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# Deposit withdrawals from distressed banks: Client relationships matter*

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ABSTRACT

We study retail deposit withdrawals from commercial banks that were differentially exposed to distress during the 2007–2009 financial crisis. We show that the propensity of clients to withdraw deposits increases with the severity of bank distress. However, an exclusive pre-crisis bank-client relationship eliminates withdrawal risk. The mechanism through which strong bank-client relationships mitigate withdrawal risk relates to the transaction costs of switching accounts rather than informational rents or differentiated services. Our findings provide empirical support to the Basel III liquidity regulations that emphasize the role of well-established client relationships for the stability of bank funding.

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## 1. Introduction

The 2007–2009 financial crisis demonstrated forcefully that the sudden withdrawal of wholesale and retail funds can jeopardize the liquidity and solvency of large commercial banks leading to costly policy interventions (e.g. Northern Rock in the U.K. or Washington Mutual in the U.S.). The crucial role of liquidity risk during that crisis has led policy makers to harmonize minimum liquidity requirements for banks within the regulatory framework of Basel III. A key feature of these regulations is that required liquidity depends not only on the contractual features of bank funding, but also on the characteristics of bank-client relationships. Banks with stronger customer relationships are required to hold less liquidity as the corresponding deposits are presumed to be a more stable source of funding (BIS, 2013).

Theory suggests that strong bank-client relationships may mitigate withdrawal risk for at least three reasons: First, clients may face explicit transaction costs of switching deposit accounts from one bank to another bank (Sharpe, 1997). Second, clients may be wary of losing informational-rents within existing bank relationships (Sharpe, 1990). Third, clients that maintain strong ties with one particular bank may prefer the differentiated services of that bank (Salop, 1979).

In this paper, we examine how bank-client relationships affect the withdrawal of retail deposits from distressed commercial banks. We study the reallocation of deposits across banks in Switzerland during the 2007–2009 financial crisis. We exploit exogenous shocks to two banks operating in the retail market. Specifically, the two largest Swiss banks, UBS and Credit Suisse, suffered substantial trading losses during the crisis – in contrast to other Swiss banks. This resulted in financial losses that triggered significant recapitalizations at both banks and a bailout of UBS in October 2008. Importantly, these losses were unrelated to the development of the domestic retail market activities in Switzerland that we examine.

In order to study the role of bank-client relationships for withdrawal risk at distressed banks it is imperative to have detailed information on all bank relationships that a client maintains. This data should indicate whether the client has a relationship

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with a distressed bank and how tight this relationship is. Importantly though, the data should also indicate whether the client has accounts with other (non-distressed) banks. In the absence of comprehensive deposit registry data (or administrative data from tax authorities) in most countries, such information is typically only available from consumer finance surveys. We study consumer finance survey data that covers 1475 households in Switzerland. It provides information on whether they reallocated deposits across banks during 2008–2009. The survey is representative of the underlying population with respect to household characteristics (e.g., income and location), which are important for our study. A significant share of households in our sample maintains multiple bank accounts. Hence, we are able to compare the withdrawal behavior from distressed banks to that from non-distressed banks for the same households. By doing so we can control for unobserved heterogeneity in the clientele of distressed versus non-distressed banks.

We document that the propensity of households to withdraw deposits is strongly related to the level of bank distress. Compared to accounts at non-distressed banks, accounts at the most distressed bank in our sample (UBS) are eighteen times (or 22.1 percentage points) more likely to experience an outflow of deposits. Accounts at the weakly distressed bank (Credit Suisse) are four times (or 4.3 percentage points) more likely to feature an outflow of deposits than accounts at non-distressed banks.

We then show that the propensity of households to withdraw deposits from the most distressed bank (UBS) is mitigated by strong bank-client relationships. Our survey provides information on the number and scope of bank relationships held by each respondent before the crisis. Our indicator of strong bank-client relationships is a measure of *exclusivity*, i.e. if the respondent had only one pre-crisis account. Our results show that, among clients who banked exclusively with UBS before the crisis, the propensity to withdraw deposits from the bank is eliminated.

In order to shed light on the mechanism through which strong bank-client relationships mitigate withdrawal risk, we exploit information on the scope of bank relationships. We compare the effect of account exclusivity on withdrawal behavior for those clients who hold a loan or a securities account with the most distressed bank to those clients who only hold a deposit account with that bank. We find that account exclusivity eliminates withdrawal risk similarly in all three subsamples. This suggests that transaction costs of switching accounts rather than informational rents or differentiated products are the main mechanism driving our results.

Our main findings are qualitatively robust across subsamples of respondents who differ by wealth and financial sophistication. However, households with higher wealth (and thus less deposit insurance coverage) are more likely to withdraw from the strongly distressed bank and are less deterred in doing so by a strong pre-crisis relationship.

Our results relate to the literature on the disciplining of distressed banks by depositors (Diamond and Rajan, 2001; Calomiris and Kahn, 1991). We hereby contribute to the scarce empirical literature which uses client-level data to examine differential withdrawal behavior across client types (Iyer et al., 2016; Davenport and McDill, 2006; Martin et al., 2018).[2] We add to these studies in two crucial dimensions: First, we study an event in which the distressed banks are systemically important commercial banks. Thus, we can examine to what extent financial distress triggers retail deposit withdrawals from banks that are commonly viewed to be "too-big-to-fail". By comparison, Davenport and McDill (2006) and Martin et al. (2018) study the collapse of small U.S. commercial banks, while Iyer et al. (2016) study withdrawals from a small Indian cooperative bank.[3] Second, our data provides household-level survey data that covers all bank relationships of each respondent. We can thus study not only to what extent the scope of the relationship with the distressed bank affects withdrawal risk, but also the exclusivity of this relationship. By comparison, Davenport and McDill (2006); Martin et al. (2018) as well as Iyer et al. (2016) use client-level administrative data from the distressed banks only. The existence of other bank relations is likely to be of first-order importance to understand withdrawal behavior in the context of large commercial banks, given that many clients hold multiple bank accounts.

Using comprehensive account information from individual tax records, Iyer et al. (2017) study the reallocation of deposits in Denmark following a reduction in the deposit insurance threshold. They document that this reduction leads to a reallocation of deposits from uninsured to insured accounts. Moreover, this reallocation is stronger for clients of non-systemic banks, for clients with lower transaction costs and for financially sophisticated households. We complement the findings of Iyer et al. (2017) by providing empirical evidence on the importance of bank-client relationships in explaining depositor reaction to another type of financial sector shock: the distress of large commercial banks.

We also contribute to the literature on relationship banking in the retail banking sector by documenting that strong bank-client relationships can mitigate withdrawal risk at distressed banks. The industrial organizational literature argues that switching costs (fees, opportunity costs of time) may reduce competition in service markets such as the retail banking sector (Klemperer, 1987; Sharpe, 1997).[4] In this framework, transaction costs prevent retail clients from changing banks and provide a rational for exclusive, long-term and broad-scoped bank-customer relationships. Moreover, if banking services are differentiated, exclusive, long-term bank-customer relationships may arise as a result of the initial choice of heterogeneous depositors (Salop, 1979) or the endogenous improvement of service quality over time (Zephirin, 1994). Kiser (2002) provides survey evidence documenting that retail bank customers in the U.S. rarely change their main bank relationship. Her findings suggest that both preferences for differentiated products as well as explicit

[2] Numerous empirical studies use bank-level balance sheet data or interest rate data to study the impact of bank distress on the flow and pricing of insured vs. non-insured deposits. However, these studies provide only a coarse understanding of the behavior of retail depositors as (i) they can rarely distinguish household deposits from those of non-financial firms, (ii) cannot relate withdrawal behavior to socioeconomic characteristics of households, and (iii) cannot relate withdrawal behavior to the number and scope of bank relations that a household has. Studies which examine bank balance-sheet data provide evidence that distressed banks suffered stronger deposit outflows during the Great Depression (Saunders and Wilson, 1996; Calomiris and Mason, 1997), the U.S. Savings and Loan crisis (Goldberg and Hudgins, 2002), the financial crises in Latin America in the 1980s and 1990s (Peria and Schmukler, 2001; Schumacher, 2000) and Eastern Europe (Karas et al., 2013; Hasan et al., 2013). Studies of bank-level interest rates provide evidence for market discipline by relating bank risk to changes in deposit interest rates for uninsured deposits (Demirguç-Kunt and Huizinga, 2004; Ellis and Flannery, 1992; Hannan and Hanweck, 1988). Calomiris and Kahn (1991) and Diamond and Rajan (2001) provide theories of market discipline emphasizing ex-ante withdrawal and ex-post withdrawals by depositors, respectively. Studies which examine the role of bank size in market discipline provide evidence both for the too big to fail hypothesis (Oliveira et al., 2015; Cubillas et al., 2017) as well as the too big to save hypothesis (Bertay et al., 2013).

[3] Iyer and Puri (2012) provide household-level evidence on withdrawal behavior in a banking panic. Iyer and Peydro (2011) study interbank contagion in the same context of Indian cooperative banks.

[4] In an empirical test, Sharpe (1997) exploits differences in migration levels across regional banking markets (e.g. a proxy for customers with low switching costs) and documents that a high proportion of movers increases the deposit rates paid by banks. Carbo-Valverde et al. (2011) and Hannan and Adams (2011) can confirm these findings. Kim et al. (2003) estimate the size of switching costs for small business borrowers in Norway.

switching costs are responsible for the stickiness of customer-bank relations. Brunetti et al. (2016) document that the number of bank relationships, as well as the intensity (number of services used), and the scope (bank services used) of the individual relationship are relevant for households' decision to switch banks. We contribute to these papers by showing that relationship exclusivity and scope are relevant for households' withdrawal decisions in periods of financial distress.

## 2. Background

Two major types of banks serve the Swiss retail banking market: On the one hand, are the two global systemically important banks UBS and Credit Suisse. On the other hand, are the domestically orientated commercial and savings banks including 25 state-owned banks and 63 regional savings banks.[5] At the onset of the 2007–2009 financial crisis, the balance sheets of Credit Suisse or UBS dwarfed those of other Swiss banks (see Appendix 1, Panel A).[6] However, they did not dominate the domestic retail market where they held roughly one-third of domestic customer deposits. Their share of the retail market also varied considerably across region within Switzerland (see Appendix 1, Panel B).

In the years running up to the financial crisis, the UBS and Credit Suisse reported significantly higher profitability than domestically focused Swiss banks (see Fig. 1, Panel A). During this period, the activities of these two banks were characterized by a significant increase in trading and commission income relative to interest income (see Fig. 1, Panel C), a development which was not observed at the other banks.[7]

During the 2007–2009 crisis UBS and Credit Suisse experienced significant losses. In the case of UBS, the total losses between 2007–2009 amounted to 59 percent of its pre-crisis equity. In response to these losses, UBS raised additional shareholder capital,[8] and required a government bailout in October 2008.[9] This intervention was the only government bail-out in the Swiss banking industry during the crisis. The impact of the crisis on Credit Suisse was less severe but still significant. At the height of the crisis in 2008 Credit Suisse posted an annual loss of 18 percent of its pre-crisis equity. In response to these losses, Credit Suisse required a capital infusion in October 2008 from a group of private investors (Credit Suisse, 2008).[10]

The losses incurred by UBS and Credit Suisse during 2007–2009 were almost entirely driven by trading losses and write-offs on international securities. Importantly for our study, they were unrelated to conditions or activities in the domestic retail market. To illustrate this, Fig. 1 (Panel A) compares the profitability of UBS and Credit Suisse to other commercial banks in Switzerland. During the crisis, these banks maintained their pre-crisis profitability levels. In Appendix 1 (Panel A), we show that none of the 18 largest banks in Switzerland – besides UBS and Credit Suisse - reported an annual loss between 2007 and 2009. In contrast to Germany, where some regional state-owned banks had also heavily invested in U.S. asset backed securities (Puri et al., 2011), this was not the case for state-owned commercial banks or savings banks in Switzerland.[11] We therefore argue that the losses incurred by UBS and Credit Suisse during the financial crisis are exogenous to their domestic retail banking activities, which we study in this paper.

Financial market data suggest that, during the crisis, investors and depositors disciplined UBS and Credit Suisse. Between mid-2007 and the end of 2008, spreads on bonds issued by the two banks rose by more than 350 and 250 basis points respectively. By contrast, yields on bonds by other Swiss banks hardly increased at all.[12] Both banks also experienced a significant decline in their wholesale funding. For example, between 2006:Q4 and 2009:Q4, the unsecured interbank liabilities of UBS (Credit Suisse) declined by 68 percent (63 percent), while capital market funding of UBS declined by 31 percent.

More important for this study, UBS and Credit Suisse experienced a significant decline in domestic customer deposits as displayed in Fig. 1 (Panel B). After experiencing a strong growth in customer funding in the run up to the crisis, total customer deposits at the two banks UBS declined by 20 percent between 2007–2009. By contrast, the other commercial banks in Switzerland experienced an increase in domestic customer funding during the same period crisis. Bank-level data reported in Appendix 1 (Panel A) shows that the drop in customer deposits was significantly stronger at UBS than at Credit Suisse.[13]

In this paper, we examine to what extent the aggregate decrease in customer deposits of Credit Suisse and UBS was driven by a decrease in the supply of funding by domestic retail depositors. Alternatively, the decline in deposit funding could be demand driven, i.e. related to the banks' decisions to deleverage. However, the development of interest rates on deposit accounts between 2007 and 2009 suggests that neither UBS nor Credit Suisse aimed to reduce customer funding. Appendix 2 shows that – compared to other banks in the domestic retail market – the two banks did not lower their deposit interest rates.

