

# Flooded Through the Back Door: The Role of Bank Capital in Local Shock Spillovers

Oliver Rehbein, Steven Ongena \*

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## Online Appendix

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\*Oliver Rehbein, University of Bonn, [oliver.rehbein@uni-bonn.de](mailto:oliver.rehbein@uni-bonn.de); Steven Ongena, University of Zurich, Swiss Finance Institute, KU Leuven and CEPR, email: [steven.ongena@bf.uzh.ch](mailto:steven.ongena@bf.uzh.ch).

# I Additional Tables for the Main Text

Table OA1: Variable Definitions

This table presents definitions of all the variables used in the regression tables and figures used in the main text and the online appendix.

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**Identification Variables:**

|                   |  |
|-------------------|--|
| DIRECTLY_AFFECTED | Dummy variable indicating whether the firm was located in a flooded region during the 2013 flood. A value of 1 indicates that the firm was located in a county with a claim ratio category of 4 or larger. A value of 0 indicates it was located in within an unaffected county (claim ratio category 1). For a description of the categories, refer to figure 1.  |
| INDIR_DIS_EXP     | Continuous variable indicating how extensively the firm is exposed to an indirect funding shock from its banks due to the flood. A value of 1 indicates that the firm is not indirectly exposed via its banks, and a value of 9 indicates that it is maximally exposed (all the other banks' firms are in the most flooded regions). See Equation (2) for details. |
| MAIN_BANK_EXP     | Disaster exposure (see INDIR_DIS_EXP) using only the firms' main bank. The main bank is the first named bank in the Dafne data.  |
| POST              | Dummy variable set equal to 1 for the years 2013 and 2014 and set equal to 0 from 2009 to 2012.  |

**Dependent Variables:**

|      |  |
|------|--|
| TOLI | Firm's total liabilities in millions of euros. Used as natural logarithm in the regressions.       |
| EMPL | Number of firm employees. Used as natural logarithm in the regressions.                            |
| TFAS | Firm's tangible fixed assets in millions of euros. Used as a natural logarithm in the regressions. |

**Control Variables:**

|                     |   |
|---------------------|---|
| CASH                | Firm level cash and cash equivalent in millions of euros. Used in first lags in the regressions (indicated by L <sub>t</sub> ). Winsorized at the 5% level.             |
| TOTAL_ASSETS        | Firm level total assets in millions of euros. Used in first lags in the regressions (indicated by L <sub>t</sub> ). Winsorized at the 5% level.                         |
| CURRENT_LIABILITIES | Firm level current liabilities in millions of euros. Used in first lags in the regressions (indicated by L <sub>t</sub> ). Winsorized at the 5% level.                  |
| CAPITAL_RATIO       | Firm level shareholder funds (common equity) divided by total assets. Used in first lags in the regressions (indicated by L <sub>t</sub> ). Winsorized at the 5% level. |

**Interaction Variables:**

|                      |  |
|----------------------|--|
| CAP (categorical)    | Variable set equal to 0 if the firm's main bank is in the lowest, 1 in the low, 2 in the high and 3 in the highest quartile of the pre-flood regulatory capitalization distribution. The pre-flood capital distribution is fixed at pre-flood (2012) values. |
| CAP_RATIO            | Main bank's regulatory capital ratio. Used in logs in the regressions. The pre-flood capital ratio is fixed at 2012 values.  |
| T1_CAP (categorical) | Variable set equal to 0 if the firm's main bank is in the lowest, 1 in the low, 2 in the high and 3 in the highest quartile of the pre-flood tier 1 capitalization distribution. The pre-flood tier 1 capitalization is fixed at pre-flood (2012) values.    |
| L_CAP (categorical)  | Variable set equal to 0 if the firm's main bank is in the lowest, 1 in the low, 2 in the high and 3 in the highest quartile of the leverage ratio (total liabilities / total assets) distribution. The leverage ratio is fixed at pre-flood (2012) values.   |
| PRE_2013_DIS_RISK    | Average disaster damages from 2002-2012 of other flood-related incidents in 9 claim ratio categories.  |
| BANK_DISTANCE        | Distance to the main bank in kilometers.   |

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## Variable Definitions Continued

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### Regional Variables:

|                 |  |
|-----------------|--|
| INDIR_DIS_EXP_R | Average disaster exposure of all firms located in the respective county.   |
| AVG_CAP_R       | Continuous variable indicating the mean level of bank capital held by the firm's banks in the county prior to the flood in 2012. |
| UNEMPL          | Unemployment rate in the respective county in %.   |
| GDP             | Per capita GDP in the respective county.   |
| INSOLV          | Absolute number of insolvencies in the respective county.  |
| PUB_DEBT        | Public debt of the local government in the respective county.  |

