How does deposit insurance affect depositor behavior in a banking crisis?

Glenn Boyle, Roger Stover, Amrit Tiwana, Oleksandr Zhylyevskyy

PII: S1042-9573(15)00009-1
DOI: http://dx.doi.org/10.1016/j.jfi.2015.02.001
Reference: YJFIN 691

To appear in: *Journal of Financial Intermediation*

Received Date: 18 December 2014

Please cite this article as: Boyle, G., Stover, R., Tiwana, A., Zhylyevskyy, O., How does deposit insurance affect depositor behavior in a banking crisis?, *Journal of Financial Intermediation* (2015), doi: http://dx.doi.org/10.1016/j.jfi.2015.02.001

HOW DOES DEPOSIT INSURANCE AFFECT DEPOSITOR BEHAVIOR IN A BANKING CRISIS?

Glenn Boyle[a]
University of Canterbury

Roger Stover[b]
Iowa State University

Amrit Tiwana[c]
University of Georgia

Oleksandr Zhylyevskyy[d]
Iowa State University

22 January 2015

[a] Department of Economics and Finance, University of Canterbury. Private Bag 4800, Christchurch 8140, NZ. *Phone*: 64-3-364-3479. *E-mail:* glenn.boyle@canterbury.ac.nz.
[b] *Corresponding author*. Department of Finance, Iowa State University. 3111 Gerdin, Ames, IA 50011, USA. *Phone:* 1-515-294-8114. *E-mail:* rstover@iastate.edu.
[c] Terry College of Business, University of Georgia. 305 Brooks Hall, Athens, GA 30602, USA. *Phone:* 1-404-492-6194. *E-mail:* tiwana@uga.edu.
[d] Department of Economics, Iowa State University. 460D Heady Hall, Ames, IA 50011, USA. *Phone:* 1-515-294-6311. *E-mail:* oz9a@iastate.edu.

HOW DOES DEPOSIT INSURANCE AFFECT DEPOSITOR BEHAVIOR IN A BANKING CRISIS?

22 January 2015

Abstract

We use a conjoint analysis approach to shed light on depositor behavior in a banking crisis. A multinational sample of respondents is provided with hypothetical account profiles and asked how, following the failure of a large competing bank, they would view each profile in terms of required interest rate premium and deposit withdrawal percentage. Respondents from countries without explicit deposit insurance behave differently. In particular, they exhibit greater withdrawal risk, suggesting that the introduction of deposit insurance during a crisis may be only partially successful in preventing bank runs. They also impose a higher deposit interest rate premium. Having a long-term bank relationship reduces withdrawal risk, as does the absence of co-insurance.

Keywords: deposit insurance, banking crises, bank runs, conjoint analysis

JEL classification: G01, G21

HOW DOES DEPOSIT INSURANCE AFFECT DEPOSITOR BEHAVIOR IN A BANKING CRISIS?

1. Introduction

The theoretical advantages and disadvantages of deposit insurance are well known. On the one hand, it provides depositors with confidence about the safety of their funds and hence reduces the likelihood of bank runs following an adverse event. On the other hand, it encourages depositors to scale back on their monitoring of bank risk-taking activities during non-crisis periods, thus making future bank failures more likely.[1] In line with the first argument, Demirgüc-Kunt et al. (2014) point out that countries with explicit deposit insurance schemes in place prior to the 2007-08 global financial crisis saw very few depositor-led bank runs, but a widespread incidence of runs on (uninsured) wholesale funding. At the same time, they also express disquiet about the long-term moral hazard implications of this success.

Most empirical research on deposit insurance has focused on existing insurance schemes, either by comparing insured and uninsured countries, or by comparing insured and uninsured depositors within the same country. By contrast, deposit insurance that is introduced during a crisis appears to have attracted little research interest to date.[2] A natural question is whether such interventions work in the desired manner. That is, can the introduction of deposit insurance during a crisis be effective in mitigating depositor runs?

Given the potential moral hazard and adverse selection costs of deposit insurance, many countries delay the introduction of deposit insurance until a banking crisis strikes.[3] However, such a strategy implicitly assumes that newly-introduced insurance is just as effective in

[1] As pointed out by an associate editor, this occurs not only because of the well known moral hazard problem, but also because of adverse selection: any insurance-induced reduction in market discipline allows incompetent and inefficient bankers to continue to operate.

[2] Anginer et al. (2012) point out that "(T)here is no study that examines the impact of deposit insurance…during a period of global risk and instability. This is an important gap in our knowledge…"

[3] See Demirgüç-Kunt et al. (2008).

preventing bank runs as long-standing insurance. Perhaps it takes time for depositors to learn about, and gain confidence in, explicit deposit insurance schemes. In that case, deposit insurance introduced following the onset of a crisis may be of limited value compared to the pre-existing kind.

In this paper, we investigate the effectiveness of explicit deposit insurance that is introduced when banking sector problems arise. The usual approach for doing so would compare the actual crisis experiences of countries that had a pre-existing deposit insurance system with those that introduced deposit insurance only once the crisis was underway. Unfortunately, because these countries also differ along a multitude of other dimensions (e.g., deposit insurance systems with widely varying features, different forms of crisis, and so on), implementation of this approach would be a daunting task.[4] Instead, we employ conjoint analysis and ask a sample of respondents to assess a number of hypothetical deposit accounts, all of which are insured to varying degrees, in the presence of a banking sector crisis. Because our sample includes respondents both from (i) countries that have explicit deposit insurance and (ii) countries that do not have such insurance, we are able to use the collected responses to gain insight into the potential effectiveness of crisis-adopted deposit insurance.