The financial distress of UBS and Credit Suisse was exacerbated by an international tax dispute over off-shore private banking services. This dispute intensified at the onset of the financial crisis. In 2008, UBS was investigated by the U.S. authorities for assisting U.S. citizens in tax-evasion. In 2009, UBS agreed to pay a fine of USD 780 million to the U.S. government and entered into a deferred prosecution agreement (Financial Times, 2009; Reuters, 2009).[14] This fine paid by UBS to the U.S. authorities amounted to less than 5 percent of its financial losses during 2007–2009. Nevertheless, it was widely accepted during this period that a failure of UBS to settle with U.S. authorities could have jeopardized the solvency of the bank (Emmenegger, 2017). As a result of subsequent inves-

[5] At year-end 2017 the segment of savings banks includes 62 regional savings banks as well as the Raiffeisen group which includes 246 member cooperatives. The 25 state-owned banks comprise of 24 regionally operating commercial banks (Cantonal banks) and one nationwide savings bank (Postfinance).

[6] As reported in Appendix 1, in 2006 UBS had a total balance sheet volume of CHF 2,397 billion while Credit Suisse had a total balance sheet of CHF 1,226 billion. By comparison Swiss GDP in 2006 amounted to just CHF 429 billion.

[7] Between 2004 and 2006 the ratio of trading income to net interest income rose from 41% to 210% at UBS, while at Credit Suisse the same ration rose from 48% to 144%.

[8] The bank raised CHF 13 billion of seasoned equity (mainly from sovereign wealth funds) at the end of 2007 and another CHF 16.3 billion through an equity rights offering to its shareholders in mid-2008 (UBS, 2007, 2008a).

[9] The Swiss National Bank agreed to take over CHF 68 billion of illiquid assets from the balance sheet of UBS via a special purpose vehicle. At the same time, UBS received CHF 6 billion of additional capital in the form of mandatory convertible notes fully placed with the Swiss Confederation (UBS, 2008b).

[10] The weaker effect of the crisis on Credit Suisse compared to UBS is coherent with the fact that the bank experienced a weaker shift of revenue sources from net interest income to trading income in the run up to the financial crisis.

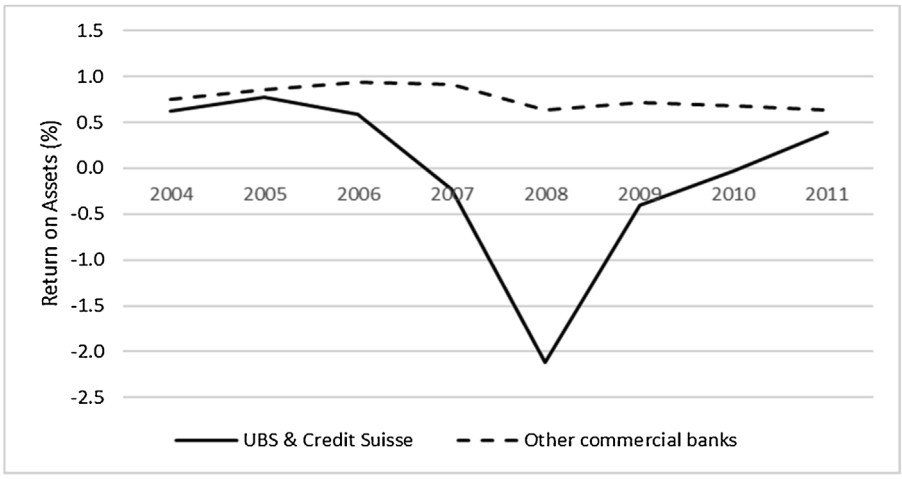
[11] The only exception is Migros Bank, which experienced a loss of CHF 18mn in 2007, which equals 0.06% of its equity (2006).

[12] See e.g. the *2010 Financial Stability Report* of the *Swiss National Bank*. https://www.snb.ch/en/mmr/reference/stabrep_2010/source/stabrep_2010.en.pdf, accessed on 10 September 2019.

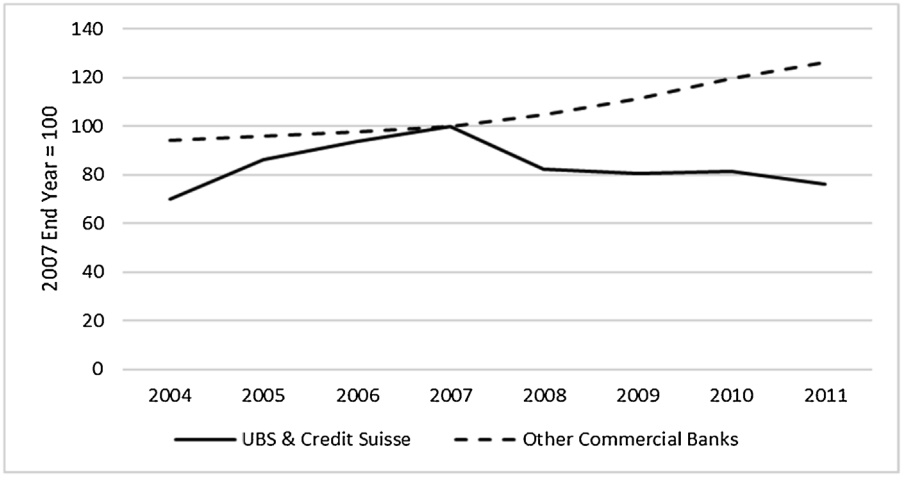
[13] Customer deposits reported in Appendix 1 (Panel A) for UBS and Credit Suisse are taken from group-level annual financial statements. They therefore include both domestic and foreign customer funding. By contrast, the data reported in Fig. 1 (Panel B) refers to domestic customer deposits only.

[14] Moreover, a settlement was reached in which Swiss tax authorities revealed information on thousands of offshore accounts of U.S. citizens with UBS to the U.S. authorities (Reuters, 2010).

Panel A. Return on assets (in %): UBS & Credit Suisse vs. Other commercial banks




Panel B. Domestic customer deposits: UBS & Credit Suisse vs. Other commercial banks




Panel C. Revenue (in billion CHF): UBS & Credit Suisse

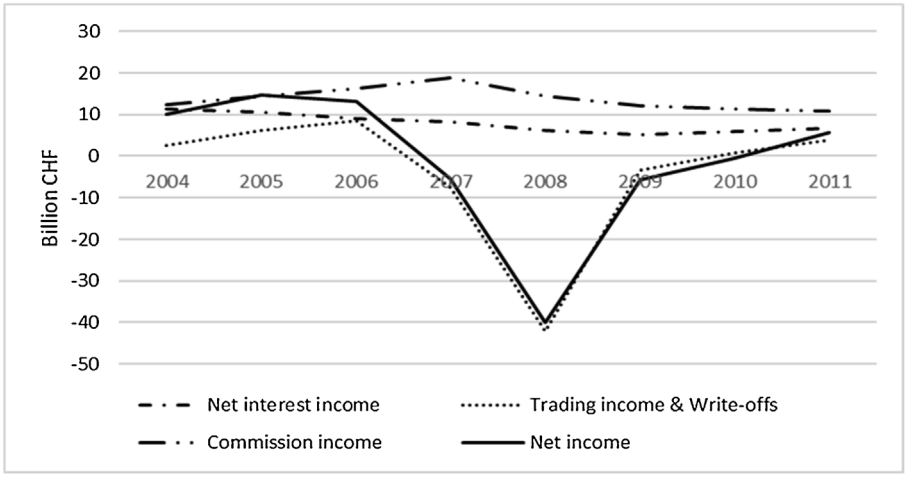



**Fig. 1.** Profitability and customer deposits, 2004-2011. This figure compares bank profitability and customer deposits for UBS and Credit Suisse to other commercial banks in Switzerland. Other commercial banks include: Cantonal Banks, Regional Savings Banks, Raiffeisen Banks. Panel A reports Return on Assets in %. Panel B reports revenue components for UBS and Credit Suisse in billion CHF. Panel C reports the volume of domestic customer deposits indexed at 100 in end 2007. Domestic customer deposits include current accounts, savings accounts and certificates of deposits of non-financial domestic clients. Source: Swiss National Bank Data Portal. See Appendix 1, Panel A for bank-level data based on consolidated annual reports.
Panel A. Return on assets (in %): UBS & Credit Suisse vs. Other commercial banks.
Panel B. Domestic customer deposits: UBS & Credit Suisse vs. Other commercial banks.
Panel C. Revenue (in billion CHF): UBS & Credit Suisse.

tigations, eleven other Swiss banks have been prosecuted by the U.S. Department of Justice since 2013. Among them, Credit Suisse, pleaded guilty to assisting tax evasion of U.S. citizens. As a result, it agreed to settle a fine of USD 2.6 billion in 2014 (Emmenegger and Eggenberger, 2018). A further 80 banks have reached settlement agreements with the U.S. authorities totaling USD 1.3 billion (Reuters, 2016). In our empirical analysis, we control for bank-specific involvement in the international tax dispute.

## 3. Data

Our analysis is based on a survey of 1475 households in the German-speaking area of Switzerland.[15] The survey sample was constructed to be representative of the underlying population with respect to gender and geographical location.[16] The survey population is also comparable to the Swiss population in terms of income and education (see Appendix 3, Panel A). The survey was implemented with telephone interviews that lasted on average 15 min. The respondents were not remunerated for their participation. However, at the beginning of each interview the respondent was informed about the academic purpose of the survey in order to encourage participation and reduce the number of non-responses.[17]

The survey questionnaire was designed to elicit information on all bank relationships maintained by each respondent as well as their reallocation of funds between banks during the financial crisis.[18] The survey was conducted in April 2011 and thus roughly 30 months after the height of the financial crisis including the bailout of UBS. This timing of the survey might raise concerns over measurement error in our data as survey participants might have forgotten about the events related to the financial crisis. To alleviate these concerns, the survey elicited participants' interest in the financial crisis. Our main results hold for respondents who report high and low interest in the financial crisis.

The survey also gathered information on socioeconomic characteristics (e.g. age, education, gender, household income and wealth), financial literacy, knowledge about deposit insurance, behavioral traits (risk aversion and time preferences) and the geographical location of the households. We match the location of each household with hand-collected information on the geographical location of all bank branches in Switzerland.[19] Appendix 4 provides definitions and summary statistics of all variables employed in our analysis.

### 3.1. Pre-crisis bank relations and the reallocation of deposits during the crisis

The observations in our study are at the household-bank relationship level. The 1475 respondents in our sample report a total of 2563 pre-crisis bank relationships. Of these bank relationships, 2414 feature demand deposits, i.e. either a savings or a current account.[20] Fig. 2 illustrates the network of pre-crisis deposit relationships in our sample.[21] The overwhelming majority of the bank relationships reported are with domestic retail banks. Only 16 relationships with specialized wealth management banks are reported. In addition, only a further 17 relationships with banks outside of Switzerland are reported.

For each respondent, the survey elicits information on the reallocation of assets across banks during the financial crisis. Specifically, each respondent was asked whether he /she "*(. . .) reallocated bank assets during the financial crisis,* i.e. *at the end of 2008 or in 2009. With reallocation we understand the transfer of (savings) deposits or securities from one bank to another.*" We explicitly focus on the reallocation of assets as opposed to all withdrawals that also include cash withdrawals. We do this to alleviate concerns that withdrawals were triggered by idiosyncratic liquidity shocks of households or household-specific consumption patterns (e.g. purchasing a new car). All respondents who replied that they reallocated funds were subsequently asked which bank they withdrew funds from. For each household-bank relationship, respondents reported the share of their assets they withdrew from this bank (less than 25 percent, 25–50 percent, 50–75 percent, more than 75 percent), what type of assets they withdrew (deposits, securities portfolios, voluntary retirement savings) and which bank they transferred the assets to. Finally, all respondents which reallocated funds were asked to state their motives for doing so. In total, 113 of the 1475 respondents in our survey report that they reallocated deposits across banks during the crisis.

The main dependent variable in our analysis is the binary variable *Withdrew deposits* which takes on the value of one if the respondent shifted demand deposits away from a bank where it had such deposits during 2008/2009 (zero otherwise). Summary statistics in Appendix 4 show that 5 percent of the pre-crisis deposit relations experience a deposit withdrawal during the crisis. In robustness tests (see section 7) we use alternative measures of asset reallocations that capture (i) the shift of non-deposit assets, (ii) the magnitude of asset reallocations and (iii) whether a bank relationship was ceased.

### 3.2. Bank distress, size and ownership

The main explanatory variables in our analysis are bank-level indicators of distress. The variable *Strong Distress* takes on the value one for a pre-crisis deposit relationship with the most distressed bank, i.e. UBS. The variable *Weak Distress* takes on the value one for a pre-crisis deposit relationship with Credit Suisse. All other household-bank relationships are classified as *No Distress*. Note that

[15] This survey was conducted by GfK, a leading international market research institute, on behalf of the University of St.Gallen in 2011. The sample size corresponds to 0.05% of the targeted population, which is an adequate coverage compared to large surveys in the U.S. or the E.U. (e.g. the Health and Retirement Study in the U.S. covers about 0.03% and the Survey of Health, Aging and Retirement in Europe about 0.04% of the targeted population).

