this table are averages across the different opened accounts for the 12 months after the treatment. For example total deposit is equivalent to the total amount deposited in the mobile money account during this period averaged across account beneficiaries. Median for each type of transaction is an average of median transactions amounts across accounts.

Table 2.10: **Determinants of MFI accounts take-up and use**

	Take-up	**Prob(use=1)**		
	(1)	(2)	(3)	(4)
	Pr(Open=1)	At least 1 deposit or withdrawal	At least 2 deposits or withdrawals	At least 3 deposits or withdrawals
Female	0.037	0.044	0.006	0.034
	[0.075]	[0.093]	[0.095]	[0.067]
Lives in couple	-0.029	0.139	0.073	0.133**
	[0.059]	[0.087]	[0.091]	[0.060]
Female⊗Lives in couple	0.009	-0.086	-0.013	-0.061
	[0.079]	[0.107]	[0.105]	[0.078]
Age	-0.006	-0.004	-0.002	-0.000
	[0.007]	[0.010]	[0.007]	[0.007]
Age squared	0.000	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Household size	-0.004	-0.014**	-0.013***	-0.009**
	[0.005]	[0.007]	[0.005]	[0.004]
Education (Attended High school or beyond=1)	-0.021	-0.098**	-0.053	-0.064*
	[0.023]	[0.044]	[0.040]	[0.037]
Owns the house	-0.095*	-0.048	-0.047	-0.086*
	[0.049]	[0.077]	[0.067]	[0.048]
Works in the informal sector	0.044	-0.013	-0.002	-0.006
	[0.049]	[0.052]	[0.047]	[0.045]
Self-Assessment of Health (Good or very good=1)	-0.012	0.050	0.024	0.032
	[0.038]	[0.038]	[0.036]	[0.035]
Distance to the nearest CLCAM branch	-0.411***	-0.118*	-0.149***	-0.092*
	[0.045]	[0.072]	[0.048]	[0.054]
Self-Assessment of Financial situation (Very poor or difficult but acceptable=1)	0.003	-0.028	-0.013	-0.036
	[0.045]	[0.055]	[0.049]	[0.054]
Use informal mobile banker services	0.005	-0.039	-0.031	-0.034
	[0.035]	[0.028]	[0.041]	[0.028]
Participate in roscas	0.039	-0.023	-0.056	-0.034
	[0.027]	[0.079]	[0.042]	[0.030]
Has Mobile Money account	0.034	0.008	0.051*	0.040
	[0.052]	[0.040]	[0.029]	[0.042]
Has received any loan in the last 3 months	0.358***	-0.033	-0.095	-0.143
	[0.089]	[0.157]	[0.176]	[0.161]
Observations	572	290	290	290
R-squared	0.094	0.089	0.081	0.077
Mean of dependent variable	0.517	0.210	0.159	0.128

Note: The use in terms of different types of transactions is measured within 12 months time span after the MFI account has been activated. All of the data on transactions on the accounts opened are administrative data coming from partner institutions. Regression in each column includes site fixed effects. Bootstrapped and clustered (at neighborhood level) standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.11: Determinants of MFI accounts use: Deposit and withdrawal

	Prob(Use=1)			
	(1) At least 1 deposit	(2) At least 1 withdrawal	(3) At least 2 deposits	At least 2 withdrawals
Female	0.027	0.011	0.048	0.010
	[0.089]	[0.096]	[0.043]	[0.064]
Lives in a couple	0.131	0.066	0.126***	0.090
	[0.094]	[0.075]	[0.034]	[0.071]
Female⊗ Lives in couple	-0.056	-0.071	-0.043	-0.047
	[0.106]	[0.098]	[0.063]	[0.081]
Age	-0.005	0.000	0.003	-0.001
	[0.009]	[0.007]	[0.006]	[0.004]
Age squared	0.000	0.000	-0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Household size	-0.013**	-0.014**	-0.010*	-0.009*
	[0.007]	[0.007]	[0.006]	[0.005]
Education (Attended High school or beyond=1)	-0.088**	-0.029	-0.040	-0.013
	[0.039]	[0.033]	[0.036]	[0.028]
Owns the house	-0.036	-0.037	-0.109***	-0.030
	[0.078]	[0.075]	[0.042]	[0.051]
Works in the informal sector	-0.022	0.025	0.010	0.014
	[0.054]	[0.044]	[0.038]	[0.039]
Self-Assessment of Health (Good or very good=1)	0.037	0.023	0.017	0.005
	[0.041]	[0.050]	[0.033]	[0.041]
Distance to the nearest CLCAM branch	-0.126	-0.122**	-0.058	-0.020
	[0.078]	[0.055]	[0.053]	[0.036]
Self-Assessment of Financial situation (Very poor or difficult but acceptable=1)	-0.037	-0.019	-0.042	-0.005
	[0.050]	[0.044]	[0.051]	[0.033]
Use informal mobile banker services	-0.049	0.017	-0.028	0.033
	[0.034]	[0.041]	[0.026]	[0.031]
Participate in roscas	-0.029	-0.097***	-0.011	-0.054***
	[0.076]	[0.027]	[0.039]	[0.014]
Has Mobile Money account	-0.002	0.060**	0.010	0.047**
	[0.035]	[0.029]	[0.037]	[0.021]
Has received any loan in the last 3 months	-0.010	0.185***	-0.128	0.091*
	[0.165]	[0.064]	[0.154]	[0.047]
Observations	290	290	290	290
R-squared	0.088	0.098	0.080	0.078
mean of depvar	0.203	0.141	0.121	0.0759

Note: The use in terms of different types of transactions is measured within 12 months time span after the mobile money account has been activated. All of the data on transactions on the accounts opened are administrative data coming from partner institutions. Regression in each column includes site fixed effects. Bootstrapped and clustered (at neighborhood level) standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.12: **Determinants of mobile money accounts take-up and use**

		Prob(use=1)			
	(1)	(2)	(3)	(4)	(5)
	Pr(Open=1)	At least 1 deposit or withdrawal	At least 1 transfer sent or received	At least 2 deposit or withdrawal	At least 3 transfers sent or received
Female	-0.034	0.495***	0.320***	0.331***	0.239***
	[0.090]	[0.113]	[0.060]	[0.096]	[0.046]
Lives in couple	-0.061	0.414***	0.270***	0.328***	0.151***
	[0.064]	[0.132]	[0.073]	[0.107]	[0.052]
Female⊗Lives in couple	0.064	-0.466***	-0.302***	-0.332***	-0.202**
	[0.096]	[0.110]	[0.094]	[0.104]	[0.083]
Age	0.005	0.015*	-0.001	0.006	0.012***
	[0.010]	[0.008]	[0.005]	[0.006]	[0.004]
Age squared	-0.000	-0.000**	0.000	-0.000	-0.000***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Household size	-0.002	-0.004	0.011**	0.003	0.001
	[0.004]	[0.008]	[0.004]	[0.007]	[0.004]
Education (Attended High school or beyond=1)	0.046	-0.060*	0.072	0.024	0.028
	[0.034]	[0.031]	[0.046]	[0.040]	[0.034]
Home owner	0.006	-0.047	-0.051	-0.042	-0.024
	[0.040]	[0.041]	[0.044]	[0.046]	[0.033]
Works in the informal sector	-0.059*	-0.058	-0.041	-0.051	-0.016
	[0.032]	[0.075]	[0.044]	[0.080]	[0.041]
Self-Assessment of Health (Good or very good=1)	-0.023	0.039	-0.039	0.044	0.021
	[0.032]	[0.064]	[0.083]	[0.052]	[0.077]
Self-Assessment of Financial situation (Very difficult=1)	0.069**	-0.021	0.029	-0.064	-0.013
	[0.033]	[0.069]	[0.065]	[0.072]	[0.072]
Bank Account	0.086*	0.088	0.139**	0.115	0.067
	[0.047]	[0.080]	[0.065]	[0.089]	[0.050]
Use informal mobile banker services	0.113***	-0.123*	-0.011	-0.072	0.023
	[0.033]	[0.067]	[0.039]	[0.061]	[0.057]
Has a formal MFI account	0.041	0.052	0.116***	0.101	0.076
	[0.038]	[0.047]	[0.038]	[0.066]	[0.047]
Participate in roscas	0.056***	-0.002	-0.071**	0.027	-0.057***
	[0.017]	[0.047]	[0.035]	[0.034]	[0.019]
Has received a loan in the last 3 months (financial institution)	-0.008	-0.106	0.034	-0.081	0.088
Observations	543	404	404	404	404
R-squared	0.343	0.094	0.090	0.077	0.070
Mean of dependent variable	0.750	0.663	0.324	0.525	0.208

Note: The use in terms of different types of transactions is measured within 12 months time span after the mobile money account has been activated. All of the data on transactions on the accounts opened are administrative data coming from partner institutions. Regression in each column includes site fixed effects. Bootstrapped and clustered (at neighborhood level) standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.13: Determinants of mobile money accounts use: Deposit and withdrawal

	Prob(Use=1)			
	(1) At least 1 deposit	(2) At least 1 withdrawal	(3) At least 2 deposits	(4) At least 2 withdrawals
Female	0.280***	0.494***	0.338***	0.385***
	[0.103]	[0.114]	[0.072]	[0.072]
Lives in couple	0.300***	0.394***	0.339***	0.406***
	[0.107]	[0.136]	[0.103]	[0.092]
Female⊗Lives in couple	-0.257**	-0.457***	-0.362***	-0.383***
	[0.118]	[0.115]	[0.112]	[0.084]
Age	0.010	0.010	-0.000	0.003
	[0.006]	[0.007]	[0.007]	[0.008]
Age squared	-0.000*	-0.000**	-0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Household size	0.004	-0.005	0.006	0.006
	[0.008]	[0.008]	[0.007]	[0.008]
Education (Attended High school or beyond=1)	0.016	-0.057*	0.020	0.015
	[0.037]	[0.034]	[0.041]	[0.047]
Owns the house	-0.045	-0.036	-0.014	-0.031
	[0.050]	[0.030]	[0.036]	[0.035]
Works in the informal sector	-0.075	-0.045	-0.101	-0.042
	[0.084]	[0.078]	[0.068]	[0.077]
Self-Assessment of Health (Good or very good=1)	0.050	0.039	0.052	0.042
	[0.058]	[0.070]	[0.059]	[0.059]
Self-Assessment of Financial situation (Very poor or difficult but acceptable=1)	-0.020	-0.032	0.009	-0.014
	[0.098]	[0.060]	[0.065]	[0.051]
Bank Account	0.120	0.057	0.132	0.112
	[0.087]	[0.078]	[0.107]	[0.102]
Use informal mobile banker services	-0.073	-0.121**	-0.012	-0.040
	[0.061]	[0.057]	[0.044]	[0.032]
Has a formal MFI account	0.125**	0.027	0.174***	0.102
	[0.057]	[0.055]	[0.059]	[0.071]
Participate in roscas	0.045	-0.013	0.038	0.008
	[0.041]	[0.043]	[0.038]	[0.039]
Has received any loan in the last 3 months	-0.090	-0.104	-0.145	-0.085
	[0.112]	[0.128]	[0.110]	[0.104]
Observations	404	404	404	404
R-squared	0.075	0.091	0.094	0.081
mean of depvar	0.530	0.636	0.426	0.478

Note: The use in terms of different types of transactions is measured within 12 months time span after the mobile money account has been activated. All of the data on transactions on the accounts opened are administrative data coming from partner institutions. Regression in each column includes site fixed effects. Bootstrapped and clustered (at neighborhood level) standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.14: Determinants of mobile money accounts use: transfers (sent or received)

	Prob(Use=1)			
	(1) At least 1 transfer sent	(2) At least 1 transfer received	(3) At least 2 transfers sent	(4) At least 2 transfers received
Female	0.114***	0.306***	-0.005	0.232***
	[0.040]	[0.058]	[0.026]	[0.048]
Lives in couple	0.115**	0.210***	0.013	0.135**
	[0.056]	[0.077]	[0.033]	[0.061]
Female⊗Lives in couple	-0.115	-0.256***	0.019	-0.202**
	[0.081]	[0.092]	[0.048]	[0.089]
Age	0.016***	-0.006	0.010***	0.004
	[0.005]	[0.006]	[0.002]	[0.004]
Age squared	-0.000***	0.000	-0.000***	-0.000**
	[0.000]	[0.000]	[0.000]	[0.000]
Household size	-0.002	0.011***	0.003	0.001
	[0.005]	[0.004]	[0.004]	[0.004]
Education (Attended High school or beyond=1)	0.046	0.053	0.058**	0.028
	[0.049]	[0.036]	[0.029]	[0.037]
Owns the house	-0.010	-0.039	-0.009	0.006
	[0.030]	[0.056]	[0.026]	[0.055]
Works in the informal sector	-0.055	0.007	0.010	0.016
	[0.043]	[0.039]	[0.025]	[0.037]
Self-Assessment of Health (Good or very good=1)	-0.085*	0.008	-0.017	0.052
	[0.044]	[0.102]	[0.017]	[0.084]
Self-Assessment of Financial situation (Very poor or difficult but acceptable=1)	0.034	0.002	0.044*	-0.019
	[0.045]	[0.052]	[0.026]	[0.064]
Bank Account	0.119**	0.101	0.091**	0.047
	[0.059]	[0.065]	[0.039]	[0.054]
Use informal mobile banker services	-0.017	-0.031	0.035	0.014
	[0.036]	[0.032]	[0.037]	[0.036]
Has a formal MFI account	0.028	0.102	0.040	0.048
	[0.040]	[0.065]	[0.033]	[0.064]
Participate in roscas	0.005	-0.069*	0.024*	-0.061**
	[0.019]	[0.039]	[0.014]	[0.029]
Has received any loan in the last 3 months	0.019	0.113	-0.044	0.178*
	[0.073]	[0.081]	[0.062]	[0.104]
Observations	404	404	404	404
R-squared	0.118	0.082	0.108	0.065
mean of depvar	0.131	0.287	0.0619	0.176

Note: The use in terms of different types of transactions is measured within 12 months time span after the mobile money account has been activated. All of the data on transactions on the accounts opened are administrative data coming from partner institutions. Regression in each column includes site fixed effects. Bootstrapped and clustered (at neighborhood level) standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.15: MFI account impacts on different deposits and loan application

	Log of monthly savings in						Prob(ask loan=1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Mobile Money Account	Cash at home	Roscas	Informal Mobile banker (Tontinier)	Self-help group	Total savings	Dummy: Applied for any loan (past 3 months)
ITT: Offered a MFI account (T1)	-0.188	-0.537	-0.535	-0.058	0.025	-0.209	0.075
	[1.048]	[0.624]	[0.376]	[0.277]	[0.023]	[0.572]	[0.072]
Observations	1,142	1,142	1,142	1,142	1,142	1,142	1,142
R-squared	0.317	0.208	0.921	0.918	0.765	0.165	0.057
Control Mean of dep. var (x 1000 CFA)	3.975	5.346	7.106	8.062	0.227	18.10	0.0566

