Online Appendix (Not for Publication)

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Appendix A Data and Sample Construction

This section provides detailed information on the construction of the balance-sheet data for the acquirers, targets, and the non-merged banks, which is used in the multivariate regression analysis.

A.1 Description of Systemic Risk Measures

A.1.1 Systemic Risk: Marginal Expected Shortfall

In our empirical analysis, the first way we measure the merger-related change in the exposure of an individual bank to systemic risk is by using the marginal expected shortfall (MES). The MES was originally proposed by Acharya et al. (2017) and in general is defined as the negative average equity return of a bank conditional on the system as a whole doing poorly. As is standard in the literature, with the MES, losses are given a positive sign. Therefore, an increase in the systemic exposure of a bank is given by a positive change in the respective bank's MES. In this way, the MES represents the co-movement between the daily stock returns of an individual institution and the decline of the aggregate stock market, thereby capturing a firm's market-based sensitivity or exposure to systemic risk.

Further, following Acharya et al. (2017), the MES used in this paper is defined as

$$MES_i^{5\%} = -\mathbf{E}\left[\frac{w_1^i}{w_0^i}|I_{5\%}\right]$$

where the net equity return is calculated using the price ratio $\frac{w_1^i}{w_0^i}$, and $I_{5\%}$ is the set of days where the market experienced its worst 5% of outcomes for a given time period. Therefore, a firm's MES in this paper is the negative average return of its equity during the 5% worst days of the overall market, where the market is represented by the CRSP Value Weighted Index that follows the procedure outlined in Bisias et al. (2012).

Furthermore, Brownlees and Engle (2012) propose a dynamic version of the MES metric that extends the original model to account for time-varying volatility and correlation between a bank's returns and the returns of the market. In this paper, we use an MES that is estimated using the static procedure outlined in Acharya et al. (2017) as well as the dynamic version, which is embedded in the SRISK measure. In addition to being a widely used measure in general, we incorporate the static MES to keep our analysis comparable to Weiss et al. (2014). Likewise, since this paper concerns the merger-related changes in a bank's MES, we follow Weiss et al. (2014) and construct the ΔMES measure. The ΔMES is the difference between a bank's post-merger and pre-merger MES. We define the pre-merger period as starting 180 days and ending 11 days before the merger announcement and the post-merger period beginning 11 days after and ending 180 days after the completion of the merger.

$$\Delta MES_i^{5\%} = MES^{5\%}_{i;\left[+11;+180\right]} - MES^{5\%}_{i;\left[-11;-180\right]}$$

The construction of the pre- and post-merger periods seeks to avoid any immediate confounding effects that the announcement and completion of the merger would have on the MES calculation.

A.1.2 Systemic Risk: SRISK

The second way we measure the merger-related change in the exposure of an individual bank to systemic risk is by using the SRISK measure. SRISK is defined as the expected capital shortfall of a financial institution conditional on a significant market decline. In this way, the capital shortfall experienced by a financial entity when the entire system is undercapitalized captures the individual firm's exposure to systemic risk. The SRISK measure itself is a function of a firm's size, its degree of leverage, and its dynamic MES. Thus, while both static and dynamic MESs only take into account equity data, the SRISK combines market and balance sheet information to construct a measure of financial distress.

As previously mentioned, the MES measure was originally created by Acharya et al. (2017) and in general is defined as the negative average equity return of a bank conditional on a market decline below a given threshold. Brownlees and Engle (2012) propose a dynamic version of the MES that extends the original model to account for time-varying volatility and correlation between a bank's returns and the returns of the market. The original static version was used by Weiss et al. (2014) and was the version of MES considered by Bisias et al. (2012), while the dynamic MES, also known as the long run marginal expected shortfall (LRMES), was used by Benoit et al. (2013), and by the NYU Stern Volatility Institute to compute SRISK. In this paper, since we are interested in SRISK, we construct the LRMES using the standard GARCH-DCC estimation technique. The GARCH-DCC method is nonparametric and is widely used in financial time-series data analyses due to its ability to capture time-varying volatility clustering (Brownlees and Engle 2017). The codes for the GARCH-DCC estimation technique are available from Kevin Sheppard's MFE Toolbox as well as Benoit et al. (2013).

Therefore, let r_{it} and r_{mt} denote the i^{th} firm's returns and those of the market respectively on day t and contain the following properties:

$$
\begin{aligned}
r_{mt} &= \sigma_{mt}\epsilon_{mt} \\
r_{it} &= \sigma_{it}\rho_{it}\epsilon_{it} + \sigma_{it}\sqrt{1-\rho_{it}^2\xi_{it}} \\
(\epsilon_{mt}, \xi_{it}) &\sim F
\end{aligned}
$$

where the shocks $(\epsilon_{mt}, \xi_{it})$ are iid over time and have zero mean and zero covariance. Meanwhile, the distribution of the residuals F is left unspecified and will be handled using a nonparametric approach. The two conditional standard deviations σ_{it} and σ_{mt} are obtained by the GARCH model while the conditional correlation ρ_{it} is obtained by the DCC. Given this framework, the LRMES is then defined as:

$$LRMES_{it} = 1 - exp(log(1-d) * \beta)$$

where $\beta = \rho_i \frac{\sigma_i}{\sigma_m}$, and d is the crisis threshold for the market index decline which has a standard value of 40% in the literature. Therefore, a firm's LRMES is the institution's expected

equity loss when the market experiences a 40% decline over a given period where the market is represented by the CRSP value-weighted index. The time horizon for the LRMES corresponds to the available price data and is taken for the pre- and post-merger periods that have already been defined.

With the construction of the LRMES, the SRISK measure can subsequently be calculated in the following manner:

$$SRISK_{it} = k * DEBT_{it} - (1 - k) * EQUITY_{it} * (1 - LRMES_{it})$$

where k is the prudential capital requirement which is typically set to 8% for US firms, $DEBT$ is the total liabilities lagged for one quarter as in Benoit et al. (2013) in order to account for the difficulty of renegotiating debt in the case of financial distress, $EQUITY$ is the current market capitalization of the firm, and $LRMES$ is the previously defined long-run marginal expected shortfall. As is standard in the literature, a positive SRISK indicates a firm's capital shortfall in millions of dollars while a negative SRISK indicates a capital surplus.

Moreover, the SRISK measure can be normalized by the firm's market capitalization and is called NSRISK.

$$NSRISK_{it} = SRISKit/EQUITYit$$

In this way, the NSRISK is the proportional capital shortfall or surplus, while SRISK is the level of capital. As recognized by Berger et al. (2019), without this normalization, the distribution of SRISK can be highly skewed toward larger firms. Further, since this paper concerns the merger-related changes in an acquiring bank's risk, we calculate and then take the difference between a bank's post-merger and pre-merger SRISK and NSRISK values.

A.1.3 Systemic Risk: Delta Conditional Value at Risk

We measure the merger-related change in the contribution of an individual bank to systemic risk by the use of the delta conditional value at risk (ΔCoVaR) as proposed by Adrian and Brunnermeier (2016). The reasoning behind the ΔCoVaR measure is that it tests how an individual firm influences the overall market. Furthermore, the difference in conditioning between the two types of systemic risk metrics used in this paper is that ΔCoVaR measures the externality a single bank has on the system, while MES and SRISK capture how much the system affects a single bank. Furthermore, as the name suggests, ΔCoVaR is the difference between two CoVaR values: the CoVaR conditional on the institution being in distress and the CoVaR in the median state of the institution. CoVaR itself is defined as the value at risk (VaR) of the financial system conditional on the well-being of an individual institution. The VaR measures the worst expected loss of an institution over a specific time interval at a given confidence level. Therefore, the ΔCoVaR captures the effect that a single financial institution potentially has on the welfare of the broader economy by comparing how the market reacts when the institution is in a median state with when it is in distress.

Following Adrian and Brunnermeier (2016), the VaR of institution i at the q percentile is defined as:

$$Pr(X^i \leq VaR^i_q) = q$$

where X_i is the loss of institution i for which the VaR_q^i is defined. The CoVaR of the financial system (j) is conditional on the event $(X^i = VaR_q^i)$, that is, when institution i's losses attain its VaR value, is denoted by:

$$Pr(X^j \leq CoVaR_q^{j|i} | X^i = VaR_q^i) = q$$

Subsequently, institution i's contribution to the risk of the system (j) is defined as:

$$\Delta CoVaR_q^{j|i} = CoVaR_q^{j|i} - CoVaR_{50\%}^{j|i}$$

Therefore, $\Delta CoVaR_q^{j|i}$ denotes the difference between the CoVaR of the financial system that is conditional on the distress of a particular financial institution i and the CoVaR of the financial system that is conditional on the median state of institution i. Thus, $\Delta CoVaR_q^{j|i}$ quantifies how much a single institution adds to the overall risk in the system.

In order to estimate the $\Delta CoVaR_q^{j|i}$, two CoVaRs for each state of a particular institution are calculated using the method of quantile regression. The joint distribution of X^i and X^j is estimated as a function of a set of state variables M_t to capture time variation. The systematic state variables M_{t-1} are lagged and consist of the following:

1. The change in the yield of 3-month US treasury bonds collected from the Federal Reserve Board's H.15 release.
2. The change in the yield spread between 10-year and 3-month US treasury bonds from the Federal Reserve Board's H.15 release.
3. A short-term TED spread (the difference between the 3-month Libor rate and the 3-month secondary market T-bill rate) from the website for the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis.
4. The change in the credit spread that is calculated by taking the difference between the long-term bond composite and the 10-year US Treasury bonds obtained from the Federal Reserve Board's H.15 release.
5. The value-weighted equity market return from CRSP.
6. The VIX volatility index from CBOE.
7. Real estate sector return (from the real estate companies with SIC codes 65-66) in excess of the market financial sector return as represented by the S&P 500 index.

The following two quantile regressions are run on weekly data:

$$X_t^i = \alpha^i + \gamma^i M_{t-1} + \varepsilon_t^i$$
$$X_t^j = \alpha^{j|i} + \beta^{j|i} X_t^i + \gamma^{j|i} M_{t-1} + \varepsilon_t^{j|i}$$

Having estimated the quantile regression parameters, the predicted values of VaR and CoVaR are:

$$VaR_t^i = \hat{\alpha}^i + \hat{\gamma}^i M_{t-1}$$
$$CoVaR_t^i = \hat{\alpha}^{j|i} + \hat{\beta}^{j|i} VaR_t^i + \hat{\gamma}^{j|i} M_{t-1}$$

Finally, $\Delta CoVaR_t^i$ for each institution is calculated as:

$$\begin{aligned}\Delta CoVaR_t^i(q) &= CoVaR_t^i(q) + CoVaR_t^i(50\%) \\ &= \hat{\beta}^{j|i}(VaR_t^i(q) - VaR_t^i(50\%))\end{aligned}$$

Thus, in order to get an estimation of institution i's contribution to systemic risk ($\Delta CoVaR_t^i$), the quantile regressions must be run twice: once for the desired distressed q (in this case $q = .05$) and once for the median $q = 0.5$. Equivalently, in our analysis, we use the expected loss (negative of the returns) and the corresponding quantile of distress which is $q = 0.95$, following Adrian and Brunnermeier (2016). Further, the merger-related change in an acquiring bank's contribution to systemic risk is then the post-merger $\Delta CoVaR_t^i$ minus the pre-merger $\Delta CoVaR_t^i$.

A.2 Construction of Time Periods

For this paper, we consider the mergers that were announced and completed during the years 1990-2016. In order to define which years constituted stable periods and which years the crisis, one natural way would be to use the official business cycle dates provided by the National Bureau of Economic Research (NBER). However, as noted in the paper, a serious drawback of this method is its inability to account for significant lags in bank failures that persisted in the system even after contractions technically ended according to the NBER dates. For example, the effect of the financial crisis continued beyond 2009 and we aim to include those lingering effects in our analysis. Therefore, we gather complementary data from the Federal Deposit Insurance Corporation (FDIC) in order to analyze the annual number of bank failures and the amount of annual bank failures by total assets. The following two graphs illustrate this data.

The first graph illustrates the very large number of failures that had a severe effect on the banking industry during the 2008 financial crisis. Further, it displays the lingering effects of the savings and loan crisis into the early years of the 1990s. For this reason, we are cautious about including the early years of the 1990s as a part of our stable period; therefore, we begin our sample in 1995 when the number of failures was normalized. [17]

In addition, one can observe a slight rise in bank failures surrounding the years of the dot-com crash; however, it appears that this crisis only had a very small effect on the banking industry. Due to this, we did not think it would be appropriate to consider bank M&A during the dot-com crash as a crisis as it was clearly not on the scale of the 2008 financial crisis. On this basis, the years surrounding the dot-com crash were included in the stable periods.

