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EXPANDING HORIZONS

The Funding of Subsidiaries Equity, “Double Leverage”, and the Risk of Bank Holding Companies

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Financial Institutions after the Crisis: Facing new Challenges and new Regulatory Frameworks

December 2, 2015, Paris

Outline

- Introduction and Overview of the Paper
- “Double Leverage”, Risk, and Capital
  - A Simple Numerical Example
- Analysis on US Bank Holding Companies (BHCs)
  - Data, Variables, and Specification
  - Main Results
  - Dealing with Endogeneity
- Conclusion and Policy Implications

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Introduction

Have you ever heard about "double leverage" inside banking groups of firms?

"Double Leverage"

- *"Double leverage is the situation in which debt is issued by the parent company and the proceeds are invested in subsidiaries as equity"*
  (Board of Governors of the Federal Reserve System, 2012, Bank Holding Company Supervision Manual)
- *Double gearing occurs whenever one entity holds regulatory capital issued by another entity within the same group and the issuer is allowed to count the capital in its own balance sheet. …external capital of the group is geared up twice"*
  (Joint Forum, July 2001, "Compendium of Documents Produced by the Joint Forum")

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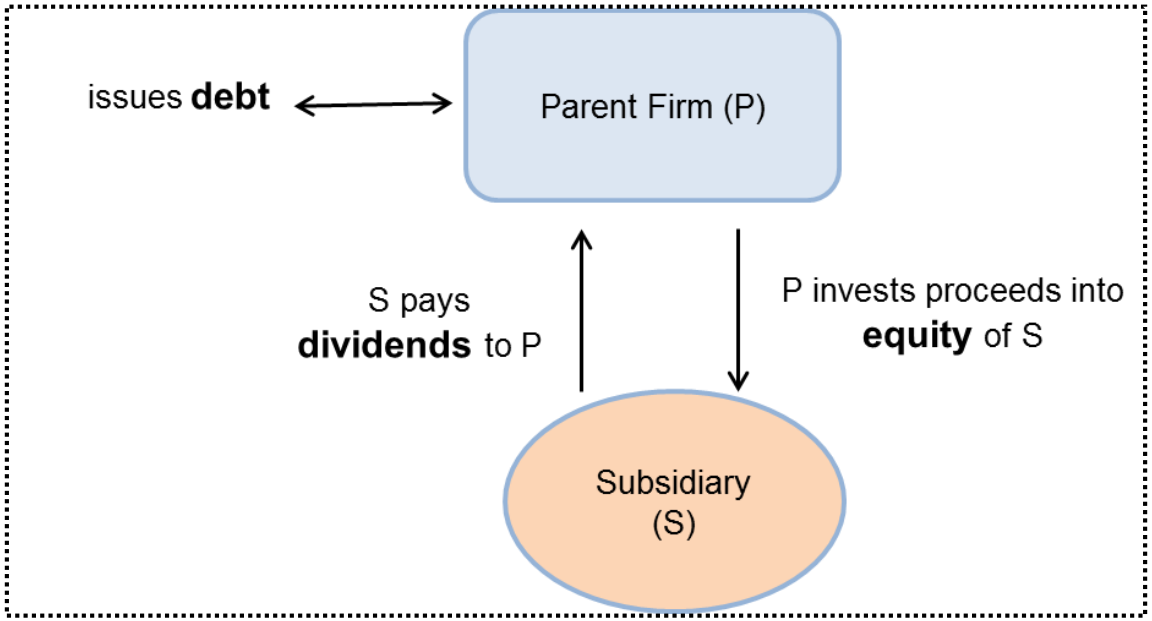

"Double Leverage"

- Financial authorities are concerned on the effect from double leverage on the group-wide capital assessment
  - *"The capital actually available is less than the data implies"* (IMF, 2004)
  - *"The same capital is used simultaneously in two or more legal entities"* (US Office of Thrift Supervision, 2009)