Our main finding is that respondents from countries without explicit deposit insurance behave differently. In particular, they exhibit greater withdrawal risk, suggesting that the introduction of deposit insurance during a crisis may be only partially successful in preventing bank runs. More generous insurance schemes are more effective but potentially involve greater long-term system risks. Newly-insured respondents also require a higher interest rate premium than their historically-insured counterparts, although there is no difference between the two groups in their pricing of bank risk.

[4] As countries typically only adopt deposit insurance once, such an approach would also have limited data observations relative to the number of potential variations.

Many papers have been written about deposit insurance, but ours is the first to examine its introduction during a banking sector crisis and assess its impact using conjoint analysis. This allows us to extend several strands of recent research. For example, Osili and Paulson (2014) find that immigrants from countries with deposit insurance schemes are more likely to use the United States banking system, from which they conjecture that insurance can potentially maintain confidence during a crisis. Our results confirm this conjecture, while at the same time clarifying which deposit insurance characteristics are most important for depositor confidence. In the paper that is perhaps most similar in spirit to ours, Karas et al. (2013) compare the reactions of newly-insured and uninsured depositors to a 2004 minor panic in the Russian banking sector; in a related manner, our study attempts to compare the reactions of newly-insured and historically-insured depositors to a hypothetical crisis that allows for a wider range of deposit insurance features and depositor attributes, and for consideration of counter-factual events. Overall, our quasi-experimental approach provides a fresh perspective on a well-travelled area by allowing us to ask new questions and re-investigate old answers. While not a substitute for traditional methods, such an approach is obviously complementary. And, as we illustrate, it can be particularly valuable in situations where traditional methods are difficult to apply.

The next section describes our research design in more detail and provides a preliminary analysis of the collected data. Section 3 outlines the econometric model and its estimation, while section 4 contains the main results. Section 5 discusses some limitations of our study and suggests several interesting directions for future research.

2. Research Design and Data Collection

Our analytical approach is straightforward. First, we use conjoint analysis to collect data on depositor responses to a hypothetical bank crisis. Second, we investigate whether these responses

are systematically related to deposit insurance features and respondent characteristics.

As described by Louviere (1988), conjoint analysis requires respondents to make judgments about criterion variables based on a series of hypothetical profiles with varying attributes, thus enabling the underlying structure of their cognitive mental models to be statistically inferred from, for example, regression models. In our case, the hypothetical profiles are bank deposit accounts and the attributes describe bank and deposit risk, and features of the deposit insurance system.

This approach is similar to an experimental design, insofar as the situations presented to respondents are hypothetical, and has several advantages over a traditional survey. First, it is less susceptible to "social desirability" and "retrospection" biases: because the situations are hypothetical, respondents need not be swayed by the possible social consequences of their crisis-induced behavior or suffer from recall difficulties. Second, it allows us to investigate how depositors trade off different deposit insurance features of our choosing. For example, a traditional survey would allow us to ask only what actions depositors took during the crisis *given* the deposit insurance system in place at that time. By contrast, our approach allows us to ask what actions they would have taken under *different* insurance scenarios.

2.1. Deposit account profiles and attributes

Based on work by Garcia (2000), Demirgüç-Kunt and Huizinga (2004), Iyer and Puri (2012), Kiss et al. (2012), Iyer at al. (2013), and Karas et al. (2013), we assign seven attributes to each hypothetical account profile: maximum deposit insurance coverage per deposit ($250,000 or $50,000), deposit size (above or below the maximum deposit insurance coverage), co-insurance provision (100% or 75% guarantee), bank capital buffer level (above or below average), pre-funding of deposit insurance (yes or no), deposit insurance premium type (risk-adjusted or flat-

rate), and insurance fund membership by banks (compulsory or voluntary). From these, we create eight conjoint profiles that contain various combinations of these attributes.[5]

2.2. Respondent sample and data collection

Our sample of respondents consists of 349 business school students at universities in Europe (132 students), New Zealand (122), and the United States (95). There are always pros and cons associated with the use of student respondents, and our study is no exception. On the one hand, focusing on students allows us to more easily construct a multinational sample containing respondents both from countries with explicit deposit insurance and from countries without such insurance. In addition, business students are likely to have a relatively good understanding of risk-return trade-offs. On the other hand, most students are younger and poorer, have more limited life experience, and are less likely to have experienced a crisis first-hand than the typical depositor. For these reasons, some caution must be applied when trying to generalize from our student sample to the depositor population.

Another important issue for policy conclusions is the extent to which our student respondents are likely to have had a reasonable understanding of deposit insurance; without such an understanding, their answers may be nothing more than guesswork and hence of little value. To address this issue, we re-sampled the same student populations (since the original respondents would have become aware of deposit insurance via their previous participation) to obtain information about their knowledge of deposit insurance. These new samples (140 responses in total: 55 from the United States, 52 from New Zealand, and 23 from Europe) were asked about the safety of a $120,000 deposit in the event of a bank failure and a $100,000 coverage limit.

[5] A description of the profiles, instructions to respondents, and other data collection details appear in a Supplementary Online Appendix (SOA), available at http://www.econ.iastate.edu/~oz9a/research/files/SOA_BoyleEtAl_DepIns_Jan2015.pdf.