### Other Variables:

|         |   |
|---------|---|
| ROA     | Firm's return on assets in %.   |
| TOAS_B  | Total assets of the firm's main bank in millions of euros. Used as logs in the regression.                        |
| COOP    | Dummy set equal to 1 if the main bank is a cooperative bank.  |
| SAVING  | Dummy set equal to 1 if the main bank is a savings bank.  |
| COMM    | Dummy set equal to 1 if the main bank is a commercial bank.   |
| IRB     | Dummy set equal to 1 if the main bank uses the internal ratings based approach to determine risk-weighted assets. |
| SINGLE  | Dummy set equal to 1 if the main bank is the firm's only bank.  |
| REL_LEN | Number of years of the bank-firm relationship (within the sample years 2009-2013).                                |
| CASH_B  | Cash and cash equivalents relative to total assets.   |

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Table OA2: Baseline Regression for Additional Variables

This table presents interactions of the difference-in-differences estimation from table 3 with the capitalization of the firm's main bank for several firm-level variables. LOAN is the amount of (long-term) loans taken by the firm. CASH is the amount of cash and cash equivalents. TOTAL\_ASSETS are firm total assets. NCAS are firm net current assets. DEPR is depreciation of assets. ROE is return on equity. ROA is return on assets. CAPITAL\_RATIO is firm capital over total assets. Only non-directly affected firms are included in the regressions. All columns specify interactions with a capitalization quartile categorical variable, which places the firm's main bank in the lowest, low, high or highest quartile of the pre-flood capital distribution. Double interaction coefficients and control variables are included but not reported. INDIR\_DIS\_EXP is a continuous variable measuring the exposure of the firm to the flood via its banks, according to equation (2). We control for firm and county  $\times$  year fixed effects and the control variables from table 2 (unreported). Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|  | 1                   | 2                   | 3                    | 4                    | 5                 | 6                  | 7                 | 8                    |
|--|---------------------|---------------------|----------------------|----------------------|-------------------|--------------------|-------------------|----------------------|
|  | ln(LOAN)            | ln(CASH)            | ln(TOTAL_ASSETS)     | ln(NCAS)             | ln(DEPR)          | ROE                | ROA               | CAPITAL_RATIO        |
| POST $\times$ INDIR_DIS_EXP                      | 0.078<br>(0.059)    | -0.034**<br>(0.015) | -0.004<br>(0.003)    | -0.037***<br>(0.008) | -0.012<br>(0.013) | -0.355<br>(0.402)  | -0.229<br>(0.188) | -0.004***<br>(0.001) |
| POST $\times$ INDIR_DIS_EXP $\times$ HIGHEST_CAP | 0.011<br>(0.081)    | 0.029<br>(0.021)    | -0.002<br>(0.005)    | 0.000<br>(0.011)     | 0.020<br>(0.017)  | 1.145**<br>(0.566) | 0.166<br>(0.267)  | 0.004**<br>(0.002)   |
| POST $\times$ INDIR_DIS_EXP $\times$ LOW_CAP     | -0.153**<br>(0.076) | 0.025<br>(0.020)    | 0.001<br>(0.004)     | 0.032***<br>(0.011)  | 0.016<br>(0.020)  | -0.043<br>(0.710)  | 0.180<br>(0.317)  | 0.004**<br>(0.002)   |
| POST $\times$ INDIR_DIS_EXP $\times$ LOWEST_CAP  | -0.080<br>(0.085)   | 0.011<br>(0.020)    | -0.012***<br>(0.005) | 0.010<br>(0.011)     | -0.023<br>(0.018) | -0.115<br>(0.536)  | -0.047<br>(0.259) | 0.003*<br>(0.002)    |
| No. of obs.                                      | 260,962             | 436,063             | 437,451              | 398,944              | 103,995           | 101,036            | 105,400           | 437,451              |
| Number of firms                                  | 85,902              | 103,364             | 103,380              | 100,617              | 30,406            | 30,040             | 30,797            | 103,380              |
| Within R <sup>2</sup>                            | 0.001               | 0.004               | 0.119                | 0.023                | 0.058             | 0.034              | 0.023             | 0.103                |
| Controls (lagged)                                | YES                 | YES                 | YES                  | YES                  | YES               | YES                | YES               | YES                  |
| Firm fixed effects                               | YES                 | YES                 | YES                  | YES                  | YES               | YES                | YES               | YES                  |
| County $\times$ year fixed effects               | YES                 | YES                 | YES                  | YES                  | YES               | YES                | YES               | YES                  |

Table OA3: Do Firms Access High Capital Alternatives?  
Highest Bank-Capital Interactions