[16] Respondents were limited to those with an age of 20-74 years, with sufficient German skills to be able to understand the questions, and to respondents which were not self-employed.

[17] In total 9,361 households were contacted, of which 6,696 refused to participate and 1,151 interviews were terminated early (primarily due to a lack of German language knowledge or to ensure that survey participants are representative for the Swiss population according to social economic household characteristics). According to GfK the response rate for the survey is comparable to other academic-orientated surveys and higher than that for regular market research surveys in the field of financial services. The reasons for non-participation do not seem to suggest that non-participation is largely related to withdrawal behavior or bank-client relationships. A large population of the contacted persons, who didn't participate in the survey, is not interested in the topic.

[18] The questionnaire is available upon request.

[19] We use data for the network of bank branches in Switzerland as per December 2012. Distance calculations are based on zip code information for both households and bank branches, and computed through the Google maps API.

[20] Our survey does not provide us directly with information on all bank relationships and products used by households prior to the crisis. However, we can construct this information using questions on relationships and products used at the time of the survey (2011) and questions on the shifts of assets during the crisis (2008/2009). Our constructed measures may be imprecise to the extent that some households altered bank relationships and products used during 2010 but not during 2008/2009. Given that in non-crisis times bank relationships are largely stable (Kiser, 2002) such changes are likely to be negligible.

[21] Deposit market shares calculated on the basis of the number of bank relationships derived from the survey are consistent with data on the allocation of the number of deposit accounts across groups of banks as reported by the Swiss National Bank (see Appendix 1, Panel B).

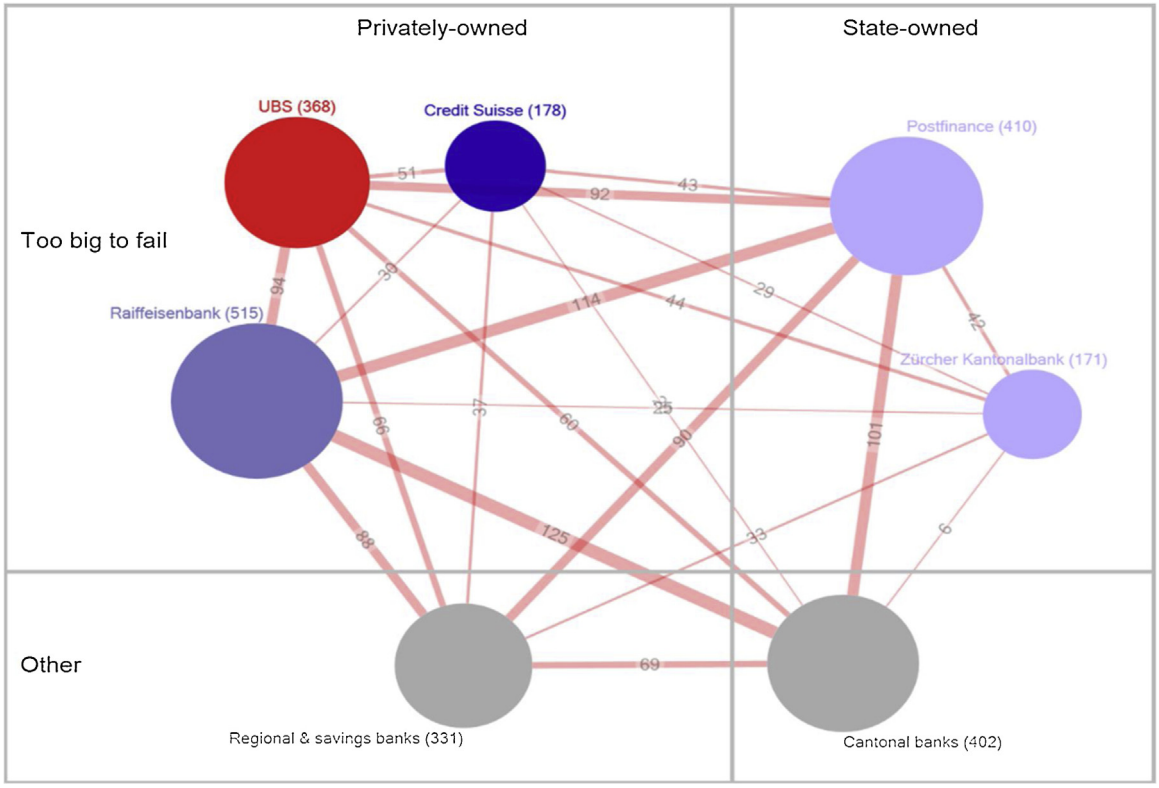



**Fig. 2.** Deposit relationships prior to the crisis. This figure shows the number of respondents by banks. Banks are displayed as circles. They are grouped in two ways: First, we differentiate by their "Too big to fail" status. Second, we differentiate by ownership (privately-owned vs. state-owned). The lines connecting two circles indicate the number of respondents that had pre-crisis deposit accounts with both of the connected banks.

we choose to use bank-specific dummies for the severity of distress rather than a continuous measure of bank performance.[22] Our choice is based on the observation that - as discussed in Section 2 - UBS and Credit Suisse were the only Swiss banks to post financial losses during the 2007–2009 period crisis. Hereby, the losses incurred by UBS were significantly larger than those incurred by Credit Suisse. Moreover, UBS was the only Swiss bank to be officially investigated and fined during 2008–2009 for its role in assisting tax evasion of off-shore private banking clients. As a robustness check, we replace our bank-specific dummy variables with a measure of bank profitability (RoA) over the period 2007–2009. We report the corresponding results in Section 7.

The two distressed banks in our sample are large, internationally operating universal banks, with significant operations in investment banking and wealth management. Therefore, there could be other potential reasons - besides financial distress - why depositors may have withdrawn funds from these two banks during 2008–2009. First, it is possible that depositors associated international universal banks with negative reports on the financial sector throughout the global financial crisis - independent of their bank-specific losses. However, as we employ two dummy variables *Strong Distress* and *Weak Distress* we can disentangle the effect of bank distress of UBS and Credit Suisse from the pure effect of being an international universal bank. In particular, if individual bank distress drives depositor behavior we expect to see a stronger effect of *Strong Distress* compared to *Weak Distress*.

Second, it is possible that - due to their size - depositors of UBS and Credit Suisse had different expectations than depositors of other banks with respect to possible implicit state guarantees. This may have triggered a different reaction to the global financial crisis, independent of the distress of the two banks themselves. On the one hand, both banks were considered too big to fail which may have dampened deposit withdrawals (Cubillas et al., 2017). On the other hand, clients may have considered that UBS and Credit Suisse were too big to save (Bertay et al., 2013), spurring more withdrawals than from other banks.[23] We control for potential expectations regarding the implicit insurance of deposits at *Too big to fail* banks. Specifically, we classify those five banks as *Too big to fail* which have pre-crisis assets exceeding CHF 50 billion (see Appendix 1). The Swiss National Bank (SNB) currently has classified these five banks as *Too big to fail*.[24] We further include a dummy variable *State-owned* to account for perceived explicit and implicit guarantees of deposits at state-owned banks. Fig. 2 documents that the two distressed banks together accounted for 546 (22 percent) of the pre-crisis bank relationships in our sample. Importantly, a significant share of bank relationships is held at other *Too big to fail* banks or *State-owned* banks. This structure of the data allows us to disentangle the effect of bank distress at UBS and Credit Suisse from the pure effect of being a large bank or expectations about a bail-out guarantee.

[22] This approach is comparable of that of Huber (2018) who examines the impact of banking crises on regional economic activity by comparing the pre-crisis exposure of German regions to lending by Commerzbank. Like UBS and Credit Suisse, Commerzbank suffered significant trading losses on international assets during the 2007-2009 financial crisis which were unrelated to the banks retail activities in Germany.

[23] Moreover, given that the Swiss deposit insurance scheme features an upper limit of CHF 6 billion on total payouts, depositors may have considered that even insured deposits were unlikely to be safe at the biggest Swiss banks, including UBS and Credit Suisse, as the total amount of insured deposits exceed the upper limit of CHF 6 billion on total payouts for one financial institution. See also our discussion of the Swiss deposit insurance scheme in Section 6.

[24] https://www.swissinfo.ch/eng/banking_snb-names-postfinance-fifth–too-big-to-fail–bank/41635514, accessed on 10 September 2019.

Finally, both UBS and Credit Suisse had significant operations in off-shore private banking activities. During 2008–2009 international efforts to cut down on tax evasion in off-shore banking intensified (Emmenegger, 2017). Thus - independent of their level of financial distress - deposit withdrawals from the two banks may have been exacerbated by their perceived role in assisting tax evasion of private banking clients and the potential implications for future bank solvency. However, as discussed in Section 2, a large number of Swiss banks, including several of the state-owned cantonal banks also had significant offshore private banking operations and were thus subsequently involved in the offshore banking tax dispute. We can thus control for any effects of bank involvement in the tax-dispute on deposit withdrawals that are unrelated to the immediate financial distress of the banks in 2008/2009. Specifically, the variable *Tax dispute* captures a bank's involvement in the tax-dispute between Switzerland and the U.S.[25]

### 3.3. Bank-client relationships

Our main measure of a strong bank-client relationship is the indicator *Single account*, which captures the exclusivity of a relationship. It takes on the value of one if the account is the only deposit account that the respective respondent had prior to the crisis.[26] Summary statistics in Appendix 4 show that in our sample 52 percent of the respondents have only one deposit account prior to the crisis. In section 7 we report on robustness tests using alternative measures of the strength of bank-client relationships, based on the relationship scope.

Theory suggests that strong bank-customer relationships may mitigate withdrawal risk for at least three reasons: First, customers may face transaction costs of moving deposit accounts or related bank services to another bank (Sharpe, 1997). Second, customers who maintain strong ties with one particular bank may have a preference for the differentiated services of that bank in the first place (Salop, 1979) or might benefit from improvements in service quality over time (Zephirin, 1994). Third, clients with strong ties to one bank may yield quasi-rents from this relation, as the bank has superior information about the client than its competitors (Sharpe, 1990; Von Thadden, 2004).

Our indicator *Single account* is likely to capture all three mitigating effects of bank-client relationships on withdrawal risk. First, having only one deposit account implies high explicit switching costs because the household would have to incur the transaction costs (fees, opportunity costs of time) of opening a new account in order to reallocate deposits. Second, customers who bank exclusively with one financial institution may be wary of losing informational benefits from that bank. For example, they may expect better future access to overdrafts or consumer credit at their incumbent bank, should they experience liquidity shocks.[27] Third, conditional on the local supply of banking services, those customers who choose to deal exclusively with one bank may have a strong preference for the services of that bank.

In order to shed light on the underlying mechanism why client relationships mitigate liquidity risk we employ information on the scope of each bank-relationship. Specifically, we use indicator variables for the holding of a *Loan*, a *Securities account* or a *Retirement account* at the respective bank.[28] Informational rents as emphasised by the theory of Sharpe (1990) should be especially relevant for households which have a *Loan*. Differentiated services should be especially relevant for households which use sophisticated financial services, e.g. a *Securities account* for wealth management purposes. By contrast, for households who maintain only simple deposit accounts, neither informational rents, nor differentiated services should be relevant. For such clients, transaction costs of switching accounts are the main reason why an exclusive bank relationship would mitigate liquidity risk. In Section 5.3 we thus examine to what extent the effect of account exclusivity on withdrawal risk depends on the scope of the bank relationship.

### 3.4. Socioeconomic controls and local banking sector conditions

It is likely that the client structure of the two distressed banks may differ systematically from that of other Swiss retail banks in ways that may affect withdrawal behavior. In particular, the internationally operating universal banks, UBS and Credit Suisse, may cater to wealthier and more financially sophisticated households. Iyer et al. (2016) and Kim (2016) document that household wealth and financial sophistication strongly influence depositor behavior. Our survey provides detailed socioeconomic information on each respondent and the respondent's household. Our vector of respondent-level / household-level control variables includes indicators of household income, household wealth, age, gender, education, nationality, risk aversion, and time preferences. A comparison of depositors across banks confirms that, on average, the clients of the two distressed banks have higher education compared to clients at non-distressed banks. Clients of Credit Suisse also have significantly higher income than clients of non-distressed banks (see Table 1, Panel B), In our empirical analysis, we employ corresponding household-level controls or household fixed effects to account for these potential confounding variables.

The local supply of banking services to households who are clients of the banks with *Strong Distress* and *Weak Distress* may also differ systematically from that of households who are clients of banks with *No Distress* in ways, which may affect withdrawal behavior. To account for this, we add control variables to capture variation in the local and regional banking sector. We use the number of bank branches in the zip code where each household lives as an indicator of local supply of financial services and

[25] Besides UBS, 11 other Swiss banks (including Credit Suisse and two large cantonal banks) were prosecuted by the U.S. authorities. In addition, a further 80 banks (category 2 banks) agreed to pay fines to the U.S. Department of Justice as they were likely to have broken U.S. law with their off-shore wealth management activities. This category includes 20 of the banks listed in Appendix 1. The remaining banks have not sought agreements with the U.S. authorities on the basis that they exclusively serve domestic clients. For all banks which were prosecuted by or paid fines to the U.S authorities the variable offshore *Tax dispute* takes on the value of 1 (see Appendix 4). For further details on this tax dispute we refer to https://web.archive.org/web/20160917051714/https://www.sif.admin.ch/sif/en/home/themen/internationale-steuerpolitik/us-steuerstreit.html, accessed on 10 September 2019.