Ninety-one percent of those surveyed answered the question correctly, with no discernible difference between students from countries with explicit deposit insurance and those from countries without it. This result means we can be reasonably confident that our respondent sample was familiar with the concept of deposit insurance. More generally, the high, and homogeneous, awareness of deposit insurance suggests that most countries have, directly or indirectly, been fairly successful in educating depositors about fundamental deposit insurance principles, and that such awareness need not require first-hand experience of a banking crisis.

Our data collection commenced with respondents being told that one of the two largest banks in their country had just failed, and that they would be asked to consider the implications of this event for interest-bearing deposit accounts at their own bank. In order to ensure that they had a common information base, and to keep the number of variables used in the subsequent analysis at a manageable level, all respondents were instructed that their deposit was at least partially covered by a fully-credible deposit insurance agency, and that their bank held a diversified portfolio of assets but was not considered "too big to fail." They were also told that their bank had no government ownership and no higher-priority securities, and that they themselves held no deposits at other banks.

Respondents reported several personal characteristics: gender, whether they had had an actual bank account for five years or more, whether they opened this account following advice from another customer, and whether they had other bank relationships (such as a loan) in addition to this account. Most importantly, they were asked to identify their home country. Our respondents originate from a wide range of countries: Austria, China, Egypt, Finland, Germany, Hungary, Italy, Liechtenstein, Malaysia, New Zealand, Philippines, Russia, Slovakia, South Korea, Sri-Lanka, Switzerland, Taiwan, United Kingdom, and USA. Crucially, three countries on the list—China, Egypt, and New Zealand—do not have explicit deposit insurance schemes.

This feature of the data allows us to compare the reaction to a bank failure of respondents originating from countries without explicit deposit insurance to that of respondents from countries with such insurance.

Respondents were also asked to assess two statements designed to elicit information about their risk preferences:

Risk Tradeoff Statement: "I am willing to take high financial risks in order to realize higher average yields;"

Risk Tolerance Statement: "I usually view myself as a risk taker."

Respondents indicated the degree of agreement (or disagreement) with these statements, based on a seven-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). Although the sample correlation between the responses to these two statements is strongly positive (0.61; std. error = 0.03), it is also significantly less than one, suggesting that the two statements capture different aspects of risk preferences.

Table 1 presents the definitions of the account and respondent characteristics, and the terminology used to identify them throughout the remainder of this paper. For the two risk preference statements, we anticipate our subsequent regression analysis and combine the "strongly disagree" and "disagree" responses into one category; we do the same for the "strongly agree" and "agree" responses.

[Insert Table 1 about here]

Table 2 provides selected summary statistics for the respondent variables and compares characteristics of two subsamples—respondents originating from countries that have explicit deposit insurance and those from countries that do not. Respondents in the latter group are significantly less likely to have had an actual bank account for five or more years and to have

multiple bank relationships, but are more likely to have opened the account on another customer's advice. However, Table 2 reveals little evidence of any difference in risk preferences across the two groups. A Pearson χ^2 test cannot reject the hypothesis that the distribution of respondent risk preferences in our sample is unaffected by prior exposure to deposit insurance.[6]

[Insert Table 2 about here]

2.3. Preliminary analysis

For each account profile, respondents were asked two questions about their reaction to news of the bank failure:

Question 1: "Compared to competing financial institutions, I would expect an annualized interest rate for this account to be…" The response options are categorical on a nine-point scale, ranging from "significantly lower" (1) to "significantly higher" (9).

Question 2: "On hearing about the news of the shock to the financial system, what percentage of your deposit are you likely to immediately withdraw?" The response options are arranged in 11 steps from 0% to 100%, with a step size of 10%.[7]

Tables 3 and 4 present the distribution of responses to these two questions, pooled across the eight account profiles. For the full sample, the interest premium responses are largely symmetric around the middle of the response scale while the deposit withdrawal responses are concentrated in the 50% or below range. More interesting are the differences between the respondents whose home countries do and do not have explicit deposit insurance. The latter group is more likely to require a higher interest premium and to withdraw 50% or more of their

[6] Given a null of independence, the *p*-value is 0.51 for the risk tradeoff statement and 0.20 for the risk tolerance statement.

[7] For both questions, the response options were chosen so as to extract maximum information while minimizing the potential for non-response risk due to respondent fatigue.

deposit following the news of a major bank failure. Also, Pearson χ^2 tests strongly reject equality of the response distributions between the respondent groups, suggesting that depositor reactions to a bank failure may depend on prior exposure to deposit insurance.

[Insert Tables 3 and 4 about here]

3. Empirical Model and Estimation Approach

Tables 3 and 4 suggest that depositors with prior exposure to deposit insurance are less likely to respond negatively (i.e., require a higher interest rate or withdraw a significant percentage of their deposit) to news about a major bank failure than those without such exposure. Why might this be the case? One possibility is that different economic experiences affect the views and behavior of economic agents—see Osili and Paulson (2014). It could be, for example, that respondents from countries with explicit deposit insurance have different *a priori* beliefs, based on different life experiences with depositor protection schemes and banking systems generally, about the safety of bank deposits and the effectiveness of deposit insurance. However, Table 2 shows that such respondents also differ in terms of other factors that could potentially affect the reaction to the bank failure news. For example, they are more likely to have had a long-term relationship with their bank, which could make deposit withdrawal less likely (Iyer and Puri, 2012). Moreover, and importantly, the effect of prior deposit insurance exposure on responses may itself be influenced by specific deposit insurance features (such as the maximum coverage limit, co-insurance, and other account profile attributes). To disentangle these various effects, we turn to multivariate regression methods.

