Essays on Financial Decision Making

D I S S E R T A T I O N
of the University of St.Gallen,
School of Management,
Economics, Law, Social Sciences
and International Affairs
to obtain the title of
Doctor of Philosophy in Economics and Finance

submitted by

Thomas Spycher

from

Köniz (Bern)

Approved on the application of

Prof. Dr. Martin Brown

and

Prof. Christian Zehnder, PhD

Dissertation no. 4865

Difo-Druck GmbH, Untersiemau, 2019

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The University of St.Gallen, School of Management, Economics, Law, Social Sciences and International Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St.Gallen, November 19, 2018

The President:

Prof. Dr. Thomas Bieger

To my parents

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Last but not least, I am deeply indebted to my parents for their enduring support over all these years and to Sasha for all the good times.

Bern, Dec. 18th 2018 Thomas Spycher

Summary

This thesis contains four essays on financial decision making. The first two essays examine the influence of cultural group membership on the accumulation of financial literacy and on intertemporal choice. The chapters exploit the Swiss language border as a natural laboratory to study the influence of culture and document substantial differences in behavior based on a self-collected survey dataset of 15-year olds living along the language border in the canton of Fribourg. An analysis of underlying channels suggests that observed differences in financial literacy and intertemporal choice are rather related to systematic differences in social norms than to differences in time and risk preferences.

The third essay investigates the influence of an extended cooling-off period for personal loans. A cooling-off period grants a borrower the right to withdraw from a signed credit contract. Cooling-off periods are a commonly used tool for consumer financial protection, but little empirical evidence exists on its use and how changes in its duration affect consumer behavior. Based on a large sample of loan offers in Switzerland, I document that cooling-off periods are rarely used. Less than 0.6% of accepted loan offers are withdrawn by the borrower. The extension of the period from 7 to 14 days did not increase the propensity to make use of the right to withdraw but rather increased the cost of regulation as credit providers disburse loans only after the cooling-off period.

The last essay examines how the numeracy level of employees is related to the quality of their on-the-job decisions. Employers place significant weight on the numerical skills of employees and the level of numeracy is associated with labor market outcomes. Based on an administrative dataset of a retail bank the study relates the performance of loan officers in a standardized math test to the accuracy of their credit assessments of small business borrowers. Results suggest that loan officers with a high level of numeracy are more accurate in assessing the credit risk of borrowers. The effect is most pronounced during the pre-crisis credit boom period when it is arguably more difficult to pick out risky borrowers.

Zusammenfassung

Diese Dissertation enthält vier Aufsätze zu finanziellen Entscheidungen. Die ersten beiden Aufsätze untersuchen den Einfluss der Zugehörigkeit zu kulturellen Gruppen auf die Akkumulation von Finanzwissen und die intertemporale Allokation von Konsum. Die Kapitel nutzen die Schweizer Sprachgrenze als natürliches Labor, um den Einfluss kultureller Unterschiede zu untersuchen. Anhand eines selbst erhobenen Datensatzes dokumentieren die Studien beträchtliche Unterschiede zwischen den Sprachgruppen. Eine Analyse der zugrundeliegenden Kanäle zeigt, dass eher Unterschiede in sozialen Normen die beobachtete Heterogenität in Finanzwissen und in der intertemporalen Allokation von Konsum erklären und dass ökonomischen Präferenzen eine untergeordnete Rolle bei der Erklärung der Unterschiede zufällt.

Der dritte Aufsatz untersucht den Einfluss einer verlängerten Widerrufsfrist bei Konsumkrediten. Eine Widerrufsfrist gibt dem Kreditnehmer das Recht, von einem unterzeichneten Kreditvertrag zurückzutreten. Widerrufsfristen sind ein gängiges Instrument des Konsumentenschutzes. Es gibt jedoch wenig empirische Evidenz, wie sich Veränderungen in der Dauer der Widerrufsfrist auf das Verbraucherverhalten auswirken. Anhand einer grossen Stichprobe von Kreditangeboten in der Schweiz dokumentiert die Studie, dass Widerrufsfristen sehr selten genutzt werden. Die Verlängerung der Frist von 7 auf 14 Tage führt zu keiner statistisch signifikanten Zunahme der Nutzung der Widerrufsfrist.

Arbeitgeber legen grossen Wert auf die numerischen Fähigkeiten der Arbeitnehmer und Studien zeigen, dass es eine positive Korrelation zwischen numerischen Fähigkeiten und Arbeitseinkommen gibt. Im letzten Aufsatz wird untersucht, wie sich numerische Fähigkeiten der Mitarbeiter auf die Qualität ihrer Entscheidungen am Arbeitsplatz auswirken. Basierend auf einem administrativen Datensatz einer Bank analysiert die Studie das Ergebnis von Kreditsachbearbeitern in einem standardisierten Test im Vergleich zur Genauigkeit der Bonitätsbeurteilungen von KMU-Krediten. Die Ergebnisse deuten darauf hin, dass Kreditsachbearbeiter mit einem hohen Mass an numerischen Fähigkeiten bei der Beurteilung des Kreditrisikos von Kreditnehmern genauer sind. Der Effekt ist am stärksten in der Zeit vor der Krise, in welcher die asymmetrische Information im Markt besonders hoch ist.

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Chapter 1

Culture and Financial Literacy: Evidence from a within-country Language Border

Martin Brown, Caroline Henchoz & Thomas Spycher

Abstract

We study the effect of culture on financial literacy by comparing secondary-school students along the German-French language border within Switzerland. We find that students in the French-speaking region have a lower level of financial literacy than students in the German-speaking region. The difference in financial literacy across the language groups is stronger for native students and monolingual students than for immigrant students and bilingual students. This supports the hypothesis that embedded cultural differences rather than unobserved heterogeneity in schooling are driving the effect. A mediation analysis suggests that the cultural divide in financial literacy is related to systematic differences in financial socialisation across the language groups. Students in the German-speaking region are more likely to receive pocket money at an early age, and are more likely to have independent access to a bank account than students in the French speaking region.

1.1 Introduction

A growing body of research documents that financial literacy is associated with better personal financial decision making. Individuals with a higher level of financial literacy perform better in retirement planning (Lusardi and Mitchell (2007), van Rooij et al. (2011)), are less prone to overindebtedness (Lusardi and Tufano, 2015) and participate more often in financial markets (van Rooij et al., 2011) with better diversified portfolios (von Gaudecker, 2015). Financial literacy is also related to higher yields on deposit accounts (Deuflhard et al., 2018) and a higher propensity to withdraw deposits from distressed banks (Brown et al., 2017).

Theory models the accumulation of financial literacy as an endogenous human capital choice (Lusardi et al. (2017), Jappelli and Padula (2013)), but is largely silent about heterogeneity in the initial stock, i.e. the level of financial literacy when entering the labour market. Recent empirical work focusses on the analysis of financial education interventions for the youth and adults (see Fernandes et al. (2014), Miller et al. (2015) and Kaiser and Menkhoff (2017) for meta-studies on financial education programs). But again, there is little empirical work analysing heterogeneity in the initial level of financial literacy which is very likely to influence the impact of financial education initiatives.

In this paper we study the effect of culture on the initial stock of financial literacy among the youth. Following Guiso et al. (2006), we define culture as the set of beliefs, norms and preferences that are shared among the members of a social group. From an economics perspective, culture may thus affect financial knowledge and decision making through systematic variation in time or risk preferences (Falk et al., 2018) or variation in social norms regarding the incurrence and repayment of debt as well as informal insurance for households in financial distress (Lindbeck, 1997). From a psychological perspective, culture may further influence financial knowledge and decision making through differences in financial socialisation or attitudes towards money (Yamauchi and Templer, 1982). Lusardi et al. (2010) document substantial differences in financial literacy among the youth in the US by ethnicity and race. This raises the question of how cultural background may influence initial financial literacy levels. Race and ethnicity are, however, often correlated with differences in socio-economic background making it difficult to identify the effect of cultural background on financial literacy.

Our aim in this paper is twofold: First, we examine the magnitude of differences

in financial literacy among the youth across well-defined cultural groups. Second, we examine to what extent these differences may be accounted for by systematic variations in different dimensions of culture, i.e. preferences, financial socialisation, norms or money attitudes across these groups.

We study the impact of culture on financial literacy at the French-German language border within Switzerland. Two institutional features make this setting ideal to study questions related to culture. First, the language border allows cultural differences in preferences, norms and attitudes to coexist over time within a small geographic area.[1] Second, the language border runs through cantons, the first administrative division of Switzerland. Since most laws and policies are set either at the federal or cantonal level, there is no major change in institutions or policies at the language border within cantons. This setting allows to mitigate the two-way interaction between culture and institutions (Alesina and Giuliano, 2015). Further, there are no geographic barriers and the transport system is fully integrated across the language border. Consequently, economic conditions that potentially influence financial literacy hardly change at the language border. Importantly, we do not study the influence of language per se on financial literacy. In contrast to the recently formulated linguistic-savings hypothesis (Chen, 2013) which focuses on the one-dimensional influence of language on patience, we use language as a proxy for a broader range of cultural differences. The language border in our setting allowed for the historical persistence of cultural heterogeneity within a narrow region and we exploit it mainly for purpose of identification.

We study survey responses of 649 secondary-school students who are located in a narrow geographic region along the language border within the Swiss canton of Fribourg. Besides measures of financial literacy, our survey captures detailed information on economic preferences, financial socialisation, norms and attitudes towards money and consumption, as well as the socio-economic background. Our subjects are on average 15 years old and in their final year of compulsory schooling. The survey covers students from all educational levels.[2] Moreover, the survey covers students which are differentially

[1] The differences in norms and preferences are for example observed in the voting behaviour. There is a clear cut in support for example for work-time regulations (Eugster et al., 2017) or left-of-centre referenda (Eugster and Parchet, 2018).

[2] The Swiss school system has on secondary level (13 – 16 years old) three levels with increasing academic difficulty. Students are assigned after the 6th grade based on their academic performance to a class on basic, medium or high level.

embedded in local culture on either side of the language border. We can compare native students and in particular those with a single mother tongue to bilingual native students and students with an immigrant background.

Our survey population allows us to study the initial level of financial literacy at an age relevant for future financial decision making. First, the youth in our sample have already been strongly exposed to cultural influences in their parental home, from family and friends as well as at school. However, as they are all still subject to mandatory schooling, their level of financial literacy is less influenced by endogenous education, labour market and financial decisions than this would be in an adult population. Second, the majority of the students in our sample are very likely to make significant independent financial decisions within a year of the survey. In particular, two-thirds of the surveyed students plan to continue their education with an apprenticeship which will provide them with a first salary. Thus we measure financial literacy at an age when independent financial decision making is looming.

We document substantial differences in financial literacy between the two cultural groups. Responding to ten questions on financial literacy, German-speaking students scored on average 1.3 points (23 percent) higher than French-speaking students. Moreover, assessing their own understanding of financial matters on a five-point scale, German-speaking students scored on average 0.6 points (again 23 percent) higher than French-speaking students. We find that differences between the language groups are particularly strong among Swiss nationals with a monolingual family background while they are weaker among students with a bilingual family background or students with an immigration background. This supports our conjecture that locally embedded culture influences financial literacy and suggests that the observed differences are not driven by unobserved heterogeneity in schooling across the language border.

In line with previous evidence we document that - at the individual level - financial literacy is strongly correlated with financial socialisation (receiving pocket money at an early age, independent access to a bank account) and time preferences (patience). We further document a substantial difference in financial socialisation between the two cultural groups, but find no significant difference in time preferences. In a formal mediation analysis, financial socialisation, thus emerges as the strongest mediator of financial literacy between the two cultural groups.

Our findings contribute to two main strands of literature: First, we contribute to the recent literature on the determinants of financial literacy. Financial literacy among adults has been modelled as an endogenous choice (Jappelli and Padula (2013) and Lusardi et al. (2017)) in which the inherent stock of financial literacy, expected lifetime income as well as time and risk preferences influence the investment in acquiring financial literacy. In line with these predictions, Meier and Sprenger (2013) show that participation in voluntary financial education programs is strongly related to patience.[3] By contrast, there is scarce empirical evidence on the origins of the *initial* stock of financial literacy. Lusardi et al. (2010) analyse how sociodemographic characteristics and family financial sophistication influence the inherent level of financial literacy among the youth. In this paper, we document that the *initial* level of financial literacy – among 15-year olds – varies strongly across cultural groups and is related to differences in financial socialisation. Our findings on the mediating role of financial socialisation add to the literature on intergenerational transmission of financial literacy and financial behaviour which shows that parents play a key role in developing financial literacy (Webley and Nyhus (2006); Bucciol and Veronesi (2014); Lusardi and Mitchell (2014); Grohmann et al. (2015); Shim et al. (2015)).

Second, we contribute to the literature on the role of culture in economic behaviour (see e.g. Chen and Hungerman (2014)) for an introduction) and specifically in financial decision making. Using survey information from 76 countries, Dohmen et al. (2015) show that observed cross-country differences in saving rates are associated with differences in time preferences. Exploiting differences in the cultural origins of immigrants to Canada and the U.S., Carroll et al. (1994) and Carroll et al. (1999) argue that culture has little impact on household savings. More recently, Haliassos et al. (2016) document substantial cultural differences in the financial assets and liabilities of immigrants to Sweden, while Fuchs-Schündeln et al. (2017) document cultural differences in saving behaviour among immigrants in Germany and the UK. Related to our study, Guin (2017) studies household saving behaviour among adults at the language border within Switzerland. He documents a significantly higher propensity to save among German-speaking households. We extend this strand of literature by documenting substantial cultural differences in financial literacy among the youth which is very likely to influence subsequent financial

[3] Numerous studies analyse the effect of financial education programs on financial literacy and financial behaviour (see Fernandes et al. (2014), Miller et al. (2015) and Kaiser and Menkhoff (2017) for meta-studies). Their findings with respect to causal effects of education programs on financial literacy and financial behaviour are ambiguous.

decision making.

The remainder of the paper is organized as follows. Section 1.2 describes the institutional background. Section 1.3 introduces the survey design and the dataset. Section 1.4 presents the analysis for differences in financial literacy. Section 1.5 presents the mediation analysis and section 1.6 concludes.

1.2 Institutional background

Switzerland has four official languages, whereby the overwhelming majority of the population speaks either German (63.3%) or French (22.7%) as their main language.[4] Figure 1.1 displays a map of Switzerland with areas shaded according to the majority language spoken in each municipality. The historical language border between the French-speaking and German-speaking regions is clear cut, leading to a sharp change in the main language spoken from one municipality to the next. This language border has allowed differences in attitudes, norms and preferences to persist over time within a narrow geographic area.[5] Thus, while neighbouring regions usually assimilate through social interaction, in this particular case the language border prevented the mixing of attitudes, norms and preferences. Hence, the French-German language border within Switzerland is equivalent to a cultural border.[6] While recent studies (Chen (2013), Sutter et al. (2018)) focused on how language itself influences preferences and behaviour, we use language as a proxy for cultural group membership.

Large parts of the German – French language border within Switzerland do not feature a geographical barrier. Importantly, the language border also runs through cantons, the first administrative subdivision of Switzerland. Since the institutional framework is mainly set at the federal and cantonal level, there is no major change in policies and institutions at the language border. The language border thus provides an ideal

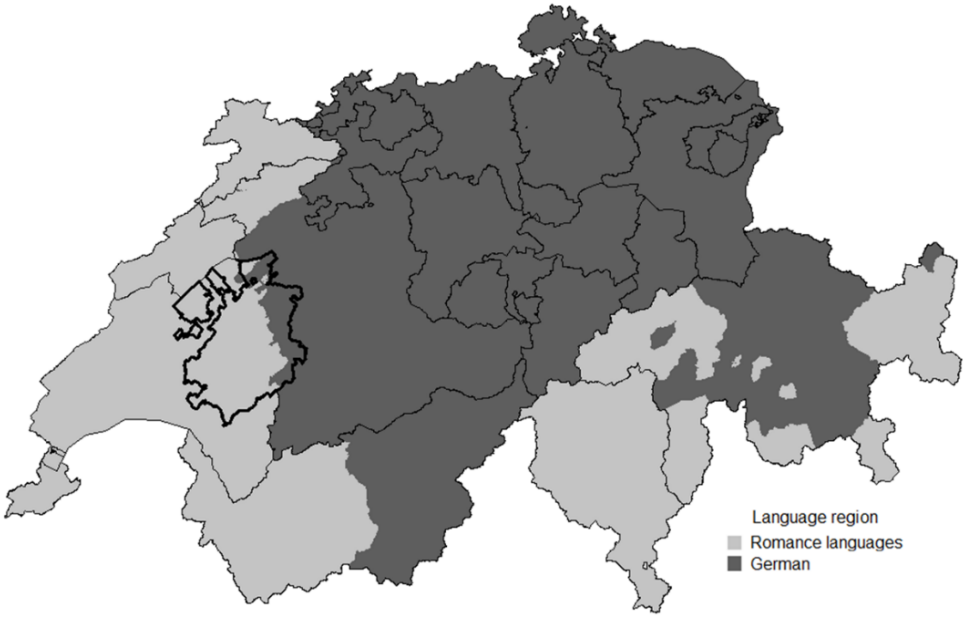
[4] 8.1% declare Italian, 0.5% Romansh and 6.8% other languages as their main language. Source: Swiss federal statistics office in 2015.

[5] Eugster et al. (2011) provide a detailed discussion of languages in Switzerland and historical language borders.

[6] There is evidence that the difference at the within-country language border with respect to financial decisions is smaller than differences across countries (as for example exploited by Carroll et al. (1994)). Bachmann and Hens (2016) show that Swiss investors in all language groups are less prone to investor mistakes compared to investors in the same language region from neighbouring countries and that there are greater similarities in investment decisions of residents of Switzerland speaking different languages than there are between these and their linguistically closest neighbours.

Figure 1.1: Language regions in Switzerland

Dark-grey areas indicate a majority of German language speakers on municipal level. Light-shaded areas indicate municipalities with a majority speaking a Romance language (French in the West, Italian in the South and Romansh in the East). Dark lines indicate cantonal borders. The canton of Fribourg is specially highlighted using an increased line width. Source: swisstopo and Federal Statistical Office (FSO)



laboratory to study the economic effects of cultural heterogeneity. That said, potential differences may exist in the implementation of policies and the day-to-day operation of institutions. In our setting the specificities of school curricula, the training of teachers and the implementation of the curricula in schools may differ across the language border.[7]

Several studies exploit the clear cut border between cultural groups within one institutional setting at the Swiss language border. Eugster et al. (2011) document a persistent, strong difference in the demand for social insurance between the French and German language region. In addition, work attitudes and unemployment durations sharply change at the language border (Eugster et al., 2017). Both studies show that the differences persist even within groups with the same economic fundamentals. Guin (2017) documents that German-speaking households are more likely to save and less prone to spend excessively compared to French-speaking households.

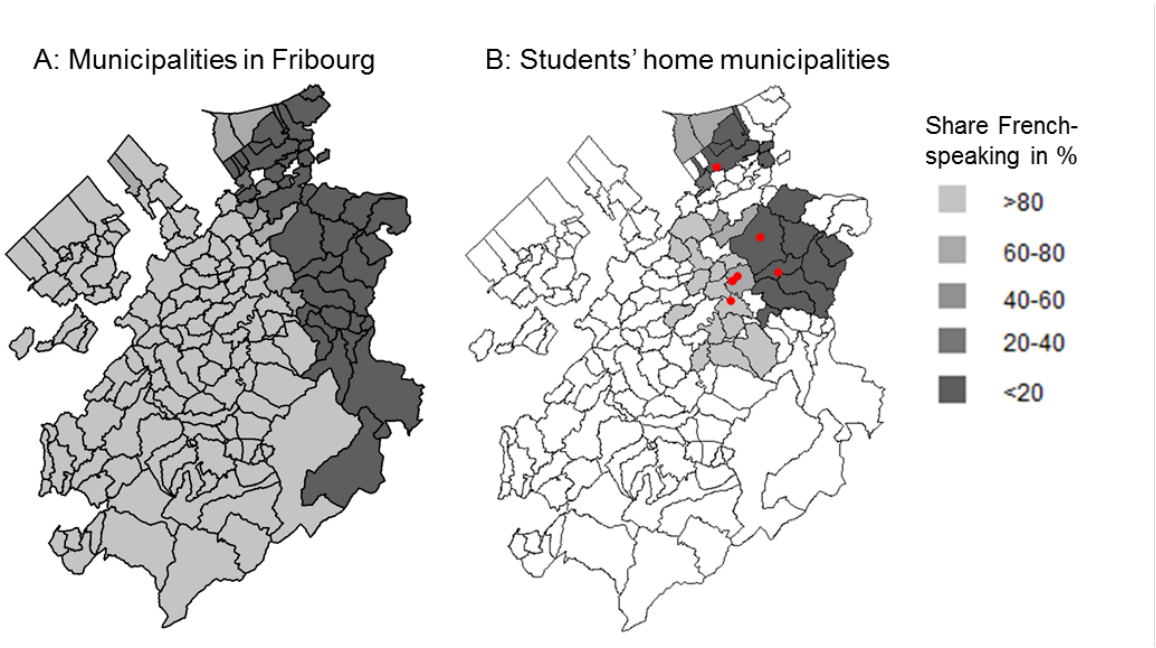
The above mentioned studies all exploit within-canton variation provided by the French-German language border running through the three cantons Berne, Fribourg and

[7] Differences in the implementation of policies may reflect the influence of culture since the local administration as well as teachers are also influenced by culture.

Valais.[8] By comparison, our study narrowly focuses on the language border region which runs through the bilingual canton of Fribourg. Fribourg has a francophone majority (125 municipalities with a total population of 235,769) in the west and a German-speaking minority (38 municipalities with a total population of 67,608[9]) in the east. Most municipalities have a distinct majority language and can therefore be clearly assigned to one language region (see Figure 1.2). There are only few bilingual municipalities where the share of native French speakers is not below 20% or not above 80% .[10]

Figure 1.2: Canton of Fribourg

Map A displays the share of the population that states French as the main language for each municipality in the canton of Fribourg. Individuals who state other languages than French and German as their main language are excluded. Map B displays home municipalities of students in the sample and the share of French-speakers in the respective municipalities. White coloured municipalities are not in the sample. Red dots mark locations of schools. Source: StatA Fribourg



[8] Other studies exploit the Swiss language border to investigate inter-jurisdictional tax competition (Eugster and Parchet, 2018) or fertility and labour force participation (Steinhauer, 2013).

[9] The number of municipalities and population information refer to December 2014; Source: Federal statistics office permanent resident population by municipality

[10] One notable exception is the cantonal capital of Fribourg. Fribourg had in 2015 38,489 inhabitants. 63.6% stated French and 21.2% German as their main language (15.2% other languages). We run a robustness check focusing on municipalities with a distinct majority language (Table 1.3).

1.3 Data

1.3.1 Sample selection and procedure

Our analysis is based on a survey of secondary school students located in a narrow geographic region along the French-German language border within the canton of Fribourg. The students are on average 15 years old and in their final year of compulsory education. The public secondary school system in Fribourg features three levels, which differ by the level of difficulty of the curriculum. Our Online Appendix provides details of the public education system in Fribourg. There we describe important commonalities of the education system across the language border (primary school starting age, assignment of students to secondary school levels) and point to relevant variation in curricula.

Table 1.1 shows the number of observations by school level, gender and school language.[11] The aim was to survey a similar number of students for both genders on each of the three school levels for each language region. From all secondary schools in the canton we pre-selected four German-speaking schools and three French-speaking schools based on the number of students at each school level and the schools' proximity to the language border. Figure 1.2 displays the location of the selected schools and the students' municipality of residence. The study was supported by the cantonal department of education which encouraged all selected schools to participate in the survey. Within the seven selected schools, we randomly selected classes of students, stratified by educational level. Overall, 786 students in 40 classes were selected for the survey. Due to non-attendance, 63 students could not be surveyed. There is no indication that non-attendance was related to the survey.[12]

The survey was conducted in November 2015 during regular school hours with paper and pen. The setting was similar to an exam situation and students were not allowed to communicate.[13] There was no reward for the completion of the survey and questions were

[11] In 2015 35% of students in the canton of Fribourg were in classes on the highest level that prepare for an academic high school which will later on qualify for the entry of university. 44% on the medium level and 19% on the lowest school level (Source: StatA Fribourg). Thus, the survey over-samples students from the lowest level.

[12] 12 students were participating in a program that allows them to retake the final year on a higher level or in a different language. These students are excluded from the sample.

[13] The survey was conducted by the authors and research assistants. They introduced the survey and replied to general questions. Instructions were always presented by a native speaker of the respective school language. During the completion of the survey no questions were answered and students were told to leave questions blank if they do not understand them. The teachers were present in the classroom but did not intervene in the process.

Table 1.1: Sample composition: Number of observations

Panel A. Sample by school level and gender

	German-speaking		French-speaking		Total
School level	Male	Female	Male	Female	
Basic	40	36	65	43	184
Medium	77	45	55	54	231
High	51	56	57	70	234
Total	168	137	177	167	649

Panel B. Sample by school level and citizenship

	German-speaking		French-speaking		Total
School level	Swiss	Non-Swiss	Swiss	Non-Swiss	
Basic	66	10	51	57	184
Medium	112	10	58	51	231
High	105	2	106	21	234
Total	283	22	215	129	649

not incentivized. The order of the questions was the same for all students. On average, it took students 30 minutes, with a minimum of 20 and a maximum of 45 minutes, to complete the survey.

The custom-made survey included a total of 67 questions covering financial literacy, risk and time preferences, financial socialisation, debt norms, money attitudes and socioeconomic background. Survey questions were chosen with respect to the suitability for this particular age group. Given the bilingual setting, the translation of survey questions received particular attention. Students on both sides of the language border should perceive and understand questions with the same meaning. In order to obtain a high quality of translation, several bilingual translators assessed the translation of the survey. Many questions originate from similar studies that were conducted in English. Some questions were first translated to German and then to French while others were first translated to French and then to German.[14]

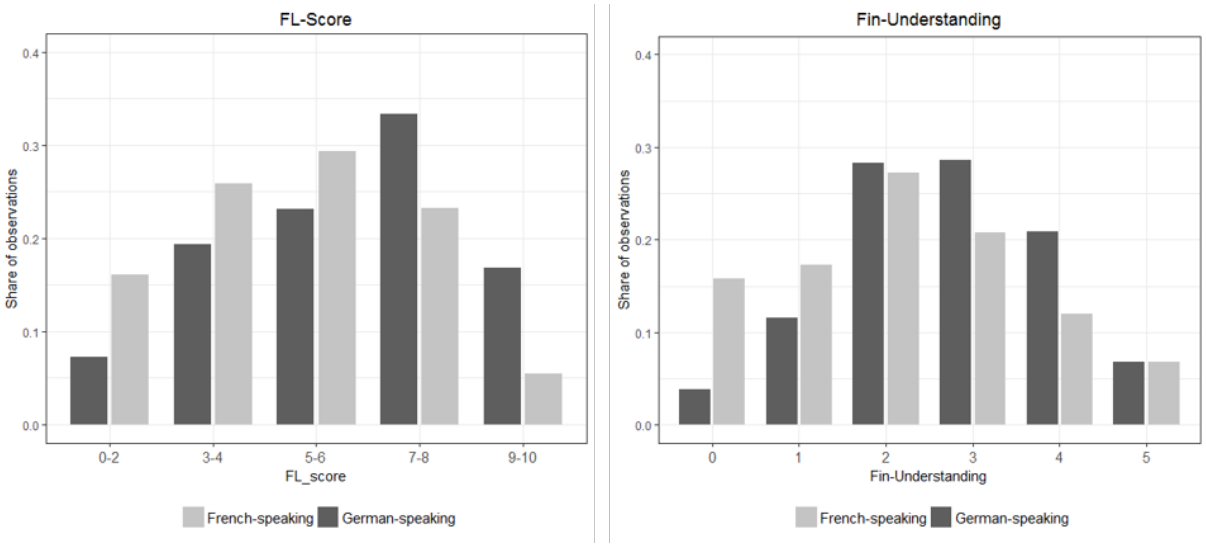
[14] An English version of the survey is available in our Online Appendix.

1.3.2 Financial literacy

We define financial literacy as the degree to which students have acquired the knowledge and skills to make sound financial decisions.[15] The survey contains 10 financial literacy questions which are based on comparable studies and adjusted to the Swiss environment as well as to the students' age. The financial literacy questions cover the following topics: Simple interest, compound interest, percentage calculation for a purchase decision, budgeting, understanding of a bank statement, graphical understanding of stock price development, inflation, and diversification. Appendix 1.A1 provides the details and sources of the ten questions. The financial literacy score (*FL-Score*) counts the number of correct responses to the 10 questions.

Students also gave a subjective assessment of their understanding of financial matters (see e.g. Gathergood (2012b)). They stated on a six-point Likert scale how strongly they agree to the statement: *Financial matters are complicated and confusing to me.* Based on the answers to this question we construct a measure of financial understanding (*Fin-Understanding)* which runs from 0 (strongly agree) to 5 (strongly disagree).

Figure 1.3: Distribution of financial literacy by school language



We obtain responses from 711 students. Due to missing values we restrict the sample to 649 students.[16] Figure 1.3 displays histograms of our two financial literacy measures

[15] This is in line with the OECD definition of finance literacy (OECD, 2014).

[16] 6 surveyed students come from another region and we therefore exclude them. For 12 observations, we lack information on gender, for 19 observations on citizenship, for 7 observations on the year of birth and for 18 observations on the municipality of residence.

by language group. The share of German-speaking students with high financial literacy scores is clearly larger than that of French-speaking students. Similarly, German-speaking students are more likely to assess their own financial understanding as higher than French-speaking students. The summary statistics in Appendix 1.A2a confirm a significant difference in financial literacy across the language groups. Compared to a sample mean of 5.53 points German-speaking students score on average 1.25 points higher on *FL-Score.* German-speaking students also score 0.56 points higher on *Fin-Understanding*, compared to a sample mean of 2.43 points.

1.3.3 Mediators of culture

Dohmen et al. (2011) provide evidence for a strong intergenerational transmission of risk attitudes.[17] Hence, cultural differences in financial literacy may be related to systematic differences in preferences across the language groups. We assess risk and time preferences of students with qualitative and quantitative questions.

Falk et al. (2016) suggest non-incentivized survey questions for the assessment of time and risk preferences that provide the best measure compared to values obtained from incentivized experiments.[18] We use the suggested general attitude questions addressing the subjectively perceived willingness to take risks and the attitude towards allocating consumption and work between present and future. For risk preferences, students state on a 6-point scale how strongly they agree with the statements (1 (strongly disagree) to 6 (strongly agree)): "I am a person who is willing to take risks" . We construct a binary variable that takes on value 1 if a student stated 4 or higher. For the time preference measure, we use three questions in a 6-point scale: 1. "I rather go without something today in order to be able to afford more tomorrow" . 2." I tend to procrastinate tasks even though it would be better to get them done immediately" . 3." I am prepared to spend now and let the future take care of itself" . We assign the value 1 to a question if the student indicated to be more patient than the mid-category (thus values >3 for question 1 and values <4 for 2 and 3). The qualitative measure of time preferences reflects the mean over the three questions.

[17] Our setting does not allow to identify the relative importance of vertical (intergenerational) and horizontal transmission of culture.

[18] The use of non-incentivized survey questions to elicit risk and time preferences may lead to different values compared to incentivized questions. For our study, this would only bias our results if the difference is influenced by cultural group membership.

We also elicit quantitative measures of time and risk preferences. Since the students are only 15 years old, we apply a framework based on the design used in Sutter et al. (2018): Students allocate a given amount between a future and an immediate payoff as well as between a safe and risky choice.[19] In contrast to Sutter et al. (2018), however, we do not make use of a choice list, responses are elicited by a pen and paper survey, and choices are not incentivized. The qualitative and quantitative measures are combined with equal weights to yield one indicator of time preferences (*Patience*) and one indicator of risk preferences (*Risk seeking*) per respondent.

Parents play an important role in the financial education of their children (Grohmann et al. (2015); Lusardi and Mitchell (2014); Shim et al. (2015); Van Campenhout (2015)) .[20] Through the dissemination of norms, the teaching of financial concepts and by giving their children the opportunity to handle their own money they also influence financial decisions (Norvilitis and MacLean, 2010) as well as financial literacy (Lusardi et al., 2010).[21] We capture parental *Financial socialisation* by constructing a measure related to observable actions of parents in fostering financial independence of their children. The measure is constructed as the average of three binary measures of financial socialization. They include a) whether a student has a bank account, b) whether a student has independent access to a bank account and c) whether the student received the first pocket money earlier than the median student in our sample (at age 12). The measure is comparable to the economic socialization measure used in Webley and Nyhus (2006).[22] The literature documents for both actions a positive correlation with savings behaviour in adult life (Webley and Nyhus (2006); Bucciol and Veronesi (2014)).

Norms towards saving and debt could be an important factor of how culture influences financial literacy.[23] We elicit the exposure of students to such norms by measuring how

[19]Sutter et al. (2018) elicit time preferences with the use of a choice list. Each child made decisions in three binary decision problems where the payoff was varied. Hence, their measure of time preferences is not fully comparable to ours.

[20] Strong correlations in financial behaviour are reported across generations (Fagereng et al. (2015); Kreiner et al. (2016); Black et al. (2017)).

[21] Webley and Nyhus (2013) provide numerous examples of parental practices that provide a learning experience.

[22] The economic socialization index in Webley and Nyhus (2006) includes having a bank account at age 16 and receiving money regularly from parents (or relatives). It further captures whether parents discuss the financial situation with children, whether children earn money and how economical parents were during childhood relative to other households.

[23] Gathergood (2012a) shows that the impact of problem debt on psychological health is less severe in localities in which problem debt is more widespread and therefore the social stigma is weaker.

often they heard the following two statements from their parents[24]: (i) "You should not spend more than what you have". (ii) "You should not have debts" . Students rated the frequency on a 6-point scale ranging from 1 (never) to 6 (very often). Both scores are transformed to a binary variable equal to 1 if students indicated values 4 – 6. The variable *Debt norms* then reflects the mean over the two answers.

Evidence from the psychology and consumer behaviour literature suggests that personal attitudes towards money and consumption, e.g. the importance of money as a means to achieve social prestige and freedom, are associated with financial literacy (Sohn et al., 2012) of adolescents. Differences in money attitudes across the language groups in our study may therefore be one driver of cultural differences in financial literacy. We capture two dimensions of money attitudes similar to the attributes mentioned in Mitchell and Mickel (1999). First, we elicit the freedom and control component of money attitudes by measuring how strongly students agree to the following two statements: 1. "For me, money is a tool to accomplish goals" . 2. "I am living according to the motto: Money gives me the freedom to do what I feel like." Students rated the statements on a 6-point scale ranging from 1 (strongly agree) to 6 (strongly disagree). Each answer is again transformed to a binary variable equal to 1 if students indicated values 4 – 6. The variable *Freedom & control* then reflects the mean over the two answers. Second, we construct a measure from two questions capturing how strongly money is connected to social status and power (Social prestige). Students rate the following two statements on a 6-point scale ranging from 1 (strongly agree) to 6 (strongly disagree): "1. For me, money is a tool to make friends." 2. "I am prepared to do everything it takes to get money" . Again, each answer is transformed to a binary variable equal to 1 if students indicated values 4 – 6. The variable *Social prestige* reflects the mean over the two answers.

Appendix 1.A2a provides definitions, summary statistics and univariate comparisons across language groups for our potential mediators of culture. Financial socialisation is much stronger among German-speaking students than among French-speaking students: They receive pocket money at an earlier age and more often have (independent access to) a bank account. German-speaking students are more often discouraged from taking on debt by their parents. Looking at money attitudes, French-speaking students connect

[24] The survey also aimed at capturing norms towards saving. The question however suffers from an endogeneity bias and mainly students who save little state that they are often told to save. We therefore do not make use of this variable.

money more strongly with freedom while the importance of money for social prestige is only marginally different between the two groups. Appendix 1.A2a documents small differences for time preferences and risk preferences between the two groups: French-speaking students are on average less patient and more risk seeking.

1.3.4 Socioeconomic background

We collect a broad set of information on the socioeconomic background of students. Besides personal characteristics such as gender and birth year we further elicit religion and citizenship. Citizenship provides a proxy of how long a family has been resident in the country.[25] Religion is reported to influence social norms and preferences (Basten and Betz, 2013). We also elicit which languages the student speaks at home with her parents and siblings. Further, we try to capture the economic background of students through several proxies; having an own room at home, whether the home is owned or rented, as well as the number of weeks on holidays each year approximate parental wealth and income.

We further elicited information on parental education and activities (cinema, theatre, classical music concerts and museums) which may influence the (financial) literacy of their children (Lusardi et al., 2010). However, these display a large number of missing values as students often respond "Do not know" or not at all. For those students which do reply Appendix 1.A8 displays pairwise correlations of parental education and activities with our above described control variables. The table shows that parental education is highly correlated with the educational level of the student as well as with our proxies for income and wealth. We therefore do not control for parental education in our main specifications. In Appendix 1.A6 we replicate our results by levels of parental education and show that they are robust across students with / without highly-educated parents.

Summary statistics and univariate comparisons of our student-level control variables are presented in Appendix 1.A2b. We find some significant differences in household characteristics across the language border. Students from the French-speaking region are less often Swiss citizens. This reflects the fact that the capital city of the canton of

[25] In Switzerland citizenship is not birth place dependent. It depends on the citizenship of the parents. In the canton of Fribourg, adults can launch the process of naturalisation after they have lived 12 years in Switzerland. Thus, the measure does not only capture a recent immigration history but also many families who immigrated decades ago.

Fribourg (the City of Fribourg from which we also sample schools) is majority French speaking. German-speaking students are more likely to live in a family which owns (rather than rents) their home and are more likely to have their own room.

One major advantage of our chosen sample is that we are comparing students across language groups, but within the same administrative setting. In particular, the main features of the public education system are set at the cantonal level and thus identical for both language groups (see the Online Appendix for details). There are, however, separate administrative offices responsible for the detailed curricula and teacher training on either side of the language border. This may cause some differences in the specificities and implementation of the curricula between the two language regions within the canton of Fribourg. At the time of our survey the school curricula in neither language region included mandatory financial education (see our Online Appendix for details on the educational system). However, teachers do have the discretion to cover financial topics at both the primary school level (e.g. use of money/coins to teach math) and the secondary school level (e.g. teaching personal finance as part of "general formation studies"). Thus not only teacher training, but also teacher attitudes towards finance and its importance for their students may influence the intensity of financial education in our sample. Our survey responses indicate variation in the coverage of financial topics both within and across language groups. As shown in Appendix 1.A2b, 39% of French-speaking students and 25% of German-speaking students state that topics related to economic and financial education were covered in secondary school.[26]

All students report the municipality in which they live. This allows us to match our survey-data to municipal-level statistics of economic conditions. The data presented in Appendix 1.A3 reveal that there are some differences between the municipalities in the two language regions. French-speaking students are more likely to live in urban municipalities with a higher share of non-Swiss residents.[27] Likely related to the urban-rural divide we find differences in the sector allocation of employees, the number of cars per inhabitant and the number of bank branches. Importantly though, the municipal financial situation measured by the tax potential index is very similar. This suggests that schools' financial

[26] The measure is vague, since for example interest rate calculations discussed in math classes can be considered as part of financial literacy. The coverage of financial literacy in class is not significantly correlated with the financial literacy score controlling for the students background (basic and extended controls).

[27] Urban municipalities have a population of more or equal 10,000.

resources are comparable across the language border.

1.4 Cultural differences in financial literacy

1.4.1 Methodology

In the first step of our analysis, we examine how exposure to a language group influences financial literacy. We aim at estimating the Average Treatment Effect (ATE) for the population of the youth where the exposure to the French-speaking language group is defined as treatment.[28] We use the school language as the mutually exclusive treatment variable.

$$ATE = E[Y_i(1) - Y_i(0)]$$

The dummy variable $T_i = 1$ indicates that student i attends a French-speaking school and is treated. T_i is equal to 0 for students of German-speaking schools. $Y_i(1)$ indicates the potential outcome of student i if she is exposed to the French-speaking region while $Y_i(0)$ indicates the potential outcome if she is exposed to the German speaking region.

Our treatment variable – the language of the school which the student attends – deserves particular discussion.[29] We argue that by defining treatment as the school language we assign students to the cultural group they are most exposed to. First, we note that for most students the school language is exogenously determined by the majority spoken language in the municipality where the family resides. However, in some bilingual municipalities parents can actively choose which school their children attend. In

[28] The treatment effects literature suggests that only mutable characteristics should be considered as treatment (e.g. Holland et al. (1985)). Even though culture is nearly immutable post-birth, the exposure to a language group is a treatment that can be manipulated. Our strategy focuses on the ATE since the definition of the treatment could be easily reversed.

[29] Our empirical strategy differs from the spatial regression discontinuity design applied by other studies exploiting the same language border (e.g. Eugster et al. (2011), Guin (2017)). We argue that using school language as treatment allows for a more precise classification of cultural group membership than the classification by the majority language of the home municipality which is typically used in RDD analyses. This is especially important since students in our sample reside in municipalities very close to the language border. Our approach, however, comes at the cost that we primarily capture the exposure to culture in school and the parental home and may not fully capture the effect from the neighborhood's culture. In a robustness tests we redefine the treatment based on the majority language in the municipality of residence and yield similar results (Appendix 1.A4).

these municipalities, most parents choose the school according to the language spoken at home.[30] Moreover, where parents are bilingual or speak a third language it is reasonable to assume that they choose the school language they feel is closer to their own cultural values. In addition, as children are influenced by their peers for our subject pool of 15-year-old students school is likely to be an important location of socialisation. To rule out that the endogenously chosen school language biases our results we run a robustness check where we limit our sample to students whose home municipality has a clear majority language, meaning their school language is exogenous (Appendix 1.A4).

We estimate the following equation in an OLS model:

$$FL - Score_i = \alpha + \beta French_i + \gamma X_i + \epsilon_i$$

where French_i is a dummy variable that is equal to one for students from French-speaking schools and vector X_i contains a set of control variables. For all estimations, standard errors are clustered on class level. As a robustness check, we apply a semi-parametric propensity score matching estimation.

We assume that the vector of observable confounders X_i captures all differences in socioeconomic characteristics of students, as well as institutions, policies and economic conditions across the language border which may influence financial literacy but are not caused by the treatment. Our data allows us to control for a wide range of indicators which capture differences in socioeconomic conditions between the two language groups. As discussed in section 1.3.4, our sample displays significant differences in these observables across language groups for several observed characteristics at the student-level and household-level (Appendix 1.A2a) and municipal-level (Appendix 1.A3). However, many of these variables may be endogenous to our treatment (Rosenbaum (1984), Huber (2015)). Specifically, observed differences in education levels, income, wealth or economic activity between the two language groups may simply reflect the influence of culture.

Given the potential for endogenous confounders at the student-level, household-level

[30] The parental language for Swiss students is highly correlated with the school's language. Only 4 students in the sample attend French-speaking schools while they speak to their parents predominantly in German (And 14 students attending German-speaking schools vice versa). 31% of students from German-speaking schools state that they speak sometimes or often in French to their parents (6% of students at French-speaking schools sometimes or often speak in German to their parents). The exposure to both cultural groups leads to a downward bias of our estimate.

and municipal level we perform our empirical analysis with two main specifications. In a first specification, control variables are limited to student-level variables which we consider to be less prone to the influence of culture (age, gender and citizenship). In a second specification, we include student-level (school-level, religion), household-level (own room, rent home, holidays) and municipal-level controls (urban location) which are potentially influenced by culture. We acknowledge that our basic and extended controls do not account for all potential confounders, e.g. unobserved differences in student (or parent) preferences. However, we again note that systematic differences in preferences (or beliefs and norms) across the two language groups may actually be the outcome of differences in culture and thus again endogenous to our treatment.

Finally, a bias may arise from measurement error related to the language region. Many qualitative questions ask the students to assess how often they perform an action or how strongly they agree to a particular statement. These are relative measures and the choice could be influenced by the reference point determined by the social environment. This may potentially cause a downward bias of our estimate. Importantly, as documented in section 1.3.1. reference dependent answers may also influence the variation in one of our financial literacy measures; our subjective assessment of financial understanding. For this reason we choose to use the objective financial literacy score *FL-Score* as our main outcome variable. We replicate our main analyses with the subjective measure *Fin-Understanding*.

1.4.2 Results

Table 1.2 presents results of our baseline OLS regressions relating school language to financial literacy. Estimates for the financial literacy score (*FL-Score)* are presented in columns (1-3), while estimates for self-assessed financial understanding (*Fin-Understanding)* are presented in columns (4-6). Columns (1, 4) display the difference in mean, columns (2, 5) include our basic student-level controls, while columns (3, 6) add our extended student-level, household-level and municipal-level controls. The column (2-3) results show that French-speaking students obtained 0.9 to 1.1 point less on the financial literacy score. This corresponds to roughly one-fifth of the full-sample mean. The column (5-6) results show that French-speaking students also score 0.5 points lower on self-assessed financial understanding which again corresponds to almost one-fifth of the total sample mean. Our

multivariate estimates are only slightly lower than the univariate difference reported in columns (1,4). Moreover, the choice of control variables does not strongly influence our point estimates. Thus, even though there are considerable differences in observable characteristics at the student-level, household-level and municipal-level, they hardly account for the observed differences in financial literacy between students of the two language regions.

Several robustness tests confirm our baseline results. In Appendix 4 we define our treatment variable as the majority language of the municipality in which the student lives (rather than the school language). In Appendix 5 we replicate our analysis, using a semi-parametric propensity score matching estimation. In Appendix 6 we add further household-level controls (parental education) and municipal-level controls (structure of economic activity, presence of bank branches). In Appendix 6 we also show that our estimates are robust across subsamples of students with different levels of parental education.

The subsample analysis by citizenship in Table 1.3 (columns 1-2) documents that there is considerable heterogeneity in the effect of language group on financial literacy between Swiss nationals and students with an immigrant background. We find a large and statistically significant treatment effect among Swiss nationals. By comparison, among immigrants the magnitude of the estimated effect is substantially smaller and not significant.