Note: the dependent variable in columns (1)-(6) represents the total monthly deposit (in Log) in the subsequent financial institution device. All of these amounts have been winsorized at the respective 99th percentile before the logarithm has been applied. Outcome in column (7) is a dummy variable capturing whether or not the agent has applied for a loan in the past 3 months. Total savings in column(6) represents the total monthly deposit in the different formal and informal savings devices available and owned. The different controls included in each regression are: gender, marital status, age, education, household size, house ownership, being working in informal sector or not, distance to the nearest CLCAM branch in the neighborhood, whether or not different savings devices (formal and informal) were owned at baseline and the lagged value of the dependent variable. The neighborhood fixed effects and the time fixed effects are also controlled for. Clustered and robust standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1

Table 2.16: Mobile money account impacts on different deposits and loan application

	Log of savings in							Prob(ask loan=1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Formal Bank	Formal MFI	Cash at home	Roscas	Informal Mobile banker (Tontinier)	Self-help group	Total savings	Dummy: Applied for any loan (past 3 months)
ITT: Offered a mobile money account (T2)	0.552	0.306	0.107	0.333*	-0.078	-0.008	0.896**	0.016
	[0.475]	[0.193]	[0.458]	[0.182]	[0.139]	[0.057]	[0.426]	[0.035]
Observations	1,031	1,031	1,031	1,031	1,031	1,031	1,031	1,031
R-squared	0.475	0.113	0.233	0.909	0.928	0.746	0.218	0.056
Control Mean of dep. var (x 1000 CFA)	4.325	1.490	5.440	6.093	8.876	0.242	20.70	0.0498

Note: the dependent variable in columns (1)-(7) represents the total monthly deposit (in Log) in the subsequent financial institution device. All of these amounts have been winsorized at the respective 99th percentile before the logarithm has been applied. Outcome in column (8) is a dummy variable capturing whether or not the agent has applied for a loan in the past 3 months. Total savings in column (7) represents the total monthly deposit in the different formal and informal savings devices available and owned. The different controls included in each regression are: gender, marital status, age, education, household size, house ownership, being working in informal sector or not, distance to the nearest CLCAM branch in the neighborhood, whether or not different savings devices (formal and informal) were owned at baseline and the lagged value of the dependent variable. The neighborhood fixed effects and the time fixed effects are also controlled for. Robust standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1

Heterogeneity in CLCAM impacts

Table 2.17: Heterogeneity in impacts of a MFI account on total deposits

	Log (total monthly deposits)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITT: Offered a MFI account (T1)	-0.243	-0.182	-0.327	-0.177	-0.281	-0.235	0.129
	[0.559]	[0.557]	[0.564]	[0.559]	[0.525]	[0.501]	[0.521]
T1⊗ hidefinance							-0.367
							[0.292]
Hide finance (savings & spending) to spouse							-0.021
							[0.255]
T1⊗ usetontinier						0.053	
						[0.193]	
Use informal mobile banker services						0.089	
						[0.160]	
T1⊗ roscasmember					0.158		
					[0.194]		
Participate in roscas					-0.124		
					[0.164]		
T1⊗ mobmoney				-0.095			
				[0.185]			
Has Mobile Money account				0.221			
				[0.148]			
T1⊗ microentrep			0.140				
			[0.209]				
Microentrepreneur			-0.170				
			[0.215]				
T1⊗ Education		-0.066					
		[0.186]					
Education (Attended High school or beyond=1)		-0.021					
		[0.214]					
T1⊗ female	0.015						
	[0.194]						
Female	0.263*						
	[0.150]						
Observations	1,142	1,142	1,142	1,142	1,142	1,142	715
R-squared	0.168	0.168	0.168	0.168	0.168	0.168	0.176

Note: Each column in the table represents a regression of the specified outcome of interest (here Log of total monthly savings) on the treatment dummy (being offered a MFI account or not), a baseline dimension along which the heterogeneous effects are analyzed and an interaction between the treatment dummy and the considered baseline characteristics. Column (1) for example shows the differential impacts of being offered a MFI account along the gender dimension on total deposit (in all types of account owned). In each of the regressions (1)-(7) a set of baseline characteristics are controlled for: marital status, age, education, household size, house ownership, sector of activity (informal vs formal), distance to the nearest CLCAM branch and whether or not each savings account or device (formal and informal) was owned at baseline. The regressions also include the appropriate fixed effects related to the considered neighborhoods. Robust and clustered standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.18: Heterogeneity in impacts of MFI account on roscas deposits

	Log (total monthly roscas deposits)					
	(1)	(2)	(3)	(4)	(5)	(6)
ITT: Offered a MFI account (T1)	-0.577	-0.476	-0.530	-0.489	-0.527	-0.363
	[0.373]	[0.382]	[0.379]	[0.382]	[0.367]	[0.340]
T1⊗ hidefinance						-0.072
						[0.076]
Hide finance (savings & spending) to spouse						0.007
						[0.070]
T1⊗ usetontinier					0.067	
					[0.065]	
Use informal mobile banker services					-0.015	
					[0.053]	
T1⊗ mobmoney				-0.031		
				[0.057]		
Has Mobile Money account				0.106**		
				[0.048]		
T1⊗ microentrep			0.031			
			[0.057]			
Microentrepreneur			-0.024			
			[0.055]			
T1⊗ Education		-0.054				
		[0.057]				
Education (Attended High school or beyond=1)		0.085*				
		[0.048]				
T1⊗ female	0.105*					
	[0.059]					
Female	-0.132***					
	[0.051]					
Observations	1,142	1,142	1,142	1,142	1,142	715
R-squared	0.923	0.923	0.923	0.923	0.923	0.931

Note: Each column in the table represents a regression of the specified outcome of interest (here Log of monthly roscas deposits) on the treatment dummy (being offered a MFI account or not), a baseline dimension along which heterogeneity in effects is analyzed, an interaction between the treatment dummy and the considered baseline characteristic. Some additional controls (marital status, age, education, household size, house ownership, distance to the nearest CLCAM branch) and whether or not each savings account or device (formal and informal) was owned at baseline have been added. Column (1) for example shows the differential impacts of being offered a MFI account along the gender dimension on roscas deposits. The regressions also include the appropriate fixed effects related to the considered neighborhoods. Robust and clustered standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Heterogeneity in MOBILE MONEY impacts

Table 2.19: Heterogeneity in impacts of a mobile money account on total deposits

	Log (total monthly savings)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITT: Offered a mobile money account (T2)	1.040**	0.861**	0.844*	0.889**	0.796*	0.756	1.006
	[0.451]	[0.411]	[0.456]	[0.427]	[0.427]	[0.462]	[0.773]
T2⊗ hidefinance							0.029
							[0.291]
Hide finance (savings & spending) to spouse							0.187
							[0.245]
T2⊗ usetontinier						0.275	
						[0.198]	
Use informal mobile banker services						0.071	
						[0.159]	
T2⊗ roscasmember					0.484**		
					[0.200]		
Participate in roscas					-0.142		
					[0.166]		
T2⊗ mfiacc				0.046			
				[0.222]			
Has a formal MFI account				0.320**			
				[0.162]			
T2⊗ microentrep			0.087				
			[0.232]				
Microentrepreneur			-0.041				
			[0.252]				
T2⊗ educ		0.090					
		[0.210]					
Education (Attended High school or beyond=1)		0.166					
		[0.233]					
T2⊗ female	-0.213						
	[0.221]						
Female	0.058						
	[0.176]						
Observations	1,031	1,031	1,031	1,031	1,031	1,031	636
R-squared	0.220	0.220	0.219	0.219	0.225	0.223	0.238

Note: Each column in the table represents a regression of the specified outcome of interest (here Log of total monthly deposits) on the treatment dummy (being offered a Mobile money account or not), a baseline dimension along which the heterogeneous effects are analyzed and an interaction between the treatment dummy and the considered baseline characteristics. Column (1) for example shows the differential impacts of being offered a Mobile money account on total monthly deposits in various savings accounts and across gender. Some additional controls (marital status, age, education, household size, house ownership, distance to the nearest CLCAM branch) and whether or not each savings account or device (formal and informal) was owned at baseline have been added. Column (1) for example shows the differential impacts of being offered a mobile money account on roscas deposits across gender dimension. The regressions also include the appropriate fixed effects related to the considered neighborhoods. Robust and clustered standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table 2.20: Heterogeneity in impacts of a mobile money account on roscas deposits

	Log (monthly roscas deposits)					
	(1)	(2)	(3)	(4)	(5)	(6)
ITT: Offered a mobile money account (T2)	0.302	0.280	0.298*	0.283	0.335*	0.453
	[0.184]	[0.176]	[0.178]	[0.179]	[0.180]	[0.358]
T2⊗ hidefinance						0.074
						[0.089]
Hide finance (savings & spending) to spouse						-0.033
						[0.070]
T2⊗ usetontinier					-0.042	
					[0.067]	
Use informal mobile banker services					0.091*	
					[0.053]	
T2⊗ microentrep				0.055		
				[0.058]		
Microentrepreneur				-0.071		
				[0.068]		
T2⊗ mfiacc			0.125			
			[0.089]			
Has a formal MFI account			-0.072			
			[0.064]			
T2⊗ Education		0.110*				
		[0.063]				
Education (Attended High school or beyond=1)		0.030				
		[0.049]				
T2⊗ female	0.026					
	[0.064]					
Female	-0.214***					
	[0.051]					
Observations	1,031	1,031	1,031	1,031	1,031	636
R-squared	0.910	0.910	0.910	0.910	0.910	0.919

Note: Each column in the table represents a regression of the specified outcome of interest (here Log of total monthly deposits) on the treatment dummy (being offered a Mobile money account or not), a baseline dimension along which the heterogeneous effects are analyzed and an interaction between the treatment dummy and the considered baseline characteristics. Column (1) for example shows the differential impacts of being offered a Mobile money account on roscas deposits across gender. In each of the regressions (1)-(7) a set of baseline characteristics are controlled for (marital status, age, household size, house ownership, distance to the MFI branch. The regressions also include the appropriate fixed effects related to the considered neighborhoods. Robust and clustered standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Appendices

A Balance check on assignment to treatment: Baseline and whole sample

Table A.1: Balance Check on clcam accounts random assignment

	Sample	Control	Treatment	Mean C.	Mean T.	P-val T=C
Age	1780	788	992	39.30	39.67	0.56
Female	1780	788	992	0.65	0.66	0.50
Lives in couple	1780	788	992	0.76	0.80	0.09
Household size	1780	788	992	4.98	5.05	0.62
Number of Under 18 children in Hhld	1473	648	825	2.89	2.81	0.45
Number of Under 5 children in Hhld	1473	648	825	0.85	0.85	0.94
Education (Attended High school or beyond=1)	1780	788	992	0.38	0.34	0.09
Valid ID/LEPI Card	1780	788	992	1.00	1.00	.
home	1780	788	992	0.17	0.16	0.60
Total Monthly Income	1780	788	992	66712.47	67260.68	0.83
Save home as you wish	1780	788	992	0.27	0.28	0.69
Participate in roscas	1780	788	992	0.28	0.29	0.63
Monthly average contribution to Rosca	514	223	291	16606.28	17649.48	0.57
Monthly Mobile money deposit	706	356	350	3310.97	4498.01	0.33
Use a mobile banker services	1780	788	992	0.27	0.27	0.96
Monthly average contribution to the mobile banker	480	212	268	23889.29	23143.28	0.72
Savings at home in a Box	1780	788	992	7399.11	7894.70	0.51
Self-Assessment of Financial situation (Very poor or difficult but acceptable=1)	1780	788	992	0.85	0.85	0.77
Experienced shock last month at or on the way to work	1780	788	992	0.04	0.03	0.34
Money spent for shock at work last month	66	33	33	74760.61	202893.94	0.41
Self-Assessment of Health (Good or very good=1)	1780	788	992	0.81	0.83	0.27
Money you spent for health problems in your Hhd	1780	788	992	14697.72	10919.55	0.18
Informal microentrepreneurs	1780	788	992	0.61	0.62	0.47
Informal sector employee	1780	788	992	0.05	0.05	0.43
Work in the public sector	1780	788	992	0.01	0.01	0.40
Formal microentrepreneurs	1780	788	992	0.14	0.14	0.84
Has sent a transfer the past 3 months, self-reported	1780	788	992	0.46	0.46	0.74
Total Amount received the past 3 months	624	289	335	28875.26	35221.81	0.19
Has received a transfer the past 3 months, self-reported	1780	788	992	0.54	0.53	0.62
Total Amount sent the past 3 months	480	212	268	20559.91	15758.58	0.11
Would you take a 2% monthly loan if accessible?	1263	558	705	0.75	0.78	0.28
Loan amount for 3 month repayment	969	420	549	76147.62	116347.91	0.14
Applied for loan the past 3 months?	1780	788	992	0.09	0.10	0.39
loan amount got the past 3 months	124	43	81	68453.49	56135.80	0.43

Source: Baseline survey

Table A.2: Balance Check on mobile money accounts random assignment

	Sample	Control	Treatment	Mean C.	Mean T.	P-val T=C
Age	1545	668	877	42.94	42.29	0.36
Female	1545	668	877	0.69	0.72	0.19
Lives in couple	1545	668	877	0.82	0.81	0.77
Household size	1545	668	877	5.17	5.27	0.51
Number of Under 18 children in Hhld	1341	579	762	2.82	2.90	0.45
Number of Under 5 children in Hhld	1341	579	762	0.81	0.80	0.84
Education (Attended High school or beyond=1)	1545	668	877	0.34	0.30	0.18
Valid ID/LEPI Card	1545	668	877	0.99	1.00	.
home	1545	668	877	0.19	0.20	0.53
Total Monthly Income	1545	668	877	78862.64	75589.88	0.35
Save home as you wish	1545	668	877	0.28	0.29	0.79
Participate in roscas	1545	668	877	0.32	0.30	0.46
Monthly average contribution to Rosca	475	212	263	21191.04	18804.37	0.33
Bank Account	1545	668	877	0.14	0.12	0.19
Monthly Bank deposit	203	96	107	20717.77	16441.12	0.46
Use a mobile banker services	1545	668	877	0.30	0.29	0.62
Monthly average contribution to the mobile banker	450	199	251	26567.34	25343.03	0.66
Savings at home in a Box	1545	668	877	9056.14	8784.84	0.73
Self-Assessment of Financial situation (Very poor or difficult but acceptable=1)	1545	668	877	0.84	0.84	0.84
Experienced shock last month at or on the way to work	1545	668	877	0.05	0.04	0.86
Money spent for shock at work last month	70	31	39	93709.68	68802.62	0.54
Self-Assessment of Health (Good or very good=1)	1545	668	877	0.77	0.76	0.71
Money you spent for health problems in your Hhd	1545	668	877	17762.72	14846.42	0.40
Informal microentrepreneurs	1545	668	877	0.68	0.67	0.55
Formal microentrepreneurs	1545	668	877	0.10	0.10	0.93
Total Amount received the past 3 months	470	213	257	30597.65	28941.63	0.64
Has received a transfer the past 3 months, self-reported	1545	668	877	0.57	0.52	0.05
Total Amount sent the past 3 months	430	194	236	21489.18	20845.98	0.85
Would you take a 2% monthly loan if accessible?	1121	488	633	0.76	0.76	0.89
Loan amount for 3 month repayment	850	369	481	90018.97	75893.97	0.28
Loan amount for 12 months repayment	850	369	481	294349.59	358648.65	0.27
Applied for loan the past 3 months?	1545	668	877	0.09	0.10	0.69
Has received a loan in the last 3 months(formal or informal)	144	60	84	0.77	0.81	0.54
loan amount got the past 3 months	114	46	68	171021.74	106911.76	0.27

Source: Baseline

B Why ANCOVA and not Diff-in-Diffs?