This table presents interactions for the capital of the best capitalized bank of any given firm. CAP\_BEST (Columns 1-3) is a categorical variable, which places firms in the lowest, low, high or highest quartile of the pre-flood capital distribution of its best capitalized bank. Columns 4-6 present continuous interactions with the best capitalized bank's capital (CAP\_RATIO\_BEST). Capitalization is fixed at pre-flood (2012) levels. Double interaction coefficients are included but not reported. Regressions include firm and county  $\times$  year fixed effects and the control variables from table 2 (unreported). Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|   | 1                   | 2                 | 3                 | 4                 | 5                 | 6                 |
|---|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|   | ln(TOLI)            | ln(EMPL)          | ln(TFAS)          | ln(TOLI)          | ln(EMPL)          | ln(TFAS)          |
| POST $\times$ INDIR_DIS_EXP                             | 0.004<br>(0.008)    | 0.001<br>(0.007)  | -0.018<br>(0.015) | -0.095<br>(0.066) | -0.020<br>(0.054) | -0.187<br>(0.117) |
| POST $\times$ INDIR_DIS_EXP $\times$ HIGHEST_CAP_BEST   | -0.016*<br>(0.010)  | -0.009<br>(0.007) | 0.009<br>(0.017)  |                   |                   |                   |
| POST $\times$ INDIR_DIS_EXP $\times$ LOW_CAP_BEST       | -0.003<br>(0.009)   | -0.009<br>(0.007) | -0.002<br>(0.016) |                   |                   |                   |
| POST $\times$ INDIR_DIS_EXP $\times$ LOWEST_CAP_BEST    | -0.019**<br>(0.009) | -0.005<br>(0.008) | -0.000<br>(0.016) |                   |                   |                   |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(CAP_RATIO_BEST) |                     |                   |                   | 0.012<br>(0.009)  | 0.002<br>(0.007)  | 0.023<br>(0.016)  |
| No. of obs.   | 466,812             | 466,812           | 466,812           | 466,812           | 466,812           | 466,812           |
| Number of firms   | 110,224             | 110,224           | 110,224           | 110,224           | 110,224           | 110,224           |
| Within R <sup>2</sup>                                   | 0.063               | 0.019             | 0.042             | 0.063             | 0.019             | 0.042             |
| Controls (lagged)                                       | YES                 | YES               | YES               | YES               | YES               | YES               |
| Firm fixed effects                                      | YES                 | YES               | YES               | YES               | YES               | YES               |
| County $\times$ year fixed effects                      | YES                 | YES               | YES               | YES               | YES               | YES               |

Table OA4: Robustness Tests for Low Bank Capital Dummy: Total Liabilities

This table presents robustness tests for the results presented in column 1 of table 3. Column 1 presents the results using equal base and post periods; here, the year 2011 and 2012 are the base and 2013 and 2014 are the post period years. Column 2 presents the results of a placebo test using the year 2011 as the placebo event year (omitting the years 2013 and 2014). Column 3 includes a post-flood firm-bank distance control. Column 4 includes sector  $\times$  year fixed effects. Column 5 provides estimates using only firm fixed effects. Column 6 is estimated with the main banks' capital winsorized at the 5% level. All columns specify interactions with a capitalization quartile categorical variable, which places the firm's main bank in the lowest, low, high or highest quartile of the pre-flood capital distribution. Double interaction coefficients and control variables are included but not reported. INDIR\_DIS\_EXP is a continuous variable measuring the exposure of the firm to the flood via its banks, according to equation (2). TOLI is firm's total liabilities. We control for firm and county  $\times$  year fixed effects and the control variables from table 2 (unreported). Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|  | Equal Periods        |                   |                      |                      |                      |                      | Sector $\times$ Time | Only Firm FE         | Winsor. Cap. |
|--|----------------------|-------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--------------|
|  | 1                    | 2                 | 3                    | 4                    | 5                    | 6                    |                      |                      |              |
| POST $\times$ INDIR_DIS_EXP                      | 0.004<br>(0.005)     | -0.005<br>(0.007) | 0.003<br>(0.006)     | 0.004<br>(0.005)     | 0.005<br>(0.004)     | 0.003<br>(0.006)     | 0.005<br>(0.005)     | 0.003<br>(0.005)     |              |
| POST $\times$ INDIR_DIS_EXP $\times$ HIGHEST_CAP | -0.009<br>(0.007)    | -0.008<br>(0.010) | -0.012<br>(0.008)    | -0.008<br>(0.007)    | -0.013**<br>(0.006)  | -0.010<br>(0.007)    | -0.010<br>(0.007)    | -0.010<br>(0.007)    |              |
| POST $\times$ INDIR_DIS_EXP $\times$ LOW_CAP     | -0.005<br>(0.007)    | -0.011<br>(0.009) | -0.009<br>(0.008)    | -0.007<br>(0.007)    | -0.006<br>(0.006)    | -0.007<br>(0.007)    | -0.006<br>(0.006)    | -0.007<br>(0.007)    |              |
| POST $\times$ INDIR_DIS_EXP $\times$ LOWEST_CAP  | -0.023***<br>(0.007) | 0.007<br>(0.009)  | -0.027***<br>(0.008) | -0.023***<br>(0.007) | -0.021***<br>(0.006) | -0.022***<br>(0.007) | -0.021***<br>(0.006) | -0.022***<br>(0.007) |              |
| POST $\times$ BANK_DISTANCE                      |                      |                   | -0.001<br>(0.001)    |                      |                      |                      |                      |                      |              |
| No. of obs.                                      | 373,433              | 153,706           | 420,500              | 437,451              | 437,451              | 437,451              | 437,451              | 437,451              |              |
| Number of Firms                                  | 103,380              | 90,504            | 99,278               | 103,380              | 103,380              | 103,380              | 103,380              | 103,380              |              |
| Within R <sup>2</sup>                            | 0.031                | 0.004             | 0.000                | 0.061                | 0.061                | 0.061                | 0.062                | 0.062                |              |
| Controls (lagged)                                | YES                  | YES               | YES                  | YES                  | YES                  | YES                  | YES                  | YES                  |              |
| Firm fixed effects                               | YES                  | YES               | YES                  | YES                  | YES                  | YES                  | YES                  | YES                  |              |
| County $\times$ year fixed effects               | YES                  | YES               | YES                  | YES                  | YES                  | YES                  | NO                   | YES                  |              |