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- The recommendation is to assess the group-wide capital taking into account of reciprocal participations (e.g. with deductions from consolidated capital)
- …Despite of this, by double leveraging banking groups can arbitrage regulatory capital (Dierick (2004); Yoo (2010); Lumpkin (2010))

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=>**This paper** asks on how intra-group funding producing double leverage relates to capital and **risk-taking of banking groups**

The Paper

- Policy Paper
- Discussion on the interaction among double leverage, capital, risktaking
- Empirical analysis on United States BHCs (1990-2014)
  - Risk importantly affected by double leverage
  - => Policy implications

Take-Aways for Researchers and Practitioners

To Academic Researchers

- Only few research on intra-firm financing and related effects on corporate decisions

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To Academic Researchers

- Only few research on intra-firm financing and related effects on corporate decisions

To Practitioners (Regulators, Supervisors, Policy Makers)

- Depart from the current views of financial authorities
- Discuss and offer to their their views quantitative evidence
- Derive hints for more effective monitor on banking groups

References to Academic Literature: Business Groups

- Internal capital markets
  - Non-financial firms: Stein (1997), Shin and Stulz (1998), Hubbard and Palia (1999), Scharfstein and Stein (2000), Matsusaka and Nanda (2002), and Desai, Foley and Hines (2004)
  - Financial firms: Houston, James and Markus (1997), Houston and James (1998), Campello (2002), De Haas and van Lelyveld (2010), and Cetorelli and Goldberg (2012)
- Debt levels of business groups
  - Bianco and Nicodano (2006), Verschueren and Deloof (2006), Manos, Murinde, and Green (2007), De Jong et al. (2011), Luciano and Wihlborg (2013), Luciano and Nicodano (2014)
- Risk incentives inside banking groups
  - Bebchuk and Spamann (2010)

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Double Leverage, Risk, and Capital: Example

- The Bank Holding Companies (BHC) is constituted by the Holding Company (HC) and one Subsidiary (S)

- Stand-alone balance sheets

Holding Company (HC)			
Assets		**Liabilities**	
Loans	L(HC)	Equity	E(HC)
		Debt	D(HC)
Total	L(HC)	Total	E(HC)+ D(HC)

Subsidiary (S)			
Assets		**Liabilities**	
Loans	L(S)	Equity	E(S)
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- Consolidated balance sheet of BHC

Consolidated Balance Sheet of Bank Holding Company (HC + S)			
Assets			
		Liabilities	
Loans	L(HC) + L(S)	Equity	E(HC) + ~~*x**(E(S))~~
~~Book Value of participation in S~~	~~*x**(E(S))~~	Minority Interests	(1−*x*)*(E(S))
		Debt	D(HC) + *x**(E(S)) + D(S)
Total	L(HC) + L(S)	Total	E(HC)+ (E(S))+D(HC)+D(S)

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Double Leverage, Risk, and Capital: Example

- Compute the "Double Leverage Ratio"
  (US Office of Thrift Supervision, Holding Company Handbook, 2009)

$$DLR = \textbf{Equity Invested into S} / \textbf{Equity of HC}$$
$$= x\mathrm{E(S)/E(HC)}$$

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- *DLR* captures how far the stand alone capital of the holding company can cover losses in the subsidiaries

- The issue is more severe when *DLR* >100%
  - The parent capital could not buffer huge losses of S

Double Leverage, Risk, and Capital: Example

Task: Relate *DLR* to the incentive of HC to undertake risk

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- S plays a value neutral strategy with loss/gain π (p=0.5)
- The value of E(HC) varies depending on π
  - If π is a gain, E(HC) raises by $x\pi$
  - If π is a loss and $x\pi$ > E(HC), equityholders are wiped out and creditors bear part of the loss

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- **Delta**: Expected benefit for HC shareholders from the strategy

$$\text{Delta} = \text{Exp}[\text{equity}_{HC} \text{ if S risks} - \text{equity}_{HC} \text{ if S does not risk}]$$

$$= 0.5*(E(HC) + x\pi + 0) - E(HC)$$

Double Leverage, Risk, and Capital: Example

- Assume the following values of the balance sheet items:

Holding Company (HC)			
Assets		**Liabilities**	
Loans	140	Equity	30
		Debt	110
Total	140	Total	140

Subsidiary (S)			
Assets		**Liabilities**	
Loans	110	Equity	50
		Debt	60
Total	110	Total	110

- Compare two different cases for for the HC ownership:
  1) $x = 80\%$
  2) $x = 100\%$

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- Compare two different cases for for the HC ownership:

1) $x = 80\% \rightarrow DLR = (80\%*50)/30 =$ **133%**

2) $x = 100\% \rightarrow DLR = (100\%*50)/30 =$ **167%**

Double Leverage, Risk, and Capital: Example

- *DLR*, Group Capital Ratio (=Equity/Assets), Delta
- $\pi = 40$

	DLR = $[x * E(S)] / E(HC)$	**Capital Ratio =** $\frac{E(HC) + (1-x) * E(S)}{L(HC) + L(S)}$	**Delta** $0.5*(\pi - \text{DLR}^{-1}*\text{E(S)})$
	133% (x = 80%)	16%	1
	167% (x = 100%)	12%	5
Percentage Change	**+20%**	**-25%**	**+400%**

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Double Leverage, Risk, and Capital: Example

Can be further showed that,

- The derivative of Delta is increasing in *DLR* and equal to

$$\frac{\partial(Delta)}{\partial DLR} = \frac{1}{DLR^2} * 0.5 * E(S)$$

- The derivative of the Capital Ratio is decreasing in *DLR* and equal to

$$\frac{\partial(Capital\ Ratio)}{\partial DLR} = -\frac{E(HC)}{L(HC) + L(S)}$$

- The gain for shareholders is more rapidly growing in *DLR* than how fast the capital ratio decraeses in *DLR* iff:

$$\frac{L(HC) + L(S)}{x} * 0.5 > DLR$$

Which is likely to be the case;
in the example it would be for 125%>*DLR* when x=100%

Double Leverage, Risk, and Capital

- Take-aways from the example
  - A holding company increasingly investing in the equity of subsidiaries as compared to its own equity capital (thus, having higher “double leverage”) might exhibit higher levels of risk
  - All else equal, this type of risk-incentive might not be entirely offset by the consolidated capital

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Empirical Specification

- United States Bank Holding Companies (BHCs) during 1990q1 - 2014q1 (SNL Financial/CRSP)

- Y: Risk-Taking (*stdev*)
  - Quarter standard deviation of holding company stock returns
    Galloway, Lee and Roden (1997), Lee (2002), Stiroh (2006), Lepetit et al (2008), Laeven and Levine (2009)

- X: Double Leverage Ratio (*DLR*)

- Z: Additional controls
  - size, market-to-book, risk weighted capital, loans, number of subs, income diversification, crisis dummy

[Appendix]

[Stats]

Name	Mean	Std dev	1st Quartile	Median	3rd Quartile
stdev (%)	6.704	7.601	2.153	4.564	8.408
DLR (%)	108.505	22.453	97.870	100.000	116.570
Firms with *DLR* > 100%	49.6	50.0	0.000	0.000	100
stdev (%)	7.572	7.594	2.934	5.450	9.384
DLR (%)	123.022	22.736	107.06	116.75	131.12

	BHCs with Lower Risk (a)	BHCs with Higher Risk (b)	Significance of Difference |a-b|	Prob {*DLR*(a) ≤ *DLR*(b)}
DLR	*stdev* < 1st quartile **103.811%**	*stdev* ≥ 1st quartile **106.481%**	***	55%
N	5712	21455		
DLR	*stdev* < 2nd quartile **104.222%**	*stdev* ≥ 2nd quartile **107.464%**	***	55.4%
N	12947	14220		
DLR	*stdev* < 3rd quartile **104.763%**	*stdev* ≥ 3rd quartile **109.384%**	***	56.8%
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- *DLR* is higher among “riskier” BHCs (Wilcoxon rank-sum test)
- Probability that BHCs in the upper quartiles of risk have also higher *DLR* always above 50 %