Doing so, however, is by no means straightforward. First, the data generated by the two response questions are not numerical. Second, the 16 answers provided by each respondent are

unlikely to be independent due to unobservable respondent-specific factors. Third, common unobservable factors are likely to induce correlation between the answers to the interest premium and deposit withdrawal questions. Our econometric approach aims to address these issues.[8] Specifically, we estimate the following system of equations:

$$\pi_{ij}^{*} = \theta_{\pi} \cdot D_i + \boldsymbol{p}_j' \cdot \boldsymbol{\alpha}_{\pi} + D_i \cdot \boldsymbol{p}_j' \cdot \boldsymbol{\beta}_{\pi} + \boldsymbol{z}_{Ai}' \cdot \boldsymbol{\gamma}_{\pi} + \boldsymbol{x}_i' \cdot \boldsymbol{\kappa}_{\pi} + \lambda_{\pi i} + \epsilon_{\pi ij}, \quad (3)$$

$$w_{ij}^{*} = \theta_{w} \cdot D_i + \boldsymbol{p}_j' \cdot \boldsymbol{\alpha}_{w} + D_i \cdot \boldsymbol{p}_j' \cdot \boldsymbol{\beta}_{w} + \boldsymbol{z}_{Bi}' \cdot \boldsymbol{\gamma}_{w} + \boldsymbol{x}_i' \cdot \boldsymbol{\kappa}_{w} + \pi_{ij}^{*} \cdot \delta_{wi} + \lambda_{wi} + \epsilon_{wij}, \quad (4)$$

where π_{ij}^{*} is a latent variable (see Maddala, 1983) for respondent i's answer to the interest premium question for account profile j (where i = 1,2,…,349 and j = 1,2,…,8), w_{ij}^{*} is a latent variable for respondent i's answer to the deposit withdrawal question for account profile j, D_i = 1 if and only if respondent i's home country does not have explicit deposit insurance, $\boldsymbol{p}_j$ is the vector of dummy variables representing account profile attributes, $\boldsymbol{z}_{Ai}$ is the vector of dummy variables representing the response to the risk tradeoff statement, $\boldsymbol{z}_{Bi}$ is the vector of dummy variables representing the response to the risk tolerance statement, and $\boldsymbol{x}_i$ is the vector of the remaining respondent-characteristic variables appearing in Table 1. The terms $\lambda_{\pi i}$ and λ_{wi} account for unobservable respondent-specific factors that do not vary across the eight account profiles. Such factors may include respondent views regarding interest rates (i.e., reflecting inter-temporal consumption substitution), respondent interpretation of the deposit withdrawal question, and so on. Because $\lambda_{\pi i}$ and λ_{wi} imply dependence of the unobserved determinants of respondent i's answers across the eight account profiles, we estimate our econometric model by maximum likelihood, while expressing the likelihood contribution of a respondent as the joint probability of all 16 interest premium and deposit withdrawal answers.

We include π_{ij}^{*} on the right hand side of Eq. (4) due to possible feedback between a respondent's choice of interest premium and withdrawal rate. For example, the withdrawal rate

[8] Details on the model estimation, as well as additional results, appear in the SOA.

for a particular account profile may be low if the respondent has indicated a high expected interest premium. We also allow this feedback effect to vary depending on whether or not the respondent originated from a country with explicit deposit insurance:

$$\delta_{wi} = \delta_w + \Delta_w \cdot D_i. \tag{5}$$

The underlying intuition of the system modeled by Eqs. (3) and (4) is straightforward. Upon learning about a major bank failure, and hence of the potential for a banking sector crisis, a respondent first decides on the interest premium required on his deposit (Eq. (3)). Then, taking this interest premium into account, he chooses how much of the deposit to withdraw (Eq. (4)). While conceptually necessary, the inclusion of π_{ij}^* in Eq. (4) creates a potential endogeneity problem. To obtain consistent parameter estimates, we follow the conventional "exclusion restriction" approach outlined by Greene (2012, Ch. 10) for systems of simultaneous equations.[9] This approach requires an explanatory variable that affects π_{ij}^*, but has no direct impact on the conditional expectation of w_{ij}^* given π_{ij}^* and other explanatory variables from Eq. (4).

We adopt an exclusion restriction based on responses to the risk preference statements. Recall that the first of these statements (*"I am willing to take high financial risks in order to realize higher average yields")* asks respondents about their willingness to trade off risk and return while the second (*"I usually view myself as a risk taker"*) asks about their willingness to tolerate risk in general. Although the two statements obviously pick up similar respondent characteristics, the first has most direct relevance for interest premium setting while the second is more closely linked to withdrawal risk. Thus, once the direct effects of the interest premium (π_{ij}^*) and risk tolerance ($\boldsymbol{z}_{Bi}$) on withdrawal (w_{ij}^*) are accounted for, it seems reasonable to assume that risk tradeoff propensity ($\boldsymbol{z}_{Ai}$) provides no additional information about withdrawal

[9] See Maddala and Lee (1976) for a discussion of the latent variable case.

risk.[10] That is, $\boldsymbol{z}_{Ai}$ serves as a vector of instruments for π_{ij}^{*} and hence satisfies the exclusion restriction.