The subsample analysis based on citizenship as well as the language a student speaks with her parents (columns 3-5) reveals that the treatment effect is strongest among monolingual Swiss students. Bilingual Swiss students, i.e. students that speak both French and German at home, display a much smaller and statistically insignificant treatment effect. The subsample of students with *Foreign languages* refers to students that speak languages other than French or German with their parents. Hereby, the group contains only students that speak foreign languages that are observed on both sides of the language border. The estimated treatment effect is again much smaller for this group of students than for monolingual Swiss students. Together these findings suggest that the observed difference in financial literacy are rooted in a historical cultural divide between the two language groups.

Table 1.2: Language group and financial literacy

Dependent variable:	FL-Score (1)	FL-Score (2)	FL-Score (3)	Fin-Understanding (4)	Fin-Understanding (5)	Fin-Understanding (6)
French	-1.252***	-0.904**	-1.140***	-0.556***	-0.512***	-0.515***
	(0.435)	(0.428)	(0.214)	(0.115)	(0.135)	(0.137)
Constant	6.197***	5.057***	4.775***	2.719***	2.905***	2.968***
	(0.328)	(0.380)	(0.508)	(0.079)	(0.219)	(0.324)
Sample mean	5.53	5.53	5.51	2.43	2.43	2.41
Observations	649	649	588	640	640	579
R-squared	0.066	0.126	0.357	0.041	0.087	0.108
Basic controls	No	Yes	Yes	No	Yes	Yes
Extended controls	No	No	Yes	No	No	Yes

Notes: This table reports results of the OLS regression French on financial literacy. Basic control include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Due to missing values, the number of observations fluctuates across specifications.

Table 1.3: Language group and financial literacy: Subsample analyses

Dependent var:	FL-Score									
Subsample:	Swiss only	Non-Swiss	Swiss monolin-gual	Swiss bilingual	Foreign lan-guages	Female	Male	High school	Not high school	Clear majority
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
French	-1.213***	-0.690	-1.675***	-0.539	-0.739*	-1.151***	-1.144***	-1.202***	-1.058***	-1.036***
	(0.222)	(0.558)	(0.338)	(0.490)	(0.383)	(0.280)	(0.288)	(0.251)	(0.307)	(0.227)
Constant	4.392***	5.248***	6.205***	2.673***	4.367***	3.752***	5.535***	6.399***	4.596***	4.861***
	(0.628)	(0.786)	(1.030)	(0.759)	(0.723)	(0.634)	(0.945)	(0.951)	(0.591)	(0.680)
Subsample mean	5.835	4.536	6.029	5.845	4.859	5.135	5.884	6.753	4.859	5.727
Obs	455	133	244	106	174	282	306	206	382	382
R-squared	0.371	0.167	0.371	0.574	0.357	0.354	0.367	0.277	0.271	0.318
P-value interaction	0.233			0.078*	0.033**	0.997		0.248		
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table shows OLS estimates of the French dummy variable for subsamples. Columns (1) - (2) show estimates for subsamples by citizenship. Columns (3) - (5) display results for subsamples based on the language students speak with their parents. Swiss monolingual contains Swiss students who speak only the school language with their parents. Swiss bilingual contains Swiss students who speak French and German with their parents. Foreign languages contain students who speak at least sometimes a language to their parents that is not native in the canton of Fribourg. The group contains only languages that are spoken in the sample on both sides of the language border. It contains students speaking with their parents in Albanian, Dutch, Hungarian, Italian, languages from former-Yugoslavia, Portuguese, Spanish, standard German, Thai , Turkish and Kurdish. Columns (6) - (7) show estimates for subsamples by gender. Columns (8) - (9) display estimates for subsamples by the planned education. (8) contains students planning a high school degree, (9) contains students planning an apprenticeship or another school (not high school). Clear majority (10) refers to students from municipalities with less than 20% or more than 80% French-speakers. The p-value of the interaction term refers to the statistical significance of the interaction of the subsample variable with French. Swiss bilingual and Foreign languages are both compared to Swiss monolingual students and the p-value indicates whether estimates for French are statistically different compared to monolingual students. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level.

Subsample comparisons by gender (columns 6-7) show similar treatment effects in both subsamples. We further split the sample according to whether students plan to start an apprenticeship after secondary school or whether they plan to go to high school (columns 8-9). Again, we find similar treatment effects in both subsamples for the financial literacy score. This suggests that the observed differences in financial literacy across the language groups is unlikely to be driven by differences in required financial skills for anticipated future career paths.

As several of our financial literacy questions require mathematical calculations the observed difference in the financial literacy score could be related to differences in the math skills between the two language groups. Our Table 1.4 (Panel A) results suggest, however, that this is not the case. We group our financial literacy questions by their "math intensity" and document significant language group differences in the number of correct responses for questions with high, low and medium math intensity. To do so we first relate correct answers for each question in a within class regression to the math grade of students. Then we group the financial literacy questions according to the measured correlation with the math grade. Table 1.4 reports the treatment effect separately for financial literacy questions which are differentially correlated with the math grade. Considering the three questions most strongly related to the math grade the estimated treatment effect of French-speaking students is 16.7 percentage points. This corresponds to 27% of the sample mean (0.62) for these three questions. For the questions with the lowest correlation with the math grade, the estimated treatment effect is 10 percentage points, corresponding to 19% of the mean score (0.53) for these three questions. Thus, the estimated treatment effect is also strong for questions which require the understanding of concepts such as inflation or diversification and the interpretation of financial graphs rather than pure calculus.

In Table 1.4 (Panel B), we group the financial literacy questions by their context and estimate the effect of culture separately for each group. Five of the questions refer to a bank account, three refer to other financial products (stocks) and two were related to a purchase decision and budgeting. The estimated difference in financial literacy between students from German- and French-speaking schools is strongest for questions related to a bank account (32% of the mean) and weaker for questions related to stocks (11% of mean) and purchasing and budgeting (14% of mean). This finding is particularly

Table 1.4: Language group and financial literacy: Subgroups of financial literacy questions

Panel A: Math skills	Most math	Medium math	Least math
	(1)	(2)	(3)
French	-0.167***	-0.084***	-0.100***
	(0.030)	(0.025)	(0.030)
Constant	0.584***	0.386***	0.493***
	(0.063)	(0.071)	(0.059)
Mean	0.62	0.51	0.53
Observations	588	588	588
R-squared	0.315	0.210	0.190
Basic controls	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes

Panel B: Context	Bank account related	Stock related	Other
	(4)	(5)	(6)
French	-0.154***	-0.070**	-0.082**
	(0.025)	(0.033)	(0.031)
Constant	0.551***	0.508***	0.248***
	(0.066)	(0.064)	(0.067)
Mean	0.284	0.329	0.37
Observations	588	588	588
R-squared	0.282	0.163	0.233
Basic controls	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes

Notes: This table reports results of the OLS regression French on financial literacy questions grouped by how answers are correlated with a higher math grade (Panel A) and the context of the question (Panel B). All outcome variables are all normalized to [0,1] to enable the comparison of the magnitude of the treatment effects. For Panel A we run a linear regression on a dummy variable indicating a correct answer on the math grade using class fixed effects and the basic and extended controls. The groups are then formed based on the magnitude of the coefficient of the math grade variable. Most math is the share of correctly answered questions 2.1, 2.3 and 2.6b). Medium math is the share of correctly answered questions 2.2, 2.4, 2.5b) and 2.6a). Least math is the share of correctly answered questions 2.5a), 2.7 and 2.8. For Panel B Bank account related questions are 2.1, 2.2, 2.5a), 2.5b) and 2.7. 2.6a), 2.6b), while questions 2.8 are asked in the context of stocks and questions 2.3 and 2.4 are classified as other questions. All outcome variables are normalized to a range of 0 to 1. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level.

interesting since we show in the following section that the observed cultural difference in financial literacy is mainly mediated by differences in financial socialisation, i.e. the age at which the subjects receive pocket money and have access to a bank account.

Is the observed difference in financial literacy across the language border specific to financial topics - or does it simply mirror differences in general cognitive ability across the two cultural groups? Unfortunately, our survey does not include measures of the general cognitive ability of students. Moreover, no results of a standardized student test are available across the language border within the Canton of Fribourg. However, the PISA 2012 study, a standardized test by the OECD conducted worldwide, was conducted for the French-speaking region of the canton of Fribourg. Hereby, students from French-speaking municipalities in the canton of Fribourg performed significantly better than the Swiss average (French- and German-speaking) in all tested subjects (reading, math and science).[31] Over all students in Switzerland for which data is available, students from the German-speaking region performed better in math and science questions of the test compared to students from the French-speaking region of Switzerland. No statistical difference exists in reading. However, it is important to note that observed regional differences are small, compared to the difference in financial literacy observed in our sample. The difference in the average PISA math score between the French-speaking and the German-speaking region is 11 points (German-speaking: 534, French-speaking: 523) representing 2% of the sample mean. Thus, the observed cultural differences in financial literacy in our sample seem to far exceed observed differences in general cognitive ability among a similar student population.

1.5 Explaining cultural differences in financial literacy

In this section we examine to what extent the observed differences in financial literacy across the language groups can be explained by systematic differences in time and

[31] Students from French-speaking municipalities in the canton of Fribourg scored 520 points (Swiss average: 507) in reading, 550 points (531) in math and 518 points (513) in science. The PISA 2012 test covered both language groups in the bilingual cantons Valais and Bern. In the canton of Valais, students from French-speaking schools performed better than students attending German-speaking schools in all three subjects. In the canton of Bern, students from German-speaking schools performed better than students from French-speaking schools in all three subjects. The PISA 2012 test results for Swiss cantons are available on http://pisa.educa.ch/de/pisa-2012-0.

risk preferences, financial socialisation, norms or money attitudes. We disentangle the previously estimated average treatment effect of culture on financial literacy into a direct effect and an indirect effect, going through the above mentioned mediators.

1.5.1 Methodology

Our analysis aims to identify the mediation effect of different potential mediators (see e.g. Baron and Kenny (1986), Pearl (2001), and Imai et al. (2011) for a detailed discussion of the methodology). In addition to the outcome Y_i and the treatment T_i we observe the value of the mediator M_i for student *i*. $M_i(1)$ denotes the potential mediator value for treated students while $M_i(0)$ denotes the potential mediator value in case of non-treatment. $Y_i(t,m)$ denotes the potential outcome under treatment status t and mediator value m. We can now define the direct effect and the mediation effect (defined as ACME: Average Causal Mediation Effect).

$$\text{Direct effect} = E[Y(1, M(t)) - Y(0, M(t))]$$
$$ACME = E[Y(t, M(1)) - Y(t, M(0))]$$

The direct effect is based on the idea of exogenously varying the treatment - the exposure to a language region - under fixed values for the mediator variable. For the ideal estimation of the ACME, an exogenous variation in the mediating variable is required while the treatment status is kept constant. In our setting, it would for example require an exogenous change in economic preferences of students that remain in their language region.

The sum of the two effects equals to the previously observed ATE or the total effect.

$$ATE = \text{Total effect} = \text{Direct effect} + ACME = Y_i(1, M_i(1)) - Y_i(0, M_i(0))$$

We are able to estimate the average causal mediation effect assuming sequential ignorability (Imai et al., 2010). The first component of sequential ignorability requires an unbiased estimation of ATE for Y and for M (as previously discussed in 4.1). The second

underlying assumption requires that:

$$Y_i(t, m) \perp\!\!\!\perp M_i \mid T_i = t, X_i = x$$

Any factor mutually influencing Y and M may bias our result. Since mediators potentially influence other mediators, this might be a source of bias. We apply the methodology suggested by Imai and Yamamoto (2013) to control for other mediators that could potentially influence the mediator of interest and the outcome Y in a robustness check (Appendix 7).[32]

In order to distinguish between a direct and a mediation effect, we estimate the following two linear regressions:

$$M_i = \alpha_2 + \beta_2 T_i + \varrho_2 X_i + \epsilon_{i2}$$
$$Y_i = \alpha_3 + \beta_3 T_i + \gamma M_i + \varrho_3 X_i + \epsilon_{i3}$$

The mediation effect is defined as ACME = β_2 x γ while the Direct effect = β_3.

1.5.2 Results

By construction, a strong mediator needs to be highly correlated with the outcome variable (financial literacy) and needs to vary significantly with the treatment (language group). Table 1.5 shows that all potential mediators are significantly correlated with financial literacy in a simple pairwise correlation test. Students who are less risk seeking and more patient have a higher financial literacy score. Financial socialisation, debt norms and money attitudes are also strongly correlated with the financial literacy score. Considering the magnitude of the pairwise correlations we find that *Patience* and *Financial socialisation* have the highest correlation with the financial literacy score. These two variables are also the two mediators most significantly correlated with our self-assessed measure of financial understanding.

[32] The underlying assumptions that allow to establish causality of the mediation effect are very strong, not testable and nearly impossible to fully meet in a setting without controlled variation of mediators (see Green et al. (2010)) for a critical analysis of the methodology). While we cannot rule out a potential bias of estimated mediation effects, the approach provides a structured analysis of potential channels of the treatment effect.

Table 1.5: Pairwise correlations of outcome variables and mediators

	FL-Score	Fin-Understanding
FL-Score	1.00	
Fin-Understanding	0.33***	1.00
Risk seeking	-0.1**	-0.02
Patience	0.27***	0.21***
Financial socialisation	0.23***	0.15***
Debt norms	0.1**	0.09**
Freedom & control	-0.08**	0.03
Social prestige	-0.18***	-0.07*

Notes: This table reports pairwise correlations. ***, **, * denote significance of the correlation coefficient at the 0.01, 0.05 and 0.10-level.

Table 1.6 presents the estimated differences in preferences, financial socialisation, norms and money attitudes between the two language groups estimated in a linear model. Our estimates reveal only small differences in relevant economic preferences between the language groups. Students at French-speaking schools are slightly more willing to take risks. By contrast our estimates do not yield significant differences for *Patience*. In line with the linguistic-savings hypothesis (Chen (2013), Sutter et al. (2018)) report significant differences in time preferences among students of a bilingual town in Sothern Tirol. There, German-speaking students are reported to be significantly more patient. Our findings, by contrast, do not support the linguistic-savings hypothesis.

Students at French-speaking schools obtain on average a by 0.14 lower value in *Financial socialisation*, which corresponds to one-fourth of the mean in the full sample. Students at French-speaking schools also report a significantly lower value for *Debt norms*, indicating that their parents less often discourage them from taking on debt. This point estimate corresponds to one-seventh of the mean in the full sample. Further, students at French-speaking schools report money as more important in attitude questions assessing the *Freedom & control* component. The estimated effect of 0.22 corresponds to 46% of the mean in the full sample. We do not observe any significant difference in money attitudes related to social prestige. Combining the results from Tables 1.5 and 1.6, we would expect that the strongest mediator of culture on financial literacy is financial socialisation. This mediator is both strongly correlated with financial literacy and differs significantly across the language groups.

In Table 1.7 we present the results of our formal mediation analysis. The table reports

for the outcome variable *FL-Score* and our six mediators of culture the average causal mediation effect (ACME) and the direct effect as well as the proportion of the estimated total effect that is mediated. In line with our findings from Tables 1.5 and 1.6, we find that *Financial socialisation* is the only statistically significant mediator of cultural group membership on financial literacy. For our objective measure of financial literacy, financial socialisation can account for 12% of the observed difference in financial literacy between the language groups.

The mediation analysis presented above may suffer from a potential violation of the sequential ignorability assumption since it implicitly assumes that the multiple mediators are causally independent of another. We apply the methodology suggested by Imai and Yamamoto (2013) to control for potential causal effects between mediators. Results from this analysis (Appendix 7) confirm the results presented in Table 1.7.

Table 1.6: Language group and potential mediators

Dependent variable:	Preferences		Financial socialisation	Norms and money attitudes		
	(1) Risk seeking	(2) Patience	(3) Financial socialisation	(4) Debt norms	(5) Freedom & control	(6) Social prestige
French	0.042**	-0.013	-0.138***	-0.096**	0.219***	0.016
	(0.020)	(0.017)	(0.035)	(0.040)	(0.035)	(0.020)
Constant	0.347***	0.649***	0.570***	0.751***	0.428***	0.137**
	(0.051)	(0.047)	(0.084)	(0.098)	(0.090)	(0.051)
Mean	0.41	0.67	0.52	0.67	0.48	0.12
Observations	528	535	546	570	583	580
R-squared	0.049	0.143	0.122	0.061	0.147	0.064
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports results of the OLS regression French on preferences, financial socialisation and money attitudes. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 1.7: Mediation analysis

Dependent variable: FL-Score	Preferences		Financial socialisation	Norms and money attitudes		
	(1) Risk seeking	(2) Patience	(3) Financial socialisation	(4) Debt norms	(5) Freedom & control	(6) Social prestige
ACME	0.00	-0.02	-0.12***	-0.03	-0.01	-0.02
	(0.93)	(0.5)	(0)	(0.29)	(0.81)	(0.25)
Direct effect	-1.03***	-1.01***	-0.89***	-0.99***	-1.01***	-1.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total effect	-1.02***	-1.02***	-1.02***	-1.02***	-1.03***	-1.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prop. mediated	0.00	0.01	0.12***	0.02	0.02	0.02
	(0.93)	(0.5)	(0)	(0.29)	(0.81)	(0.25)
Obs	461	461	461	461	461	461
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports results of the mediation analysis. The R package mediation (Tingley et al. 2014) was used to implement the analysis. ACME is the average causal mediation effect capturing the mediation effect of a particular mediation channel. The proportion mediated is defined as ACME/Total effect. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level.

Cultural differences in financial literacy may be transmitted from one generation to another (vertical transmission) as well as via peers (horizontal transmission) (see for example Bisin and Verdier (2001)). Our analysis does not allow us to identify the relative importance of vertical as opposed to horizontal transmission. Specifically, our measure of *Financial socialisation* is related to actions of the students' parents; i.e. giving their children pocket money and access to a bank account. However, we do not know whether parents give their children pocket money (or set up a bank account) because they themselves received pocket money at an early age (intergenerational transfer). Alternatively, parents may give their children pocket money because all other children in their neighbourhood (or at school) receive pocket money (peer effects). Thus, while our mediation analysis does allow us to identify financial socialisation as an important driver of cultural differences in financial literacy, we remain silent on the role of parents and peers in this process.

1.6 Discussion

This paper studies to what extent and through which channels culture influences financial literacy among the youth. We employ survey data for 15-year old secondary school students located in a narrow geographic region along the German-French language border within the Swiss canton of Fribourg.

We find that students from the German-speaking area are more financially literate as revealed by their responses to a standard set of financial literacy questions as well as by their own subjective assessment. The difference mainly exists for native students from monolingual families that are arguably most strongly influenced by local culture. A mediation analysis suggests that financial socialisation is a significant driver of the cultural divide in financial literacy. Systematic variation in the age at which children receive pocket money and whether they have their own bank account is the predominant mediator through which culture translates into financial literacy in our context.

Our empirical setting at a within-country language border ensures that both cultural groups are exposed to very similar institutions, policies and economic conditions. Nevertheless, we do observe significant differences in relevant household-level and municipal-level characteristics across the language border. Our analysis shows that our estimates

are robust to model specifications which include varying sets of household-level and municipal-level controls. Nevertheless, there remains a concern that households and their socioeconomic environments may also differ in unobservable characteristics which could potentially bias our estimates. That said, many unobservable differences in socioeconomic conditions across the language border may be endogenous to culture - i.e. systematic differences in preferences, beliefs and norms between the two language groups.

Our analysis provides a case-study of how cultural differences – i.e. systematic differences in preferences, beliefs or norms across distinct social groups – can impact on financial knowledge and skills. Further research in our empirical setting suggests that the observed differences in financial literacy among the youth are consistent with differences in saving and consumption behaviour among the youth (see chapter 2) and adults (Guin, 2017) as well as with indebtedness among young adults (Henchoz et al., 2017). Our results do not imply that in all contexts different cultural backgrounds will translate into significant differences in economic literacy or behaviour. However, they do support previous findings which suggest that the cultural background of consumers may strongly impact on their economic decision making under very similar economic institutions and conditions.

Financial literacy has gathered considerable attention among policy makers in recent years. Substantial investments in financial education initiatives have been made by the public and private sector with many countries implementing financial education initiatives on a countrywide scale, e.g. in public schools. The findings of our study are especially relevant for designing more effective programs in countries with a culturally diverse population, e.g. due to a large immigrant population or historical language and religious borders. Our results suggest that in such contexts policy makers should carefully assess the initial levels of knowledge among their target population before they administer financial education initiatives. In our context, for example, teachers in secondary school should be aware that the familiarity of students with basic financial products varies significantly due to differences in financial their socialisation. In other contexts the relevant differences in initial financial literacy levels may lie elsewhere.

Chapter 2

Culture, Saving and Consumption: Evidence from the Youth

Thomas Spycher

Abstract

This paper studies the influence of culture on consumption and savings behavior among the youth exploiting the French-German language border within Switzerland. The language border separates two social groups with different cultural background within a narrow geographical region and a common institutional setting. I find that French-speaking students save less and regret their purchases more frequently compared to German-speaking students. I study the underlying channels through which cultural group membership translates into a difference in consumption and savings. Analyzing six measures of norms and preferences suggests that the treatment effect from cultural group membership transmits through social norms captured by money attitudes rather than through differences in time and risk preferences.

2.1 Introduction

The intertemporal allocation of consumption is a key factor on the household level but also in the aggregate. Cross-country statistics and within-country datasets display substantial variation in household savings rates.[1] Empirical evidence points towards a strong intergenerational correlation of financial behavior, partially driven by the genetic disposition (Cronqvist and Siegel, 2015), but also through nurture (Fagereng et al. (2015); Kreiner et al. (2016); Black et al. (2017)). While a rich literature documents the influence of culture on judgment and decision making (Weber and Morris, 2010) less is known about a potential influence of cultural group membership on intertemporal consumption and especially through which channels an influence may occur.

This paper analyzes the effect of cultural group membership on saving and consumption among the youth. Following Guiso et al. (2006), culture is defined as the set of beliefs, norms and preferences that are shared among the members of a social group and transmit fairly unchanged from one generation to the next. The study exploits the unique setting at the French-German language border in Switzerland which is ideal to study questions related to culture. First, the language border allows cultural differences in preferences, norms and attitudes to coexist over time within a small geographic area.[2] The objective of the paper is not to study the effect of language per se but the broader influence of cultural heterogeneity. Second, the language border runs through cantons, the first administrative division of Switzerland. Laws and policies are mainly set either at the federal or cantonal level and there is no change in policies or institutions at the language border within cantons. This setting allows to mitigate the two-way interaction between culture and institutions (Alesina and Giuliano, 2015) as a homogeneous set of institutions is applied to both groups independent of their respective culture. Further, the language border does not coincide with any geographic barriers and the transport system is fully integrated across the language border.

The analysis is based on survey responses of 649 15-year-old students residing in a

[1] For example a comparison of households' savings rates in the Euro area in 2013 shows rates between 8% (Finland) and 18% (Germany) (Rodriguez-Palenzuela and Dees, 2016). **??** document in a meta analysis substantial cross-crountry differences in the elasticity of intertemporal substitution.

[2] Results on municipality level from numerous referenda reveal strong differences at the language border. There is for example a clear cut in support for work-time regulations (Eugster et al., 2017) and left-of-centre referenda (Eugster and Parchet, 2018).

narrow band (less than 10 km) along the language border within the canton of Fribourg.[3] The survey captures several measures of intertemporal consumption such as savings decisions and consumption regret. It further elicits available financial resources, consumption behavior, measures of economic preferences, financial socialization, norms, money attitudes and socio-economic background. This sample of 15-year-olds provides two major advantages. First, the students have been strongly exposed to cultural influences in their parental home and peer groups. Second, up to the age of 15, all students were subject to mandatory education. Thus, saving and consumption is less influenced by endogenous educational and labor market choices. This is also a relevant sample since two-thirds of the students will enter the labor market and pursue an apprenticeship 8 months after the survey was conducted. This step will provide them with a first salary as well as require them to take first important financial decisions.

I document substantial differences between French-speaking and German-speaking students in savings and consumption behavior. German-speaking students save 9.3 percentage points (17.5 percent of the sample mean) more of their available monthly funds than French-speaking students. This difference is strongly influenced by students who do not save any funds (8% among German-speaking students, 22% among French-speaking students). Moreover, one third of French-speaking students reports that they often or occasionally regret a purchase the day after, twice the frequency among German-speaking students. All results are robust to a broad set of control variables including student characteristics, available financial resources and parental background. No differences are observed for questions capturing the purchase of specific goods (sweets, alcohol, cigarettes, magazines, music) or the frequency of online purchases. This finding suggests that consumption behavior differs for decisions related to intertemporal choice but that there is no difference in general consumption behavior.

I show that the difference in savings and consumption regret only exists for monolingual students. No statistically significant difference is observed among bilingual students who were exposed to both cultures in their families and among students with a recent immigration history. These findings support the hypothesis that observed differences are driven by cultural group membership rather than by differences in economic conditions or by the school.

[3]The dataset was collected for a larger research project on the influence of culture on financial decision making. In a related paper, Brown et al. (2018) study the influence of culture on financial literacy.

In a second step, I examine potential transmission mechanisms of culture. Based on literature in economics and consumer psychology, I analyze six channels: risk preferences, time preferences, financial socialization, debt norms, money attitudes related to freedom and control and money attitudes related to social prestige.

Results suggest that the treatment effect on *Saving* is most strongly transmitted through the channel of money attitudes. This measure which is based on studies in the psychology and consumer behavior literature captures to what degree individuals associate having money with accomplishing goals and living a free life. Also for the variable *Consumption regret* money attitudes explain the largest share of the treatment effect. Overall, the observed channels explain 51% (*Saving*) and 36% (*Consumption regret*) of the observed treatment effect. Thus, money attitudes rather than time preferences as suggested by the linguistic savings hypothesis (Chen (2013), Roberts et al. (2015)) appear to be the strongest channel of the treatment effect.

This paper is related to the growing literature on the role of culture in intertemporal choice. Several studies compare savings and consumption behavior and underlying drivers across countries, between the native and immigrant population or between immigrants from heterogeneous background to show behavioral differences driven by culture: Chen et al. (2005) provide evidence for differences in consumer impatience between Western and Eastern consumers. Christelis et al. (2013) find notable cross-country differences in households' asset allocation. Using survey information from 76 countries, Dohmen et al. (2015) show that observed cross-country differences in saving rates are associated with differences in time preferences. Exploiting differences in the cultural origins of immigrants to Canada and the U.S., Carroll et al. (1994) argue that culture has little impact on household savings. More recently, Haliassos et al. (2016) document substantial cultural differences in the financial behavior of immigrants to Sweden, but also how exposure to Swedish institutions leads to an assimilation to Swedish behavior. Fuchs-Schündeln et al. (2017) document differences in savings behavior among second generation migrants in Germany and in the UK related to their cultural background. While cross-country studies are not able to disentangle the two-way interaction of culture and institutions, studies focusing on an immigrant population may suffer from selection issues. Closely related to this study, Guin (2017) studies household savings behavior among adults at the language border within Switzerland.

Based on the linguistic savings hypothesis, a recent strand of literature focuses on the role of language per se in shaping individuals' intertemporal choice. Chen (2013) exploits variation in future orientation of languages to document a plausibly causal relationship of language syntax and intertemporal choice. In line with the linguistic savings hypothesis, Sutter et al. (2018) provide evidence for differences in an intertemporal choice experiment between German-speaking and Italian-speaking children in a bilingual town in Northern Italy. While the linguistic savings hypothesis primarily focuses on the effect of language on time preferences, this paper defines the treatment more broadly as culture – thus a set of norms and preferences that influences economic behavior. In contrast to Sutter et al. (2018), I focus on actual savings and consumption decisions of students instead of a choice list in an experimental setting and the students are already at an age when they take first financial decisions.

The contribution of this paper is twofold: First, using the unique setting at the language border, the paper documents substantial cultural differences in saving and consumption already among 15-year-olds. The setting allows for a narrow identification of the effect in comparison to studies focusing on immigrant populations. Second, the data allow to study potential channels through which culture influences intertemporal consumption. An analysis of the underlying channels suggests that the observed effect on financial behavior transmits through attitudes and not through time preferences as predicted by the linguistic savings hypothesis.

The rest of the paper proceeds as follows: Section 2.2 presents a stylized two-period model to pin down potential mechanisms of cultural transmission. Section 2.3 describes the institutional setting and the data collection. Section 2.4 introduces the survey and the dataset. Section 2.5 discusses the empirical strategy. Section 2.6 presents results. Section 2.7 analyses potential channels of the treatment effect. Section 2.8 discusses the general consumption behavior and section 2.9 concludes.

2.2 Theoretical motivation

In this section, I use a stylized two-period model to pin down potential channels through which culture may influence consumption behavior in my sample. The intertemporal choice of adolescents and adults differs in three main aspects: First, the range

of goods that are purchased is clearly more narrow but at the same time, adolescents have a high discretion of their spending since fix costs are covered by parents. Second, the income stream contains mainly the unconditional pocket money. Third, minors are excluded from formal credit markets.[4]

The students in my model yield utility from consuming a non-durable consumption good C in each period and a durable good D only available in period 2. Thus, students face not only the trade-off between consuming in the first or the second period as it is the case in a standard intertemporal choice model, but the second period also comes with an additional consumption option. While the general consumption C covers a bundle of repeated expenses (e.g. food and drinks, magazines, iTunes etc.), D may cover a larger purchase (e.g. shoes, electronic device).

I assume an isoelastic utility function where θ determines the curvature of the utility function and governs the intertemporal elasticity of substitution.[5] Utility obtained in period 2 is the sum of utilities obtained from consuming the two goods. Z is a factor that determines the relative utility obtained from non-durable consumption versus the purchase of a durable good. Consumption in the second period is discounted by β. Each student receives in each period financial resources w unconditionally (e.g. pocket money). I abstract from the possibility to receive gifts or obtain labor income. Prices for the two goods are fixed over both periods, p represents the relative price of the two goods $p = \frac{p_D}{p_C}$ and for simplicity $p_C = 1$.

I assume that individuals in my sample are credit constrained and can only have positive savings ($s_1 \leq 0$). No interest occurs on savings s_1.

Students maximize utility under the following constraints:

$$max[U(C_1) + \beta U(C_2, D)]$$
$$s.t.\ C_1 = w - s_1; s_1 \geq 0$$
$$and\ C_2 + Dp = w + s_1$$

[4]Informal credit within the family may exist.

[5]I assume CRRA preferences. Even in a setting without risk and a constant discount factor, differences in the intertemporal elasticity of substitution, the inverse of the risk aversion coefficient, affect intertemporal choice (Andersen et al., 2008).

From the maximization problem the following consumption trade-offs evolve:[6]

$$C_1^* = \frac{1}{\beta^{\frac{1}{\theta}}} C_2^*$$
$$D^* = \left(\frac{Z}{p}\right)^{\frac{1}{\theta}} C_2^*$$

Through which channels could culture influence the share of financial resources saved $\frac{s_1}{w}$ in the sample? Based on the consumption trade-offs above, the share saved can be expressed as a function $\frac{s_1}{w} = f(\beta, Z, p, \theta)$ that is independent of wealth. The relative price p is assumed to be equal across the language border given the narrow geographical region of the students' locations. In this simple model, differences in intertemporal consumption can emerge from a difference in:

1. Discount factor β
2. Intertemporal elasticity of substitution $\frac{1}{\theta}$
3. Relative utility for the two goods represented by Z

The share saved does increase with a stronger preference for the durable good D (increase in Z), with a higher β and with a lower value of θ. In terms of economic interpretation the three parameter have a different influence: While β governs consumption between the two periods, Z governs the consumption between consumption goods. Since consumption of the durable good only occurs in period 2, Z also affects the savings rate. θ sets the curvature of the utility function and therefore the path of decreasing marginal utility, which governs consumption between C_1, C_2 and D.

The stylized model provides first insights into channels of culture on saving and consumption. It does not incorporate present bias or risk, which could influence the savings behavior but especially also the measure of consumption regret.[7]

[6] See Appendix B for the derivation.

[7] The regret of consumption in a later period is often used as a proxy of present bias (e.g. Parker (2017)).

2.3 Institutional setting and sample selection

2.3.1 Institutional setting

Culture and language are closely associated and a common language can influence a person's identity (Clots-Figueras and Masella, 2013) as well as the feeling of belonging to a group. Both shape norms and values which influence individuals' behavior. A language border, an abrupt change in the main language spoken, allows for the historical persistence of differences in norms and values of two social groups within a small geographic area since social interaction is hampered. While recent studies (Chen (2013) and Sutter et al. (2018)) exploit the bilingual setting to identify the explicit role language plays in shaping intertemporal choice, this paper uses the language border as a proxy for cultural group membership and therefore exploits the historically persistent change in norms and values within a given institutional setting.[8]

Switzerland has four official languages: German, French, Italian and Rhaeto-Romanic.[9] Figure 2.1 displays the geographical distribution of German and Romance languages (French, Italian, and Rhaeto-Romanic) in Switzerland on municipal level. The French-German language border represents a sharp cut in the North-South direction running between municipalities. While most Swiss cantons are unilingual, the language border splits four cantons (Berne, Fribourg and Valais at the French-German language border and the trilingual Grisons in the East) into two (or three) language regions. The language shares on country and on cantonal level have remained stable since the modern foundation of Switzerland as a federal state in 1848.[10] This suggests that only few households migrate across the language border.[11]

Large parts of the French-German language border do not feature a geographical barrier or a major administrative border. The language border runs through cantons, the first administrative subdivision of Switzerland. Since most policies are either set at

[8] German is a weak-FTR language and French is a strong-FTR language. The linguistic savings hypothesis would therefore predict German-speakers to save more than French-speakers.

[9] The Swiss Federal Statistics Office (FSO) reports in 2015 the following main language shares: German 63.3%, French 22.7%, 8.1% Italian and 0.5% Rhaeto-Romanic (6.8% declared other languages as their main language).

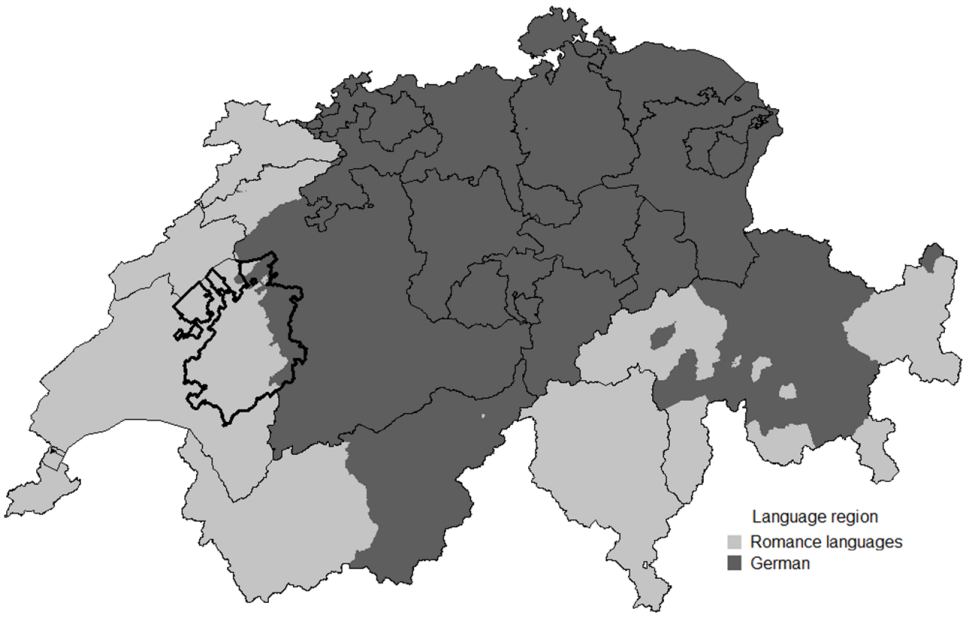
[10] See Eugster et al. (2011) and Eugster et al. (2017) for a more detailed discussion of the historical persistence of the language border. The FSO reports for 1910 the following language shares: 69.1% German, 21.1% French, 8.1% Italian, 1.1% Rhaeto-Romanic and 0.6% other languages.

[11] Eugster and Parchet (2018) provide descriptive evidence for moving behavior in the French-German bilingual cantons Berne, Fribourg and Valais. 60% of households that move stay within 20km of their initial domicile.

the national or cantonal level, there is little change in major policies and institutions at the language border and the setting allows to mitigate the two-way interaction of culture and institutions (Alesina and Giuliano, 2015) as a homogeneous set of policies is applied to both language groups in a canton.[12] A potential endogeneity of the institutional setting could, however, emerge from the implementation of policies. Local teachers can for example influence the teaching of the school curriculum.

Figure 2.1: Language regions in Switzerland

Dark-grey areas indicate a majority of German language speakers on municipal level. Light-shaded areas indicate municipalities with a majority speaking a Romance language (French in the West, Italian in the South and Romansh in the East). Dark lines indicate cantonal borders. The canton of Fribourg is specially highlighted using an increased line width. Source: swisstopo and Federal Statistical Office (FSO).



This unique setting has been exploited to address various research questions related to culture and economic behavior. Eugster et al. (2011) find a persistent difference in demand for social insurance. Eugster et al. (2017) analyze changes in work attitudes and unemployment durations at the language border. Steinhauer (2013) studies the influence of culture on fertility and female labor force participation. Rustagi and Veronesi (2017) exploit the setting to study the role of historical experience of democracy in shaping norms of reciprocity. Related to this study, Guin (2017) studies savings rates among households living around the language border.

[12]Municipality tax rates are one exception. Municipalities set their municipal tax rate as share of the cantonal tax rate (as for example discussed in detail in Eugster and Parchet (2018))

This paper differs in terms of the sample in two dimensions from previously mentioned studies. First, the dataset used for this analysis contains only individuals living very close to the language border in one canton. By comparison, mentioned studies use several bilingual cantons and analyze households domiciled in a bandwidth of 30 or 50 km around the language border.

Second, this study focuses on behavior of 15-years-old adolescents while the existing evidence typically uses administrative data or household survey data for the adult population.[13] While the reported differences in labor market behavior (Eugster et al. (2011); Steinhauer (2013)) can influence intertemporal choice among the adult population it should not directly influence intertemporal choice of adolescents prior to labor market entry.

2.3.2 Sample selection and implementation

This study focuses on the language border region which runs through the bilingual canton of Fribourg. Fribourg has a francophone majority (125 municipalities with a total population of 235,769) in the west and a German-speaking minority (38 municipalities with a total population of 67,608[14]) in the east. Most municipalities have a distinct majority language and can therefore be clearly assigned to one language region. There are only few bilingual municipalities where the share of native French speakers is not below 20% or not above 80%.[15] Surveys are run in seven secondary schools located close to the French-German language border. The dataset covers students in their final year of compulsory education.[16] The students are on average 15 years old. From all secondary schools in the canton, four German-speaking schools and three French-speaking schools were selected based on the number of students, the composition by gender and school level and the schools' proximity to the language border. Figure 2.2 displays the location of the selected schools and the students' municipality of residence. The dataset was initially collected for the analysis of cultural heterogeneity in financial literacy (Brown

[13]Brown et al. (2018) use the same survey dataset to study differences in financial literacy.

[14]The number of municipalities and population information refer to December 2014; Source: Swiss Federal statistics office permanent resident population by municipality.

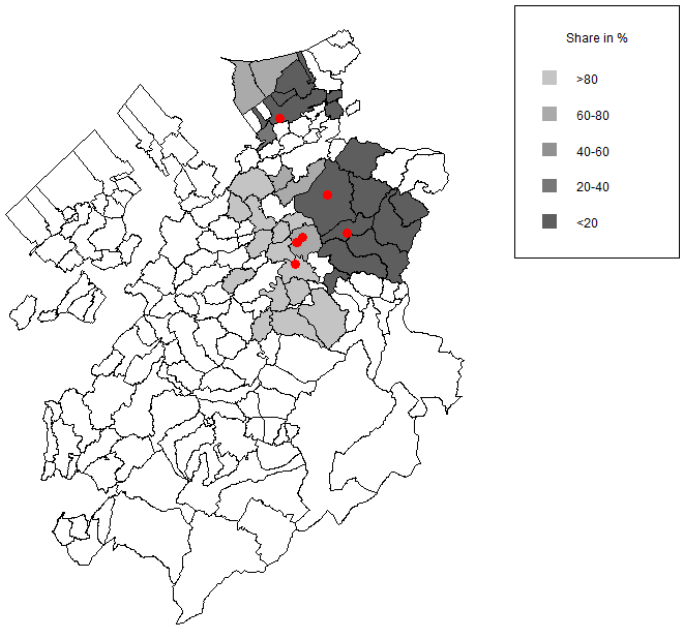
[15]One notable exception is the cantonal capital of Fribourg. For robustness, a subsample analysis in Table 2.2 focuses on municipalities with a distinct majority language.

[16]35% of students in the sample plan to continue education in high school which prepares for university education. Students not attending high school typically pursue a vocational training in a firm.

et al., 2018)[17] and the study was supported by the cantonal department of education which encouraged all selected schools to participate in the survey.

Figure 2.2: Students' home municipalities in sample

The map displays home municipalities of students in the sample and the share of French-speakers in the respective municipalities. White coloured municipalities are not in the sample. Red dots mark locations of schools. Source: swisstopo, StatA Fribourg



The public secondary school system in the canton of Fribourg features three levels, which differ by the level of difficulty of the curriculum. The aim was to survey a similar number of students for both genders on each of the three school levels for each language region. The classes were randomly selected, stratified by educational level. Overall, 786 students in 40 classes were selected for the survey. Due to non-attendance, 63 students could not be surveyed. There is no indication that non-attendance was related to the survey.[18]

The survey was conducted in November 2015 during regular school hours with paper and pen. The setting was similar to an exam situation and students were not allowed to

[17]Evidence suggests that there is a correlation between financial literacy and the quality of financial decisions among adults (e.g. van Rooij et al. (2011); von Gaudecker (2015)) and therefore this channel may influence intertemporal consumption. This is not the case in my sample. Arguably, intertemporal consumption at that age is not significantly influenced by the level of financial literacy since students are not yet subject to complex financial decisions and are not required to choose between financial products.

[18]12 students were participating in a program that allows them to retake the final year on a higher level or in a different language. These students are excluded from the sample.

communicate.[19] No reward was offered for the completion of the survey and questions were not incentivized. The order of the questions was the same for all students. On average, it took students 30 minutes, with a minimum of 20 and a maximum of 45 minutes, to complete the survey.

2.4 Survey design and dataset

The survey contains 67 questions covering consumption and saving, financial literacy, risk and time preferences, financial socialization, debt norms, money attitudes and socioeconomic background. Survey questions were chosen with respect to the suitability for this particular age group. Given the bilingual setting, the translation of survey questions received particular attention. Students on both sides of the language border should perceive and understand questions with the same meaning. In order to obtain a high quality of translation, several bilingual translators assessed the translation of the survey. Many questions originate from similar studies that were conducted in English. Some questions were first translated to German and then to French while others were first translated to French and then to German.

2.4.1 Measures of saving and consumption

As pointed out in section 2.2, the intertemporal choices of adolescents are governed by the trade-off between short-term consumption (e.g. spending for refreshments and entertainment) and saving for durable goods (e.g. clothes, electronic devices). Most students in the sample can freely allocate their available funds so that lower savings can be seen as giving in more often to non-durable goods, and in many cases temptation goods. Thus it might be a proxy for a lack of self-control.[20]

[19]The survey was conducted by the author and research assistants. They introduced the survey and replied to general questions. Instructions were always presented by a native speaker of the respective school language. During the completion of the survey no questions were answered and students were told to leave questions blank if they do not understand them. The teachers were present in the classroom but did not intervene in the process.

[20]The survey elicits which expenses students have to cover with the available funds. Appendix Figure 2.A3 displays the distribution by school language. Only 3.7% of students stated, that they have to cover cost related to school with the given amount. 18% of students have to cover transportation cost, 14% lunch, 12% clothes, 20% expenses related to the use of a mobile phone and 5% for sport activities. Statistically significant differences in the distribution exists for the expenses: Mobile phone, lunch meals, clothes and public transport. The differences are however small in magnitude.

The survey elicits information on the students' available financial resources and savings in the last month. The variable *Saving* measures the share of financial resources saved in the last month for individuals who had financial resources. Six students who reported not to receive any money through pocket money, side jobs or other sources are excluded from the analysis. Students in the dataset save on average 49% of their available resources (Appendix Table 2.A1). This high share of savings reflects the high discretion of students in handling their financial resources. The majority of students do not have to cover expenses with little discretion such as for transportation to school (see Appendix Figure 2.A2). German-speaking students saved 13 percentage points more compared to French-speaking students (56% vs. 43%, see Figure 2.3). The cumulative distribution in Appendix Figure 2.A1 for *Saving* reveals that the difference stems mainly from students that do not save any of their financial resources.[21]

The variable *Consumption regret* captures the degree to which students make time-consistent consumption choices. It reflects responses to the question: *How often do you regret a purchase the day after?* Students responded on a 4-point scale ranging from 1 (never) to 4 (often).[22] The question captures past spending which is perceived as suboptimal and is thus an indicator for impulsive consumption and self-control problems.[23] The variable may also capture risk preferences. Assuming the absence of any present bias, consumers who are taking higher risks in their consumption decisions will more often be disappointed and therefore regret the purchase. The variable *Consumption regret* is a binary variable equal to 1 if a student indicated 3 or 4. 24% of students indicate that they often or occasionally regret a purchase the day after. The share of students regretting a purchase occasionally or often is lower than the 40% reported by Parker (2017) for a representative sample of US households. Figure 2.3 displays the difference between school languages: While only 15% of German-speaking students state that they occasionally or often regret a purchase, 33% of French-speaking students do (see Appendix A1 for univariate differences).