[26] Note that as we elicit the number of bank relationships at the respondent level rather than at the household level, the variable *Single account* may underestimate the effect of exclusive bank relationships. In particular in multi-person households the respondent may have only one account himself or herself, but may have the opportunity to transfer funds to the account of his or her partner. That said, one could argue that even single-person households could have the opportunity to transfer funds to the account of a family member should they want to do so.

[27] Puri et al (2017) document that information from deposit and transaction accounts is valuable assessing and monitoring the creditworthiness of retail clients.

[28] The overwhelming majority of loans in our sample are residential mortgages (98%). Consumer loans in Switzerland are typically granted by specialized providers or subsidiaries of commercial banking groups. By contrast, residential mortgages are overwhelmingly provided by commercial and savings banks. Swiss banks urge new mortgage clients to move their transaction accounts and other products (savings accounts, tax-preferred retirement savings accounts and wealth management custody accounts) to the bank. However, there is no legal requirement for clients to do so (even if they pledge their retirement savings as a down payment on the mortgage) and there is no legal impediment preventing them from moving deposits away from a bank where they have an outstanding mortgage. The overwhelming majority of mortgages have a maturity of 10 years at origination and the costs of prepayment are prohibitively high.

**Table 1**
Bank distress and asset withdrawals.

Panel A. Withdrawal behavior by banks (household-bank relationship level)

| | Strong distress (UBS) (1) | Weak distress (Credit Suisse) (2) | No distress (other banks) (3) | Difference (1)-(3) | Difference (2)-(3) | Difference (1)-(2) |
|---|---|---|---|---|---|---|
| Withdrew deposits | 0.234 (N = 368) | 0.056 (N = 178) | 0.013 (N = 1,868) | 0.221*** (N = 2,236) | 0.043*** (N = 2,046) | 0.178*** (N = 546) |
| Withdrew non-deposits | 0.145 (N = 186) | 0.038 (N = 105) | 0.019 (N = 795) | 0.126*** (N = 981) | 0.019 (N = 900) | 0.107*** (N = 291) |
| Withdrew assets | 0.237 (N = 397) | 0.054 (N = 205) | 0.017 (N = 1,956) | 0.220*** (N = 2,353) | 0.037*** (N = 2,161) | 0.183*** (N = 602) |
| Withdrew assets (less 50%) | 0.076 (N = 397) | 0.029 (N = 205) | 0.007 (N = 1,956) | 0.069*** (N = 2,353) | 0.023*** (N = 2,161) | 0.046** (N = 602) |
| Withdrew assets (at least 50%) | 0.161 (N = 397) | 0.024 (N = 205) | 0.010 (N = 1,956) | 0.151*** (N = 2,353) | 0.014* (N = 2,161) | 0.137*** (N = 602) |
| Bank relationship ceased | 0.110 (N = 400) | 0.010 (N = 205) | 0.007 (N = 1,958) | 0.103*** (N = 2,358) | 0.003 (N = 2,163) | 0.100*** (N = 605) |

Panel B. Characteristics of depositors by banks (household-bank relationship level)

| | Strong distress (UBS) (1) | Weak distress (Credit Suisse) (2) | No distress (other banks) (3) | Difference (1)-(3) | Difference (2)-(3) | Difference (1)-(2) |
|---|---|---|---|---|---|---|
| Single account | 0.293 (N = 368) | 0.303 (N = 178) | 0.309 (N = 1,868) | −0.015 (N = 2,236) | −0.006 (N = 2,046) | −0.010 (N = 546) |
| Low wealth | 0.629 (N = 334) | 0.533 (N = 152) | 0.681 (N = 1,692) | −0.052* (N = 2,026) | −0.148*** (N = 1,844) | 0.096* (N = 486) |
| Low income | 0.331 (N = 338) | 0.287 (N = 164) | 0.388 (N = 1,723) | −0.057** (N = 2,061) | −0.102** (N = 1,887) | 0.045 (N = 502) |
| University | 0.408 (N = 368) | 0.444 (N = 178) | 0.325 (N = 1,868) | 0.083** (N = 2,236) | 0.119*** (N = 2,046) | −0.036 (N = 546) |
| Insurance knowledge | 0.307 (N = 368) | 0.393 (N = 178) | 0.280 (N = 1,868) | 0.027 (N = 2,236) | 0.113** (N = 2,046) | −0.086* (N = 546) |
| Financial literacy | 0.538 (N = 368) | 0.545 (N = 178) | 0.535 (N = 1,868) | 0.003 (N = 2,236) | 0.010 (N = 2,046) | −0.007 (N = 546) |

Panel C. Financial services used (household-bank relationship level)

| | Strong distress (UBS) (1) | Weak distress (Credit Suisse) (2) | No distress (other banks) (3) | Difference (1)-(3) | Difference (2)-(3) | Difference (1)-(2) |
|---|---|---|---|---|---|---|
| Loan | 0,228 (N = 400) | 0.234 (N = 205) | 0.210 (N = 1,958) | 0.017 (N = 2,358) | 0,024 (N = 2,163) | −0.007 (N = 605) |
| Retirement account | 0,265 (N = 400) | 0.293 (N = 205) | 0.264 (N = 1,958) | 0.001 (N = 2,358) | 0.029 (N = 2,163) | −0.028 (N = 605) |
| Securities account | 0,352 (N = 400) | 0.341 (N = 205) | 0.244 (N = 1,958) | 0.109*** (N = 2,358) | 0.098*** (N = 2,163) | 0.011 (N = 605) |

Panel A of this table shows mean asset withdrawals from accounts at the strongly-distressed bank *(UBS)*, the weakly-distressed bank *(Credit Suisse)* and non-distressed banks (other banks). The variables of interest are *Withdrew deposits*, *Withdrew non-deposits*, *Withdrew assets*, *Withdrew assets (less* 50 *%)*, *Withdrew assets (at least* 50 *%)* and *Bank relationship ceased*. Panel B of this table compares household characteristics of those households with deposit relationships at the strongly-distressed bank *(UBS)*, households with deposit relationships at the weakly-distressed bank *(Credit Suisse)* and households with deposit relationships only with non-distressed banks. Panel C of this table shows financial services used in relationships with the strongly-distressed bank *(UBS)*, the weakly-distressed bank *(Credit Suisse)* and non-distressed banks (other banks). All panels display variables on the household-bank relationship level. ***, **, * denote statistical significance of the univariate tests at the 0.01, 0.05 and 0.10-level respectively. Definitions and summary statistics of the variables are provided in Appendix 4.

competition.[29] In addition, we measure the geographical proximity of the municipality in which the household lives to the nearest branch of UBS, the nearest branch of Credit Suisse and the nearest branch of a non-distressed bank. These geographic measures could affect households' decision to bank with particular financial institutions. Besides, they can affect their decisions to withdraw funds if a bank experiences financial distress. To account for variation in competition at the regional level we add 20 canton-level fixed effects to our main multivariate analyses. In all regression specifications, we cluster standard errors at the cantonal level.

[29] One municipality can consist of several zip codes. The households in our sample are located in 707 different zip codes. The number of bank branches per zip code ranges from 0 to 10 averaging 1.9 branches per ZIP code (Appendix 4).

## 4. Bank distress and deposit withdrawals

In this section, we show that the propensity of respondents to withdraw deposits during the crisis is strongly related to the magnitude of bank distress. Table 1 (Panel A) compares the propensity of households to withdraw deposits from banks with *Strong Distress* (UBS), *Weak Distress* (Credit Suisse) and *No Distress* (all other banks). The table shows that for the bank with strong distress the propensity to withdraw (23.4 percent) is eighteen-times higher than for banks with no distress (1.3 percent) and four times higher than for the bank with weak distress (5.6 percent).

A comparison of our Table 1 (Panel A) results with the data presented in Fig. 1 (Panel A) suggests that the incidence of withdrawals observed in our sample of households is lower than the share of the deposit volume withdrawn from the two distressed banks. Fig. 1 shows a 20 % drop in the volume of domestic customer deposits between 2007 and 2009 for UBS and Credit Suisse together. By com-

parison, the results presented in Table 1 suggests a withdrawal rate of roughly 10 %.[30] However, the bank-level data in Fig. 1 reports the volume of all (non-bank) customer deposits, including large corporate and institutional investors while our survey data reports the incidence of household deposits only. Existing evidence suggests that retail clients are less prone to withdraw deposits than business clients or institutional investors (Davenport and McDill, 2006; Rose, 2015; Carlson and Rose, 2016).

### 4.1. Methodology

We estimate linear parametric models using ordinary least squares in which the dependent variable $Withdrew\ deposits_{i,j,c}$ captures whether respondent $i$ who lives in canton $c$ withdraws deposits from bank $j$. As our dependent variable is categorical, we conduct robustness checks in which we replicate our main analysis using non-linear (logit) models (see section 7).

$$Withdrew\ deposits_{i,j,c} = \alpha_c + \beta_1 \cdot Strong\ Distress_j + \beta_2 \cdot Weak\ Distress_j + \delta_1 \cdot Z_j + \delta_2 \cdot X_i + \delta_3 \cdot Y_i + \varepsilon_{i,j} \quad (1a)$$

$$Withdrew\ deposits_{i,j} = \alpha_i + \beta_1 \cdot Strong\ Distress_j + \beta_2 \cdot Weak\ Distress_j + \delta_1 \cdot Z_j + \varepsilon_{i,j} \quad (1b)$$

As illustrated by Eqs. (1a and 1b) the estimate of $\beta_1$ for the variable *Strong Distress* and the estimate of $\beta_2$ for the variable *Weak Distress* are our coefficients of interest. The difference in magnitude between the estimated coefficients $\beta_1$ and $\beta_2$ indicates how the severity of bank distress influences withdrawal behavior. Our estimation model includes the vector $Z_j$ of bank-level covariates (*Too big to fail, State-owned bank, Tax dispute*) discussed in Section 3. In Model [1a] the vector of household-level socioeconomic characteristics $X_i$ accounts for observable heterogeneity in socioeconomic characteristics across households. We further include a vector of variables $Y_i$ which capture the local supply / competition of bank services (Distance to bank branches of UBS, Credit Suisse and non-distressed banks as well as the number of bank branches in the ZIP code where the household lives). Finally, we include regional fixed effects $\alpha_c$ (at the cantonal level) to account for regional bank competition.

It is questionable whether we observe and correctly measure all household-level variables that jointly affect withdrawals of deposits and the decision to have a relationship with one of the distressed banks. We therefore replicate our analysis on a sub-sample of respondents that had a pre-crisis relationship with multiple banks (including at least one of the distressed banks). Fig. 2 shows that the majority of clients of the distressed banks have multiple bank relationships. This large share of multiple account holders in our sample allows us to compare the withdrawal behavior of the same household from accounts at distressed versus non-distressed banks. As illustrated in Eq. (1b), in this sample we can control for unobserved heterogeneity at the household level with household fixed effects $\alpha_i$.[31] The estimated effects of $\beta_1$ and $\beta_2$ in model [1b] are not biased by unobserved heterogeneity across clients of distressed and non-distressed banks. However, the identified effects are not representative for the average effect across all households, because they are estimated in the sample of clients with at least two bank accounts. In particular, if we conjecture that exclusive bank-customer relationships reduce the propensity of households to withdraw deposits then the estimated effect in this subsample of multiple account holders should be higher than in the full sample including households with only one deposit account. In Table 2 we therefore report estimates for model [1a] based on the full sample of deposit accounts (columns 1–4) as well as for model [1b] on the subsample of households with accounts at multiple banks (column 5). In all models, we calculate heteroscedasticity-robust standard errors by clustering at the cantonal level.

### 4.2. Results

The multivariate analysis presented in Table 2 confirms that the incidence of deposit withdrawals is highly correlated with the magnitude of bank distress. Controlling only for observable differences in socioeconomic characteristics between respondents, we find that the propensity to withdraw is 21.7 percentage points higher at the bank with strong distress compared to non-distressed banks (column 1). Adding additional bank-level controls (column 2) and controls for regional bank supply and competition (columns 3–4) hardly changes the estimated effect. In our preferred specification (column 4) we find that the propensity to withdraw from the strongly distressed bank is 22.8 percentage points higher than for non-distressed banks. The point estimates for *Weak distress* in column (4) suggests that the propensity to withdraw deposits from the weakly distressed bank (Credit Suisse) is 5.1 percentage points higher than for non-distressed banks. An F-test confirms that the point estimate for *Strong Distress* is significantly higher than that for *Weak Distress.* Thus, the magnitude of bank distress affects withdrawal behavior. This finding also alleviates concerns that withdrawals are driven by a general concern about internationally operating commercial banks. If this were the case, we would expect similar magnitudes of the estimated coefficients for *Strong Distress* and *Weak Distress*.

In column (5) we replicate our estimates for the subsample of households which hold deposit accounts at multiple banks. In this specification, we include household fixed effects to account for unobserved heterogeneity in the client structure across banks (see Eq. (1b)). The results suggest that the observed relation between bank distress and depositor behavior is not driven by unobserved heterogeneities in the clientele across banks.