Of particular interest in Eqs. (3)–(4) are the estimates of $\theta_{\pi}, \theta_{w}, \boldsymbol{\beta}_{\pi}$, and $\boldsymbol{\beta}_{w}$ as these reflect differences in responses attributable to variation in prior exposure to deposit insurance. Recall that we distinguish between respondents whose home country offers explicit deposit insurance and those whose home country provides no such protection. Since all our hypothetical account profiles offer deposit insurance, we can think of the two respondent groups as representing "historically-insured" and "newly-insured" depositors respectively. Thus, the estimates of $\theta_{\pi}, \theta_{w}, \boldsymbol{\beta}_{\pi}$, and $\boldsymbol{\beta}_{w}$ can shed light on the effectiveness of introducing deposit insurance during a crisis.

4. Regression Model Results

The results from estimating the system of Eqs. (3) and (4) appear in Table 5. From a policy perspective, our primary interest is in the extent to which the effectiveness of deposit insurance depends on prior insurance exposure. Regardless of respondent background, deposit insurance seems to matter: deposits with an uninsured component ("large deposits," i.e., those above the coverage limit) require a significantly higher interest rate and have an excess withdrawal rate of more than 20 percentage points.[11] However, the overall effectiveness of deposit insurance in mitigating withdrawal risk depends on respondents' country of origin. From the first row of Table 5, we see that the average small deposit withdrawal rate is 33.62 percentage points greater among newly-insured respondents than it is among historically-insured respondents, a difference that is statistically significant at the 1% level. For large deposits, the difference is 24.72 (= 33.62

[10] More formally, we assume that w_{ij}^{*} is conditionally mean-independent of $\boldsymbol{z}_{Ai}$; see Manski and Pepper (2000, p. 998).

[11] From the third column of Table 5, the estimated withdrawal rate for large deposits is 31.66% among historically-insured respondents and (31.66 − 8.90) = 22.76% among newly-insured respondents.

– 8.90) percentage points. These results suggest that the introduction of deposit insurance during a crisis may be less successful than an already-existing insurance scheme in mitigating withdrawal risk.

[Insert Table 5 about here]

Nevertheless, certain deposit insurance features can close this gap considerably. In particular, the difference in withdrawal rate between newly- and historically-insured respondents falls by 18.6 percentage points if the deposit insurance scheme covers 100% (rather than 75%) of eligible deposit amounts, an estimate that differs from zero at the 1% significance level. This estimate suggests that any deposit insurance scheme introduced during a crisis must be transparently generous in order to have the desired impact on withdrawal risk.

Although our research design precludes detailed investigation, insurance scheme generosity may be less important when the insurance promise has imperfect credibility. We instruct respondents to assume that the deposit insurance provider cannot fail, but such an assumption has not always been borne out in practice.[12] Allowing for imperfect credibility makes an insurance scheme less generous and so would appear likely to affect depositor behavior in a similar manner to greater co-insurance.

A pre-funded deposit insurance scheme lowers the difference by a further 9.87 points (significant at the 5% level), a finding that is somewhat more difficult to interpret given that pre-funding is unlikely to have any impact on the short-run attractiveness of a newly-introduced scheme. Nevertheless, it may reflect a belief among newly-insured respondents that holdup

[12] The Iceland government's default on insurance payments to foreign depositors of *Landsbanki* in 2008 is a notable example. Ennis and Keister (2009) argue that bank runs in Argentina in 2001 were partly attributable to depositor fears about the credibility of the government's insurance scheme; Martinez Peria and Schmukler (2001) discuss several cases where market discipline was unaffected by the presence of deposit insurance, an outcome they attribute to depositor doubts about the solvency of the provider.

problems are less likely with such a provision. For example, an insurance scheme that is rushed into existence during a crisis may not seem particularly convincing to depositors who worry that unforeseen complications could result in payout delays. In these circumstances, the existence of a pre-funding provision could signal to depositors that banking administrators have devoted sufficient thought to the details of the new insurance scheme.

Although less serious than bank runs in the short-term, excessive deposit interest rate increases have the potential to raise banks' funding costs, with a consequent adverse effect on investment and general economic activity. Table 5 shows that newly-insured respondents tend to require a significantly higher interest premium than their historically-insured counterparts (coefficient estimate = 0.73; p-value < 0.01), which suggests that introducing deposit insurance during a crisis may be relatively ineffective in moderating funding risk. Again, however, this difference is smaller for schemes with no co-insurance (coefficient estimate = -0.33; p-value = 0.03). Also, despite requiring a higher interest premium in general, newly-insured respondents reveal no greater tendency towards risk-pricing than do historically-insured respondents: the estimated sensitivity of the interest premium to bank capital is statistically indistinguishable between the two groups (coefficient estimate = -0.01; p-value = 0.94).

To the extent that funding risk may be seen as less harmful than withdrawal risk, another policy question of interest is the extent to which depositors can be encouraged to respond to a crisis by requiring higher interest rates rather than withdrawing deposits. The estimates in Table 5 suggest there may be some scope for such response: respondents who most strongly agree with the risk tradeoff statement require a relatively large interest premium, but the closely-related respondents who most strongly agree with the risk tolerance statement withdraw relatively less of their deposit. Although the latter effect is economically fairly small (4.85 percentage points), it is statistically significant at the 1% level.