And lastly, the second graph shows bank failures by total assets. This is an especially important image that underscores the seriousness of the failures that occurred during the 2008 financial crisis. Using this data in conjunction with the number of failures, we decided to define the years of the crisis from 2007 to 2010. We designated 2010 as the end due to the drop back to relatively normal levels. In this way, we hoped to capture the effect of the 2008 financial crisis that persisted after 2009.

[17] Please see Bennett & Unal (2015) for an analysis of bank failures in the earlier periods before the 2008 financial crisis.

Figure 1: Annual Number of Bank Failures

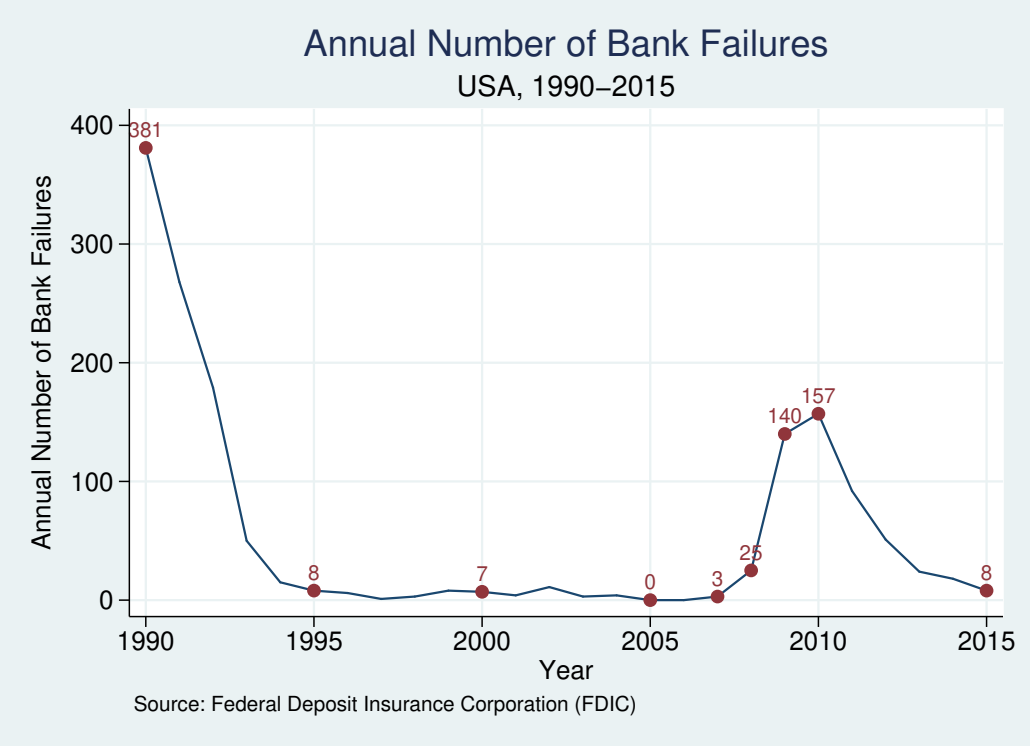
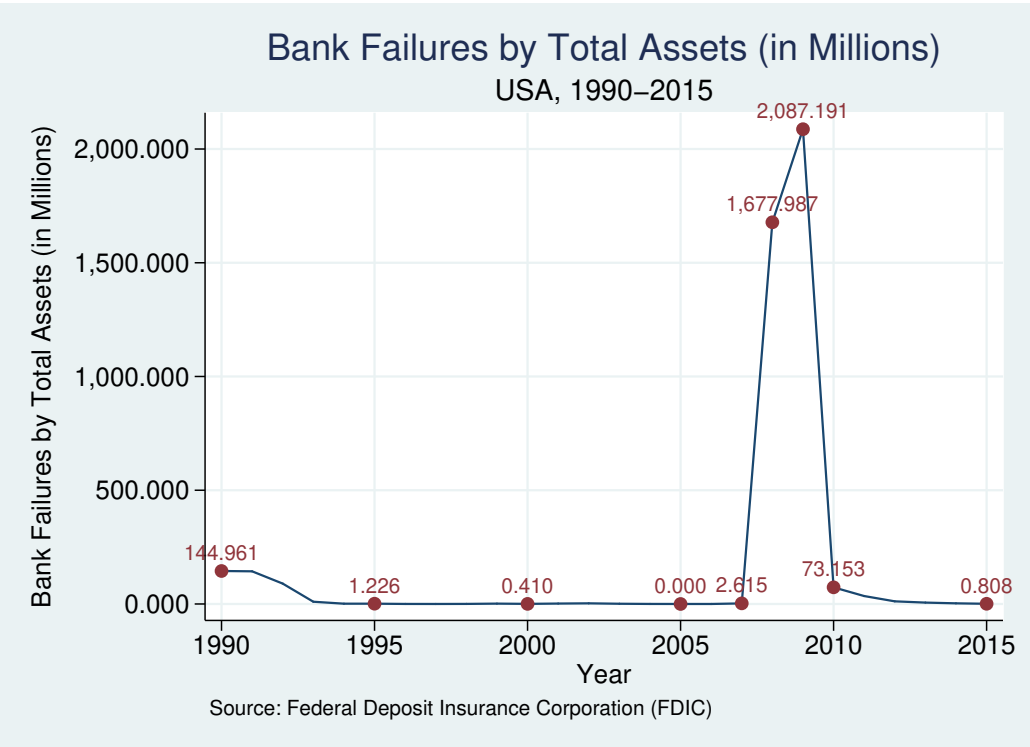


Figure 2: Bank Failures by Total Assets



A.3 Pre-merger Risk Analysis of Acquirers and Targets

Table 11: Pre-Merger MES Values of Acquirers and Targets

	Whole Sample		Acquirer Assets <=10000		Acquirer Assets>10000	
	(Stable)	(Crisis)	(Stable)	(Crisis)	(Stable)	(Crisis)
Pre-MES						
Acquier Pre-MES	1.26	2.83	1.05	2.67	1.82	2.91
Target Pre-MES	0.70	2.16	0.48	1.00	1.27	3.78
Relative Pre-MES	1.81	1.31	2.20	2.68	1.43	0.77
Pre-MAES						
Acquier Pre-MAES	-0.81	-1.47	-1.06	-1.87	-0.17	-0.76
Target Pre-MAES	-1.37	-2.13	-1.64	-3.54	-0.71	0.11
Relative Pre-MAES	0.59	0.69	0.65	0.53	0.24	-6.83

This table shows the pre-merger MES and MAES values for the acquirers and the targets. Relative values are calculated by dividing the mean values of acquirers by the mean values of the targets.

Table 12: Pre-Merger NSRISK Values of Acquirers and Targets

	Whole Sample		Acquirer Assets <=10000		Acquirer Assets>10000	
	(Stable)	(Crisis)	(Stable)	(Crisis)	(Stable)	(Crisis)
Pre-NSRISK						
Acquier Pre-NSRISK	-0.16	-0.04	-0.17	0.01	-0.12	-0.15
Target Pre-NSRISK	-0.12	0.25	-0.12	0.25	-0.09	0.19
Relative Pre-NSRISK	1.35	-0.15	1.41	0.04	1.28	-0.76
Pre-MANSRISK						
Acquier Pre-MANSRISK	-0.05	-0.11	-0.07	-0.12	0.00	-0.09
Target Pre-MANSRISK	-0.01	0.18	-0.02	0.12	0.03	0.26
Relative Pre-MANSRISK	5.68	-0.64	3.12	-1.03	0.10	-0.34

This table shows the pre-merger NSRISK and MANSRISK values for the acquirers and the targets. Relative values are calculated by dividing the mean values of acquirers by the mean values of the targets.

Table 13: Pre-Merger ΔCoVaR Values of Acquirers and Targets

	Whole Sample		Acquirer Assets <=10000		Acquirer Assets>10000	
	(Stable)	(Crisis)	(Stable)	(Crisis)	(Stable)	(Crisis)
Pre-ΔCoVar						
Acquier Pre-ΔCoVar	2.08	2.28	1.71	1.86	2.74	2.74
Target Pre-ΔCoVar	0.86	1.20	0.60	0.89	1.33	1.59
Relative Pre-ΔCoVar	2.43	1.90	2.86	2.09	2.06	1.73
Pre-MAΔCoVar						
Acquier Pre-MAΔCoVar	-1.05	-1.14	-1.40	-1.74	-0.47	-0.27
Target Pre-MAΔCoVar	-2.28	-2.22	-2.51	-2.71	-1.89	-1.42
Relative Pre-MAΔCoVar	0.46	0.51	0.56	0.64	0.25	0.19

This table shows the pre-merger ΔCoVaR and MAΔCoVaR values for the acquirers and the targets. Relative values are calculated by dividing the mean values of acquirers by the mean values of the targets.

A.4 Dynamics of the Effects of Bank Mergers on Market-Adjusted Systemic Risk Measures

This section contains graphs that track the 90-day rolling-window averages for the relevant market-adjusted systemic risk measures (MES, NSRISK, and ΔCoVaR). The figures display the averages during the crisis (blue) and stable (red) periods as well as their corresponding 95% confidence intervals. The x-axis of each figure illustrates the months relative to the bank-merger announcement, in which case "Month 0" indicates the time of the announcement.

Figure 3: Dynamics of Market-Adjusted MES for Banks that merged during the crisis period versus stable periods

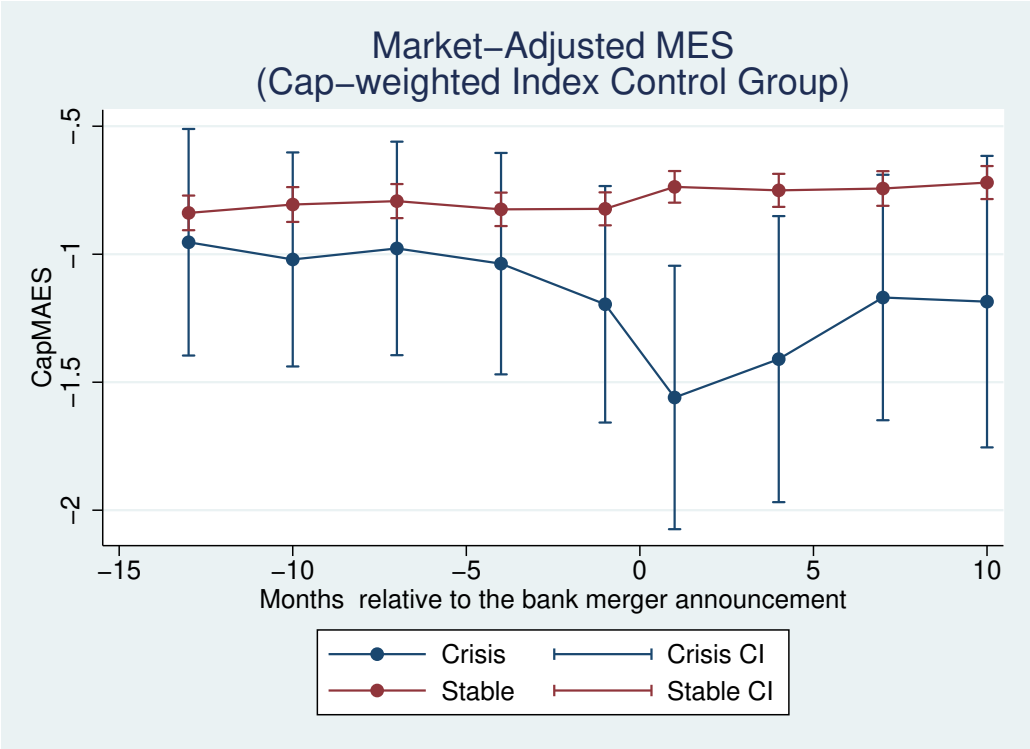


Figure 4: Dynamics of Market-Adjusted NSRISK for Banks that merged during the crisis period versus stable periods