The magnitudes of the Table 2 findings are somewhat surprising given that both of the distressed banks were systemically important and thus considered to be "*Too big to fail*". Our results suggest that implicit bail-out guarantees may not insulate a bank from retail deposit withdrawals when the bank itself is in distress. This finding is in line with van der Cruijsen et al. (2012) who document that customers at bailed out banks are subsequently more likely to spread their savings across accounts at different banks. It is important to note, however, that we can make no statement on how the observed withdrawal risk for large distressed commercial banks would compare to the potential withdrawal risk for smaller distressed banks. Existing evidence suggests that systemically important banks may attract deposits in a banking crisis (Iyer et al., 2017; Oliveira et al., 2015). However, the evidence is not conclusive on whether large distressed banks experience stronger or weaker market discipline than small distressed banks (Cubillas et al., 2017; Bertay et al., 2013).

### 4.3. Mechanism

One reason for deposit withdrawals from large commercial banks is that government intervention may act as a public signal which triggers or maintains concerns among depositors. Shin

[30] As documented in Table 1 among the UBS clients, 16.1% withdraw at least 50% of their assets, and an additional 7.6% withdraw less than 50% of their deposits. Among the Credit Suisse clients, 2.4% withdraw at least 50%, and 2.9% withdraw less than 50% of their deposits. Weighing the withdrawal rates by the number of relationships in our sample yields an average withdrawal of 10% of deposits for the two large banks.

[31] As we introduce household-level fixed effects we must for reasons of collinearity drop region fixed effects as well as controls for the supply of local banking services.

**Table 2**
Bank distress and deposit withdrawals.

| Dependent variable<br>Sample (deposit accounts) | Withdrew deposits<br>All deposit accounts<br>(1) | Withdrew deposits<br>All deposit accounts<br>(2) | Withdrew deposits<br>All deposit accounts<br>(3) | Withdrew deposits<br>All deposit accounts<br>(4) | Withdrew deposits<br>Multiple deposit accounts<br>(5) |
|---|---|---|---|---|---|
| Strong distress (UBS) | 0.217*** | 0.225*** | 0.228*** | 0.228*** | 0.356*** |
| | (0.015) | (0.019) | (0.020) | (0.021) | (0.043) |
| Weak distress (Credit Suisse) | 0.039*** | 0.046*** | 0.050*** | 0.051*** | 0.156*** |
| | (0.012) | (0.014) | (0.015) | (0.016) | (0.040) |
| *Bank control variables* | | | | | |
| Too big to fail | | −0.010** | −0.010* | −0.008 | −0.054*** |
| | | (0.005) | (0.005) | (0.006) | (0.015) |
| State-owned | | 0.002 | 0.004 | 0.006 | 0.050 |
| | | (0.010) | (0.010) | (0.011) | (0.041) |
| Tax dispute | | −0.004 | −0.003 | −0.008 | −0.010 |
| | | (0.010) | (0.009) | (0.010) | (0.042) |
| Household Controls | YES | YES | YES | YES | NO |
| Bank Competition Controls | NO | NO | YES | YES | NO |
| Household Fixed Effects | NO | NO | NO | NO | YES |
| Regional Fixed Effects | NO | NO | NO | YES | NO |
| Observations | 2.093 | 2.093 | 2.093 | 2.093 | 858 |
| Households | 1.231 | 1.231 | 1.231 | 1.231 | 333 |
| Mean of dependent variable | 0,050 | 0,050 | 0,050 | 0,050 | 0,110 |
| R-squared | 0.144 | 0.145 | 0.147 | 0.159 | 0.261 |
| Clustered standard errors | YES | YES | YES | YES | YES |
| Method | OLS | OLS | OLS | OLS | OLS |

This table shows the estimates of a linear probability model where the dependent variable is *Withdrew deposits*. The main explanatory variables are *Strong distress (UBS)* and *Weak distress (Credit Suisse)*. Columns 1–4 report the results for the full sample of all deposit relationships with distressed or non-distressed banks. Column 5 reports the results for the subsample of multiple deposit relationships held by households with deposits relationships with at least one distressed bank. Household control variables are the *Wealth* dummy variables (including interactions of wealth dummy variables indicating wealth of at least CHF 100,000 with *Single account)* and *Income* dummy variables, *Age, Male, University, Swiss nationality, Risk aversion, Time preference*. Bank competition control variables are *Distance UBS km, Distance Credit Suisse km, Distance non-distressed bank km* and *Banks / ZIP code*. Definitions and summary statistics of the variables are provided in Appendix 4. Regional Fixed Effects are on the cantonal level. Standard errors are clustered on the cantonal level and are reported in parentheses. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

(2009) documents that in the 2007 case of the U.K. bank Northern Rock, retail deposit withdrawals occurred only after the provision of liquidity support by the Bank of England.[32] In the case of the 1984 run on the U.S. Bank Continental Illinois, Carlson and Rose (2016) document that a blanket guarantee on all bank liabilities provided by the FDIC slowed down but by no means halted deposit outflows.

A further explanation is that retail clients are angered or disappointed by a bank, which has to be bailed out with public funds. The consumer research literature provides ample evidence that corporate crises damage organizational reputations and affect how clients interact with a company (see Jorgensen, 1996; Pearson and Clair, 1998). In the aftermath of the 2007–2009 crisis banks and their senior executives were repeatedly subject to public anger.[33] In our context, the withdrawals of deposits from UBS could have been at least partly driven by anger with the bank and its management, and not just by the fear of losing savings.

In our survey, all respondents who withdrew assets from a bank during the financial crisis were asked about their motives for doing so. Respondents were asked to what extent they agreed (on a scale of 0–4) to the propositions that they withdrew their funds because they (i) were offered better conditions or better services at other banks, (ii) feared that their funds were at risk at the current bank, or (iii) did not agree with the corporate policy of the bank. The absolute number of respondents in our sample which withdraw deposits and state their reasons for doing so is too small (103) to enable a formal analysis of motivations across banks. Moreover, the large majority of these households withdrew from UBS (78) while only very few withdrew from Credit Suisse (7) or from banks with no distress (18). Nevertheless, a descriptive analysis of motives presented in Table 3 yields interesting insights. First, we find that in the case of UBS the perceived riskiness of the bank was a major concern of depositors who withdrew funds. Second, Table 3 suggests that disagreement with corporate policy was also an important motivation for households to withdraw deposits.

Table 3 suggests that the substantial withdrawal of deposits from the strongly distressed bank UBS is driven by risk considerations and anger, rather than better conditions at other banks. This finding is supported by the pattern of banks' deposit rates during our observation period (Appendix 2). Prior to the crisis UBS and Credit Suisse offered interest rates below or at the lower end of the interquartile range. In 2008 and 2009 UBS offered deposit rates at the top of the interquartile range. Meanwhile, the deposit rates of Credit Suisse converged to the median rate during 2009. Thus, if anything the two large banks raised their interest rates relative to their competitors, most likely as a reaction to the outflow of deposits triggered by their distress.[34]

If clients of UBS reallocate their deposits out of fear of losing their funds and/or anger toward the bank's management, we would expect these funds to be shifted to safer banks with different business models. In our survey, all respondents who reported a reallocation of deposits were asked which bank they shifted deposits to. Among the 97 UBS clients who respond to this question, 39 % shifted deposits to the cooperative Raiffeisen banks, 24 % to a state-owned cantonal bank and 20 % to the state-owned postal bank (Postfinance). Thus, the overwhelming majority of UBS clients shift

[32] See Brown et al. (2017) for experimental evidence on the role of salience in bank runs.

[33] For example, public outcry over the involvement of Barclays Bank in the recent LIBOR scandal contributed to the dismissal of their CEO in 2012. See e.g. http://www.ft.com/cms/s/0/2f869726-b33b-11e2-b5a5-00144feabdc0.html, retrieved on October 1st, 2013.

[34] Besides the interest rate other price (fees) and non-price conditions (e-banking, ATM network) may affect the allocation of customer deposits to banks. Previous research suggests that customer deposits are largely sticky (Kiser, 2002). However, it is feasible that major changes in products or services during our observation period may have triggered deposit flows. To capture major innovations in product offerings over the period 2007-2009 we checked the press releases and historical websites of the largest ten banks in Switzerland. We could not identify any major change to product offerings which would have made deposit accounts at UBS or Credit Suisse less attractive than those of their domestic competitors.

**Table 3**
Motivation for asset withdrawals.

| Motivation for asset withdrawals | Corporate policy (1) | Bank risk (2) | Prices (3) | Corporate policy = Bank risk > Prices (4) | Other (5) | Observations (6) |
|---|---|---|---|---|---|---|
| Withdrew from strongly-distressed bank (UBS) | 0.23 | 0.22 | 0.14 | 0.22 | 0.19 | N = 78 |
| Withdrew from weakly-distressed bank (Credit Suisse) | 0.00 | 0.29 | 0.14 | 0.14 | 0.43 | N = 7 |
| Withdrew from non-distressed banks | 0.06 | 0.11 | 0.44 | 0.17 | 0.22 | N = 18 |

This table shows the motivation for asset withdrawals as reported by 103 households which withdrew assets. The variables of interest are *Corporate policy* (column 1), *Bank risk* (column 2), *Prices* (column 3), *Corporate policy = Bank risk > Prices* (column 4) and *Other* (column 5). *Corporate policy* takes on the value of one if the respondent states that the reason *Corporate policy* was more important than *Bank risk* and *Prices* (zero otherwise). *Bank risk* takes on the value of one if the respondent states that the reason *Bank risk* was more important than *Corporate policy* and *Prices* (zero otherwise). *Prices* takes on the value of one if the respondent states that the reason *Prices* was more important than *Bank risk* and *Corporate policy* (zero otherwise). *Corporate policy = Bank risk > Prices* takes on the value of one if the respondent states that *Corporate policy* and *Bank risk* were equally important and more important than *Prices. Other* takes on the value of one otherwise. Row 1 reports the relative frequencies for the subsample of households that withdrew assets only from the strongly-distressed bank (*UBS*). Row 2 shows the relative frequencies for the subsample of households that withdrew assets only from the weakly-distressed bank (*Credit Suisse*). Row 3 shows the relative frequencies for the subsample of households that withdrew assets only from non-distressed banks. Column 6 shows the number of households. In total 113 households in our sample report that they reallocated assets during the crises. This table omits 10 households of which 5 households did not respond to the questions on why they withdrew assets and 5 households withdrew from multiple banks.

deposits either to a bank with an explicit state-guarantee or a bank with a business model focused entirely on local savings and credit as opposed to international universal banking.[35]

## 5. Bank-customer relationships and withdrawal risk

In this section, we document that strong bank-client relationships as measured by exclusive pre-crisis bank accounts (*Single account*) mitigate the withdrawal risk of retail deposits. Our analysis focusses on the 368 respondents who have a pre-crisis deposit relationship with the strongly distressed bank (UBS). We focus our attention on this subsample because only in this sample do we observe a significant number of respondents who actually withdraw deposits (N = 86).[36]

Table 4 provides univariate evidence that strong client relationships reduce the propensity to withdraw deposits from the strongly distressed bank. We compare the 86 UBS clients who withdraw deposits from the bank during the crisis to the 282 households that do not withdraw. The table shows that households that withdraw are 26.2 percentage points less likely to bank exclusively with UBS before the crisis.

Table 4 shows that households which withdraw from the strongly distressed bank do not differ significantly from those who do not withdraw in terms of income and education. Households which withdraw do display somewhat higher wealth levels, a better knowledge of deposit insurance and higher levels of financial literacy. While these differences are not statistically significant, they do suggest that when examining the role of bank-client relationships, it is important to account for potential confounding household characteristics. The only significant difference relates to the self-perceived risk aversion of households.[37] Households withdrawing their deposits are more risk averse as compared to the households who do not withdraw their assets. This finding is not surprising as deposit withdrawal in a distress environment is expected to be correlated with the individual level of risk aversion of a household.

Table 4 further shows that households which withdraw from the strongly distressed bank do use a narrower range of financial services from the bank. In particular, households which withdraw are less likely to have a loan, a securities account or a retirement account with the bank. In Section 5.3 we will exploit variation in the scope of relationships with the distressed bank to shed light on the mechanism why strong bank relationships mitigate liquidity risk.

### 5.1. Methodology

Again, we estimate linear parametric models using ordinary least squares in which the dependent variable $Withdrew\ deposits_{i,j}$ captures whether respondent $i$ reallocates deposits away from the strongly distressed bank $j$.[38] Our key variable of interest is the indicators of exclusivity of the bank-client relationship *Single account*. As illustrated by Eq. (2) we control for observable household characteristics $X_i$ and indicators of the supply of local banking services $Y_i$, $\alpha_c$ which may confound the relationship between the strength of bank-relationships and deposit withdrawals.

$$Withdrew\quad deposits_{i,j,c} = \alpha_c + \beta_1 \cdot Single\quad account_{i,j} + \delta_1 \cdot X_i + \delta_2 \cdot Y_i + \varepsilon_i \tag{2}$$

where $j$: strongly distressed bank only

### 5.2. Results

Table 5 (Panel A) reports estimates for our variable of interest in Eq. (2): *Single account*. In column (1) we report estimates controlling for observable household characteristics $X_i$ only. In column (2) and column (3) we subsequently add controls for local banking supply and competition $Y_i$ as well as cantonal fixed effects $\alpha_c$. In this sample of clients of the strongly distressed bank, the average propensity to withdraw deposits is 23 %. The column (1–3) estimates for *Single account* suggest that an exclusive bank relationship eliminates this propensity to withdraw completely, i.e. reduces it by 27 percentage points.