Table OA5: Robustness Tests for the Low Bank Capital Dummy: Employment

This table presents robustness tests for the results presented in column 2 of table 3. Column 1 presents the results when using equal base and post periods; here, the years 2011 and 2012 are the base and 2013 and 2014 are the post period years. Column 2 presents the results of a placebo test using the year 2011 as the placebo event year (omitting the years 2013 and 2014). Column 3 includes a post-flood firm-bank distance control. Column 4 includes sector  $\times$  year fixed effects. Column 5 provides estimates using only firm fixed effects. Column 6 is estimated with the main banks' capital winsorized at the 5% level. All columns specify interactions with a capitalization quartile categorical variable, which places the firm's main bank in the lowest, low, high or highest quartile of the pre-flood capital distribution. Double interaction coefficients and control variables are included but not reported. INDIR\_DIS\_EXP is a continuous variable measuring the exposure of the firm to the flood via its banks, according to equation (2). EMPL is the number of firm employees. We control for firm and county  $\times$  year fixed effects and the control variables from table 2 (unreported). Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|  | Equal Periods     |                   |                    |                    |                    |                    | Sector $\times$ Time |          |          | Firm FE  | Winsor. Cap. |
|--|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|----------------------|----------|----------|----------|--------------|
|  | 1                 | 2                 | 3                  | 4                  | 5                  | 6                  | ln(EMPL)             | ln(EMPL) | ln(EMPL) | ln(EMPL) | ln(EMPL)     |
| POST $\times$ INDIR_DIS_EXP                      | -0.005<br>(0.003) | 0.001<br>(0.005)  | -0.006*<br>(0.004) | -0.006*<br>(0.003) | -0.006*<br>(0.003) | -0.006*<br>(0.003) |                      |          |          |          |              |
| POST $\times$ INDIR_DIS_EXP $\times$ HIGHEST_CAP | 0.000<br>(0.004)  | -0.000<br>(0.006) | 0.000<br>(0.005)   | 0.002<br>(0.005)   | 0.001<br>(0.005)   | 0.001<br>(0.005)   |                      |          |          |          |              |
| POST $\times$ INDIR_DIS_EXP $\times$ LOW_CAP     | 0.002<br>(0.005)  | -0.006<br>(0.006) | 0.003<br>(0.005)   | 0.003<br>(0.005)   | 0.003<br>(0.005)   | 0.003<br>(0.005)   |                      |          |          |          |              |
| POST $\times$ INDIR_DIS_EXP $\times$ LOWEST_CAP  | -0.006<br>(0.006) | 0.007<br>(0.007)  | -0.006<br>(0.006)  | -0.001<br>(0.006)  | -0.003<br>(0.005)  | -0.002<br>(0.006)  |                      |          |          |          |              |
| POST $\times$ BANK_DISTANCE                      |                   |                   | -0.001<br>(0.001)  |                    |                    |                    |                      |          |          |          |              |
| No. of obs.                                      | 373,433           | 153,706           | 420,500            | 437,451            | 437,451            | 437,451            |                      |          |          |          | 437,451      |
| Number of Firms                                  | 103,380           | 90,504            | 99,278             | 103,380            | 103,380            | 103,380            |                      |          |          |          | 103,380      |
| Within R <sup>2</sup>                            | 0.015             | 0.007             | 0.000              | 0.019              | 0.019              | 0.019              |                      |          |          |          | 0.019        |
| Controls (lagged)                                | YES               | YES               | YES                | YES                | YES                | YES                |                      |          |          | YES      | YES          |
| Firm fixed effects                               | YES               | YES               | YES                | YES                | YES                | YES                |                      |          |          | YES      | YES          |
| County $\times$ year fixed effects               | YES               | YES               | YES                | YES                | YES                | YES                |                      |          |          | NO       | YES          |