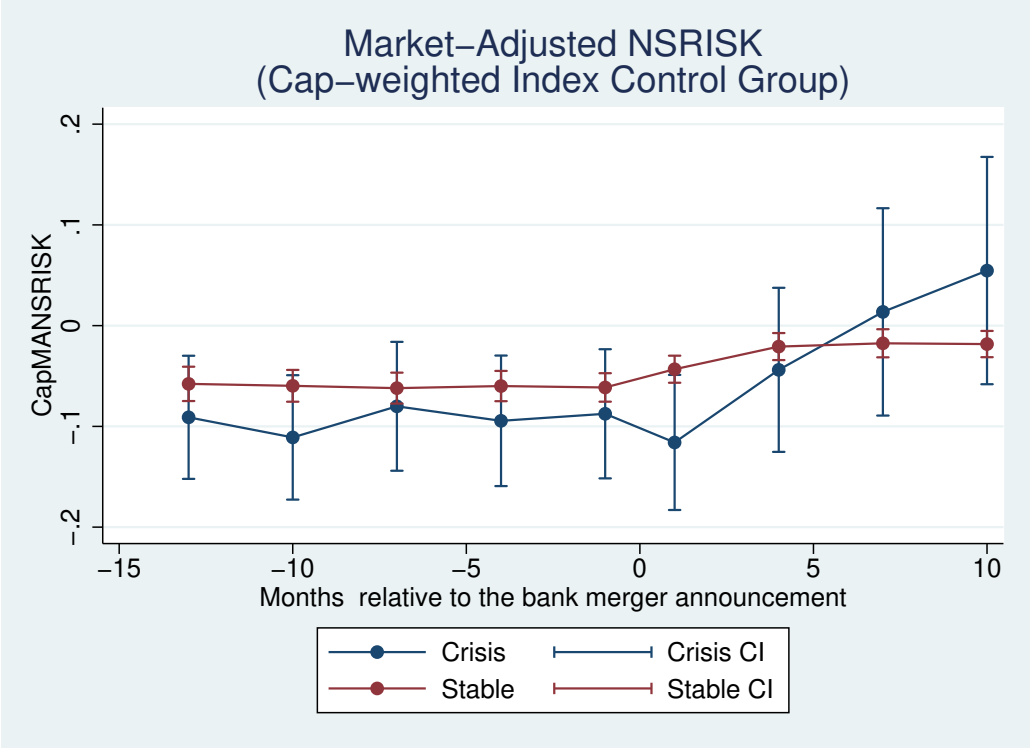
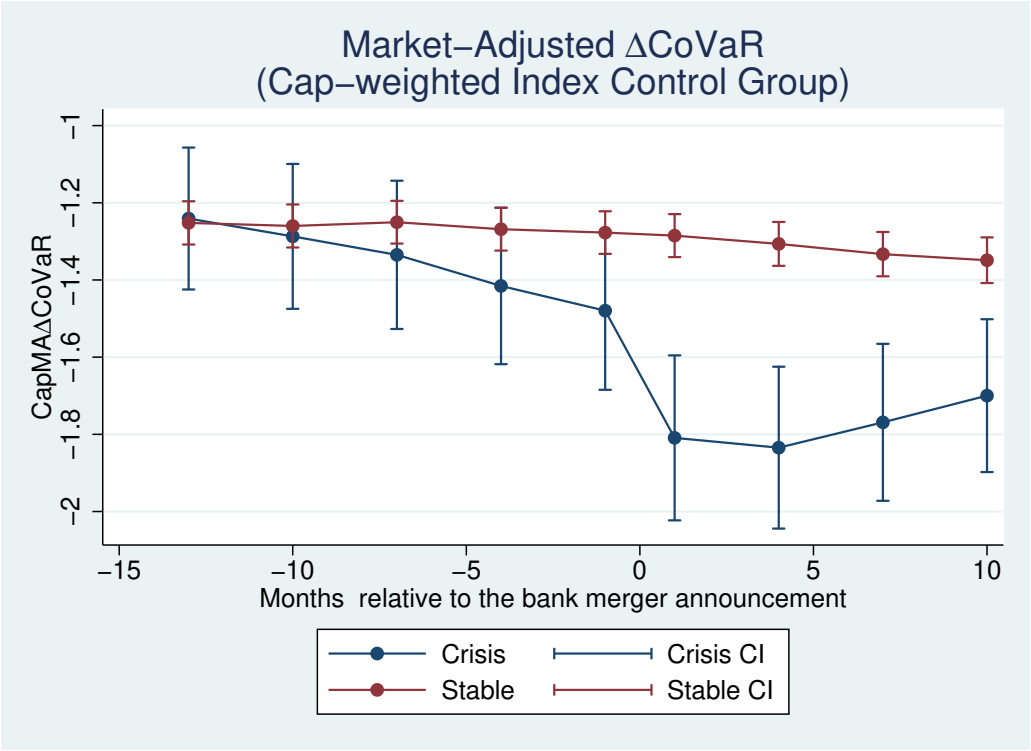


Figure 5: Dynamics of Market-Adjusted ΔCoVaR for Banks that merged during the crisis period versus stable periods



A.5 Tests of Equal Variance Between Samples

MES

	Equal Variance Test for ΔMES	
	Std. Dev.	Obs.
Stable	1.314	525
Crisis	3.398	54
All	1.704	579

Ha: ratio <0 Ha: ratio > 0
Pr(F < f) =0.0000 Pr(F > f) = 1.0000
Ha: ratio ≠1
2 Pr(F < f) = 0.0000

	Equal Variance Test for ΔCapMAES	
	Std. Dev.	Obs.
Stable	1.164	519
Crisis	2.167	47
All	1.297	566

Ha: ratio <0 Ha: ratio > 0
Pr(F < f) =0.0000 Pr(F > f) = 1.0000
Ha: ratio ≠1
2 Pr(F < f) = 0.0000

NSRISK

	Equal Variance Test for ΔNSRISK	
	Std. Dev.	Obs.
Stable	0.177	430
Crisis	0.372	49
All	0.221	479

Ha: ratio <0 Ha: ratio > 0
Pr(F < f) =0.0000 Pr(F > f) = 1.0000
Ha: ratio ≠1
2 Pr(F < f) = 0.0000

	Equal Variance Test for ΔCapMANSRISK	
	Std. Dev.	Obs.
Stable	0.159	423
Crisis	0.325	46
All	0.184	469

Ha: ratio <0 Ha: ratio > 0
Pr(F < f) =0.0000 Pr(F > f) = 1.0000
Ha: ratio ≠1
2 Pr(F < f) = 0.0000

ΔCoVaR

	Equal Variance Test for Change in ΔCoVaR	
	Std. Dev.	Obs.
Stable	0.508	252
Crisis	1.058	39
All	0.662	291

Ha: ratio <0 Ha: ratio > 0
Pr(F < f) =0.0000 Pr(F > f) = 1.0000
Ha: ratio ≠1
2 Pr(F < f) = 0.0000

	Equal Variance Test for Change in CapMAΔCoVaR	
	Std. Dev.	Obs.
Stable	0.419	250
Crisis	0.693	36
All	0.468	286

Ha: ratio <0 Ha: ratio > 0
Pr(F < f) =0.0000 Pr(F > f) = 1.0000
Ha: ratio ≠1
2 Pr(F < f) = 0.0000

A.6 Balance-sheet Data Construction

For acquirers, targets, and non-merged banks, we use CRSP/Compustat Merged data set that we accessed via the Wharton Research Data Services (WRDS). Specifically, we match the bank sample in Thomson One M&A data set with the CRSP/Compustat Merged data set with respect to banks' six-digit CUSIP or issue CUSIP, depending on the availability. CRSP/Compustat Merged data set contains balance-sheet data for all acquirers in the sample, except for a negligible few for which target data is missing for some banks. For acquirers, we take all available balance-sheet data from Compustat for banks that match the list of acquirers from the Thomson One sample. Similarly, for targets, we take all available balance-sheet data from Compustat to create a single data set that matches the list of targets from the Thomson One sample. Since the collection of balance-sheet data for the acquirers and the targets is separate, the case of excluding an acquirer who in turn is eventually acquired is avoided. When the data are combined into one file, we confirm that these banks are not counted twice. Further, to create the non-merged sample, we take balance-sheet data for all banks from Compustat and once again use the merger data from the Thomson One sample by removing all acquirers and targets. For all of the banks in the acquirer, target, and the non-merged samples, time-series data is created by collecting balance-sheet data for all years available.

A.6.1 Summary Statistics for the Explanatory Variables

Table 14: Summary Statistics: Explanatory Variables for Acquirers

	Mean	Std.Dev.	Min	Max	Obs.	Sample Obs.
Asset Growth	15.88	13.23	-19.81	106.24	1599	1402
Stock Price Growth	9.70	32.49	-78.77	216.90	1670	1402
Bank Size	7.80	1.53	4.50	12.16	1680	1402
ROA	0.99	0.45	-3.79	2.15	1701	1402
Liquidity	5.24	3.58	0.67	24.61	1698	1402
Tangibility	1.59	0.69	0.21	4.33	1699	1402
Loans Ratio	64.14	10.65	23.61	88.92	1713	1402
Non-performing Loans	0.78	0.88	0.00	8.00	1708	1402
Tobin's Q	106.20	5.94	93.37	125.90	1684	1402
Tier 1 Capital	11.62	3.30	5.28	25.80	1646	1402

Table 15: Summary Statistics: Explanatory Variables for Targets

	Mean	Std.Dev.	Min	Max	Obs.	Sample Obs.
Asset Growth	6.22	9.34	-23.55	44.71	179	145
Stock Price Growth	37.95	43.04	-75.97	171.49	188	145
Bank Size	6.86	1.38	4.41	11.92	520	145
ROA	0.76	0.63	-3.06	2.19	529	145
Liquidity	5.09	3.79	0.67	24.22	520	145
Tangibility	1.45	0.84	0.23	4.29	525	145
Loans Ratio	64.08	12.18	23.43	88.94	526	145
Non-performing Loans	0.96	1.25	0.00	8.43	521	145
Tobin's Q	103.60	5.05	93.75	122.47	522	145
Tier 1 Capital	11.27	3.58	5.26	25.40	492	145

Table 16: Summary Statistics: Explanatory Variables for Non-Merging Sample

	Mean	Std.Dev.	Min	Max	Obs.	Sample Obs.
Asset Growth	8.80	11.63	-172.14	130.11	9397	7771
Stock Price Growth	9.05	49.58	-95.11	1460.17	9846	7771
Bank Size	6.97	1.43	4.36	12.13	10543	7771
ROA	0.72	0.74	-3.90	2.19	10511	7771
Liquidity	5.41	4.06	0.66	24.52	10523	7771
Tangibility	1.58	0.82	0.21	4.36	10515	7771
Loans Ratio	65.33	12.28	23.39	88.99	10505	7771
Non-performing Loans	1.12	1.40	0.00	9.09	10496	7771
Tobin's Q	103.60	5.65	93.34	125.89	10509	7771
Tier 1 Capital	11.65	3.54	5.24	26.03	10042	7771

Table 17: Size Distribution of Overall Banking Sector

	p25	p50	p75	p90	p95
1994	243.99	515.19	1637.52	7729.34	17632.10
1995	258.73	535.68	1563.45	7564.51	19933.50
1996	273.28	610.96	1695.78	7720.80	21246.60
1997	304.27	669.23	1938.24	8951.11	25315.40
1998	286.92	649.56	1964.34	7648.10	25806.26
1999	283.27	567.37	1753.82	7725.18	23921.32
2000	304.07	637.03	1886.27	8265.22	25687.83
2001	341.71	682.17	2041.91	8736.78	23015.00
2002	382.69	763.62	2285.37	9552.32	23884.71
2003	400.47	855.53	2433.97	10305.04	26963.11
2004	434.37	878.65	2709.09	10037.71	28687.81
2005	528.52	994.40	2885.02	10309.98	31446.79
2006	541.77	1048.22	2898.83	10571.82	31854.77
2007	556.82	1130.11	3200.19	11167.16	30579.82
2008	598.83	1222.08	3172.98	10881.52	22358.38
2009	630.96	1310.36	3211.40	11588.23	21257.20
2010	661.58	1399.40	3519.39	12465.62	24698.95
2011	666.57	1335.41	3711.37	13541.40	27567.90
2012	676.85	1428.84	4325.72	14920.10	32356.04
2013	724.22	1542.60	4732.01	16934.63	35749.33
2014	781.20	1800.30	5848.20	20010.73	39344.64
2015	903.15	2248.50	7311.35	22839.46	50317.80
2016	1016.18	2573.82	8073.71	23975.30	63239.16

A.6.2 Acquirer and Target Data Comparison

Table 18: Acquirer Data Comparison

	p25	p50	p75	p90	p95	Obs.
Panel A: Acquirer Relative Risk (Acquirer Pre-MES / Target Pre-MES)						
No Restriction						
Crisis	0.61	1.05	3.73	6.82	10.08	50
Stable	0.04	0.90	1.90	4.54	6.91	478
Acquirer Assets≤10000						
Crisis	0.60	2.00	5.27	9.96	12.54	31
Stable	-0.35	0.72	2.06	5.09	7.04	326
Acquirer Assets≥10000						
Crisis	0.61	0.81	1.72	3.73	7.72	19
Stable	0.62	1.08	1.69	4.08	6.58	152
Panel B: Acquirer Relative Risk (Acquirer Pre-NSRISK / Target Pre-NSRISK)						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	-0.10	0.25	0.95	1.95	3.27	45
Stable	0.01	0.61	1.09	2.31	4.88	393
Acquirer Assets≤10000						
Crisis	-0.12	0.17	0.97	1.95	2.13	28
Stable	0.03	0.62	1.08	2.52	4.88	259
Acquirer Assets≥10000						
Crisis	0.00	0.39	0.86	3.27	9.19	17
Stable	-0.04	0.60	1.14	2.31	4.94	134
Panel C: Acquirer Relative Risk (Acquirer Pre-ΔCoVaR / Target Pre-ΔCoVaR)						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	1.34	2.23	3.39	5.23	9.43	37
Stable	1.46	2.55	4.36	8.63	14.01	229
Acquirer Assets≤10000						
Crisis	1.34	2.23	3.65	5.00	8.25	21
Stable	1.58	2.76	5.08	11.21	22.76	141
Acquirer Assets≥10000						
Crisis	1.28	2.14	3.11	5.23	17.99	16
Stable	1.43	1.95	3.90	5.57	8.16	88