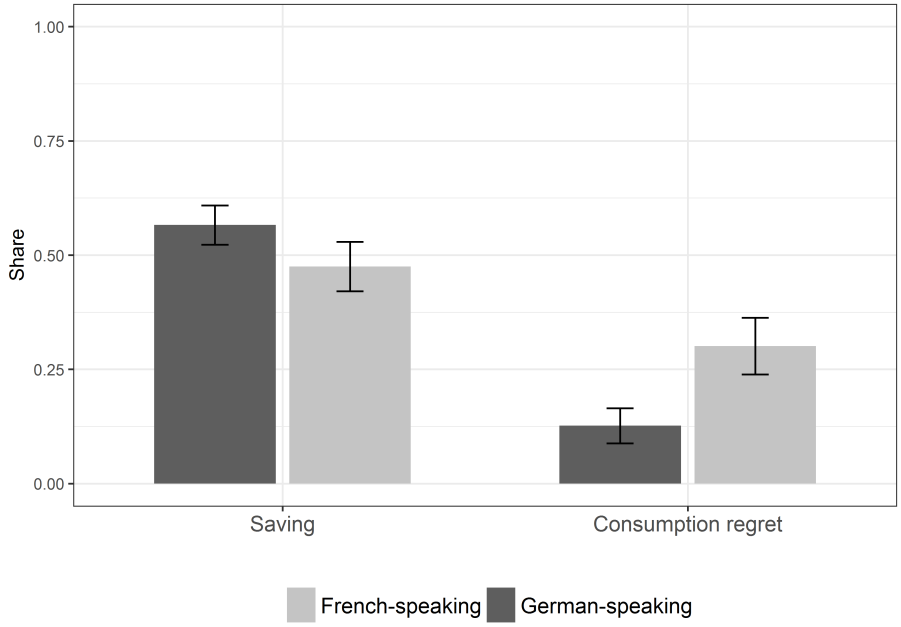
[21] 15% of students did not save at all with a higher share (22%) among students attending French-speaking schools. Erskine et al. (2006) report a comparable value (21%) for a sample of 12-24-year old adolescents in Canada.

[22] In Appendix Table 2.A9, the analysis exploits the full set of information of the question using an ordered Probit model. These estimates are comparable to baseline results.

[23] The question has been used as a proxy of self-control among adults (Parker, 2017). The dataset does not allow for a clear distinction between a Beta and a Delta measure of future discounting (Laibson, 1997a).

Figure 2.3: Difference in intertemporal consumption

The figure shows averages for the main outcome variables by school language. *Saving* indicates the share saved in the last month. *Consumption regret* refers to the share of students that stated that they occasionally or often regret a purchase the day after.



2.4.2 Potential channels

The stylized model in section 2 pointed out, that observed differences in intertemporal choice could emerge from a dissimilarity in time preferences (β), in the intertemporal elasticity of substitution captured by the risk parameter θ or the relative utility from non-durable and durable goods captured by Z. Based on literature in economics and psychology, I compare six potential channels that could mediate the treatment effect of culture by influencing economic preferences or the relative utility of goods.

Dohmen et al. (2011) provide evidence for a strong intergenerational transmission of risk and trust attitudes. Hence, cultural differences in saving and consumption could be related to systematic differences in preferences across the language groups. The survey assesses risk and time preferences of students with qualitative and quantitative questions. The two measures are combined with equal weights to yield one indicator of time preferences (*Patience*) and one indicator of risk preferences (*Risk seeking*). In theory, these variables captures differences in β and θ.

Falk et al. (2016) suggest non-incentivized survey questions for the assessment of time and risk preferences that provide the best measure compared to values obtained from in-

centivized experiments.[24] The proposed general attitude questions were employed to elicit the subjectively perceived willingness to take risks and the attitude towards allocating consumption and work between present and future. For risk preferences, students state on a 6-point scale how strongly they agree with the statements (1 (strongly disagree) to 6 (strongly agree)): *I am a person who is willing to take risks.* A binary variable is constructed that takes on value 1 if a student stated 4 or higher. For the time preference measure, three questions with a 6-point scale are employed: 1. *I rather go without something today in order to be able to afford more tomorrow.* 2. *I tend to procrastinate tasks even though it would be better to get them done immediately.* 3. *I am prepared to spend now and let the future take care of itself.* I assign the value 1 to each question if the student indicated to be more patient than the mid-category. The qualitative measure of time preferences reflects the mean over the three questions. Since the students are only 15 years old, a framework based on the design used in Sutter et al. (2018) is applied to obtain a quantitative measure of time and risk preferences. Students allocate a given amount between a future and an immediate payoff as well as between a safe and risky choice.[25] In contrast to Sutter et al. (2018), choice lists are not used, responses are elicited by a pen and paper survey, and choices are not incentivized.

The remaining four channels capture norms and attitudes that could influence preferences for durable versus non-durable consumption.

Parents play a vital role in the consumption and savings behavior of their children. Through the dissemination of norms, the teaching of financial concepts and by giving their children the opportunity to handle their own money they influence financial decisions (Webley and Nyhus (2006); Norvilitis and MacLean (2010)).[26] Otto (2013) mentions the strong relation between financial socialization and savings behavior of adolescents. The variable *Financial socialization* measures observable actions of parents in fostering financial independence of their children. The measure covers the age at which the student first received pocket money, whether a student has a bank account and whether a student

[24]The use of non-incentivized survey questions to elicit risk and time preferences could lead to different values compared to incentivized questions. This would cause a bias of the results if the difference is influenced by cultural group membership.

[25]Sutter et al. (2018) elicit time preferences with the use of a choice list. Each child made decisions in three binary decision problems where the payoff was varied. Hence, their measure of time preferences is not fully comparable to the measure used in this paper.

[26]Webley and Nyhus (2013) provide numerous examples of parental practices that provide a learning experience.

can independently access her bank account.

Norms towards saving and debt could be an important factor of how culture influences intertemporal choice.[27] The exposure of students to such norms is elicited by measuring how often they were told the following two statements by their parents: 1. *You should not spend more than what you have.* 2. *You should not have debts.* Students rated the frequency on a 6-point scale ranging from 1 (never) to 6 (very often). Each answer is transformed to a binary variable equal to 1 if students indicated values 4 – 6. The variable *Debt norms* then reflects the mean over the two answers. The indicator thus captures financial socialization as passing on norms such as debt aversion to the next generation.

Evidence from the psychology and consumer behavior literature further suggests that personal attitudes towards money, e.g. the higher importance of money as a means to achieve social prestige and freedom, are associated with more impulsive consumption (Roberts and Jones, 2001). Differences in money attitudes across the language groups in this study may therefore be one driver of cultural differences. The survey captures two dimensions of money attitudes similar to the attributes mentioned in Mitchell and Mickel (1999). First, the survey elicits the freedom and control component of money attitudes by measuring how strongly students agree to the following two statements: 1. *For me, money is a tool to accomplish goals.* 2. *I am living according to the motto: Money gives me the freedom to do what I feel like.* Students rated the statements on a 6-point scale ranging from 1 (strongly agree) to 6 (strongly disagree). Each answer is again transformed to a binary variable equal to 1 if students indicated values 4 – 6. The variable *Freedom & control* then reflects the mean over the two answers. Second, a measure from two questions capturing how strongly money is connected to social status and power is constructed (*Social prestige*). Students rate the following two statements on a 6-point scale ranging from 1 (strongly agree) to 6 (strongly disagree): 1. *For me, money is a tool to make friends.* 2. *I am prepared to do everything it takes to get money.* Again, each answer is transformed to a binary variable equal to 1 if students indicated values 4 – 6. The variable *Social prestige* reflects the mean over the two answers.

[27] Gathergood (2012a) shows that the impact of problem debt on psychological health is less severe in localities in which problem debt is more widespread and therefore the social stigma is weaker. Similar differences are possible between cultural groups.

2.4.3 Socioeconomic background

The survey elicits various dimensions of the students' socio-economic background. This includes personal characteristics such as gender, age, religion and citizenship, proxies for the family background that capture parental education[28] as well as parental income and wealth (having an own room, homeownership, number of weeks on vacation).

The survey further elicits information on the students' financial resources in the month prior to the survey. While in theory the amount does not influence the share saved, this must not necessarily hold for the empirical exercise. Students list the total available amount as well as the source (pocket money, side job, and presents). On average students had CHF 165 with no statistically significant difference between school languages. Comparing univariate values, German-speaking students are 13 percentage points more likely to obtain income from a side job (Appendix Table 2.A3). No differences exist in the likelihood to receive pocket money and money as a present. Appendix Table 2.A6 provides estimates for the variable *French* on the amount obtained from different sources and on the existence of the sources for the sample of Swiss students. Swiss students at French-speaking schools obtain more money from other sources. The total amount is higher for French-speaking students if the specification controls for basic and extended control variables (10-% level of statistical significance). The propensity to receive job income is lower among French-speaking households in the model controlling only for basic control variables. No statistically significant difference emerges when controlling for an extended set of socio-economic variables.

The dataset covers responses from 711 students. Due to missing values the sample is restricted to 649 students.[29] Appendix Table 2.A3 shows descriptive statistics of socio-demographic variables of students. In line with the previously described municipal characteristics, German-speaking students are more often Swiss citizens and their families are more often protestant instead of catholic. Differences also exist in parental homeownership and having a single room.

[28] Due to missing values, parental education is not used as a control variable in the main analysis. Appendix Table 2.A13 provides descriptive statistics. Using parental education as control variables in the main specification does not influence the magnitude of the estimates or the level of statistical significance.

[29] 6 surveyed students come from another region and are therefore excluded. For 12 observations, I lack information on gender, for 19 observations on the nationality, for 7 observations on the year of birth and for 18 observations on the home municipality.

2.5 Identification

The aim of the paper is to identify the effect of cultural group membership on intertemporal choice among the young. The school language is used as a proxy for cultural background. Hence, the treatment is defined as the exposure to a cultural region.[30] Students with exposure to the French-speaking region are defined as treated throughout the analysis. In order to obtain an estimate of cultural group membership that focuses on the vertical transmission of culture, the main specifications focus on the sample of Swiss students.[31]

In the baseline specification, I estimate the following model:

$$Y_{is} = \alpha + \beta French_s + \gamma X_i + \epsilon_{is}$$

where Y_{is} is the outcome of interest for individual i attending school s. $French_s$ is a binary variable reflecting the school language at school s and equal to 1 for French-speaking schools. X_i is a vector of observable individual characteristics that potentially confound the effect of culture. For all estimations, standard errors are clustered at class level.[32] This paper uses school language as treatment of culture. I argue that school language reflects the cultural background students are most exposed to. For many students in the sample the school language is exogenously determined by the majority spoken language in their home municipality. In bilingual municipalities, parents can actively choose the school language. The school language is predominantly in line with the main language spoken at home.[33] In cases where parents are bilingual or the families speak a third language, it seems natural to assume that parents choose the school language they connect more with their own norms and values. In a subsample analysis, I focus on bilingual students, students with a recent immigration history and municipalities with a

[30]The treatment effects literature suggests that only mutable characteristics should be considered as treatment (e.g. Holland et al. (1985)). Even though culture is nearly immutable post-birth, the exposure to a language group is a treatment that can be manipulated. Theoretically, the estimate tries to capture the effect of two twins that are given up for adoption and are randomly assigned to families east and west of the language border.

[31]Results are not sensitive to the inclusion of bilingual or non-Swiss students in the main specification. Appendix Table 2.A4 presents summary statistics for the sample of Swiss students.

[32]In an unreported analysis, all estimations are replicated using bootstrapped standard errors. Results remain unaffected.

[33]The parental language for Swiss students is highly correlated with the school's language. Only 4 students in the sample attend French-speaking schools while they speak to their parents predominantly in German (And 14 students attending German-speaking schools vice versa).

clear majority to rule out the concern of active school language choice.

The applied identification differs from the local border contrast strategies[34] employed by related papers due to two reasons. First, the students in the sample reside in a narrow band across the language border and there is little variation in distance to the language border which would allow for a meaningful estimation of the trend over the distance. Second, school language arguably reflects a more precise treatment of culture than majority language. School language goes for the majority of students in line with the language that is predominantly spoken at home.

The discussion of potential confounders X_i deserves particular attention. Which covariates should be controlled for when estimating the effect of culture? First, in order to obtain an unbiased estimate, the vector X_i should contain any factor that mutually influences the treatment $French_i$ and the outcome Y_i and therefore influences the potential outcomes of the intertemporal choice variables. Thus, any characteristics that cause a student with higher (or lower) potential savings rate or level of consumption regret to attend a French-speaking rather than a German-speaking school should be controlled for. For most students the assignment to a school is determined by the majority language of the municipality. The surveyed schools cover all students from most municipalities in the sample and classes were randomly selected. Thus, no bias should arise from the selection of students. A larger concern is the selection into these municipalities. Are households living on the left and right side of the language border comparable?[35] Appendix Table 2.A2 reveals differences in citizenship and also in economic conditions (*Single room*) and religion. But differences in household characteristics may not only reflect differences in the two samples but it could potentially be the result of exposure to local culture. Factors included in X_i should not be influenced by local culture in order to avoid any bias caused by the inclusion of endogenous controls (Rosenbaum, 1984). For example, cultural group membership can influence the preference for home ownership.

[34]For example Eugster et al. (2011) and Guin (2017) employ an RD design where distance to the language is used as the forcing variable border and the treatment status changes at the language border (distance = 0). Appendix Table 2.A7 uses municipal majority language as treatment what is comparable to the RD design since municipalities in the sample are located closely to the language border.

[35]A potential concern could be a difference in attractiveness of the observed border region relative to the rest of the language region. If highly educated individuals and their families in the German-speaking part tend to move to larger German-speaking cities (e.g. Bern or Zurich) while highly educated individuals stay in the French-speaking language border region, this could cause a bias. Eugster and Parchet (2018) provide evidence that 60% of moving households stay within 20km of their initial domicile. This reduces the importance of this potential concern.

Are municipalities on both sides of the language border comparable? Municipality characteristics weighted by the number of students in the sample are displayed in Appendix Table 2.A5. The difference in mean shows that there are differences in size as well as economic activity and religion. Differences are to a certain extent driven by the cantonal capital Fribourg, from where 72% of students in the sample attend a French-speaking school. Excluding two urban municipalities reduces differences in municipality characteristics. Importantly, there is no significant difference in municipal tax potential which reflects the average potential tax return in the municipal population which could influence the quality of schooling and would be an indicator for differences in parental income.

The analysis deals with the potential endogeneity of control variables by a staggered use of covariates. In a basic specification X_i contains gender and age. These variables are most likely least affected by local culture. In further specifications the vector X_i controls for the school level, parental wealth, religion and the population of the home municipality (*urban*). In a final model, I control for financial resources of the students. Thus, parental culture can influence pocket money or the propensity to have a side job. Estimates therefore reflect the difference in intertemporal consumption conditional on the available financial resources.[36]

2.6 Results

2.6.1 Saving and Consumption Regret

Table 2.1 presents regression estimates for the binary variable *French* applying three specifications. In columns (1), (4) and (9) the model is estimated only with basic control variables for which the endogeneity to the treatment culture is less of a concern. The additional specifications control for parental background, school level as well as for

[36] Available financial resources need to be analyzed relative to the required expenses. The survey elicits information on who (student or parents) covers certain expenses. Appendix Figure 2.A3 displays the distribution of responses for each expense. A Chi square test reveals that the distribution of expenses for mobile phone, lunch meals and public transportation are different at the 5% level of statistical significance. Results are not uniform: German-speaking students are more likely to have mobile phone expenses fully covered by parents, but are also more likely to cover it themselves while French-speaking students share the expense more frequently. A similar pattern is observed for public transportation but German-speaking students are most likely to share the expense. Conditional on the required coverage of expenses, no statistically significant difference in the available financial resources is observed. resources.

the available financial resources. These variables are potentially influenced by parental culture and could be considered endogenous controls. Conditional on the distribution of outcome variables Ordinary Least Squares (*Saving*) and Probit (*Consumption regret*) estimates are reported.

Table 2.1: Regression results controlling for socio-economic background

Outcome	Saving			Consumption regret		
Specification	OLS			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
French	-0.093**	-0.106**	-0.105**	0.163***	0.148***	0.152***
	(0.046)	(0.043)	(0.042)	(0.046)	(0.042)	(0.046)
Mean of outcome	0.53	0.53	0.53	0.20	0.21	0.21
Observations	392	363	359	497	454	411
Clusters	40	40	40	40	40	40
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	Yes	No	Yes	Yes
Financial resources	No	No	Yes	No	No	Yes

Notes: This table reports results of the model French on several outcome variables. Probit models present marginal effects calculated at the mean. Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Financial resources control for Ln(amount), Job income and Other sources. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level. Due to missing values, the number of observations fluctuates across specifications.

Columns (1) – (3) in Table 2.1 report the difference in *Saving*. The magnitude of the regression estimates are in line with the mean difference. Depending on the model, French-speaking students save 9.3 to 10.5 percentage points less compared to German-speaking students. The estimate represents 17.5% of the sample mean.

A subsample analysis presented in Table 2.2 reveals substantial heterogeneity of the effect by social origin but also by gender. The first subsample analysis splits the sample by the language students speak in the parental home. Monolingual contains Swiss students who speak their school language with their parents. Bilingual students speak French and German with their parents. Foreign language contains students that speak other languages in their parental home (apart from French and German). This groups

contains only languages that are represented on both sides of the language border.[37] The difference in *Saving* is particularly strong among monolingual Swiss students and small and insignificant for bilingual students and student that speak non-regional languages in their families. This supports the conjecture that the estimated treated effects stems from a vertically transmitted effect of culture rather than from differences in schools.

The treatment effect is stronger among females: The difference is 19.1 percentage points among female students while the point estimate for the male sample is only at 2.1 percentage points. The estimate by gender is statistically different on the 1% significant level applying a Chow test.

Appendix Table 2.A8 shows estimates for the binary variable *Saved*. The variable is equal to one if a student saved any of the financial resources. Estimates reveal that the propensity to save any financial resources is about 11 percentage points lower for French-speaking students. This supports the graphical evidence in Appendix Figure 2.A1 that suggests that the difference mainly stems from the high share of French-speaking students that are not saving at all.

Marginal effect estimates of a Probit model applied to the outcome variable *Consumption regret* are in line with the univariate evidence but the magnitude of the estimated effect is lower than the simple mean difference. French-speaking students have a 15 percentage point higher propensity to state that they regret a purchase occasionally or often. The estimated effect represents two-thirds of the sample mean. Results from an ordered Probit model exploiting the full variation of the responses support this finding (Appendix Table 2.A9).

Also for *Consumption Regret*, the subsample analysis presented in Table 2.2 shows heterogeneity of the treatment effect. The treatment effect is strongest among monolingual Swiss students. Estimates for bilingual students and for students with another language spoken at home are smaller in magnitude and not statistically significant.

Subsample estimates by gender reveal that the effect is similar for female and male students. There is, however, no statistically significant heterogeneity by language or

[37]These subsamples offer important advantages compared to a subsample by citizenship. First, the number of non-Swiss students attending German-speaking schools is very low (22 vs 110 in the sample with extended control variables). Second, the group of non-Swiss students differs by citizenship across the language border. The sample contains for example 7 students with German citizenship attending German-speaking schools (32% of non-Swiss students attending German-speaking schools) but none attending French-speaking schools. The subsample by parental language therefore serves better as a theoretical control group.

gender using a Chow test or a difference-in-differences estimate, what could be due to the low number of students in the bilingual and foreign language group.

Table 2.2: Subsample estimates

	Language			Gender		Clear
	Monolingual	Bilingual	Foreign lang.	Female	Male	Majority
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: Saving						
Method: OLS						
French	-0.118**	-0.036	-0.049	-0.191***	-0.021	-0.108**
	(0.049)	(0.078)	(0.075)	(0.052)	(0.057)	(0.044)
Obs	190	104	130	176	187	352
Mean of outcome	0.51	0.58	0.42	0.51	0.54	0.52
Dependent Variable: Consumption regret						
Method: Probit						
French	0.124**	0.091	0.072	0.158**	0.149***	0.155***
	(0.056)	(0.080)	(0.085)	(0.065)	(0.045)	(0.044)
Obs	243	123	162	218	236	436
Mean of outcome	0.20	0.16	0.24	0.25	0.16	0.21
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports estimates for subsamples. Monolingual contains Swiss students who speak only the school language with their parents. Bilingual contains Swiss students who speak French and German with their parents. Foreign languages contain students who speak at least sometimes a language to their parents that is not native in the canton of Fribourg. The group contains only languages that are spoken in the sample on both sides of the language border (Albanian, Dutch, Hungarian, Italian, languages from former-Yugoslavia, Portuguese, Spanish, standard German, Thai , Turkish and Kurdish). The subsample by gender and by municipality language contains only Swiss students. Clear majority refers to municipalities with a majority language share of more than 80%. Probit models present marginal effects calculated at the mean. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Financial resources control for Ln(amount), Job income and Other sources. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Magnitude of effect and correlation with control variables

Appendix Table 2.A10 reveals coefficients of all control variables. Especially the school level variables are strongly correlated with the outcome variables. Students are assigned to a school level after the 6th grade based on their academic performance. Students in the highest level typically pursue a university education while students on basic and medium level usually enter the labor market at the age of 16 through an apprenticeship. The school level dummies therefore capture cognitive ability of students, but also parental background such as parental preferences for formal education. The estimate of *French* for the outcome variables *Saving* and *Consumption regret* is higher than the correlation of a one level increase in school level. The number of weeks students spend away on vacation with their parents are positively correlated with *Saving*. Students from protestant families report lower savings rates. *Consumption regret* is positively correlated with female and urban.

2.7 Potential channels

In this section, I examine channels through which cultural group membership influences the documented differences in saving and consumption behavior. By construction, a potential channel is required to be a) different across cultural groups and b) strongly correlated with the outcome variable. As suggested by Guiso et al. (2006) differences in preferences, norms or attitudes may drive observed differences in intertemporal consumption.

Table 2.3 displays correlations of potential channels with the outcome variables. Columns (1) and (2) display pairwise correlations. Columns (3) and (4) show correlations in OLS estimations conditional on all channels. Columns (5) and (6) show standardized Beta estimates to allow for a comparison of the effect size of each channel.

Observed correlations are largely in line with predictions based on the existing literature. *Patience* is strongly correlated with *Saving* and *Consumption regret*. *Saving* is also significantly correlated with *Freedom & control*. *Risk seeking* is strongly correlated with *Consumption regret*. Hence, regretting a purchase could partially reflect more risky purchasing decisions – which are more likely to turn out to be disappointing. Comparing the magnitude of the effect from one standard deviation change shows that *Patience* and

Freedom & control have the highest estimates.

Table 2.4 shows estimates for the binary variable *French* for the six measures of economic preferences, norms and money attitudes in three regression specifications. The findings are largely robust across specifications. Column (1) shows that French-speaking students are less risk averse. There is no difference observed in the variable *Patience* (Column (2)).[38] Hence, in contrast to Sutter et al. (2018) and the prediction based on the linguistic savings hypothesis (Chen, 2013), I do not find a difference in the time preference measure. Strong differences exists in the variable *Financial socialization*.[39] The univariate difference represents 34% of the sample mean. The difference stems from all three underlying factors: German-speaking students have a bank account more often and have independent access to it more often. They also receive the first pocket money more often before the age of 12 years (median age).

The norms and attitudes measures differ in two dimensions. Column (4) shows a significant difference for *Debt norms*. The variable captures debt aversion in the family. A notable difference is observed for *Freedom & control*. The difference is strong, representing half of the sample mean.

[38] Appendix Table 2.A11 presents the difference in risk and time preference measures for each component. French-speaking students are less patient in the quantitative time preference measure but more patient in their response to the question: "I rather go without something today in order to be able to afford more tomorrow". The difference in *Risk seeking* stems mainly from a strong difference in the response to the question: "I am a person who is willing to take risks".

[39] Brown et al. (2018) show that the variable financial socialization is the strongest mediator of the influence of culture on financial literacy.

Table 2.3: Correlation of channels with outcomes

	Pairwise correlations		OLS		OLS: Stand. Betas	
	Saving	Consumption reg.	Saving	Consumption reg.	Saving	Consumption reg.
	(1)	(2)	(3)	(4)	(5)	(6)
Risk seeking	-0.085	0.178***	-0.022	0.245**	-0.004	0.046**
			(0.114)	(0.119)	(0.021)	(0.022)
Patience	0.307***	-0.222***	0.538***	-0.392***	0.084***	-0.061***
			(0.144)	(0.132)	(0.022)	(0.021)
Financial socialization	0.014	-0.072	0.043	-0.064	0.013	-0.020
			(0.057)	(0.060)	(0.018)	(0.019)
Debt norms	-0.084*	-0.02	-0.100**	0.041	-0.040**	0.016
			(0.047)	(0.051)	(0.019)	(0.021)
Freedom & control	-0.138***	0.159***	-0.138***	0.151**	-0.056***	0.062**
			(0.051)	(0.060)	(0.021)	(0.024)
Social prestige	-0.086*	0.037	0.004	-0.059	0.001	-0.014
			(0.076)	(0.075)	(0.018)	(0.017)
Observations			302	372	302	372
Clusters			40	40	40	40
R-squared			0.198	0.181	0.198	0.181
French dummy			No	No	No	No
Basic controls			Yes	Yes	Yes	Yes
Extended controls			Yes	Yes	Yes	Yes

Notes: The table reports pairwise correlations of mediators with the outcome variables (1 - 2) and the results of a multivariate linear estimation (3 - 4). Standardized Beta estimates (5 - 6) display the change in outcome for a one standard deviation change in the mediator variable and allow for a better comparison of the magnitude of the estimators of each mediating variable. Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 2.4: Difference in preferences, norms and attitudes

Estimate of French	Risk seeking (1)	Patience (2)	Financial socialization (3)	Debt norms (4)	Freedom & control (5)	Social prestige (6)
Univariate	0.049**	-0.010	-0.146***	-0.107**	0.239***	0.011
	(0.024)	(0.024)	(0.032)	(0.045)	(0.036)	(0.026)
Basic controls	0.051**	-0.008	-0.143***	-0.103**	0.234***	0.011
	(0.024)	(0.023)	(0.032)	(0.046)	(0.033)	(0.026)
Basic & extended controls	0.043*	-0.012	-0.118***	-0.075*	0.223***	-0.002
	(0.025)	(0.018)	(0.037)	(0.044)	(0.038)	(0.021)

Notes: The table displays estimates of the binary variable French for three OLS specifications. Univariate refers to the univariate difference between the two school language groups. Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

2.7.1 Analysis of channels

This section analyses the explanatory power of the mentioned channels. Borrowing from the labor economics literature that analyzes the underlying drivers of the gender gap (e.g. Bertrand et al. (2010), Azmat and Ferrer (2017)), I compare the base line estimate β_2 to the estimate β_3 when the specification controls for channel M. The share explained is defined as the reduction of the estimate for the treatment variable *French*.

$$Y_{is} = \alpha_2 + \beta_2 French_s + \delta_2 X_i + \epsilon_{is}$$
$$Y_{is} = \alpha_3 + \beta_3 French_s + \gamma_3 M_{is} + \delta_3 X_i + \epsilon_{is}$$
$$Share = \frac{\beta_2 - \beta_3}{\beta_2}$$

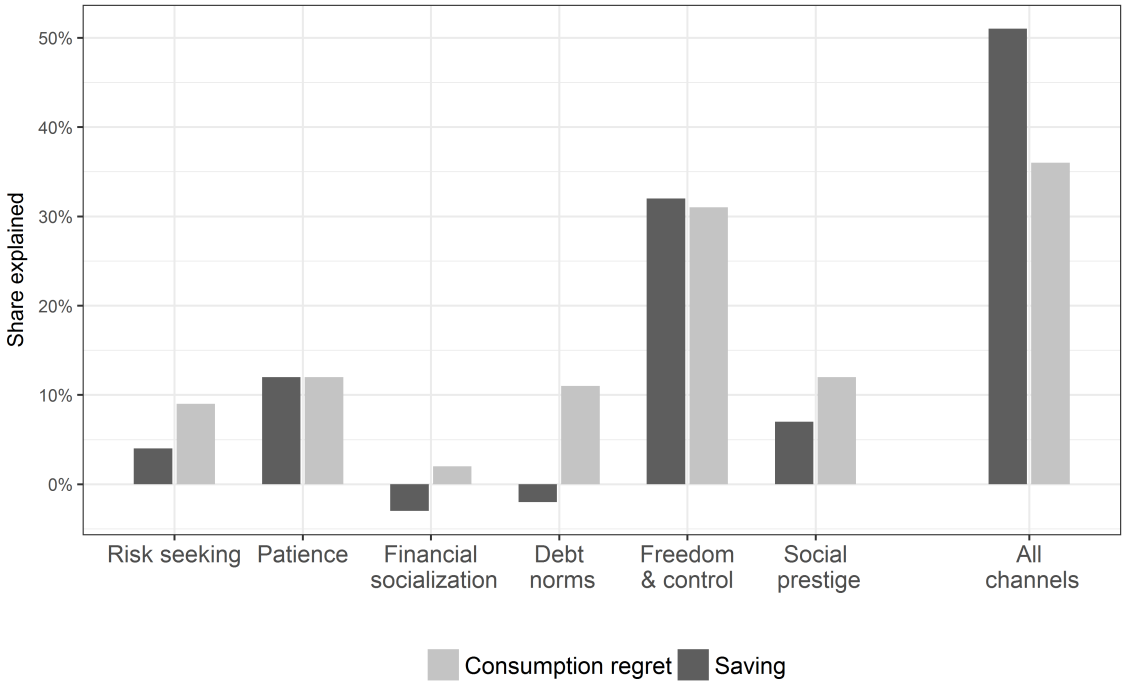
Figure 2.4 summarizes the share explained by each channel. For the outcome variable *Saving*, *Freedom & control* captures the largest share. In the specification with the variable, the estimate of French declines by 32%. *Patience* captures 12%, *Social prestige* 7%. The specification with all channels reduces the estimate of French by 51%. This shows that a large share of the observed difference in savings behavior remains unexplained. This could be due to missing factors but also partially due to the construction of variables or functional form assumptions in a linear model.

For *Consumption regret Freedom & control* again captures the largest share (31%). *Patience* (12%), *Social prestige* (12%), *Debt norms* (11%) and *Risk seeking* (9%) also substantially reduce the estimate of *French*. When controlling for all six factors the estimate is 36% lower than the baseline estimate and clearly lower the the sum of all channels. This reflects the correlation of the observed channels with each other. Appendix Table 2.A12 presents all estimates. Findings are generally in line with an unreported mediation analysis (Pearl (2001), Imai et al. (2011))

Overall, these results suggest that the effect of culture on *Saving* and *Consumption regret* rather translates through attitudes than through standard economic preferences.

Figure 2.4: Analysis of channels

The figure depicts the *Share explained* by each potential channel of culture. Each bar documents the change in the estimate of *French* when controlling for the respective channel. *All channels* presents the change in the estimate of *French* when controlling for all six channels.



2.8 Difference in consumption preferences

The model in section 2.2 and the empirical analysis in section 2.6 emphasize the role of time preferences, risk preferences and the relative value of non-durable and durable consumption in shaping intertemporal choice among the youth. In this section, I examine whether the observed differences in intertemporal choice go hand in hand with differences in broader consumption behavior, i.e. differences in preferences for everyday consumption goods.

The survey elicits information on how often students spend money on *Sweets, Magazines, Music, Cigarettes* and *Alcohol*. Responses range from 1 (never) to 4 (often). Appendix Figure 2.A2 displays the distribution of the consumption good variables by school language. Comparing the distributions of the variables across school language in a Chi-square test does not reveal substantial differences. *Buy online* captures potential differences in access to consumption channels that may influence intertemporal choice. The binary variable is equal to one if a student stated that (s)he makes purchases online.

The question explicitly indicates that it relates not only to online purchases of goods (e.g. clothes) but also to the online purchase of music or in-app purchases. 70% of students state that they make online purchases.[40]

Table 2.5 reports regression results of the linear model *French* on the consumption good outcome variables. Columns (1) – (10) report results for the five consumption goods for two specifications. Only spending for cigarettes shows a statistical difference between the two groups at the 10% level of significance when controlling for extended control variables. All other specifications show no statistically significant difference in spending on these specific consumption goods.[41] Columns (11) – (12) report regression estimates of the linear probability model of *French* on *Buy online*. Results do not point towards a difference in online purchasing behavior. These results support the hypothesis that the documented gap in intertemporal choice variables is not associated with a broader difference in consumption behavior.

[40]The majority of students states that they use credit cards of their parents for online purchases.
[41]Unreported results from an ordered Probit model support this finding.

Table 2.5: Difference in consumption goods and consumption channel

Outcome:	Sweets		Alcohol		Cigarettes		Magazines		Music		Buy online	
Specification:	OLS		OLS		OLS		OLS		OLS		OLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
French	0.012	0.003	0.025	0.039	0.035	0.054*	0.021	0.023	-0.040	-0.042	0.024	0.040
	(0.076)	(0.093)	(0.036)	(0.036)	(0.032)	(0.027)	(0.024)	(0.030)	(0.046)	(0.046)	(0.046)	(0.052)
Mean of outcome	2.27	2.28	1.29	1.31	1.24	1.26	1.40	1.41	1.68	1.66	1.70	1.70
Observations	494	406	496	408	494	406	496	409	495	408	491	406
Clusters	40	40	40	40	40	40	40	40	40	40	40	40
R-squared	0.007	0.047	0.085	0.133	0.057	0.132	0.012	0.037	0.016	0.069	0.020	0.044
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Financial resources	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: This table reports results of the model French on several outcome variables. The outcome variables are ordinal variables over the range 1(never) to 4(often). Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Financial resources control for Ln(amount), Job income and Other sources. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

2.9 Conclusion

Exploiting the unique setting of the language border within Switzerland, this paper has presented an analysis on how culture influences intertemporal consumption in a sample of students – most of them just about to enter the labor market. The students in the sample save on average a surprisingly high share (49%) of their available financial resources and only 24% state that they occasionally or often regret a purchase compared to 40% reported for a representative sample of US households (Parker, 2017).

I document a substantial difference in savings and consumption behavior based on cultural group membership. Students from the German-speaking area save more and regret consumption less often. Results are robust to a broad set of control variables including parental background and available financial resources. The treatment effect is stronger for students that clearly belong to a single cultural group compared to bilingual students and students with a recent immigration history. This supports the conjecture that the effect is rather driven by locally embedded culture than by differences in school curriculum.

An analysis of potential channels suggests that the effect of culture translates mainly through money attitudes but less through standard time preferences as suggested by the linguistic savings hypothesis. Overall, the analysis finds a strong role of culture shaping intertemporal consumption behavior among the youth.

Since the recent financial crisis, consumer financial protection has been amplified in many countries and at the same time, substantial investments in financial education have been made through private and public sector initiatives. The findings of this paper are especially relevant for policies targeting a heterogeneous population, for example as a result of a large migrant population or historical heterogeneities in local cultures but also when regulatory measures are harmonized across countries.

Chapter 3

Cooling-off Periods for Personal Loans: Evidence from an Extension in Switzerland

Thomas Spycher

Abstract

Cooling-off periods are a common tool of consumer financial protection that allows borrowers to withdraw from a signed credit contract. Using a detailed loan offer level dataset, this paper analyses the impact of an extension of a cooling-off period for personal loans from 7 to 14 days on offer non-acceptance and contract cancellation. 17.3% of loan offers are not accepted and less than 0.6% of borrowers with signed contracts make use of the right to withdraw. While no impact is observed for the full sample, I find higher non-acceptance rates among applicants with a preference for fast access to the loan amount after the extension of the cooling-off period.

3.1 Introduction

The recent financial crisis has triggered a surge of interest in consumer finance and the regulation of the consumer finance market. In the US, the Dodd-Frank Wall Street Reform and Consumer Protection Act established a Consumer Financial Protection Bureau in 2010. It regulates products frequently used by households such as mortgages, credit cards and consumer loans. In the European Union a similar development took place with the new regulation on consumer protection that aims to simplify disclosures and tighten advice requirements related to financial products.

One frequently used measure of consumer financial protection is the cooling-off period.[1] It provides consumers with the option to reconsider a signed contract over a certain period and to withdraw from the contract at no extra cost. Economic theory suggests that a cooling-off period protects individuals from making impulsive, time-inconsistent decisions (e.g. hyperbolic discounters (Laibson, 1997b)). It is therefore mainly applied to decisions that individuals face infrequently and that could be influenced by impulsive behavior – characteristics that apply to consumer credit decisions. Apart from financial products, cooling-off periods exist in many countries for door-to-door sales and online purchases. While the rationale behind cooling-off periods is largely uncontested (Camerer et al. (2003), Loewenstein et al. (2003), Sunstein and Thaler (2003)), scarce empirical evidence exists on its use and how its existence and duration impacts consumer decisions.

In this study, I use a unique dataset containing personal loan offers to first investigate how loan and household characteristics are related to the use of the cooling-off period and non-acceptance. The paper further studies the influence of an extension of the cooling-off period from 7 to 14 days using a difference-in-differences estimation strategy.

The dataset covers 330,000 personal loan offers of major banks in Switzerland (75% of the market) over the period January 2014 – December 2016. The dataset contains detailed information on household characteristics, offer characteristics, borrowers' decisions and the timing of the decisions for each loan offer. This makes the dataset ideal to study how an extended cooling-off period affects borrowers' decisions.

I first present descriptive evidence on non-acceptance of loan offers and contract cancellation. In the full dataset, 17.3% of loan offers are not-accepted. The strongest predic-

[1] A three-day cooling-off period exists for consumer credit contracts in the US. In the EU, the Consumer Credit Directive allows borrowers to withdraw from the contract within 14 days.

tor of non-acceptance is the presence of an open application at another lender, a measure that captures the intensity of the search behavior of consumers. However, only 10% of applicants had an open application at another lender. Non-acceptance is further positively correlated with loan maturity and negatively correlated with the applicant's age.

In the full sample 2.1% of accepted loans were reported as canceled. This contains withdrawals by customers using the cooling-off period as well as the occurrence of a condition subsequent.[2] The cancellation date allows for the calculation of an upper bound of the share of borrowers using the right to withdraw. In the years 2014 - 2016, less than 0.6% of accepted offers were withdrawn during the cooling-off period.

I then analyze the impact of an extension of the cooling-off period from 7 to 14 days that became effective in July 2016. Descriptive evidence shows that consumers delay the acceptance decision with the extended cooling-off period. The share of borrowers accepting the loan offer at the offer date decreases by 15 percentage points from 57% to 42% of borrowers. This change is most pronounced among online borrowers where the share decreases by 25 percentage points. No difference in the occurrence of cancellations is observed.

To obtain an estimate of the impact of the regulatory change, I use a difference-in-differences approach that captures potential seasonal effects using the pre-year as a counterfactual trend. A vector of detailed loan offer and borrower characteristics is applied to control for potential differences in the composition of borrowers. Based on an estimation of the average treatment effect, the extension of the cooling-off period did not have a statistically significant impact on non-acceptance or cancellation.

I analyze heterogeneous treatment effects for subsamples that were defined in a pre-analysis plan. Applying the same difference-in-difference strategy, estimates for subsamples by the proneness to present bias or search effort do not show any statistically significant effect. As banks disburse loans only after the cooling-off period, the extension led to a longer waiting period between loan application and loan disbursement. Analyzing subsamples by the preference for fast access to funds shows increasing non-acceptance for subsamples with a strong preference for fast access. Estimates show that non-acceptance increases by 2.2 (1.6) percentage points for online applications (the 3rd loan volume ter-

[2]Examples of condition subsequents that frustrate and therefore terminate a credit contract are the failure to hand in supplementary documents (e.g. proof of employment) or the statement of false information in the loan application.

tile). These findings suggest that households with a strong preference for fast access to funds increase non-acceptance of loan offers.

Overall, the available evidence suggests that the cooling-off period plays a negligible role in overcoming present-biased decisions in consumer lending.[3] There is no indication that the extension of the cooling-off period increased consumer financial protection. Results rather suggest that by delaying access to funds the change in regulation may have had adverse effects on applicants that value fast access to funds.

The paper contributes to a broader literature on consumer financial protection that has pointed out that there is an economic rationale for regulating certain consumer financial products as well as the importance of understanding costs and benefits of regulation (Bar-Gill and Warren (2008), Campbell et al. (2011), Campbell (2016)). Recent empirical contributions analyze improvements in the transparency of costs related to financial products (Agarwal et al., 2014), changes in product complexity (Célérier and Vallée, 2017), the effect of advertisement on demand (Bertrand et al., 2010) or the influence of usury laws and access to high cost credit (e.g. Alessie et al. (2005), Zinman (2010), Morse (2011), Melzer (2011), Rigbi (2013), Bhutta et al. (2016)). Cooling-off periods have been discussed in the law literature (e.g. Sher (1967); Rekaiti and Van den Bergh (2000); Camerer et al. (2003)), but scarce empirical evidence exists on its use and how the duration of the cooling-off period affects consumer behavior.[4] I contribute to the literature by presenting first empirical evidence on the use of a cooling-off period for personal loans and provide suggestive evidence of an upper bound of the duration of a cooling-off period for personal loans.

The study is further related to the literature on the right to withdraw from a contract or a purchase. Krähmer and Strausz (2015) analyze welfare implications of the right to withdraw from online purchases in a theoretical model. Inderst and Ottaviani (2013) study contract cancellation and product return policies in markets in which sellers advise customers. Ben-Shahar and Posner (2011) develop a theoretical model to study the trade-off between allowing consumers to learn about goods and protecting sellers from the depreciation of those goods. The learning about the quality of a purchased product

[3]The effects of the right to withdraw on market practices and dynamics may go beyond the observed contract cancellation (Loewenstein et al., 2003). Thus, this study does not provide a general assessment of the impact of the cooling-off period.

[4]One exemption is the study of the influence of the introduction of a mandatory cooling-off period on divorces in Korea (Lee, 2013) that led to a reduction of divorce rates.

and the signaling of quality is a key component of these models. Compared to the right to return a purchased product, the case of cooling-off periods for loans differs. Loans are typically connected to the purchase of a good (or service). The learning about the quality evolves around the purchased good but not around the quality of the loan. This paper contributes by transferring theoretical considerations from return policies to the case of lending and connecting it to empirical evidence.

The rest of the article proceeds as follows. Section 3.2 uses a simple theoretical framework to guide the econometric analysis. Section 3.3 describes the Swiss consumer finance industry and the regulatory change. Section 3.4 describes the data, and presents descriptive evidence on the correlation of loan offer and borrower characteristics with non-acceptance and contract cancellation. Section 3.5 describes the empirical approach and presents results. Section 3.6 discusses the findings.

3.2 Cooling-off Periods and Consumer Behavior

Based on the simple framework introduced by Camerer et al. (2003), this section derives predictions for the impact of an extension of a cooling-off period and derives two hypotheses.

Customers assess the purchase of good x for which they require an unsecured personal loan. Let $\mu = U(x, l)$ denote the net benefit obtained from purchasing good x with help of loan l. μ' represents the net benefit with a cooling-off period, μ'' the net benefit with an extended cooling-off period. Loan l is a standard unsecured personal loan and the loan characteristics (interest rate, amount, maturity) are independent of a cooling-off period. Lenders disburse loans after a cooling-off period has expired and the net benefit of the purchase decreases as time evolves ($\mu \geq \mu'$).[5] Fully rational households undertake the purchase if $\mu > 0$.

I further assume that a share p of consumers has a positive error ϵ in their assessment of their net benefit.[6] The positive error might be due to projection bias (Loewenstein

[5] I assume that consumers value access to the good. In the extreme case, a delay may make a consumption opportunity that is tied to a deadline impossible (e.g. used car market) and a household loses the consumption opportunity.

[6] Customers may also face negative errors. Customers at the margin with a negative bias would not purchase a good even though their net benefit is larger than 0. Measures for consumer protection typically address the case with a positive bias, as the consumer can undertake the purchase as soon as the negative bias vanishes if the availability of a good is time-independent.

et al., 2003) or present bias (Laibson, 1997b).[7] Customers purchase the good if $\mu+\epsilon > 0$. The error ϵ is assumed to decrease as time evolves ($\epsilon \geq \epsilon' \geq \epsilon''$).

No cooling-off period: Without a cooling-off period, consumers accept the offer if $\mu + \epsilon > 0$. Households with $\mu + \epsilon > 0$ and $\mu < 0$ experience a loss of up to ϵ from the purchase financed by a personal loan. Households with a zero bias or households with a bias that does not influence their purchase decision obtain μ.

With a cooling-off period: The introduction of a cooling-off period has two effects: First, it allows a consumer to reconsider the purchase. Households with $\mu+\epsilon > 0$, $\mu < 0$ and $\mu' + \epsilon' < 0$ withdraw from the loan contract and avoid a loss of up to ϵ. Second, it delays the loan disbursement and therefore the purchase for all households. Households without bias experience a loss of $Min[\mu - \mu', \mu]$ due to the delayed loan disbursement.

Whether a cooling-off period increases welfare henceforth depends on the share p of households with bias ϵ, the magnitude of ϵ, the distribution of μ and the magnitude of $\mu - \mu'$.

With an extended cooling-off period: An extension of the cooling-off period has two effects compared to the case with cooling-off period. It allows consumers that require more time to reduce their bias to withdraw from the contract (consumers with $\mu'+\epsilon' > 0, \mu' < 0$ and $\mu'' + \epsilon'' < 0$) and therefore avoid a loss of up to ϵ'. The net benefit of the purchase decreases with the extended cooling-off period for households that suffer a loss from an additional waiting period ($\mu' > \mu''$). Thus, these households experience a loss of $Min[\mu' - \mu'', \mu']$. The total effect therefore depends on the share of households with $\mu' + \epsilon' > 0$ and $\mu' < 0$, the distribution of μ' and the magnitude of $\mu' - \mu''$.

This leads to two hypotheses for the extension of the cooling-off period from 7 to 14 days.

1. Non-acceptance of loan offers may increase for households with $\mu' > 0$ and $\mu'' < 0$. This effect should be most pronounced among households with strongest preferences for fast access to funds or with an immediate consumption need.

2. The propensity of households to withdraw from a signed contract may increase if some households require more than 7 days to obtain an unbiased value of the net

[7] Biases related to the perceived cost of the loan (e.g. exponential growth bias (Stango and Zinman, 2009)) may also affect bias ϵ. But these biases are not expected to decrease with a cooling-off period

benefit of the loan. This effect should be most pronounced among households with a high propensity for having a large error ϵ.