## II Extensions: Other Potential Shock Amplifiers

**Firm Characteristics** In this section, we investigate other potential mechanisms that may amplify shock transfers between regions. We start by investigating the financial constraints of individual firms as an alternative explanation. Table OA6 demonstrates the results of continuous interactions using the firm’s pre-flood capital ratio (columns 1-3) and the firm’s pre-flood cash holdings (columns 4-6) in addition to our baseline triple interaction. There is little evidence that either firm capital or firm liquidity can explain our baseline result. Controlling for bank capital, neither firm-level effect adds any statistically significant explanatory power to the baseline model. At the same time, the coefficient that interacts with the disaster difference-in-differences coefficient remains essentially the same.

– Table OA6 around here –

**Bank Size and Liquidity** Next, we test whether bank characteristics amplify local shock spillovers. We specifically investigate bank size and bank liquidity. We define bank size as the log of banks’ total assets and bank liquidity as the share of liquid assets over total assets. Similar to the baseline estimation, we fix these two variables at their pre-flood (2012) values and interact them continuously with the difference-in-differences indicator in table OA7. The results suggest that beyond the amplification effect of bank capital established in the baseline regression, neither bank size nor bank liquidity appears to play an important role in the amplification of local shock transfers.

– Table OA7 around here –



**Bank Type** Germany’s banking system is dominated by three major categories of banks: (government) savings banks, cooperative banks and commercial banks. The bank type may be important in explaining the extent of banks’ lending shifts. Government banks may be pressured into providing more loans to disaster-affected businesses because it is politically beneficial for local and regional politicians (Carvalho (2014)). As a result, government banks might shift more lending from unaffected to affected regions. Government banks also constitute a major difference from previous papers looking at bank lending in the aftermath of natural disasters in the United States (Chavaz (2016); Cortés and Strahan (2017)). German savings and cooperative banks are typically restricted to a certain geographical area, although customers can also bank with more distant savings banks on occasion.<sup>1</sup> Nevertheless, these banks typically do not own distant branches from which they are likely to shift lending to disaster areas. It is thus interesting whether these local German banks react differently to disaster demand than commercial banks.

Furthermore, some banks might be more flexible with regard to their capital structure because they can use internal models to determine the risk weights of the assets on which they have to hold capital. As a result, we also investigate whether such banks might be less prone to transfer shocks across regions.

– Table OA8 around here –

We test these ideas by interacting the difference-in-differences coefficient with a dummy for each of the three major bank types and whether the firm’s main bank is an

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<sup>1</sup>Savings banks are not allowed to actively acquire customers outside of their own region but also do not have to reject them if they are actively sought out. Additionally, bank customers may stick with their regional savings banks even if they change locations, as savings banks cooperate nationwide for certain banking services such as cash withdrawals.

IRB bank. The results are provided in table OA8. There is little evidence that government banks indeed cause a differentially larger reduction in real effects, although there is some indication of this effect, as the triple interaction coefficient for employment is negative and significant. In contrast, for cooperative banks and IRB banks, there is a positive and significant effect on the number of employees. This finding indicates, although only weakly, that government savings banks may transfer the shock more strongly than other banks and that cooperative banks and IRB banks may be better able to buffer local shocks than other banks. Most importantly, however, the main baseline results are untouched by any of the presented interactions. Regardless of the bank type, a bank's regulatory capital appears to be a significant amplification mechanism for local shock transfers.

**Relationship Factors** Additional banking characteristics may play a role in lending shifts following a natural disaster. Prior literature indicates that relationship banking (Boot (2000)) might play a twofold role following natural disasters. First, relationship banks may provide more lending to areas affected by the natural disaster because they have more proprietary information about borrowers, giving them a competitive advantage in times of crisis. As a result, such banks may need to withdraw more funding from unaffected areas simply because they lend more to disaster-affected areas. However, relationship banks may be less inclined to restrict credit to other firms because they also want to retain their lending relationship in unaffected areas. They might thus shift less lending or be more inclined to refinance their lending to disaster areas or fund it by raising new equity.