This table shows the changes in the acquirers' pre-merger risk relative to the targets' pre-merger risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 19: Acquirer Data Comparison

Panel A: Acquirer Relative Size (Acquirer Size / Target Size)						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	1.88	3.62	10.63	22.01	31.07	48
Stable	2.34	4.61	10.01	22.26	36.65	395
Acquirer Assets≤10000						
Crisis	1.68	3.22	6.63	9.98	11.22	32
Stable	2.10	3.85	6.99	11.73	16.82	269
Acquirer Assets>10000						
Crisis	5.38	14.15	25.44	31.59	95.88	16
Stable	4.35	10.20	22.51	45.80	73.47	124
Panel B: Acquirer Asset Growth						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	5.70	10.10	17.30	27.00	33.79	152
Stable	7.59	13.29	21.53	31.99	41.78	1447
Acquirer Assets≤10000						
Crisis	5.79	10.37	15.63	26.21	33.77	118
Stable	8.02	13.74	22.15	32.25	41.78	1124
Acquirer Assets>10000						
Crisis	3.55	9.26	22.50	29.43	49.98	34
Stable	6.49	11.10	18.97	31.03	39.89	323
Panel C: Acquirer Stock Price Growth						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	-32.00	-19.50	-4.17	11.20	22.75	152
Stable	-7.69	10.17	30.68	52.53	63.94	1518
Acquirer Assets≤10000						
Crisis	-30.89	-19.46	-3.89	13.32	22.75	121
Stable	-7.93	10.47	30.44	52.53	64.37	1211
Acquirer Assets>10000						
Crisis	-38.60	-22.33	-6.34	0.50	9.19	31
Stable	-7.01	8.12	31.82	51.02	60.00	305
Panel D: Acquirer Assets						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	1002.10	2828.92	7846.13	20559.21	100669.00	151
Stable	752.73	1989.98	6144.77	20852.25	44630.00	1530
Acquirer Assets≤10000						
Crisis	851.10	2124.92	4098.14	7101.25	7945.53	121
Stable	622.04	1347.20	3046.98	5521.34	6825.37	1222
Acquirer Assets>10000						
Crisis	12582.47	20710.30	100669.00	146528.36	182201.61	30
Stable	13228.90	21441.42	46904.50	84785.60	139280.38	294

This table shows the balance-sheet characteristics of the acquirers.

Table 20: Acquirer Data Comparison (Continued)

Panel E: Acquirer Return on Assets						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.57	0.88	1.17	1.36	1.47	154
Stable	0.77	1.03	1.25	1.49	1.63	1547
Acquirer Assets≤10000						
Crisis	0.57	0.85	1.15	1.30	1.37	121
Stable	0.74	1.00	1.23	1.46	1.60	1212
Acquirer Assets>10000						
Crisis	0.69	1.02	1.32	1.52	1.64	33
Stable	0.93	1.15	1.36	1.61	1.78	321
Panel F: Acquirer Liquidity						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	2.47	3.57	5.57	9.05	10.41	153
Stable	2.77	4.28	6.81	10.25	12.51	1545
Acquirer Assets≤10000						
Crisis	2.45	3.58	5.69	9.20	10.20	120
Stable	2.79	4.26	6.75	9.83	12.31	1207
Acquirer Assets>10000						
Crisis	2.70	3.51	4.60	7.65	10.72	33
Stable	2.68	4.41	7.08	11.24	13.93	324
Panel G: Acquirer Tangibility						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	1.04	1.48	2.06	2.87	3.18	152
Stable	1.10	1.47	2.02	2.48	2.80	1547
Acquirer Assets≤10000						
Crisis	1.22	1.65	2.20	3.02	3.23	118
Stable	1.16	1.58	2.14	2.54	2.85	1210
Acquirer Assets>10000						
Crisis	0.69	1.07	1.67	1.85	2.54	34
Stable	0.97	1.25	1.58	2.01	2.27	322

This table shows the balance-sheet characteristics of the acquirers.

Table 21: Acquirer Data Comparison (Continued)

	p25	p50	p75	p90	p95	Obs.
Panel H: Acquirer Loans Ratio						
No Restriction						
Crisis	64.08	69.44	74.78	80.92	83.73	155
Stable	57.90	64.81	70.47	75.59	79.53	1558
Acquirer Assets≤10000						
Crisis	64.98	70.31	76.16	82.11	84.54	121
Stable	58.32	65.41	71.22	76.42	80.66	1217
Acquirer Assets>10000						
Crisis	61.61	66.40	69.97	72.69	75.59	34
Stable	57.32	63.16	68.16	71.65	74.93	326
Panel I: Acquirer Non-performing Loans Ratio						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.26	0.52	1.08	2.12	2.98	155
Stable	0.31	0.52	0.89	1.62	2.41	1553
Acquirer Assets≤10000						
Crisis	0.26	0.54	1.10	2.08	2.94	121
Stable	0.30	0.52	0.93	1.67	2.53	1214
Acquirer Assets>10000						
Crisis	0.27	0.48	0.75	2.12	3.01	34
Stable	0.34	0.51	0.73	1.37	2.01	325
Panel J: Acquirer Tobin's Q						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	101.36	104.47	109.85	111.78	112.79	155
Stable	101.99	105.42	109.89	114.54	117.58	1529
Acquirer Assets≤10000						
Crisis	101.25	104.40	109.52	111.65	112.51	121
Stable	101.72	105.06	109.52	113.74	117.11	1205
Acquirer Assets>10000						
Crisis	101.52	104.94	110.47	112.59	112.79	34
Stable	103.31	107.17	111.41	115.89	120.09	309
Panel K: Acquirer Tier-1 Capital Ratio						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	9.42	10.80	12.50	15.04	17.30	155
Stable	9.35	11.38	13.56	15.96	17.80	1491
Acquirer Assets≤10000						
Crisis	9.80	11.35	12.90	16.06	17.30	121
Stable	9.93	11.81	14.03	16.51	18.11	1163
Acquirer Assets>10000						
Crisis	8.14	9.26	10.40	12.30	13.85	34
Stable	8.10	9.50	11.45	12.71	14.32	315

This table shows the balance-sheet characteristics of the acquirers.

Table 22: Target Data Comparison

Panel A: Target Relative Risk (Target Pre-MES / Acquirer Pre-MES)						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.19	0.54	1.43	1.89	2.24	50
Stable	0.04	0.54	1.15	2.56	4.03	479
Acquirer Assets≤10000						
Crisis	0.10	0.38	1.04	1.67	2.11	31
Stable	-0.11	0.39	1.12	2.93	4.96	327
Acquirer Assets≥10000						
Crisis	0.58	1.23	1.63	2.24	2.35	19
Stable	0.28	0.79	1.24	1.75	2.28	152
Panel B: Target Relative Risk (Target Pre-NSRISK / Acquirer Pre-NSRISK)						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	-0.31	0.85	2.98	14.80	18.89	45
Stable	0.10	0.93	1.67	3.38	7.90	393
Acquirer Assets≤10000						
Crisis	-1.63	0.78	3.24	14.20	15.14	28
Stable	0.10	0.97	1.68	4.36	8.46	259
Acquirer Assets≥10000						
Crisis	0.11	1.17	2.58	18.89	2134.15	17
Stable	-0.03	0.84	1.66	2.56	4.80	134
Panel C: Target Relative Risk (Target Pre-ΔCoVaR / Acquirer Pre-ΔCoVaR)						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.27	0.44	0.73	1.08	2.57	37
Stable	0.20	0.36	0.63	0.89	1.18	229
Acquirer Assets≤10000						
Crisis	0.25	0.44	0.73	1.10	2.57	21
Stable	0.16	0.31	0.54	0.85	1.02	141
Acquirer Assets≥10000						
Crisis	0.32	0.47	0.79	0.90	1.08	16
Stable	0.25	0.48	0.69	1.07	1.25	88

This table shows the changes in the targets' pre-merger risk relative to the acquirers' pre-merger risk.

Table 23: Target Data Comparison

Panel A: Target Relative Size (Target Size / Acquirer Size)						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.09	0.28	0.53	0.93	1.08	48
Stable	0.10	0.22	0.43	0.77	1.06	395
Acquirer Assets≤10000						
Crisis	0.15	0.31	0.60	0.93	1.37	32
Stable	0.14	0.26	0.48	0.81	1.07	269
Acquirer Assets>10000						
Crisis	0.04	0.07	0.27	0.59	1.08	16
Stable	0.04	0.10	0.23	0.56	0.78	124
Panel B: Target Asset Growth						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	-1.49	2.19	6.94	10.11	14.23	17
Stable	0.52	4.62	11.56	18.40	24.48	148
Acquirer Assets≤10000						
Crisis	-2.75	0.29	4.67	9.48	9.51	12
Stable	0.55	4.62	10.91	18.19	23.07	110
Acquirer Assets>10000						
Crisis	4.21	6.94	10.11	14.23	14.23	5
Stable	0.49	3.46	12.32	22.55	34.63	37
Panel C: Target Stock Price Growth						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	-8.33	17.47	41.67	55.32	64.78	17
Stable	18.25	33.02	66.19	90.85	123.14	156
Acquirer Assets≤10000						
Crisis	9.27	25.37	47.74	55.32	64.78	12
Stable	18.25	33.77	65.33	95.78	126.51	120
Acquirer Assets>10000						
Crisis	-55.47	-54.84	21.38	24.73	24.73	5
Stable	17.50	28.61	66.40	89.90	123.14	35
Panel D: Target Assets						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	573.74	946.27	2898.83	7371.13	11120.50	49
Stable	334.47	686.41	1687.68	6034.12	15052.59	417
Acquirer Assets≤10000						
Crisis	465.69	653.41	1110.95	1868.18	2898.83	32
Stable	270.49	512.76	921.28	1601.98	2402.30	282
Acquirer Assets>10000						
Crisis	1079.26	3496.37	6465.04	11120.50	150374.08	17
Stable	791.45	2459.78	6929.26	22984.99	36378.97	133

This table shows the balance-sheet characteristics of the targets.

Table 24: Target Data Comparison (Continued)

Panel E: Target Return on Assets						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.21	0.63	0.91	1.17	1.21	49
Stable	0.55	0.86	1.15	1.37	1.49	424
Acquirer Assets≤10000						
Crisis	-0.36	0.47	0.82	0.92	1.13	31
Stable	0.50	0.80	1.11	1.34	1.45	291
Acquirer Assets>10000						
Crisis	0.50	0.86	1.11	1.22	1.28	18
Stable	0.68	0.97	1.21	1.43	1.64	131
Panel F: Target Liquidity						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	2.21	3.51	5.78	9.93	10.94	50
Stable	2.52	4.17	6.31	10.91	12.50	415
Acquirer Assets≤10000						
Crisis	3.07	4.19	7.34	10.62	11.42	32
Stable	2.50	4.25	6.69	10.88	12.32	284
Acquirer Assets>10000						
Crisis	1.96	2.21	2.98	4.69	6.85	18
Stable	2.60	3.90	5.93	11.32	13.80	129
Panel G: Target Tangibility						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.92	1.55	2.20	2.82	3.30	50
Stable	0.80	1.25	1.83	2.48	3.13	420
Acquirer Assets≤10000						
Crisis	0.88	1.73	2.22	2.79	3.63	32
Stable	0.86	1.31	1.91	2.63	3.29	288
Acquirer Assets>10000						
Crisis	0.92	1.30	2.04	3.15	3.30	18
Stable	0.73	1.07	1.65	2.06	2.41	130

This table shows the balance-sheet characteristics of the targets.