In the framework of this study, we used an ANCOVA approach, which consists in regressing an outcome of interest on its baseline value (and a bunch of controls). This method allows for higher power (as compared to diff-in-diffs) in impact measurement, when there is low autocorrelation in the outcome of interest, in the context where there is one baseline and one follow-up surveys; see McKenzie (2012) for details on this point.

The diff-in-diffs estimation shows different results compared to ANCOVA probably due to two factors: i) the parallel trend assumption (Roth, 2018; Kahn-Lang and Lang, 2020), and ii) the relatively lower power compared to ANCOVA McKenzie (2012). First, a key condition for the validity of the diff-

in-diffs method is, in fact, that the parallel trend assumption between treatment arms (constant difference over time in savings); is verified prior to the treatment. Checking for this parallel trend would require two distinct data points in the main outcomes before the treatment. Unfortunately, we cannot test for the parallel trend assumption in this study since we do not have savings data on these two groups prior to the intervention (treatment implementation). Second, when the outcome of interest's autocorrelation between baseline and follow-up is low (less than 0.5), diff-in-diffs estimation performs poorly.[44] In fact, in such a context, by controlling for a simple difference in the outcome of interest between treatment and control groups at baseline, the diff-in-diffs considers a perfect autocorrelation for the outcome of interests time persistency. ANCOVA on the contrary better reflects the time persistency of the outcome by explicitly considering the actual autocorrelation between the dependant variable and its lag (e.g. McKenzie, 2012, for further details).

C Attrition

The study aims to identify the effect of a MFI deposit account and a mobile money account on the beneficiaries outcomes (investment, total savings, savings in each of the informal institution). At the baseline, we intended to offer 990 individuals a deposit account at CLCAM but ended finding 65% of them of which 10% happened to be ineligible post baseline. This means they had a valid ID card (minimal condition to be eligible to the MFI account) at baseline survey but during the treatment phase, either they lost the card or the card expired but was not renewed and they were not eager to renew either. The remaining 35% of the eligible people who were not covered by the treatment were actually not found (due to permanent departure from the neighborhoods for most cases). As for the mobile money accounts, 877 eligible were randomly assigned to offered the activation process and the initial balance but 62% of them were actually treated. There were 26.5% who were ineligible either due to the ID card problem mentioned above or and most importantly due to broken mobile phone device (or lost). People not found for this treatment either migrated from the study area or could not be reached during the phase. Despite the great effort to track all of these people (treated, assigned to treatment but untreated and control group) at follow up, we ended up with an attrition of about 30%. Nevertheless, as shown in Table C.1, we

[44] The estimated values of autocorrelation coefficient found in this study are all lower than 0.5. For instance, total savings and ROSCAs have an autocorrelation coefficient of respectively 0.24 and 0.06. As a result, further follow up data would be helpful to check whether the current results hold.

find no significant difference in attrition between treatment and control group for both accounts.

Table C.1: Attrition at follow-up

	Prob(completed follow-up=1)			
	MFI		**Mob. Money**	
	(1)	(2)	(3)	(4)
ITT: Offered a MFI account (T1)	-0.227	-0.221		
	[0.219]	[0.210]		
ITT: Offered a mobile money account (T2)			0.119	0.109
			[0.131]	[0.139]
Female		-0.031		0.005
		[0.056]		[0.072]
Lives in couple		0.019		-0.006
		[0.053]		[0.068]
Female ⊗ Lives in couple		0.028		-0.004
		[0.063]		[0.078]
Age		0.020***		0.013**
		[0.005]		[0.005]
Age squared		-0.000***		-0.000**
		[0.000]		[0.000]
Household size		0.005		0.007
		[0.005]		[0.005]
Education (Attended High school or beyond=1)		0.084***		0.011
		[0.025]		[0.027]
Own house		0.012		-0.024
		[0.035]		[0.035]
Works in the informal sector		0.035		0.025
		[0.031]		[0.032]
Self-Assessment of Health (Good or very good=1)		0.060*		0.060*
		[0.033]		[0.032]
Self-Assessment of Financial situation (Very poor or difficult but acceptable=1)		0.021		0.038
		[0.033]		[0.033]
Bank Account				-0.022
				[0.036]
Use informal mobile banker services		0.022		-0.012
		[0.026]		[0.028]
Has a formal MFI account				0.041
				[0.031]
Participate in roscas		0.025		0.009
		[0.025]		[0.025]
Observations	1,780	1,780	1,545	1,545
R-squared	0.090	0.116	0.095	0.109
Mean of depvar	0.670	0.670	0.717	0.717

Note: The regressions include each covariate level. We only report the interaction terms and the treatment dummies.
*** p<0.01, ** p<0.05, * p<0.1.

D Follow-up CLCAM and mobile money accounts ownership by ownership at baseline

Table D.1: Follow-up CLCAM account ownership

Had Mobile Money account	**Follow-up CLCAM account ownership**					
	NO		**YES**		**Total**	
	n	%	n	%	n	%
NO	883	96	41	4	924	100
YES	192	92	17	8	209	100
Total	1075	95	58	5	1133	100

Table D.2: Follow-up mobile money account ownership

Had a CLCAM account	**Follow-up mobile money account ownership**					
	NO		**YES**		**Total**	
	n	%	n	%	n	%
NO	411	52	383	48	794	100
YES	15	42	21	58	36	100
Total	426	51	404	49	830	100

E More on heterogeneity in impacts

MFI

Table E.1: Heterogeneity in impacts of a MFI account on *Tontinier* deposits

	Log (monthly tontinier deposits)					
	(1)	(2)	(3)	(4)	(5)	(6)
ITT: Offered a MFI account (T1)	-0.107	-0.136	-0.081	-0.082	-0.090	-0.028
	[0.264]	[0.265]	[0.269]	[0.269]	[0.264]	[0.307]
T1⊗ hidefinance						-0.053
						[0.097]
Hide finance (savings & spending) to spouse						-0.060
						[0.095]
T1⊗ roscasmember					0.008	
					[0.065]	
Participate in roscas					0.025	
					[0.056]	
T1⊗ mobmoney				-0.009		
				[0.062]		
Has Mobile Money account				0.048		
				[0.050]		
T1⊗ microentrep			0.002			
			[0.063]			
Microentrepreneur			-0.048			
			[0.057]			
T1⊗ Education		0.083				
		[0.059]				
Education (Attended High school or beyond=1)		-0.074				
		[0.047]				
T1⊗ female	0.029					
	[0.062]					
Female	-0.037					
	[0.048]					
Observations	1,142	1,142	1,142	1,142	1,142	715
R-squared	0.919	0.919	0.919	0.919	0.919	0.921

Note: Each column in the table represents a regression of the specified outcome of interest (here Log of monthly *Tontinier* deposits) on the treatment dummy (being offered a MFI account or not), a baseline dimension along which heterogeneity in effects is analyzed, an interaction between the treatment dummy and the considered baseline characteristic. Some additional controls (marital status, age, education, household size, house ownership, distance to the nearest CLCAM branch) and whether or not each savings account or device (formal and informal) was owned at baseline have been added. Column (1) for example shows the differential impacts of being offered a MFI account along the gender dimension on *Tontinier* deposits. The regressions also include the appropriate fixed effects related to the considered neighborhoods. Robust and clustered standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Table E.2: Heterogeneity in impacts of a mobile money account on *Tontinier* deposits

	Log (monthly tontinier deposits)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ITT: Offered a mobile money account (T2)	-0.034	-0.103	-0.084	-0.122	-0.072	-0.061	0.250*
	[0.146]	[0.142]	[0.143]	[0.139]	[0.139]	[0.139]	[0.148]
T2⊗ hidefinance							0.078
							[0.107]
Hide finance (savings & spending) to spouse							-0.073
							[0.103]
T2⊗ mfiacc						-0.095	
						[0.092]	
Has a formal MFI account						0.135*	
						[0.074]	
T2⊗ bank					-0.050		
					[0.089]		
Bank Account					0.122		
					[0.080]		
T2⊗ roscasmember				0.176**			
				[0.073]			
Participate in roscas				-0.096			
				[0.059]			
T2⊗ microentrep			0.020				
			[0.060]				
Microentrepreneur			0.058				
			[0.074]				
T2⊗ Education		0.075					
		[0.062]					
Education (Attended High school or beyond=1)		-0.073					
		[0.052]					
T2⊗ female	-0.062						
	[0.066]						
Female	0.031						
	[0.059]						
Observations	1,031	1,031	1,031	1,031	1,031	1,031	636
R-squared	0.928	0.929	0.929	0.929	0.928	0.929	0.917

Note: Each column in the table represents a regression of the specified outcome of interest (here Log of total monthly deposits) on the treatment dummy (being offered a Mobile money account or not), a baseline dimension along which the heterogeneous effects are analyzed and an interaction between the treatment dummy and the considered baseline characteristics. Column (1) for example shows the differential impacts of being offered a Mobile money account on *Tontinier* deposits across gender. In each of the regressions (1)-(7) a set of baseline characteristics are controlled for (marital status, age, household size, house ownership, distance to the MFI branch. The regressions also include the appropriate fixed effects related to the considered neighborhoods. Robust and clustered standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1.

Chapter 3

A behavioral model for credit-constrained microentrepreneurs' financial and investment decisions

Abstract

I study a financially-constrained microentrepreneur's borrowing and investment decisions, based both on her risk-aversion and on her time-inconsistency. I find that as long as the outside option to investment (wage work) provides a higher mean income than returns to investment, for a given level of moderate risk-aversion, she finds it welfare improving to choose the wage work. This result holds up to a threshold risk tolerance level (wage variance) allowed by her time-inconsistency. The risk tolerance threshold is higher for a more time-inconsistent agent as the mean wage income becomes higher. The implication of this result is that a highly time-inconsistent agent will tend to often default on a loan (failing to invest) if she is not highly risk-averse, and in particular if she is naive. On the contrary, a sophisticate agent with the same moderate risk-aversion as the naive, with a relatively lower time-inconsistency will tend to default less often, since she feels more the outside option's risk and can credibly use it as a commitment mechanism. Financial institutions would therefore gain in eliciting their borrowers' risk-aversion and time-inconsistency so as to supply tailored loans and suggest credible commitment mechanisms, in particular for sophisticate agents.

3.1 Introduction

This chapter aims to characterize, at the extensive margin, borrowing and investment decisions of an agent with risk-averse and time-inconsistent preference. The agent faces financial constraints and therefore she has to borrow first before an investment can be made. The loan decision happens one period ahead of the investment decision. A decision to take a loan is based on a premise that investment is welfare improving. Once the loan is obtained, the agent may, however, decide to consume instead of investing if she displays a high degree of time-inconsistency preferences.

As an alternative to investment the agent may supply labour to the market, which pays a wage income. Average wage may be higher than returns from investment. On the contrary, returns to investment are assumed to be less volatile than wage income. As a result of these considerations, the analysis also includes the role of the standard deviation and average of future income on the agent's decisions.

As it is well known, a risk-averse agent will tend to discard the riskier option if average returns are identical across the different choices she faces (Morduch, 1995). The main contribution of this work is an attempt to add preferences on time-inconsistency in this issue in a unified analysis. In particular, I analyze the joint effect of risk aversion and time-inconsistency on investment and borrowing decisions. To which extent the interaction between these parameters may constitute a commitment mechanism to investing when financial constraint is relaxed? Moreover, the analysis distinguishes two types of time inconsistencies based on agents' beliefs: i) a naïve agent who wrongly believes she will be time-consistent, and ii) a sophisticate type agent who has a correct belief about her time-inconsistency and takes it into account in her decision-making. For the purpose of the analysis, the study uses a simple theoretical model which is solved with numerical simulations.

One interest of the study is that it may help suggest tailored loans to microentrepreneurs. Such loans would be based not only on their borrowers' present-bias, but also on their awareness of it and on their degree of aversion to risk. Information on risk-aversion, beliefs about time-inconsistency, along with the characteristics of the projects being financed (including available outside options) are in fact key information likely to help financial institutions design differentiated loans. For instance, a highly risk-averse and highly moderately time-inconsistent agent is more likely to commit to his plans in the face of a risky outside option compared to an agent who is relatively less risk-averse if both are sophisticates. Likewise, a naïve and highly risk-averse agent is prone to relatively less prediction errors compared to a relatively less risk-averse and naïve agent.

For the purpose of the analysis, the study uses a simple theoretical behavioral framework of three periods with an agent making decisions on loan (first period), on investment (second period) and who faces the outcome of her choices (wages versus returns to investment) in the final period. The model have been solved with numerical simulations.

Three main findings stand out. First, the naïve agent with a high degree of time-inconsistency always makes a prediction error on welfare accrued to taking the loan because she wrongly assigns a low degree of time-inconsistency when taking the loan decision. As a result, she always finds that investing will yield a higher utility in the future. It is, however, most likely that she would tend to fail investing afterwards. The main intuition for this result is as follow. When the loan decision period has passed, the naïve agent will face her true degree of time-inconsistency, which would imply a much lower level of utility from investing as compared to consuming the loan. Moreover, when the degree of time-inconsistency is very high, a naïve agent will not feel that much the level of risk underlying a risky outside option as a threat, because her welfare is less sensitive to the shocks on wage income (notably when wage income

rises).

One implication of the analysis is that the naïve with a high degree of time-inconsistency may overborrow and will face overindebtedness.[1] On the other hand, the sophisticate agent with similar preferences will often tend to self-exclude herself from borrowing, in particular if she cannot have access to strong commitment mechanisms (credible mechanisms depending on her risk aversion and time-inconsistency).

Second, for a given (intermediate level, say $\gamma < 10$) level of risk-aversion, the lower the degree of time-inconsistency, the less the agent is willing to accept uncertainty in exchange of higher mean wage compared to the net returns to investment. For less time-inconsistent agents, risk- aversion appears to be most effective in favoring investment compared to the outside option. This result is due to the fact that relatively less time-inconsistent agents give relatively more weights to the future and therefore, feels relatively more uncertainty than would do highly time-inconsistent agents. Finally, for highly risk-averse agents, the risk tolerance thresholds relative to the outside option tend to align, irrespective of the degree of time-inconsistency and the mean wage

Third, both the mean and the variance of the two options (wage work and investment) also play an important role in the sophisticate and the naive agents' choices. The effects of the interaction of time-inconsistency and risk-aversion in fact vary with the first two moments of the two alternatives (investment returns and wage). A highly time-inconsistent agent for instance, is able to accept more risk for a higher mean from the outside option compared to a less time-inconsistent agent, for the same level of risk-aversion. There are however some threshold levels of risk above which investing becomes welfare improving. These risk tolerance thresholds in fact depend both on time-inconsistency and risk-aversion.

[1] Overindebtedness may also be well explained by moral hazard issues. While this channel is relevant, this study does not account for it and assume the moral hazard dimension is well handled by lenders.