3.3 Institutional Background

3.3.1 Swiss consumer credit market

At the end of 2016, the consumer credit market in Switzerland had 375,909 personal loans outstanding with a total outstanding balance of CHF 7.1bn and 587,553 leasing contracts with an outstanding balance of CHF 8.4bn.[8] 85 percent of personal loans (excl. automotive leasing) are unsecured cash credits.[9] Table 3.1 presents the number of newly disbursed cash credits for the observed years and the loan offers resulting in a disbursed loan in my dataset. In 2015, 117,115 cash credits with an average volume of CHF 30,184 and an average maturity of 50,3 months were granted (ZEK, 2016). The table depicts that the dataset covers a substantial share of the market (approx. 75% of issued loans and 60% of the issued loan volume).

Table 3.1: Newly issued cash credits in Switzerland vs dataset

A: Market size (ZEK Annual report)				
Year	Number of newly issued cash credits	Total volume in mn CHF	Average volume in CHF	Average maturity in months
2014	116,854	3,499	29,946	49.9
2015	117,115	3,534	30,184	50.3
2016	112,841	3,510	31,108	51,7
B: Dataset				
Year	Number of disbursed offers	Total volume in mn CHF	Average volume in CHF	Average maturity in months
2014	90,283	2,095	23,201	48.8
2015	88,098	2,075	23,555	49.3
2016	88,261	2,170	24,591	51.1

[8]Switzerland had in 2016 a population of 8.3mn, 3.7mn households and a GDP of CHF 659.8bn (Source: Federal Statistics Office). Hence, the volume of outstanding consumer credits represented 1% of GDP and 10% of household hold consumer credit (Source: ZEK Annual Report).

[9] Consumer finance statistics further list hire-purchase agreements (8.9% of outstanding credits), fixed-rate loans (0.03%) and overdraft facilities (5.6%).

According to survey evidence by the Swiss Federal Statistics Office (SILC survey 2015) 10.5% of households in Switzerland report to have consumer credit debt (excl. leasing). The product is more commonly used than credit card debt (9% of households[10]). A comparison of the use of consumer credit in Europe shows that Switzerland is at the lower end. Magri et al. (2011) report higher shares of households using the product based on data from the SILC 2008 survey for France (35.3%), Germany (22.2%), Italy (14.8%), Netherlands (14.5%), Portugal (20.4%), Spain (26.7%) and the UK (46.1%).

Survey evidence further suggests that households in Switzerland use consumer debt products (incl. leasing) mainly to finance cars (58.5%) and furnishings (22%). Hence, the product is rather used to finance durable consumption goods than short term consumption.

3.3.2 Consumer credit regulation and the extension of the cooling-off period

The Swiss federal consumer credit act (CCA) regulates the legal environment of consumer loans with maturities longer than 3 months and volumes between CHF 500 and CHF 80,000 (1CHF $\approx$ 1USD). The act regulates consumer lending and advocates consumer protection such as the cooling-off period, a transparent communication of credit costs, an interest rate cap and the appropriate assessment of the borrowers' repayment capability. The act further sets the right for prepayment and prohibits prepayment penalties.[11]

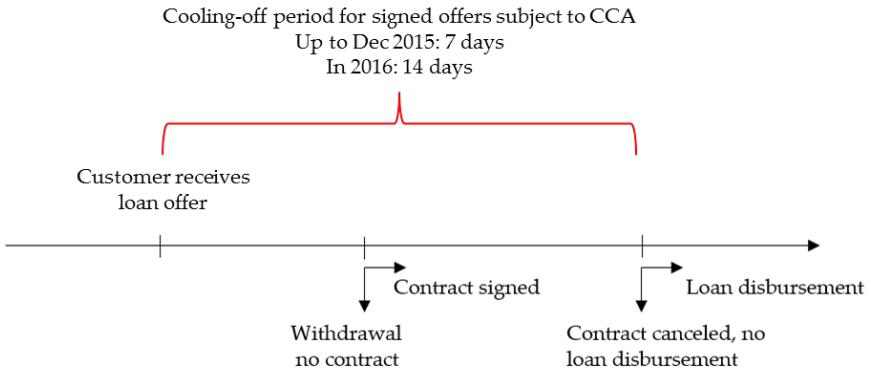
The cooling-off period provides the borrower with the right to withdraw from a signed credit contract within a set time span. The cooling-off period starts when the consumer receives a copy of the loan agreement. Figure 3.1 shows the work flow after the bank issued a loan offer and it displays the borrower decisions: First, the borrower accepts or declines the offer. Second, the borrower does or does not use the cooling-off period to cancel the contract. By law, a statement of the right to withdraw from the contract and the cooling-off period has to be mentioned in the contract. Bank employees further

[10]The SILC survey 2013 reports that one third of Swiss households do not have a credit card.

[11]In the absence of a cooling-off period, the right to prepay a loan could potentially be used by customers wishing to withdraw from the contract. This comes with the assumption that the customer has not yet spent the credit amount or the purchase can be reversed. Thus, prepayment is not a perfect substitute for the right to withdraw.

mentioned that they point out the cooling-off period to their clients since the loan will only be disbursed after the cooling-off period. Thus, it is reasonable to assume that most borrowers are aware of the cooling-off period latest after signing the contract. The occurrence of a condition subsequent[12] is a second reason that a signed contract may not result in a disbursed loan. The condition subsequent triggers a termination of the contract for example if a customer fails to hand in required documents such as the proof of employment or if a customer stated false information in the application. From a legal point of view the two cases clearly differ. In the dataset, it is not always possible to fully distinguish the two cases.

Figure 3.1: Work flow after loan offer



In January 2016 a change in the cooling off period became effective. The federal government extended the cooling-off period for loans regulated by the consumer credit act from 7 to 14 days. Thus, the new cooling-off period reaches the level of the cooling-off period in the European Union. Loans below CHF 500 and above CHF 80,000 and with maturities shorter than 3 months were not affected by the reform. The extension of the cooling-off period was publicly announced in an official press release on October 20, 2015. With the change of the cooling-off period, the regulator also adjusted the regulation on "aggressive advertisement".[13] The regulation of advertisement could potentially affect the pool of applicants. The available dataset on the pool of applicants from one bank does not show any change in household characteristics. Further, there was no case that a lender was accused of "aggressive advertisement. Hence, it is not expected to affect

[12] A condition subsequent is defined as an event or state of affairs that, if it happens, defeats or modifies an existing arrangement or discharges an existing duty. In a contract, a condition subsequent can often terminate the duty of one party to perform under the agreement. (Source: Legal Information Institute)

[13] The law keeps the definition of "aggressive advertisement" vague. The industry association set a definition of "aggressive advertisement" and members agreed to follow the code of conduct.

consumers' acceptance and cancellation behavior.

Another important regulatory change in the CCA was announced on December 11th, 2015 and implemented in July 2016. The maximum interest rate set by the CCA was reduced from 15% p.a. to CHF Libor + 10% or to a minimum of 10% (Max (3m Libor + 10%, 10%)). Given the interest rate environment (Libor in July 2016: -75bps) the change resulted in a reduction of the maximum interest rate on consumer loans by 5 percentage points and likely had a substantial impact on the offered APR.[14] The change in July 2016 should not have influenced borrowers behavior in January 2016. But for the empirical analysis, it is important to keep in mind the potential influence from this change. Based on conversations with bank employees, lenders started to adjust their interest rates in April 2016. Henceforth, the main analysis will only use observations up to March 2016.

3.4 Data

3.4.1 Summary statistics

The loan level dataset was provided by major providers of personal loans in Switzerland. It contains all loan offers by these providers over the period January 2014 to December 2016.

The initial dataset contains 332,022 loan offers to customers with volumes ranging from CHF 500 to CHF 160,000 and maturities from 4 to 84 months. I restrict the dataset to loan offers with volumes up to CHF 80,000 that are regulated by the CCA.[15] The sample of loans regulated by the CCA contains 328,999 loan offers. The main analysis will compare customer decisions from September 2015 to March 2016 to decisions taken from September 2014 to March 2015. Thus, the sample is restricted to 118,624 loan offers that occurred over these 14 months.

Table 3.A1 provides an overview of the sample. The average loan offer has a volume

[14]Screen shots of supplier websites from the Web Archive suggest that a substantial share of personal loans issued in 2014 and 2015 was priced above the new maximum interest rate. Several consumer lenders mention the reduced maximum interest rate as the reason for lower net interest income in their annual reports.

[15]Ideally, loan offers with volumes larger than CHF 80,000 could be employed as counterfactual trend for offers under CCA. However, Appendix Figure 3.A1 shows that the average duration from an offer to payout also strongly increases for loans that are not regulated by CCA. This suggests that the extended cooling-off period led banks to adjust internal processes for all offers without exemptions for non-CCA offers what clearly violates the Stable Unit Treatment Value Assumption for this control group.

of CHF 23,994 and a maturity of 50 months.[16] For 19% of loan offers the application was filed online. Offline applications include applications at bank branches as well as at loan brokers or other intermediaries. For a subsample of loans, a measure of search effort is available. *2nd Application* is a binary variable equal to one if a customer has at least one pending loan application at another bank that was registered at the central credit registry.[17] 10% of applicants had another application in process.

The median household income lies in the bucket CHF 4000 - 6000.[18] Households in the age span 25 - 55 years represent the bulk of borrowers. Only 5% of loan offers go to applicants younger than 25 years. One third of applications is filed by a female applicant[19] and 37% of the applications have children. 43% of offers go to single households and 46% to married applicants. The pool of offers contains mainly borrowers who are employees (95%). The comparison to the full sample in Table 3.A1 shows that the two samples are very similar in terms of household and application characteristics.

18% of the loan offers are not accepted by the applicant. Hence, 82% result in a signed loan contract. *Cancel* refers to the share of signed contracts that are reported as canceled and therefore do not result in a disbursed loan. 2.1% of accepted loan offers were reported as canceled. The dataset contains information on the time of the cancellation. Only 0.4% of signed contracts are reported as canceled within 7 days, 0.7% within 14 days.

The composition of the sample is one major concern in comparing offers pre- and post-change. Since the level of observation is the loan offer rather than the loan application, an adjustment in rejection policy by banks would influence the composition of the sample. A change in rejection policy should be visible in a) the overall number of loan offers and b) household characteristics and loan offer characteristics.[20] Figure 3.2 plots the number of loan offers per month for the observation period. A clear seasonal trend is visible

[16] Offered loan terms match in 99% of cases with requested loan terms for offers for which this information is available.

[17] Banks obtain this information by pulling a credit report from the credit registry. The information is only available for offers from some data providers.

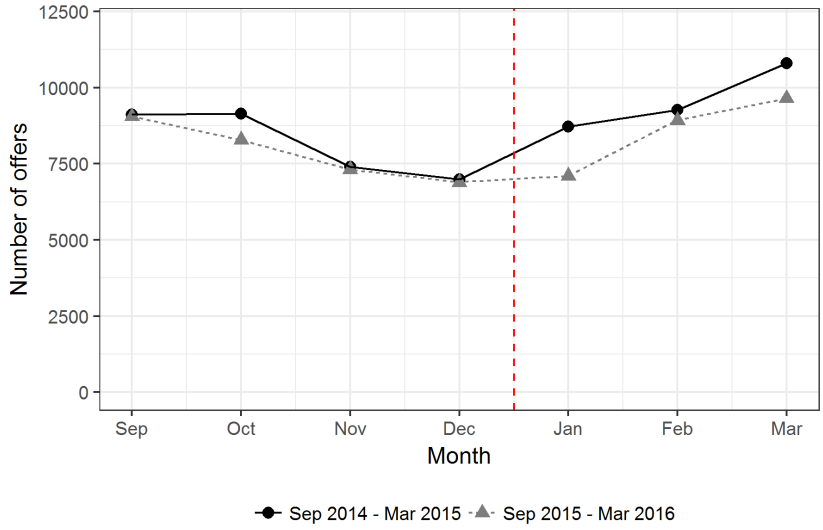
[18] The Swiss Federal Statistics Office reports for 2014 an average disposable monthly household income of CHF 7,112.

[19] Women file 22% of applications by married households.

[20] One bank delivered the full set of loan applications. This allows to observe the rejection policy during the regulatory change. In an unreported analysis, I apply the same year-end difference-in-differences strategy for the binary variable *rejection*. Estimates do not show any statistically significant effect of the regulatory change in January 2016 on rejection decisions. This does not rule out that other banks introduced changes in their rejection policy.

with an increase in spring. Comparing the two trends, a visible difference in the number of offers is observed in January 2016. However, the composition of borrowers based on household and loan characteristics remains stable compared to the pre-year month and to December and February (Appendix Table 3.A3). Thus, based on the available information the decline might be due to a lower number of applications.[21] The gap is not persistent and numbers for February and March converge to the pre-year level.

Figure 3.2: Number of offers per month



3.4.2 Consumer Decisions: Non-acceptance and Cancellation

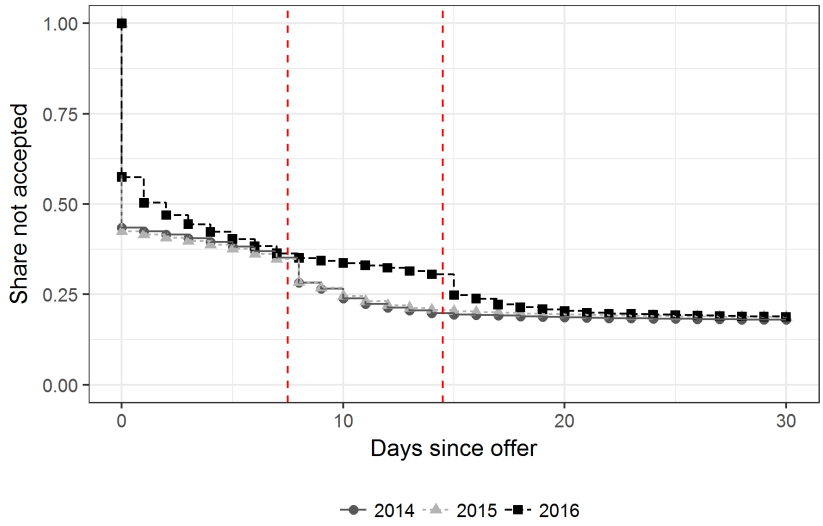
Non-acceptance

Non-acceptance occurs if a customer applies for a loan, receives the loan offer, but does not sign the offered loan contract. The dataset allows to analyze the point in time when offers are accepted. Figure 3.3 displays the share of not accepted offers after the offer date for the first quarter of each year. In 2014 and 2015, acceptance decisions follow a nearly identical pattern with more than 50% of offers being accepted at the offer date and a drop of about 8 percentage points after 7 days when the cooling-off period expired. In 2016, acceptance decisions happen with a delay. While 15 days after the offer date, the acceptance rate in 2016 was still 5 percentage points lower than in the previous years, there is no difference in non-acceptance observed after 30 days. A lower

[21] The average number of offers on a working day was in January 2016 83 loans lower compared to January 2015. There is no statistical difference in average amount, income or age.

share of applicants accepts the offer at the offer date and a visible drop of 7 percentage points occurs after 14 days when the extended cooling-off period expires. The change in acceptance behavior could also be driven by adjustments in the communication of the bank with a client.[22]

Figure 3.3: Survival Analysis: Non-acceptance for January - March



Appendix Figure 3.A2 displays the time span between offer and acceptance date by channel. Same day acceptance is more common among online applications compared to offline applications. For 2016, the change in pattern is strongest for online applications where immediate acceptance decreases from 75 percent by 25 percentage points to 50 percent.

Cancellation

Cancellation is defined as the cancellation of a signed personal loan contract. Two incidents can cause a cancellation: First, the customer can make use of its right to withdraw from a contract during the cooling-off period by notifying the bank about the contract cancellation. Second, a cancellation may occur due to the occurrence of a condition subsequent defined in the contract. Examples are the failure to hand in supplementary documents (e.g. proof of employment) or the statement of false information in the loan application.

[22] Unfortunately, no data is available on the communication of banks with clients such as when reminder emails are sent or reminder calls are conducted.

The dataset does not allow us to differentiate between withdrawals by customers making use of the right to withdraw and the occurrence of a condition subsequent. Based on the time of the cancellation, we can however provide an upper bound of the share of accepted offers that were canceled according to the cooling-off period in the CCA. Table 3.2 displays the share of signed loan offers that were canceled within a defined time period for the months January - March. In 2014 and 2015 (2016), only loan offers reported as canceled within 7 (14) days are potential withdrawals by the customer. For 2014/2015 the upper bound lies at 0.47% of accepted loan offers, for 2016 at 0.69%. Comparing cancellations up to 14 days does not reveal a change in cancellation behavior (2014: 0.99%, 2015: 0.72%, 2016: 0.69%). The largest share of cancellations occurs after the cooling-off period due to the occurrence of a condition subsequent.[23] Figure 3.4 supports the conjecture that the extended cooling-off period had little impact on contract cancellations. While the level of cancellations is higher in 2014, the trend of cancellations over time in 2015 and 2016 evolves nearly congruent. The figure further reveals that withdrawals occur steadily.

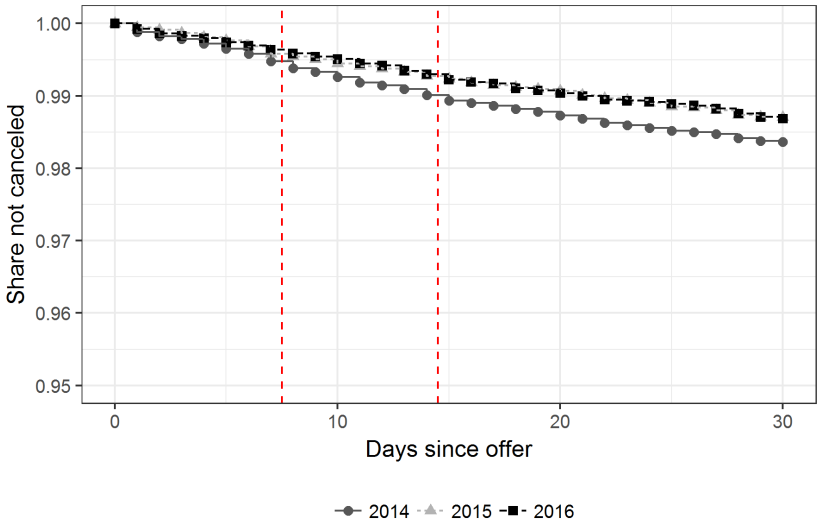
Table 3.2: Cancellation time of accepted offers in percent: Jan - Mar

Outcome	Since offer date	2014	2015	2016	Total
Canceled	0 - 7 days	0.52	0.42	0.36	0.43
	8 - 14 days	0.47	0.30	0.33	0.37
	>14 days	1.18	1.11	1.69	1.31
Total Canceled		2.16	1.83	2.39	2.11
Not canceled		97.84	98.17	97.61	97.88
Observations		23,351	23,720	21,242	68,313

Overall, the descriptive evidence suggests that only few customers make use of the right to withdraw from a signed contract within the cooling-off period. Combining the observed upper bounds shows that less than 0.6% of signed loan contracts result in a withdrawal by the customer. Based on the descriptive analysis, there is no evidence that the extended cooling-off period led to a change in the share of cancellations.

[23]Bank employees further stated that the usage of the cooling-off period may even lie clearly below the stated upper bounds.

Figure 3.4: Survival Analysis: Cancellation for January - March



Appendix figure 3.A3 depicts a survival analysis of cancellations by the number of days between offer date and acceptance date. The plots show evidence that early acceptance leads more often to contract cancellations within the cooling-off period. The plot for the years 2014/2015 shows many cancellations for offers accepted after 1-2 days. They however mainly occur after the expiration of the cooling-off period (7 days) and are therefore likely due to the occurrence of a condition subsequent that causes the determination of the loan contract.

3.4.3 Correlations with household and loan characteristics

This section provides descriptive evidence on the correlation of consumer decisions with loan offer and household characteristics. All figures display correlations for all available observations (Jan 2014 - Dec 2016) regulated under CCA (up to CHF 80,000). As stated earlier, 17.3% of loan offers are not accepted (*Not accept*) and 2.1% of accepted offers are reported as canceled (*Cancel*). Figure 3.5 depicts pairwise correlations with the outcome variables *Not accept* and *Cancel*. The variables are scaled to zero mean and unit variance so that the correlation coefficients are comparable. In panel a) loan amount and loan maturity are positively correlated with non-acceptance. *Age*, *Female* and *Single* have a negative correlation with non-acceptance while having kids is positively correlated. The strongest correlation coefficient is shown for *2nd Application*. Having an open application is strongly positively correlated with non-acceptance. Given the large

number of observations, pairwise correlation coefficients are all significantly different from zero.

Panel b) depicts correlations with *Cancel*. *Offered amount* and *Offered maturity* are negatively correlated with the propensity for an accepted offer to be cancelled. Online application submission is strongly correlated with *Cancel*. A potential reason for the strong positive correlation is that the likelihood of the occurrence of a condition subsequent (e.g. failure to hand in supplementary documents or the statement of false information in the application) is lower if the applicant is guided by a bank employee or a credit broker compared to the case where the borrower files the application online. *Income*, *Age*, *Female* and *Kids* show negative correlations. The strongest correlation, apart from the variable *Online*, are observed for the variable *Single*. All correlation coefficients but the coefficient for *2nd Application* are significantly different from 0.

Figure 3.5: Pairwise correlations with outcome variables

The figures display pairwise correlation coefficients of loan offer and borrower characteristics with the outcome variables *Not accept* (a) and *Cancel* (b). The income and age variable are ordinal based on the available categories. All variables are scaled to zero mean and unit variance to make correlation coefficients comparable. The correlation with *2nd Application* is measured for the subsample that contains this information. All pairwise correlations expect the correlation of *2nd Application* with *Cancel* are significantly different from 0 at the 1% level.

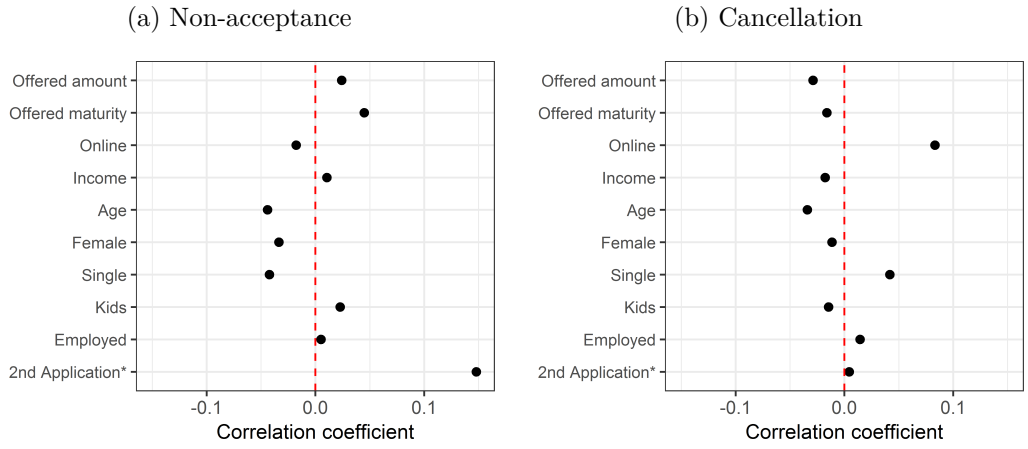


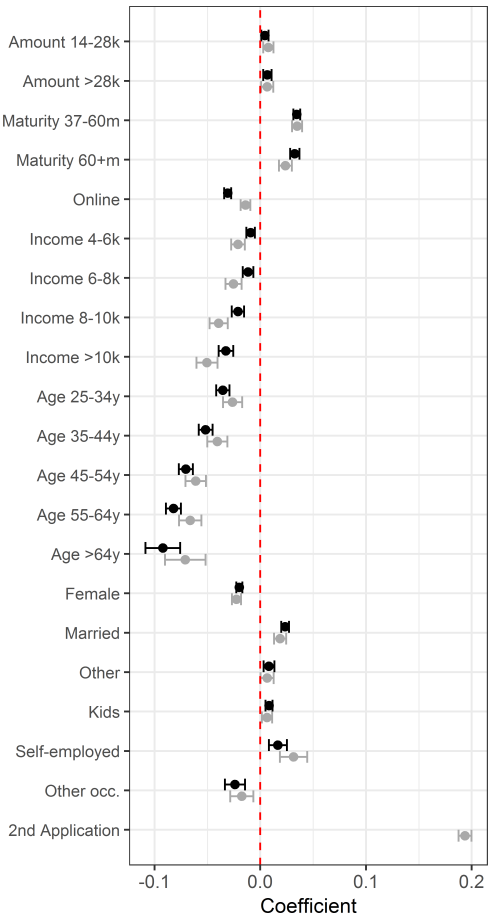
Figure 3.6 presents coefficients of a linear probability model of the consumer decision variables on a vector of loan offer and borrower characteristics. All variables are binary variables where loan offer amount and maturity were split in tertiles. Specifications contain bank fixed effects and month times year fixed effects. a) shows coefficients for *Not accept*. Among the loan offer characteristics, maturity has the largest correlation with *Not accept* while amount and channel (*Online*) seem less strongly correlated controlling

for other factors. Among household characteristics, the age variables have the largest coefficient. b) displays coefficients for *Cancel*. Only the coefficient of *Online* picks up a strong positive correlation in the full sample. The plot shows that there is hardly any clear correlation of loan terms or household characteristics with the variable *Cancel*.

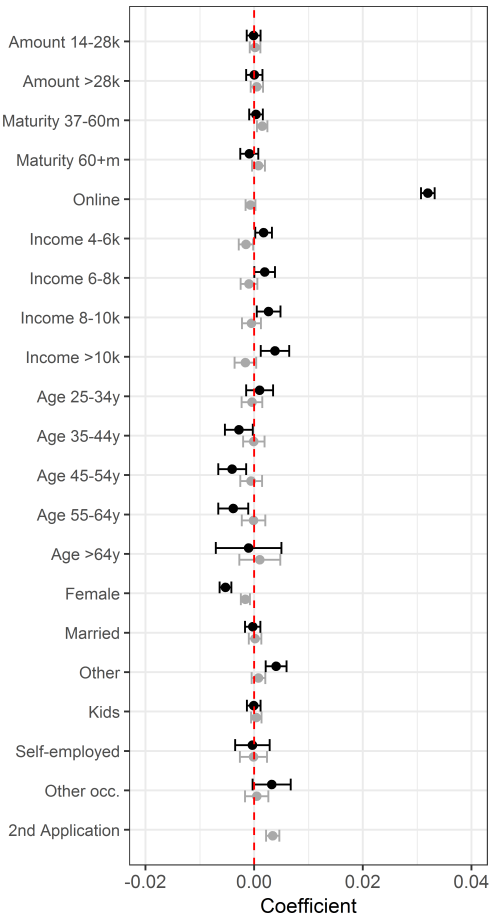
Figure 3.6: Coefficients of a linear probability model

The figures display coefficients of the linear probability model regressing the outcome variables *Not accept* (a) and *Cancel* (b) on a vector of binary variables capturing loan offer and borrower characteristics. All estimations use the full sample (Jan 2014 - Dec 2016) and contain bank and month x year fixed effects. Estimates from the full sample are displayed in black. Estimates from the sample containing information on 2nd loan applications are displayed in gray. The baseline category for variables with multiple dummies are defined as follows: Amount is up to CHF 14,000; Maturity up to 36 months; Income up to CHF 4,000; Age <25 years; Civil status single; Employment employed. 95%-CI are shown as bars around the coefficients. The coefficients are also presented in regression Table 3.A5 in the Appendix.

(a) Non-acceptance



(b) Cancellation



3.5 Empirical Estimation

The empirical analysis was laid out in a preanalysis plan prior to the receipt of the dataset.[24] A pre-analysis comes with many advantages also for non-RCT analyses (see e.g. Olken (2015)) as it forces the investigator to formulate hypotheses and empirical specifications ex-ante. Non-experimental datasets often contain unforeseeable surprises for example with respect to the number of observations in a specific subgroup or the availability and definition of certain variables. This makes it difficult to fully comply with the predefined plan. The following empirical analysis generally follows the preanalysis plan, but adjustments were performed where needed. Appendix Table 3.A4 discusses adjustments and the underlying reasons.

3.5.1 Empirical Strategy

This section analyzes the impact of the extension of the cooling-off period from 7 to 14 days on non-acceptance and contract cancellation. I employ a difference-in-differences strategy that uses the turn of the year 2014/2015 as counterfactual trend. I define the difference-in-differences estimator as:

$$y_i = f(\beta_1 Post_i \times Affected_i + \beta_2 Post_i + \beta_3 Affected_i + \gamma MonthFE + \delta X_i)$$

where y_i represents the binary variables *Not accept* or *Cancel*. $f()$ is a function representing the identity function (linear model). *Post* is a binary variable equal to one for loan offers in January - March. *Affected* is a binary variable equal to one for loan offers filed in the period Sep 2015 - Mar 2016. *MonthFE* contains monthly dummy variables to capture the seasonal trend and X contains a set of loan offer and household characteristics.

The strategy relies on two main assumptions. First, no contaminating events should differently affect the treatment and control groups. Any event or shock other than the analyzed change in regulation that affects non-acceptance and cancellation around the end of the year 2015 (or end of the year 2014) could potentially bias our estimates. From a regulatory perspective, the change in the cooling-off period was implemented simultaneously with a law on "aggressive advertisement". This law is not expected to

[24]The preanalysis plan is available at the registry of Evidence in Governance and Politics (egap) https://egap.org/registration/2426. The plan was uploaded on March 24, 2017. The data providers transfered the datasets on April 13, 2017.

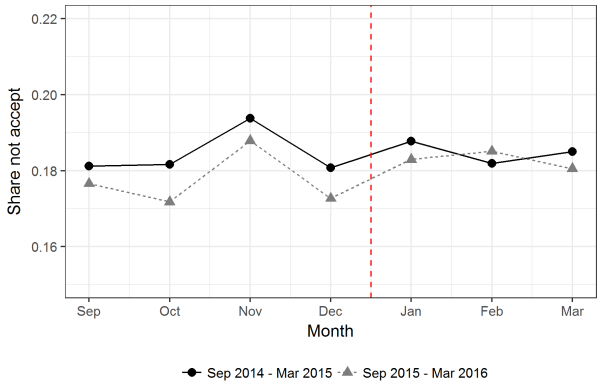
have had an impact an the observed outcomes (See section 3.3). I can not rule out that any bank internal changes would affect consumer behavior simultaneously with the change in regulation. Additionally, any event that causes a change in the borrower composition in the January 2016 may bias the estimate. Appendix Table 3.A3 presents the difference-in-differences development of each loan and borrower characteristic. While some measures (e.g. the share of households with kids) did not follow a parallel trend, for most variables parallel trends exist.

Second, the parallel trend assumption requires that there are no unobserved characteristics affecting the two groups differently. Using the trend from the previous year as control group captures seasonal trends. But it is prone to shocks affecting only one group that may bias the DiD estimate. The assumption can be confirmed visually. Figure 3.7 displays the trends of the two outcome variables over the observed months. For non-acceptance, the lines follow a parallel pre-trend and non-acceptance seems to increase slightly in 2016. For cancellation, trends are parallel apart from a drop in December 2015.

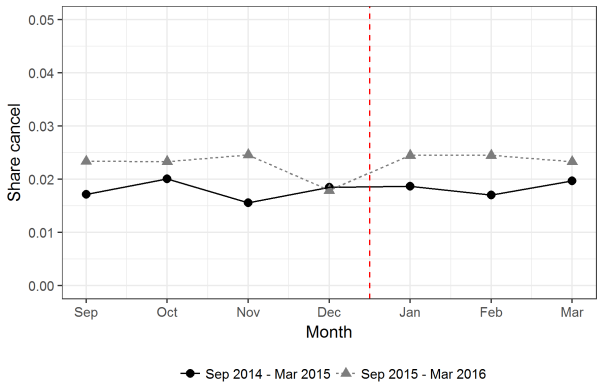
Figure 3.7: Trend in Non-acceptance and Cancellation

The figures depict the trend in monthly average non-acceptance (cancellation) rate from September 2015 to March 2016 compared to the period September 2014 to March 2015.

(a) Non-acceptance



(b) Cancellation



3.5.2 Average Treatment Effect

Table 3.3 displays estimates of the difference-in-differences model of the effect of the extended cooling-off period for the outcome variables *Not accept* and *Cancel*. Columns (1) and (3) present baseline results without any control variables. Columns (2) and (4) show estimates that control for month and bank fixed effects as well for a vector of household and application controls. No statistically significant effect of the extension of the cooling-off period is observed for the full sample.

Table 3.3: Difference-in-differences: Full sample

The table presents estimates for the effect of the extension in cooling-off period using a difference-in-differences approach. The dependent variables are binary equal to one if a customer did not accept a loan offer (*Not accept*) or if an accepted offer is reported as canceled (*Cancel*). Month and Bank FE controls for month and bank fixed effects. The vector of control variables controls for Offered amount, Offered maturity, Offline, Income groups, Age groups, Female, Single, Married, Kids, Employed, Self-employed and Canton dummies. ***, **, * denote significance at the 1, 5 and 10% level respectively.

	Dependent variable:			
	Not accept		Cancel	
	(1)	(2)	(3)	(4)
Post x Affected	0.005	0.006	0.001	0.001
	(0.005)	(0.004)	(0.002)	(0.002)
Post	0.001	0.002	0.001	0.002
	(0.003)	(0.005)	(0.001)	(0.002)
Affected	-0.007^{**}	-0.009^{***}	0.005^{***}	0.003^{***}
	(0.003)	(0.003)	(0.001)	(0.001)
Mean of outcome	0.182	0.182	0.021	0.021
Month + Bank FE	No	Yes	No	Yes
Controls	No	Yes	No	Yes
Observations	118,484	118,484	96,891	96,891
R^2	0.0001	0.030	0.0003	0.023

3.5.3 Heterogeneous Treatment Effects

This section performs subsample estimates of the previously specified analysis. The selected subsamples were predefined in the preanalysis plan and motivated in section 3.2.

Impulsive behavior

Impulsive behavior, present-biased preferences or emotionally "hot" states (Camerer et al., 2003) of consumers provide an economic rationale for cooling-off periods. As illustrated in section 3.2, an extension of a cooling-off period would only affect consumer decisions if the additional days improve the customer's ability to reduce error ϵ. Additionally, we cannot differentiate between a reduction in error ($\epsilon' - \epsilon''$) and a change in net benefit due to the longer waiting period ($\mu' - \mu''$). Only if $\mu' + \epsilon' > \mu'' + \epsilon''$ holds, an effect would be observed. In models with a present-biased agent (e.g. Laibson (1997b)), a one-period cooling-off period should be sufficient for an impulsive consumer to reverse time-inconsistent decisions. I group households according to observable characteristics into two groups with high and low likelihood for present-biased behavior. Based on descriptive statistics in Meier and Sprenger (2010), the group with high likelihood contains households that meet the following characteristics: <25 years, male, lowest 2 income brackets, single and no kids. The low likelihood group contains households with the following characteristics: 35-55 years, highest 2 income brackets, married with kids.

Table 3.4 displays results for the difference-in-differences approach for the subsamples *Low PB* (households with low propensity for present bias) and *High PB* (Households with high propensity for present bias). Results do not show any statistically significant effect of the extended cooling-off period on *Not accept* or *Cancel* for these subsamples. Hence, there is no evidence that the extended cooling-off period has caused an increase in contract cancellations and I cannot reject the null hypothesis for the previously stated hypothesis 2.

Shopping around

A cooling-off period may influence the distribution of negotiation power between borrowers and lenders since customers have additional time to shop for a better alternative and it may affect business practices in an industry (Loewenstein et al., 2003) since a customer can reconsider an accepted offer. To analyze a potential heterogeneous effect for clients who invest more search effort, I compare loan offers to households with an open loan application at another lender to households without an open application. For a subsample of loans, the dataset contains information on the existence of loan applications at other banks. The information stems from the central loan register and can be

Table 3.4: Difference-in-differences: Subsamples by likelihood for present bias

The table displays estimates of the effect of the extension in cooling-off period using a linear propensity model and a difference-in-differences approach for subsamples. The dependent variables are binary equal to one if a client did not accept a loan offer (*Not accept*) or if an accepted offer is reported as canceled (*Cancel*). *Low PB* contains loan offers to households that have based on observed characteristics a low likelihood for present-biased behavior. *High PB* contains loan offers to households that have a high likelihood for present-biased behavior. Month and Bank FE controls for month and bank fixed effects. The vector of control variables controls for Offered amount, Offered maturity, Offline, Income groups, Age groups, Female, Single, Married, Kids, Employed, Self-employed and Canton dummies. ***, **, * denote significance at the 1, 5 and 10% level respectively.

	Dependent variable:			
	Not accept		Cancel	
	Low PB	High PB	Low PB	High PB
	(1)	(2)	(3)	(4)
Post x Affected	0.015	0.013	0.004	0.007
	(0.010)	(0.023)	(0.003)	(0.010)
Post	0.006	0.014	−0.001	0.001
	(0.011)	(0.025)	(0.003)	(0.011)
Affected	−0.022***	−0.007	0.006***	−0.009
	(0.007)	(0.016)	(0.002)	(0.007)
Mean of outcome	0.196	0.233	0.015	0.029
Month + Bank FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	23,194	5,391	20,960	4,365
R^2	0.023	0.041	0.021	0.035

accessed by banks. The measure is a proxy for households' search efforts. In the observed period, only 10% of loan offers go to households that have an open application at another supplier. Thus, only few households seem to compare loan offers.[25] Households that file a second application have a clearly higher rate of non-acceptance (42.3% vs. 20.4% for households without another application).

Table 3.5 displays estimates of the difference-in-differences approach for the sample for which the variable *2nd Application* is available. Columns (1) and (4) present results for all observations. Results for the subsample with a second application are displayed in columns (2) and (5). Columns (3) and (6) display estimates for the subsample without another application. Overall, there is no statistically significant estimate. The point estimate in column (2) is with 3.9 percentage points large, but not statistically significant. Thus, results do not provide evidence that the extended cooling-off period had a heterogeneous effect on households by provided search effort.

[25]This is in line with evidence from the Swiss mortgage market that shows that only a low share of households obtains offers from more than one lender (Brown and Hoffmann, 2016)

Table 3.5: Difference-in-differences: Subsamples by 2nd Application

The table displays estimates of the effect of the extension in cooling-off period using a linear propensity model and a difference-in-differences approach for subsamples by having an open loan application with another bank. The dependent variables are binary equal to one if a client did not accept a loan offer (*Not accept*) or if an accepted offer is reported as canceled (*Cancel*). Month and Bank FE controls for month and bank fixed effects. The vector of control variables controls for Offered amount, Offered maturity, Offline, Income groups, Age groups, Female, Single, Married, Kids, Employed, Self-employed and Canton dummies. ***, **, * denote significance at the 1, 5 and 10% level respectively.

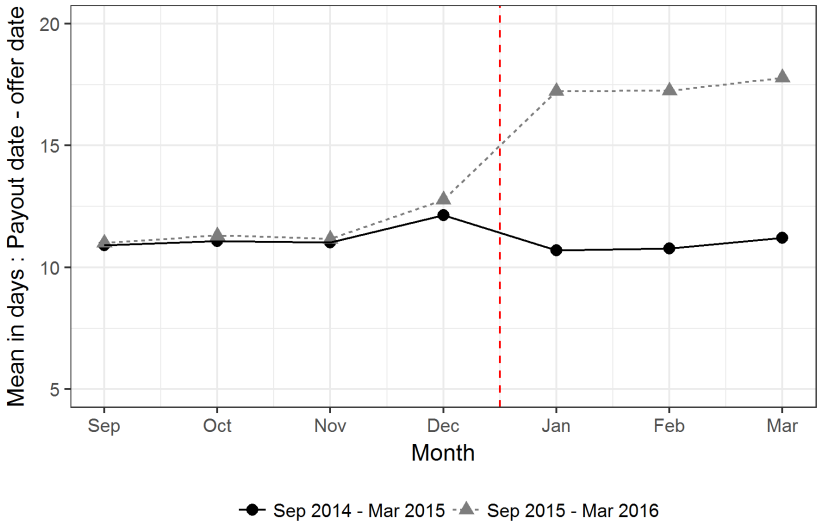
	Dependent variable:					
	Not accept			Cancel		
	All	2nd Application	No 2nd Application	All	2nd Application	No 2nd Application
	(1)	(2)	(3)	(4)	(5)	(6)
Post x Affected	0.009	0.039	0.007	0.002	0.001	0.002
	(0.006)	(0.024)	(0.007)	(0.002)	(0.007)	(0.002)
Post	−0.002	0.051*	−0.007	−0.001	0.004	−0.001
	(0.007)	(0.027)	(0.007)	(0.002)	(0.007)	(0.002)
Affected	−0.015***	−0.025	−0.014***	0.005***	0.011***	0.005***
	(0.004)	(0.016)	(0.004)	(0.001)	(0.004)	(0.001)
Mean of outcome	0.227	0.423	0.204	0.008	0.011	0.007
Month + Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	68,082	7,007	61,075	52,658	4,044	48,614
R^2	0.013	0.023	0.011	0.013	0.037	0.012

Preference for fast access to funds

The simple theory framework illustrated, that non-acceptance may increase for households with the strongest difference between the value of the loan after the old cooling-off period (μ') and the value of the loan after the extended cooling-off period (μ''). Banks pay out loans only after the cooling-period. Figure 3.8 displays the monthly average time span between the loan offer date and the disbursement date for accepted loans for September to March. It shows that the average time span increased by 6.5 days from 11 to 17.5 days in January 2016 indicating that loans are only disbursed after the cooling-off period has expired. While banks could legally disburse loans during the cooling-off period, a disbursed and canceled contract would likely cause high administrative efforts.

Figure 3.8: Extension of cooling-off period: Effect on days to payout

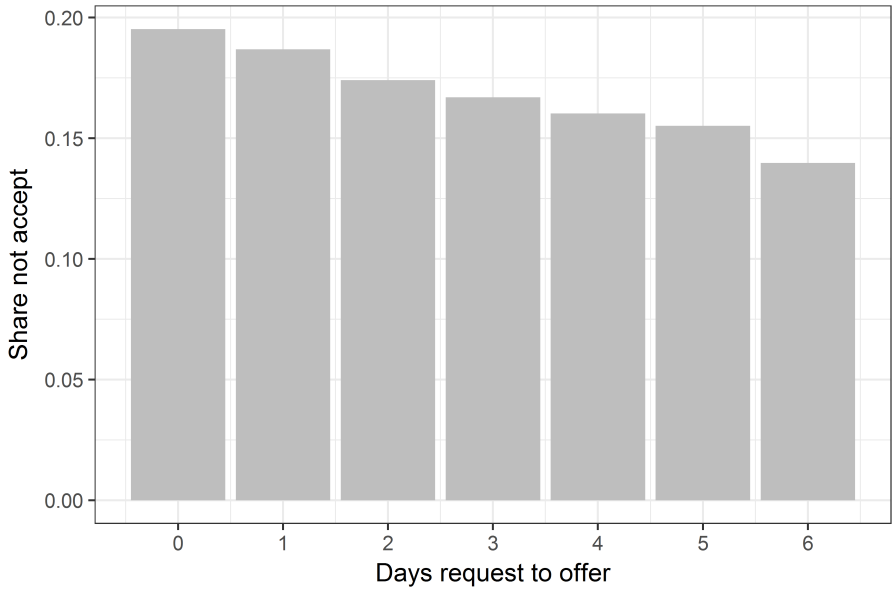
The figure depicts the trend in the monthly average time span from offer data to payout date for disbursed loan offers regulated by CCA.



In this section, I aim to identify subsamples of households that experience the strongest loss from the delayed payout. Apart from the duration of the cooling-off period, the processing time within the bank affects the time span from the application until a client can access and spend the loan amount. The processing time is likely related to borrowers' quality and therefore also to borrowers' decisions. Figure 3.9 shows non-acceptance by the processing time which is defined by the offer date minus the request date. There is a clear negative correlation observed: Non-acceptance decreases with additional days

to process the request.[26] The correlation is likely driven by underlying differences in borrower characteristics: More risky or opaque borrowers require additional processing time. Appendix Table 3.A7 shows non-acceptance by processing time and subsample. Differences are largest by income and application channel. The issue of unobserved characteristics affecting processing time and non-acceptance however remains.

Figure 3.9: Share of offers not accepted by processing time



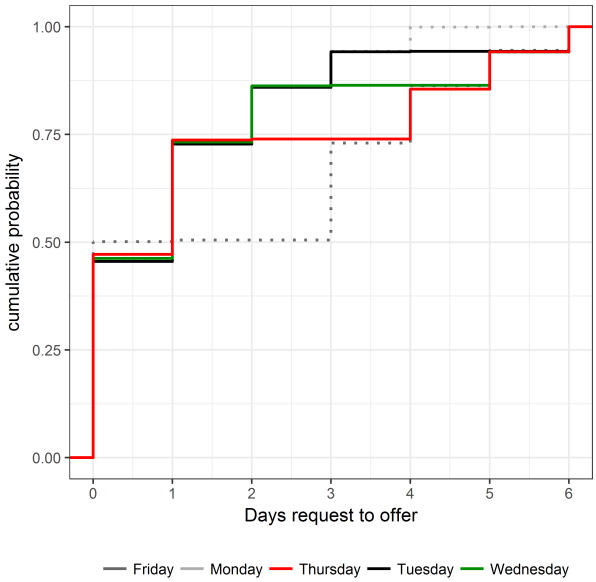
It requires exogenous variation in the processing time to obtain an understanding on which households react strongest to delays. I instrument the processing time with the application's day of the week to obtain an estimate of how an increase in processing time affects non-acceptance. Applications filed closer to the weekend have a higher propensity to be delayed by the weekend and therefore to result in a longer processing time.[27]

Two crucial assumptions underly the strategy: First, in order to have a strong instrument, the day of the week needs to be strongly correlated with the processing time. Figure 3.10 displays the CDF of processing time by weekday. Apart from Friday, all days follow a nearly equal path. The occurrence of the weekend then delays unprocessed applications by two days. On day 5, the shares processed convert again. Panel A in Table 3.6 shows the first stage of the instrumental variable estimation. It is strongly statistically significant and hence the first assumption holds.