Table 25: Target Data Comparison (Continued)

Panel H: Target Loans Ratio						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	65.63	69.50	76.32	80.67	81.88	49
Stable	55.45	64.05	72.22	78.56	80.73	423
Acquirer Assets≤10000						
Crisis	66.74	69.59	77.20	80.06	82.40	31
Stable	55.18	64.13	72.46	79.16	82.65	289
Acquirer Assets>10000						
Crisis	60.88	66.88	73.03	81.12	81.88	18
Stable	55.92	63.81	71.25	75.83	79.09	132
Panel I: Target Nonperforming Loans Ratio						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	0.21	0.49	1.43	2.96	3.92	50
Stable	0.24	0.49	1.09	2.63	3.64	417
Acquirer Assets≤10000						
Crisis	0.21	0.72	2.48	3.09	4.32	32
Stable	0.22	0.53	1.35	3.08	4.35	285
Acquirer Assets>10000						
Crisis	0.21	0.39	0.64	1.02	1.43	18
Stable	0.28	0.46	0.71	1.27	2.16	130
Panel J: Target Tobin's Q						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	98.05	101.45	107.07	109.12	110.41	50
Stable	99.96	102.77	106.93	110.36	112.53	416
Acquirer Assets≤10000						
Crisis	97.33	99.43	103.99	107.07	108.69	32
Stable	99.45	101.88	105.36	108.65	111.21	285
Acquirer Assets>10000						
Crisis	101.87	105.97	109.03	111.34	113.49	18
Stable	101.84	105.46	108.49	112.48	114.81	129
Panel K: Target Tier-1 Capital Ratio						
	p25	p50	p75	p90	p95	Obs.
No Restriction						
Crisis	8.46	10.43	12.26	14.59	15.90	49
Stable	8.74	10.75	13.25	16.20	18.12	390
Acquirer Assets≤10000						
Crisis	9.18	10.47	12.63	14.59	16.50	32
Stable	9.14	11.00	13.66	17.00	18.58	265
Acquirer Assets>10000						
Crisis	7.97	10.22	11.05	12.63	15.43	17
Stable	8.20	10.30	12.29	14.80	15.47	123

This table shows the balance-sheet characteristics of the targets.

A.6.3 Correlation Coefficients for the Explanatory Variables

Table 26: Correlation Coefficient Matrix: Data for Acquirers

Dependent variable:	Asset Growth	Stock Price Growth	Bank Size	Return on Assets	Liquidity	Tangibility	Loans Ratio	Non-performing Loans	Tobin's Q	Tier 1 Capital
Asset Growth	1.000									
Stock Price Growth	-0.022	1.000								
Bank Size	-0.145	-0.048	1.000							
ROA	-0.082	-0.031	0.215	1.000						
Liquidity	0.088	0.067	-0.056	-0.015	1.000					
Tangibility	0.073	-0.070	-0.219	-0.053	0.152	1.000				
Loans Ratio	0.047	-0.076	-0.086	-0.004	-0.216	0.065	1.000			
Non-performing Loans	-0.160	0.061	-0.024	-0.303	0.021	0.044	0.070	1.000		
Tobin's Q	0.158	-0.346	0.224	0.507	0.034	0.021	0.006	-0.310	1.000	
Tier 1 Capital	-0.038	0.008	-0.293	0.115	0.152	0.175	-0.136	0.109	-0.012	1.000

Table 27: Correlation Coefficient Matrix: Data for Targets

Dependent variable:	Asset Growth	Stock Price Growth	Bank Size	Return on Assets	Liquidity	Tangibility	Loans Ratio	Non-performing Loans	Tobin's Q	Tier 1 Capital
Asset Growth	1.000									
Stock Price Growth	-0.101	1.000								
Bank Size	0.009	-0.039	1.000							
ROA	0.273	-0.117	0.135	1.000						
Liquidity	-0.146	0.127	-0.054	-0.054	1.000					
Tangibility	0.010	-0.011	-0.104	-0.046	0.100	1.000				
Loans Ratio	0.034	0.031	-0.157	0.008	-0.119	0.086	1.000			
Non-performing Loans	-0.343	0.154	-0.077	-0.515	0.142	0.095	0.088	1.000		
Tobin's Q	0.342	-0.222	0.324	0.505	0.026	0.024	-0.059	-0.377	1.000	
Tier 1 Capital	-0.014	0.008	-0.237	0.099	0.224	0.104	-0.135	-0.019	-0.038	1.000

Appendix B Difference-in-Differences Analysis

B.1 Difference-in-Differences Analysis (NSRISK and ΔCoVaR)

In this section, we examine the difference in the acquirers' pre- and post-merger levels of systemic risk and denote them as ΔNSRISK, and Change in ΔCoVaR.[18] The pre-merger values are calculated over a [-11, -180] day window before the merger announcement and post-merger values are calculated over a [+11, +180] day window after the merger completion.

Moreover, in order to determine whether this change in systemic risk is truly caused by a merger as opposed to a general trend in the banking sector, a comparison between merged and non-merged banks is necessary. We construct a control group and use it to adjust for the changes in the non-merged banks' systemic risk. To construct our control group, we calculate the systemic risk for each bank available in the CRSP database. Next, for each merger, we create a broad cap-weighted index for the non-merged banking sector by excluding the corresponding acquirer from the sample and weighting each bank's systemic risk according to its market capitalization for NSRISK and ΔCoVaR. We name these cap-weighted non-merged control groups as CapNSRISK and CapΔCoVaR, respectively, and calculate the change in those measures around each merger by deducting the average pre-merger values from the post-merger averages and denote them with ΔCapNSRISK and Change in CapΔCoVaR. Next, we control for the aggregate risk by deducting the change in the cap-weighted non-merged aggregate risk measures from the change in the acquirer risk and name it Market-Adjusted change in risk (controlled for the cap-weighted index for non-merged banks) that is shown in the last row of Table 28 and denoted by ΔCapMANSRISK and Change in CapMAΔCoVaR, respectively.

Table 28: Definitions of Risk Measures

Risk Measure	NSRISK	ΔCoVaR
Change in Acquirer Risk (Post Merger-Pre Merger)	**ΔNSRISK**	**Change in ΔCoVaR**
Cap-weighted Non-merging Banking Sector Risk	CapNSRISK	CapΔCoVaR
Change in Cap-weighted Non-merging Banking Sector Risk (Post Merger-Pre Merger)	ΔCapNSRISK	Change in CapΔCoVaR
Market-Adjusted Change in Risk Controlled for Cap-weighted Non-merging Banking Sector Risk (Post Merger-Pre Merger)	**ΔCapMANSRISK =ΔNSRISK-ΔCapNSRISK**	**Change in CapMAΔCoVaR =ΔCoVaR-Change in CapΔCoVaR**

B.1.1 Summary Statistics

In this analysis, we use the change in the acquirer risk after the merger that is illustrated in the third row of Panels A and B of Table 29 as NSRISK and ΔCoVaR, respectively. The results show that the risk has increased for the acquirer following a merger in the overall sample.

The sixth row of Panels A and B illustrate the change in risk for the cap-weighted bank index. The results in the constructed cap-weighted index show that on average, banks experienced a rise in their exposure to systemic risk with respect to ΔCapNSRISK and a decline in their

[18] Since the results of SRISK are asymmetrically impacted by mergers involving larger banks, we exclude the results of the SRISK measure from our main analysis. These results are available on request.

contribution to systemic risk with respect to the change in CapΔCoVaR.

The ninth row of Panels A and B illustrate the change in the market-adjusted risk for which we calculate the change in the acquirers' risk after controlling for the risk changes in the cap-weighted index for non-merged banks. The results show that in the overall sample, merged banks' exposure to systemic risk (ΔCapNSRISK) did not change after controlling for the cap-weighted bank index. Moreover, in the overall sample, merged banks' contribution to systemic risk (change in CapΔCoVaR) went up even after controlling for the changes in the banking sector with the help of the cap-weighted bank index.

B.1.2 Results for Difference-in-Differences Analysis

In this section, we focus on the mergers during the 2008 financial crisis and explore whether the acquirers in those mergers experienced an increase or a decrease in their exposure and contribution to systemic risk compared to the mergers during stable periods. To analyze the crisis's effect on the merged banks' systemic risk and test H1, we split the sample between the crisis (defined as 2007 to 2010) and the stable periods (1995-2006 & 2011-2016) and conduct a DiD analysis. In order to capture the size effects on the systemic risk, we also consider different subsamples with respect to acquirer size and relative size (target assets/acquirer assets) to test H1a.

Table 29: Summary Statistics

	Mean	p25	Median	p75	Std.Dev.	Min	Max	Obs
Panel A: NSRISK								
Pre-merger NSRISK	-0.14	-0.31	-0.17	-0.03	0.25	-0.63	1.39	479
Post-merger NSRISK	-0.13	-0.30	-0.18	-0.03	0.26	-0.64	1.20	479
ΔNSRISK	0.01	-0.09	-0.00	0.09	0.22	-0.74	1.28	479
Pre-merger CapNSRISK	-0.10	-0.23	-0.18	0.02	0.18	-0.30	0.51	469
Post-merger CapNSRISK	-0.09	-0.23	-0.19	-0.01	0.23	-0.30	1.10	469
ΔCapNSRISK	0.01	-0.07	-0.02	0.06	0.17	-0.41	1.05	469
Pre-merger CapMANSRISK	-0.05	-0.18	-0.06	0.07	0.22	-0.63	1.44	469
Post-merger CapMANSRISK	-0.05	-0.17	-0.06	0.08	0.22	-0.91	0.96	469
ΔCapMANSRISK	0.00	-0.08	-0.00	0.09	0.18	-0.71	0.94	469
Panel B: ΔCoVaR								
Pre-merger ΔCoVaR	1.96	1.25	1.82	2.51	1.00	0.04	4.88	291
Post-merger ΔCoVaR	2.14	1.29	1.96	2.70	1.16	0.04	5.20	291
Change in ΔCoVaR	0.18	-0.15	0.06	0.36	0.66	-1.82	2.85	291
Pre-merger CapΔCoVaR	3.17	2.45	3.24	3.82	0.73	2.00	4.69	286
Post-merger CapΔCoVaR	3.12	2.35	3.10	3.88	0.84	1.89	4.96	286
Change in CapΔCoVaR	-0.04	-0.45	-0.10	0.34	0.75	-2.08	2.37	286
Pre-merger CapMAΔCoVaR	-1.21	-1.78	-1.16	-0.53	0.98	-4.02	1.11	286
Post-merger CapMAΔCoVaR	-0.98	-1.55	-0.93	-0.33	0.98	-4.03	1.24	286
Change in CapMAΔCoVaR	0.23	-0.01	0.19	0.50	0.47	-1.51	1.68	286

NSRISK

Table 30 presents the DiD results for the NSRISK with restrictions on the sizes of acquirers and targets. The first row shows that ΔNSRISK is negative in the subsample for mergers in the stable periods and positive in the crisis subsample that indicates a significantly negative difference. In particular, banks that merged during the crisis experienced a greater capital shortage than their counterparts in stable periods. Further, with NSRISK, any change in a bank's capital levels (surplus or shortfall) is relative to the bank's market capitalization. However, if we also take into account the market conditions by analyzing ΔCapMANSRISK, the sign of the relationship reverses but remains significant. This reversal indicates that if we control for the overall increase in risk in the system, banks that merged during the crisis actually had a reduction in risk. This decrease in exposure to systemic risk is attributed to a capital surplus after the merger for the banks that merged during the crisis.

Additionally, restrictions on the sample with respect to the acquirers' absolute size show that the values of ΔCapMANSRISK are more significant and larger for acquirers that are smaller than $10,000 million. Further analysis on the grouping of the target sizes indicates that the magnitude of the risk reduction becomes even larger as the target's relative asset size increases. Altogether, when using the market-adjusted NSRISK measure, we find that banks that merged during the crisis experienced a significant reduction in their exposure to systemic risk compared to their counterparts in stable periods.

Table 30: Difference-in-Differences Analysis (Target-Adjusted Capweighted Pre-merger Risk)

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
NSRISK						
No Restriction						
ΔNSRISK	430	-0.0176	49	0.253	-0.271***	(0.000)
ΔCapMANSRISK	423	0.0125	46	-0.0888	0.101**	(0.042)
Relative Target Assets≥0.05						
ΔNSRISK	368	-0.0189	41	0.211	-0.230***	(0.000)
ΔCapMANSRISK	361	0.0113	38	-0.122	0.133**	(0.019)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
ΔNSRISK	279	-0.00863	33	0.177	-0.186***	(0.010)
ΔCapMANSRISK	274	0.0258	30	-0.130	0.156**	(0.023)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
ΔNSRISK	89	-0.0513	8	0.349	-0.400***	(0.004)
ΔCapMANSRISK	87	-0.0345	8	-0.0911	0.0566	(0.539)

This table shows the changes in the merged banks' target-adjusted systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

ΔCoVaR

Table 31 presents the DiD results for ΔCoVaR with restrictions on the sizes of acquirers and targets. In the first row, the risk difference is negative and significant when there is no size restriction or control group. This difference indicates that acquirers contribute to the systemic risk more during the crisis. However, this result needs to be confirmed with the market-adjusted ΔCoVaR. When we adjust for the market through the use of the cap-weighted market index as the control group, the signs are reversed yet remain significant. The negative coefficient for the mergers during the crisis period indicates that at this time, an acquiring bank's contribution to the market-adjusted systemic risk actually diminished after the merger. Moreover, focusing on the various size groupings, the signs are consistent, and the difference between these two periods is significant, particularly for the mergers that involved smaller acquirers with larger targets in terms of their absolute size.