The Table 5 (Panel A) results suggest that among the clients of the strongly distressed bank (UBS) the strength of the relationship with this bank plays a crucial role in mitigating withdrawal risk. However, these results do not inform us whether strong bank relationships are especially important in deterring deposit withdrawals from a strongly distressed bank as opposed to a weakly distressed bank or non-distressed bank. In Appendix 6 we disentangle the role of bank-client relationships at the strongly distressed bank (UBS) as opposed to the weakly distressed bank (Credit Suisse) and non-distressed banks. We estimate Eq. (2) on our full sam-

[35] In line with our survey data, the bank-level data presented in Appendix 1 suggests that both the state-owned banks (cantonal banks and Postfinance) as well as the cooperative Raiffeisen banks experienced significant inflows of customer deposits during 2007-2009.

[36] By comparison, among the 178 households with a deposit account at the weakly distressed bank (Credit Suisse) only 10 withdraw. Among the 1868 deposit relations with a non-distressed bank only 24 experience a withdrawal.

[37] Survey participants are asked, on a scale from 1 to 6, how much risk they would be willing to accept under the condition that they might lose (part of) their wealth consisting of deposit and securities accounts. Based on this survey question we created the variable *Risk aversion*, which takes the value of 1 if the respondent has high risk aversion (below 3 on a scale from 1 (high) to 6 (low)) and 0 otherwise.

[38] Robustness tests using non-linear logit estimates are presented in Appendix 10.

**Table 4**
Characteristics of clients with deposits at the strongly-distressed bank (UBS).

| Dependent variable | Withdrew deposits (1) | Did not withdraw (2) | Difference (3) |
|---|---|---|---|
| *Bank relationship variables* | | | |
| Single account | 0.093 | 0.355 | −0.262*** |
| | (N = 86) | (N = 282) | (N = 368) |
| Loan | 0.116 | 0.255 | −0.139*** |
| | (N = 86) | (N = 282) | (N = 368) |
| Securities account | 0.244 | 0.355 | −0.110* |
| | (N = 86) | (N = 282) | (N = 368) |
| Retirement account | 0.186 | 0.284 | −0.098* |
| | (N = 86) | (N = 282) | (N = 368) |
| *Household control variables* | | | |
| Low wealth | 0.571 | 0.646 | −0.074 |
| | (N = 77) | (N = 257) | (N = 334) |
| Low income | 0.342 | 0.328 | 0.014 |
| | (N = 79) | (N = 259) | (N = 338) |
| University | 0.419 | 0.404 | 0.014 |
| | (N = 86) | (N = 282) | (N = 368) |
| Insurance knowledge | 0.372 | 0.287 | 0.085 |
| | (N = 86) | (N = 282) | (N = 368) |
| Financial literacy | 0.593 | 0.521 | 0.072 |
| | (N = 86) | (N = 282) | (N = 368) |
| Age | 3.840 | 3.799 | 0.041 |
| | (N = 86) | (N = 282) | (N = 368) |
| Male | 0.477 | 0.475 | 0.002 |
| | (N = 86) | (N = 282) | (N = 368) |
| Risk averse | 0.729 | 0.583 | 0.146** |
| | (N = 85) | (N = 276) | (N = 361) |
| Time preference | 0.306 | 0.231 | 0.075 |
| | (N = 85) | (N = 281) | (N = 366) |
| *Bank competition control variables* | | | |
| Distance UBS km | 4.008 | 3.556 | 0.452 |
| | (N = 86) | (N = 282) | (N = 368) |
| Distance Credit Suisse km | 6.262 | 5.926 | 0,336 |
| | (N = 86) | (N = 282) | (N = 368) |
| Distance non-distressed bank km | 0.543 | 0.837 | −0.294 |
| | (N = 86) | (N = 282) | (N = 368) |
| Banks / ZIP code | 2.035 | 2.202 | −0.167 |
| | (N = 86) | (N = 282) | (N = 368) |

The table compares household characteristics of clients of the strongly-distressed bank *(UBS)* conditional on whether they withdrew deposits from this bank during the crisis. The last column tests the differences in means (t-test). The number of households (N) are reported in parentheses. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively (calculated using ordinary standard errors). Definitions and summary statistics of the variables are provided in Appendix 4.

ple of bank-relationships (column 1) as well as on a subsample excluding relationships with non-distressed banks (column 2). We hereby add the interaction term *Strong distress* ∗ *Single account* to the model. This interaction term captures whether the exclusivity of a bank relationship reduces the propensity of households to withdraw from the strongly distressed bank more than it reduces the probability to withdraw from a non-distressed bank and/or the weakly-distressed bank.

The results reported in Appendix 6 suggest that the exclusivity of a bank relationship also mitigates withdrawal risk when a bank is not in severe distress. The main effect of *Single account* is negative and significant in column (1). In Panel A the point estimate for the main effect of *Single account* suggests that not having another bank account reduces withdrawal risk by 2.1 percentage points when banks are not strongly distressed. This effect is small compared to the estimate for the interaction term *Strong distress * Single account* in the same column (22 percentage points). That said, Table 1 shows that the average propensity to withdraw deposits from banks which are not distressed (1.3 percent) or only weakly distressed (5.6 percent) is much lower than for the strongly distressed bank (23.4 percentage points). This means that in relative terms the mitigating effect of an exclusive bank relationship (as captured by the main effect of *Single account*) is also strong when the solvency of a bank is not severely impaired. Column (2) of Appendix 6 reports qualitatively similar findings when we exclude all bank relationships with non-distressed banks.

### 5.3. Mechanism

As emphasized above, theory suggests three possible mechanisms which could explain why strong bank-client relationships mitigate withdrawal risk: Informational rents (Sharpe, 1990), differentiated products (Salop, 1979), or pure transaction costs of switching service providers (Sharpe, 1977). For the design of future bank regulation as well as for bank risk management it is important to understand *why* client relationships may mitigate liquidity risk. In this section we shed light on the relative importance of these three mechanisms in our context.

Descriptive statistics thus suggest that, in addition to pure transaction costs of switching accounts, both informational rents and product differentiation could be potential mechanisms behind the mitigation of withdrawal risk in our context. The theory of Sharpe (1990) suggests that banking relationships will feature informational rents if there is asymmetric information between lenders about the creditworthiness of borrowers. This is especially likely to be the case when consumers (or firms) borrow exclusively from one bank. Our data reveals that almost all households in our sample which have a loan borrow from one bank only (99 %). The theory of Salop (1979) suggests that differentiated service provision by different banks may explain why clients choose specific banks and are reluctant to switch between banks. In Table 1 (Panel C) we show that the distressed banks in our sample (UBS, Credit Suisse) do seem to provide some differentiated services as compared to the non-distressed banks. In particular,

**Table 5**
Bank-client relationships and deposit withdrawals.

Panel A. Full sample analysis

| Dependent variable | Withdrew deposits | | |
|---|---|---|---|
| Sample (deposit accounts) | Deposit accounts with strongly-distressed bank (UBS) | | |
| | (1) | (2) | (3) |
| Single account | −0.275*** | −0.268*** | −0.270*** |
| | (0.037) | (0.036) | (0.038) |
| Household Controls | YES | YES | YES |
| Bank Competition Controls | NO | YES | YES |
| Household Fixed Effects | NO | NO | NO |
| Regional Fixed Effects | NO | NO | YES |
| Observations | 321 | 321 | 321 |
| Households | 321 | 321 | 321 |
| Mean of dependent variable | 0.231 | 0.231 | 0.231 |
| R-squared | 0.122 | 0.133 | 0.175 |
| Clustered standard errors | YES | YES | YES |
| Method | OLS | OLS | OLS |

Panel B. Subsample analysis

| Dependent variable | Withdrew deposits | | |
|---|---|---|---|
| Sample (deposit accounts) | Deposit accounts with strongly-distressed bank (UBS) | | |
| Subsample (bank relationships) | Loan (1) | Securities account (2) | Deposit account only (3) |
| Single account | −0.163* | −0.206** | −0.297*** |
| | (0.074) | (0.081) | (0.053) |
| Household Controls | YES | YES | YES |
| Bank Competition Controls | NO | NO | NO |
| Household Fixed Effects | NO | NO | NO |
| Regional Fixed Effects | NO | NO | NO |
| Observations | 77 | 103 | 183 |
| Households | 77 | 103 | 183 |
| Mean of dependent variable | 0.117 | 0.165 | 0.262 |
| R-squared | 0.205 | 0.117 | 0.155 |
| Clustered standard errors | YES | YES | YES |
| Method | OLS | OLS | OLS |

This table displays the estimates of a linear probability model where the dependent variable is *Withdrew deposits.* The main explanatory variable is *Single account.* Panel A shows the results for the subsample of deposit relationships with the strongly-distressed bank *(UBS).* Other deposit relationships are excluded. Panel B examines subsamples of relationships with a loan (column 1), relationships with securities accounts (column 2) and relationships with only simple deposit accounts (column 3). Household control variables are the *Wealth* dummy variables (including interactions of wealth dummy variables indicating wealth of at least CHF 100,000 with *Single account), Income* dummy variables, *Age, Male, University, Swiss nationality, Risk aversion* and *Time preference.* Bank competition control variables are *Distance UBS km, Distance Credit Suisse km, Distance non-distressed bank km* and *Banks / ZIP code.* Definitions and summary stastistics of the variables are provided in Appendix 4. Regional Fixed Effects are on the cantonal level. Standard errors are clustered on the cantonal level and are reported in parentheses. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

relationships with the distressed banks are more likely to feature a securities account, than relationships with non-distressed banks.

In Table 5 (Panel B) we disentangle whether informational rents, differentiated products or transaction costs of switching can explain why exclusive bank-client relationships eliminate withdrawal risk at the strongly distressed bank. To this end, we exploit information on the scope of bank relationships which households maintained with this bank. Specifically, we split our sample into subsamples of clients by whether they hold a *Loan*, a *Securities account*, or only a deposit account with the bank. Our first subsample includes clients with a loan at the strongly distressed bank. These are clients who should be particularly wary of losing informational rents. Our second subsample consists of clients who hold a securities account related to wealth management at the strongly distressed bank. These are clients who are likely to be attracted by the more comprehensive set of services which the bank provides. Our third subsample consists of clients of the strongly distressed bank who only use basic banking products (deposit account). These households are unlikely to fear losing informational rents, nor are they likely to value differentiated financial services. For these households we conjecture that transaction costs of switching their deposit account to another bank is relevant for mitigating withdrawal risk.

For each of our three subsamples we estimate model [2] separately. We present the subsample estimates in Table 5 (Panel B). The column (1–3) estimates suggest that an exclusive bank-client relationship eliminates withdrawal risk in all three subsamples. For the subsample of clients with a loan (column 1) the coefficient of *Single account* is -16 percentage points compared to an average withdrawal risk of 12 percent in this subsample. In the subsample of clients with a securities account (column 2) the coefficient of *Single account* is -20 percentage points compared to an average withdrawal risk of 17 percent for this subsample. In the subsample of clients which hold a deposit account only (column 3) the coefficient of *Single account* is -30 percentage points compared to an average withdrawal risk of 26 percent for this subsample. Thus, we find that even for clients who are unlikely to benefit from informational rents or to value differentiated products, account exclusivity eliminates withdrawal risk. This finding suggests that pure transaction costs of switching accounts, rather than informational rents or differentiated products seem to be the main mechanism through which exclusive bank-client relationships mitigate withdrawal risk.

## 6. The role of deposit insurance and financial sophistication

In this section we examine to what extent our main results reported in Tables 2 and 5 vary across households depending on

their coverage by deposit insurance and their financial sophistication.

### 6.1. Deposit insurance

All banks that maintain branches in Switzerland are required by law to participate in the depositor protection scheme.[39] In December 2008 the coverage threshold of the scheme was increased from CHF 30,000 to CHF 100,000 per depositor and bank. Our survey data does not provide information on the volume of deposits held by households with each of their banks. However, it does include information on the total financial wealth of each household. We therefore use the variable *Low wealth* - indicating that total financial wealth (and thus also the volume of deposits at any bank) is below CHF 100,000 - as a proxy for deposit insurance coverage and split the sample based on this indicator. Summary statistics (reported in Appendix 4) show that 72 percent of the households in our survey are fully covered by deposit insurance according to this proxy. In Section 7 we report robustness checks in which we use alternative proxies of insurance coverage taking into account the number of bank accounts that households have and their allocation of financial wealth to bank deposits as opposed to non-deposit financial assets.