[26]Based on the sample of applications that result in an offer within 6 days, 46% result in an offer the same day, 23% take one day, 9% two days, 8% three day, 15% four to six days

[27]I analyzed the potential use of regional holidays such as May 1st to obtain exogenous variation in processing time. However, the first stage does not show a strong statistically significant correlation. Thus, the instrument is not valid.

Figure 3.10: Share of offers not accepted by time from request to offer



Second, the exclusion restriction requires that the weekday of an application is not related to any unobserved offer or borrower characteristics that affect non-acceptance. Appendix Table 3.A6 presents means for household and loan offer characteristics by weekday. The characteristics are nearly identical. In order to reduce doubt pertaining to the exclusion restriction, I focus the IV analysis on applications filed from Tuesday to Thursday.[28] In order to avoid any potential influence of the policy change, the IV estimation is performed for the pre-2016 sample.

Panel A in Table 3.6 presents results of the baseline estimation and estimates of the 2SLS IV approach. Panel B shows results of IV estimations for subsamples. Weekday is a continuous variable ranging from 2 (Tuesday) to 4 (Thursday). Column (1) displays the previously discussed negative correlation in the OLS specification. Columns (2) and (3) present the IV estimates. The 2SLS estimates suggest that a one-day increase in processing time increases non-acceptance by 1.9 percentage points. It is however important to keep in mind that the estimate represents a local average treatment affect (LATE) for applications that were affected by the distance to the weekend.

[28]Monday is typically a resting day in the hospitality industry. Friday is the most common day for home office. To reduce the potential influence of outliers, I focus the analysis on requests processed within 7 days. Results are robust to varying the maximum processing time in the sample. In an unreported estimation, processing time is instrumented by day dummy variables yielding nearly equal estimates. Including Monday and Friday in the analysis yields comparable results. Especially observations from Friday may contain defiers if lenders aim to process as many observations as possible before the weekend.

Table 3.6: Processing time and non-acceptance: Instrumental variable estimation

Panel A displays the baseline OLS estimate of the correlation of *Days request to offer* and *Not accept* (1). Columns (2) and (3) display the first and second stage of the IV estimation for the full sample. Panel B displays IV estimates for subsamples. Month and Bank FE controls for month and bank fixed effects. The vector of control variables controls for Offered amount, Offered maturity, Offline, Income groups, Age groups, Female, Single, Married, Kids, Employed, Self-employed and Canton dummies. ***, **, * denote significance at the 1, 5 and 10% level respectively.

PANEL A: Baseline OLS estimates and 2SLS IV estimates

	Not accept	Days request to offer	Not accept
	OLS	IV 1.stage	IV 2.stage
	(1)	(2)	(3)
Days request to offer	−0.012***		0.019***
	(0.001)		(0.007)
Weekday		0.190***	
		(0.007)	
Mean of outcome	0.186	1.294	0.186
Month + Bank FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	110,552	110,552	110,552

PANEL B: 2SLS IV estimates for subsamples

	Not accept				
	By channel		By loan amount		
	Online	Offline	<=14k	14-28k	28-80k
	(4)	(5)	(6)	(7)	(8)
Days request offer	0.024*	0.018**	0.010	0.025*	0.025*
	(0.015)	(0.009)	(0.012)	(0.014)	(0.013)
Mean of outcome	0.174	0.189	0.164	0.192	0.204
Month + Bank FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observations	18,610	91,942	39,047	36,893	34,612

Panel B shows IV estimates for subsamples by channel and loan amount.[29] The loan offers are grouped into tertiles by loan amount. Estimates suggest that non-acceptance of households with loan offers resulting from applications filed online and with offers for larger loan amounts are most affected by an increase in processing time. Hence, these groups are expected to be most affected by the extended cooling-off period.

I now run the main analysis for the previously identified subsamples.[30] Online applicants and applications in the 2nd and 3rd loan amount tertile have the strongest preference for fast access to funds compared to the group of offline applications or the 1st loan amount tertile. Table 3.7 provides estimates of the influence of the extended cooling-off period for these subsamples using the difference-in-differences approach. Column (1) and (2) show that non-acceptance increased for online applications by 2.2 percentage points while no change is observed for applications filed offline. Estimates for subsamples by loan amount show that no statistically significant effect is observed for small and medium sized loans. For the largest volumes (> CHF 28,000), column (5) reports a 1.6 percentage point higher non-acceptance after the introduction of the extended cooling-off period. Based on the theoretical prediction, the channel should only affect non-acceptance but not cancellation. In line with the prediction, columns (6) - (10) do not display any statistically significant effect on the propensity to cancel an accepted loan offer.

Given the large market share of the dataset, it is unlikely that the observed effect would be driven by borrowers substituting the observed banks with alternative loan suppliers. The available dataset does not allow to analyze whether personal loans were substituted with alternative financing options (e.g. family and friends) or whether the increased non-acceptance resulted in households fully abstaining from the planned purchase. Thus, the analysis provides only suggestive evidence of the effect on the propensity to take up a loan offer but not on the effect on consumption.

[29] In an unreported analysis, IV estimates for subsamples by age and income were obtained. There is not heterogeneity observed for these factors.

[30] I analyzed household characteristics by the stated reason for consumer finance (SILC survey data (BFS)) to obtain an understanding for the underlying reasons to take a loan in the subsamples. Unfortunately, the dataset does not contain any information on amount, maturity or channel of application. Financing cars and furniture are the most commonly stated reasons. Based on the available information, there is little difference in household income by reasons. Households that use a personal loan for furniture are more often married with children.

Table 3.7: Difference-in-differences: Subsamples by preference for access to funds

The table displays estimates of the effect of the extension in cooling-off period using a linear propensity model and a difference-in-differences approach for subsamples. The dependent variables are binary equal to one if a client did not accept a loan offer (*Not accept*) or if an accepted offer is reported as canceled (*Cancel*). Month and Bank FE controls for month and bank fixed effects. The vector of control variables controls for Offered amount, Offered maturity, Offline, Income groups, Age groups, Female, Single, Married, Kids, Employed, Self-employed and Canton dummies. ***, **, * denote significance at the 1, 5 and 10% level respectively.

	Dependent variable:				
	Not accept				
	By channel		By loan amount		
	Online	Offline	<=14k	14-28k	28-80k
	(1)	(2)	(3)	(4)	(5)
Post x Affected	0.022**	0.002	0.004	0.0003	0.016**
	(0.010)	(0.005)	(0.007)	(0.008)	(0.008)
Post	−0.019*	0.007	−0.003	0.002	0.004
	(0.011)	(0.005)	(0.008)	(0.009)	(0.009)
Affected	−0.011*	−0.008**	−0.001	−0.009	−0.018***
	(0.007)	(0.003)	(0.005)	(0.005)	(0.005)
Mean of outcome	0.164	0.187	0.163	0.189	0.195
	Cancel				
	By channel		By loan amount		
	Online	Offline	<=14k	14-28k	28-80k
	(6)	(7)	(8)	(9)	(10)
Post x Affected	−0.003	0.003	0.002	0.001	0.001
	(0.006)	(0.002)	(0.003)	(0.003)	(0.003)
Post	0.003	0.002	0.005	−0.001	0.004
	(0.006)	(0.002)	(0.004)	(0.004)	(0.003)
Affected	−0.0004	0.004***	0.004	0.003	0.004**
	(0.004)	(0.001)	(0.002)	(0.002)	(0.002)
Mean of outcome	0.043	0.015	0.024	0.021	0.016
Month + Bank FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

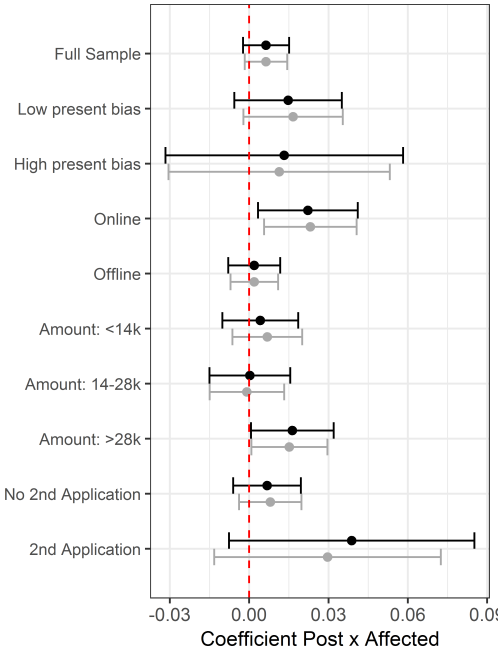
3.5.4 Robustness

The selection of the time window is a major concern when interpreting the results. The market undergoes a major change starting in April with the reduction of the maximum interest rate. It is therefore difficult to make a statement whether observed changes in non-acceptance in the subsample persist over time. Figure 3.11 plots estimates of the interaction term *Post* x *Affected* for the full sample and for the analyzed subsamples for the time window September to March (black) and for the time window September to April (gray). Estimates remain robust also when the window in extended to April 2016.

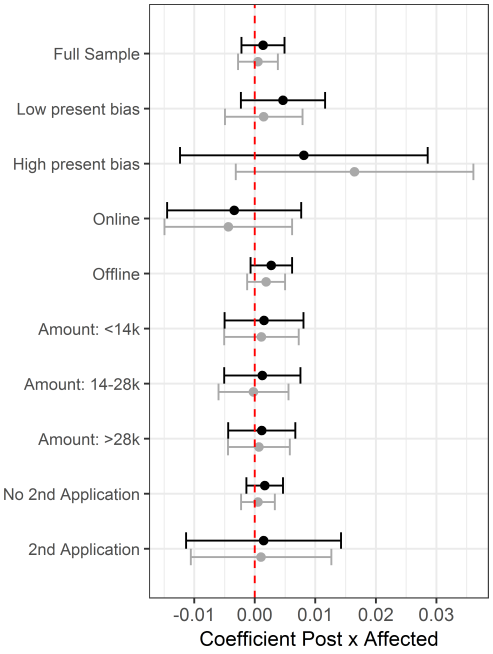
Figure 3.11: Robustness: Extending the window from March to April

The graphs present coefficients for the variable *Post x Affected* for the full sample and specific subsamples. The baseline estimates covering the months Sep - Mar are displayed in black. Estimates for the sample covering Sep - Apr are displayed in dark gray. 95%-CI are shown as bars around the coefficients.

(a) Non-acceptance



(b) Cancellation



3.6 Conclusion

This paper studies non-acceptance and contract withdrawal for personal loans in Switzerland. Using a detailed dataset covering three quarters of the Swiss personal loan market, the paper analyses the use of the cooling-off period and the impact of its extension from 7 to 14 days in January 2016.

The descriptive evidence from the dataset suggests that offer non-acceptance absorbs most customers with a negative net benefit from taking the loan. While 17.3% of customers do not accept the loan, the cooling-off period is rarely used (<0.6% of accepted offers).

The analysis of the influence of the extended cooling-off period from 7 to 14 shows no effect on non-acceptance and cancellation in the full loan offer sample. I analyze heterogeneous treatment effects for subsamples that were defined in a preanalysis plan. Applying the same difference-in-difference strategy, estimates for subsamples by the proneness to present bias or search effort do not show any statistically significant effect. As banks disburse loans only after the cooling-off period, the extension led to a longer waiting period between loan application and loan disbursement. Analyzing subsamples by the preference for fast access to funds shows increasing non-acceptance for subsamples with a strong preference for fast access. These findings suggest that households with a strong preference for fast access to funds increase non-acceptance of loan offers.

Consumer financial protection has gathered considerable attention among policy makers since the financial crisis. This paper provides a case study of one regulatory tool, the cooling-off period, for personal loans. The findings suggest that the extension of the cooling-off period from 7 to 14 days did not increase consumer protection but rather increased the cost of regulation for certain customer groups. The paper does not study the case without cooling-off period and can therefore not make a statement on the effects of the cooling-off period overall that may go well beyond the observed consumer decisions (e.g. effect on market practices). When interpreting the usage of the cooling-off period, it is important to keep in mind the features of the observed market. For the median borrower, loan volumes represent approximately 30% of annual income and loans are typically spent for durable goods such as cars and furniture. The usage of the right to withdraw and the share of present-biased decisions may clearly differ in a market catering to short-term consumption and with small volumes.

Chapter 4

Numeracy and the Quality of on-the-job Decisions: Evidence from Loan Officers

Martin Brown, Karolin Kirschenmann & Thomas Spycher

Abstract

We examine how the numeracy level of employees influences the quality of their on-the-job decisions. Based on an administrative dataset of a retail bank we relate the performance of loan officers in a standardized math test to the accuracy of their credit assessments of small business borrowers. We find that loan officers with a high level of numeracy are more accurate in assessing the credit risk of borrowers. The effect is most pronounced during the pre-crisis credit boom period when it is arguably more difficult to pick out risky borrowers.

4.1 Introduction

Employers in a broad range of industries place significant weight on the numerical skills of job applicants when hiring new employees. Numerical skills are also associated with better labor market outcomes among workers (Koedel and Tyhurst (2012); Joensen and Nielsen (2009)). These two observations suggest that employees with strong numerical skills are more productive or make better on-the-job decisions. Numerical skills themselves may foster better decision making as employees are better able to draw meaning from numerical information (Peters et al., 2006). Alternatively, numeracy may be correlated with other personal traits – IQ or social skills – which improve decision speed or quality (Burks et al., 2009). While it is plausible that high levels of numeracy are associated with better job-related decision making, there is almost no empirical evidence to support this conjecture.

This paper empirically examines the relation between employee numeracy and the quality of on-the-job decisions. Our analysis focuses on decisions made by loan officers in a retail bank. A key task of loan officers is the screening of loan applicants, i.e. the assessment of the borrowers' creditworthiness.[1] We study how the numeracy of loan officers relates to the accuracy of their credit assessments of small business borrowers: Are loan officers with high numeracy better able to identify those borrowers who ex-post turn out to be risky? With the unique dataset provided by the bank we are able to match loan officers' performance in a standardized numeracy test with data on all loan applications that they process (before the test). The loan-level data contain information on the requested loan terms, the borrower, the initial credit assessment by the loan officer, the approval decision and, for the approved loans, the granted loan terms as well as regular updates of the loan performance. The sample period 2007 – 2010 further allows for the analysis of a heterogeneous influence of numeracy during a credit boom and bust phase.

Small business lending provides an ideal framework to study the relationship between numeracy and the quality of on-the-job decision making. The production and processing of information is a core function of financial intermediaries (Diamond, 1984). Two key features of small business lending allow us to study the importance of loan officer nu-

[1] Apart from client acquisition and advising customers, the US Bureau of Labor Statistics mentions the gathering, verification and analysis of applicants' information and the loan approval decision as typical tasks of a loan officer (see http://www.bls.gov/ooh/business-and-financial/loan-officers.htm).

meracy in this function. First, the lending methodology applied by most small business lenders leaves discretion to the individual loan officer in screening potential borrowers (Berger and Udell, 1995). The screening process requires loan officers to collect, verify and assess both quantitative and qualitative information. Loan officers' skills can strongly influence the collection or processing of information. Hence, differences in skills across loan officers should translate into a difference in the quality of client screening. Second, loan officers make a large number of comparable lending decisions for which outcomes are quantitatively measurable. By comparison, for most skilled professionals on-the-job performance is difficult to measure and hardly comparable across employees.

We face two identification challenges when studying the relation between loan officer numeracy and the accuracy of credit assessments: First, the assignment of loan applications to loan officers is hardly random – and is likely to be related to loan officers' numeracy levels. A profit maximizing bank should allocate the most skilled loan officers to those tasks where their skills can generate the highest profit.[2] Intuitively we would expect banks to allocate those loan applications which are more difficult to assess to their most skilled loan officers. In this case, our estimates of the effect of numeracy on the screening accuracy could be downward biased. However, it is also feasible that the allocation of loan applications is driven by borrower characteristics that most strongly influence the bank's profit but that, at the same time, make the assessment easier. For instance, the most skilled loan officers might be assigned to larger clients, which also have more accurate financial information, leading to an upward bias of our estimates. The detailed loan-level data at hand help us to account for differences in borrower and application characteristics which may confound the relationship between loan officer numeracy and the accuracy of credit assessments.

Second, other loan officer characteristics such as education, age, gender, or job experience might be correlated with both loan officers' numeracy level and their screening accuracy. Our estimates may therefore suffer from an omitted variable bias and represent a spurious relationship between numeracy and screening accuracy. Our administrative dataset includes information on education, age, gender and experience which allows us to control for these confounding loan officer characteristics.

Our results show that loan officers with higher numeracy make more accurate credit

[2]Fang et al. (2014) show that fund families allocate their most skilled managers to less efficient market segments. In less efficient markets skills have the highest reward and the allocation maximizes profits.

assessments. Accuracy is hereby measured by the discriminatory power of the ex-ante risk scores assigned by loan officers: Those borrowers classified as risky ex-ante are more likely to fall into payment arrears ex-post than those borrowers classified as less risky. Subsample analyses suggest that numeracy is especially important for accuracy in the pre-crisis credit boom when information asymmetries seem strongest. Before the crisis, high numeracy loan officers are clearly better able to discriminate borrowers by their creditworthiness than low numeracy loan officers. This difference in accuracy between loan officers with high and low numerical skills decreases in the crisis period due to a considerable improvement in the accuracy of low numeracy loan officers.

Previous research has shown that numeracy is correlated with an array of cognitive and social skills which may prove essential in the screening of small and opaque borrowers. Individuals with higher numeracy seem less prone to framing effects (Peters et al., 2006), and seem better able to anticipate social behavior (Burks et al., 2009). Thus, loan officers with higher levels of numeracy can be expected to be more accurate in verifying and interpreting hard information as well as evaluating soft information. Individuals with higher numeracy have also been found to be more patient (Frederick (2005); Burks et al. (2009)), which might imply that they are better able to take the longer-term future into account when assessing borrowers' credit risk. Our happenstance data does not allow us to disentangle the effect of pure numerical skills, i.e. the ability to understand and work with numbers and to do logical reasoning, from correlated personal traits, such as general cognitive ability or social skills. However, our results highlight that a simple test which captures numerical skills and correlated personal traits can be used to identify employees with better decision making skills.

Our findings contribute to a broader literature in finance, economics and psychology that analyzes how numerical skills affect corporate and personal[3] decision making as well as labor market performance. Experimental research provides evidence that numeracy influences strategies used for decision making and the quality of the decisions taken. Individuals with higher numeracy have superior judgment abilities Ghazal et al. (2014) and are more likely to choose the normatively better option with a higher expected value (Pachur and Galesic, 2013).

Empirical studies based on field data document that numeracy, cognitive skills and

[3] See Reyna et al. (2009) for an overview on health decisions.

financial literacy are associated with better personal financial decisions. Investors with higher IQ are able to select mutual funds with lower fees (Grinblatt et al., 2015), are less prone to the disposition effect and are able to generate higher returns (Grinblatt et al., 2012). Individuals with lower financial literacy more frequently transact in high-cost manners, e.g., they pay higher credit card fees or use more high-cost debt (Lusardi and Tufano, 2015). Gerardi et al. (2013) document significantly higher mortgage default rates among individuals who are not able to perform basic mathematical calculations. And, in a sample of members of the US military, Agarwal and Mazumder (2013) find that a higher math test score is associated with fewer personal finance mistakes related to credit card use and home equity loans compared to other skills tested in the Armed Forces Qualifying Test (AFQT).

Labor economics provides evidence that employers value math skills in the hiring process (Koedel and Tyhurst, 2012) and that more mathematical education results in better labor market outcomes (Joensen and Nielsen, 2009).[4] These findings support the conjecture that employees with high numeracy are more productive and make better on-the-job decisions. However, to our knowledge, there is only one study connecting a concept related to numerical skills to job performance.[5] Burks et al. (2009) find that truck drivers with higher cognitive skills are more likely to avoid planning mistakes that could lead to performance failures such as arriving late for deliveries. Our study extends the literature by providing unique evidence for the effect of numeracy on on-the-job performance among skilled professionals.

Our findings also contribute to a strand in the empirical banking literature which studies the role of loan officers in bank internal decision making. Recent studies have analyzed the influence of internal organization (e.g. Liberti and Mian (2009); Hertzberg et al. (2010); Brown et al. (2015); Qian et al. (2015)) and incentives (e.g. Agarwal and Ben-David (2018); Berg (2015); Cole et al. (2015)). Other papers focus on loan officers' characteristics that might explain why certain loan officers perform better within

[4]Joensen and Nielsen (2009) show that higher earnings are mainly the results of differences in career paths and not of differences in earnings of individuals following a comparable career path.

[5] A recent literature analyses the importance of CEO traits and skills for performance. Custódio and Metzger (2014) show that CEOs' financial expertise is correlated with differences in firms' financial policies that benefit performance. Kaplan et al. (2012) study CEOs involved in private equity deals and document a positive correlation between their skills (performance in a general ability test and execution skills) and their performance. Further, a related strand of literature analyzes the impact of fund manager skills on fund performance (e.g. Chevalier and Ellison (1999); Li et al. (2011).

a given organizational and incentive structure. Existing work looks at the influence of loan officers' gender (Beck et al., 2013), experience (Andersson (2004); Bruns et al. (2008)), education (Bruns et al., 2008) and traumatic experiences (Morales-Acevedo and Ongena, 2015). We add to this literature by documenting an important role of loan officers' numerical skills for the quality of lending decisions.

Finally, we contribute to the recent literature which examines lending standards over the business cycle (e.g. Berger and Udell (2004); Dell'Ariccia and Marquez (2006); Dell'Ariccia et al. (2012); Beck et al. (2018)). In line with Becker et al. (2017), we provide evidence for a lower accuracy of internal risk ratings during the credit boom, pointing towards higher information asymmetries. We add to the literature by showing that loan officer skills are most important during this boom phase with strong information asymmetries.

The remainder of this paper is organized as follows. In section 2, we describe the institutional background and in Section 3 we derive hypotheses from the existing literature. In section 4 we describe our data, while we explain our methodology in section 5. We present our results in section 6 and conclude in section 7.

4.2 Institutional Background

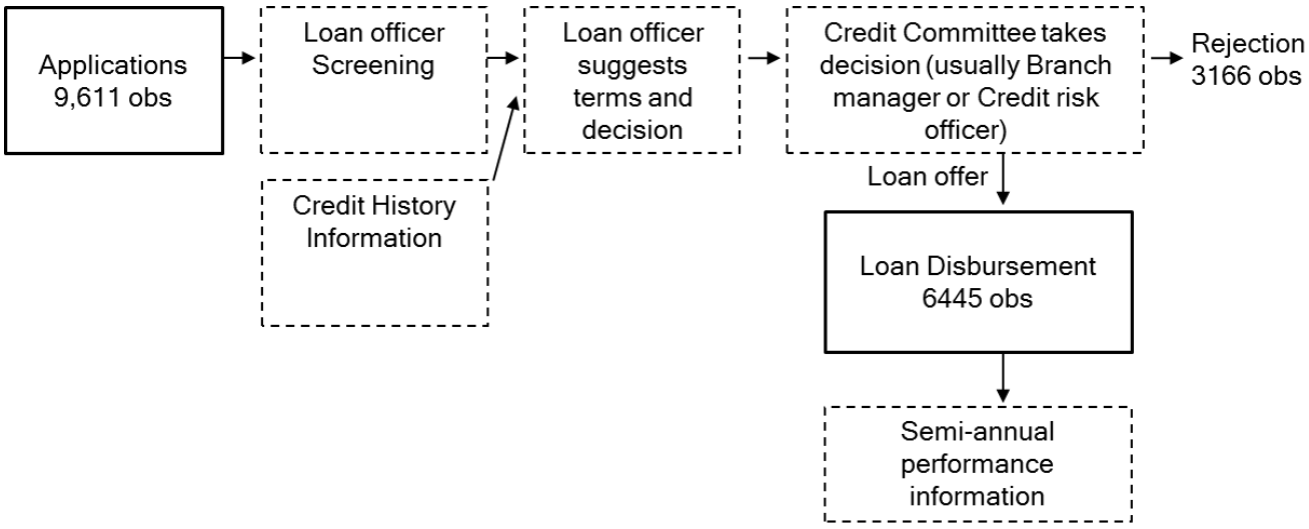
4.2.1 The bank and its lending process

The bank that provided us with the data is a country-wide retail bank in Romania. It is part of an international banking group and serves mainly micro and small enterprises as well as households. The bank does not substantially differ in terms of business practices and loan products from small US or other European commercial banks which specialize in relationship lending to small businesses. One potential difference to some commercial lenders is the incentive structure of the bank: The bank regularly agrees with branch managers and loan officers on performance goals. However, while the achievement of these goals may affect the career path of employees within the bank, goal achievement is *not* financially incentivized through performance pay.

Our analysis focuses on first-time loans to small businesses with amounts of up to 30,000 Euro. These "micro" loans make up the bulk of the bank's loan portfolio. The credit assessment and approval process for these loans follows a standardized process

which is illustrated in Figure 4.1.[6]

Figure 4.1: Lending process



In a first step, prospective borrowers fill in a paper-based application form and submit it to the closest bank branch. For first time borrowers, the application is filled out without loan officer involvement and is therefore not influenced by loan officer skills. Clients state their requested amount, requested currency and requested maturity and provide information on the loan purpose, other bank relationships as well as the ownership structure and the free cash flow or disposable income of the firm.

Each loan application is then assigned to a loan officer within the branch where the borrower submitted the application. The allocation of an application to a loan officer is first and foremost based on loan officers' available capacity. That said, our data reveals that some loan officers do have an industry focus or tend to process predominantly requests of either small or large volumes.

In a second step, the assigned loan officer screens the application. During an on-site visit, the loan officer verifies the quantitative information provided in the application such as accounting data that allow for the computation of disposable income or free cash flow. Further, the loan officer assesses collateral values, the entrepreneur's character and overall managerial quality as well as the market outlook for the business. Concurrently,

[6] Our description of the lending process is based on extensive interviews with loan officers and credit risk managers of the bank.

the bank's back office provides credit registry information on the borrower to the loan officer.[7] It is important to note that many of the banks' first-time micro loan applicants have never had another bank loan before and henceforth no credit registry information exists. If information is available it becomes part of the credit risk assessment. The bank has a policy that loans with very negative credit registry information (e.g., the days of arrears within the last two years are above a certain threshold) or with clearly poor financial information are rejected as early as possible in the screening process. For all other loan applications the loan officer enters the collected qualitative (managerial quality and market outlook) and verified quantitative information into a standardized spread sheet to retrieve the initial risk score. Generally, the risk score can take on values from 1 (lowest risk class) to 5 (highest risk class). However, the bank's policy is to reject first loan applications with an initial risk score exceeding 3. Accordingly, we only observe initial risk scores from 1 to 3 and treat firms with initial scores other than 1 as risky.

In a third step, the loan officer suggests loan terms (volume, currency, maturity) and recommends the lending decision to the credit committee.[8] For the majority of loan applications in our sample there are two members in the credit committee: the branch manager and the loan officer. The credit committee evaluates the provided information, verifies the risk score, reviews the loan officer's suggestion and makes a final lending decision.

In case of a positive lending decision (70 percent of the applications) and if the client accepts the loan terms (95 percent of the offered loans), the loan is disbursed and the repayment performance reported semi-annually.

4.2.2 The numeracy test

To perform the credit assessment described above loan officers require diverse skills. We have an indicator of loan officers' numerical skills in the form of a score on a math test conducted in February 2010. All loan officers employed at that date were obliged to take the test at the same time at selected locations in the country. The test was announced on short notice so there was limited time for preparation. Passing the math test (there was an option to retake the test) was a requirement for the continuation of the employment

[7] Unfortunately, we do not have access to the credit registry information.

[8] Interest rates are largely standardized for the loans in our sample (as is the usual practice with micro loans), i.e. that they are mainly determined by the size of the loan and are not fully risk-adjusted.

relationship. The math test was prescribed by the international banking group to all its subsidiaries worldwide and thus can be considered as exogenous to the Romanian subsidiary – and its loan officers - which we study. The test measured basic numerical skills on the level of high school math covering percentage calculations, probability theory, logic and geometric understanding and equations.[9] Thus, the test is a comprehensive measure of numeracy comparable to tests discussed in Ginsburg et al. (2006).

4.2.3 The economic environment

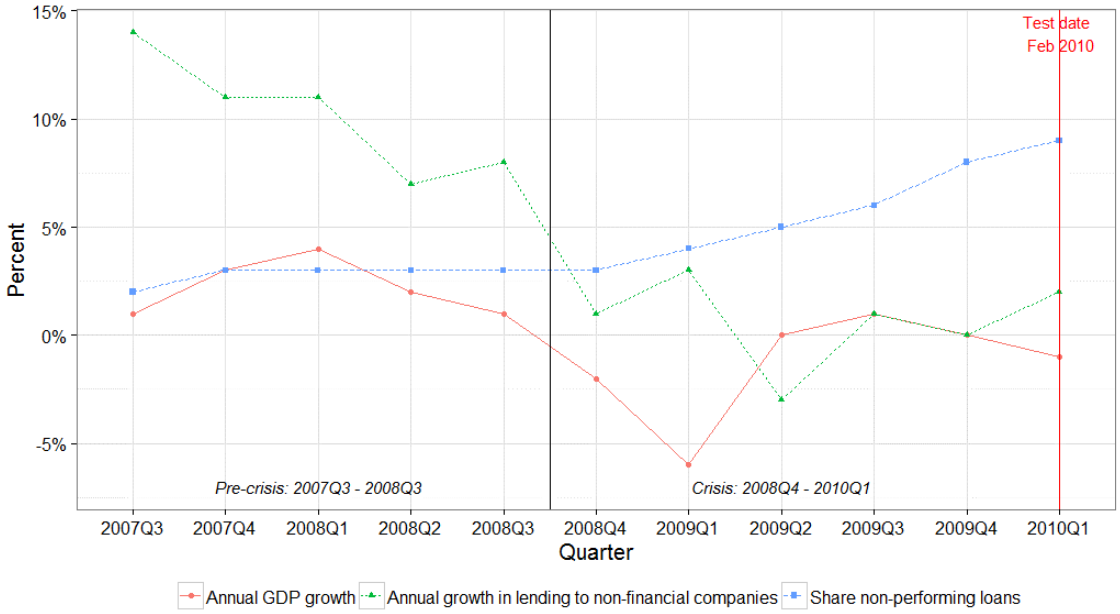
Romania experienced a substantial lending boom over the period 2000 to 2007 during which the stock of credit relative to GDP increased from 7% to 35%. Credit to firms and households grew in some years by more than 50%. Figure 4.2 illustrates that lending volumes slowed down significantly and economic growth turned negative in the last quarter of 2008. With the crisis hitting Romania in 2009, the share of non-performing loans in banks' portfolios rose sharply. These underlying economic conditions had a severe impact on the bank that we study. Figure 4.3 shows that its total assets, gross loans and total deposits decreased in 2009 while its non-performing loan ratio increased sharply. After years of branch network expansion, several branches were also closed in 2010.

Our dataset covers both pre-crisis and crisis years so that we can analyze potential heterogeneities in the effect of numeracy on loan officers' decision quality over a boom and bust cycle. Based on the macroeconomic and bank variables, we classify our sample into two subperiods. The pre-crisis period lasts up to the third quarter of 2008 with positive GDP and credit growth and very low non-performing loan rates. We classify October 2008 to February 2010 (when the math test was conducted) as the crisis period over which Romania's GDP dropped significantly and non-performing loan rates increased steadily.

[9] Three example questions from the test are provided in Appendix 4.7. The test was part of a series of tests such as a more advanced math test as well as an accounting test. The additional tests were taken at different dates and only completed by a subgroup of loan officers who took the first math test. Hence, we focus on the first math test as our measure of numerical skills.

Figure 4.2: Economic development and crisis period

The figure displays the development of the Romanian economy over the sample period. Values of GDP at market prices are from the ECB. Lending volumes and non-performing loans ratios are from the Romanian central bank (NBR). The non-performing loans ratio is only available on quarterly basis from 2009Q3 on. Prior to 2009Q3, annual values were extrapolated.



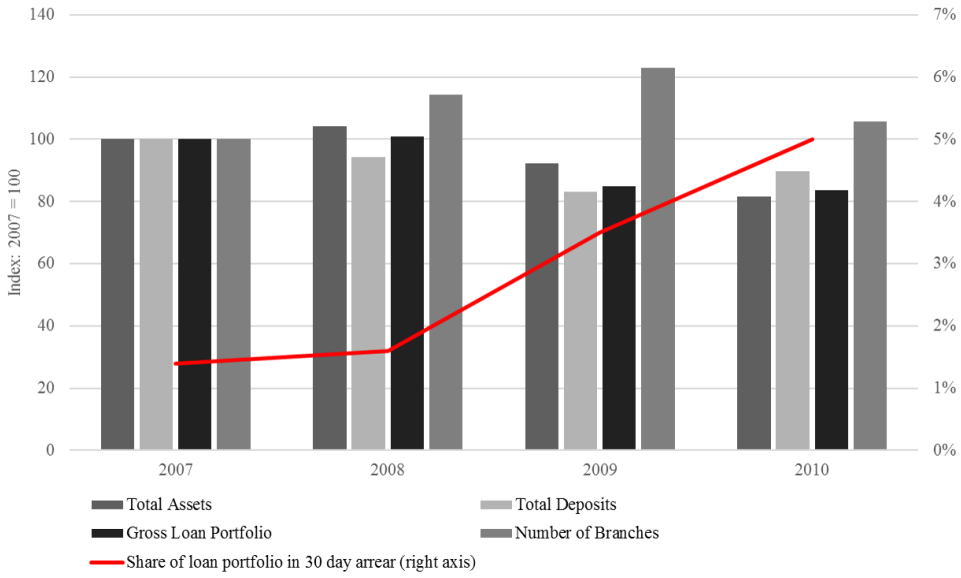
4.3 Hypothesis development

We examine whether loan officers with higher levels of numeracy are more accurate in assessing the creditworthiness of small businesses. As mentioned above, our measure of numeracy captures the effect of pure numerical skills, i.e. the ability to understand and work with numbers and to do logical reasoning, as well as that of potentially correlated personal traits such as general cognitive ability or social skills. In the following we clarify how numeracy, cognitive abilities and social skills may affect the accuracy of credit assessments at our bank.

We measure loan officers' screening performance by the accuracy of the initial risk score that they assign to each borrower. We therefore need to consider which components of the initial risk score are potentially influenced by numeracy. As described above, the initial risk score is based on quantitative financial statement information as well as qualitative information on managerial quality and the firm's market outlook. The loan officer enters this information into a spreadsheet, which then automatically calculates the risk score based on the underlying model. The process does not require any manual

Figure 4.3: Development of the bank

Development of the bank's total assets, total deposits, gross loan portfolio, branches and loan performance based on annual reports. The total assets, total deposits, gross loan portfolio and the number of branches are indexed at Dec 2007 = 100.



calculations. Therefore, any difference in accuracy should originate from differences in the loan officers' input to the rating model rather than from their ability to simply calculate numbers. We expect higher numeracy to improve the verification and interpretation of quantitative information as well as the precision of qualitative information.

While all loan officers receive the quantitative financial statement information with the loan application, they need to verify the provided information during the on-site visit. A first source of heterogeneity could stem from differences in the quality of the financial information verification. Peters et al. (2006) show that higher numeracy individuals are less prone to framing effects and are able to draw stronger and more precise affective meaning from numbers and comparisons using numbers.

H1: High numeracy loan officers are more accurate in assessing borrowers' credit worthiness. This is due to their ability to verify the hard information in a more accurate and objective way.

During the on-site visit, loan officers also evaluate borrowers on three qualitative dimensions. First, loan officers assess the borrower's character.[10] Loan officers evaluate, for instance, to what extent a borrower is discouraged from defaulting, e.g. through

[10] The assessment of character is a standard process of a borrower assessment, e.g. in the 5Cs (Character, Capacity, Capital, Collateral and Conditions) framework mentioned in any banking textbook.

social norms and moral constraints.[11] Second, an assessment of the borrower's managerial quality is required. Based on the past development of the firm and the on-site observations loan officers evaluate the borrower's capability to manage the firm. This assessment arguably also requires social skills. There is evidence that cognitive skills are useful for social interaction. Burks et al. (2009) find in their experimental study in a sample of American trainee truckers that individuals with higher cognitive skills are in a prisoner's dilemma game better able to anticipate the behavior of the first mover. Third, the assessment of the firm's market outlook could be influenced by numerical skills through several channels. Framing effects and the skill to draw precise affective meaning (Peters et al., 2006) as well as the higher likelihood to choose the normatively better option with a higher expected value (Pachur and Galesic, 2013) may influence the precision of the market outlook analysis.

H2: High numeracy loan officers are more accurate in assessing borrowers' creditworthiness. This is due to their ability to elicit and interpret the qualitative information in a more precise way.

Both our hypotheses suggest that high numeracy loan offices should be more accurate in assessing borrowers' creditworthiness. Our main empirical analysis will test this prediction. In additional analyses we will examine whether the superior accuracy of high loan numeracy is related to their processing of quantitative and / or qualitative information.

4.4 Data

We merge two bank-internal administrative datasets. The loan officer data comprises all loan officers that passed the numerical test in February 2010 and contains information on loan officer characteristics including their numeracy score. The credit file data contains information on the loans (and loan applications) that were handled by these loan officers between 2006 and 2013. Appendix 4.A2a provides definitions and full sample summary statistics of all credit file variables that we employ in our analysis. Appendix 4.A3 shows summary statistics by subperiod.

[11] Similar to a trust game, social conventions can help to overcome asymmetric information Karlan (2005).

4.4.1 Loan officer data

We have information on the characteristics of the 155 loan officers who obtained the minimum passing score (*Numeracy score*) of 65% or higher in the above described math test. We were not able to obtain information on 38 loan officers with numeracy scores below 65% . This restricts the range of the treatment variable, the numeracy measure, but still leaves us with considerable variation in the numeracy score. Importantly, this sample restriction does not cause a bias of our estimates since the selection did not occur based on the outcome variable. Overall, the sample restriction should lead to a lower observed treatment effect between the highest and the lowest observed level of numeracy compared to the ideal case where loan officers across all test results and their lending decisions would be observed.

The *Numeracy score* reflects the share of correctly answered questions. We exclude loan officers whose highest degree is not a bachelor degree (21 loan officers) to ensure that a potential effect of numeracy on loan officers' risk score accuracy is not driven by heterogeneity in education.[12] Further, we exclude 6 loan officers who only processed loans after the numeracy test took place. Figure 4.4 provides a histogram of the *Numeracy score* of the 128 loan officers in our final sample. We use dummy variables to distinguish three levels of numeracy. *Low numeracy* is a dummy variable that is 1 for loan officers with a numeracy score between 65% and 80% , *Medium numeracy* is a dummy variable that is 1 for loan officers with an numeracy score from 80% to 89% and *High numeracy* is a dummy variable that is 1 for all loan officers with a numeracy score of 90% -100% .[13]

Table 4.1 displays the average numeracy score, gender, age and work experience for our sample of loan officers by numeracy level. Table 4.1 shows that loan officers with a medium level of numeracy are more often female and more experienced than both high and low numeracy loan officers.

[12] In robustness tests we use the full sample of loan officers and control for their educational background. Results remain qualitatively unchanged.

[13] The thresholds ensure that roughly one third of the loan applications in our final analysis sample are handled by loan officers in each numeracy level. In robustness tests we set the thresholds so that one third of loan officers are in each numeracy category and we use the linear numeracy score. In both cases results remain qualitatively unchanged.

Figure 4.4: Distribution of numeracy score in loan officer sample

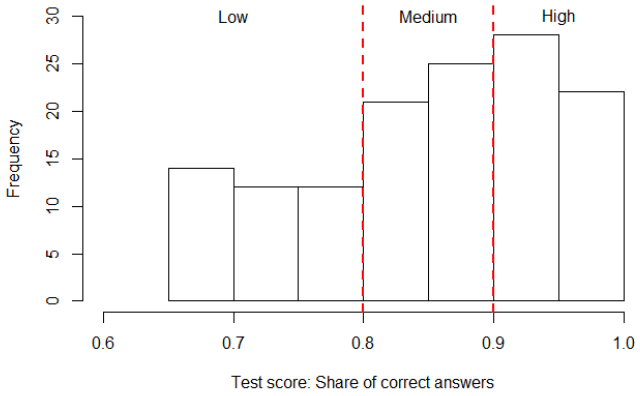


Table 4.1: Loan officer summary statistics

Numeracy Score Range in %	Low 65 - 79	Medium 80 - 89	High 90 - 100	Total
Nr Loan officers	34	38	56	128
Initial numeracy score	0.72	0.85	0.95	0.86
Female	0.56	0.76	0.63	0.65
Experienced	0.38	0.63	0.54	0.52
Age	31.97	32.18	32.66	32.34

4.4.2 Credit file data

Our initial credit file dataset consists of all 37,988 loan applications submitted over the period 2006 – 2013 to the bank and processed by loan officers who passed the numeracy test in February 2010. Out of these applications, 6,048 did not enter the screening stage due to formal errors, very negative credit registry information or because the client did not want to proceed further. We therefore observe 31,940 loan applications which were processed, out of which the bank made 22,485 loan offers (70%). In 1,136 cases, the client did not accept the loan offer so that the raw dataset contains 21,349 granted loans.

For our analysis, we restrict the raw dataset in several ways. We focus our analysis on the period July 2007 to February 2010. Since our sample contains only loans processed by loan officers that took the numeracy test in February 2010, there are very few loans in the sample for 2006 and early 2007. We begin our sample in July 2007 to ensure a sufficient number of loans per quarter and to cover a long enough pre-crisis period (5 quarters). In order to rule out any influence of the numeracy test itself, we exclude all loan applications made after the test. Furthermore, we only include installment loans up

to 30,000 Euros into our analysis because the large majority of applications is targeted towards such micro loans. Applications for larger volumes are less frequent and most often processed by credit analysts.[14] Our loan sample contains only first-time borrowers. Since no information from previous loans is available for first time borrowers, screening is most difficult and any effect from numeracy should be most prevalent. Also, the focus on first-time borrowers ensures that the assignment of loan applications to loan officers is not influenced by past loan performance.[15]

Our final dataset contains 5,928 loan applications and 3,619 loans granted to firms without prior credit relationships with the bank. These loan applications were screened by 128 loan officers at 31 bank branches over the period July 2007 to February 2010.

For each loan application, we know which loan officer handled it and can therefore match loan application and loan officer data. For loan applications, the dataset further contains information on the requested amount, the requested currency[16], the opening date of the client's account with the bank as well as the involved bank branch. For granted loans, the dataset contains additional information on the borrowing firm at application date (financial information, industry, and firm age), the granted loan terms (volume, currency, interest rate, collateral, maturity) and the initial internal risk rating (which ranges from 1 (lowest risk) to 3). In our final sample used in the empirical analysis, we have 2,757 loans with an initial risk score of 1 and 816 (46) loans with an initial score of 2 (3). In our analysis, the variable *Risky* reflects the initial risk rating at loan disbursement. Given the low number of loans with risk score 3, we construct Risky as a binary variable that takes on the value 1 if a loan is assigned an initial risk score of 2 or 3 and zero if the loan is assigned a risk score of 1.

We further have semi-annual information on the performance of granted loans as measured by the days in payment arrear. We construct the variable *Arrears* which captures the performance of each loan during the first 24 months after the loan was disbursed. We focus on the first 24 months since initial credit assessment processes in commercial banks

[14] Our initial sample covers 14 credit analysts. They are excluded from the analysis since their job description differs from the job description of loan officers.

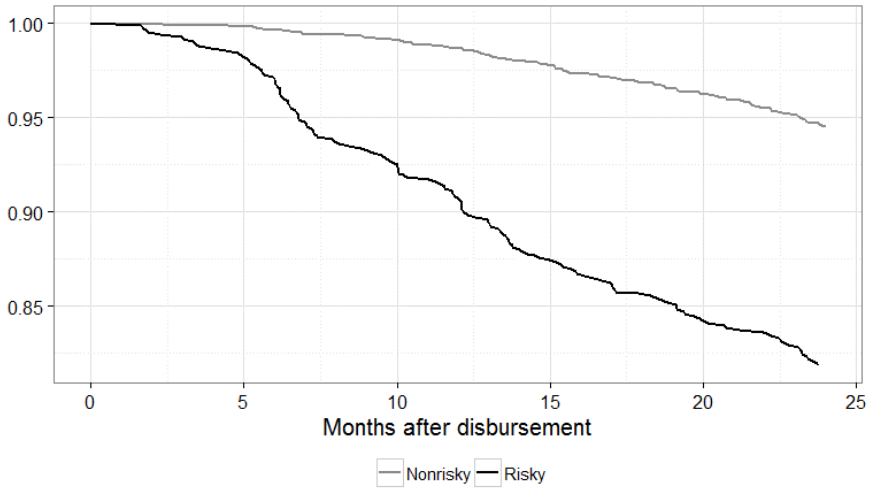
[15] This comes at the disadvantage that we cannot observe differences over a client relationship as for example documented for credit rationing by Kirschenmann (2016).

[16] Only 2% of loans were granted in a currency different from the requested currency (for 1% of loans, the application was in Euro and the granted loan in RON and for 1% of loans the application was in RON and the granted loan in Euro). There is no evidence that adjustments of the loan currency substantially differ by the level of loan officer numeracy and that bank-wide changes influencing the loan currency (e.g. the funding structure (Brown et al., 2015)) would affect loan officers with different numeracy differently.

are designed to capture potential loan defaults in the first years after disbursement.[17] For each loan, the days in arrear are reported for end of June and end of December. Hence, we can retrace when exactly each loan falls into arrears for at least 30 days for the first time. The binary variable *Arrears* then takes on the value 1 if a loan falls into arrears for at least 30 days within the first 24 months. On average, 8 percent of the loans in our final sample fall into arrears for at least 30 days during the first 24 months of their maturity. The Kaplan-Meier plot in Figure 4.5 displays the share of non-risky (grey line) and risky (black line) loans that have *not* fallen into 30-day arrears over the first 24 months after loan disbursement. At each point in time, the share of non-risky loans that is not in arrears is higher than the share of risky loans not in arrears, with the difference between the two increasing steadily. The figure also highlights that the incidence of falling into arrears occurs quite evenly distributed over time for both risky and non-risky loans.