This chapter is closely related to the literature that analyzes commitment mechanisms to enforce investment decisions for time-inconsistent agents. For instance, Basu (2016) shows that the riskiness of term deposits in the form of savings may help enforce investment plans. This analysis, however, ignores the extent to which different levels of time-inconsistency issues can interact with the degree of risk-aversion. For instance, if risk-aversion is sufficiently low, a highly time-inconsistent agent, even if sophisticate may fail to invest if she relies on self-commitment (the fear of losing part of her term deposit as discussed in (Basu, 2016)). Other studies also discuss the question of the effect of time-inconsistency on agents' choices. O'Donoghue and Rabin (2001) show theoretically that naive agents tend to delay immediate costs activities (such as investment) and do to soon rewards activities. They found that sophisticate agents tend to limit this. Kaur et al. (2015) also discuss the problem of self-control but in the context of work place. They show that in order to avoid not working as much as they would like, workers tend to choose contracts that penalize low effort in order to constrain their future selves. This chapter contributes to this literature by integrating the analysis of risk. Moreover, most studies analyzing investment behavior of time-inconsistent agents do not specifically include loan decisions, assuming that the required investment funds are available (e.g. O'Donoghue and Rabin, 1999, 2001; DellaVigna and Malmendier, 2006). In the framework of this study, agents are financially constrained and, their investment decision and the financing are linked. This further renders the agents decision-making interesting to analyze since both financing and investment decisions are to be taken.

The rest of the chapter proceeds as follows. Section 3.2 discusses some stylized facts motivating the model. Section 3.3 provides the analytical framework and describes the model's set up and the solution concept used. In Section 3.4, I discuss the agent's decision-making as regards borrowing and investment. Section 3.5 concludes.

3.2 Stylized facts

The model discussed in this chapter and the findings require to be motivated by three stylized facts. First, naïve agents with a high degree of time inconsistency will tend to display a high level of over-indebtedness. Second, sophisticate agents with a high degree of time-inconsistency will tend to display a low demand for credit by self-exclusion. This situation occurs despite the fact that investors face a financial constraint. Third, the returns to investment along with the mean and the volatility of wage income (alternative to investment's returns), are important elements agents take into account in their decisions. It is hard to find stylized facts on these three points in a unified framework. In such circumstances, I have relied on different sources.

3.2.1 Overindebtedness

In the Indian context, for instance, linking time-inconsistency issues to microcredit, Bauer et al. (2012) find that about one-third of their sample consists in individuals with present bias time preferences (19.9% are strongly present-biased and 13.2% are weakly present-biased, whereas fewer than 10 % of individuals are more patient). They find a robust and positive correlation between present bias and microcredit contracting. This result is suggestive that Microfinance, given its rigid structure and social pressure to repay group loans, for instance, may help provide structure and support to agents facing self-discipline issues. However, some agents end up overindebted. In a study on overindebtedness in the microfinance sector, Schicks and Rosenberg (2011) summarize the extent of the issue. Based on different definitions of overindebtedness[2] they report that overindebtedness rate ranges from 12% to the extreme

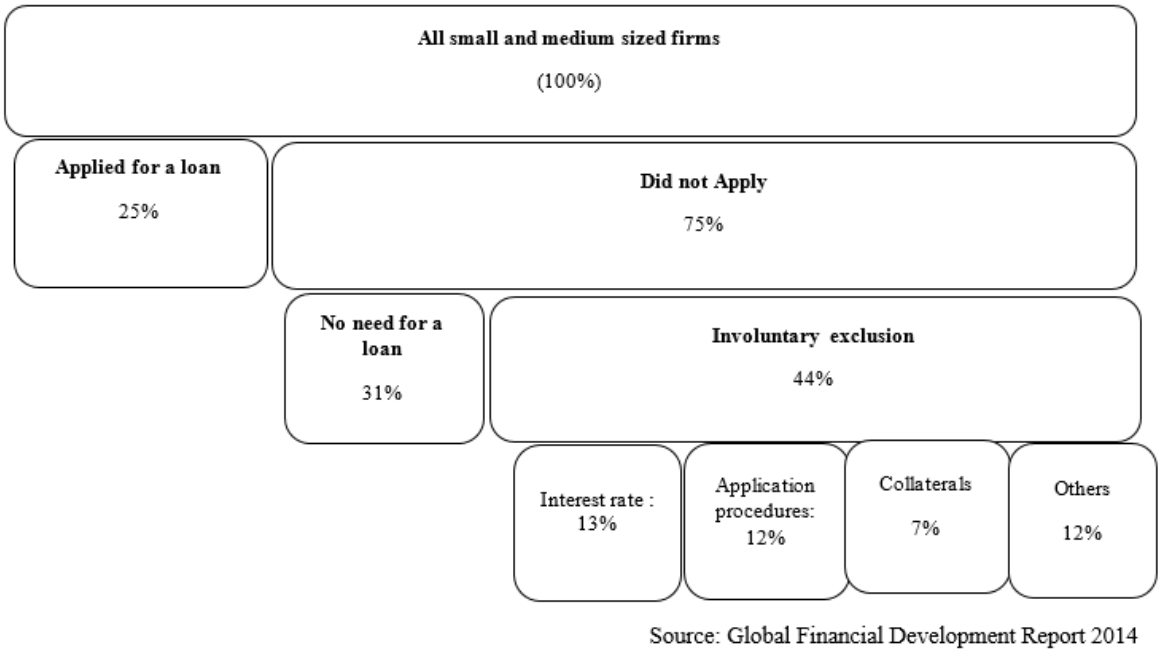
[2] Costly unanticipated actions to repay in Bolivia (Gonzalez, 2008) microbusiness, decapitalizing in Ghana (Grammling, 2009) (Krishnaswamy, 2011), impoverishment through debt in Tamil Nadu, India (Guérin and Roesch, 2013), chronic and involuntary inability to meet all payment obligations by means of household's excess cash proxied by arrears,

case of 85%.

3.2.2 Demand for credit and self-exclusion

Difficulties in access to finance is often reported by firms as the main constraint (e.g. Kuntchev et al., 2013). Despite access to finance is ranked as the top constraint facing microentrepreneurs (36%)[3] a substantial proportion (31%, as shown in Figure 3.1) tends to self-exclude from credit markets. This means, even if these microentrepreneurs claim they are financially constrained, the fear, for instance, of not being able to reimburse due to their time-inconsistency might refrain them from actually demanding a loan. Such a behaviour might signal some sort of sophistication about time-inconsistency.

Figure 3.1: Self-exclusion from credits markets (low income countries)



Source: Global Financial Development Report 2014

write-offs, debt-service ratio, in a multi-country study etc. (Kappel et al., 2010).

[3] These figures are from the Global Financial Development Report 2014 and account for over 10,000 firms, from 30 low income countries, of which 90% are microenterprises or very small (5-9 employees).

On the other hand, self-exclusion from borrowing also suggests that, apart from issues related to insufficient growth prospects or limited innovative capacity from microentrepreneurs, time-inconsistency (and beliefs formed on it), along with risk-aversion matter. A survey from Benin (2016) used in Chapter 2 shows for example that, 45% of people who have not applied to a loan the previous year did not actually because they fear overindebtedness.[4]

Two main explanations may help understand the contrast between potential demand for credit and actual demand for credit. On the one hand, there are the usual supply side factors, regarding the terms of loan contracts apply and are linked to financial institutions' capacity to handle information asymmetry issues as explained above (see Figure 3.1). On the other hand, self-exclusion from borrowing also suggests that, apart from issues related to insufficient growth prospects or limited innovative capacity from microentrepreneurs, time-inconsistency (and beliefs formed on it), along with risk-aversion matter. A survey from Benin (2016) used in Chapter 2 shows for example that 45% of people who have not applied to a loan the previous year did not actually because they fear overindebtedness.[5] In fact, the fear of over-indebtedness, for instance may refrain risk-averse agents from borrowing and investing, in particular, highly time-inconsistent and sophisticate agents. In fact, the fear of over-indebtedness, for instance may refrain risk-averse agents from borrowing and investing, in particular, highly time-inconsistent and sophisticate agents.

[4] The other reasons are lack of confidence 8%, poor economic environment 20%, lack of business ideas, other reasons 15%, do not know what to do with the loan 12%. The sample includes 3908 surveyed in total and 10% of them actually took-up a loan the previous year.

[5] The other reasons are lack of confidence 8%, poor economic environment 20%, lack of business ideas, other reasons 15%, do not know what to do with the loan 12%. The sample includes 3908 surveyed in total and 10% of them actually took-up a loan the previous year.

3.2.3 Returns to investment and wage income

The assumption that wages may be more volatile in the framework of this study is related to fact that in developing countries, and in particular in the informal sector, wages tend to be irregular and risky, notably for unskilled workers (see for instance, Chen et al., 2002; Becker, 2004, for more details on the riskiness of informal wage work). Besides, the types of microentrepreneurship I am referring to in this paper consist mainly in selling necessity goods or services such as, transport on motorbike, fruits, vegetables, foods, etc. These activities tend to be relatively less volatile. To that extent, both wages' volatility and mean, as an outside option to investment returns, are relevant in the analysis conducted in this chapter. Although I have assumed that investments returns are less volatile than wage income in the context of this study, the results can be generalized to the case where returns to investment would be more volatile than wage income riskiness. In fact, the interaction between risk-aversion, time-inconsistency and the mean income from the two options will still be key to determine the extent to which the agents welfare is more or less sensitive to shocks and therefore her choices.

3.3 Analytical framework

This section presents the agent's problem, the considered assumptions and the model developed.

3.3.1 Setting

Let's consider a decision-maker, with quasi-hyperbolic preferences characterized by time-inconsistency. She lives three periods $t \in \{0, 1, 2\}$ and her decision-making includes financial choices (savings and borrowing), occupational choice (self-employment or microentrepreneurship) and consumption plans over her lifetime. The timing of the agent's problem is described in

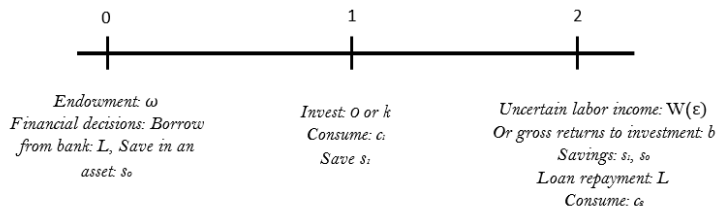
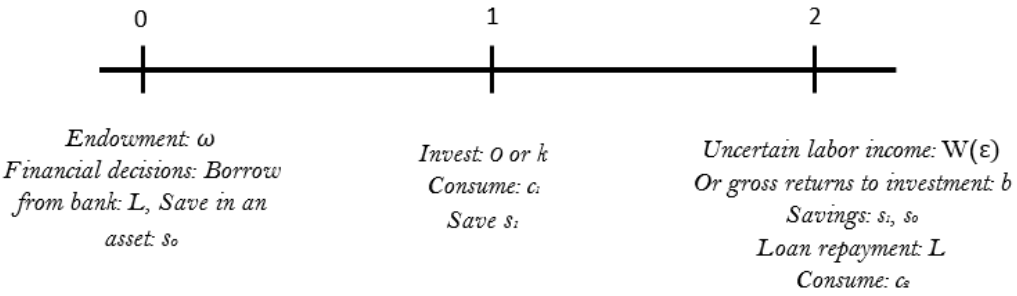


Figure 3.3

Figure 3.2 and proceeds as follows.

At $t = 0$, the agent is born. She receives an exogenous endowment ω and decides whether to borrow an amount L from a bank if she foresees an investment opportunity at $t = 1$.

Figure 3.2: Microentrepreneur's decision making timeline



She also determines her optimal lifetime consumption plan $\{c_1, c_2\}$[6] and can save at $t = 0$, s_0 in an illiquid asset (maturing at $t = 2$ with certainty) for consumption smoothing purposes. If the microentrepreneur borrows an amount L from the bank, she carries on the amount $\omega + L - s_0$ to $t = 1$. The loan is assumed to be repaid at $t = 2$ and the agent cannot strategically default. For simplicity, I assume as, for instance, in Basu (2016) that there is

[6] There is no consumption at $t = 0$, only financial decisions (savings and borrowing) are taken. This is a simplifying assumption to focus on investment decision tracking

no interests on savings and borrowing for simplicity.

At $t = 1$, the agent either chooses to become a microentrepreneur by investing or she is left with the default option, an unskilled wage work. Wages are subject to a log-normally distributed shock: $\varepsilon_i \sim LogN(\mu, \sigma)$. Self-employment requires a lumpy investment k but the agent is resource constrained $(k > \omega)$[7] which yields gross returns $b \geq k$ at $t = 2$ with certainty. Investment opportunities can be perfectly foreseen by the agent and are assumed to be always profitable. If the agent does not invest, she can earn a wage W whose value is determined by the shock ε. The assumption that wages are volatile is related to fact that in developing countries and in particular in the informal sector, wages are low, irregular, and risky in particular for unskilled workers (see, for instance, Chen et al., 2002; Becker, 2004, for more details on the riskiness of informal wage work).

In this framework, occupational choices are assumed to be mutually exclusive, that is, either the agent mainly operate as an microentrepreneur or rather as a wage worker. This assumption is plausible since the main activity is considered in this setting as being an occupation to which the agents devotes most of her time and can derive a revenue, as opposed to secondary activities. Based on the liquidity inherited from $t = 0$, the agent can consume $c_1 \leq \omega + L - s_0 - s_1$ if she does not invest and $c_1 \leq \omega + L - k - s_0 - s_1$ if she invests. If there remains some cash, call it s_1, it is passed on to period $t = 2$.