– Table OA9 around here –

Table OA9 provides two tests of differential effects for relationship banking indicators. First, we test whether firms that rely on a single (relationship) bank perform differently following the indirect disaster shock. Columns 1-3 report the results of interacting the difference-in-differences indicator with a single bank dummy. The results suggest that single bank firms perform better in terms of total borrowing and employment following indirect disaster exposure. Next, we test whether firms who have previously maintained a longer relationship with their main bank are more or less affected by the indirect shock from the flood. Columns 4-6 report the continuous interaction of the difference-in-differences estimator with the firm-bank relationship length in years. There appears to be no effect on the dependent variables. Importantly, the baseline effect of bank capital also remains essentially unchanged by these additions, suggesting that these alternative hypotheses cannot sufficiently explain our results.

### III Online Appendix Figures and Tables

Table OA6: Other Potential Shock Amplifiers: Firm Factors

This table presents interactions of the standard difference-in-differences estimation from table 2 with firm financial constraint indicators. Columns 1-3 specify interactions with a continuous *firm* capitalization variable (*CAPITAL\_RATIO*). Columns 4-6 specify interactions with a *firm* liquidity variable (*CASH*). All regressions include the baseline triple interaction with the main bank's capital (*CAP\_RATIO*). All three variables are fixed at their pre-flood (2012) level for the interaction. Double interaction coefficients and control variables are included but not reported. *INDIR\_DIS\_EXP* is a continuous variable measuring the exposure of the firm to the flood via its banks, according to equation (2). We control for firm and county  $\times$  year fixed effects and the control variables from table 2 (unreported). Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|  | Capitalization       |                   |                      | Liquidity            |                   |                      |
|--|----------------------|-------------------|----------------------|----------------------|-------------------|----------------------|
|  | 1                    | 2                 | 3                    | 4                    | 5                 | 6                    |
|  | ln(TOLI)             | ln(EMPL)          | ln(TFAS)             | ln(TOLI)             | ln(EMPL)          | ln(TFAS)             |
| POST $\times$ INDIR_DIS_EXP                            | -0.071***<br>(0.027) | -0.029<br>(0.021) | -0.158***<br>(0.047) | -0.077***<br>(0.027) | -0.029<br>(0.021) | -0.156***<br>(0.047) |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(CAP_RATIO)     | 0.022**<br>(0.010)   | 0.007<br>(0.007)  | 0.048***<br>(0.017)  | 0.024**<br>(0.010)   | 0.007<br>(0.007)  | 0.051***<br>(0.017)  |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(CAPITAL_RATIO) | 0.002<br>(0.009)     | 0.002<br>(0.006)  | 0.018<br>(0.014)     |                      |                   |                      |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(CASH)          |                      |                   |                      | 0.018<br>(0.011)     | 0.012<br>(0.007)  | -0.008<br>(0.022)    |
| No. of obs.  | 437,451              | 437,451           | 437,451              | 436,690              | 436,690           | 436,690              |
| Number of Firms  | 103,380              | 103,380           | 103,380              | 103,129              | 103,129           | 103,129              |
| Within R <sup>2</sup>                                  | 0.063                | 0.019             | 0.043                | 0.062                | 0.019             | 0.042                |
| Controls (lagged)                                      | YES                  | YES               | YES                  | YES                  | YES               | YES                  |
| Firm fixed effects                                     | YES                  | YES               | YES                  | YES                  | YES               | YES                  |
| County $\times$ year fixed effects                     | YES                  | YES               | YES                  | YES                  | YES               | YES                  |