	Risk (pooled OLS)
stdev (t-1)	0.320***
	(0.021)
DLR (t-1)	0.080***
	(0.022)
SIZE (t-1)	0.201**
	(0.084)
MKBK (t-1)	-0.006***
	(0.001)
RISKBASED CAP (t-1)	0.305**
	(0.139)
LOANS_DEPOSITS (t-1)	0.000
	(0.005)
NONBANK SUBS (t)	0.006
	(0.013)
DEPOSITORY SUBS (t)	-0.314*
	(0.171)
NONINTEREST INCOME (t-1)	-0.149*
	(0.077)
DLR(t-1)*RISKBASED CAP (t-1)	-0.004***
	(0.002)
DLR(t-1)*CRISIS_DUMMY	0.042**
	(0.017)
Quarter Dummies	Yes
N	17014
R^2	0.312

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- Raising in double leverage the stock returns of the parent become more volatile
  - Reflect variability in consolidated revenues
- **Economic impact**: Taking the average across specifications, a marginal change in *DLR* induces a 22% increase in risk
- Similar pattern also from **panel data analysis**

Attenuate Endogeneity

- Endogeneity might spoil regression results

- Implement several econometric techniques for pinning down the endogeneity issue and detect some causality from *DLR* on *stdev*:
  - Propensity Score Matching
  - Regression Discontinuity
  - Other tests

Attenuate Endogeneity: PSM

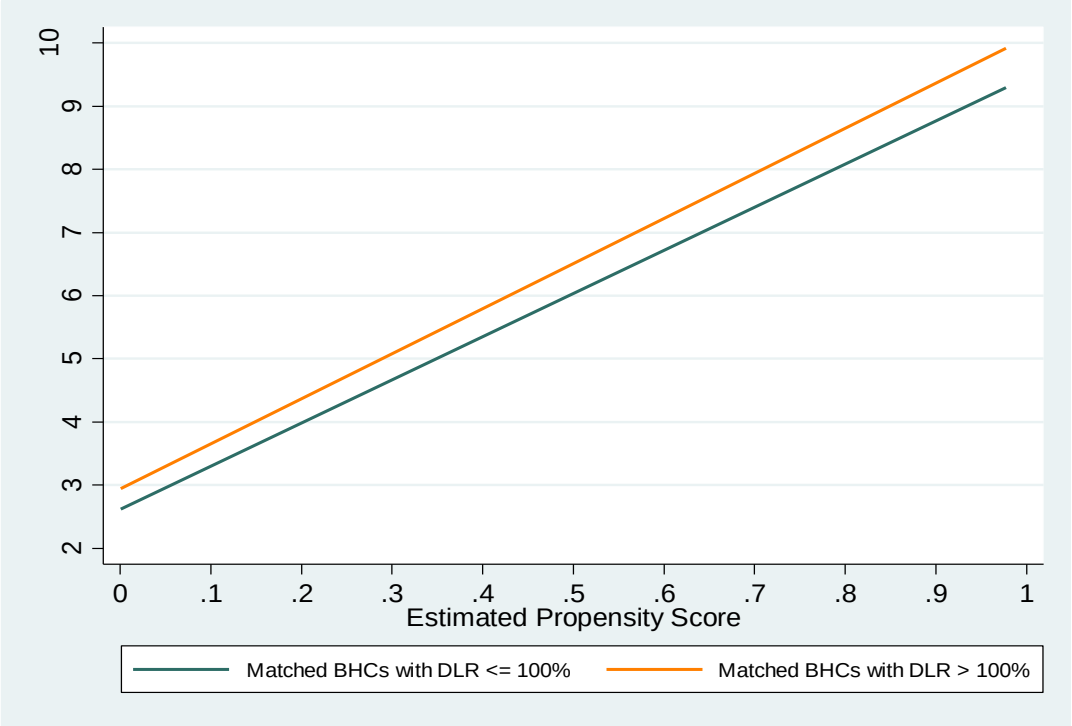
- Treatment effects estimated by *n*-to-*n* propensity score matching
  - Treatment defined by *DLR* above/below 100%