Figure 4.5: 30 day arrears over the first 24 months

The graph displays the share of loans falling into 30 day arrear over the first 24 months. The lines display the share of loans that have not been in 30 day arrear at any time after disbursement.



[17] In small business lending, banks typically update their credit assessment annually, when new financial statement data on the firm becomes available through its annual accounts.

4.5 Methodology

Our objective is to estimate the relationship between loan officer numeracy and the accuracy of their credit assessments. Consider a bank which is recruiting loan officers from a population of interest, i.e. in our case college graduates. The bank is interested in how the accuracy of its credit assessments will change if it hires college graduates with high numerical skills rather than college graduates with lower numerical skills.

For a given portfolio of loan applications L the bank is thus interested in estimating the average treatment effect of replacing a low numeracy loan officer with a high numeracy loan officer. We define A as the accuracy level and N as the numeracy level of the loan officer employed by the bank. The average treatment effect is then given by:

$$ATE = E[A(N = high, L) - A(N = low, L)]$$

In order to estimate the average treatment effect in equation (1) one possible experiment would be the following: First, the bank randomly chooses loan officers from the population of interest (e.g. college graduates). The bank then randomly assigns loan applications to these loan officers. We would then measure the accuracy of the credit assessments A for each loan officer. And we would compare the average accuracy of loan officers with a high numeracy level to the average accuracy of loan officers with a low numeracy level.[18]

Our empirical analysis of the administrative data presented above deviates from this ideal experiment in two main dimensions: measurement and identification. First, the available data does not allow us to measure the accuracy of credit assessments at the loan officer level, but only for groups of loan officers. Second, loan officers in our sample are hardly randomly chosen, and loan applications are hardly randomly assigned to loan officers. In the following, we first discuss how we measure the accuracy of credit

[18] An alternative experiment would be to randomly hire loan officers from the same population of interest (college graduates). Then the bank would randomly assign the recruited loan officers to a numeracy training. After the training the bank would randomly assign loan applications to loan officers. We would then compare the accuracy of the credit assessments of those who received training to those who did not. We analyze a similar case in the Internet Appendix (see https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2997114 and section 6.5). The bank organized math trainings in 2011 and 2012 to prepare employees for a second math test. Exploiting the staggered introduction of the trainings, we do not find evidence for a significant impact of the training attendance on loan officers' rejection decisions or accuracy.

assessments. We then discuss identification.

4.5.1 Measuring and comparing loan officer accuracy

We measure the accuracy of loan officers' credit assessments by comparing their ex-ante risk assessment of a borrower to the ex-post performance of that borrower's loan. This approach follows the methodology applied to assess the discriminatory power of internal rating systems, i.e. the system's ability to discriminate ex-ante between defaulting and non-defaulting borrowers (Cantor and Mann, 2003).

For each granted loan in our sample we observe the initial risk rating as assigned before loan disbursement by the loan officer. We hereby distinguish *Risky* (initial risk score = 2 or 3) from non-risky (initial risk score =1) loans. We also observe whether a loan falls into *Arrears* within 24 months of disbursement. A loan officer who is very accurate in assessing the creditworthiness of borrowers would classify most loans as non-risky which ex-post are not in arrears, while he would classify most loans as risky that fall into arrears. Thus, in the portfolio of loans handled by an accurate loan officer we should see that the share of defaulting loans among those classified as risky is much higher than the share of defaulting loans among those classified as non-risky. By contrast, the portfolio of a loan officer who is not accurate at all would display a similar share of defaulting loans, irrespective of whether the loan was rated as risky or non-risky.

The bar charts in Figure 4.6 display the share of loans falling into arrears by risk rating, loan officer numeracy and sub-period. Starting with the total sample in the top panel, the graph shows that borrowers initially classified as risky (grey bar charts) are more likely to fall into arrears than borrowers initially classified as non-risky (white bar charts), and the discriminating power is largest for the high numeracy loan officers. The same pattern holds for the crisis period. For the pre-crisis sample we find that for *low* numeracy loan officers a higher share of non-risky loans falls into payment arrear than of risky loans. Hence, during this period the initial rating of these loan officers is unable to discriminate borrowers by creditworthiness.

To formally measure and compare the accuracy of credit assessments across loan portfolios processed by loan officers with different numeracy scores we choose the following

methodology:[19] Consider a portfolio consisting of $l = 1 \ldots L$ loans and the following linear probability model:

$$Arrears_l = \alpha + \beta Risky_l + \epsilon_l$$

The estimated coefficient β from this regression provides us with an indicator of the discriminatory power of the initial risk rating for the underlying portfolio of loans. If the risk rating cannot discriminate between those loans which fall into arrears and those that do not, we would yield an estimated coefficient of β =0.[20] If the risk rating perfectly discriminates between those loans which fall into arrears and those that do not, we would yield an estimated coefficient of β =1.[21]

Applying equation (2) we can formally compare the discriminatory power of the risk rating across two portfolios of loans l and $l^{'}$. Specifically, we can estimate β within portfolio l and $\beta^{'}$ within portfolio $l^{'}$. We can then compare the estimated coefficients β and $\beta^{'}$ with a Chow test. This is the methodology we pursue in this paper to measure and compare the accuracy of credit assessments by loan officer numeracy. We split our sample of 3,619 loans into three portfolios based on whether the loan was processed by a high, medium or low numeracy loan officer. Applying equation (2) to each subsample separately we estimate β^{high} , β^{medium} , and β^{Low}. We then compare these estimated coefficients applying a Chow test.

Note that theoretically we could estimate equation (2) separately for each loan officer. We would then obtain a measure of individual loan officer accuracy as depicted in equation (1). However, with the administrative data at hand it is not feasible to estimate accuracy indicators at the loan officer level with reasonable precision. The precision of the estimated coefficient β in the linear regression (2) depends on the size of the underlying loan portfolio and the share of loans which actually default. A crucial limitation to stud-

[19] An alternative approach for measuring the discriminatory power of risk ratings is to calculate the accuracy ratio (see e.g., Engelmann et al. (2003), Cantor and Mann (2003), BIS (2005)). The accuracy ratio compares the ratio of the correctly classified loans within a loan portfolio to the classification of a perfect model and a random model. However, a major drawback of using the accuracy ratio for our purpose is that there is no method for formally comparing the measure across loan portfolios, i.e. for loans processed by low numeracy as opposed to high numeracy loan officers.

[20] In this case the estimated constant would equal the average default rate in the portfolio.

[21] In this case the estimated constant would equal zero and Risky would be perfectly collinear with Arrears.

ies of bank credit risk is that only a small share of loans actually defaults. In our sample 8% of the loans enter into payment arrears within 24 months of loan disbursement. Our sample consists of 3,619 granted loans handled by 128 loan officers and thus an average of 28 loans per loan officer. With a default rate of 8% this implies that on average just over 2 loans fall into arrears per loan officer. Given the limited number of loans handled by each loan officer and the low default rate it is thus not feasible to precisely measure the accuracy ratio at the loan officer level.

4.5.2 Identification

We apply regression (2) to measure the accuracy of the initial risk ratings separately for the portfolios of loans processed by (all) high numeracy, medium numeracy and low numeracy loan officers, respectively. The comparison of β^{high} , β^{medium} , and β^{Low} will provide us with an unbiased estimate of the effect of numeracy on loan officer accuracy if (i) observed numeracy is orthogonal to other loan officer characteristics which may affect the accuracy of their credit assessments and (ii) loan applications are randomly assigned to loan officers. It is unlikely that either of these assumptions hold. Our analysis thus faces two main identification challenges. First, other loan officer characteristics such as education, age, gender or job experience might be correlated with both, loan officers' numeracy levels and the accuracy of their credit assessments. Second, the assignment of loan applications to loan officers is likely to be influenced by numeracy or related characteristics and therefore the unobserved counterfactual accuracy is not equal to the observed outcomes.

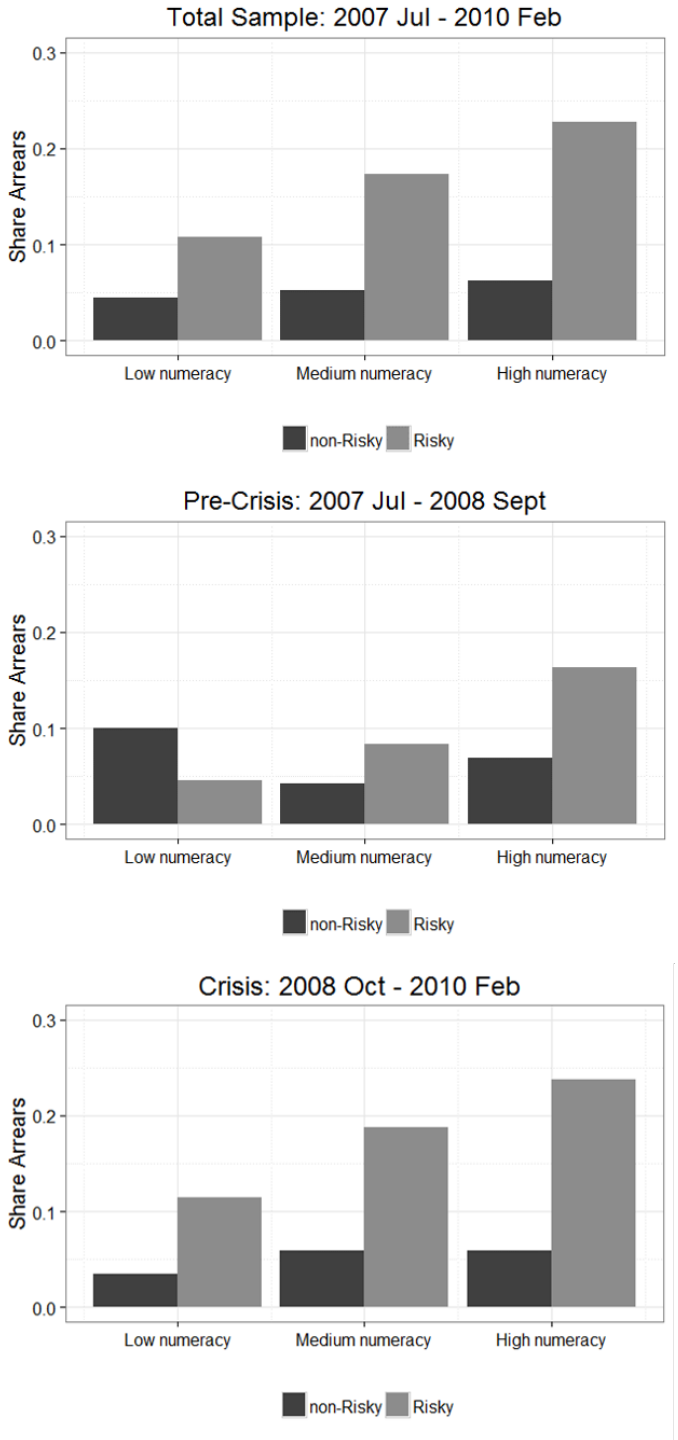
To address these identification challenges, we augment equation (2) with two vectors of control variables that capture loan officer characteristics LO_j and loan application characteristics X_i . We estimate the following linear probability model for each numeracy level n separately[22]:

$$Arrears_{i,j} = \alpha + \beta_n Risky_i + \delta LO_j + \gamma X_i + \epsilon_{i,j}$$

[22] The comparison of coefficients across groups comes with very strong assumptions in non-linear models. We therefore prefer a linear probability model that comes at the cost of misspecifying the function form of the dependent variable. In robustness tests we estimate the same effect in a non-linear logit model and in a linear probability model using the linear numeracy score but with interaction terms pooling the observations from all numeracy levels. The results confirm our main findings.

Figure 4.6: Accuracy of initial rating

The figure displays the share of loans in 30 day payment arrear within 24 months after loan issuance by initial risk rating and numeracy.



As discussed above, the coefficient of primary interest in equation (3) is β_n . It captures the discriminatory power of the initial rating *Risky* within the portfolios of loans processed by loan officers with numeracy level n .

LO_j is a vector of observable loan officer characteristics that are likely to be correlated with numeracy and the accuracy of loan officers' credit assessments. Beck et al. (2013) find that the loan portfolios of female loan officers perform better than those of male loan officers. Since the effect is most pronounced when female loan officers handle loans of female borrowers, they conclude that female loan officers are better in building trust relationships with their clients. *Female* thus is a dummy that is 1 of the loan officer is female and 0 if male. Andersson (2004) and Bruns et al. (2008) show that job experience or specific human capital might matter for loan officers' lending decisions and the decision process. We therefore include *Experienced* which is a dummy variable that is 1 for loan officers who have worked with the bank for more years than the median of work years at the math test date (2.13 years). *Age* captures the age of the loan officer in years to control for the general life experience of the loan officers.

X_i is a vector of loan-level covariates controlling for factors that could potentially influence the assignment of a loan application to a high numeracy loan officer and be correlated with the potential accuracy of the credit assessment, i.e. the difficulty of assessing the creditworthiness of the borrower. A profit-maximizing bank should employ the most skilled loan officers where their skills can generate the highest profit. Intuitively, we would expect banks to allocate those loan applications which are most difficult to assess to their best loan officers. However, it is also feasible that the allocation of loan applications is driven by borrower characteristics that most strongly influence the bank's profit but that, at the same time, make the assessment easier. For instance, the more able loan officers might be assigned to deal with the larger clients, which also have more accurate financial information.

We would like to control for all loan-level or firm-level characteristics which may confound the relationship between loan officer numeracy and the potential accuracy of credit assessments. At the same time we should avoid using endogenous control variables, i.e. firm-level or loan-level variables which may be influenced by the numeracy level of the loan officer processing the application. We therefore employ two sets of application and firm control variables. Basic controls contain loan and firm characteristics elicited in the

loan application form: The measurement of these variables is thus arguably independent of the loan officer's numeracy level. *Ln(Requested amount)* controls for the volume of the application and *Request Euro* for the requested currency. *New client*, a binary variable equal to 1 if a client has no account history with the bank, and *Time relationship,* a variable reflecting the years that a firm has an account at the bank, control for the level of information about the firm that is available within the bank and thus are also measures of opaqueness.

Extended firm-level controls include variables which are elicited or verified during the credit assessment process: *Leverage, ln(Sales), Young firm, Agriculture and Total assets/requested amount*. These variables allow controlling for firm size, riskiness, industry and opaqueness in more detail. However, these variables are also potentially influenced by the loan officer's verification procedure and are therefore potentially endogenous control variables. *Ln(Sales)* controls for the size of the applicant and *Total assets/requested amount* for the relative size of the loan application. *Leverage*, defined as the debt capital and the applied loan amount over equity, should provide some obvious signals about the riskiness of the loan application. *Agriculture* is a dummy variable taking on the value 1 if a firm is active in agriculture. *Young firm*, a binary variable capturing firms that were founded less than 5 years prior to the loan application, controls for the firm's opaqueness.

We further include branch fixed effects and quarter fixed effects. The branch fixed effects control for the general local economic and cultural environment as well as branch-specific practices. The branch fixed effects are also important to control for the time-invariant characteristics and the numeracy of the branch manager as he forms part of the credit committee that checks the credit score and makes the final lending decision.[23] The quarter fixed effects control for the changing macroeconomic conditions during the boom and bust cycle.[24]

Regarding the interpretation of our results, we note that our observable measure of

[23] Unfortunately, we do not have comprehensive and detailed information on the branch manager characteristics and the credit committee. We have information on the composition of the credit committee from mid-2010 onwards and for 80% of the loans the credit committee consists of the loan officer and the branch manager. For the other 20% the credit committee consists of the branch manager and of a credit risk officer located at the bank's headquarter. Therefore, the branch dummies do not fully capture the influence of the credit committee or the branch manager.

[24] For example, in the first quarter of 2009 more than 95% of issued loans in the sample were classified as risky compared to 10% -20% in the quarters before and after. Obviously, the bank made some short-term adjustments to its policies at the beginning of the crisis, however these adjustments apply to all loan officers independent of their numeracy level.

numeracy is very likely correlated with unobservable personal traits of loan officers such as general cognitive ability and social skills. This implies that our estimated "effect" captures the combined effect of numerical skills and the broader set of correlated cognitive and social skills. Our results can therefore not be interpreted as the potential gain to a bank (or other employers) of promoting the numerical skills of employees, e.g. through an education intervention. Rather our results can inform us about the potential gain to a firm of hiring staff with high observable numerical skills (and related, but less observable, cognitive and social abilities).

4.6 Results

4.6.1 Numeracy and accuracy

Table 4.2 presents our baseline analysis for different sets of control variables. In each column the coefficient of *Risky* reflects the degree to which loan officers in that subsample are able to discriminate borrowers by their creditworthiness. Hence, a higher estimate for *Risky* reflects more accurate credit decisions. Results of the Chow test comparing the coefficients across numeracy levels are presented in the bottom panel of the table. Columns 1 – 3 display results of the estimation controlling only for basic control variables, loan officer controls and branch fixed effects. In columns 4 – 6 we add quarter fixed effects and in columns 7 – 9 extended control variables. Standard errors are heteroscedasticity robust and clustered at the loan officer level.

Considering the specification with basic controls and branch fixed effects only, the magnitude of the estimated coefficient of *Risky* is substantially larger in the sample of loans processed by high numeracy loan officers (column 3: 0.249) as compared to loans processed by low numeracy loan officers (column 1: 0.112) or medium numeracy loan officers (column 2: 0.116). Chow tests reported in the bottom part of the table confirm that the credit assessments of high numeracy loan officers are significantly more accurate than those of low numeracy loan officers. We yield almost identical results in the specifications including quarter fixed effects (columns 4-6) and extended controls (columns 7-9). Estimating the difference in accuracy by numeracy of the loan officer in the full sample with interaction terms confirms that high numeracy loan officers are more accurate than low numeracy loan officers (see Appendix 4.A4 for a corresponding linear

probability model and Appendix 4.A5 for a logit model).[25]

Appendix 4.A6 shows that the higher accuracy of high numeracy loan officers is confirmed for various subsamples of borrowers. Whether loan officers assess borrowers from agriculture vs. other industries (columns 1-6) or young vs. older firms (columns 7-12), the high numeracy loan officers are more accurate in their credit assessments than the low numeracy loan officers (although the difference is not significant in the sample spilt by firm age). Interestingly, however, we find that the length of the bank-borrower relationship does matter. The estimated coefficient of *Risky* is not significant at any numeracy level and there is no significant difference between the high and the low numeracy loan officers in their accuracy when assessing new clients, i.e. borrowers that have only recently opened an account or do not have an account at the bank at all (columns 13-15). By contrast, when assessing existing clients (columns 16-18), the estimated coefficient of *Risky* is significant at all numeracy levels, and high numeracy loan officers are significantly more accurate in their credit assessments than low numeracy loan officers. Given that we only examine applications from first-time borrowers at the bank, these results confirm that observing account activity provides useful information for banks when assessing borrowers' creditworthiness (Mester et al. (2006), Norden and Weber (2010)).

[25] In addition, in Appendix 4.A7 we replace the three numeracy categories by the linear numeracy score and show that our results do not hinge on the construction of the numeracy categories. Appendix 4.A8 reports results for the sample of loan officers from all educational backgrounds (controlling for education) and shows that our main results are not driven by the selection of the loan officer sample.

Table 4.2: Numeracy and accuracy: Full sample results

The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1. We compare the coefficients of Risky by numeracy level using a Chow test.

OLS regression	Total sample: 2007 Jul - 2010 Feb								
	Basic controls			Basic controls with Quarter FE			Extended controls with Quarter FE		
Numeracy level	Low	Medium	High	Low	Medium	High	Low	Medium	High
Dep var: Arrears	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Risky	0.112**	0.165***	0.249***	0.115**	0.173***	0.264***	0.095*	0.163***	0.254***
	(0.044)	(0.046)	(0.041)	(0.048)	(0.043)	(0.044)	(0.048)	(0.044)	(0.042)
Mean Arrears	0.058	0.079	0.108	0.058	0.079	0.108	0.058	0.079	0.108
Observations	1,072	1,225	1,322	1,072	1,225	1,322	1,072	1,225	1,322
R-squared	0.064	0.100	0.129	0.076	0.112	0.146	0.096	0.137	0.167
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	No	No	No	No	No	Yes	Yes	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Difference in coefficients of Risky: P-values of Chow test in parentheses									
Compared to high numeracy	-0.137**	-0.084		-0.149**	-0.091		-0.159***	-0.091	
	(0.02)	(0.165)		(0.02)	(0.13)		(0.01)	(0.124)	
Compared to medium numeracy	-0.053		0.084	-0.058		0.091	-0.068		0.091
	(0.397)		(0.165)	(0.363)		(0.13)	(0.287)		(0.124)

4.6.2 Hard vs. soft information

The previous baseline analysis shows that higher numerical skills are associated with more accurate credit assessments. As outlined in section 3, there are two potential drivers of this superior accuracy. First, high-numeracy loan officers may be better able to draw meaning from existing quantitative information on the borrower. Second, they may be better able to assess and verify soft "qualitative" information.

In Appendix 4.A9 we examine – separately for low, medium and high numeracy loan officers - to what extent the risk classification of a borrower is related to observable characteristics of the borrower and his application. We find that there is no significant difference in the influence of observed application or borrower characteristics on the risk classification. This suggests that the higher accuracy of high numeracy loan officers is not primarily driven by a different interpretation of well observable, "hard" financial information.

In Appendix 4.A10 we examine to what extent the risk classification of the loan officer helps predict loan arrears beyond the available hard financial information on the borrower. The degree to which this is the case provides us with an indicator of the value of the loan officer's assessment of soft, qualitative information about the borrower. Columns 1, 3 and 5 of Appendix 4.A10 show that the R^2s of the simple regressions containing only the basic controls vary very little between the three numeracy groups. However, when adding the *Risky* indicator in columns 2, 4 and 6, the R^2 is much higher in the regression for the high numeracy loan officers than for the medium and low numeracy loan officers. Results including the extended controls are qualitatively the same. This suggests that high numeracy loan officers are more accurate because they are better able to collect and assess the soft information that enters the rating decision.

Our estimates in Table 4.2 account for differences in average borrower characteristics between the pools of loans processed by high, medium and low numeracy loan officers. However, the loan portfolios may also differ with respect to the variation in observable characteristics across borrowers. The higher accuracy of high numeracy loan officers might therefore be partially explained by the fact that it is just easier for them to classify risky versus safe borrowers, because there is more variation in the pool of loans they process. Appendix 4.A11 compares the distribution of observable borrower characteristics for the pool of loans processed by low, medium and high numeracy loan officers. We find that the

standard deviation of some variables (*Time relationship*, *Leverage*, *Total assets/requested amount*) is indeed somewhat higher in the pool of loans processed by high numeracy loan officers. That said, the range of the distributions of all variables largely overlaps. Thus, our main results can hardly be explained by the fact that high numeracy loan officers have more variation to exploit in their loan portfolios.

4.6.3 The influence of the crisis

In Table 4.3 we present separate results for the subsample of loans in the pre-crisis and crisis periods. We report the results for the model with all controls, branch fixed effects and quarter fixed effects. For both subperiods the difference between the estimates of *Risky* for low and high numeracy loan officers is statistically significant at the 5% - level. The difference is, however, larger in the pre-crisis period (0.231 vs. 0.131). In the pre-crisis period (column 1) the predictive power of the risk rating of loans processed by low numeracy loan officers is even worse than a random assignment. The ability to discriminate borrowers by quality improves significantly for all numeracy levels in the crisis period with the improvement being largest for the low numeracy loan officers.[26] These findings are in line with Becker et al. (2016) who show that it is most difficult to accurately sort borrowers according to their riskiness during boom periods in which informational frictions are highest.

An alternative explanation for the improved accuracy of low numeracy loan officers (compared to high numeracy loan officers) could be that they became more rigorous in their assessment of loan applicants once the crisis started. An analysis of the processing time of loan applications by numeracy level over our sample period shows that, on average, the processing time increases for all loan officers after the start of the crisis (see Appendix 4.A12). However, mean processing times increase the least for low numeracy loan officers. Thus, the relative improvement in the accuracy of low numeracy loan officers does not seem to be driven by a more diligent assessment.

[26] Chow tests show that the difference in the estimate of Risky between the pre-crisis and crisis period is $0.265** *$ for low numeracy loan officers and $0.208** *$ ($0.156** $) for medium (high) numeracy loan officers.

Table 4.3: Numeracy and accuracy: Subperiod analysis

The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1. We compare the coefficients of Risky by numeracy level using a Chow test.

OLS regression	Pre-crisis: 2007 Jul - 2008 Sept			Crisis: 2008 Oct - 2010 Feb		
Numeracy level	Low	Medium	High	Low	Medium	High
Dep var: Arrears	(1)	(2)	(3)	(4)	(5)	(6)
Risky	-0.111*	-0.006	0.131*	0.154***	0.202***	0.287***
	(0.062)	(0.035)	(0.072)	(0.049)	(0.051)	(0.048)
Mean Arrears	0.092	0.046	0.085	0.052	0.095	0.115
Observations	152	391	294	920	834	1,028
R-squared	0.210	0.173	0.139	0.114	0.159	0.212
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Difference in coefficients of Risky: P-values of Chow test in parentheses						
Compared to high numeracy	-0.242***	-0.137*		-0.133**	-0.085	
	(0.005)	(0.067)		(0.046)	(0.208)	
Compared to medium numeracy	-0.105		0.137*	-0.048		-0.085
	(0.103)		(0.067)	(0.485)		(0.208)

Another potential explanation for the above results could be that the hiring policy at the bank changed once the crisis unfolded. Appendix 4.A13 reports results for the subsample of only those loan officers who worked at the bank already before the crisis and we find our main results confirmed. The improved accuracy in the crisis period therefore does not stem from the hiring of better loan officers after the start of the crisis. Rather do these results corroborate that it is most difficult to sort borrowers according to their riskiness during boom periods.[27]

4.6.4 The influence of gender and experience

Our results so far establish a clear role for numeracy in loan officers' screening performance. Previous research has shown that loan officers' lending decisions and performance are also related to their gender (Beck et al., 2013) and experience (Andersson (2004), Bruns et al. (2008)). In Table 4.4 we explore how gender and experience affect the accuracy of loan officers' credit assessments in our sample.

First, we replicate our full sample estimates of loan officer accuracy (Table 4.2) by gender and experience, rather than by numeracy. The results presented in Table 4.4 show no significant gender or experience effect in loan officer accuracy. These results are not necessarily in conflict with the results of Beck et al. (2013). Beck et al. (2013) focus on loan performance rather than accuracy and show that the interplay between the loan officers' and the clients' characteristics (such as gender) is important. In our study, we lack the information on the gender of the borrower.

[27] An additional concern could be that low and high numeracy loan officers experience arrear events of the loans that they granted before the crisis at different points in time, which could systematically influence their screening behavior during the crisis. When we compare Kaplan-Meier survival estimates (available upon request) for loans disbursed in the pre-crisis period by low, medium and high numeracy loan officers, we do not find systematic differences in the timing when arrears occur. For instance, independent of the loan officer's numeracy level almost no arrear events occur during the first six months after a loan's disbursement and the incidence of arrears slowly increases the longer the time since a loan's disbursement.

Table 4.4: Gender, experience and accuracy

The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1. We compare the coefficients of Risky by numeracy level using a Chow test.

OLS regression	Total sample: 2007 Jul - 2010 Feb			
	Gender		Experienced	
	Female	Male	No	Yes
Dep var: Arrears	(1)	(2)	(3)	(4)
Risky	0.195***	0.175***	0.217***	0.177***
	(0.032)	(0.047)	(0.046)	(0.033)
Mean Arrears	0.086	0.082	0.101	0.074
Observations	2,055	1,564	1,253	2,366
R-squared	0.130	0.130	0.159	0.114
Basic controls	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes
Loan officer controls	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Difference in coefficients of Risky: P-values of Chow test in parentheses				
Compared to male	0.020			
	(0.728)			
Compared to experienced			0.040	
			(0.467)	

Table 4.5: Numeracy and accuracy: Subsample by gender and experience

The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1. We compare the coefficients of Risky by numeracy level using a Chow test.

	Total sample: 2007 Jul - 2010 Feb											
	by gender						by experience at application					
OLS regression	Female			Male			<=2 years			>2years		
Numeracy level	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Dep var: Arrears	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Risky	0.117*	0.179***	0.221***	0.065	0.123*	0.271***	0.045	0.190***	0.231***	0.181	0.130***	0.253***
	(0.060)	(0.058)	(0.049)	(0.090)	(0.055)	(0.077)	(0.034)	(0.062)	(0.071)	(0.119)	(0.044)	(0.060)
Mean Arrears	0.065	0.089	0.105	0.050	0.065	0.113	0.049	0.093	0.102	0.072	0.063	0.115
Observations	551	731	773	521	494	549	657	656	687	415	569	635
R-squared	0.126	0.154	0.204	0.160	0.151	0.229	0.108	0.189	0.203	0.173	0.172	0.213
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference in coefficients of Risky: P-values of Chow test in parentheses												
Compared to high numeracy	-0.104	-0.042		-0.206*	-0.148*		-0.186**	-0.041		-0.072	-0.123*	
	(0.159)	(0.569)		(0.067)	(0.099)		(0.014)	(0.648)		(0.565)	(0.083)	
Compared to medium numeracy	-0.062		0.042	-0.058		0.148*	-0.145**		0.041	0.051		0.123*
	(0.431)		(0.569)	(0.563)		(0.099)	(0.034)		(0.648)	(0.665)		(0.083)

In Table 4.5 we explore potential interaction effects between numeracy, gender and experience. We start by comparing the effect of numeracy on accuracy for female (columns 1 - 3) vs. male (columns 4 - 6) loan officers. Interestingly, we find a significant effect of numeracy on accuracy only in the subsample of male loan officers. Thus, the difference in the screening accuracy across numeracy levels stems mainly from the male loan officers. We further compare the effect of numeracy on accuracy for inexperienced loan officers (columns 7-9), i.e. those with work experience at the bank of up to two years at the test date, vs. experienced loan officers with more than two years of experience at the test date (columns 10 – 12). The results from these columns suggest that numeracy seems to have a stronger effect on accuracy among inexperienced loan officers.

4.6.5 Loan rejections

The analysis so far has focused on the sample of granted loans and studied the accuracy of loan officers' credit assessments. However, if numeracy is related to the ability to pick out risky borrowers, it might also lead to systematic differences between the samples of loans which are approved when the application is handled by low, medium and high numeracy loan officers. The observed differences in the screening performance of loan officers of different numeracy levels would then be influenced by their preceding approval vs. rejection decisions.

Our dataset covers all loan applications processed by our sample of loan officers during the sample period. Figure 4.7 displays the development of the quarterly rejection rate for first time applicants by the level of the loan officers' numeracy. Over the entire sample period 39% of all loan applications are rejected (see also Appendix 4.A2b). Low numeracy loan officers display substantially lower rejection rates (32%) compared to loan officers with medium numeracy (40%) and high numeracy (42%).

Figure 4.7: Quarterly rejection rate by numeracy over the sample period

Share of rejected first time borrowers by quarter and level of numeracy.

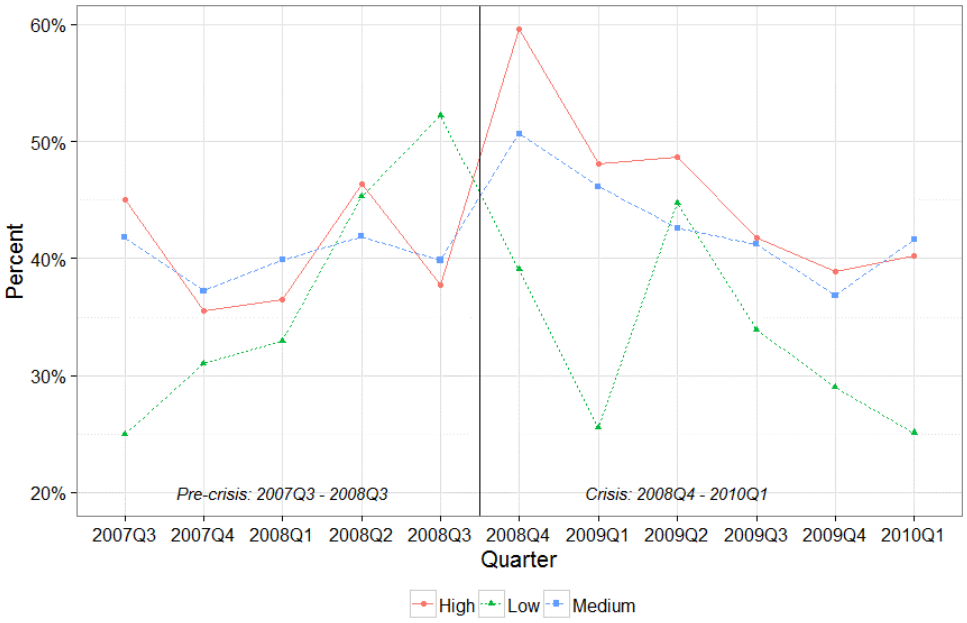


Table 4.6: Numeracy and loan rejections

The dependent variable Rejection is a binary variable equal to 1 if a loan application was rejected and 0 otherwise. Loan officer controls include Female, Experienced and Age. Standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1; We compare the coefficients of available application controls in the subsample analysis (1) - (3) using a Chow test. Results suggest that there is no significant difference in the coefficients of application controls in the subsamples of low and high numeracy loan officers. Comparing coefficients of the medium numeracy subsample to high/low subsamples, the only significant difference (10%-level) exists for Request Euro between medium and high numeracy.

	Subsample by numeracy level			Total sample:	Pre-Crisis:	Crisis:
	Low	Medium	High	2007 Jul - 2010 Feb	2007 Jul - 2008 Sep	2008 Oct - 2010 Feb
Dep var: Rejection	(1)	(2)	(3)	(4)	(5)	(6)
High Numeracy				0.043**	0.006	0.053***
				(0.019)	(0.051)	(0.019)
Medium Numeracy				0.025	-0.020	0.021
				(0.019)	(0.045)	(0.024)
Ln(Requested amount)	0.058***	0.047***	0.054***	0.054***	0.033***	0.064***
	(0.012)	(0.010)	(0.011)	(0.007)	(0.010)	(0.009)
Request Euro	0.041	0.098***	0.021	0.056**	0.008	0.072***
	(0.042)	(0.029)	(0.040)	(0.021)	(0.042)	(0.026)
Time relationship	-0.013*	-0.024**	-0.024***	-0.020***	-0.023**	-0.021***
	(0.007)	(0.009)	(0.008)	(0.004)	(0.011)	(0.005)
New client	0.495***	0.523***	0.546***	0.528***	0.543***	0.518***
	(0.047)	(0.029)	(0.031)	(0.020)	(0.037)	(0.025)
Mean Rejection	0.322	0.404	0.423	0.390	0.399	0.387
Observations	1,581	2,055	2,292	5,928	1,392	4,536
R-squared	0.425	0.390	0.413	0.398	0.356	0.421
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes

In Table 4.6, we estimate a linear probability model of the rejection decision. The dependent variable is *Rejection*, which is a dummy variable that is 1 if the loan application is rejected and 0 if it is approved. All regressions include as explanatory variables the loan application characteristics *Request Euro, (Ln) Requested amount, New client* and *Time relationship*. All regressions further include controls for loan officer characteristics (gender, experience, age) as well as for branch and quarter fixed effects.

In columns 1 - 3 of Table 4.6 we estimate the model separately for low numeracy, medium numeracy and high numeracy loan officers. The results suggest that – at all levels of numeracy – loan officers are more likely to reject applications for large loans as well as applications from new clients or existing clients with a short relationship with the bank. We then compare the column 1-3 coefficients across numeracy levels applying Chow tests. We find no significant difference between coefficients of low and high numeracy loan officers. Thus the rejection behavior of loan officers seems to be similarly related to observable borrower characteristics, independent of the loan officer's numeracy level.

The observed differences in average rejection rates between the low versus medium / high numeracy loan officers could be caused by differences in the assigned application pool. Comparing the characteristics of loan applications (see Appendix 4.A2b) highlights that medium and high numeracy loan officers are indeed more likely to handle loan applications with a larger requested loan size as well as applications from new clients. In columns 4 - 6 of Table 4.6, we examine whether loan officer numeracy influences rejection rates conditional on loan application characteristics. We pool the samples of applications across loan officers and add our indicators of *High numeracy* and *Medium numeracy* to the regression model. Column 4 reports results for the full sample period, while columns 5 - 6 report results for the pre-crisis and crisis period separately. The column 4 - 6 estimates show that, controlling for loan application characteristics, high numeracy loan officers are significantly more likely to reject loans than low numeracy loan officers. Over the entire observation period the estimated difference in rejection rates is 4.3 percentage points. This amounts to more than one-tenth of the average rejection rate in the sample (39%) and accounts for more than one-third of the observed difference in rejection rates between low and high numeracy loan officers. The sub-period analysis shows that there is no significant difference in the rejection rate before the crisis (column 5) but that the significantly higher rejection rate of high compared to low numeracy loan officers observed

in the full sample stems from the crisis period (column 6).

The Table 4.6 results show that high numeracy loan officers are more likely to reject observationally similar loan applications than low numeracy loan officers. This finding suggests that high numeracy loan officers may be assigned loan applications which are riskier based on application and borrower characteristics that are unobservable to us.

To what extent does the difference in loan rejection rates by high versus low numeracy loan officers imply that our main results on screening accuracy (Table 4.2) are biased? The estimated effect of numeracy on accuracy would be upward (downward) biased if borrowers whose loan application was approved by high numeracy loan officers are easier (more difficult) to assess than borrowers whose loan application was approved by low numeracy loan officers. Given that – conditional on observable characteristics - high numeracy loan officers reject more loan applications than low numeracy officers, it seems more plausible that their sample of approved loans is more difficult (rather than easier) to assess. We therefore argue that – if anything – our estimates of the effect of numeracy on accuracy in Table 4.2 is downward biased.

4.6.6 The effect of a math training

The above analysis suggests that initial ratings assigned by loan officers with high numeracy are more accurate than ratings assigned by loan officers with low numeracy. But can a bank improve the accuracy through a targeted investment in loan officers' numerical skills or are observed differences mainly related to the cognitive abilities of loan officers? Our bank subsequently implemented four-day math trainings over the years 2011 and 2012 to prepare employees for a second math test.[28]

Our Internet Appendix[29] presents estimates for the impact of the math training on loan officer accuracy and rejection rates. We exploit the staggered implementation of the training and apply a within loan officer analysis. We do not find a significant influence of the math training on loan officer accuracy nor on their rejection decisions. However, our analysis is limited by the number of loan officers (59) and only allows us to compare a limited number of loan applications in a narrow time window after the training. That said,

[28] While recent studies mainly analyzed the impact of trainings for small-business bank clients (e.g. Karlan (2005); Drexler et al. (2014)), our setting allows to study the influence of a training for loan officers.

[29] See https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2997114.

the findings presented in our Internet Appendix suggest that the difference in accuracy between high and low numeracy loan officers may rather be related to general cognitive ability or social skills than to easily teachable math skills.

4.7 Conclusion

We provide novel evidence documenting that employees with high numerical skills make more accurate on-the-job decisions. In the context of small business lending we relate the numeracy of loan officers to the accuracy of their credit assessments. In line with findings from experimental studies, we document significant differences in accuracy between loan officers with low versus high numeracy. Initial ratings assigned by high numeracy loan officers are better able to predict which borrowers will default and which will not.

The difference in accuracy between high and low numeracy loan officers is most pronounced in the pre-crisis credit boom phase. This finding is in line with Becker et al. (2017) who show that it is most difficult to accurately sort borrowers according to their riskiness during boom periods in which informational frictions are highest. Our results thus provide evidence that hiring skilled loan officers is most important during boom times when separating borrowers by quality is most difficult. Our findings further show that higher numerical skills are a complement to other characteristics (gender, experience) that have been connected to improved loan performance in the literature.

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Appendix Chapter 1

Table 1.A1: Financial literacy questions

Question	Concept	Question adapted from:	Share correctly answered		
			German-speaking	French-speaking	Difference
2.1	Simple interest	Atkinson and Messy (2012)	0.77	0.42	0.35***
2.2	Compound interest	Lusardi and Tufano (2015)	0.37	0.22	0.15***
2.3	Percentage calculation of purchase decision	FSA (2006)	0.80	0.71	0.09***
2.4	Budgeting	OECD (2012)	0.50	0.42	0.08**
2.5 a)	Understanding of bank statement	OECD (2012)	0.63	0.58	0.05
2.5 b)	Understanding of bank statement	OECD (2012)	0.70	0.54	0.16***
2.6 a)	Graphical understanding of stock price development	OECD (2012)	0.64	0.71	-0.07*
2.6 b)	Graphical understanding of stock price development	OECD (2012)	0.62	0.47	0.15***
2.7	Inflation	Lusardi and Mitchell (2011)	0.37	0.25	0.12***
2.8	Diversification	Lusardi and Mitchell (2011)	0.80	0.62	0.18***

Notes: The table displays the individual topics covered in the financial literacy score and the source of the question. It further provides the share of correctly answered questions by school language. The sample means are compared using a t-test. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. For questions 2.5 and 2.6 a) and b) were related to the same graphical element (2.5 image of a bank statement: a) reading the balance in the account statement b) the sum of account outflows; 2.6 line plot of a stock price; a) the best month to buy a stock, b) the stock price increase over 12 months.)