The respondent background characteristics (other than prior exposure to deposit insurance) do not tend to affect the required interest premium or withdrawal rate. The one exception is the length of an existing bank relationship: respondents who have held an actual bank account for more than five years withdraw less, but also require a higher interest premium, than others. More familiarity with banking, it seems, breeds respect (in the sense of smaller withdrawals), but also some caution.[13]

Finally, in untabulated analysis (but available in the SOA), we assess the in-sample goodness-of-fit of our model by comparing actual and predicted distributions of responses. For the full sample, and for the newly-insured and historically-insured subsamples, the actual and the predicted distributions are very similar; in no case are we able to reject the null hypothesis that the model provides a good fit for the data. These tests also reinforce our earlier finding of higher withdrawal rates among the newly-insured group of respondents.

5. Concluding Remarks

When a banking crisis strikes, can the belated introduction of deposit insurance help prevent bank runs? Our results suggest that such a policy response may only be partially successful, at least compared to the effectiveness of a pre-existing insurance scheme. Faced with a hypothetical bank failure, respondents from countries without deposit insurance indicate they would withdraw a greater percentage from insured accounts, and require a higher interest premium on these accounts, than respondents from countries with explicit deposit insurance. To some extent at least, more generous insurance schemes are more effective at reducing these excess withdrawal and funding risks.

These results have intriguing implications for policy. Nevertheless, some caution is

[13] Using depositor data from an Indian bank that experienced a run following the failure of a neighboring bank, Iyer and Puri (2012) document a similar effect.

advisable as our study has several limitations that should be kept in mind. First, in common with experimental research, our data are obtained from hypothetical situations. Actual depositors, faced with sharper incentives, may behave differently. This concern is potentially exacerbated by our use of student respondents: the combination of weak incentives and generally lower wealth, for example, may cause our respondents' risk attitudes to differ from those of the depositor population, which could skew the estimated impact of deposit insurance. Second, our analytical approach necessarily simplifies the choices faced by real-world depositors. To make the analysis tractable, we consider only a subset of possible deposit insurance attributes, and limited variation in these attributes. Actual insurance systems vary much more markedly, and may affect depositor behavior in ways that our analysis cannot identify.

Finally, our study leaves some interesting questions for future research. While we focus on the immediate reaction of depositors to news about a major bank failure, and hence on the short-run effectiveness of deposit insurance, an obviously important policy issue concerns the potential implications of a new, crisis-adopted insurance scheme for long-run moral hazard risk. Does the extent of depositor monitoring in such a case quickly converge to that prevailing in countries with long-established insurance schemes, or might there be a persistent "crisis dividend?" Moreover, as implied by the work of Nier and Baumann (2006), does the speed of such convergence depend on the level of bank competition and the generosity of the newly-introduced insurance scheme? In addition, because our research design requires each respondent to answer questions in isolation from other respondents, it does not allow for social network effects (see Iyer and Puri, 2012; Kiss et al., 2014). To the extent that such effects can influence the ability of depositors to distinguish between fundamental shocks and panics, they may have important implications for the relative effectiveness of crisis-adopted deposit insurance.

References

Anginer, D., A. Demirguc-Kunt, and M. Zhu. 2012. "How Does Deposit Insurance Affect Bank Risk? Evidence from the Recent Crisis." World Bank Policy Research Working Paper 6289.

Demirgüç-Kunt, A., and H. Huizinga. 2004. "Market Discipline and Deposit Insurance." *Journal of Monetary Economics* 51: 375–399.

Demirgüç-Kunt, A., E. Kane, and L. Laeven. 2008. "Determinants of Deposit Insurance Adoption and Design." *Journal of Financial Intermediation* 17: 407–438.

_____. 2014. "Deposit Insurance Database." World Bank Policy Research Working Paper 6934.

Ennis, H., and T. Keister. 2009. "Bank Runs and Institutions: The Perils of Intervention." *American Economic Review* 99: 1588–1607.

Garcia, G. 2000. "Deposit Insurance: Actual and Good Practices." Occasional Paper 197. Washington, DC: International Monetary Fund.

Greene, W.H. 2012. *Econometric Analysis.* 7th ed. Upper Saddle River, NJ: Prentice Hall.

Iyer, R., and M. Puri. 2012. "Understanding Bank Runs: The Importance of Depositor-Bank Relationships and Networks." *American Economic Review* 102: 1414–1445.

Iyer, R., M. Puri, and N. Ryan. 2013. "Do Depositors Monitor Banks?" NBER Working Paper 19050.

Karas, A., W. Pyle, and K. Schoors. 2013. "Deposit Insurance, Banking Crisis, and Market Discipline: Evidence from a Natural Experiment on Deposit Flows and Rates." *Journal of Money, Credit and Banking* 45: 179–200.

Kiss, H.J., I. Rodriguez, and A. Rosa-Garcia. 2014. "Do Social Networks Prevent or Promote Bank Runs?" *Journal of Economic Behavior & Organization* 101: 87–99.

Kiss, H.J., I. Rodriguez-Lara, and A. Rosa-Garcia. 2012. "On the Effects of Deposit Insurance and Observability on Bank Runs: An Experimental Study." *Journal of Money, Credit and Banking* 44: 1651–1665.

Louviere, J. 1988. *Analyzing Decision Making: Metric Conjoint Analysis*. Beverly Hills, CA: Sage.

Maddala, G.S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge, UK: Cambridge University Press.