Table 31: Difference-in-Differences Analysis (Target-Adjusted Capweighted Pre-merger Risk)

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
ΔCoVaR						
No Restriction						
Change in ΔCoVaR	252	0.0814	39	0.851	-0.769***	(0.000)
Change in CapMAΔCoVaR	250	0.257	36	0.00932	0.248**	(0.043)
Relative Target Assets≥0.05						
Change in ΔCoVaR	222	0.103	32	0.540	-0.437***	(0.009)
Change in CapMAΔCoVaR	220	0.275	30	-0.0791	0.354***	(0.013)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	158	0.0754	24	0.442	-0.366**	(0.022)
Change in CapMAΔCoVaR	156	0.301	22	-0.0641	0.365**	(0.041)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	64	0.170	8	0.833	-0.663	(0.173)
Change in CapMAΔCoVaR	64	0.213	8	-0.120	0.333	(0.175)

This table shows the changes in the merged banks' target-adjusted systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

B.2 Comparison of MES Analysis with Weiss et al. (2014)

In this section, we compare our findings to the systemic risk literature, of which the closest study to our analysis is Weiss et al. (2014). Following the same procedure outlined in Weiss et al. (2014), we replicate the analysis on MES captured in Table 3 of that paper using data available from 1995 to 2013. Weiss et al. (2014) calculate the change in the acquirers' systemic risk after the merger in Table 3 by using the MES for different regions of the world along with North America. They find that the change in MES is positive for the different regions that indicates there is an increase in the exposure to systemic risk after the merger. However, when Weiss et al. (2014) control for the change in the systemic risk of competitors, defined as region-specific indexes of non-merged banks, they find that the competitor-adjusted (aka market-adjusted) risk is insignificant. Weiss et al. (2014) interpret the insignificant market-adjusted change in risk as an increase in the overall risk of the system due to mergers. We revisit this finding and observe that when the sample is broken up into the crisis period and stable periods, the results are different. Specifically, we find that there is a significant increase in the market-adjusted risk during the stable periods and a significant decrease in the market-adjusted risk during the crisis, which in the overall sample cancel each other out.[19]

In Table 32, columns 2 to 4 show the pre- and post-merger values of the MES as well as the change in the MES for the acquirers. Columns 5 to 7 show the pre- and post-merger MES for the competitors (denoted by ES) and the change in their systemic risk during the same time periods (denoted by ΔES). Columns 8 to 10 illustrate the competitor-adjusted systemic risk in order to eliminate any market-related trend. In our analysis, the competitor is defined as the cap-weighted index for non-merged banks. The first row illustrates the results for our overall sample, which corresponds to North America in Weiss et al. (2014). The second row excludes the banks that merged during the crisis, and the third row only includes the banks that merged during the crisis.

Similar to Weiss et al. (2014), the first row shows that systemic risk increased for both acquirers and competitors. Moreover, in line with the findings of Weiss et al. (2014), the competitor-adjusted systemic risk is insignificant. Weiss et al. (2014) explain this finding by saying that mergers increase the systemic risk of the banking system as a whole. Specifically, they assert that: "ΔMAES between the bidders' MES and the regional bank sectors' ES show that both acquiring banks and their competitors suffer to the same extent from an increase in systemic risk due to consolidation." However, when we repeat the same analysis but exclude the mergers that took place during the 2008 financial crisis, we find that the competitor-adjusted systemic risk is positive and significant that indicates these acquirers experienced an increase in their risk relative to their competitors. By the same token, when we only include the mergers that took place during the 2008 financial crisis, we find that the competitor-adjusted systemic risk is negative and significant that indicates the systemic risk of the acquirers decreased. Therefore, the insignificant result in the overall sample is due to these opposing effects canceling each other.

[19]Note that in this section, in line with Weiss et al. (2014), we only consider the change in the acquirer's risk after the merger and do not adjust for the target risk.

Table 32: Replication of Weiss et al. (2014)

Replication of Weiss et al. (2014) for MES (Cap-weighted)										
		Acquirers' systemic risk			Competitors' systemic risk			Competitor-adjusted systemic risk		
	N	MES_{pre}	MES_{post}	ΔMES	ES_{pre}	ES_{post}	ΔES	$MAES_{pre}$	$MAES_{post}$	ΔMAES
Whole Sample	1558	1.292	1.559	0.267***	2.248	2.538	0.290***	-0.956	-0.979	-0.023
Crisis Excluded	1405	1.148	1.314	0.166***	2.116	2.187	0.071*	-0.968	-0.873	0.095*
Crisis Only	153	2.609	3.810	1.201***	3.462	5.767	2.306***	-0.852	-1.957	-1.105***

This table shows the replication results for Table 3 in Weiss et al. (2014) using the data available from 1995 to 2013. Columns 2 to 4 show the pre- and post-merger MES values and the ΔMES for the acquirers. Columns 5 to 7 show the pre- and post-merger MES for the competitors and the change in their systemic risk during the same time periods. Columns 8 to 10 illustrate the competitor-adjusted systemic risk in order to eliminate any market-related trend. The first row illustrates the results for our overall sample and correspond to North America in Weiss et al. (2014). The second row excludes the banks that merged during the crisis, and the third row only includes the banks that merged during the 2008 financial crisis. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

B.3 Effect of Mergers on Aggregate Risk (NSRISK and ΔCoVaR)

In this section, we analyze the aggregate risk effects of acquirers with respect to NSRISK and ΔCoVaR in Table 33 and Table 34, respectively. For both NSRISK and ΔCoVaR, as shown in the last column, the difference between the stable and crisis periods is always positive that indicates the aggregate acquirer effect on the systemic risk is smaller during the crisis.

Table 33: Difference-in-Differences Analysis for Aggregate Risk

NSRISK					
	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference
No Restriction					
∑Acquirer Effect (Cap-weighted)	430	0.01	49	-0.04	0.05
Relative size ≥ 0.05					
∑Acquirer Effect (Cap-weighted)	368	0.00	41	-0.05	0.05
Acquirer Assets≤10000 & Relative size ≥ 0.05					
∑Acquirer Effect (Cap-weighted)	279	0.01	33	-0.00	0.01
Acquirer Assets>10000 & Relative size≥0.05					
∑Acquirer Effect (Cap-weighted)	89	0.00	8	-0.05	0.05

This table shows the sum of the merged banks' marginal effects on the change in the aggregate systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 34: Difference-in-Differences Analysis for Aggregate Risk

CoVaR					
	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference
No Restriction					
∑Acquirer Effect (Cap-weighted)	252	0.12	39	0.07	0.06
Relative size ≥ 0.05					
∑Acquirer Effect (Cap-weighted)	222	0.11	32	0.01	0.10
Acquirer Assets≤10000 & Relative size ≥ 0.05					
∑Acquirer Effect (Cap-weighted)	158	0.05	24	0.00	0.04
Acquirer Assets>10000 & Relative size≥0.05					
∑Acquirer Effect (Cap-weighted)	64	0.07	8	0.00	0.07

This table shows the sum of the merged banks' marginal effects on the change in the aggregate systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

B.4 Robustness Checks

B.4.1 Placebo Tests for Difference-in-Differences Analysis

Table 35: Difference-in-Differences Analysis (Placebo) for MES

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
MES						
No Restriction						
ΔMES	461	0.537	118	-0.00548	0.543***	(0.000)
ΔCapMAES	449	-0.0944	117	0.465	-0.559***	(0.000)
Relative Target Assets≥0.05						
ΔMES	391	0.518	95	0.0253	0.493***	(0.000)
ΔCapMAES	380	-0.0946	94	0.509	-0.604***	(0.000)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
ΔMES	312	0.414	69	0.109	0.304**	(0.049)
ΔCapMAES	303	-0.0733	68	0.650	-0.723***	(0.000)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
ΔMES	79	0.931	26	-0.198	1.129***	(0.000)
ΔCapMAES	77	-0.178	26	0.140	-0.318**	(0.050)

This table shows the changes in the merged banks' systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 36: Difference-in-Differences Analysis (Placebo) for NSRISK

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
NSRISK						
No Restriction						
ΔNSRISK	375	0.00604	104	0.0249	-0.0189	(0.254)
ΔCapMANSRISK	365	-0.00379	104	0.0251	-0.0289*	(0.052)
Relative Target Assets≥0.05						
ΔNSRISK	323	-0.00176	86	0.0262	-0.0279	(0.119)
ΔCapMANSRISK	313	-0.00963	86	0.0286	-0.0382**	(0.022)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
ΔNSRISK	251	0.00163	61	0.0498	-0.0482**	(0.021)
ΔCapMANSRISK	243	0.000561	61	0.0498	-0.0493**	(0.017)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
ΔNSRISK	72	-0.0136	25	-0.0316	0.0180	(0.582)
ΔCapMANSRISK	70	-0.0450	25	-0.0232	-0.0218	(0.349)

This table shows the placebo test results regarding the changes in the merged banks' NSRISK. The crisis period consists of observations for the years 2002-2005. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 37: Difference-in-Differences Analysis (Placebo) for ΔCoVaR

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
ΔCoVaR						
No Restriction						
Change in ΔCoVaR	207	0.283	84	-0.0584	0.341***	(0.000)
Change in CapMAΔCoVaR	202	0.162	84	0.381	-0.219***	(0.000)
Relative Target Assets≥0.05						
Change in ΔCoVaR	182	0.238	72	-0.0457	0.284***	(0.000)
Change in CapMAΔCoVaR	178	0.163	72	0.405	-0.241***	(0.000)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	133	0.166	49	0.0100	0.156**	(0.024)
Change in CapMAΔCoVaR	129	0.166	49	0.493	-0.326***	(0.000)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	49	0.435	23	-0.165	0.600***	(0.001)
Change in CapMAΔCoVaR	49	0.156	23	0.217	-0.0611	(0.482)

This table shows the placebo test results regarding the changes in the merged banks' ΔCoVaR. The crisis period consists of observations for the years 2002-2005. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

B.4.2 Exclusion of Non-bank Targets in Diff-in-Diff Analysis

Table 38: Difference-in-Differences Analysis (Non-bank Targets Excluded)

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
MES						
No Restriction						
ΔMES	340	0.167	50	2.010	-1.843***	(0.000)
ΔCapMAES	336	0.0661	44	-0.835	0.901***	(0.004)
Relative Target Assets≥0.05						
ΔMES	287	0.200	41	1.553	-1.353***	(0.006)
ΔCapMAES	283	0.0602	35	-0.994	1.054***	(0.003)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
ΔMES	215	0.146	33	1.300	-1.154**	(0.016)
ΔCapMAES	211	0.113	29	-1.071	1.184***	(0.004)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
ΔMES	72	0.362	8	2.596	-2.234	(0.179)
ΔCapMAES	72	-0.0959	6	-0.621	0.525	(0.448)

This table shows the changes in the merged banks' systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 39: Difference-in-Differences Analysis

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
NSRISK						
No Restriction						
ΔNSRISK	281	-0.0172	45	0.264	-0.281***	(0.000)
ΔCapMANSRISK	275	0.00902	43	-0.0847	0.0937*	(0.075)
Relative Target Assets≥0.05						
ΔNSRISK	244	-0.0152	37	0.219	-0.235***	(0.001)
ΔCapMANSRISK	238	0.0118	35	-0.120	0.132**	(0.030)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
ΔNSRISK	175	0.000128	29	0.184	-0.184**	(0.018)
ΔCapMANSRISK	170	0.0322	27	-0.128	0.160**	(0.034)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
ΔNSRISK	69	-0.0542	8	0.349	-0.403***	(0.004)
ΔCapMANSRISK	68	-0.0393	8	-0.0911	0.0517	(0.574)

This table shows the changes in the merged banks' systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 40: Difference-in-Differences Analysis

	Stable Obs.	Stable	Crisis Obs.	Crisis	Risk Difference	p-value
ΔCoVaR						
No Restriction						
Change in ΔCoVaR	178	0.108	36	0.901	-0.793***	(0.000)
Change in CapMAΔCoVaR	175	0.251	34	0.000637	0.250**	(0.052)
Relative Target Assets≥0.05						
Change in ΔCoVaR	159	0.121	29	0.570	-0.449***	(0.012)
Change in CapMAΔCoVaR	156	0.262	28	-0.0959	0.358**	(0.018)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	109	0.0664	22	0.463	-0.397**	(0.017)
Change in CapMAΔCoVaR	106	0.272	21	-0.0938	0.366**	(0.048)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	50	0.239	7	0.908	-0.668	(0.227)
Change in CapMAΔCoVaR	50	0.240	7	-0.102	0.342	(0.226)

This table shows the changes in the merged banks' systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

Appendix C Heckman Selection Model

C.1 OLS Regression Results

C.1.1 MES

Table 41 presents the regression results for ΔCapMAES, with even columns accounting for year fixed effects. We use year dummies except for the years between 2007 and 2010, where "Crisis" dummy captures the time variation during this time period. In the first two columns, the crisis dummy stays negative and significant that indicates the post-merger systemic risk is distinctly lower for the banks that merged during the 2008 financial crisis. In the following columns where we include the relative size and its interaction with the crisis dummy, the coefficient of the crisis dummy is negative but not significant. Considering the effects of control variables on the systemic risk, we find that all variables except for bank size and loans ratio are insignificant across the majority of regressions. The negative coefficient for loans ratio and the positive coefficient for bank size mean that the banks with more loans had a lower change in risk while larger banks had a larger change in the risk.