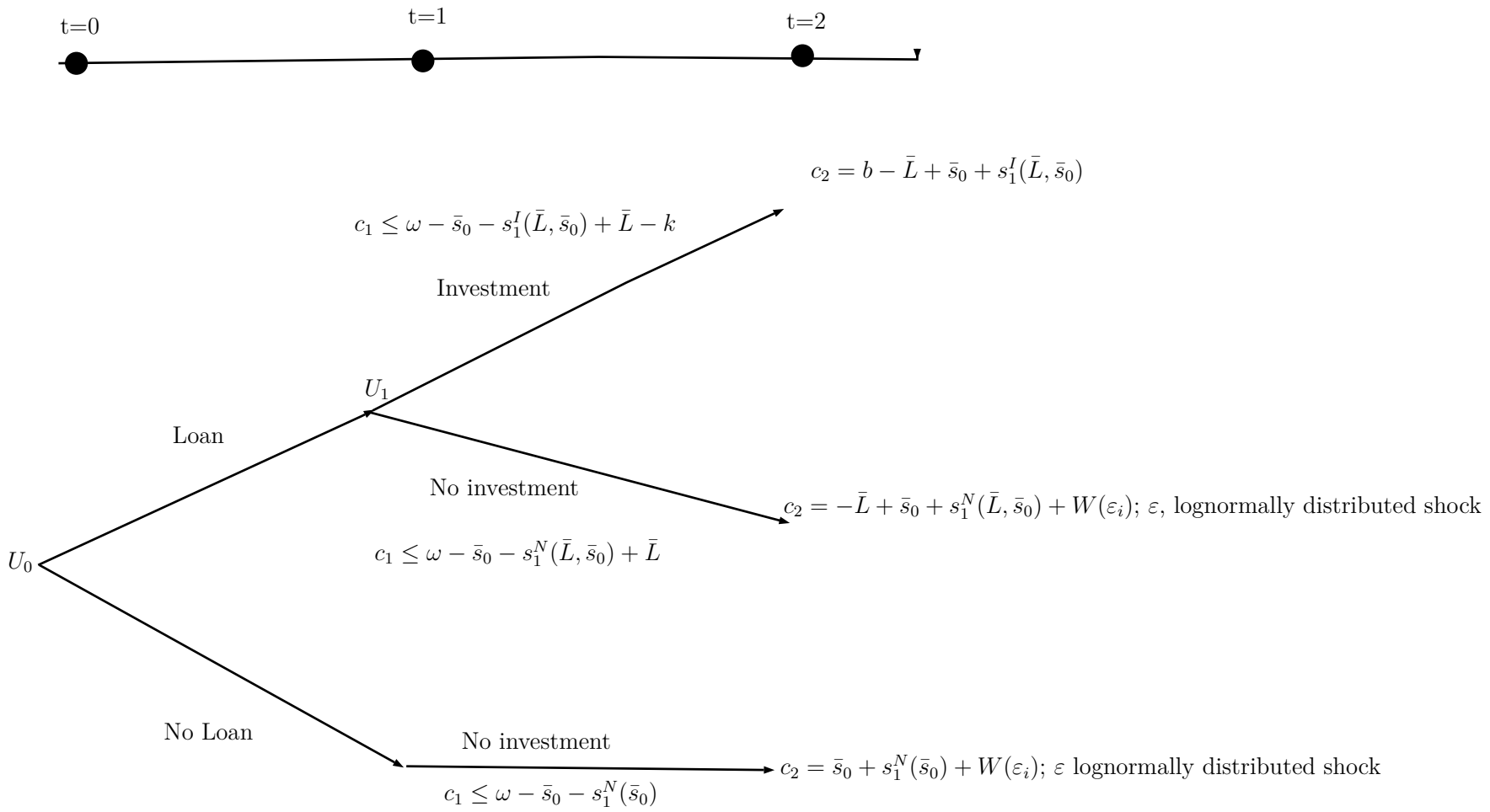
At $t = 2$, the end of the timeline, she receives s_0 and s_1. Depending on whether the agent had invested at $t = 1$, either she receives either gross returns to investment b, or a wage $W = A * exp(-\frac{1}{2}\sigma^2)\varepsilon$, with A, the mean of W as defined for consumption in Lucas Jr (2003). Finally the agent repays the loan L and consumes the rest c_2.

Given the microentrepreneur's Self 0 and Self 1's preferences and her initial endowment ω, she chooses her lifetime consumption plan, whether to invest

[7] This implies that without access to finance she cannot invest.

or not and therefore, her savings and borrowings. The optimal decision is a sub-game perfect nash equilibrium to a sequential game where the first player to move (the agent's current self) internalizes the second player's (her future selves) potential behaviors as described in Figure 3.4 in her decision-making.

Figure 3.4: Decision tree facing the time-inconsistent agent



3.3.2 Preferences

In the literature, the time-inconsistency problem has been commonly modeled by the so called quasi-hyperbolic preferences (Laibson, 1997). These preferences are preferred for tractability of the present-bias parameter. They are in particular characterized by impatience relative to current trade-offs (today's rewards preferred over tomorrow's) and patience regarding future trade-offs (one year and a day's rewards preferred over one year's).

The agent's intertemporal utility function given her time- inconsistency is given by the following $\beta - \delta$ model (Laibson, 1997):

$$U_t = u(c_t) + \sum_{s=1}^{T} \beta\delta^s u(c_{t+s}), \quad s \in \{1, ..., T\} \tag{3.1}$$

where c_k is the instantaneous consumption at any period k and β, the present bias discount factor ($0 < \beta < 1$). δ is the standard exponential discount factor and is assumed without loss of generality to be equal to 1 for simplicity. The lower the β, the higher the present-bias issue. As Laibson explained, having $\beta < 1$ captures the idea that the discount between today and tomorrow is higher than the discount between any future time and the day after that future time, from the perspective of the agent's current self. That is the basis of the quasi-hyperbolic structures of the agent.

$u()$ is the instantaneous utility function and is assumed to be CRRA in this framework:

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma} \tag{3.2}$$

with $\gamma \geq 0$, the coefficient of relative risk aversion.

From equation 3.1, the agent's Self 0 and Self 1's preferences are as follows.

Self 0's preferences:

$$U_0(c_1, c_2) = \beta[u(c_1) + u(c_2)]; c_1 > 0 \; and \; c_2 > 0 \tag{3.3}$$

Self 1's preferences:

$$U_1(c_1, c_2) = u(c_1) + \beta u(c_2) \tag{3.4}$$

When $\beta = 1$, the agent is time-consistent and she values the present and the future the same way. For such an agent, the intertemporal utility is:

$$U_0 = u(c_1) + u(c_2) \equiv U_1 \tag{3.5}$$

Equation 3.5 gives the welfare benchmark of the hyperbolic discounter. This welfare is assumed to be the one he would like to maximize at the start of her life in a time-consistent way (O'Donoghue and Rabin, 1999).

Since the agent lives three periods, the setting considers each incarnation of the agent or her three different selves as distinct agents.

3.3.3 Solving the model

The purpose of this section is to show how the equilibrium strategy of the agent is determined. The agent makes decision in the framework of a sequential game where different Selves (Self 0, Self 1 and Self 2) have to decide on the strategy bringing them a higher utility compared to the alternative strategy. Such sequential games are solved by backward induction, starting from the terminal subgame. Before discussing the different steps to be followed to solve the game, I clarify first, the strategy profile of the game and the underlying pay-offs (utilities). Given that at $t = 2$ there is no other choice than consuming the rest of resources after repaying the loan L if taken up at $t = 0$, the chore of the game is played between Self 0 and Self 1. The normal form of their

strategic interactions is depicted on Table 3.1.

Table 3.1: Normal form of the game between Self 0 and Self 1

		Self 1 $(t=1)$	
		$Invest$	$No-invest$
Self 0 $(t=0)$	$Loan$	U_0^L, U_1^I	U_0^L, U_1^{NI}
	$No-Loan$	U_0^{NL}, U_1^I	U_0^{NL}, U_1^{NI}

In the game, we have a strategy profile of four possible outcomes:

$$(Strategy_{t=0}, Strategy_{t=1}) \in \{(Loan, Invest); (Loan, No-invest) \\ (No-Loan, Invest); (No-Loan, No-invest)\}.$$

However, in the context of this study, the outcome $(No-Loan, Invest)$ is not plausible given the resource constraint assumption facing the agent $(k > \omega)$. This strategy can not be an equilibrium strategy.

The goal of the study is to understand whether investment is undertaken when the loan is taken by an agent, and the extent to which this investment decision might be enforced by the alternative option (wage work) characteristics (level wage compared to net returns to investment, uncertainty) and the agent's risk aversion.

In order to understand investment decisions, I solve respectively two case scenarios: (i) the case where both the returns to investment and wages (the outside option) are non random and, (ii) the case where there is the variance of returns to investment is normalized to zero and wages are random.

In all cases, consumption, and investment choices can be determined based on the following 4 basic steps, as part of the backward induction solution concept.

Step 1: Consumption at t=2 is given by the rest of resources allowed by choices at $t = 1$ and $t = 0$.

Step 2: the agent's Self 1 takes the resource constraint from $t = 2$ into account and decides on her consumption at$t = 1$. Along with her consumption choices, she also decides whether to invest, given loan availability.

Step 3: she chooses to invest at $t = 1$, conditional on the loan, if doing so brings higher utility from $t = 1$ perspective:

$$\begin{gathered} U_1^I > U_1^{\text{NI}} \\ that\ is\ if:\ u(c_1^I) + \beta u(c_2^I) > \ u(c_1^{NI}) + \beta E[u(c_2^{NI})]. \end{gathered} \tag{3.6}$$

Step 4: Finally the loan decision is made. The loan is taken if investment brings relatively higher utility from $t = 0$'s perspective compared to the default option of not taking the loan, based on Self 1 consumption choices.

The agent takes the loan if:

$$\begin{gathered} U_0^L > U_0^{\text{NL}} \\ that\ is,\ if:\ \beta[u(c_1^I) + u(c_2^I)] > \beta[u(c_1^{NI}) + E[u(c_2^{NI})]] \end{gathered} \tag{3.7}$$

c_1^I and c_2^{NI} are derived from Self 1's optimal choices.

The agent chooses her strategy (Loan vs No-Loan) by comparing her welfare from her self 0's perspective consumption choices under investment and under no-investment at $t = 1$ regarding consumption and see whether there is welfare improvement for her at $t = 0$'s perspective.

Finding analytically consumption bundles or conditions on parameters for which inequalities 3.6 and 3.7 always hold is tricky. In this framework I base

the analysis on the agent's optima, in particular at $t = 1$, and then take the choices to $t = 0$. The advantage of such a choice is that it focuses on the best state possible the agent would like to be and therefore, gives a sense of, the decision making regarding investment and loan in that state.

3.4 Borrowing and investment decisions

In this section, I study the agent's investment decisions when she has access to credit and determine her Self 0's choices regarding the loan, based on her Self 1's consumption choices.

I discuss two main points in this Section. First, I solve the model in the case where both investment's net returns and wages are non-random, and briefly discuss the results. I briefly compare the naive and sophisticate agents decisions, just to fix ideas on how the naive's decisions are prone to some errors. Second, I solve the model when net returns to investment are non-random while wages are random. I discuss extensively how different levels of risk-aversion and time-inconsistency matter in the agent's choices.

3.4.1 Choices at optimum: non-random wages and returns to investment

I solve respectively for the agents optimal consumption plans from her Self 1's perspective and see how this is perceived by her Self 0. In this case, since there is no uncertainty on investment's returns and wages, the analytical solutions can be derived.

(i) Agent's optimal choices at $t = 1$

At $t = 1$, the agent decides whether to invest. She considers investing if this strategy is welfare-improving compared to the default option (non-investing).

So the agent invests if:

$$U_1^{Invest} > U_1^{\text{NI}}$$
$$that\ is\ if:\ u(c_1^I) + \beta u(c_2^I) > u(c_1^{NI}) + \beta E[u(c_2^{NI})]$$

I conduct the analysis in 3 stages. First, I solve for optimal consumption under investment and determine the indirect utility at optimum. Second, I do the same thing for the wage work option by simulating different consumption paths given the analytical solutions. Finally I compare the two maximum utilities and conclude on whether investment is welfare improving compared to the default option. Morever, I take the analysis to $t = 0$ to see whether the loan is taken.

$$\begin{aligned} \max_{c_1>0, c_2>0} U_1^I &= u(c_1^I) + \beta u(c_2^I) \\ s.t \quad c_2^I &= b - k + \omega - c_1^I \end{aligned} \tag{3.8}$$

Substituting the constraint in the objective function 3.8 yields the following unconstrained optimization with respect to c_1:

$$\max_{c_1>0} U_1^I = u(c_1^I) + \beta u(b - k + \omega - c_1^I) \tag{3.9}$$

$$\text{FOC: } u'^I(c_1) + \beta u'(b - k + \omega - c_1^I) = 0$$

Then, from the FOC and given $u'(c) = c^{-\gamma}$, we have:

$$c_1^{-\gamma} = \beta(\omega - k + b - c_1^I)^{-\gamma} \tag{3.10}$$

Solving for c_1 yields:

$$c_1^{*^I} = \frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}};\ c_2^{*^I} = \beta^{\frac{1}{\gamma}} * \frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \tag{3.11}$$

Given that consumption must be positive, the following condition on the

parameters must hold: $\omega + \mathbf{b} - \mathbf{k} > \mathbf{0}$.

I can also derive savings s_1^* as follows:

$$\begin{aligned} s_1^* =& \omega - s_0 + L - k - c_1^* \\ &= \omega - s_0 + L - k - \frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \end{aligned} \tag{3.12}$$

The maximum utility under investment at $t = 1$ is given by:

$$\begin{aligned} U_1(invest)^{max} &= u(c_1^{*I}) + \beta u(c_2^{*I}) \\ &= \frac{1}{1-\gamma} * \left[\left(\frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} + \beta \left(\beta^{\frac{1}{\gamma}} * \frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} \right] \\ &= \frac{1}{1-\gamma} \left(1 + \beta^{\frac{1}{\gamma}} \right) \left(\frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} \end{aligned}$$

Similarly, under no investment,

$$\begin{aligned} U_1(no - invest)^{max} &= u(c_1^{*I}) + \beta u(c_2^{*I}) \\ &= \frac{1}{1-\gamma} * \left[\left(\frac{\omega + W}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} + \beta \left(\beta^{\frac{1}{\gamma}} * \frac{\omega + W}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} \right] \\ &= \frac{1}{1-\gamma} \left(1 + \beta^{\frac{1}{\gamma}} \right) \left(\frac{\omega + W}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} \end{aligned}$$

(ii) Decision at $t = 0$ ***regarding whether to take the loan***

At $t = 0$, the agent is favorable to the loan if taking the loan and investing brings higher utility compared to compared to not taking it, and therefore not investing.

The agent takes the loan if:

$$\begin{aligned} U_0^{Invest} &> U_0^{\text{No invest}} \\ that\ is,\ if:\ \beta[u(c_1^I) + u(c_2^I)] &> \beta[u(c_1^{NI}) + u(c_2^{NI})] \end{aligned} \tag{3.13}$$

Since the analysis is conducted first at the optimum, I determine the consumption bundle planned by Self 0 and the corresponding utilities under the two scenarios of investment (given loan) and the default utility of no loan which, by construction (no cost of borrowing and no default) gives the same consumption bundle at the optimum, compared to no-investment case. Although this might not always be the case, I at least, assume it in this study. Doing so allows me to have a unique benchmark and ensure tractability. The decision to take the loan derives equivalently (to equation 3.13) from:

$$U_0^{Loan}(c_1^*, c_2^*) > U_0^{No\ Loan}(c_1^*, c_2^*) \tag{3.14}$$

For the wage work option (No loan), the optimal utility is given by:

$$\begin{aligned} U_0(no-loan) &= \beta[u(c_1^{*I}) + u(c_2^{*I})] \\ &= \frac{\beta}{1-\gamma} * \left[\left(\frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} + \left(\beta^{\frac{1}{\gamma}} * \frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} \right] \\ &= \frac{\beta}{1-\gamma} \left(1 + \beta^{\frac{1}{\gamma}-1} \right) \left(\frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} \right)^{1-\gamma} \end{aligned} \tag{3.15}$$

In order to understand how time-inconsistency (β) and the risk aversion (γ) play a role in this penalty factor between Self 1 and Self 0's choices and how these choices are viewed from Self 0's perspective. I first compute the utility gap accrued to investment and show the condition under which each of them at t=0 and t=1 is positive. Second I assess the extent to which Self 0 discount Self 1's decisions by computing the ratio between the utility gaps

found by Self 1 and by Self 0.