Maddala, G.S., and L. Lee. 1976. "Recursive Models with Qualitative Endogenous Variables." *Annals of Economic and Social Measurement* 5: 525–545.

Manski, C.F., and J.V. Pepper. 2000. "Monotone Instrumental Variables: With an Application to the Returns to Schooling." *Econometrica* 68: 997–1010.

Martinez Peria, M.S., and S. Schmukler. 2001. "Do Depositors Punish Banks for Bad Behavior? Market Discipline, Deposit Insurance, and Banking Crises." *Journal of Finance* 56: 1029–1051.

Nier, E., and U. Baumann. 2006. "Market Discipline, Disclosure, and Moral Hazard in Banking." *Journal of Financial Intermediation* 15: 332–361.

Osili, U., and A. Paulson. 2014. "Crises and Confidence: Systemic Banking Crises and Depositor Behavior" *Journal of Financial Economics* 111: 646–660.

Table 1
Description of variables used to identify account and respondent characteristics

Variable Name	Description
D_i	1 if respondent *i*'s home country does not have explicit deposit insurance (0 if it does)
Account characteristics	
High DI limit	1 if deposit insurance coverage limit is $250,000 (0 if $50,000)
No co-insurance	1 if guaranteed payout percentage is 100% (0 if 75%)
Large deposit	1 if deposit size exceeds the coverage limit
Pre-funded DI	1 if bank contributes to a deposit insurance fund
High buffer capital	1 if the level of bank's buffer capital is above average
Respondent characteristics	
Male	1 if respondent is male
Bank account ≥ 5 years	1 if respondent has had an actual deposit account for 5 or more years
Multiple bank relationships	1 if respondent has two or more additional relationships (e.g., a loan), besides the actual deposit account, with his or her bank
Peer influence	1 if respondent opened his or her actual deposit account on the advice of another bank customer
Risk tradeoff-low	1 if respondent disagrees or strongly disagrees with Risk Tradeoff statement (baseline category)
Risk tradeoff-below average	1 if respondent somewhat disagrees with Risk Tradeoff statement
Risk tradeoff-average	1 if respondent is neutral with respect to Risk Tradeoff statement
Risk tradeoff-above average	1 if respondent somewhat agrees with Risk Tradeoff statement
Risk tradeoff-high	1 if respondent agrees or strongly agrees with Risk Tradeoff statement
Risk tolerance-low	1 if respondent disagrees or strongly disagrees with Risk Tolerance statement (baseline category)
Risk tolerance-below average	1 if respondent somewhat disagrees with Risk Tolerance statement
Risk tolerance-average	1 if respondent is neutral with respect to Risk Tolerance statement
Risk tolerance-above average	1 if respondent somewhat agrees with Risk Tolerance statement
Risk tolerance-high	1 if respondent agrees or strongly agrees with Risk Tolerance statement

Table 2
Summary statistics for respondent characteristics

Variable	Full Sample		Subsample: $D_i = 0$		Subsample: $D_i = 1$		Equal Proportions Test	
	Mean	SD	Mean	SD	Mean	SD	z-statistic	p-value
Male	0.61	0.49	0.60	0.49	0.64	0.48	-0.81	0.42
Bank relationship ≥ 5 years	0.66	0.48	0.71	0.46	0.56	0.50	2.75	0.01
Multiple bank relationships	0.45	0.50	0.51	0.50	0.33	0.47	3.14	0.01
Peer influence	0.28	0.45	0.24	0.42	0.38	0.49	-2.87	0.00
Risk tradeoff-low	0.23	0.42	0.24	0.42	0.21	0.41	0.55	0.58
Risk tradeoff-below average	0.16	0.37	0.15	0.36	0.19	0.40	-0.99	0.32
Risk tradeoff-average	0.12	0.33	0.11	0.31	0.16	0.36	-1.33	0.18
Risk tradeoff-above average	0.27	0.45	0.28	0.45	0.25	0.44	0.59	0.56
Risk tradeoff-high	0.21	0.41	0.23	0.42	0.19	0.40	0.75	0.45
Risk tolerance-low	0.31	0.46	0.28	0.45	0.37	0.48	-1.67	0.10
Risk tolerance-below average	0.23	0.42	0.24	0.42	0.21	0.41	0.10	0.58
Risk tolerance-average	0.18	0.39	0.19	0.39	0.17	0.38	0.32	0.75
Risk tolerance-above average	0.16	0.36	0.18	0.39	0.10	0.31	1.91	0.06
Risk tolerance-high	0.13	0.33	0.12	0.32	0.15	0.36	-0.86	0.39
N	349		234		115		—	

Notes. D_i = 0 (1) if respondent *i*'s home country does (does not) have explicit deposit insurance. All variables are dummies, as defined in Table 1. For each variable, the final two columns report the z-statistic and corresponding p-value for the null hypothesis of equality between the subsamples.

Table 3
Distribution of responses to interest premium question

Response	Full Sample (%)	Subsample: $D_i = 0$ (%)	Subsample: $D_i = 1$ (%)
1. Significantly lower	4.26	5.18	2.39
2	9.20	10.68	6.20
3	13.72	14.00	13.15
4	14.90	15.33	14.02
5	17.26	17.20	17.39
6	15.72	15.12	16.96
7	12.61	10.47	16.96
8	6.81	6.30	7.83
9. Significantly higher	3.33	2.56	4.89
-1: Missing	2.18	3.15	0.22
N	2,792	1,872	920
Pearson χ^2 test:		$\chi^2(9)$ statistic=84.16, *p*-value=0.00	

Notes. This table presents the distribution of responses (pooled across the eight account profiles) to the question "*Compared to competing financial institutions, I would expect an annualized interest rate for this account to be…*" Responses could range from significantly lower (1) to significantly higher (9). $D_i = 0$ (1) if respondent *i*'s home country does (does not) have explicit deposit insurance.