Table 1.A2a: Summary statistics and variable definitions

Variable	Obs	Mean	SD	Min	Max	Mean German	Mean French	Diff	P-value t-test	Description
FL-Score	649	5.53	2.44	0.00	10.00	6.20	4.94	1.25	0.00	Financial literacy score; 10 = highest FL
Fin-Understanding	640	2.43	1.37	0.00	5.00	2.72	2.16	0.56	0.00	Financial matters are confusing; 0 - 5; 5=fully disagree
Patience	584	0.67	0.16	0.07	1.00	0.69	0.66	0.02	0.06	Average of quantitative and qualitative time preference measure
Time preferences quant. measure	599	0.74	0.25	0.00	1.00	0.77	0.70	0.07	0.00	Share allocated to patient choice in time preference game
Time preferences qual. measure	633	0.61	0.18	0.07	1.00	0.60	0.61	-0.02	0.27	General qualitative patience questions; High if more patient
Risk seeking	581	0.41	0.18	0.00	1.00	0.39	0.43	-0.05	0.00	Average of quantitative and qualitative risk preference measure
Risk preferences quant. measure	593	0.26	0.23	0.00	1.00	0.25	0.27	-0.01	0.47	Share allocated to risky choice in risk preference game
Risk preferences qual. measure	635	0.64	0.21	0.17	1.00	0.60	0.67	-0.06	0.00	General risk attitude from qualitative question; High if high willingness to take risks
Financial socialisation	598	0.52	0.32	0.00	1.00	0.61	0.43	0.18	0.00	Average over next 3 variables
Bank account	642	0.75	0.43	0.00	1.00	0.88	0.63	0.25	0.00	Binary variable = 1 if student has a bank account
Independent bank account	638	0.33	0.47	0.00	1.00	0.40	0.27	0.13	0.00	Binary variable = 1 if can independently use bank account
Dummy pocket money	611	0.45	0.50	0.00	1.00	0.55	0.37	0.18	0.00	Binary variable = 1 if first pock money received <12 years old (median 12 years)
Debt norms	629	0.67	0.41	0.00	1.00	0.74	0.62	0.12	0.00	Average over next 2 variables
Not spend more than what you have	641	0.66	0.47	0.00	1.00	0.73	0.60	0.13	0.00	Binary variable = 1 if parents told student sometimes or often not to spend more than what she/he has
Should not make debt	633	0.68	0.47	0.00	1.00	0.74	0.62	0.12	0.00	Binary variable = 1 if parents told student sometimes or often not to make debt
Freedom & control	642	0.48	0.41	0.00	1.00	0.35	0.59	-0.24	0.00	Average over next 2 variables; high = money important for freedom and control
Tool to obtain goals	642	0.56	0.50	0.00	1.00	0.45	0.65	-0.21	0.00	Binary variable = 1 if student agrees or tends to agree that money is a tool to obtain goals
Provides freedom	647	0.39	0.49	0.00	1.00	0.26	0.51	-0.26	0.00	Binary variable = 1 if student agrees or tends to agree that money provides freedom to do what I feel like
Social prestige	639	0.12	0.23	0.00	1.00	0.11	0.14	-0.03	0.09	Average over next 2 variables; high = money important for social prestige
Tool to make friends	644	0.06	0.23	0.00	1.00	0.09	0.02	0.07	0.00	Binary variable = 1 if student agrees or tends to agree that money is a tool to make friends
Willing to do everything required to obtain money	641	0.19	0.40	0.00	1.00	0.12	0.26	-0.13	0.00	Binary variable = 1 if student agrees or tends to agree that he/she is willing to do everything required to obtain money

Table 1.A2b: Summary statistics control variables and variable definitions

Variable	Obs	Mean	SD	Min	Max	Mean German	Mean French	Diff	P-value t-test	Description
Basic controls: Variables independent of cultural group membership										
Female	649	0.47	0.50	0.00	1.00	0.45	0.49	-0.04	0.36	Binary variable = 1 if female
Swiss	649	0.77	0.42	0.00	1.00	0.93	0.63	0.30	0.00	Binary variable = 1 if Swiss citizen
Born in 2000	649	0.63	0.48	0.00	1.00	0.65	0.60	0.04	0.24	Binary variable = 1 if born in year 2000
Born after 2000	649	0.21	0.41	0.00	1.00	0.23	0.19	0.04	0.17	Binary variable = 1 if born after year 2000
Extended controls: Variables potentially influenced by cultural group membership										
Urban	649	0.29	0.45	0.00	1.00	0.17	0.39	-0.22	0.00	Binary variable = 1 if home municipality has >=10,000 inhabitants
Basic school level	649	0.28	0.45	0.00	1.00	0.25	0.31	-0.06	0.07	Binary variable = 1 if basic school level
Medium school level	649	0.36	0.48	0.00	1.00	0.40	0.32	0.08	0.03	Binary variable = 1 if medium school level
High school level	649	0.36	0.48	0.00	1.00	0.35	0.37	-0.02	0.63	Binary variable = 1 if high school level
Single room	615	0.86	0.35	0.00	1.00	0.91	0.81	0.10	0.00	Binary variable = 1 if student has own room
Rent home	633	0.42	0.49	0.00	1.00	0.27	0.56	-0.29	0.00	Binary variable = 1 if family rents home
Holidays	640	3.02	1.56	0.00	5.00	3.08	2.97	0.11	0.36	Weeks of holidays together with parents this year
Catholic	637	0.59	0.49	0.00	1.00	0.55	0.62	-0.08	0.05	Binary variable = 1 if catholic
Protestant	637	0.14	0.35	0.00	1.00	0.23	0.06	0.17	0.00	Binary variable = 1 if protestant
Other religion	637	0.14	0.34	0.00	1.00	0.10	0.17	-0.07	0.02	Binary variable = 1 if other religion
Not religious	637	0.14	0.35	0.00	1.00	0.13	0.15	-0.02	0.39	Binary variable = 1 if not religious
Variables not used in main specifications										
Economic education	634	0.33	0.47	0.00	1.00	0.25	0.39	-0.14	0.00	Binary variable = 1 if topics related to financial education were covered in school
Father university	570	0.31	0.46	0.00	1.00	0.34	0.29	0.05	0.24	Binary variable = 1 if father attended university
Father no add. educ	570	0.12	0.33	0.00	1.00	0.03	0.22	-0.19	0.00	Binary variable = 1 if father neither attended university nor completed an apprenticeship
Mother university	551	0.27	0.45	0.00	1.00	0.28	0.27	0.01	0.73	Binary variable = 1 if mother attended university
Mother no add. educ	551	0.21	0.41	0.00	1.00	0.10	0.33	-0.23	0.00	Binary variable = 1 if mother neither attended university nor completed an apprenticeship
Parents activities	626	0.29	0.45	0.00	1.00	0.30	0.27	0.03	0.42	Binary variable = 1 if parents attend concerts, visit museums and visit theaters (2 out of 3)

Table 1.A3: Heterogeneity of home municipalities

Variable	German-speaking	French-speaking	Diff	p-value t-test
Nr of students	305	344		
Nr of municipalities	31	23		
Main language spoken				
Share German	0.67	0.17	0.49***	0.00
Share French	0.25	0.72	-0.47***	0.00
Share other language	0.08	0.11	-0.02***	0.00
Population				
Population in 1000	9.04	17.02	-7.98***	0.00
Urban municipalities (>=10000 residents)	0.17	0.39	-0.22***	0.00
Share of non-Swiss residents	0.18	0.29	-0.1***	0.00
Economic activity				
Share employed in primary sector	0.09	0.04	0.05***	0.00
Share employed in secondary sector	0.28	0.21	0.08***	0.00
Share employed in tertiary sector	0.63	0.75	-0.12***	0.00
Nr of cars per 1000 inhabitants	568.09	517.28	50.81***	0.00
Nr of bank branches in municipality	4.8	8.0	-3.2***	0.00
Municipalities without bank branch	0.16	0.13	0.04	0.16
Income tax as share of cantonal tax	0.79	0.81	-0.02***	0.00
Municipal tax potential; Cantonal average: 100	102.24	102.39	-0.15	0.93
Religion				
Share catholic	0.66	0.78	-0.12***	0.00
Share protestant	0.23	0.10	0.13***	0.00
Share other	0.05	0.05	0.00	0.86
Share not religious	0.06	0.07	-0.01***	0.00

Notes: The table displays the mean by language group of municipality characteristics in our sample. The variables are weighted by the number of students in the sample from the respective municipality. Source: StatA Fribourg; bank branch information from Brown and Hoffmann (2016)

Table 1.A4: Municipal majority language and financial literacy

Dependent variable:	(1) FL-Score	(2) FL-Score	(3) Fin-Understanding	(4) Fin-Understanding
French municipality	-0.558	-0.954***	-0.586***	-0.693***
	(0.429)	(0.233)	(0.122)	(0.131)
Constant	4.783***	4.318***	2.977***	3.014***
	(0.425)	(0.557)	(0.212)	(0.332)
Sample mean	5.494	5.464	5.494	5.465
Observations	629	570	620	561
R-squared	0.100	0.330	0.095	0.122
Basic controls	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes

Notes: This table reports results of the OLS regression French municipality on financial literacy. The framework corresponds to the RDD framework applied in other studies exploiting the language border (e.g. Eugster et al. 2011; Guin 2015). Since our observations stem from municipalities very close to the language border we do not apply a Local Border Contrast. The French municipality dummy takes on value 1 for 419 students and 0 for 215 students. A home municipality is defined as French-speaking if more than 50% of its inhabitants state French as their main language. The cantonal capital Fribourg is classified as a French-speaking municipality since 64% of the population state French as their first language. Consequently, 98% of students at the German-speaking school in Fribourg are classified as French-speaking according to the majority language definition. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 1.A5a: Propensity score matching: Language group and financial literacy

		Financial literacy	
		(1) FL-Score	(2) FL-Score
NN(2)	ATE	-0.79***	-1.14***
	SE	0.21	0.27
	p-value	0.00	0.00
NN(5)	ATE	-0.73***	-1.07***
	SE	0.21	0.24
	p-value	0.00	0.00
IPW	ATE	-0.81***	-1.12***
	SE	0.20	0.19
	p-value	0.00	0.00
Observations		649	588
Pscore estimation:			
Basic controls		Yes	Yes
Extended controls		No	Yes

Notes: This table reports the ATE of the propensity score matching model. The propensity score is estimated in a probit model. The table reports three matching procedures: NN(2) refers to 2 nearest neighbours; NN(5) refers to 5 nearest neighbours; IPW refers to inverse probability weighting. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are bootstrapped. The p-value indicates the level of significance.

Table 1.A5b: Propensity score matching: Balancing properties

Specification (1) NN(5)

Variable	Mean Treated	Mean Control	%bias	t-test t	t-test p>| t |
Obs	344	305			
Female	0.49	0.49	-0.5	-0.06	0.95
Swiss	0.63	0.63	0.0	0.00	1.00
Born in 2000	0.60	0.64	-6.8	-0.90	0.37
Born after 2000	0.19	0.16	8.1	1.15	0.25

Specification (2) NN(5)

Variable	Mean Treated	Mean Control	%bias	t-test t	t-test p>| t |
Obs	307	281			
Female	0.50	0.52	-3.10	-0.39	0.70
Swiss	0.64	0.64	0.30	0.03	0.97
Born in 2000	0.60	0.59	2.10	0.26	0.79
Born after 2000	0.20	0.21	-3.50	-0.44	0.66
Urban	0.36	0.32	10.50	1.19	0.23
Rent home	0.54	0.52	3.60	0.42	0.68
Single room	0.81	0.82	-4.10	-0.46	0.65
Holidays	2.98	2.98	0.10	0.01	0.99
Medium school level	0.34	0.34	-1.10	-0.14	0.89
High school level	0.37	0.35	3.70	0.45	0.65
Catholic	0.62	0.64	-3.60	-0.45	0.65
Not religious	0.15	0.15	-0.20	-0.02	0.98
Protestant	0.06	0.04	7.30	1.41	0.16
Other religion	0.17	0.18	-1.90	-0.21	0.83

Notes: The tables below display the balancing properties of variables used in the propensity score estimation with basic (1) and extended (2) controls.

Table 1.A6: Parental education and additional municipal controls

Dependent variable	FL-Score		FL-Score			FL-Score		
Sample	Full sample		by maternal level of education			by paternal level of education		
			No add. educ	Apprenticeship	University	No add. educ	Apprenticeship	University
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
French	-1.259***	-1.237***	-1.648***	-1.147***	-1.270**	-1.157	-1.050***	-1.140**
	(0.277)	(0.243)	(0.422)	(0.320)	(0.499)	(0.707)	(0.295)	(0.432)
Constant	4.683***	4.590***	4.867***	4.600***	4.389***	6.037***	4.458***	4.436***
	(0.616)	(0.689)	(1.110)	(0.925)	(1.094)	(1.143)	(0.751)	(1.162)
Sample mean	5.7	5.465	5.22	5.543	6.176	4.719	5.418	6.3
Observations	471	570	109	256	142	64	292	167
R-squared	0.375	0.351	0.420	0.384	0.430	0.539	0.320	0.358
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental education	Yes	No	No	No	No	No	No	No
Add. municipal contr.	No	Yes	No	No	No	No	No	No

Notes: This table reports robustness tests adding additional control variables to our baseline OLS regressions presented in Table 2. Basic controls include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Parental education includes Mother: apprenticeship, Mother: University, Father: Apprenticeship, Father: University. Additional municipal controls include: Nr. of bank branches, Share employed in tertiary sector, Tax potential. Standard errors are clustered at class level and are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Due to missing values, the number of observations fluctuates across specifications.

Table 1.A7b: Mediation analysis with confounding by alternative mechanisms

Notes: This table reports results of the mediation analysis taking into account causally dependent multiple mechanisms as described in Imai and Yamamoto (2013). The R package mediation (Tingley et al., 2014) was used to implement the analysis. The Diff column reports the difference of the estimate in this table compared to the estimate reported in Table 7. Alternative mediators included in the analysis are listed in the rightmost column. Basic control variables include: Female, Swiss, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious.

		FL-Score				Control for potentially
		Estimate	95%-CI		Diff	confounding mediators
Risk seeking	ACME	-0.01	-0.07	0.04	-0.02	Patience
	Direct effect	-1.01	-1.42	-0.61	0.01	Financial socialization
	Total effect	-1.03	-1.44	-0.65	0.00	
	Prop. mediated	0.01			0.02	
Patience	ACME	-0.04	-0.10	0.03	-0.02	Financial socialization
	Direct effect	-0.99	-1.39	-0.59	0.02	
	Total effect	-1.03	-1.40	-0.60	-0.01	
	Prop. mediated	0.03			0.02	
Financial socialisation	ACME	-0.11	-0.22	-0.01	0.01	Patience
	Direct effect	-0.91	-1.30	-0.52	-0.02	Debt norms
	Total effect	-1.03	-1.40	-0.64	0.00	
	Prop. mediated	0.11			-0.01	
Debt norms	ACME	-0.02	-0.08	0.04	0.01	Patience
	Direct effect	-1.00	-1.40	-0.61	-0.01	Financial socialization
	Total effect	-1.03	-1.42	-0.63	-0.01	
	Prop. mediated	0.02			0.00	
Freedom & control	ACME	0.00	-0.13	0.12	0.01	Patience
	Direct effect	-1.02	-1.43	-0.61	-0.01	Social prestige
	Total effect	-1.03	-1.43	-0.65	0.00	
	Prop. mediated	0.00			-0.01	
Social prestige	ACME	-0.02	-0.07	0.03	-0.00	Patience
	Direct effect	-1.00	-1.40	-0.61	0.00	Freedom & control
	Total effect	-1.03	-1.44	-0.64	0.00	
	Prop. mediated	0.02			0.00	
Obs		461				
Basic controls		Yes				
Extended controls		Yes				

Table 1.A8: Pairwise correlations of control variables capturing socioeconomic background with parental education

	Swiss	Urban	Basic school level	High school level	Rent home	Single room	Holidays
Father university	0.079*	0.188***	-0.194***	0.214***	-0.094**	-0.037	0.207***
Father no additional education	-0.377***	0.112***	0.133***	-0.107***	0.261***	-0.152***	-0.011
Mother university	0.01	0.199***	-0.163***	0.126***	-0.119***	0.023	0.245***
Mother no additional education	-0.351***	0.138***	0.133***	-0.048	0.250***	-0.204***	-0.01
Parents culture	0.198***	0.056	-0.172***	0.233***	-0.240***	0.117***	0.140***

Notes: This table reports pairwise correlations. ***, **, * denote significance of the correlation coefficient at the 0.01, 0.05 and 0.10-level. Parental education variables and parents culture have some missing values. The pairwise correlations are reported for all the available observations in the sample. Parent university is a binary variable equal to 1 if the parent attended university. Parent no additional education is a binary variable equal to 1 if the parent did neither attend university nor do an apprenticeship. Parents culture is a binary variable equal to 1 if parents attend at least two of the three events: Theatre, museum, classical music concerts or opera

Appendix Chapter 2

Table 2.A1: Summary statistics: Outcomes and consumption goods

Variable	Obs	Mean	SD	Min	Max	Mean German	Mean French	Diff	P-value t-test	Description
Intertemporal consumption										
Saving	505	0.49	0.35	0	1	0.56	0.43	0.13	0.00	Share of availabe financial resources saved in last month (Missing if no funds available)
Consumption regret	646	0.24	0.43	0	1	0.15	0.33	-0.17	0.00	Regret purchase the day after; Binary variable = 1 if often or occasionally
Consumption goods										Responses to question: How often to you spend money on ... ? 1 = never; 4 = often
Sweets	641	2.27	0.82	1	4	2.26	2.28	-0.02	0.81	Sweets
Alcohol	644	1.29	0.66	1	4	1.27	1.31	-0.04	0.39	Alcohol
Cigarettes	641	1.24	0.72	1	4	1.21	1.28	-0.07	0.23	Cigarettes
Magazines	643	1.40	0.68	1	4	1.41	1.39	0.02	0.77	Magazines
Music	641	1.68	0.86	1	4	1.73	1.63	0.10	0.15	Music
Consumption channel										
Buyonline	641	0.70	0.46	0	1	0.72	0.68	0.04	0.27	Do you make purchases online? Binary variable = 1 if yes

Table 2.A2: Summary statistics: Channels

Variable	Obs	Mean	SD	Min	Max	Mean German	Mean French	Diff	P-value t-test	Description
Patience	584	0.67	0.16	0.07	1.00	0.69	0.66	0.02	0.06	Average of quant. and qual. time preference measure
Time preferences quant. measure	599	0.74	0.25	0.00	1.00	0.77	0.70	0.07	0.00	Share allocated to patient choice in time preference game
Time preferences qual. measure	633	0.61	0.18	0.07	1.00	0.60	0.61	-0.02	0.27	General qualitative patience questions; High if more patient
Risk seeking	581	0.41	0.18	0.00	1.00	0.39	0.43	-0.05	0.00	Average of quant. and qual. risk preference measure
Risk preferences quant. measure	593	0.26	0.23	0.00	1.00	0.25	0.27	-0.01	0.47	Share allocated to risky choice in risk preference game
Risk preferences qual. measure	635	0.64	0.21	0.17	1.00	0.60	0.67	-0.06	0.00	General risk attitude from qualitative question; High = more risk seeking
Financial socialization	598	0.52	0.32	0.00	1.00	0.61	0.43	0.18	0.00	Average over next 3 variables
Bank account	642	0.75	0.43	0.00	1.00	0.88	0.63	0.25	0.00	Binary variable = 1 if student has a bank account
Independent bank account	638	0.33	0.47	0.00	1.00	0.40	0.27	0.13	0.00	Binary variable = 1 if can independently use bank account
Dummy pocket money	611	0.45	0.50	0.00	1.00	0.55	0.37	0.18	0.00	Binary variable = 1 if first pock money received <12 years old (median 12 years)
Debt norms	629	0.67	0.41	0.00	1.00	0.74	0.62	0.12	0.00	Average over next 2 variables
Not spend more	641	0.66	0.47	0.00	1.00	0.73	0.60	0.13	0.00	Binary variable = 1 if parents told student sometimes or often not to spend more than what she/he has
Should not make debt	633	0.68	0.47	0.00	1.00	0.74	0.62	0.12	0.00	Binary variable = 1 if parents told student sometimes or often not to make debt
Freedom & control	642	0.48	0.41	0.00	1.00	0.35	0.59	-0.24	0.00	Average over next 2 variables; high = money important for freedom and control
Tool to obtain goals	642	0.56	0.50	0.00	1.00	0.45	0.65	-0.21	0.00	Binary variable = 1 if student agrees or tends to agree that money is a tool to obtain goals
Provides freedom	647	0.39	0.49	0.00	1.00	0.26	0.51	-0.26	0.00	Binary variable = 1 if student agrees or tends to agree that money provides freedom to do what I feel like
Social prestige	639	0.12	0.23	0.00	1.00	0.11	0.14	-0.03	0.09	Average over next 2 variables; high = money important for social prestige
Tool to make friends	644	0.06	0.23	0.00	1.00	0.09	0.02	0.07	0.00	Binary variable = 1 if student agrees or tends to agree that money is a tool to make friends
Everything required	641	0.19	0.40	0.00	1.00	0.12	0.26	-0.13	0.00	Binary variable = 1 if student agrees or tends to agree that (s)he is willing to do everything required to obtain money

Table 2.A3: Summary statistics: Control variables

Variable	Obs	Mean	SD	Min	Max	Mean German	Mean French	Diff	P-value t-test	Description
Basic controls										
Female	649	0.47	0.50	0.00	1.00	0.45	0.49	-0.04	0.36	Binary variable = 1 if female
Swiss	649	0.77	0.42	0.00	1.00	0.93	0.63	0.30	0.00	Binary variable = 1 if Swiss citizen
Born in 2000	649	0.63	0.48	0.00	1.00	0.65	0.60	0.04	0.24	Binary variable = 1 if born in year 2000
Born after 2000	649	0.21	0.41	0.00	1.00	0.23	0.19	0.04	0.17	Binary variable = 1 if born after year 2000
Extended controls										
Urban	649	0.29	0.45	0.00	1.00	0.17	0.39	-0.22	0.00	Binary variable = 1 if municipality >=10,000 inh.
Basic school level	649	0.28	0.45	0.00	1.00	0.25	0.31	-0.06	0.07	Binary variable = 1 if basic school level
Medium school level	649	0.36	0.48	0.00	1.00	0.40	0.32	0.08	0.03	Binary variable = 1 if medium school level
High school level	649	0.36	0.48	0.00	1.00	0.35	0.37	-0.02	0.63	Binary variable = 1 if high school level
Single room	615	0.86	0.35	0.00	1.00	0.91	0.81	0.10	0.00	Binary variable = 1 if student has own room
Rent home	633	0.42	0.49	0.00	1.00	0.27	0.56	-0.29	0.00	Binary variable = 1 if family rents home
Holidays	640	3.02	1.56	0.00	5.00	3.08	2.97	0.11	0.36	Holiday weeks together with parents this year
Catholic	637	0.59	0.49	0.00	1.00	0.55	0.62	-0.08	0.05	Binary variable = 1 if catholic
Protestant	637	0.14	0.35	0.00	1.00	0.23	0.06	0.17	0.00	Binary variable = 1 if protestant
Other religion	637	0.14	0.34	0.00	1.00	0.10	0.17	-0.07	0.02	Binary variable = 1 if other religion
Not religious	637	0.14	0.35	0.00	1.00	0.13	0.15	-0.02	0.39	Binary variable = 1 if not religious
Financial resources										
Total amount	571	165.22	280.36	0.00	4'000	156.40	173.25	-16.84	0.47	Total available financial resources; Sum of pocket money, income of a side job and money from other sources
Ln(Total amount)	565	4.48	1.06	1.61	8.29	4.50	4.46	0.04	0.66	Ln(Total amount)
Job income	571	0.29	0.46	0.00	1.00	0.36	0.23	0.13	0.00	Binary variable = 1 if student had side job
Other sources	571	0.38	0.49	0.00	1.00	0.37	0.39	-0.02	0.68	Binary variable = 1 if student received money from other sources (e.g. presents)

Table 2.A4: Summary statistics: Sample of Swiss students

Variable	Obs	Mean	SD	Min	Max	German	French	Diff	P-value
Saving	392	0.53	0.35	0.00	1.00	0.57	0.47	0.10	0.00
Consumption regret	497	0.20	0.40	0.00	1.00	0.13	0.30	-0.17	0.00
Patience	461	0.69	0.16	0.07	1.00	0.69	0.68	0.01	0.48
Risk seeking	460	0.41	0.19	0.00	1.00	0.39	0.44	-0.05	0.01
Financial socialization	464	0.55	0.31	0.00	1.00	0.61	0.47	0.15	0.00
Debt norms	487	0.69	0.40	0.00	1.00	0.73	0.63	0.11	0.00
Freedom & control	493	0.45	0.41	0.00	1.00	0.34	0.58	-0.24	0.00
Social prestige	493	0.12	0.23	0.00	1.00	0.11	0.12	0.01	0.61
Female	498	0.47	0.50	0.00	1.00	0.45	0.50	-0.05	0.24
Born in 2000	498	0.64	0.48	0.00	1.00	0.66	0.62	0.03	0.43
Born after 2000	498	0.23	0.42	0.00	1.00	0.24	0.21	0.02	0.55
Urban	498	0.22	0.42	0.00	1.00	0.15	0.32	-0.16	0.00
Basic school level	498	0.23	0.42	0.00	1.00	0.23	0.24	0.00	0.92
Medium school level	498	0.34	0.47	0.00	1.00	0.40	0.27	0.13	0.00
High school level	498	0.42	0.49	0.00	1.00	0.37	0.49	-0.12	0.01
Single room	474	0.89	0.31	0.00	1.00	0.92	0.86	0.06	0.02
Rent home	486	0.31	0.46	0.00	1.00	0.23	0.41	-0.18	0.00
Holidays	491	2.97	1.57	0.00	5.00	3.04	2.88	0.16	0.27
Catholic	489	0.59	0.49	0.00	1.00	0.55	0.64	-0.09	0.05
Protestant	489	0.17	0.37	0.00	1.00	0.24	0.07	0.17	0.00
Other religion	489	0.09	0.29	0.00	1.00	0.08	0.11	-0.04	0.16
Not religious	489	0.15	0.36	0.00	1.00	0.13	0.17	-0.04	0.17
Total amount	447	173.92	299.69	0.00	4,000	155.28	198.23	-42.95	0.13
Job income	447	0.33	0.47	0.00	1	0.37	0.27	0.10	0.03
Other income	447	0.40	0.49	0.00	1	0.37	0.44	-0.07	0.13

Table 2.A5: Municipality characteristics in sample

Variable	Total sample			Only non-urban (<10k pop.) mun.		
	German-speaking	French-speaking	Diff	German-speaking	French-speaking	Diff
Nr of students	283	215		240	147	
Nr of municipalities	31	23		29	21	
Main language spoken						
Share German	68.26	15.90	52.36***	77.33	13.24	64.09***
Share French	23.77	74.60	-50.83***	15.94	80.10	-64.16***
Population						
Population in 1000	8.58	14.52	-5.94***	4.02	3.52	0.5*
Urban municipalities (>=10k residents)	0.15	0.32	-0.16***	-	-	0
Share of non-Swiss residents	0.18	0.26	-0.08***	0.15	0.21	-0.07***
Economic activity						
Share employed in primary sector	0.09	0.06	0.04***	0.11	0.08	0.03**
Share employed in secondary sector	0.29	0.21	0.08***	0.32	0.27	0.05***
Share employed in tertiary sector	0.62	0.73	-0.11***	0.57	0.65	-0.07***
Nr of cars per 1000 inhabitants	571.46	530.15	41.31***	598.65	591.22	7.42
Nr of brank branches in municipality	4.64	6.74	-2.1***	2.59	1.07	1.52***
Municipalities without bank branch	0.17	0.15	0.02	0.20	0.22	-0.02
Municipal tax potential; Cantonal average: 100	101.22	99.82	1.4	97.45	94.17	3.28
Religion						
Share catholic	0.65	0.79	-0.14***	0.63	0.82	-0.18***
Share protestant	0.24	0.09	0.15***	0.26	0.09	0.18***
Share other	0.05	0.05	0***	0.05	0.04	0.01***
Share not religious	0.06	0.07	-0.01***	0.05	0.06	-0.01***

Notes: The table displays the mean by language group of certain municipality characteristics in our sample. The variables are weighted by the number of Swiss students in the sample from the respective municipality. The municipal tax potential refers to tax revenues divided by population. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level. Source: Cantonal statistics office Fribourg, bank branch information from Brown and Hoffmann (2016)

Table 2.A6: Difference in financial resources

Financial resources: Amounts in CHF

	Total (1)	Total (2)	Pocketmoney (3)	Pocketmoney (4)	Job income (5)	Job income (6)	Other income (7)	Other income (8)
French	47.107	65.663*	15.434	17.144	-10.674	-0.499	42.012**	47.839**
	(34.884)	(36.116)	(13.197)	(15.063)	(14.090)	(14.662)	(20.256)	(20.402)
Sample mean	176	173	66	66	45	44	65	64
Observations	447	415	427	396	447	415	447	415
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes	No	Yes	No	Yes

Financial resources: Incidence of sources

	Any money (9)	Any money (10)	Pocketmoney (11)	Pocketmoney (12)	Job income (13)	Job income (14)	Other income (15)	Other income (16)
French	0.002	0.005	0.013	-0.000	-0.094**	-0.054	0.078	0.052
	(0.007)	(0.010)	(0.023)	(0.024)	(0.043)	(0.047)	(0.051)	(0.054)
Sample mean	0.99	0.99	0.93	0.93	0.33	0.33	0.40	0.40
Observations	447	415	442	410	447	415	447	415
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The table displays estimated differences in amounts received (columns (1) - (8)) and in the existence of specific income sources (columns (9) - (16), a linear probability model is applied). Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 2.A7: Treatment by majority language

Outcome	Saving			Consumption regret		
Specification	OLS			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
French municipality	-0.090*	-0.094**	-0.094**	0.154***	0.121***	0.121***
	(0.047)	(0.046)	(0.044)	(0.045)	(0.038)	(0.040)
Obs	392	363	359	497	454	411
Observations	505	463	457	646	586	518
Clusters	40	40	40	40	40	40
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	Yes	No	Yes	Yes
Financial resources	No	No	Yes	No	No	Yes

Notes: This table reports results of the model French municipality on several outcome variables. The French municipality dummy is equal to 1 if the majority of the population in a municipality state French as their main language. The framework corresponds to the RDD framework applied in other studies exploiting the language border (e.g. Eugster et al. 2011; Guin 2015). Since the observations stem from municipalities very close to the language border the model takes the mean difference instead of applying a Local Border Contrast. Probit models present marginal effects calculated at the mean. Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Financial resources control for Ln(amount), Job income and Other sources. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 2.A8: Difference in any savings (*Saved*) and full savings (*All Saved*)

Outcome	Saved			All Saved		
Specification	Probit			Probit		
	(1)	(2)	(3)	(4)	(5)	(6)
French	-0.111***	-0.121***	-0.114***	-0.047	-0.061	-0.059
	(0.034)	(0.029)	(0.025)	(0.036)	(0.040)	(0.040)
Mean of outcome	0.87	0.86	0.86	0.17	0.17	0.17
Obs	392	363	359	392	363	359
Clusters	40	40	40	40	40	40
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	Yes	No	Yes	Yes
Financial resources	No	No	Yes	No	No	Yes

Notes: This table reports marginal effects at the mean of the Probit model *French* on *Saved* (1-3) and on *All Saved* (4-6). *Saved* is binary variable equal to 1 if a student saved a share >0 of the available financial resources. *All Saved* is a binary variable if a student saved 100% of the available financial resources. Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Financial resources control for Ln(amount), Job income and Other sources. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level. Due to missing values, the number of observations fluctuates across specifications.

Table 2.A9: Consumption regret: Ordered probit regression

Outcome	Consumption regret in cat. (min=1; max=4)			
Specification	Ordered Probit			
	(1)	(2)	(3)	(4)
French	0.636***	0.626***	0.639***	0.655***
	(0.129)	(0.128)	(0.146)	(0.164)
Constant cut1	-0.614***	-0.580***	-0.971***	-1.137**
	(0.068)	(0.109)	(0.323)	(0.468)
Constant cut2	1.154***	1.205***	0.813**	0.670
	(0.119)	(0.129)	(0.337)	(0.456)
Constant cut3	2.462***	2.518***	2.192***	2.011***
	(0.174)	(0.167)	(0.357)	(0.470)
Observations	497	497	454	411
Basic controls	No	Yes	Yes	Yes
Extended controls	No	No	Yes	Yes
Financial resources	No	No	No	Yes

Notes: The table displays results of an ordered probit regression. The model makes use of the full information of the survey questions "How often do you regret a purchase the day after?" where 1 = never, 2=sometimes, 3=occasionally, 4=often. Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Financial resources control for Ln(amount), Job income and Other sources. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 2.A10: All coefficients of main regression

Outcome	Saving		Consumption regret	
Specification	OLS		Probit	
	(1)	(2)	(3)	(4)
French	-0.093**	-0.105**	0.163***	0.152***
	(0.046)	(0.042)	(0.046)	(0.046)
Female	-0.029	-0.032	0.080**	0.066
	(0.032)	(0.033)	(0.039)	(0.044)
Born in 2000	0.020	-0.010	0.009	0.073
	(0.053)	(0.064)	(0.049)	(0.056)
Born after 2000	0.107	0.062	-0.020	0.057
	(0.068)	(0.075)	(0.059)	(0.068)
Urban		-0.106*		0.149**
		(0.059)		(0.075)
Rent home		-0.072		0.002
		(0.045)		(0.042)
Single room		-0.111		-0.050
		(0.067)		(0.069)
Holidays		0.019*		-0.012
		(0.010)		(0.014)
Medium school level		0.086		-0.116**
		(0.053)		(0.056)
High school level		0.156***		-0.155***
		(0.054)		(0.052)
Catholic		-0.071		-0.044
		(0.055)		(0.076)
Not religious		-0.084		-0.028
		(0.070)		(0.095)
Protestant		-0.160**		-0.127
		(0.065)		(0.082)
Job income		0.042		-0.061
		(0.039)		(0.048)
Other income		0.002		-0.026
		(0.034)		(0.049)
Ln(amount)		0.007		0.011
		(0.025)		(0.021)
Obs	392	359	497	411
Basic controls	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes
Financial resources	No	Yes	No	Yes

Notes: This table reports all regression coefficients of the model French on several outcome variables presented in Table 2. Probit models present marginal effects calculated at the mean. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 2.A11: Measures of economic preferences

Time preference measures										
	Quant. measure		Qual. measure		Components of qualitative measure of time preferences					
					Save today		Procrastinate		Spend now	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
French	-0.042	-0.063***	0.026	0.039*	0.254**	0.297**	0.027	0.130	0.090	0.142
	(0.033)	(0.022)	(0.021)	(0.022)	(0.107)	(0.117)	(0.142)	(0.169)	(0.160)	(0.143)
Mean of outcome	0.76	0.76	0.61	0.61	4.65	4.64	3.08	3.09	4.45	4.45
Observations	472	434	486	447	496	454	494	451	492	452
Risk preference measures										
	Quant. measure		Qual. measure							
	(11)	(12)	(13)	(14)						
French	0.010	-0.008	0.070***	0.071***						
	(0.026)	(0.029)	(0.025)	(0.025)						
Mean of outcome	0.26	0.27	0.63	0.63						
Observations	467	428	490	448						
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: This table reports results of the linear model French on measures of time and risk preferences. Quantitative measure (columns 1, 2, 11 and 12) refers to measures obtained from students' choices in a game. Qualitative measures (3, 4, 13 and 14) are obtained through survey questions. Columns 5 - 10 reflect estimates for each of the survey questions used for the qualitative time preference measure. The variables Save today (I rather go without something today in order to be able to afford more tomorrow), Procrastinate (I tend to procrastinate tasks even though it would be better to get them done immediately) and Spend now(I am prepared to spend now and let the future take care of itself) reflect the answer on a 1 - 6 scale (1(strongly disagree) to 6(strongly agree)) where the variable was transformed so that 6 is always the most patient choice. Basic control variables include: Female, Born in 2000, Born after 2000. Extended controls include: Urban, School level, Single room, Rent home, Holidays, Catholic, Protestant, Other religion, Not religious. Standard errors are clustered at class level and are reported in brackets. ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Table 2.A12: Analysis of channels

	Saving: OLS			Consumption regret: Probit		
Variable	Baseline Estimate	Estimate with control	Share explained	Baseline Estimate	Estimate with control	Share explained
Risk seeking	-0.10	-0.10	4.0%	0.14	0.13	9.0%
Patience	-0.11	-0.10	12.0%	0.15	0.13	12.0%
Financial socialization	-0.09	-0.09	-3.0%	0.14	0.14	2.0%
Debt norms	-0.09	-0.09	-2.0%	0.14	0.13	11.0%
Freedom & control	-0.10	-0.07	32.0%	0.15	0.10	31.0%
Social prestige	-0.11	-0.10	7.0%	0.15	0.13	12.0%
All channels	-0.07	-0.04	51.0%	0.14	0.09	36.0%

Notes: The table presents the share explained by each channel. Baseline estimate refers to the estimate of French in the baseline specification with basic and extended controls. The baseline estimates vary due to missing values for the channel variables. Estimate with control presents the estimate of French for the baseline model controlling for the respective channel. The share explained is equal to $1 - \frac{Estimate\ with\ control}{BaselineEstimate}$.

Table 2.A13: Parental level of education

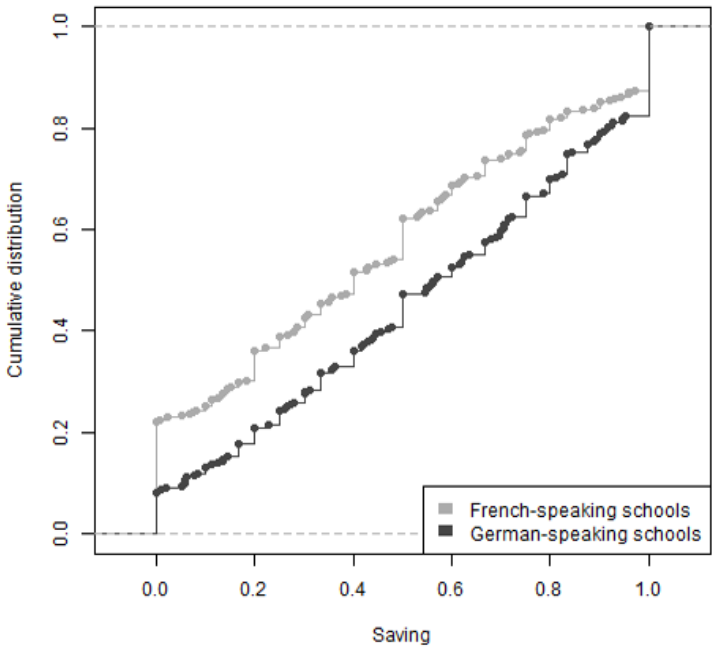
Variable	Total sample			Swiss students only		
	Mean German	Mean French	Diff.	Mean German	Mean French	Diff.
Education mother						
Mother none	0.100	0.328	-0.22***	0.084	0.223	-0.13***
Mother apprenticeship	0.621	0.406	0.215***	0.645	0.497	0.147***
Mother university	0.279	0.266	0.012	0.271	0.279	-0.008
Education father						
Father none	0.031	0.220	-0.18***	0.019	0.124	-0.10***
Father apprenticeship	0.632	0.489	0.142***	0.646	0.548	0.097**
Father university	0.337	0.291	0.046	0.336	0.328	0.007

Notes: The table displays differences in parental level of education between cultural groups in the sample. Due to missing values, the variables are not used in the main analysis. Controling for parental education does not impact the presented results in Table 2.1 ***,**, * denote significance at the 0.01, 0.05 and 0.10-level.

Figure 2.A1: Distribution of saving and consumption regret

The figures display a) the distribution of the responses to the question *How often do you regret a purchase the day after?* by school language and b) the cumulative distribution function of the share of financial resources that students saved by school language.

(a) Saving



(b) Consumption regret

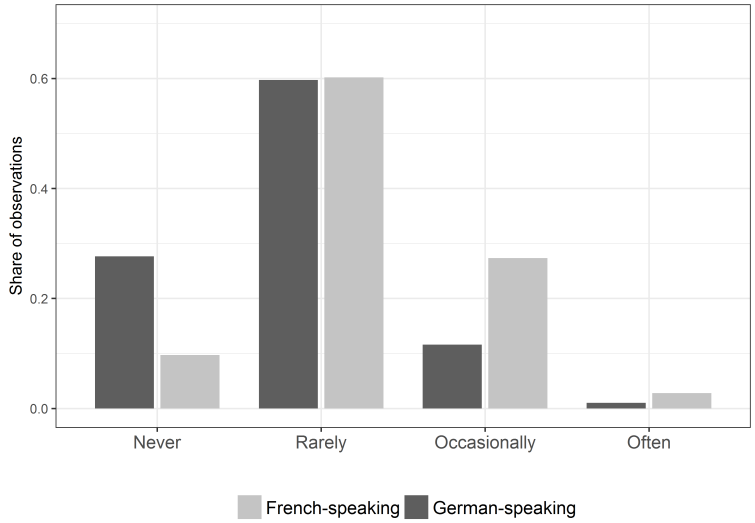
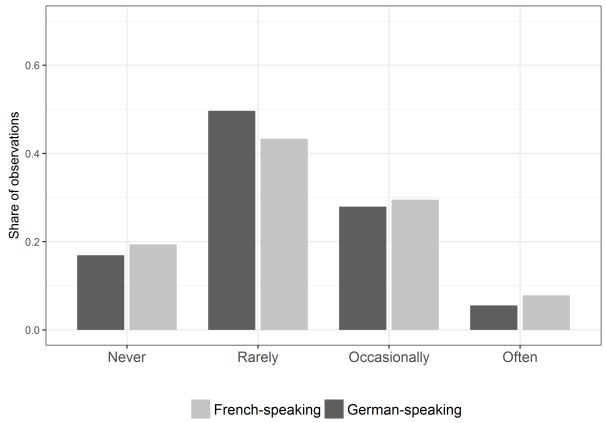


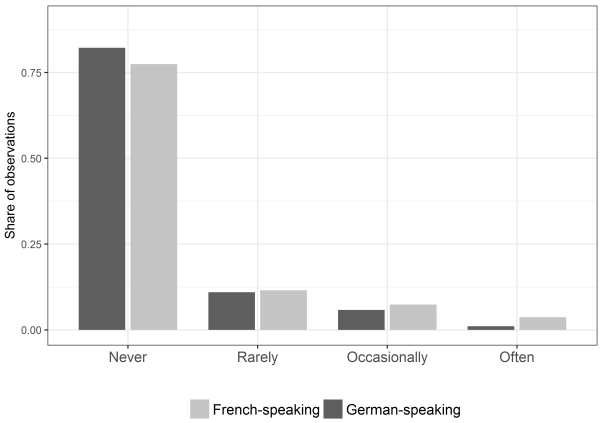
Figure 2.A2: Difference in consumption by school language

The figures display the distribution of answers by school language group to the question: *How often do you spend money on these goods?* The table displays values of the p-value of a Chi2-test comparing the distributions.

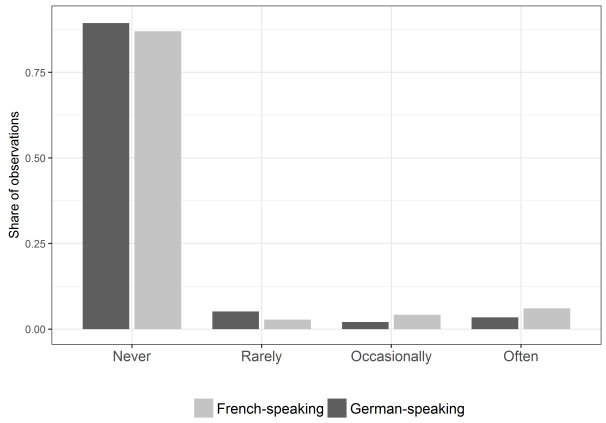
(a) Sweets



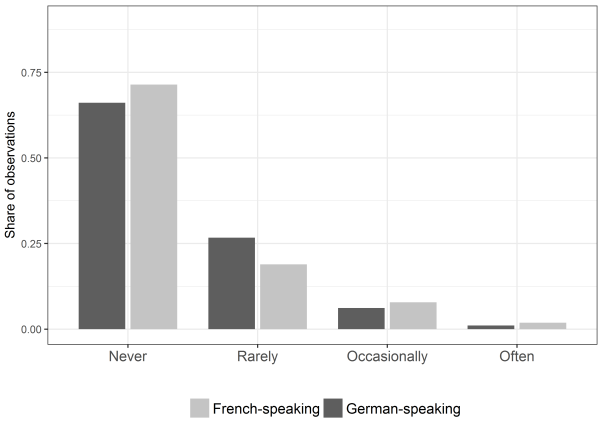
(b) Alcohol



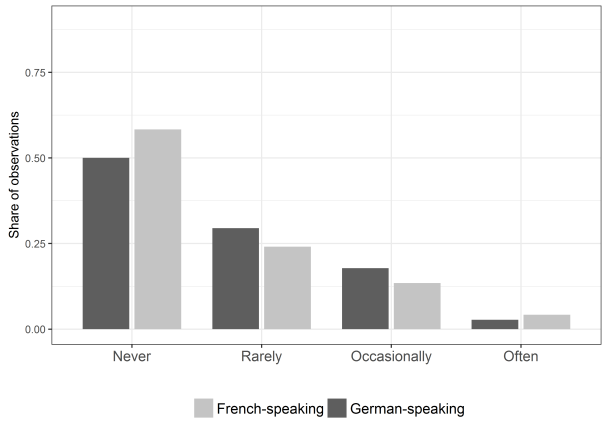
(c) Cigarettes



(d) Magazines



(e) Music



(f)

Variable	P-value Chi2
Sweets	0.399
Alcohol	0.269
Cigarettes	0.174
Magazines	0.138
Music	0.178

***, **, * denote significance at 0.01, 0.05 and 0.10-level.

Figure 2.A3: Difference in expenses covered by parents by school language

The figures display the distribution of answers by school language group to the question: *Who is covering the following expenses?* The table displays values of the p-value of a Chi2-test comparing the distributions (excl. do not have expense).

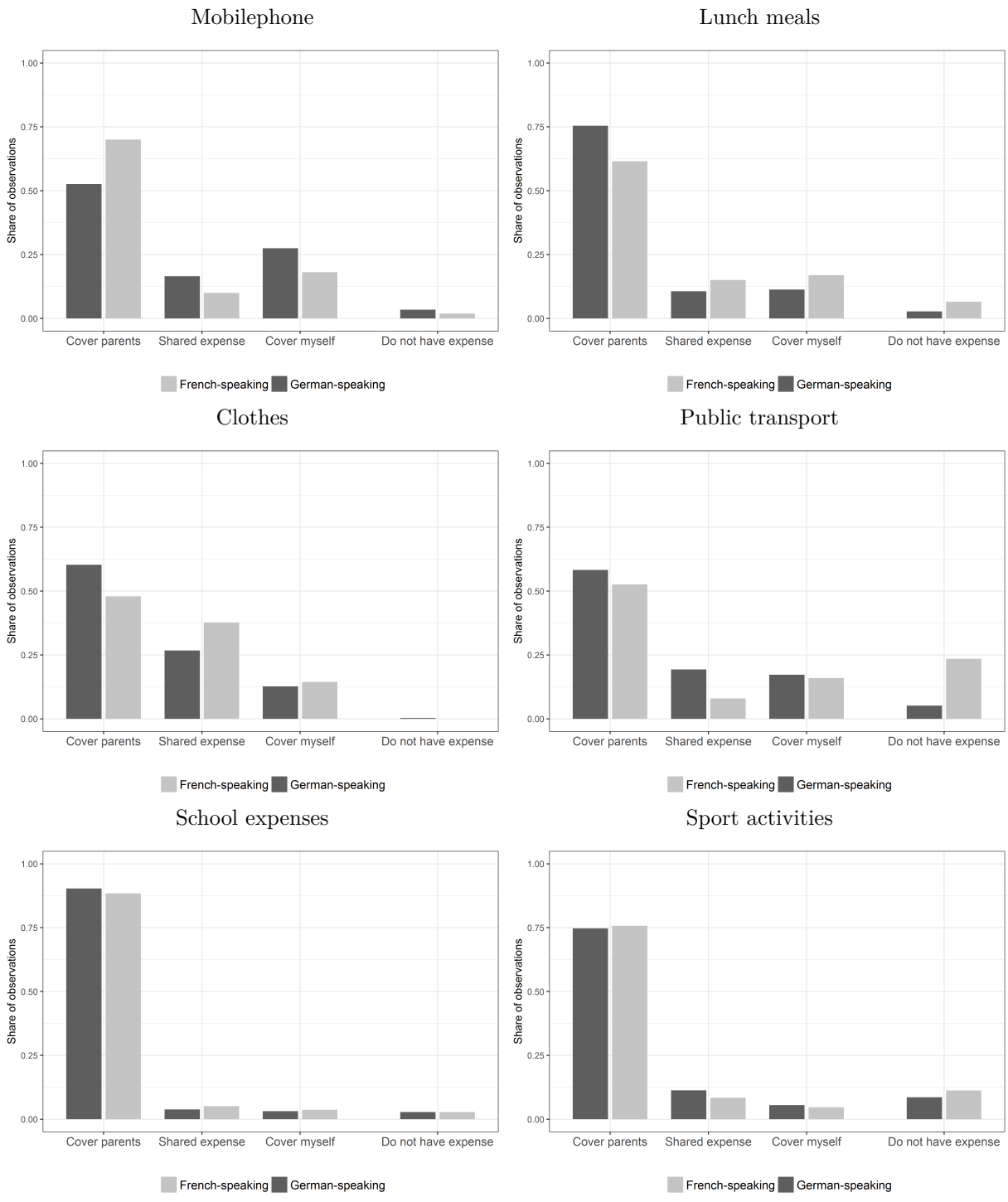
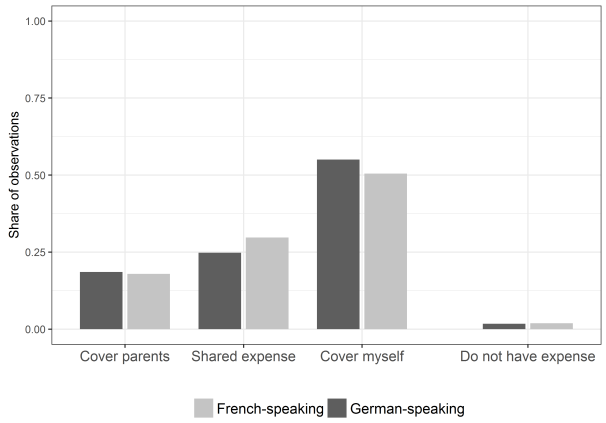


Figure 2.A3 *(Cont.)*: Difference in expenses covered by parents by school language

Variable	P-value Chi2
Mobilephone	0.002***
Lunch meals	0.015**
Clothes	0.009***
Public transport	0.022**
School expenses	0.889
Sport activities	0.511
Leisure activities	0.496

***,**, * denote significance at 0.01, 0.05 and 0.10-level.

Leisure activities



Theory Appendix 2

I assume isoelastic preferences, additive utility and set the price of good C equal to 1. p is the relative price of the two goods. Individuals are subject to the following maximization problem:

$$\begin{aligned} max[U(C_1) + \beta U(C_2, D)] \\ s.t.\ C_1 = w - s_1 \\ and\ C_2 + Dp = w + s_1 \end{aligned}$$

The following FOCs can be obtained:

$$L: \ \frac{1}{1-\theta}C_1^{1-\theta} + \beta[\frac{1}{1-\theta}C_2^{1-\theta} + Z\frac{1}{1-\theta}D^{1-\theta}] - \lambda(2w - C_1 - C_2 - Dp)$$

$$\begin{aligned} C_1^{-\theta} + \lambda = 0 \\ \beta C_2^{-\theta} + \lambda = 0 \\ Z\beta D^{-\theta} + \lambda p = 0 \\ 2w - C_1 - C_2 - Dp = 0 \end{aligned}$$

The following trade offs between consumption decisions evolve:

$$\begin{aligned} C_1 = \frac{1}{\beta^{\frac{1}{\theta}}}C_2 \\ D = \left(\frac{Z}{p}\right)^{\frac{1}{\theta}} C_2 \end{aligned}$$

Solving for the three consumption decisions yields:

$$C_1^* = \frac{1}{\beta^{\frac{1}{\theta}}} \frac{2w}{\frac{1}{\beta^{\frac{1}{\theta}}} + 1 + Z^{\frac{1}{\theta}} p^{\theta}}$$

$$C_2^* = \frac{2w}{\frac{1}{\beta^{\frac{1}{\theta}}} + 1 + Z^{\frac{1}{\theta}} p^{\theta}}$$

$$D^* = \left(\frac{Z}{p}\right)^{\frac{1}{\theta}} \frac{2w}{\frac{1}{\beta^{\frac{1}{\theta}}} + 1 + Z^{\frac{1}{\theta}} p^{\theta}}$$

The share saved in period 1 $\frac{s_1}{w}$ can be expressed as:

$$s_1 = w - C_1$$

$$\frac{s_1}{w} = 1 - \frac{C_1}{w}$$

$$\frac{s_1}{w} = 1 - \frac{\frac{1}{\beta^{\frac{1}{\theta}}} \frac{2w}{\frac{1}{\beta^{\frac{1}{\theta}}} + 1 + Z^{\frac{1}{\theta}} p^{\theta}}}{w}$$

$$\frac{s_1}{w} = 1 - \frac{2}{\beta^{\frac{1}{\theta}} (\frac{1}{\beta^{\frac{1}{\theta}}} + 1 + Z^{\frac{1}{\theta}} p^{\theta})}$$

$$\frac{s_1}{w} = f(\beta, Z, p, \theta)$$

Thus, observed differences in savings and consumption behavior may stem from differences in the discount factor β, the relative utility from consuming good C and good D captured by Z, the relative price p or the curvature of the utility function captured in θ.