At $t = 1, \Delta U_1 = U_1(invest) - U_1(no - invest)$ is given by:

$$\Delta U_1 = \frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} \tag{3.16}$$

At $t = 0, \Delta U_0 = U_0(loan) - U_0(no - loan)$ is given by:

$$\Delta U_0 = \frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}$$

Each of this utility gap is positive if $b - k \geq W$ (proof in Appendix). This minimal condition is critical for investment to be attractive over the wage work option. It says that the net returns to investment must be higher to the outside option wage.

The ratio between the two utility gap at $t = 0$ and $t = 1$ gives a sense fo the extent to which a present biased agent, in particular if she is sophisticate discount Self1's decisions in her decision making.

The factor of discount is given by 3.17 (proof in appendix):

$$\frac{\Delta U_0(loan)}{\Delta U_1(invest)} = \frac{\beta^{\frac{1}{\gamma}} + \beta}{\beta^{\frac{1}{\gamma}} + 1} \tag{3.17}$$

This factor depends both on the agent's present bias and her risk aversion. Figure 3.5 shows the extent to which each factor matters.

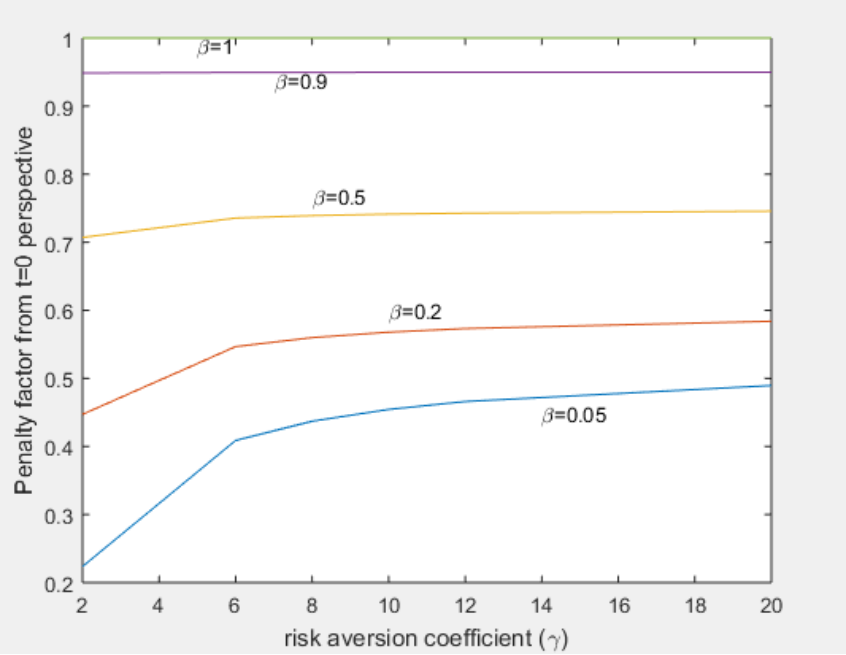


Figure 3.5: Penalty factor on Self 1's choices by Self 0

Two main information can be derived from figure 3.5: i) the higher the time-consistency, the less the agent's Self 0 discounts Self 1's decisions and, ii) the contribution of risk aversion to this penalty factor increases faster (becomes steeper) for highly time-inconsistent agents. The effect of risk aversion therefore decreases the more the agent is time-consistent.

3.4.1.1 Naive versus sophisticate behaviors

An agent with present-biased preferences ($\beta < 1$) is assumed to be sophisticate if she has a correct belief on the value of her present-bias parameter. That is, the agent knows that her future self will continue to be time-inconsistent. The sophisticate's decision-making consists in determining her consumption plans with her actual β at t=1 and check at t=0 whether any welfare effect found at t=1 is compatible with Self 0's preference, just as discussed above.

A fully naive agent wrongly believes she will be time-consistent and base

her decisions on the assumption that her $\beta = 1$. The naïve therefore tends to overweight the future compared to what her actual time-inconsistency parameter allows for. In fact, in practice, a fully naïve agent determines her optimal consumption under investment and no-investment at t=1 based on the belief that =1, and check whether this "wrong" consumption plan under investment is in line with her Self 0's welfare.

At $t = 0$, let's determines the naive agent's planned consumption path. She solves under investment (and conditional on loan availability) :

$$\begin{aligned} \max_{c_1>0} U_0^L &= \beta[u(c_1^L) + u(b - k + \omega - c_1^L)] \\ &with \quad c_2 = b - k + \omega - c_1 \end{aligned} \tag{3.18}$$

The solutions are given by:

$$c_1^* = c_2^* = \frac{\omega + b - k}{2} \tag{3.19}$$

and the maximal utility:

$$\begin{aligned} \hat{U}_0(loan)^{max} &= \hat{\beta}\ [u(c_1^{*I}) + u(c_2^{*I}]) \\ &= \frac{2\hat{\beta}}{1-\gamma} * \left(\frac{\omega + b - k}{2}\right)^{1-\gamma} \\ &= \frac{2}{1-\gamma} * \left(\frac{\omega + b - k}{2}\right)^{1-\gamma} \end{aligned} \tag{3.20}$$

The naive compares the utility of taking the loan based on a the assumption that she will invest to the utility of not taking the loan.

Similarly to solutions 3.19 and 3.20, the naive agent's optimal consumption path planned at $t = 0$ if she does not take the loan is given by:

$$c_1^* = c_2^* = \frac{\omega + W}{2} \tag{3.21}$$

and the maximal utility:

$$\begin{aligned}\hat{U}_0(no-loan)^{max} &= \hat{\beta}\ [u(c_1^*)+u(c_2^*)] \\ &= \frac{2\hat{\beta}}{1-\gamma} * \left(\frac{\omega+W}{2}\right)^{1-\gamma} \\ &= \frac{2}{1-\gamma} * \left(\frac{\omega+W}{2}\right)^{1-\gamma}\end{aligned} \tag{3.22}$$

Th naive's utility perceived premium at $t=0$ when she takes the loan and consistently invest, is given by:

$$\begin{aligned}\Delta U_0 =& U_0(loan) - U_0(no-loan) \\ =& \frac{2}{1-\gamma} * \left(\frac{\omega+b-k}{2}\right)^{1-\gamma} - \frac{2}{1-\gamma} * \left(\frac{\omega+W}{2}\right)^{1-\gamma} \\ =& \frac{2}{1-\gamma} * \left(\left(\frac{\omega+b-k}{2}\right)^{1-\gamma} - \left(\frac{\omega+W}{2}\right)^{1-\gamma}\right)\end{aligned} \tag{3.23}$$

As already shown, $\Delta U_0 > 0$ for positive consumption if $b-k \geq W$.

The naive agent therefore takes the loan at $t=0$ if $\Delta U_0(loan) > 0$.

The error made by the naive can be seen, for instance, from Figure 3.16. This Figure shows the sophisticate and the naive's welfare premia under investment compared to non-investment ($U(invest) - U(no-invest)$) at t=1 and at t=0 in function of increasing excess returns over fixed wages ($b-k-W>0$). So given a welfare premium ΔUt_1 (blue curve) allowed by a time-inconsistency parameter β, the sophisticate, taking into account her present-bias applies the penalty factor identified above to evaluate, from her Self 0's perspective, the welfare gain (red curve) from favoring Self 1's optimal choices. As expected, the higher the excess net returns from investment over wages, the higher the welfare premia when investment is chosen, both for the naive and for the sophisticate. The error committed by the naive is the gap between the dotted red curve and the plain red curve (sophisticate one). I provide in appendix .3 a discussion on how the naive and the sophisticate's choices evolve in function

of different time-inconsistency and risk-aversion levels.

3.4.2 Agent's choices: non-random returns to investment and random wages

In this case, the outside option's wage is random and defined by:
$W = A * exp(-\frac{1}{2}\sigma^2)\varepsilon$ as defined for consumption in Lucas Jr (2003), with $log(\varepsilon)$ following a normal distribution of (0, σ^2) and A the mean of W.

At $t = 1$

$$\begin{aligned} \max_{c_1>0, c2>0} U_1^{NI} &= u(c_1) + \beta E[u(c_2(\varepsilon))] \\ s.t \quad c_2(\varepsilon_i) &= W(\varepsilon_i) + \omega - c_1 \end{aligned} \tag{3.24}$$

Replacing $c_2 = W(\varepsilon_i) + \omega - c_1$ gives:

$$\max_{c_1>0} U_1^{NI} = u(c_1) + \beta \sum_i p(\varepsilon_i) u(W(\varepsilon_i) + \omega - c_1)) \tag{3.25}$$

I simulate 3.25 with a grid of starting values of consumption considering different draws of W. This procedure allows me to find optimal values of consumption c_1 and c_2 that maximize utility for different shocks σ.
In order to evaluate the role of risk- aversion in the agent's choices (non-random returns to investment vs random wages), I consider 2 case scenarios. First, I assume that the net returns to investment $(b - k)$ is the same as the mean of W for different shock σ and observe how risk-aversion and time-inconsistency affects borrowing and investment decisions. Second, I challenge the investor by allowing the outside option's mean wage to be higher than the net returns to investment and do the same analysis as in the first case.

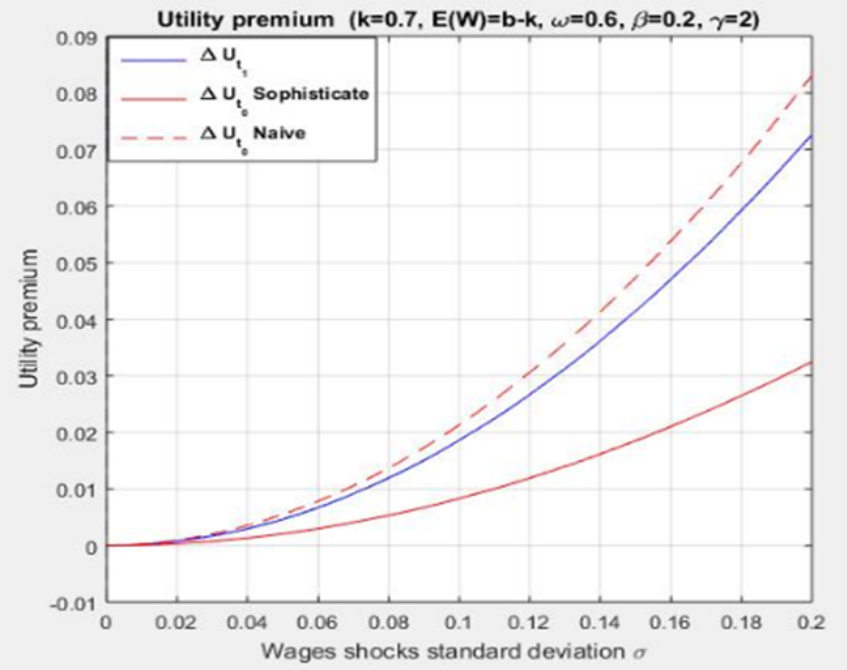
1) Equal wage mean and returns to investment with wage shocks

I discuss below how a naïve and a sophisticate agents' borrowing and investment decisions are affected by risk-aversion and time-inconsistency, based on

the mean and riskiness of the wage work. I show first the case where both investment's returns and the outside option wage work are equal. Second, I discuss the case where wages can provide higher mean and see the extent to which agents are willing to bear some risk, based on their time-inconsistency and risk-aversion.

The naïve's choices affect her current decisions in the sense that, she will tend to overvalue any future welfare gain compared to what her preferences actually predict. Assuming full naiveté (the agent believes she is fully time-consistent, $\beta = 1$), the overvaluation of future welfare can be seen from the preferences U_0 and U_1 via β. The overvaluation of t=1 welfare premium (in terms of U(invest) - U(no-invest)) can be seen from Figure 3.6.

Figure 3.6: Utility premium from a highly time-inconsistent naïve and sophisticate agents with relatively low risk aversion



On Figures 3.6 to 3.8, I have fixed the same value to net investment returns and wages and observe changes in welfare premia (both at t=0 and t=1) for

the naïve and the sophisticate agents for different levels of shocks to wages (in terms of shocks standard deviations). For the same mean, higher risk on the outside option brings more welfare improving when investment is chosen. This welfare premium rises with the levels of risk-aversion and, for a given level of risk-aversion, higher time-consistency further improves welfare. This result stems from the fact that a higher time-consistency tends to smooth consumption choices, and to positively affects welfare.

Figure 3.7: Utility premium from a highly time-inconsistent naïve and sophisticate agents with relatively high risk aversion

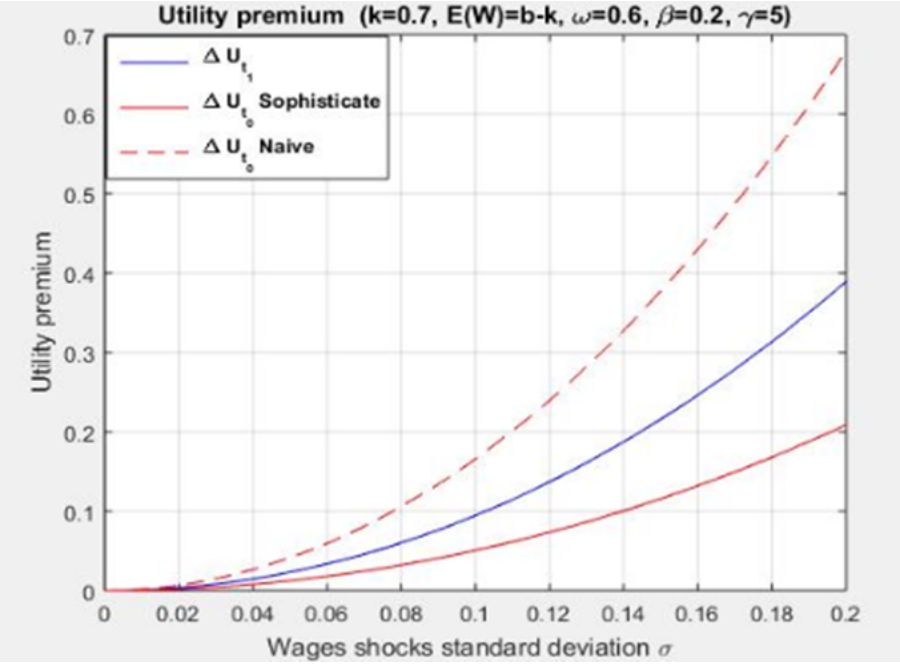
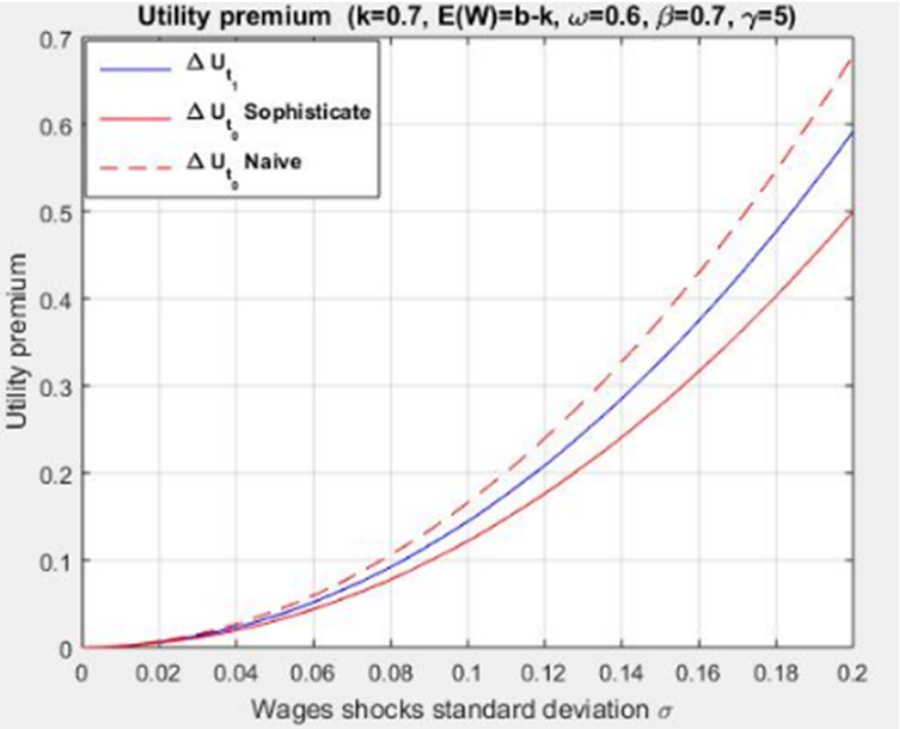


Figure 3.8: Utility premium from relatively less time-inconsistent naïve and sophisticate agents with relatively high risk aversion



2) Fixed net returns to investment and volatile wages with higher mean

The purpose of this part is to see how agents' choices change when there are offered an outside option that may yield higher wage, on average, compared to investment returns, but bears some uncertainty.