The survey further elicited the knowledge of respondents about deposit insurance protection: Respondents were asked if they knew whether a deposit insurance scheme existed in Switzerland or not. If they responded correctly, they were then asked whether they knew the current coverage threshold. We split our sample based on the binary variable *Insurance knowledge* which takes on the value of one if the respondent correctly answered both questions on the deposit insurance scheme. We acknowledge that this variable is potentially endogenous as survey participants are asked *after* the financial crisis. Households with a bank account at a distressed bank may have better knowledge with regard to deposit insurance as they acquired knowledge throughout the financial crisis because they were exposed to a distress situation.[40] Summary statistics (reported in Appendix 4) show that only 25 percent of all respondents are knowledgeable about the scheme. This finding is consistent with recent survey evidence suggesting that households are not well informed about the coverage by and procedures of deposit insurance schemes across Europe (Bartiloro, 2011; Sträter et al., 2008). The low-level of deposit insurance knowledge among the respondents in our sample is nevertheless surprising, given that there was a substantial public debate about the Swiss deposit insurance system during the crisis.[41]

In Table 6, we replicate our analysis of bank distress and deposit withdrawals (Table 2, column 4) for subsamples of respondents. Columns (1 & 2) present subsample splits by the level of financial wealth, which proxies for deposit insurance coverage, while, columns (3 & 4) report subsample splits by deposit insurance knowledge. The results show that our main finding is robust across all four subsamples: Households are much more likely to withdraw from the strongly distressed bank than from non-distressed banks. Households are also more likely to withdraw from the weakly distressed bank as compared to non-distressed banks. However, as in our full sample regressions this effect is much smaller, and thus, due to the lower number of observations in the subsamples, not always significant.

The results presented in columns (1–4) of Table 6, however, also reveal that the propensity to withdraw deposits from the strongly distressed bank (UBS) is higher among households with high wealth than among households with low wealth (27 vs. 21 percentage points). Likewise, households with more knowledge of the deposit insurance scheme are more likely to withdraw than households with low knowledge (26 vs. 22 percentage points). Formal tests suggest that the differences in the point estimate of *Strong distress* between columns (1 & 2) and between columns (3 & 4) are statistically significant.[42]

In Table 7, we replicate our analysis of relationship exclusivity on withdrawal risk at the strongly distressed bank for different subsamples of households. Columns (1 & 2) of Table 7 present subsample splits by wealth, while columns (3 & 4) split the sample by deposit insurance knowledge. The column (1–4) results suggest that our main finding is again robust across all four subsamples: Our indicator of bank relationship exclusivity (*Single account*) is associated with lower propensities to withdraw deposits from the strongly distressed bank. However, comparing the magnitude and significance of the point estimates across columns (1 & 2) reveals that exclusive bank-client relationships are less likely to deter withdrawals among households with high-wealth.[43] There is no significant impact of deposit insurance knowledge on the relation between client relationships and withdrawal risk (column 3–4).

Together the column (1–4) results in Tables 6 and 7 show that our main results are robust across subsamples, which differ in their coverage by and knowledge of deposit insurance. Importantly though, deposit insurance coverage does seem to affect the propensity to withdraw deposits as well as the potential for strong bank relationships in mitigating withdrawal risk. Those households who are less likely to be covered by deposit insurance are more likely to withdraw deposits from the strongly distressed bank and less likely to be deterred from doing so by strong client relationships. These findings are consistent with recent evidence suggesting that deposit insurance may affect the reaction of depositors to distressed banks (Iyer et al., 2016) or banking crises (Iyer et al., 2017).

[39] See www.esisuisse.ch/en for details of the Swiss depositor protection scheme. The Swiss deposit insurance scheme explicitly prohibits any set-off of customer debts and this information is clearly communicated. This is in contrast to the U.S. where outstanding loans can be offset against uninsured deposits (see https://www.fdic.gov/deposit/diguidebankers/insurance-basics.html#right_offset.

[40] This endogeneity issue potentially also holds for the variable *Financial literacy* as it was also collected after the financial crisis. Households exposed to a distressed bank during the financial crisis may have acquired more financial knowledge due to the very event of a distress situation.

[41] During 2008 depositors received conflicting signals about the ability of the Swiss deposit insurance scheme *esisuisse* to pay out in the case of a bank failure. On the one hand, the collapse of the Swiss branch of the Icelandic bank Kaupthing demonstrated that the scheme was in a position to swiftly pay out insured depositors of small banks. In October 2008, the Swiss Federal Banking Commission declared receivership of Kaupting's Swiss branch. At that point of time, the branch had a total volume of CHF 37 million deposits of which CHF 30 million were covered by the deposit insurance scheme. Kaupthing deposits accounts with less than CHF 5,000 were paid back within one week, while remaining guaranteed accounts were paid back within four weeks (SFBC, 2008). The "Kaupthing" case was widely reported in the Swiss press. On the other hand, in autumn 2008 several media outlets questioned whether *esisuisse* would have sufficient funds to cover all insured deposits of one of the larger banks (e.g. UBS). The background to this discussion is the fact that *esisuisse* is an unfunded scheme. The payouts of insured deposits are expected to be covered first by liquid assets of the distressed bank itself. If a bank cannot make required payments to insured depositors, the other banks in the system are obliged to make up the difference. However, the joint liability of the other banks in the system is capped at CHF 6 billion (CHF 4 billion prior to the crisis). This is less than any of the largest Swiss banks have in terms of customer deposits (see Appendix 1).

[42] A Wald test (based on a seemingly unrelated estimation) comparing the estimate for *Strong distress* in column (1) versus (2) yields a p-value < 0.001 (chi2 (2) = 109.53). An identical test comparing the estimate in column (3) versus (4) yields a p-value < 0.001 (chi2 (2) = 149.46).

[43] A Wald tests (based on a seemingly unrelated estimation) comparing the estimate for *Single account* (p-value < 0.001; chi2 (2) = 103.64)) in column (1) versus column (2) rejects the hypothesis of equality. Similarly, we can reject the hypothesis of equality of our estimates for *Single account* in column (3) vs. column (4) (p-value < 0.001, chi2 (2) = 66.31).

**Table 6**
Bank distress and deposit withdrawals: Subsample analyses.

| Dependent variable | Withdrew deposits | | Withdrew deposits | | Withdrew deposits | |
|---|---|---|---|---|---|---|
| Sample (deposit accounts) | All deposit accounts | | All deposit accounts | | All deposit accounts | |
| Subsample (households) | Low wealth | High wealth | Low insurance knowledge | High insurance knowledge | Low financial literacy | High financial literacy |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Strong distress (UBS) | 0.208*** | 0.271*** | 0.217*** | 0.263*** | 0.213*** | 0.239*** |
| | (0.024) | (0.049) | (0.026) | (0.037) | (0.030) | (0.033) |
| Weak distress (Credit Suisse) | 0.033 | 0.076* | 0.027 | 0.102*** | 0.065*** | 0.038** |
| | (0.023) | (0.038) | (0.016) | (0.035) | (0.022) | (0.017) |
| *Bank control variables* | | | | | | |
| Too big to fail | −0.007 | −0.018 | −0.003 | −0.026* | −0.010 | −0.007 |
| | (0.007) | (0.014) | (0.004) | (0.013) | (0.009) | (0.007) |
| State-owned | 0.006 | 0.012 | 0.008 | 0.010 | 0.016 | −0.006 |
| | (0.011) | (0.034) | (0.011) | (0.023) | (0.015) | (0.016) |
| Tax dispute | −0.001 | −0.025 | −0.008 | −0.021 | −0.003 | −0.008 |
| | (0.007) | (0.030) | (0.009) | (0.027) | (0.008) | (0.018) |
| Household Controls | YES | YES | YES | YES | YES | YES |
| Bank Competition Controls | YES | YES | YES | YES | YES | YES |
| Household Fixed Effects | NO | NO | NO | NO | NO | NO |
| Regional Fixed Effects | YES | YES | YES | YES | YES | YES |
| Observations | 1.383 | 710 | 1.469 | 624 | 925 | 1.168 |
| Households | 879 | 352 | 908 | 323 | 586 | 645 |
| Mean of dependent variable | 0,040 | 0.068 | 0.041 | 0.071 | 0.042 | 0,056 |
| R-squared | 0.150 | 0.206 | 0.180 | 0.187 | 0.160 | 0.191 |
| Clustered standard errors | YES | YES | YES | YES | YES | YES |
| Method | OLS | OLS | OLS | OLS | OLS | OLS |

This table shows the estimates of a linear probability model where the dependent variable is *Withdrew deposits.* The main explanatory variables are *Strong distress (UBS)* and *Weak distress (Credit Suisse).* The full sample of all deposit relationships with distressed or non-distressed banks is split by *Wealth* (column 1–2), *Insurance knowledge* (column 3–4), *Financial literacy* (column 5–6). Household control variables are *Wealth* dummy variables (including interactions of wealth dummy variables indicating wealth of at least CHF 100,000 with *Single account), Income* dummy variables, *Age, Male, University, Swiss nationality, Risk aversion* and *Time preference.* Bank competition control variables are *Distance UBS km, Distance Credit Suisse km, Distance non-distressed bank km* and *Banks / ZIP code.* Definitions and summary statistics of the variables are provided in Appendix 4. Regional Fixed Effects are on the cantonal level. Standard errors are clustered on the cantonal level and are reported in parentheses. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

**Table 7**
Bank-client relationships and deposit withdrawals: Subsample analyses.

| Dependent variable | Withdrew deposits | | Withdrew deposits | | Withdrew deposits | |
|---|---|---|---|---|---|---|
| Sample (deposit accounts) | Deposit accounts with strongly-distressed bank (UBS) | | Deposit accounts with strongly-distressed bank (UBS) | | Deposit accounts with strongly-distressed bank (UBS) | |
| Subsample (households) | Low wealth | High wealth | Low insurance knowledge | High insurance knowledge | Low financial literacy | High financial literacy |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Single account | −0.257*** | −0.031 | −0.250*** | −0.282* | −0.224** | −0.255** |
| | (0.030) | (0.205) | (0.034) | (0.134) | (0.080) | (0.094) |
| Household Controls | YES | YES | YES | YES | YES | YES |
| Bank Competition Controls | YES | YES | YES | YES | YES | YES |
| Household Fixed Effects | NO | NO | NO | NO | NO | NO |
| Regional Fixed Effects | YES | YES | YES | YES | YES | YES |
| Observations | 201 | 120 | 223 | 98 | 139 | 182 |
| Households | 201 | 120 | 223 | 98 | 139 | 182 |
| Mean of dependent variable | 0.209 | 0.267 | 0.215 | 0.265 | 0.201 | 0.253 |
| R-squared | 0.235 | 0.259 | 0.244 | 0.325 | 0.279 | 0.264 |
| Clustered standard errors | YES | YES | YES | YES | YES | YES |
| Method | OLS | OLS | OLS | OLS | OLS | OLS |

This table shows the estimates of a linear probability model where the dependent variable is *Withdrew deposits.* The main explanatory variable is *Single account.* The subsample of deposit relationships with the strongly-distressed bank (UBS) is split by *Wealth* (column 1–2), *Insurance knowledge* (column 3–4), *Financial literacy* (column 5–6). Household control variables are *Wealth* dummy variables (including interactions of wealth dummy variables indicating wealth of at least CHF 100,000 with *Single account), Income* dummy variables, *Age, Male, University, Swiss nationality, Risk aversion* and *Time preference.* Bank competition control variables are *Distance UBS km, Distance Credit Suisse km, Distance non-distressed bank km* and *Banks / ZIP code.* Definitions and summary statistics of the variables are provided in Appendix 4. Regional Fixed Effects are on the cantonal level. Standard errors are clustered on the cantonal level and are reported in parentheses. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

### 6.2. Financial sophistication

Recent evidence suggests that financial literacy and numerical ability is strongly related to household financial behavior, i.e. retirement savings (Van Rooij et al., 2012), financial market participation (Van Rooij et al., 2011), consumer borrowing (Lusardi and Tufano, 2015; Agarwal and Mazumder, 2013), mortgage default (Gerardi et al., 2013), and savings account choice (Deuflhard et al., 2017). Related to our study, Kim (2016) documents that regional variation in financial literacy in the U.S. is associated with different reactions of local depositors to bank distress. Our data allows us to examine the relationship between financial literacy and withdrawal behavior at the household level.

We employ a measure of financial sophistication available from the survey and split our sample based on this indicator: The dummy variable *Financial literacy* measures whether households answer

correctly to three standard financial literacy questions on interest, inflation and risk diversification.[44] Our summary statistics show that 50 percent of the respondents have a high level of financial literacy (see Appendix 4).

In columns (5 & 6) of Tables 6 and 7 we replicate our main analysis for subsamples of respondents with low vs. high financial literacy. The Table 6 results show that our main finding is again robust across these two subsamples: Households are much more likely to withdraw from the strongly distressed bank than from non-distressed banks. However, the magnitude of the point estimate for *Strong distress* suggests that the propensity to withdraw deposits from the strongly distressed bank (UBS) is higher among households that are more financial literate (24 vs. 21 percentage points).[45] The Table 7 column (5 & 6) results suggest that in both subsamples strong client relationships are associated with lower propensities to withdraw deposits from the strongly distressed bank. Comparing the magnitude and significance of the point estimates across columns reveals no significant association between financial literacy and the role of client relationships in deterring withdrawal risk. [46]

## 7. Robustness checks

In this section, we report on a series of robustness checks to our main analysis as presented in Tables 2,5,6 and 7. We examine to what extent our results are affected by (i) our chose estimation method, (ii) our chosen indicators of withdrawals, (iii) our chosen indicator of bank distress, (iv) our chosen indicators of the scope of bank relationships, and (v) our measures of deposit insurance coverage. We further report on subsample analyses which examine whether our results are (vi) robust to the local presence (and thus saliency) of the distressed banks, and (vii) robust to households having securities accounts as opposed to households not having such accounts (to alleviate concerns of idiosyncratic wealth shocks of households triggering deposit withdrawals).