Appendix Chapter 3

Table 3.A1: Summary statistics

	Difference-in-differences sample					Full sample				
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
Outcomes										
Not accept	118624	0.182	0.39	0	1	328999	0.173	0.38	0	1
Cancel	97023	0.021	0.14	0	1	271966	0.021	0.14	0	1
Cancel within 7 days	97023	0.004	0.06	0	1	271966	0.004	0.06	0	1
Cancel within 14 days	97023	0.007	0.08	0	1	271966	0.007	0.08	0	1
Treated	118624	0.48	0.50	0	1					
Post	118624	0.46	0.50	0	1					
Application characteristics										
Offered amount	118624	23994	16770	500	80000	328999	23901	16800	500	80000
Offered maturity	118624	50.01	17.84	5	84	328999	50.08	18.06	4	84
Online	118624	0.19	0.40	0	1	328999	0.20	0.40	0	1
2nd Application	68082	0.10	0.30	0	1	188559	0.10	0.31	0	1
Household characteristics										
<=4000 CHF	118624	0.16	0.36	0	1	328999	0.16	0.36	0	1
4 - 6000 CHF	118624	0.40	0.49	0	1	328999	0.41	0.49	0	1
6 - 8000 CHF	118624	0.23	0.42	0	1	328999	0.23	0.42	0	1
8 - 10000 CHF	118624	0.14	0.35	0	1	328999	0.14	0.35	0	1
10000+ CHF	118624	0.07	0.26	0	1	328999	0.07	0.25	0	1
<25 years	118624	0.05	0.22	0	1	328999	0.05	0.22	0	1
25-34 years	118624	0.27	0.44	0	1	328999	0.27	0.44	0	1
35-44 years	118624	0.28	0.45	0	1	328999	0.27	0.45	0	1
45-54 years	118624	0.27	0.44	0	1	328999	0.27	0.44	0	1
55-64 years	118624	0.13	0.33	0	1	328999	0.13	0.34	0	1
64+ years	118624	0.01	0.09	0	1	328999	0.01	0.09	0	1
Female	118624	0.30	0.46	0	1	328999	0.30	0.46	0	1
Single	118624	0.43	0.50	0	1	328999	0.43	0.50	0	1
Married	118624	0.46	0.50	0	1	328999	0.47	0.50	0	1
Other	118624	0.10	0.30	0	1	328999	0.10	0.30	0	1
Kids	118624	0.37	0.48	0	1	328999	0.38	0.48	0	1
Employed	118624	0.95	0.22	0	1	328999	0.95	0.21	0	1
Self-employed	118624	0.03	0.16	0	1	328999	0.02	0.15	0	1
Other occ.	118624	0.03	0.16	0	1	328999	0.02	0.15	0	1

Table 3.A2: Variable descriptions

Variable	Description
Outcomes	
Not accept	Binary variable equal to one if an offer was not accepted
Cancel	Binary variable equal to one if an accepted offer was canceled
Cancel within 7 days	Binary variable equal to one if an accepted offer was canceled within 7 days of offer date
Cancel within 14 days	Binary variable equal to one if an accepted offer was canceled within 14 days of offer date
Application characteristics	
Treated	Binary variable equal to one if offer in time span Sept 2015 - Mar 2016
Post	Binary variable equal to one if offer in months Jan - Mar
Offered amount	Offered amount in CHF
Offered maturity	Offered loan maturity in months
Online	Binary variable equal to one if application was filed online
2nd Application	Binary variable equal to one if applicant has an open loan application at another lender
Income	Income dummies
<=4000 CHF	
4 - 6000 CHF	
6 - 8000 CHF	
8 - 10000 CHF	
10000+ CHF	
Age	Age dummies
<25 years	
25-34 years	
35-44 years	
45-54 years	
55-64 years	
64+ years	
Other borrower characteristics	
Female	Binary variable equal to one if applicant is female
Single	Binary variable equal to one if applicant is single
Married	Binary variable equal to one if applicant is married
Other	Binary variable equal to one if applicant is divorced or widowed
Kids	Binary variable equal to one if applicant has kids
Employed	Binary variable equal to one if applicant is employed
Self-employed	Binary variable equal to one if applicant is self-employed
Other occ.	Binary variable equal to one if applicant has another employment status

Table 3.A3: Differences in means

The table displays the difference in mean of outcome and control variables. *Before* relates to the months September to December, *After* to January to March. The sample mean *Before* and *After* are compared using a t-test. ***, **, * denote significance at the 1, 5 and 10% level respectively. Diff-Diff shows the difference in the Diff measures.

	Aug 2014 - Mar 2015			Aug 2015 - Mar 2016			
	Before	After	Diff	Before	After	Diff	Diff-Diff
Not accept	0.18	0.18	-0.004	0.18	0.18	-0.005*	0.002
Cancel	0.02	0.02	0	0.02	0.02	-0.001	0.001
Offered amount	23471.58	24188.09	-716.511***	23774.99	24163.17	-388.173***	-328.338
Offered maturity	49.14	49.88	-0.742***	49.67	51.10	-1.436***	0.694
Online	0.20	0.19	0.005	0.21	0.21	-0.004	0.008
2nd Application	0.10	0.11	-0.008***	0.10	0.10	-0.003	-0.005
<=4000 CHF	0.16	0.16	0.003	0.16	0.15	0.01***	-0.008
4 - 6000 CHF	0.41	0.40	0.007*	0.41	0.40	0.006	0.001
6 - 8000 CHF	0.23	0.23	-0.003	0.22	0.23	-0.003	-0.000
8 - 10000 CHF	0.14	0.14	-0.008***	0.13	0.15	-0.012***	0.004
10000+ CHF	0.07	0.07	0.001	0.07	0.07	-0.002	0.003
<25 years	0.04	0.05	-0.009***	0.05	0.06	-0.006***	-0.002
25-34 years	0.26	0.27	-0.01***	0.27	0.27	-0.005	-0.006
35-44 years	0.27	0.28	-0.006*	0.28	0.28	0	-0.007
45-54 years	0.27	0.27	0.007**	0.27	0.26	0.003	0.003
55-64 years	0.14	0.13	0.013***	0.13	0.12	0.005*	0.008
64+ years	0.01	0.01	0.005***	0.01	0.01	0.002**	0.003
Female	0.30	0.29	0.011***	0.30	0.30	-0.001	0.011
Single	0.43	0.42	0.013***	0.45	0.45	-0.001	0.014
Married	0.47	0.48	-0.013***	0.45	0.45	0.001	-0.014
Other	0.10	0.10	0	0.10	0.10	0.001	-0.001
Kids	0.36	0.39	-0.026***	0.36	0.36	-0.001	-0.024
Employed	0.95	0.95	-0.005***	0.95	0.95	-0.005***	0.000
Self-employed	0.03	0.02	0.002	0.03	0.02	0.003**	-0.001
Other occ.	0.03	0.02	0.003***	0.02	0.02	0.002	0.001

Table 3.A4: Preanalysis plan discrepancies

PAP Chapter	Preanalysis Plan	Modification	Table
Estimation methodology			
6c.i	Difference-in-differences: CCA vs non-CCA trend	Not implemented since group of non-CCA loans is also affected by the regulatory change. Figure 3.A1 shows that the processing time strongly increased also for non-CCA offers. Hence, they can not be used as a counterfactual trend.	-
6c.ii	Difference-in-differences: Year-end/beginning trend as counterfactual trend	Implemented	3.3
6c.iii	RDD estimation of the impact of CCA	Not implemented since the number of offers around the year end is low (public holidays) and RDD assumptions are likely violated.	-
Subsample analysis			
2B1	Impulsive consumption	Implemented	3.4
2B2	Shopping around	Implemented	3.5
2B3	Fast liquidity and more difficult consumption	Implemented; the PAP did not contain a clear definition of the subsample. I use an IV strategy to define the relevant subsample.	3.7

Table 3.A5: Coefficients of a linear probability model

The table depicts coefficients of the linear probability model on the outcome variables *Cancel* and *Not accept*. Columns (1) and (3) present results of all loan offers. Columns (2) and (4) present results of the subsample of offers that contains information on a second loan application.

	Dependent variable:			
	Not accept		Cancel	
	(1)	(2)	(3)	(4)
Amount 14-28k	0.004**	0.008***	−0.0001	0.0002
	(0.002)	(0.003)	(0.001)	(0.001)
Amount >28k	0.007***	0.007**	0.00004	0.0005
	(0.002)	(0.003)	(0.001)	(0.001)
Maturity 37-60m	0.035***	0.035***	0.0004	0.001***
	(0.002)	(0.002)	(0.001)	(0.0005)
Maturity 60+m	0.033***	0.024***	−0.001	0.001
	(0.002)	(0.003)	(0.001)	(0.001)
Online	−0.031***	−0.014***	0.032***	−0.001
	(0.002)	(0.002)	(0.001)	(0.0005)
Income 4-6k	−0.009***	−0.021***	0.002**	−0.001**
	(0.002)	(0.003)	(0.001)	(0.001)
Income 6-8k	−0.012***	−0.025***	0.002**	−0.001
	(0.003)	(0.004)	(0.001)	(0.001)
Income 8-10k	−0.021***	−0.039***	0.003**	−0.0005
	(0.003)	(0.004)	(0.001)	(0.001)
Income >10k	−0.032***	−0.050***	0.004***	−0.002
	(0.004)	(0.005)	(0.001)	(0.001)
Age 25-34y	−0.035***	−0.026***	0.001	−0.0004
	(0.003)	(0.005)	(0.001)	(0.001)
Age 35-44y	−0.052***	−0.041***	−0.003**	−0.0001
	(0.003)	(0.005)	(0.001)	(0.001)
Age 45-54y	−0.070***	−0.061***	−0.004***	−0.001
	(0.003)	(0.005)	(0.001)	(0.001)
Age 55-64y	−0.082***	−0.066***	−0.004***	−0.0001
	(0.004)	(0.005)	(0.001)	(0.001)
Age >64y	−0.092***	−0.071***	−0.001	0.001
	(0.008)	(0.010)	(0.003)	(0.002)
Female	−0.020***	−0.023***	−0.005***	−0.002***
	(0.001)	(0.002)	(0.001)	(0.0004)
Married	0.024***	0.019***	−0.0003	0.0002
	(0.002)	(0.003)	(0.001)	(0.001)
Other	0.008***	0.007**	0.004***	0.001
	(0.003)	(0.003)	(0.001)	(0.001)
Kids	0.008***	0.006***	−0.0001	0.0004
	(0.002)	(0.002)	(0.001)	(0.0005)
Self-employed	0.017***	0.031***	−0.0003	−0.0001
	(0.004)	(0.007)	(0.002)	(0.001)
Other occ.	−0.024***	−0.017***	0.003*	0.0005
	(0.005)	(0.006)	(0.002)	(0.001)
2nd Application		0.194***		0.003***
		(0.003)		(0.001)
Month + Bank FE	Yes	Yes	Yes	Yes
Observations	329,005	188,565	296,438	171,900
R^2	0.028	0.030	0.024	0.013

Table 3.A6: Summary statistics by day of the week

This table presents sample means by day of the week for the full sample. Bank is a categorical variable ranging from 1 to 3 capturing the offer issuing bank. Income and Age group are ordinal variables based on the income and age groups.

	Mon	Tue	Wed	Thu	Fri
Not accept	17.2%	18.1%	18.4%	18.8%	18.0%
Days request offer	1.00	1.12	1.26	1.50	1.93
Offered amount	23'314	23'688	23'612	23'595	23'689
Offered maturity	49.35	49.70	49.86	49.96	50.03
Online	0.22	0.18	0.17	0.17	0.17
Month	6.28	6.26	6.28	6.28	6.26
Single	0.45	0.44	0.45	0.44	0.45
Employee	0.96	0.96	0.96	0.95	0.95
Bank	2.22	2.20	2.21	2.21	2.22
Female	0.30	0.30	0.30	0.31	0.30
Kids	0.36	0.36	0.36	0.37	0.37
Income group	1.53	1.54	1.53	1.54	1.54
Age group	3.18	3.18	3.18	3.17	3.18

Table 3.A7: Non-acceptance by time to offer

The table displays the mean in the variable *Not accept* by subsamples. Days to offer stands for the duration between the request and the offer date.

	0-1 days to offer	2-6 days to offer	Difference
Loan offer characteristics			
Offline	0.19	0.17	0.02
Online	0.20	0.13	0.06
Amount <14k	0.17	0.14	0.03
Amount 14-28k	0.20	0.17	0.03
Amount >28k	0.21	0.18	0.03
Maturity <37m	0.17	0.13	0.04
Maturity 37-60m	0.18	0.17	0.02
Maturity 60+m	0.21	0.18	0.03
Household characteristics			
Age <25	0.24	0.21	0.03
Age 25-34	0.20	0.17	0.03
Age 35-44	0.20	0.17	0.04
Age 45-54	0.18	0.16	0.03
Age 55+	0.16	0.13	0.02
Income <4k	0.17	0.15	0.02
Income 4-6k	0.19	0.16	0.03
Income 6-8k	0.20	0.17	0.04
Income 8-10k	0.21	0.17	0.04
Income 10+	0.20	0.15	0.05

Figure 3.A1: Extension of cooling-off period: Effect on days to payout for non-CCA loans

The figure depicts the trend in the monthly average time span from offer data to payout date for disbursed loan offers with loan volumes exceeding the CHF 80,000 CCA threshold.

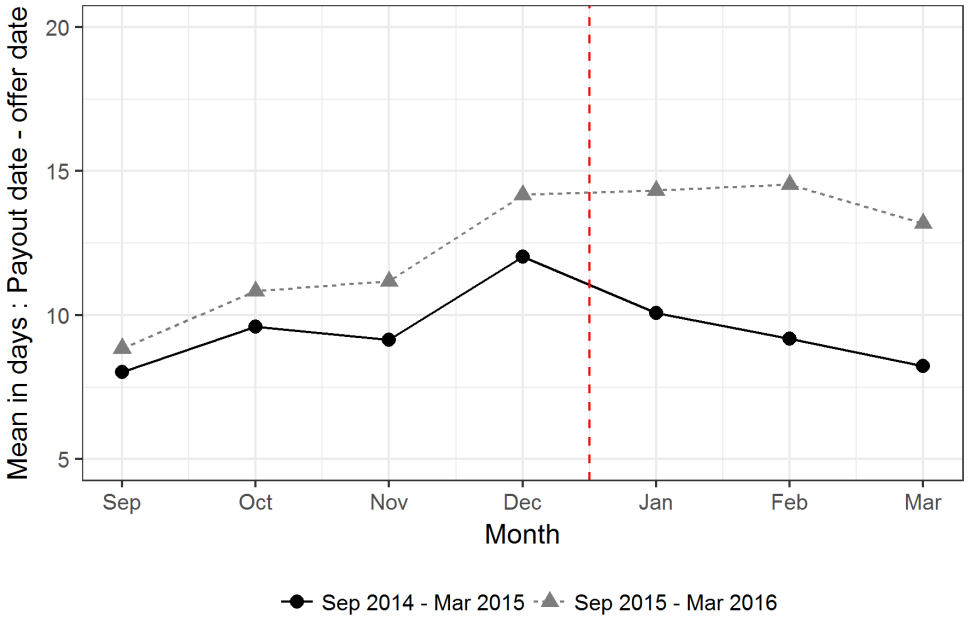
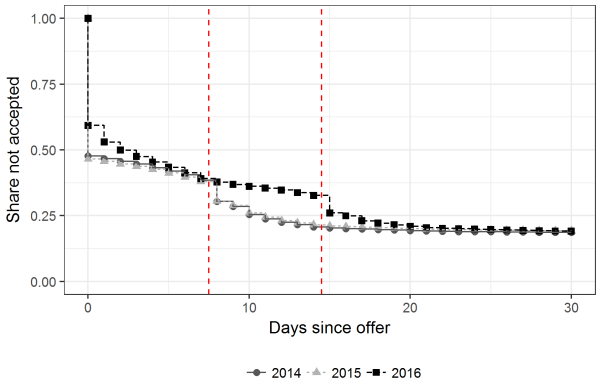


Figure 3.A2: Survival Analysis: Non-acceptance for Jan - March

The figures depict a survival analysis of the acceptance behavior of borrowers for applications filed online and offline comparing the first three months of the years 2014, 2015 and 2016.

Offline



Online

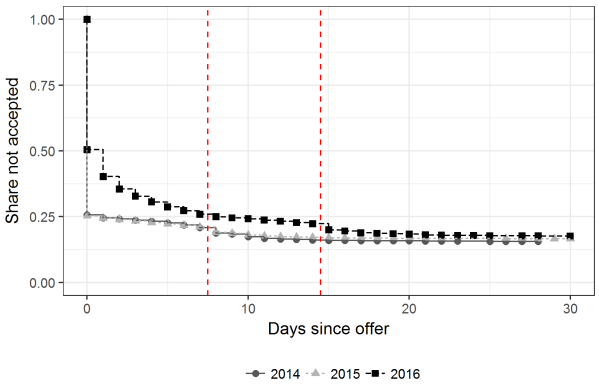
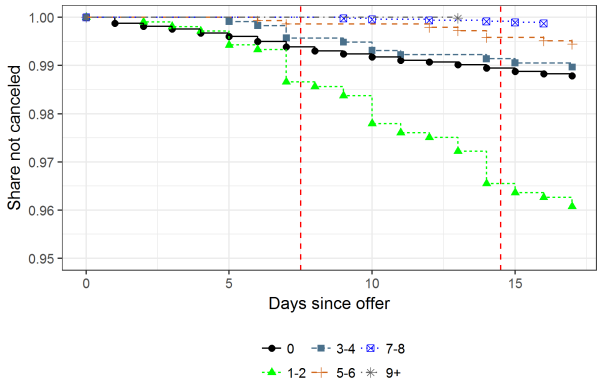


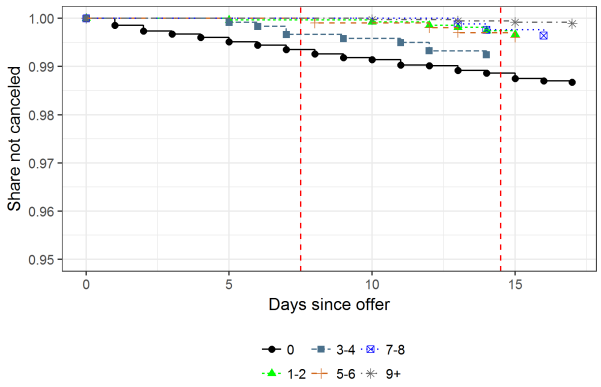
Figure 3.A3: Cancellations by day of acceptance

The figures depict a survival plot of the cancellation behavior by the day of acceptance. The accepted offers are grouped into six groups according to the number of days between offer date and acceptance date. a) presents the plot for Jan - Mar in 2014 and 2015. b) presents the plot for Jan - Mar 2016.

Jan - Mar 2014/2015



Jan - Mar 2016



Appendix Chapter 4

4.A1: Example Questions from the Numeracy Test

The 3 questions below are taken from the bank's numeracy test. They are representative for the overall level of difficulty of the test.

1. Calculate the value of the following expressions.

$$\frac{(\frac{3}{4}+2)}{[\frac{2x3-2(-6)}{3}-7]} =$$

2. Calculate the original price if the current price of 88 EUR was obtained after the original price was first increased by 10% and then decreased by 4%.

3. Six friends want to buy a piece of land, each paying an equal share. The day before the contract is signed two of the friends decide to withdraw their offer. The remaining four friends must therefore each increase their share by 4500 EUR in order to be able to pay the asking price. Calculate the price of the land.

Table 4.A2a: Summary statistics and variable definitions

Panel A: Granted loans	**Obs**	**Mean**	**SD**	**Min**	**Max**	**Mean Low**	**Mean Medium**	**Mean High**	**Description**
Dependent Variables									
Arrears	3619	0.08	0.28	0.00	1.00	0.06	0.08	0.11	Dummy = 1 if 30 day payment arrear within first 24 months
Variables of Interest									
Risky	3619	0.24	0.43	0.00	1.00	0.21	0.22	0.28	Dummy = 1 if initial score >1
Low numeracy	3619	0.30	0.46	0.00	1.00	1.00	0.00	0.00	Dummy = 1 if low numeracy loan officer; score<0.8
Medium numeracy	3619	0.34	0.47	0.00	1.00	0.00	1.00	0.00	Dummy = 1 if medium numeracy loan officer; score 0.8-0.89
High numeracy	3619	0.37	0.48	0.00	1.00	0.00	0.00	1.00	Dummy = 1 if high numeracy loan officer; score 0.9-1
Numeracy score	3619	0.84	0.11	0.65	1.00	0.70	0.84	0.95	Numeracy score as measured in the test
Transformed numeracy score	3619	0.54	0.30	0.00	1.00	0.15	0.55	0.85	Transformed numeracy score: (Numeracy score - 0.65) /0.35
Basic controls									
Ln(Requested amount)	3619	8.30	0.98	4.76	10.31	8.05	8.41	8.40	Ln(requested amount in EUR)
Requested amount in Euro	3619	6187	5900	117	30000	5111	6539	6734	Requested amount in EUR
Request Euro	3619	0.16	0.37	0.00	1.00	0.15	0.13	0.19	Dummy = 1 if requested loan in Euro
Time relationship	3619	1.66	1.66	0.00	7.47	1.62	1.60	1.74	Years since bank account at bank; 0 if no account
New client	3619	0.34	0.47	0.00	1.00	0.32	0.37	0.32	Dummy = 1 if account since <0.1 year
Extended controls									
Leverage	3619	1.02	1.66	0.02	20.00	0.87	1.02	1.15	(Debt capital + requested loan)/Equity)
ln(Sales)	3619	7.30	1.47	3.24	12.54	6.93	7.50	7.42	Ln(Sales in EUR)
Young firm	3619	0.26	0.44	0.00	1.00	0.18	0.32	0.27	Dummy = 1 if firm Age <5
Agriculture	3619	0.53	0.50	0.00	1.00	0.71	0.41	0.49	Dummy = 1 if agricultural firm
Total assets/requested amount	3619	5.86	12.53	0.04	449.62	5.37	5.62	6.48	(Fixed assets and chattel items) /Requested amount
Loan officer controls									
Female	3619	0.57	0.50	0.00	1.00	0.51	0.60	0.58	Dummy = 1 if loan officer female
Experienced	3619	0.65	0.48	0.00	1.00	0.58	0.76	0.62	Dummy = 1 if loan officer experience > median at test date
Experience at application	3619	0.45	0.50	0.00	1.00	0.39	0.46	0.48	Dummy = 1 if loan officer experience at application date >2years
Age	3619	32.36	2.71	27.00	41.00	32.59	32.33	32.19	Age in years

Table 4.A2b: Summary statistics and variable definitions

Panel B: Loan applications	**Obs**	**Mean**	**SD**	**Min**	**Max**	**Mean Low**	**Mean Medium**	**Mean High**	**Description**
Dependent Variable									
Rejection	5928	0.39	0.49	0.00	1.00	0.32	0.40	0.42	Dummy = 1 if application rejected by the bank
Variables of Interest									
Low numeracy	5928	0.27	0.44	0.00	1.00	1.00	0.00	0.00	Dummy = 1 if low numeracy loan officer; score<0.8
Medium numeracy	5928	0.35	0.48	0.00	1.00	0.00	1.00	0.00	Dummy = 1 if medium numeracy loan officer; score 0.8-0.89
High numeracy	5928	0.39	0.49	0.00	1.00	0.00	0.00	1.00	Dummy = 1 if high numeracy loan officer; score 0.9-1
Control variables									
Ln(Requested amount)	5928	8.46	0.99	4.76	10.31	8.23	8.54	8.55	Ln(requested amount in EUR)
Requested amount in Euro	5928	7191	6461	117	30000	6028	7488	7728	Requested amount in EUR
Request Euro	5928	0.18	0.39	0.00	1.00	0.17	0.15	0.22	Dummy = 1 if requested loan in Euro
Time relationship	5928	1.07	1.55	0.00	7.50	1.15	1.00	1.08	Years since bank account at bank; 0 if no account
New client	5928	0.57	0.49	0.00	1.00	0.52	0.61	0.58	Dummy = 1 if account since <0.1 year

Table 4.A3: Variable mean by period and numeracy level

	Pre-crisis: 2007 Jul - 2008 Sep			Crisis: 2008 Oct - 2010 Feb		
Panel A: Granted loans	Low	Medium	High	Low	Medium	High
Obs	152	391	294	920	834	1028
Dependent Variables						
Arrears	0.09	0.05	0.09	0.05	0.09	0.11
Variables of Interest						
Risky	0.14	0.09	0.17	0.22	0.28	0.31
Low numeracy	1.00	0.00	0.00	1.00	0.00	0.00
Medium numeracy	0.00	1.00	0.00	0.00	1.00	0.00
High numeracy	0.00	0.00	1.00	0.00	0.00	1.00
Numeracy score	0.73	0.85	0.95	0.70	0.84	0.95
Transformed Numeracy score	0.22	0.56	0.84	0.14	0.55	0.86
Basic controls						
Ln(Requested amount)	8.79	8.42	8.78	7.93	8.40	8.29
Requested amount in Euro	9563	7135	9001	4376	6259	6085
Request Euro	0.09	0.02	0.08	0.17	0.18	0.23
Time relationship	1.12	1.09	1.07	1.71	1.84	1.94
New client	0.40	0.42	0.43	0.30	0.35	0.29
Extended controls						
Leverage	0.73	0.93	1.17	0.89	1.06	1.14
ln(Sales)	7.90	7.40	7.96	6.77	7.55	7.27
Yong firm	0.35	0.35	0.46	0.15	0.31	0.22
Agriculture	0.53	0.49	0.30	0.73	0.37	0.55
Total assets/requested amount	6.06	4.92	5.25	5.26	5.94	6.84
Loan officer controls						
Female	0.63	0.57	0.64	0.50	0.61	0.57
Experienced	0.93	0.97	0.96	0.52	0.66	0.52
Experience at application	0.34	0.14	0.44	0.39	0.62	0.49
Age	33.32	32.71	32.89	32.47	32.16	31.99
Panel B: Loan applications	Low	Medium	High	Low	Medium	High
Obs	253	651	488	1328	1404	1804
Dependent Variable						
Rejection	0.40	0.40	0.40	0.31	0.41	0.43
Control variables						
Ln(Requested amount)	8.74	8.53	8.81	8.13	8.54	8.47
Requested amount in Euro	9,240	7,924	9,333	5,416	7,285	7,294
Request Euro	0.08	0.03	0.07	0.18	0.21	0.26
Time relationship	0.69	0.69	0.67	1.24	1.14	1.19
New client	0.63	0.63	0.64	0.50	0.59	0.56

Table 4.A4: Accuracy on loan level: Total sample with interaction terms

The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1

OLS regression	Total sample		Pre-crisis		Crisis	
Dep var: Arrears	(1)	(2)	(3)	(4)	(5)	(6)
High numeracy x Risky	0.064	0.149**	0.170**	0.193**	0.048	0.139**
	(0.039)	(0.059)	(0.072)	(0.076)	(0.042)	(0.065)
Medium numeracy x Risky	0.015	0.066	0.076	0.089	0.003	0.052
	(0.043)	(0.057)	(0.052)	(0.062)	(0.048)	(0.063)
High numeracy	0.011		-0.067**		0.025	
	(0.013)		(0.027)		(0.016)	
Medium numeracy	-0.011		-0.054*		0.003	
	(0.014)		(0.029)		(0.017)	
Risky	0.160***	0.100**	-0.046	-0.070	0.202***	0.147***
	(0.037)	(0.046)	(0.039)	(0.050)	(0.041)	(0.047)
Mean Arrears	0.083	0.083	0.068	0.068	0.088	0.088
Observations	3,619	3,619	837	837	2,782	2,782
R-squared	0.096	0.126	0.076	0.102	0.124	0.156
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes	No	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	Yes	No	Yes	No	Yes
Numeracy level x Quarter	No	Yes	No	Yes	No	Yes

Table 4.A5: Accuracy on loan level: Logit regression

This table contains results of a logit model. Effects are displayed as marginal effects at the mean using the delta method. The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1

Logit regression: Marginal effects	Total sample		Pre-crisis		Crisis	
Dep var: Arrears	(1)	(2)	(3)	(4)	(5)	(6)
High numeracy x Risky	0.065	0.110*	0.071	0.130*	0.063	0.059
	(0.040)	(0.057)	(0.058)	(0.074)	(0.043)	(0.067)
Medium numeracy x Risky	0.004	0.061	0.034	0.030	0.005	0.022
	(0.041)	(0.053)	(0.049)	(0.035)	(0.045)	(0.067)
High numeracy	0.014		-0.062*		0.011	
	(0.011)		(0.036)		(0.010)	
Medium numeracy	-0.001		-0.075**		0.026**	
	(0.009)		(0.033)		(0.011)	
Risky	0.103***	0.121***	0.039*	0.018	0.112***	0.149***
	(0.016)	(0.021)	(0.022)	(0.023)	(0.017)	(0.022)
Mean Arrears	0.083	0.083	0.068	0.071	0.087	0.088
Observations	3610	3598	801	789	2759	2759
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes	No	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	Yes	No	Yes	No	Yes
Numeracy level x Quarter	No	Yes	No	Yes	No	Yes

Table 4.A6: Accuracy on loan level by client characteristics and relationship length

The table shows results for clients of different characteristics (agriculture vs. other industries and young vs. older) and by relationship length (new client vs. existing client). The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1. We compare the coefficients of Risky by numeracy level using a Chow test.

Industry	Agriculture			Not Agriculture			Young firms (<5 years)			Not Young firm (>= 5 years)			New client			Existing client		
Numeracy level	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Dep var: Arrear	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Risky	0.120	0.187**	0.345***	0.072	0.154***	0.227***	0.123	0.169***	0.231***	0.137*	0.164***	0.282***	0.018	0.072	0.013	0.124**	0.192***	0.330***
	(0.071)	(0.067)	(0.091)	(0.067)	(0.051)	(0.040)	(0.093)	(0.060)	(0.060)	(0.075)	(0.049)	(0.056)	(0.049)	(0.054)	(0.070)	(0.059)	(0.053)	(0.052)
Observations	757	504	648	315	721	674	190	394	358	882	831	964	341	455	419	731	770	903
R-squared	0.076	0.122	0.195	0.161	0.127	0.205	0.275	0.152	0.272	0.104	0.129	0.191	0.160	0.141	0.158	0.113	0.207	0.238
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference in coefficients of Risky: P-values of Chow test in parentheses																		
Compared to high num.	-0.225**	-0.158		-0.155**	-0.073		-0.108	-0.062		-0.145	-0.118		0.005	0.059		-0.206***	-0.138*	
	(0.042)	(0.142)		(0.033)	(0.242)		(0.272)	(0.433)		(0.107)	(0.101)		(0.953)	(0.477)		(0.006)	(0.054)	
Compared to medium num.	-0.067		0.158	-0.082		0.073	-0.046		0.062	-0.027		0.118	-0.054		-0.059	-0.068		0.138*
	(0.473)		(0.142)	(0.300)		(0.242)	(0.641)		(0.433)	(0.755)		(0.101)	(0.425)		(0.477)	(0.373)		(0.054)

Table 4.A7: Accuracy on loan level: Linear model of numeracy score

The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1 The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1

OLS Regression	Total sample period		Pre-Crisis		Crisis	
Dep. var: Arrears	(1)	(2)	(3)	(4)	(5)	(6)
Transformed numeracy score x Risky	0.091	0.177**	0.184*	0.226**	0.083	0.183**
	(0.062)	(0.083)	(0.099)	(0.103)	(0.069)	(0.092)
Transformed numeracy score	0.017	0.005	-0.059	0.066	0.032	0.036
	(0.017)	(0.044)	(0.036)	(0.070)	(0.022)	(0.058)
Risky	0.068	0.082	-0.056	-0.094	0.083*	0.117*
	(0.042)	(0.055)	(0.054)	(0.065)	(0.048)	(0.059)
Mean Arrears	0.083	0.083	0.068	0.068	0.088	0.088
Observations	3,619	3,619	837	837	2,782	2,782
R-squared	0.094	0.125	0.071	0.101	0.123	0.155
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	Yes	No	Yes	No	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	Yes	No	Yes	No	Yes
Numeracy level x Quarter	No	Yes	No	Yes	No	Yes

Table 4.A8: Accuracy on loan level: All loan officers

This table contains results of the sample including loan officers from various educational backgrounds (Highest degree high school, bachelor and master). The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced, Age and Education. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1. We compare the coefficients of Risky by numeracy level using a Chow test.

OLS regression	Total Sample: 2007 Jul - 2010 Feb			Pre-crisis: 2007 Jul - 2008 Sept			Crisis: 2008 Oct - 2010 Feb		
Numeracy level	Low	Medium	High	Low	Medium	High	Low	Medium	High
Dep var: Arrears	(1)	(2)	(3)	(1)	(2)	(3)	(4)	(5)	(6)
Risky	0.109**	0.173***	0.226***	-0.088	0.019	0.120*	0.155***	0.211***	0.251***
	(0.041)	(0.041)	(0.040)	(0.064)	(0.050)	(0.071)	(0.042)	(0.046)	(0.045)
Mean Arrears	0.065	0.082	0.103	0.091	0.052	0.095	0.061	0.095	0.106
Observations	1,245	1,354	1,539	175	422	336	1,070	932	1,203
R-squared	0.093	0.138	0.143	0.192	0.161	0.140	0.115	0.159	0.189
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference in coefficients of Risky: P-values of Chow test in parentheses									
Compared to high numeracy	-0.117**	-0.053		-0.208**	-0.101		-0.096	-0.04	
	(0.036)	(0.343)		(0.018)	(0.217)		(0.107)	(0.528)	
Compared to medium numeracy	-0.064		0.053	-0.107		0.101	-0.056		0.04
	(0.253)		(0.343)	(0.152)		(0.217)	(0.349)		(0.528)

Table 4.A9: Influence of loan characteristics on Risky

This table displays results of a linear probability model estimation. The dependent variable Risky is a binary variable equal to 1 if a loan was classified as risky at loan disbursement. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1

	Total Sample: 2007 Jul - 2010 Feb			Difference in coefficients P-values of Chow test in parentheses		
OLS regression Dep var: Risky	Low (1)	Medium (2)	High (3)	Low vs. medium	Low vs. high	Medium vs. high
Ln(Requested amount)	-0.006	0.008	-0.015	-0.014	0.009	0.023
	(0.018)	(0.018)	(0.017)	(0.588)	(0.719)	(0.362)
Request Euro	0.485***	0.508***	0.372***	-0.023	0.113	0.136
	(0.102)	(0.070)	(0.060)	(0.848)	(0.324)	(0.131)
Time relationship	-0.009	-0.006	0.007	-0.003	-0.016	-0.013
	(0.010)	(0.011)	(0.011)	(0.812)	(0.288)	(0.434)
New client	-0.044	-0.039	0.014	-0.005	-0.058	-0.053
	(0.029)	(0.031)	(0.037)	(0.894)	(0.206)	(0.268)
Leverage	0.019**	0.016	0.024***	-0.005	-0.005	-0.008
	(0.009)	(0.011)	(0.006)	(0.813)	(0.617)	(0.482)
ln(Sales)	0.009	0.018	0.031**	-0.009	-0.022	-0.013
	(0.015)	(0.013)	(0.014)	(0.669)	(0.276)	(0.464)
Young firm	0.069	0.002	0.002	0.067	0.067	0.000
	(0.044)	(0.029)	(0.036)	(0.19)	(0.229)	(0.992)
Agriculture	-0.058	-0.083**	-0.042	0.025	-0.016	-0.041
	(0.038)	(0.041)	(0.044)	(0.636)	(0.781)	(0.48)
Total assets/requested amount	0.000	0.002	0.000	-0.002	0.000	0.002
	(0.002)	(0.001)	(0.001)	(0.435)	(0.891)	(0.288)
Mean Risky	0.207	0.221	0.279			
Observations	1,072	1,225	1,322			
R-squared	0.639	0.486	0.523			
Basic controls	Yes	Yes	Yes			
Extended controls	Yes	Yes	Yes			
Loan officer controls	Yes	Yes	Yes			
Branch FE	Yes	Yes	Yes			
Quarter FE	Yes	Yes	Yes			

Table 4.A10: Predictive power of hard information

This table displays the predictive power of application and firm variables for the outcome variable Arrears. The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1.

	Basic controls						Basic and Extended controls					
Numeracy level	Low		Medium		High		Low		Medium		High	
Dep var: Arrear	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Risky		0.107**		0.177***		0.262***		0.083*		0.156***		0.252***
		(0.042)		(0.046)		(0.041)		(0.044)		(0.046)		(0.040)
Observations	1,072	1,072	1,225	1,225	1,322	1,322	1,072	1,072	1,225	1,225	1,322	1,322
R-squared	0.017	0.033	0.008	0.054	0.003	0.088	0.036	0.044	0.040	0.074	0.026	0.102
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes

Table 4.A11: Distribution of firm characteristics

This table displays the distribution of all continuous firm control variables.

Variable	Numeracy	Mean	SD	p10	p25	p50	p75	p90
Ln(Requested amount)	low	8.05	1.02	6.62	7.28	8.16	8.78	9.41
	medium	8.41	0.92	7.18	7.77	8.46	9.14	9.54
	high	8.40	0.96	7.10	7.77	8.46	9.14	9.59
Time relationship	low	1.62	1.56	0.00	0.00	1.44	2.69	3.88
	medium	1.60	1.70	0.00	0.00	1.23	2.65	4.17
	high	1.74	1.70	0.00	0.00	1.49	2.89	4.18
Leverage	low	0.87	1.41	0.15	0.25	0.47	0.97	1.97
	medium	1.02	1.57	0.17	0.30	0.57	1.12	2.27
	high	1.15	1.92	0.16	0.29	0.61	1.30	2.31
ln(Sales)	low	6.93	1.51	5.18	5.84	6.70	7.93	8.94
	medium	7.50	1.39	5.88	6.48	7.23	8.58	9.39
	high	7.42	1.47	5.74	6.40	7.15	8.53	9.45
Total assets/requested amount	low	5.37	6.82	1.04	1.82	3.42	6.09	11.68
	medium	5.62	12.81	0.97	1.72	3.19	6.15	11.41
	high	6.48	15.48	0.90	1.68	3.33	6.69	13.33

Figure 4.A12: Processing time of loan applications over time

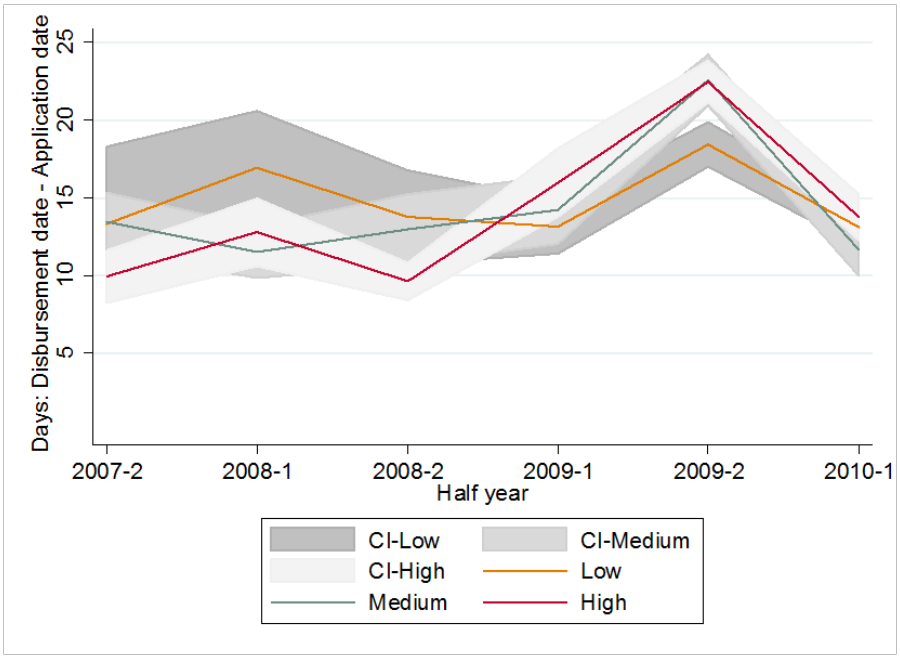


Table 4.A13: Accuracy on loan level: Only loan officers who were in pre-crisis sample

This table contains results for the subsample of loan officers who were already working at the bank in the pre-crisis period. The dependent variable Arrears is a binary variable equal to 1 if a firm went into 30 day payment arrear within the first 24 months of the loan. Basic controls include Ln(Requested amount), Request Euro, Time relationship, New client. Extended controls include Leverage, ln(Sales), Young firm, Agriculture, Total assets/requested amount. Loan officer controls include Female, Experienced and Age. Standard errors in parentheses; standard errors are clustered on loan officer level; *** p<0.01, ** p<0.05, * p<0.1. We compare the coefficients of Risky by numeracy level using a Chow test.

OLS regression	Total Sample: 2007 Jul - 2010 Feb			Pre-crisis: 2007 Jul - 2008 Sept			Crisis: 2008 Oct - 2010 Feb		
Numeracy level	Low	Medium	High	Low	Medium	High	Low	Medium	High
Dep var: Arrears	(1)	(2)	(3)	(1)	(2)	(3)	(4)	(5)	(6)
Risky	0.029	0.183***	0.250***	-0.111*	-0.006	0.131*	0.134	0.235***	0.290***
	(0.074)	(0.050)	(0.052)	(0.062)	(0.035)	(0.072)	(0.112)	(0.056)	(0.062)
Mean Arrears	0.074	0.073	0.104	0.092	0.046	0.085	0.063	0.089	0.112
Observations	404	1,028	1,047	152	391	294	252	637	753
R-squared	0.144	0.156	0.152	0.207	0.172	0.138	0.197	0.204	0.207
Basic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Extended controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan officer controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference in coefficients of Risky: P-values of Chow test in parentheses									
Compared to high numeracy	-0.221***	-0.067		-0.242***	-0.137*		-0.156	-0.055	
	(0.009)	(0.333)		(0.005)	(0.067)		(0.188)	(0.492)	
Compared to medium numeracy	-0.154*		0.067	-0.105		0.137*	-0.101		0.055
	(0.069)		(0.333)	(0.103)		(0.067)	(0.383)		(0.492)

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Papers	Culture and Financial Literacy: Evidence from a within-country Language Border (with Martin Brown & Caroline Henchoz), *Journal of Economic Behavior and Organization* (2018) Link
	Numeracy and the Quality of on-the-job Decisions: Evidence from Loan Officers (with Martin Brown & Karolin Kirschenmann) *Working Paper*
	Culture, Saving and Consumption: Evidence from the Youth
	Cooling-off Periods for Personal Loans: Evidence from an Extension in Switzerland
Presentations	3rd Cherry Blossom Financial Education Institute (Washington D.C.), Boulder Summer Conference on Consumer Financial Decision Making, EEA 2018, Harvard University, SSES Annual Meeting 2017, SSES Annual Meeting 2018, University of St.Gallen, Winter Conference on Financial Intermediation (poster)

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