On Figure 3.9, I plot a welfare premium in terms of $U(loan - invest) - U(no - loan - no - invest)$ both for the sophisticate and the naïve at t=0 and the welfare premium perceived by Self1's choices. Figure 3.9 shows that for very low levels of excess average wage over investment returns, investment's welfare premia (positive or not) perceived at t=1 (Figure 3.9) are also seen at t=0, both for the naïve (Figure 3.10) and for the sophisticate (Figure 3.11).

The results found in the case of equal average wage and investment returns can be seen for equal excess mean wage and net returns to investment. The new result is that higher excess mean wage compared to net returns to investment make the agent worse-off of she invests, up to a certain level of shock. For instance, the figures show that for given mean returns to investment with a normalized variance (normalized to 0), for low levels of risks, it is never welfare improving to invest as excess average wage income (over investment returns) rises. The preference for the outside option still holds, both for the naive and for the sophisticate, even when the risk faced is becomes larger. There are however some thresholds levels of risk above which investing becomes welfare improving. These risk tolerance thresholds depend both on time-inconsistency and risk-aversion. For the naive agent, for instance, this threshold risk for an excess wage mean of 0.5 (62.5% higher than returns to investment) is around 0.28 wage shocks standard deviation while that of a sophisticate is 0.25 standard deviation. These thresholds can be better observed from Figure 3.13 (the 2-D version of Figure 3.9).

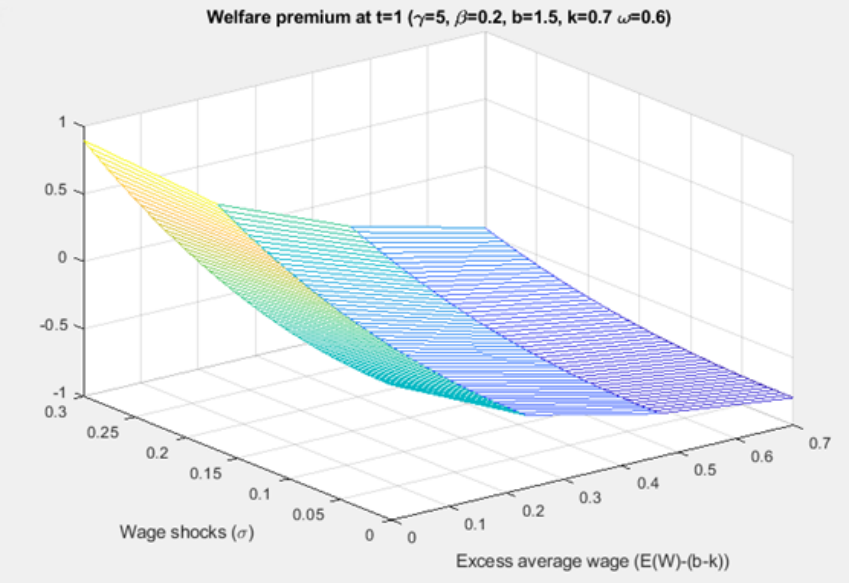


Figure 3.9

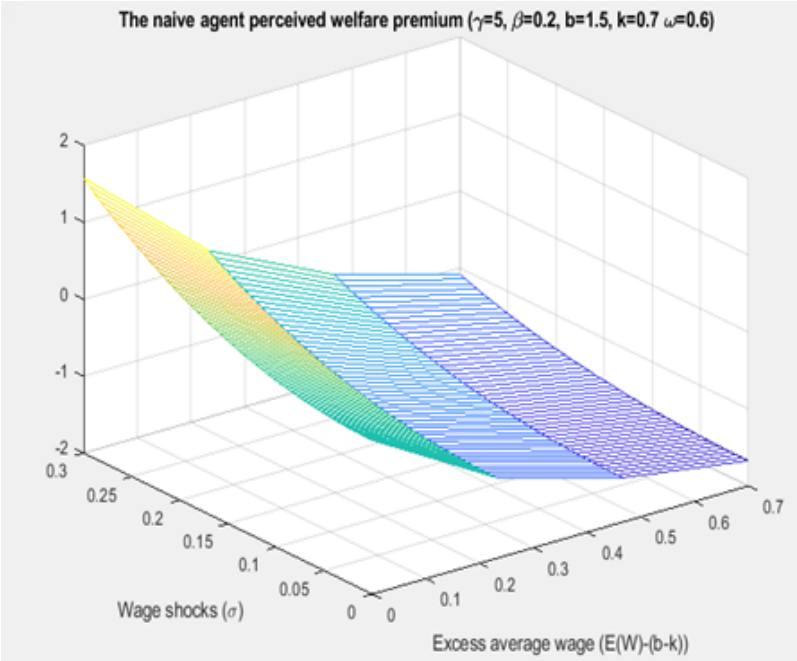


Figure 3.10

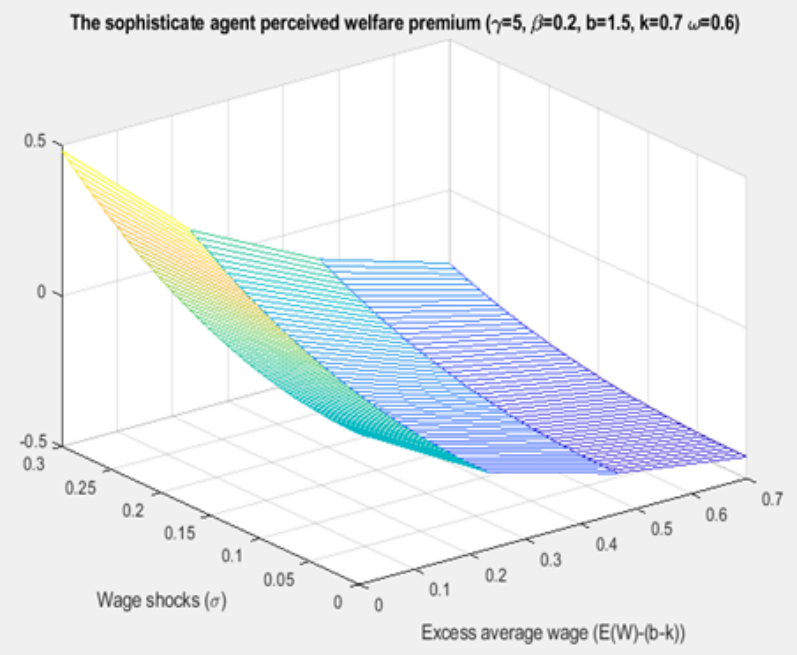


Figure 3.11

Figures 3.12, 3.13, 3.14 and 3.15 show the extent to which a time-inconsistent agent is willing to tolerate wage risk by considering the outside wage work option at the expense of investment for which a loan is available at t=0. For each of the figures, each plot shows the welfare premium accrued to wage work compare to investment for fixed returns to investment while the average wage increases (0.8-top left plot; 1.03-top right plot; 1.26-bottom left plot; 1.5-bottom right plot).

Figures 3.12 and 3.13 depict the extent to which an agent who is highly time-inconsistent would tolerate the outside's option risk, in exchange of higher mean wage. In other words , for a given level of net returns to investment (b-k=0.8), up to which point will an agent be willing to accept taking the risk of not investing with a higher wage mean as compensation, based both on the level of risk-aversion and on level of time-inconsistency. The top left plot shows the case where the two alternatives (investment and wage work) have the same mean. In that case, failing to invest makes the agent worse-off both from t=1 and t=0's perspectives. The tolerance to risk of this highly time-inconsistent agent decreases with her risk aversion, just as is the case of the agent with relatively lower time-inconsistency (Figures 3.14 and 3.15), but decreases more slowly, suggesting that high time-inconsistency may makes feel less risk aversion and therefore less threat from a risky alternative.