Output from Propensity Score Matching		
		Mean
Propensity Score		0.574
Bias (%)	Before	36.541
	After	2.199
ATT		0.453
ATE		0.478

  - Average Treatment Effect (ATE): Expected gain in risk-taking from being “double levered” for a randomly selected unit of the population

Attenuate Endogeneity: PSM (cont´d)

- Treatment effects estimated by *n*-to-*n* propensity score matching
  - Treatment defined by *DLR* above/below 100%



  - stdev increases in the prop score
  - Risk of matched “double levered” BHCs always higher
  - ATE = 0.478

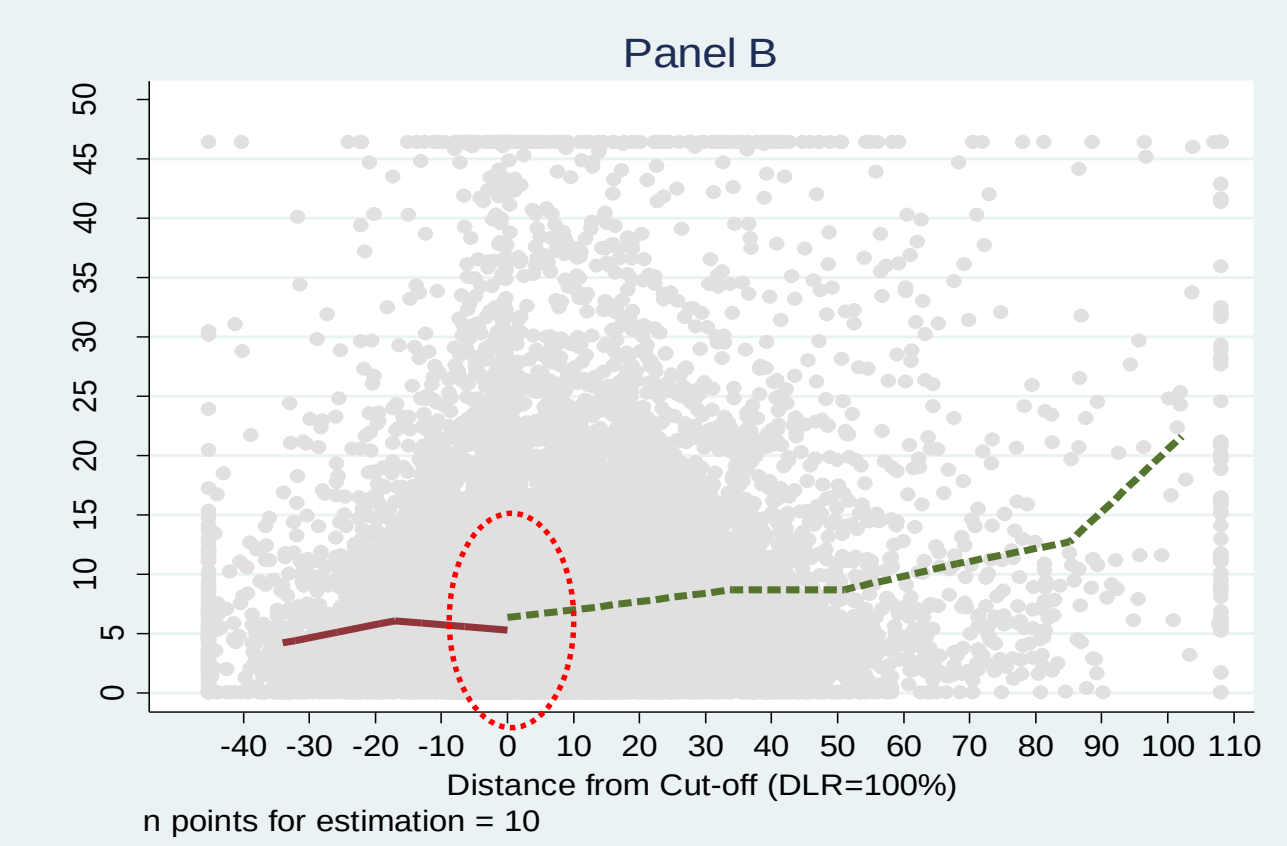
Attenuate Endogeneity: RD

- Test whether in the neighborhood of *DLR*=100%, there is a discontinuous jump in *stdev* (causal impact from the treatment)

Cut-off in *DLR*	Bandwidth	Wald Estimator	Standard Error	P-value
100%	Optimal = 3.943	1.038	0.257	0.000
100%	50% of Optimal = 1.971	0.946	0.312	0.000
100%	200% of Optimal = 7.886	1.104	0.211	0.000
90.82%	Optimal = 5.100	-0.157	0.399	0.694
97.87%	Optimal = 2.693	-0.306	0.294	0.297
116.57%	Optimal = 5.176	0.044	0.504	0.931
135.58%	Optimal = 6.422	0.228	1.014	0.822

- RD approach detects jump in risk only for *DLR*=100%, not other percentiles

Attenuate Endogeneity: RD (cont´d)



- RD detects a jump in risk at *DLR*=100%, while not for other percentiles

Attenuate Endogeneity: Other Tests

- Models with endoegenous treatment effects using maximum likelihood and two-step procedure (Heckman (1976, 1978); Maddala, (1983))

- OLS regression on two the sub-samples
  - *stdev* is positively affected by *DLR* only for BHCs where *DLR* > 100%
  - Chow test detects the presence of a structural break at *DLR* = 100%

[Output1]

[Output2]

Changes in Corporate Taxes and *DLR*

- Increases in corporate taxation make larger tax shields
  - More levered capital structures (Schandlbauer (2014, Wp))
  - Double leverage techniques become cheaper