Table 4
Distribution of responses to deposit withdrawal question

Response	Full Sample (%)	Subsample: $D_i = 0$ (%)	Subsample: $D_i = 1$ (%)
0%	22.67	24.20	19.57
10%	6.91	6.89	6.96
20%	11.32	10.90	12.17
30%	10.78	11.06	10.22
40%	8.42	8.76	7.72
50%	10.85	9.99	12.61
60%	5.30	5.40	5.11
70%	7.56	7.16	8.37
80%	5.73	5.24	6.74
90%	2.72	2.78	2.61
100%	6.66	6.09	7.83
-1: Missing	1.07	1.55	0.11
N	2,792	1,872	920
Pearson χ^2 test:		$\chi^2(11)$ statistic=30.33, *p*-value=0.00	

Notes. This table presents the distribution of responses (pooled across the eight account profiles) to the question "*On hearing about the news of the shock to the financial system, what percentage of your deposit are you likely to immediately withdraw?"* Responses could range from 0% to 100%. $D_i = 0$ (1) if respondent *i*'s home country does (does not) have explicit deposit insurance.

Table 5

Regression model of respondent reaction to the failure of a major domestic bank

	Dependent Variable			
	Interest Premium		*Deposit Withdrawal*	
Explanatory Variable	Coefficient	Std. Error	Coefficient	Std. Error
D_i	0.73***	0.18	33.62***	7.60
Account attributes $\boldsymbol{p}_j$				
High DI limit	-0.18**	0.08	-4.64	2.88
No co-insurance	-0.22**	0.09	-9.92***	2.34
Large deposit	0.44***	0.06	31.66***	2.36
Pre-funded DI	0.02	0.09	4.76*	2.60
High buffer capital	-0.20**	0.09	-5.88*	3.51
Interactions $D_i \times \boldsymbol{p}_j$				
$D_i \times$ High DI limit	-0.01	0.14	1.25	4.86
$D_i \times$ No co-insurance	-0.33**	0.15	-18.60***	4.24
$D_i \times$ Large deposit	0.02	0.12	-8.90***	3.26
$D_i \times$ Pre-funded DI	-0.27	0.17	-9.87**	4.73
$D_i \times$ High buffer capital	-0.01	0.15	-3.94	5.50
Respondent background characteristics $\boldsymbol{x}_i$				
Male	0.05	0.05	-1.46	1.28
Bank account ≥ 5 years	0.11***	0.04	-7.30***	1.32
Multiple bank relationships	0.01	0.04	1.40	1.08
Peer influence	-0.02	0.05	1.93	1.18
Risk tradeoff characteristics $\boldsymbol{z}_{Ai}$				
Risk tradeoff-below average	-0.02	0.06		
Risk tradeoff-average	-0.12*	0.06		
Risk tradeoff-above average	0.24***	0.05		
Risk tradeoff-high	0.11**	0.05		
Risk tolerance characteristics $\boldsymbol{z}_{Bi}$				
Risk tolerance-below average			2.84**	1.39
Risk tolerance-average			3.59**	1.63
Risk tolerance-above average			-0.68	1.58
Risk tolerance-high			-4.85***	1.75
Latent interest premium			1.16	4.56
Latent interest premium $\times D_i$			-4.55***	1.48
Constant	1.76***	0.28	25.34***	8.26

Notes. This table presents the estimated system described by Eqs. (3) and (4):

$$\pi^*_{ij} = \theta_\pi \cdot D_i + \boldsymbol{p}'_j \cdot \boldsymbol{\alpha}_\pi + D_i \cdot \boldsymbol{p}'_j \cdot \boldsymbol{\beta}_\pi + \boldsymbol{z}'_{Ai} \cdot \boldsymbol{\gamma}_\pi + \boldsymbol{x}'_i \cdot \boldsymbol{\kappa}_\pi + \lambda_{\pi i} + \epsilon_{\pi ij},$$

$$w^*_{ij} = \theta_w \cdot D_i + \boldsymbol{p}'_j \cdot \boldsymbol{\alpha}_w + D_i \cdot \boldsymbol{p}'_j \cdot \boldsymbol{\beta}_w + \boldsymbol{z}'_{Bi} \cdot \boldsymbol{\gamma}_w + \boldsymbol{x}'_i \cdot \boldsymbol{\kappa}_w + \pi^*_{ij} \cdot \delta_{wi} + \lambda_{wi} + \epsilon_{wij},$$

where π^*_{ij} is the latent interest premium, w^*_{ij} is the latent deposit withdrawal percentage, D_i = 0 (1) if respondent *i*'s home country does (does not) have explicit deposit insurance, and $\delta_{wi} = \delta_w + \Delta_w D_i$. See Table 1 for other variable definitions. Statistical significance: $^{*}\,p < 0.1$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$. Each equation also includes dummies for risk-adjusted, and compulsory bank participation in, deposit insurance, but these are suppressed to conserve space as they have little effect on the two dependent variables. The number of observations for each of the two dependent variables is 2,792 (349 responses to eight questions).