Figure 3.12: Utility premium $U(wage) - U(invest)$ for $\gamma = 10$ & β=0.2

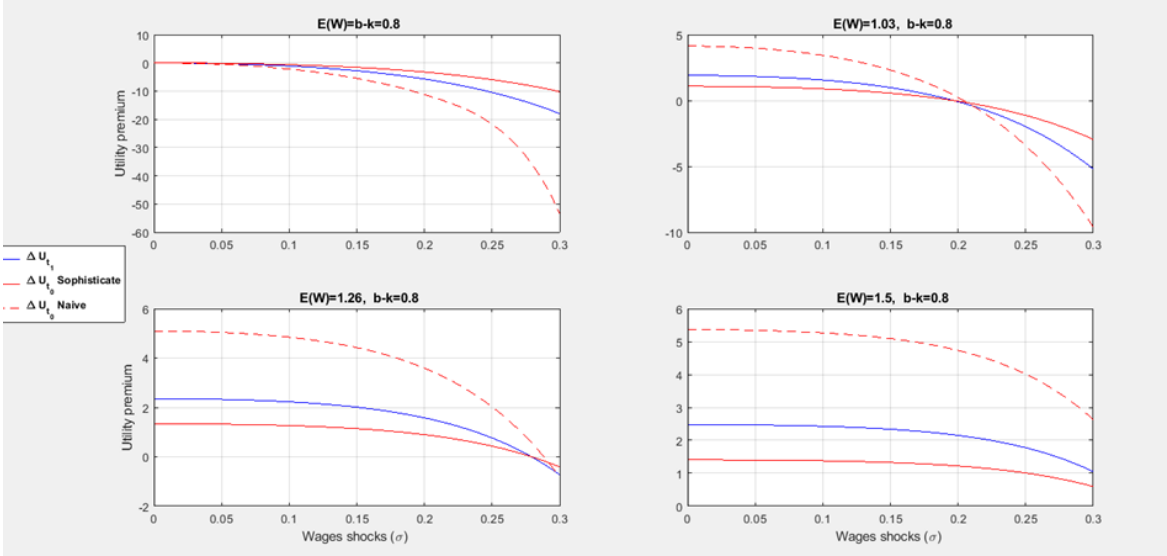


Figure 3.13: Utility premium $U(wage) - U(invest)$ for γ=5 & $\beta = 0.2$

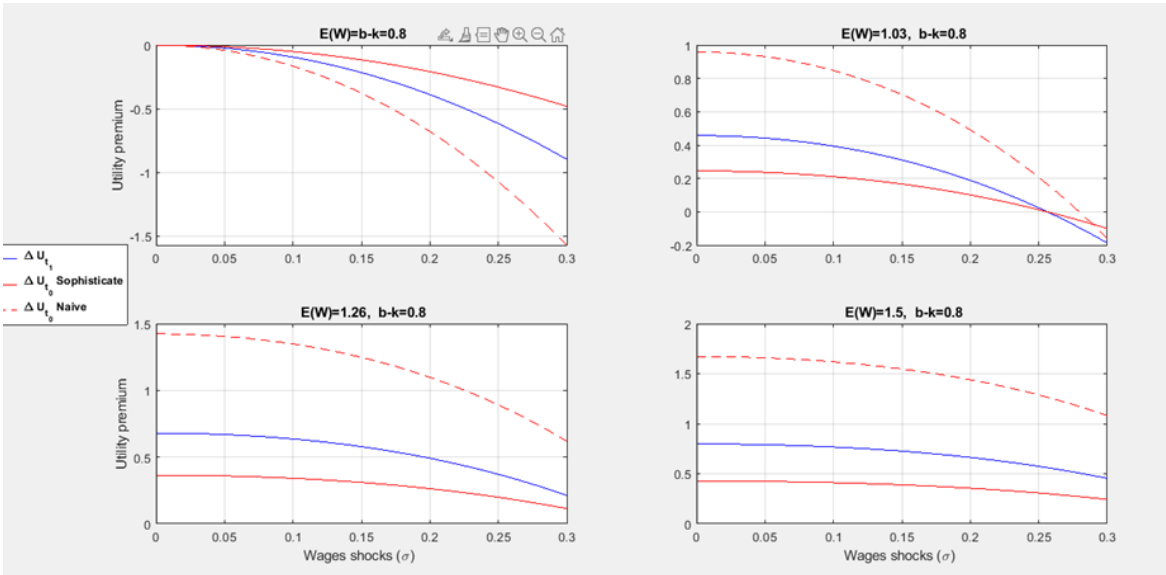


Figure 3.14: Utility premium U(wage)-U(invest) for $\gamma = 5$ & $\beta = 0.7$

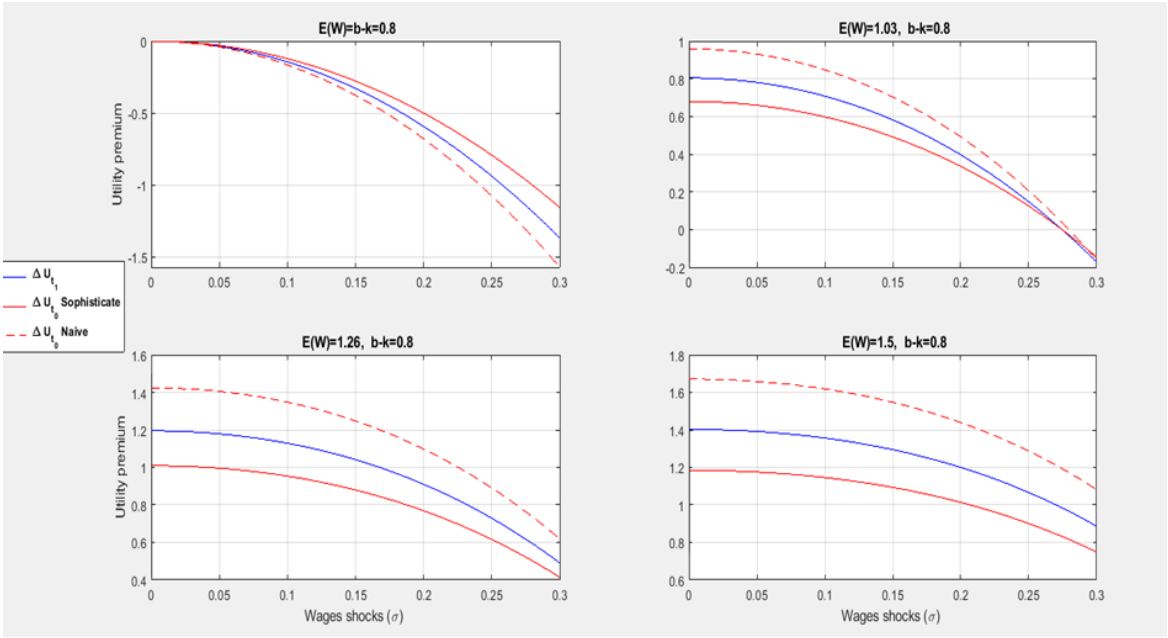
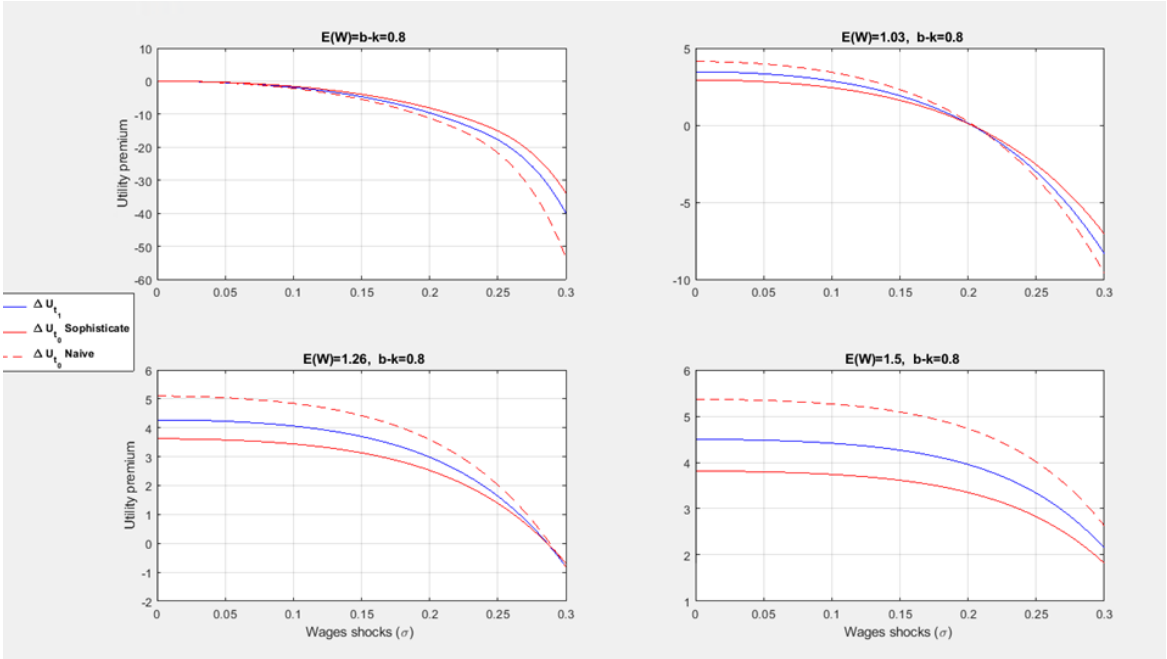


Figure 3.15: Utility premium U(wage)-U(invest) for $\gamma = 10$ & $\beta = 0.7$



3.5 Conclusion

In this paper I use a theoretical framework to characterize time-inconsistent agents' behavior regarding their borrowing and investment choices. I specifically discuss how beliefs about their time-inconsistency and the levels of their risk-aversion, along with the means and variances of the available alternative options affect these choices.

In a resource-constrained environment where borrowing is required to invest, it is not sufficient to expand access to credit to increase investment and ensure loan repayment (Fafchamps, 2014). I show that time-inconsistency and the beliefs agents have on their own one, along with the level of risk aversion are critical to determine whether the decision to take a loan for investment purposes is worthwhile. While self-commitment (Bryan et al., 2010) often helps circumvent time-inconsistency issues, in particular for sophisticate agents, there is evidence that most people do not make commitment. The benefits of commitment are frequently outweighed by its costs from the present-biased agent's perspective (Laibson, 2015). I show that the interaction between time-inconsistency and the level of risk-aversion can determine whether there is room for a credible (self) commitment mechanism for an agent regarding her borrowing and investment plans. To that extent, the supply side may play an important role in including tailored commitment mechanisms in loan contracts so as to attract entrepreneurs and in particular, the sophisticates. A way to this may consist, for instance, in buying the materials needed to operate directly to the entrepreneur. Some thought experiments may also be conducted among people demanding loans in order to elicit their types (naiveté, risk aversion).

Tailored loans should both account for borrowers' present-bias, their awareness of it and on their level of aversion to risk. Information on risk-aversion, beliefs about time-inconsistency, along with the characteristics of the projects

being financed (including available outside options) are in fact key information likely to help financial institutions design differentiated loans. For instance, a highly risk-averse and moderately time-inconsistent agent is more likely to commit to his plans in the face of a risky outside option compared to an agent who is relatively less time-inconsistent with the same level of risk-aversion, if both agents are sophisticates. Likewise, a naïve and highly risk-averse agent is prone to relatively less prediction errors compared to a relatively less risk-averse and naïve agent.

Further research could help elaborate empirically on the distribution of naive versus sophisticate microentrepreneurs, and discuss the proportion of each type (combination of risk aversion and time-consistency) of agents who ultimately take a loan and invest, and the share of those who do not (take the loan and consume, or refrain from taking the loan). This identification will allow to have a better sense of the extent of issues such as overindebtedness and self-exclusion in credit markets. Besides, an experimentation providing different degrees of commitment mechanisms by the supply side within loan contracts could also be used in practice, to help elicit microentrepreneurs' types. The elicitation of microentrepreneur's types, as regards their time-inconsistency and risk-aversion can help understand empirically the minimal conditions for a consistent behavior. Finally, such elicitation would allow to design commitment mechanisms that would work best for borrowers based on their types.

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Appendix

.1 Condition for investment to be welfare improving

1. At $t = 1, \Delta U_1 = U_1(invest) - U_1(no - invest)$ is given by:

$$\begin{aligned}\Delta U_1 =& \frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} \\ =& \frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}\right)\end{aligned} \tag{3.26}$$

From 3.26, for $\gamma > 1$, $\Delta U_0 > 0$ if

$$\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} < 0$$

given that: $\frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right) < 0.$

So this gives $\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} < \left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}$

With the ratio inside each parenthesis being positive and $1-\gamma < 0$,

$$\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} < \left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}$$

gives: $\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}} > \frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}$

and with $1+\beta^{\frac{1}{\gamma}} > 0$

One can can derive that $\Delta U_0 > 0$

only if $b - k > W$ ■.

Similarly, at $t=0, \Delta U_0 = U_0(loan) - U_0(no-loan)$ is given by:

$$\Delta U_0 = \frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}-1}\right)^{1-\gamma} - \frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}$$
$$= \frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}\right)$$

This expression is strictly positve if $b-k>W$ ■

.2 Derivation of the sophisticate penalty factor

$$\frac{U_0(loan)-U_0(no-loan)}{U_1(invest)-U_1(no-invest)} = \frac{\frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}-1}\right)^{1-\gamma} - \frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}}{\frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}}$$

$$\frac{U_0(loan)-U_0(no-loan)}{U_1(invest)-U_1(no-invest)} = \frac{\frac{\beta}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}-1}\right)\left(\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}\right)}{\frac{1}{1-\gamma}\left(1+\beta^{\frac{1}{\gamma}}\right)\left(\left(\frac{\omega+b-k}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma} - \left(\frac{\omega+W}{1+\beta^{\frac{1}{\gamma}}}\right)^{1-\gamma}\right)}$$

$$\frac{\Delta U_0(loan)}{\Delta U_1(invest)} = \frac{\beta^{\frac{1}{\gamma}}+\beta}{\beta^{\frac{1}{\gamma}}+1}\ ■.$$

.3 Basic case: Non-random wages and returns to investment

I discuss here how risk-aversion affects the naive's decision making as regard whether to take the loan or not. There are 4 cases combining risk-aversion and time inconsistency to analyze the naive agent 's behaviour: i) Low risk-aversion and low time inconsistency, ii) low risk aversion and moderate to low high time-inconsistency, iii) high risk aversion and high time inconsistency and (iv) high risk aversion and moderate to low time-inconsistency.

Case 1: Low risk-aversion and high time-inconsistency

Figure 3.16 shows that when a naive agent is highly present-biased with a relatively low risk aversion, then her naive decisions (dotted red curve) might be erroneous. In fact, she tends to overvalue investment returns welfare compared to the sophisticate (utility premium) and therefore, compared to what her time-inconsistency actually allows for (see the plain red and blue curves).

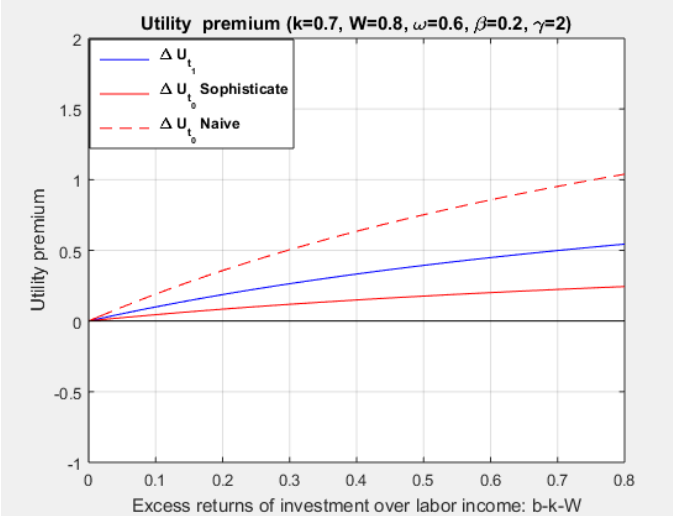

Figure 3.16

The implication for this welfare overvaluation by the naive is that, for relatively low excess returns to investment compared to the wage work option, if she takes the loan she might not invest given that she will actually see, at $t = 1$ outside option consumption more favorably and requires more consumption compared to what she initially planned:

At t=1:

$$c_1(invest)^{*non-naive} = \frac{\omega + b - k}{1 + \beta^{\frac{1}{\gamma}}} < c_1(invest)^{*naive} = \frac{\omega + b - k}{2}, \text{for } \beta < 1.$$

Case 2: Low risk aversion and low time-inconsistency

Figure 3.17 depicts utility premium and excess returns to investment for the naive time-

inconsistent with a low risk aversion. It can be seen that the bias in the naive agent's decision making decreases for a given low level of risk-aversion as she becomes more time-consistent.

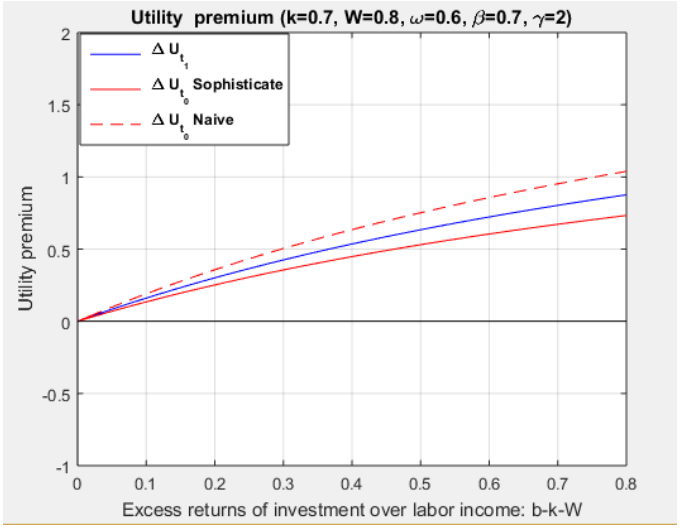

Figure 3.17

Case 3: High risk aversion and low-time-inconsistency

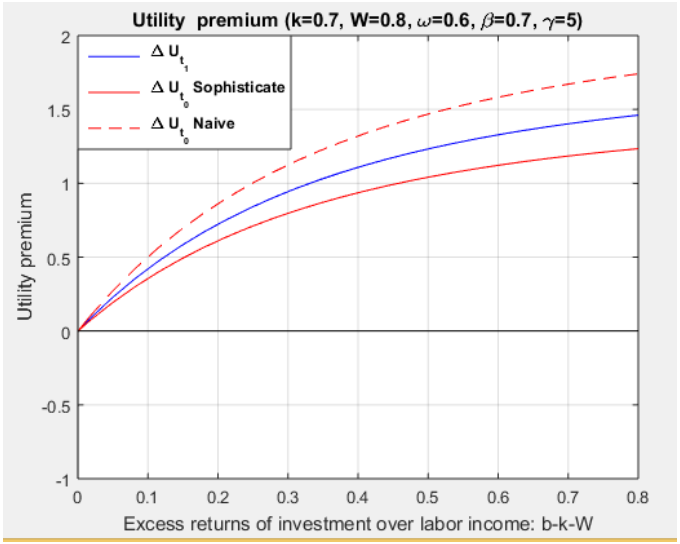

Figure 3.18

Case 4: High risk aversion and high time-inconsistency

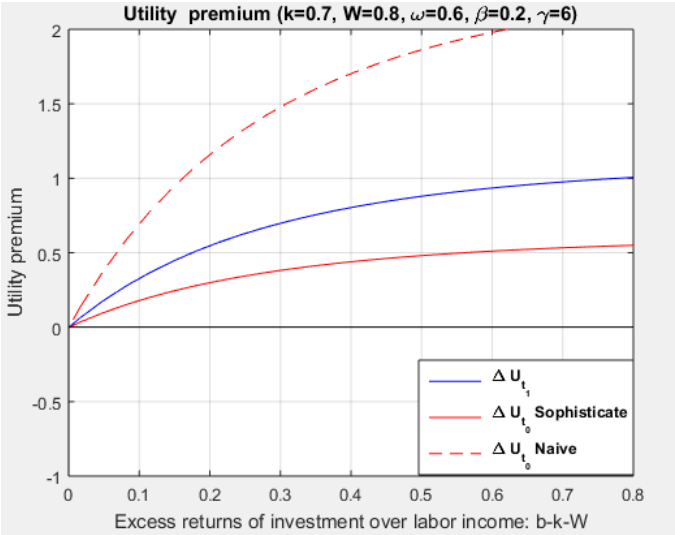

Figure 3.19

These figures in the four cases (3.16-3.19) also show that, for a given level of low risk aversion, the higher the time-consistency, the more aligned are the naïve and the sophisticate investment and borrowing decisions. Similarly, for a given level of high risk-aversion, the less time inconsistent is the agent the closer naïve and the sophisticate. In this case, the alignment is stronger. This suggests that risk-aversion can also play a role in helping avoiding naïve decisions due to time-inconsistency.