Table OA7: Other Potential Shock Amplifiers: Bank Characteristics

This table presents interactions of the continuous difference-in-differences estimation from table 2 interacted with the liquidity of the firm's main bank. Only non-directly affected firms are included. Columns 1-3 specify interactions with *main bank's* total assets (TOAS\_B). Columns 4-6 specify continuous interactions with the main bank's liquidity (CASH\_B). All regressions include the baseline triple interaction with the main bank's capital (CAP\_RATIO). All three variables are fixed at their pre-flood (2012) level for the interaction. Double interaction coefficients and control variables are included but not reported. INDIR\_DIS\_EXP is a continuous variable measuring the exposure of the firm to the flood via its banks, according to equation (2). We control for firm and county  $\times$  year fixed effects and the control variables from table 2 (unreported). Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|  | Assets              |                   |                      | Liquidity           |                   |                      |
|--|---------------------|-------------------|----------------------|---------------------|-------------------|----------------------|
|  | 1                   | 2                 | 3                    | 4                   | 5                 | 6                    |
| POST $\times$ INDIR_DIS_EXP                        | ln(TOLI)            | ln(EMPL)          | ln(TFAS)             | ln(TOLI)            | ln(EMPL)          | ln(TFAS)             |
|  | -0.061**<br>(0.029) | -0.018<br>(0.022) | -0.128***<br>(0.050) | -0.068**<br>(0.028) | -0.028<br>(0.022) | -0.156***<br>(0.048) |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(CAP_RATIO) | 0.023**<br>(0.010)  | 0.008<br>(0.007)  | 0.048***<br>(0.017)  | 0.021**<br>(0.010)  | 0.008<br>(0.008)  | 0.049***<br>(0.018)  |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(TOAS_B)    | -0.001<br>(0.001)   | -0.001<br>(0.001) | -0.003<br>(0.002)    |                     |                   |                      |
| POST $\times$ INDIR_DIS_EXP $\times$ CASH_B        |                     |                   |                      | 0.011<br>(0.015)    | 0.008<br>(0.011)  | -0.011<br>(0.027)    |
| No. of obs.  | 437,451             | 437,451           | 437,451              | 437,451             | 437,451           | 437,451              |
| Number of Firms                                    | 103,380             | 103,380           | 103,380              | 103,380             | 103,380           | 103,380              |
| Within R <sup>2</sup>                              | 0.062               | 0.019             | 0.042                | 0.062               | 0.019             | 0.042                |
| Controls (lagged)                                  | YES                 | YES               | YES                  | YES                 | YES               | YES                  |
| Firm fixed effects                                 | YES                 | YES               | YES                  | YES                 | YES               | YES                  |
| County $\times$ year fixed effects                 | YES                 | YES               | YES                  | YES                 | YES               | YES                  |

Table OA8: Other Potential Shock Amplifiers: Bank Types

This table presents interactions of the standard difference-in-differences estimation from table 2 with bank types. SAVING is a dummy set equal to 1 if the firm's main bank is a savings bank and 0 otherwise. COOP is a dummy set equal to 1 if the firm's main bank is a cooperative bank and 0 otherwise. COMM is a dummy set equal to 1 if the firm's main bank is a commercial bank and 0 otherwise. IRB is a dummy set equal to 1 if the firm's main bank use the internal ratings-based approach for determining capital weights and 0 otherwise. All regressions include the baseline triple interaction with the main bank's capital (CAP\_RATIO). INDIR\_DIS\_EXP is a continuous variable measuring the exposure of the firm to the flood via its banks, according to equation (2). We control for firm and county  $\times$  year fixed effects and the control variables from table 2 (unreported). Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|  | Savings banks        |                      |                      | Cooperative banks    |                     |                      | Commercial banks     |                   |                      | IRB bank             |                    |                      |
|--|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|-------------------|----------------------|----------------------|--------------------|----------------------|
|  | 1                    | 2                    | 3                    | 4                    | 5                   | 6                    | 7                    | 8                 | 9                    | 10                   | 11                 | 12                   |
| POST $\times$ INDIR_DIS_EXP                        | -0.072***<br>(0.027) | -0.030<br>(0.022)    | -0.156***<br>(0.047) | -0.072***<br>(0.027) | -0.031<br>(0.021)   | -0.157***<br>(0.047) | -0.066***<br>(0.028) | -0.026<br>(0.022) | -0.156***<br>(0.049) | -0.069***<br>(0.028) | -0.024<br>(0.021)  | -0.157***<br>(0.047) |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(CAP_RATIO) | 0.023***<br>(0.010)  | 0.010<br>(0.008)     | 0.052***<br>(0.017)  | 0.023***<br>(0.010)  | 0.008<br>(0.008)    | 0.049***<br>(0.017)  | 0.022***<br>(0.010)  | 0.008<br>(0.008)  | 0.049***<br>(0.017)  | 0.023***<br>(0.010)  | 0.006<br>(0.007)   | 0.050***<br>(0.017)  |
| POST $\times$ INDIR_DIS_EXP $\times$ SAVING        | -0.001<br>(0.005)    | -0.012***<br>(0.004) | -0.014<br>(0.009)    |                      |                     |                      |                      |                   |                      |                      |                    |                      |
| POST $\times$ INDIR_DIS_EXP $\times$ COOP          |                      |                      |                      | 0.008<br>(0.005)     | 0.013***<br>(0.004) | 0.010<br>(0.008)     |                      |                   |                      |                      |                    |                      |
| POST $\times$ INDIR_DIS_EXP $\times$ COMM          |                      |                      |                      |                      |                     |                      | 0.000<br>(0.006)     | 0.007<br>(0.005)  | -0.007<br>(0.011)    |                      |                    |                      |
| POST $\times$ INDIR_DIS_EXP $\times$ IRB           |                      |                      |                      |                      |                     |                      |                      |                   |                      | 0.006<br>(0.007)     | 0.009**<br>(0.005) | -0.007<br>(0.012)    |
| No. of obs.  | 437,451              | 437,451              | 437,451              | 437,451              | 437,451             | 437,451              | 437,451              | 437,451           | 437,451              | 437,451              | 437,451            | 437,451              |
| Number of Firms                                    | 103,380              | 103,380              | 103,380              | 103,380              | 103,380             | 103,380              | 103,380              | 103,380           | 103,380              | 103,380              | 103,380            | 103,380              |
| Within R <sup>2</sup>                              | 0.062                | 0.019                | 0.042                | 0.062                | 0.019               | 0.042                | 0.062                | 0.019             | 0.042                | 0.062                | 0.019              | 0.042                |
| Controls (lagged)                                  | YES                  | YES                  | YES                  | YES                  | YES                 | YES                  | YES                  | YES               | YES                  | YES                  | YES                | YES                  |
| Firm fixed effects                                 | YES                  | YES                  | YES                  | YES                  | YES                 | YES                  | YES                  | YES               | YES                  | YES                  | YES                | YES                  |
| County $\times$ year fixed effects                 | YES                  | YES                  | YES                  | YES                  | YES                 | YES                  | YES                  | YES               | YES                  | YES                  | YES                | YES                  |