C.1.2 NSRISK

Table 42 presents the regression results for ΔCapMANSRISK, with even columns accounting for year fixed effects. In these models, the crisis dummy stays negative and significant in the first two columns, while the coefficient becomes insignificant in the following columns when we include the relative size and its interaction with the crisis dummy. Considering the effects

of control variables on the systemic risk, the loan ratio is associated with higher exposure to the systemic risk. Moreover, the increase in stock price is associated with lower exposure to systemic risk, while higher tier-1 capital is associated with lower market-adjusted exposure to risk. Bank size has a negative and significant effect on systemic risk. This effect may be due to the definition of NSRISK as it is defined as SRISK divided by the market capitalization, which is positively correlated with bank size. Therefore, when the bank size goes up, NSRISK tends to fall. Last, the nonperforming loans were negatively associated with the change in risk.

C.1.3 ΔCoVaR

Table 43 presents the regression results for the change in CapMAΔCoVaR. In these models, the crisis dummy stays significantly negative. Considering the effects of control variables on the systemic risk, the bank size is associated with a higher contribution to the systemic risk. Moreover, the increase in stock price is associated with a higher contribution to systemic risk, while higher ROA is associated with a lower market-adjusted contribution to risk. Last, the nonperforming loans are positively associated with the change in risk and relative size is negatively associated with the change in risk.

Consequently, the negative and significant coefficient for the crisis dummy in all our regression means that the mergers that took place during the 2008 financial crisis experienced a reduction in their exposure and contribution to market-adjusted systemic risk, which is consistent across different systemic risk measures and regression models. Moreover, the results still hold when we also control for the target's balance-sheet data and are available on request.

Table 41: ΔCapMAES (OLS Regressions)

	(1)	(2)	(3)	(4)
Crisis	-0.703**	-0.725*	-5.278	-4.884
	(0.337)	(0.413)	(4.943)	(5.093)
Pre-merger CapMAES	-0.799***	-0.927***	-0.744***	-0.853***
	(0.068)	(0.068)	(0.072)	(0.071)
Crisis x Pre-merger CapMAES	-0.081	0.050	-0.181*	-0.068
	(0.108)	(0.111)	(0.101)	(0.101)
Bank Size	0.265***	0.265***	0.226***	0.250***
	(0.052)	(0.055)	(0.058)	(0.058)
Stock Price Growth	0.001	0.000	0.000	-0.001
	(0.002)	(0.003)	(0.002)	(0.003)
ROA	-0.226	-0.336	-0.141	-0.375*
	(0.182)	(0.211)	(0.178)	(0.191)
Liquidity	0.005	0.022	0.001	0.015
	(0.017)	(0.018)	(0.018)	(0.019)
Tangibility	-0.139	-0.170	-0.115	-0.140
	(0.122)	(0.111)	(0.127)	(0.109)
Loans Ratio	-0.016**	-0.014*	-0.014*	-0.010
	(0.008)	(0.008)	(0.008)	(0.008)
Non-performing Loans	0.061	-0.026	-0.002	-0.123
	(0.092)	(0.113)	(0.088)	(0.092)
Tobin's Q	0.025*	0.030	0.019	0.028
	(0.015)	(0.018)	(0.015)	(0.019)
Tier 1 Capital	-0.009	-0.003	-0.005	0.006
	(0.021)	(0.022)	(0.023)	(0.024)
Bank Size / Target Size			-0.435	-0.175
			(0.440)	(0.390)
Crisis x Relative Size			3.724	3.370
			(4.060)	(4.183)
Constant	-3.967**	-4.504**	-2.628	-4.227**
	(1.764)	(2.015)	(1.900)	(2.102)
Year Fixed Effects	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
N	372	372	336	336
R^2	0.477	0.567	0.477	0.573

This table shows the multivariate regression results for ΔCapMAES. Year fixed effects are included. Robust standard errors are clustered by bank and are in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 42: ΔCapMANSRISK (OLS Regressions)

	(1)	(2)	(3)	(4)
Crisis	-0.188***	-0.216***	-0.349	-0.303
	(0.030)	(0.053)	(0.266)	(0.389)
Pre-merger CapMANSRISK	-0.380***	-0.466***	-0.383***	-0.458***
	(0.046)	(0.051)	(0.047)	(0.051)
Crisis x Pre-merger CapMANSRISK	-0.385***	-0.273***	-0.392***	-0.295***
	(0.087)	(0.087)	(0.090)	(0.094)
Bank Size	-0.026***	-0.003	-0.028***	-0.004
	(0.007)	(0.008)	(0.008)	(0.009)
Stock Price Growth	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.037	0.006	0.035	0.005
	(0.028)	(0.029)	(0.029)	(0.031)
Liquidity	0.001	-0.003	0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Tangibility	-0.023	-0.011	-0.028*	-0.010
	(0.015)	(0.014)	(0.016)	(0.015)
Loans Ratio	0.000	0.002*	0.000	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
Non-performing Loans	-0.046***	-0.035***	-0.047***	-0.033***
	(0.013)	(0.012)	(0.013)	(0.011)
Tobin's Q	-0.003*	-0.009***	-0.003	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)
Tier 1 Capital	-0.009***	-0.003	-0.008**	-0.003
	(0.003)	(0.003)	(0.004)	(0.003)
Bank Size / Target Size			0.056	0.103*
			(0.071)	(0.057)
Crisis x Relative Size			0.136	0.083
			(0.221)	(0.322)
Constant	0.679***	1.024***	0.612**	0.855***
	(0.232)	(0.229)	(0.278)	(0.277)
Year Fixed Effects	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
N	315	315	299	299
R^2	0.448	0.583	0.452	0.582

This table shows the multivariate regression results for ΔCapMANSRISK. Year fixed effects are included. Robust standard errors are clustered by bank and are in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 43: Change in CapMAΔCoVaR (OLS Regressions)

	(1)	(2)	(3)	(4)
Crisis	-0.769**	-0.879**	-2.545*	-2.425*
	(0.298)	(0.351)	(1.325)	(1.456)
Pre-merger CapMACoVaR	-0.152***	-0.097	-0.144**	-0.104
	(0.056)	(0.064)	(0.057)	(0.066)
Crisis x Pre-merger CapMACoVaR	-0.287*	-0.342**	-0.320**	-0.369**
	(0.150)	(0.160)	(0.152)	(0.161)
Bank Size	0.039	0.067**	0.028	0.066**
	(0.030)	(0.033)	(0.030)	(0.033)
Stock Price Growth	0.002*	0.002	0.002*	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
ROA	-0.053	-0.164*	-0.003	-0.138
	(0.098)	(0.083)	(0.093)	(0.086)
Liquidity	0.010	0.015*	0.002	0.009
	(0.010)	(0.008)	(0.010)	(0.009)
Tangibility	-0.069	-0.044	-0.098	-0.080
	(0.071)	(0.055)	(0.074)	(0.056)
Loans Ratio	-0.005	-0.000	-0.006*	-0.001
	(0.003)	(0.004)	(0.004)	(0.004)
Non-performing Loans	-0.057	-0.136***	-0.054	-0.123***
	(0.056)	(0.042)	(0.056)	(0.044)
Tobin's Q	-0.001	-0.000	-0.003	-0.002
	(0.006)	(0.007)	(0.006)	(0.007)
Tier 1 Capital	0.006	0.014*	0.004	0.013*
	(0.009)	(0.008)	(0.009)	(0.008)
Bank Size / Target Size			-0.778***	-0.820***
			(0.236)	(0.224)
Crisis x Relative Size			1.457	1.539
			(1.074)	(1.164)
Constant	0.298	-0.275	1.655**	0.683
	(0.740)	(0.847)	(0.822)	(0.931)
Year Fixed Effects	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
N	197	197	190	190
R^2	0.203	0.426	0.252	0.465

This table shows the multivariate regression results for the change in CapMAΔCoVaR. Year fixed effects are included. Robust standard errors are clustered by bank and are in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

C.2 Heckman Selection Model with Probit Distribution

C.2.1 Heckman Selection Model Second Stage (Probit) with NSRISK and ΔCoVaR Risk Measures

Table 44: ΔCapMANSRISK (Heckman's 2-step Estimation (Probit))

	(1)	(2)
Crisis	-0.229	-0.246
	(0.536)	(0.656)
Pre-merger CapMANSRISK	-0.446***	-0.435***
	(0.054)	(0.056)
Crisis x Pre-merger CapMANSRISK	-0.250**	-0.283**
	(0.114)	(0.129)
Bank Size	-0.007	-0.015
	(0.011)	(0.012)
Crisis x Bank Size	0.003	0.003
	(0.064)	(0.067)
Stock Price Growth	-0.001***	-0.001***
	(0.000)	(0.000)
ROA	0.011	0.007
	(0.034)	(0.035)
Liquidity	-0.003	-0.001
	(0.003)	(0.004)
Tangibility	-0.001	-0.001
	(0.015)	(0.016)
Loans Ratio	0.002**	0.002**
	(0.001)	(0.001)
Non-performing Loans	-0.038**	-0.035**
	(0.016)	(0.016)
Tobin's Q	-0.009***	-0.009***
	(0.003)	(0.003)
Tier 1 Capital	-0.003	-0.003
	(0.003)	(0.004)
λ	-0.034	-0.065*
	(0.035)	(0.039)
Bank Size / Target Size		0.153**
		(0.068)
Crisis x Relative Size		0.035
		(0.359)
Constant	1.061***	0.972***
	(0.322)	(0.351)
Year Fixed Effects	Yes	Yes
Bank Fixed Effects	Yes	Yes
N	11836	11836
R^2	0.557	0.559

This table shows the multivariate regression results of ΔCapMANSRISK. We control for selection bias using Heckman's Selection Model by including the inverse Mills ratio obtained from the first-stage probit regression. Year fixed effects are included. Robust standard errors are clustered by bank and are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 45: Change in CapMAΔCoVaR (Heckman's 2-step Estimation (Probit)

	(1)	(2)
Crisis	-6.090***	-7.956***
	(1.133)	(2.301)
Pre-merger CapMAΔCoVaR	-0.040	-0.038
	(0.065)	(0.060)
Crisis x Pre-merger CapMAΔCoVaR	-0.854***	-0.903***
	(0.144)	(0.195)
Bank Size	0.008	0.014
	(0.041)	(0.042)
Crisis x Bank Size	0.509***	0.520***
	(0.116)	(0.163)
Stock Price Growth	0.002	0.001
	(0.001)	(0.001)
ROA	-0.225***	-0.200*
	(0.083)	(0.107)
Liquidity	0.019**	0.010
	(0.009)	(0.013)
Tangibility	-0.068	-0.102*
	(0.046)	(0.056)
Loans Ratio	0.003	0.003
	(0.004)	(0.004)
Non-performing Loans	-0.164***	-0.157***
	(0.045)	(0.051)
Tobin's Q	0.005	0.006
	(0.008)	(0.008)
Tier 1 Capital	0.020*	0.021**
	(0.011)	(0.010)
λ	-0.005	0.043
	(0.131)	(0.151)
Bank Size / Target Size		-0.844***
		(0.267)
Crisis x Relative Size		1.724*
		(0.963)
Constant	-0.416	0.098
	(1.148)	(1.222)
Year Fixed Effects	Yes	Yes
Bank Fixed Effects	Yes	Yes
N	11691	11691
R^2	0.543	0.585

This table shows the multivariate regression results of the change in CapMAΔCoVaR. We control for selection bias using Heckman's Selection Model by including the inverse Mills ratio obtained from the first-stage probit regression. Year fixed effects are included. Robust standard errors are clustered by bank and are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 46: Heckman Selection Model Second Stage Results with More Interaction Variables