Our multivariate analysis presented in Tables 2 and 5 is based on linear parametric models. As our dependent variable is categorical, we replicate our analysis using a non-linear (logit) model. The corresponding estimates are presented in Appendix 7 for Table 2 and Appendix 8 for Table 5, respectively. The non-linear estimates confirm the findings from our linear regressions.

While our study focusses on the withdrawal of demand deposits, it is informative to examine whether there were similar movements in non-deposit assets. In Appendix 9 and Appendix 10 we replicate our main regression analysis replacing our dependent variable *Withdrew deposits* with the variable *Withdrew non-deposits*. This variable measures whether a household withdrew funds from a securities account or a retirement account. We bundle securities accounts and retirement accounts together as tax deferred retirement accounts in Switzerland often include mutual fund holdings. Among the 2563 pre-crisis bank-relationships in our sample 1086 feature a securities account and/or a retirement account. As shown in Table 1 the incidence of withdrawals of non-deposit assets is 14.5 % for the strongly distressed bank, 3.8 % for the weakly distressed bank and 1.9 % for non-distressed banks. The Appendix 9 (column 1) estimates confirm that households are significantly more likely to withdraw non-deposit assets from the strongly distressed bank than from non-distressed banks. However, the point estimate of *Strong distress* (16.1 percentage points) is smaller than that reported for demand deposits in Table 2. The point estimate for *Weak distress* is also smaller than that reported in Table 2 and is not significant. The Appendix 10 (column 1) estimates suggest that our indicator of strong bank-relationships (*Single accoun*t) is associated with fewer withdrawals of non-deposit assets. However, the point estimate of *Single account* is smaller and less precisely estimated than that reported for deposits in Table 5. Thus, qualitatively our findings for the withdrawal of demand deposits seem to also hold for non-deposit assets. However, the effects for non-deposit assets are much weaker than for demand deposits.

The variables *Withdrew deposits* and *Withdrew non-deposits* both capture the incidence of asset withdrawals but have little to say about the magnitude of these withdrawals. In our survey, respondents report what share of their total assets with a bank they reallocated during the crisis and whether they ceased the respective bank relationship. Based on this information we establish three indicators of the magnitude of asset withdrawals: *Withdrew assets (less* 50 %*)*, *Withdrew assets (at least* 50 %*)*, and *Bank relationship ceased*. Table 1 shows that large withdrawals are much more frequent than small withdrawals at the strongly distressed bank (16.1 % versus 7.6 %). This is the case neither for the weakly distressed bank (2.4 % versus 2.9 %) nor for the non-distressed banks (1 % versus 0.7 %). Moreover, the closure of bank relationships is much more frequent for the strongly distressed bank (11 %) than for the weakly distressed bank (1 %) or non-distressed banks (0.7 %). The estimates in Appendix 9 (columns 3–5) confirm that significant asset withdrawals (at least 50 % of assets) and account closures are much more frequent at the strongly distressed bank than at the other banks. The estimated difference between the strongly distressed bank and the other banks is less pronounced for small withdrawals (less than 50 % of assets). The Appendix 10 estimates show that strong bank-client relationships (as proxied by *Single account*) are particularly effective in mitigating significant asset withdrawals (column 4) and account closures (column 5). By contrast, strong client-bank relationships seem to play little role in deterring less significant asset withdrawals (column 3).

Our main indicators of bank distress (*Strong Distress*, *Weak Distress*) are bank specific indicators for UBS and Credit Suisse respectively. As discussed in Section 3 we choose these bank-specific dummies rather than a continuous measure of bank performance, as these were the only two Swiss banks experiencing financial losses during the 2007–2009 crisis. As a robustness check, we replicate our main results with a measure of profitability (Return on Assets between 2007–2009). In Appendix 11 we examine whether our main results presented in Table 2 are robust to using RoA as opposed to our indicator variables of bank distress. In Panel A of Appendix 11 we use a continuous measure of RoA. We confirm that banks with stronger financial performance experienced fewer deposit withdrawals. In Panel B we distinguish banks with RoA below zero (UBS), between 0 % and 1 % (Credit Suisse), between 1 % and 2 % (6 banks) as well as RoA exceeding 2 % (9 banks). The results from this panel suggest that our main results are not influenced by allowing for variation in the profitability of banks, among those which were more profitable than the distressed banks UBS and Credit Suisse. In Appendix 6, Panel B we interact bank profitability (RoA) with our measures of client relationships to examine the differential effect of client relationships on deposit withdrawals across banks by performance. We confirm our existing analysis in Panel A of Appendix 6 by showing that client relationships are more likely to mitigate withdrawals among banks with weak profitability.

Our main indicator of strong bank-client relationships (*Single account*) captures the exclusivity each relationship. However, as

[44] See Lusardi and Mitchell (2011) for a cross-country comparison of financial literacy using these three questions. See Brown and Graf (2013) for evidence on financial literacy in Switzerland based on the survey data used in this study.

[45] A Wald test (based on a seemingly unrelated estimation) comparing the estimate for *Strong distress* in column (5) versus column (6) yields a p-value < 0.001 (chi2 (2) = 159.91).

[46] A Wald test (based on a seemingly unrelated estimation) comparing the estimate for *Single account* in column (5) versus column (6) yields a p-value < 0.001 (chi2 (2) = 75.38).

Table 4 suggests, withdrawal risk may also be directly related to the scope of a bank relationship.[47] In Table 5 (Panel B) we employed three measures of relationship scope *Loan*, *Securities account* and *Retirement account* to study the mechanism through which exclusive bank relationships mitigate liquidity risk. In Appendix 12 we use the same three measures of relationship scope as alternative measures of relationship strength. Appendix 12 replicates our main analysis from Table 5 (Panel A) and confirms that a broader relationship scope as measured by the holding of a loan or a securities account mitigates withdrawal risk from the strongly distressed bank. The magnitude and significance of the estimate for *Securities account* (column 4) is similar to that for *Loan* (column 2). By contrast, the estimate for *Retirement account* (column 3) is smaller and less precisely estimated. Comparing the column (2–4) estimates in Appendix 12 to that of *Single account* in column 1 suggests that the exclusivity of a bank relationship has a stronger mitigating effect on withdrawal risk than the scope of the relationship.[48]

Our next robustness test relates to our indicators of deposit insurance coverage as employed in the sample splits in Tables 6 and 7. Compared to recent studies based on administrative data our survey provides only an approximate indicator of deposit insurance coverage. In our main analysis, we use the dummy variable *Low wealth* as our proxy of insurance coverage. This proxy is equal to one if households have total financial wealth below the insurance coverage threshold of CHF 100,000. However, households with total financial wealth exceeding CHF 100,000 may be fully covered by deposit insurance if these funds are spread across multiple bank accounts, or if some of their financial wealth is invested in securities. In Appendix 13 and 14 we replicate the Tables 6 and 7 subsample splits using two alternative proxies of deposit insurance coverage. First, we account for the fact that not all financial wealth is held in deposit accounts. In our survey, households report which share of their total financial wealth is held in deposits and which share is held in securities. Based on this information we establish the indicator *Low wealth (deposits)* which is 1 for households with total financial wealth below CHF 100,000 or total financial wealth between CHF 100,000 and 250,000 but not more than 50 % in bank deposits. Second, we account for the fact that households with multiple bank accounts may be fully covered by deposit insurance even if they have a total deposit volume exceeding CHF 100,000. We therefore define those households as *Insured* that have total financial wealth of less than CHF 100,000, or between CHF 100,000 and 250,000 but at least 2 accounts. The Appendix 13 results confirm that the propensity of households to withdraw from the strongly distressed bank is higher for uninsured households. The Appendix 14 results confirm that strong bank-client relationships are less likely to mitigate withdrawals from the strongly distressed banks when households are uninsured.

In a further robustness test, we examine to what extent the deposit withdrawals at the two distressed banks are affected by their local market presence. The two large internationally operating banks UBS and Credit Suisse may have been associated with negative reports about the banking sector as a whole. Thus, the two distressed banks in our sample may have potentially experienced deposit outflows even if they had not experienced financial distress simply because they were more salient. As we show in section 2 the balance sheet volume of UBS or Credit Suisse dwarf those of other Swiss banks but they do not have a dominating position in the Swiss domestic retail market. Moreover, their share of the retail market varies considerably across regions within Switzerland. As we show in Appendix 1 (Panel B) the regional market share of customer deposits of UBS and Credit Suisse in the market for customer deposits varies from less than 10 % to more than 50 % across the cantons. Likewise, the regional share of bank branches of UBS and Credit Suisse varies from less than 10 % to more than 30 % across the cantons. We replicate the Table 2 estimates for cantons in which UBS and Credit Suisse jointly have at least 17 % of regional bank branches (which equals the average countrywide share), and cantons where they have less than 17 % of regional bank branches. The results of this sample-split are presented in Appendix 15. These suggest that the propensity to withdraw deposits from the distressed banks is similar across regions which vary in the local presence and thus saliency of these two banks.

In a last robustness test, we alleviate concerns of reverse causality. Clients at the distressed banks, UBS and Credit Suisse, might have experienced idiosyncratic liquidity shocks because they themselves had directly invested in financial assets that lost value. As a result, they might have withdrawn their deposits from these banks. We argued above that this is unlikely as (i) we focus on reallocations of deposits which do not include cash withdrawals and (ii) we provide results for specifications in which we control for all household characteristics via household fixed effects. To further alleviate these concerns, we run a robustness test in which we replicate the main results displayed in column 4 of Table 2 using subsamples of households that had securities accounts and compare the results to subsamples of households that did not have securities accounts. The results displayed in Appendix 16 suggest that the withdrawal propensity of UBS clients not having a securities account is even larger (26 percent) compared to households having securities account (16 percent). We conclude that investments losses incurred by clients of the two distressed banks, UBS and Credit Suisse, are almost certainly not driving our results.

## 8. Conclusions

We study retail deposit withdrawals from commercial banks in Switzerland that were differentially exposed to distress during the 2007–2009 financial crisis. Our analysis uses consumer finance survey data providing information on 2563 pre-crisis bank relations of 1475 consumers and documenting their reallocation of assets across banks during 2008–2009. This data allows us to examine to what extent strong relationships with a distressed bank mitigate deposit withdrawal risk.

We document that retail clients do discipline - in our case systemically important - commercial banks when these banks are subject to financial distress. Importantly though, strong bank-client relationships play a crucial role in mitigating withdrawal risk at distressed banks. Clients who maintain an exclusive relationship with a distressed bank are less likely to withdraw funds. Strong client-bank relationships mitigate withdrawal risk even for those banks that are not in distress. However, in absolute terms the magnitude of this mitigating effect is substantially larger when a bank is distressed. In our setting, 23 percent of the clients of the most distressed bank withdraw funds from the bank during 2008–2009. Our estimates suggest that this effect is eliminated if a client banked exclusively with this institution prior to the crisis. Exploring the mechanism why exclusive bank relationships eliminate withdrawal risk, we find that the transaction costs of switching accounts - rather than informational rents or differentiated services - is the most likely mechanism.

[47] Consumer research emphasizes that “convenience” is major reason for consumers to bundle financial services at one bank (Devlin, 2002)

[48] In an unreported analysis, we replicate column (2) of Appendix 12 separately for households with low vs. high wealth. We find that the mitigating effect of a *Loan* on withdrawal risk is stronger in the low wealth than in the high wealth sample, similar to our finding for *Single account* in Table 7. This result suggests that the mitigating effect of credit linkages on withdrawal risk is hardly driven by customers who expect their outstanding debt to be netted off with their deposits. If this were the case, the households with deposits exceeding the insurance threshold, should be more sensitive to credit linkages than households with deposits below the insurance level.

Our results provide empirical support to the configuration of the recently introduced Basel III minimum liquidity requirements for banks. The Liquidity Coverage Ratio (LCR), for example, requires banks to hold sufficient highly liquid assets in order to withstand expected fund outflows over a 30-day period in a severe distress scenario. The LCR regulations assume that in such a scenario the expected fund outflows will not only depend on the contract type and maturity of the underlying bank funding, but also on the characteristics of depositors that a bank caters to and the relationship they maintain with depositors (BIS, 2013). Our findings support the conjecture that banks with stronger depositor relationships should hold less liquidity as the corresponding deposits are a more stable source of funding. Moreover, our findings suggest that the stability of customer funding is primarily related to the exclusivity of the bank relationship, rather than to the scope of services used.

Our results should bear relevance beyond the specific case of large universal Swiss banks which we study. First, we find that the mitigating effect of strong bank-client relationships on withdrawal risk is not confined to wealthy households who demand sophisticated financial services. On the contrary, strong bank-client relationships also eliminate withdrawal risk for low wealth households and households which use basic deposit accounts only. Second, the incidence of deposit withdrawals which we report for the distressed banks in our sample is consistent with that of recent studies documenting very different incidences of distress, for very different types of banks in very different economic conditions (Rose, 2015; Davenport and McDill, 2006; Shin, 2009; Iyer et al., 2016). Nevertheless, more research is required to guide policy makers on the potential magnitude of run-off rates for "stable" and "less stable" deposits in different bank stress scenarios. The stress scenario reported in this paper is very particular: The distressed banks are systemically important, internationally operating commercial banks. The main source of financial distress to these banks were losses on the portfolio of tradable assets. More research is required to examine how bank-client relationships mitigate withdrawal risk among banks that are not too big to fail and/or are primarily focused on the domestic retail market.

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## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jfs.2019.100707.

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