Table OA9: Other Potential Shock Amplifiers: Relationship Characteristics

This table presents results including interactions with characteristics of the bank-firm relationship. SINGLE is a dummy set equal to 1 if the firm has only one bank relationship and 0 otherwise. REL\_LEN is the length of the bank-firm relationship in years prior to the disaster. All regressions include the baseline triple interaction with the main bank's capital (CAP\_RATIO). Indirect disaster exposure is a continuous variable measuring the exposure of the firm to the flood via its banks, according to equation (2). We control for firm and county  $\times$  year fixed effects. Clustered standard errors on the firm level of the point estimates are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5%, and 1% levels, respectively.

|  | Single Bank         |                    |                      |                      |                   |                      | Relationship Length |          |          |          |          |          |
|--|---------------------|--------------------|----------------------|----------------------|-------------------|----------------------|---------------------|----------|----------|----------|----------|----------|
|  | 1                   | 2                  | 3                    | 4                    | 5                 | 6                    | 1                   | 2        | 3        | 4        | 5        | 6        |
|  | ln(TOLI)            | ln(EMPL)           | ln(TFAS)             | ln(TOLI)             | ln(EMPL)          | ln(TFAS)             | ln(TOLI)            | ln(EMPL) | ln(TOLI) | ln(EMPL) | ln(TFAS) | ln(TFAS) |
| POST $\times$ INDIR_DIS_EXP                        | -0.071**<br>(0.027) | -0.023<br>(0.021)  | -0.158***<br>(0.047) | -0.072***<br>(0.027) | -0.028<br>(0.022) | -0.151***<br>(0.047) |                     |          |          |          |          |          |
| POST $\times$ INDIR_DIS_EXP $\times$ ln(CAP_RATIO) | 0.021**<br>(0.010)  | 0.005<br>(0.008)   | 0.050***<br>(0.017)  | 0.023**<br>(0.010)   | 0.009<br>(0.007)  | 0.050***<br>(0.017)  |                     |          |          |          |          |          |
| POST $\times$ INDIR_DIS_EXP $\times$ SINGLE        | 0.008**<br>(0.004)  | 0.008**<br>(0.003) | 0.001<br>(0.007)     |                      |                   |                      |                     |          |          |          |          |          |
| POST $\times$ INDIR_DIS_EXP $\times$ REL_LEN       |                     |                    |                      | -0.000<br>(0.002)    | -0.001<br>(0.002) | -0.003<br>(0.004)    |                     |          |          |          |          |          |
| No. of obs.  | 437,451             | 437,451            | 437,451              | 437,451              | 437,451           | 437,451              |                     |          |          |          |          |          |
| Number of firms                                    | 103,380             | 103,380            | 103,380              | 103,380              | 103,380           | 103,380              |                     |          |          |          |          |          |
| Within R <sup>2</sup>                              | 0.062               | 0.019              | 0.042                | 0.062                | 0.020             | 0.042                |                     |          |          |          |          |          |
| Controls (lagged)                                  | YES                 | YES                | YES                  | YES                  | YES               | YES                  |                     |          |          |          |          | YES      |
| Firm fixed effects                                 | YES                 | YES                | YES                  | YES                  | YES               | YES                  |                     |          |          |          |          | YES      |
| County $\times$ year fixed effects                 | YES                 | YES                | YES                  | YES                  | YES               | YES                  |                     |          |          |          |          | YES      |

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