	ΔCapMAES		ΔCapMANSRISK		Change in CapMAΔCoVar	
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis x Pre-merger CapMAES	-0.381*	-0.308				
	(0.222)	(0.232)				
Crisis x Pre-merger CapMANSRISK			-0.341**	-0.267*		
			(0.140)	(0.141)		
Crisis x Pre-merger CapMAΔCoVaR					-0.855***	-0.954***
					(0.183)	(0.195)
Crisis	-47.463*	-47.635	1.607	1.341	-13.864	-14.576
	(28.732)	(30.525)	(5.201)	(5.114)	(9.138)	(9.995)
Pre-merger CapMAES	-0.692***	-0.777***				
	(0.071)	(0.068)				
Bank Size	0.239***	0.205***	-0.040***	-0.016	-0.013	0.014
	(0.071)	(0.076)	(0.011)	(0.012)	(0.044)	(0.032)
Crisis x Bank Size	5.075	5.077	-0.216	-0.180	1.226	1.313
	(3.168)	(3.373)	(0.618)	(0.607)	(1.065)	(1.195)
Bank Size / Target Size	-0.759	-0.381	0.103	0.156**	-0.755***	-0.851***
	(0.480)	(0.450)	(0.072)	(0.067)	(0.243)	(0.252)
Crisis x Relative Size	36.130	35.889	-1.675	-1.372	7.042	7.484
	(25.259)	(26.659)	(4.743)	(4.673)	(7.995)	(9.146)
Crisis x Relative Size x Bank Size	-3.911	-3.881	0.203	0.162	-0.653	-0.696
	(2.802)	(2.960)	(0.562)	(0.553)	(0.947)	(1.120)
Stock Price Growth	0.000	-0.001	-0.001***	-0.001***	0.002	0.001
	(0.003)	(0.003)	(0.000)	(0.000)	(0.001)	(0.001)
ROA	-0.132	-0.480**	0.028	0.003	-0.045	-0.183*
	(0.219)	(0.229)	(0.032)	(0.033)	(0.098)	(0.097)
Liquidity	-0.011	0.009	0.002	-0.001	0.004	0.009
	(0.023)	(0.026)	(0.003)	(0.004)	(0.013)	(0.011)
Tangibility	-0.072	-0.084	-0.018	-0.000	-0.123**	-0.106**
	(0.132)	(0.122)	(0.019)	(0.017)	(0.063)	(0.053)
Loans Ratio	-0.005	-0.002	0.001	0.002**	-0.002	0.004
	(0.007)	(0.008)	(0.001)	(0.001)	(0.004)	(0.004)
Non-performing Loans	-0.051	-0.171	-0.046***	-0.036**	-0.084	-0.157***
	(0.101)	(0.107)	(0.016)	(0.016)	(0.061)	(0.048)
Tobin's Q	0.032*	0.043**	-0.003	-0.009***	0.002	0.005
	(0.017)	(0.021)	(0.002)	(0.003)	(0.009)	(0.010)
Tier 1 Capital	0.016	0.028	-0.009**	-0.003	0.015	0.024**
	(0.024)	(0.026)	(0.004)	(0.004)	(0.011)	(0.010)
λ	0.391	0.163	-0.072*	-0.069*	-0.004	0.041
	(0.247)	(0.268)	(0.040)	(0.039)	(0.154)	(0.123)
Pre-merger CapMANSRISK			-0.369***	-0.435***		
			(0.057)	(0.056)		
Pre-merger CapMAΔCoVaR					-0.106*	-0.035
					(0.054)	(0.057)
Constant	-5.183**	-6.017**	0.766**	0.972***	1.136	0.137
	(2.253)	(2.431)	(0.347)	(0.350)	(1.414)	(1.249)
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	11907	11907	11836	11836	11691	11691
R^2	0.484	0.589	0.430	0.561	0.373	0.595

This table shows the multivariate regression results with more interaction variables. We control for selection bias using Heckman's Selection Model by including the inverse Mills ratio obtained from the first-stage probit regression. Year fixed effects are included. Robust standard errors are clustered by bank and are in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

C.3 Heckman Selection Model with Logit Distribution

C.3.1 Heckman Selection Model First Stage (Logit)

Table 47: Heckman Selection Model First Stage Results (Logit)

	(1)	(2)	(3)
Asset Growth	4.686***		4.290***
	(0.333)		(0.272)
Stock Price Growth	0.002**	0.002***	
	(0.001)	(0.001)	
Bank Size	0.438***	0.404***	
	(0.030)	(0.029)	
ROA	0.618***	0.426***	
	(0.109)	(0.087)	
Liquidity	-0.022*	-0.015	
	(0.012)	(0.011)	
Tangibility	0.188***	0.199***	
	(0.054)	(0.054)	
Loans Ratio	-0.000	0.001	
	(0.004)	(0.004)	
Non-performing Loans	0.024	-0.076*	
	(0.044)	(0.046)	
Tobin's Q	0.022***	0.045***	
	(0.008)	(0.008)	
Tier 1 Capital	0.039***	0.023*	
	(0.013)	(0.013)	
Constant	-9.351***	-10.516***	-2.475***
	(0.898)	(0.878)	(0.065)
Bank Fixed Effects	Yes	Yes	Yes
N	8917	9508	10711
Pseudo R^2	0.132	0.094	0.044

This table shows the first-stage logit estimation results of the Heckman selection model. The first step estimates the likelihood that a bank becomes an acquirer. The dependent variable is equal to one if a bank makes an acquisition in the relevant year, and zero otherwise. Similar to Srivastav et. al (2018), Asset Growth is a new variable intended to represent a bank's propensity to acquire, but not its risk after acquisition. It is computed as the two-year growth in bank assets prior to the year in which the acquisition was announced.

C.3.2 Heckman Selection Model Second Stage (Logit)

Table 48: Heckman Selection Model Second Stage Results (Logit)

	ΔCapMAES		ΔCapMANSRISK		Change in CapMAΔCoVar	
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis x Pre-merger CapMAES	-0.102	0.025				
	(0.193)	(0.202)				
Crisis x Pre-merger CapMANSRISK			-0.333***	-0.248**		
			(0.110)	(0.112)		
Crisis x Pre-merger CapMAΔCoVaR					-0.275*	-0.326**
					(0.162)	(0.149)
Crisis	-0.769**	-0.896**	-0.182***	-0.199***	-0.773***	-0.850***
	(0.360)	(0.414)	(0.047)	(0.053)	(0.297)	(0.290)
Pre-merger CapMAES	-0.761***	-0.887***				
	(0.071)	(0.075)				
Bank Size	0.256***	0.244***	-0.026***	0.000	0.024	0.058
	(0.079)	(0.092)	(0.010)	(0.011)	(0.046)	(0.051)
Stock Price Growth	0.001	0.000	-0.001***	-0.001***	0.002*	0.002
	(0.002)	(0.003)	(0.000)	(0.000)	(0.001)	(0.001)
ROA	-0.138	-0.325	0.042	0.014	-0.068	-0.175*
	(0.218)	(0.240)	(0.033)	(0.034)	(0.103)	(0.105)
Liquidity	0.007	0.024	0.000	-0.004	0.016	0.019**
	(0.020)	(0.024)	(0.003)	(0.003)	(0.012)	(0.009)
Tangibility	-0.133	-0.138	-0.012	0.000	-0.085	-0.059
	(0.127)	(0.123)	(0.018)	(0.015)	(0.060)	(0.048)
Loans Ratio	-0.013*	-0.013	0.001	0.002**	-0.006	-0.000
	(0.008)	(0.009)	(0.001)	(0.001)	(0.004)	(0.004)
Non-performing Loans	0.039	-0.052	-0.048***	-0.040**	-0.072	-0.148***
	(0.103)	(0.130)	(0.016)	(0.015)	(0.060)	(0.045)
Tobin's Q	0.025	0.034*	-0.003	-0.009***	-0.003	-0.002
	(0.017)	(0.019)	(0.002)	(0.003)	(0.008)	(0.008)
Tier 1 Capital	-0.014	-0.008	-0.009***	-0.002	0.008	0.016
	(0.023)	(0.024)	(0.003)	(0.003)	(0.011)	(0.011)
λ	0.909	0.649	-0.085	0.004	-0.491	-0.322
	(1.277)	(1.420)	(0.109)	(0.104)	(0.662)	(0.611)
Pre-merger CapMANSRISK			-0.370***	-0.447***		
			(0.056)	(0.055)		
Pre-merger CapMAΔCoVaR					-0.169***	-0.116*
					(0.058)	(0.064)
Constant	-4.861*	-5.306*	0.667**	0.865***	1.079	0.259
	(2.781)	(2.982)	(0.290)	(0.313)	(1.454)	(1.302)
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	11907	11907	11836	11836	11691	11691
R^2	0.426	0.522	0.416	0.555	0.224	0.440

This table shows the multivariate regression results of ΔCapMAES, ΔCapMANSRISK, and the change in CapMAΔCoVaR. We control for selection bias using Heckman's Selection Model by including the inverse Mills ratio obtained from the first-stage logit regression. Year fixed effects are included. Robust standard errors are clustered by bank and are in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

Appendix D Ex-Post Analysis

D.1 Ex-Post Difference-in-Differences Analysis

Table 49: Ex-post Difference-in-Differences Analysis for the Acquirers, Pre- and Post-Crisis First Years Excluded

	Obs.	Crisis Non-merging	Obs.	Crisis Merging	Difference	p-value
Δ Asset Growth	194	-0.0778	41	-0.0578	-0.0201	(0.510)
Δ Stock Price Growth	197	43.00	37	25.99	17.00*	(0.063)
Δ Bank Size	225	0.374	42	0.846	-0.472***	(0.000)
Δ ROA	225	-0.0801	42	-0.534	0.454	(0.146)
Δ Return Volatility	230	0.151	42	0.0849	0.0659	(0.108)
Δ Liquidity	225	2.314	42	0.817	1.496**	(0.011)
Δ Tangibility	225	-0.00214	42	0.0456	-0.0477	(0.596)
Δ Loans Ratio	225	-4.045	42	-1.793	-2.251	(0.120)
Δ Non-performing Loans	222	2.391	42	1.588	0.803*	(0.060)
Δ Tobin's Q	225	-8.089	42	-7.729	-0.360	(0.611)
Δ Tier 1 Capital	198	1.432	42	2.124	-0.692	(0.191)

This table shows the comparison of the performance of the acquirers that merged during the 2008 financial crisis with those that did not. For each variable reported below, the Δ*variable* is calculated by subtracting the pre-crisis values from the post-crisis values where post-crisis values are defined for the year 2012 and pre-crisis values are defined for the year 2005. The crisis non-merged group is defined as the banks that did not merge in the years from 2007 to 2010 while the crisis merging group is defined as the banks that merged during those years. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

D.2 Comparison of Pre- and Post-Crisis Risk (NSRISK and ΔCoVaR)

Table 50: Difference-in-Differences Analysis

	Pre-Crisis Obs.	Pre-Crisis	Post-Crisis Obs.	Post-Crisis	Risk Difference	p-value
NSRISK						
No Restriction						
ΔNSRISK	328	-0.00426	75	-0.0712	0.0669***	(0.002)
ΔCapMANSRISK	323	0.0233	70	-0.0461	0.0694***	(0.001)
Relative Target Assets≥0.05						
ΔNSRISK	273	-0.00491	72	-0.0727	0.0678***	(0.003)
ΔCapMANSRISK	268	0.0229	67	-0.0483	0.0712***	(0.001)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
ΔNSRISK	201	0.0123	61	-0.0934	0.106***	(0.000)
ΔCapMANSRISK	198	0.0397	56	-0.0501	0.0899***	(0.000)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
ΔNSRISK	72	-0.0529	11	0.0422	-0.0951**	(0.028)
ΔCapMANSRISK	70	-0.0247	11	-0.0393	0.0146	(0.768)

This table shows the changes in the merged banks' systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 51: Difference-in-Differences Analysis

	Pre-Crisis Obs.	Pre-Crisis	Post-Crisis Obs.	Post-Crisis	Risk Difference	p-value
ΔCoVaR						
No Restriction						
Change in ΔCoVaR	166	0.0807	70	0.0804	0.000319	(0.996)
Change in CapMAΔCoVaR	161	0.302	69	0.197	0.105*	(0.098)
Relative Target Assets≥0.05						
Change in ΔCoVaR	143	0.106	68	0.0854	0.0207	(0.760)
Change in CapMAΔCoVaR	139	0.322	67	0.201	0.120*	(0.070)
Acquirer Assets≤10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	95	0.0828	57	0.0517	0.0312	(0.618)
Change in CapMAΔCoVaR	92	0.371	56	0.194	0.176**	(0.031)
Acquirer Assets>10000 & Relative Target Assets≥0.05						
Change in ΔCoVaR	48	0.152	11	0.260	-0.108	(0.625)
Change in CapMAΔCoVaR	47	0.226	11	0.237	-0.0107	(0.893)

This table shows the changes in the merged banks' systemic risk. The crisis period consists of observations for the years 2007-2010. The p-values are reported with respect to unequal variance (Welch) t-test. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.