- Examine the tax increases at the country-level in the US during 2000-2010
  - Diff-in-diff on the changes in *DLR*
    - $\Delta DLR_{i,t} = \alpha + \beta * Tax\ Increase + \epsilon_{i,t}$
    - Estimated ß > 0
  - Use $Tax\ Increase$ as instrument for *DLR* (2sls)
    - $stdev$ positively affected by the instrumented *DLR*

[Output Diff]
[Output 2sls]

Further Robustness Tests

- Other measure for risk-taking
  - Negative and significant relationship between *DLR* and *zscore*
- Compute other ratios for the holdings of subsidiaries´ equity
  - Ratios of over (i) assets and (ii) total investment into subs have no significant coefficients
- Test effect on risk from the investment of the parent into equity of banking/non-banking subsidiaries
  - Investment into banking subs is more strongly correlated with *stdev*

Output1
Output2

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Conclusion

- Opportunities for double leveraging inside banking groups can distort risk-taking and induce losses which are not offset by consolidated capital
  - "Risk of interdependence" (Board of Governors of the Federal Reserve System, 2012)
  - Consolidated capital requirements do not capture subtle issues of conglomerates (Jackson, 2005)
- Policy Implication: More effective monitoring (e.g with supervisory inspections, moral suasion, supervisory letters…) and/or intervention on the design of capital rules
- Relevant issue also in the context of recent proposals on the capital regulation of banking groups
  - So called "2013 rule" in the US: more stringent leverage standards for covered BHCs and their Subs Insured Depository Institutions
  - New rules from the FED for foreign banks operating in the US

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End of Presentation

Variable Name	Description
stdev (%)	Quarterly standard deviation of parent company stock returns
zscore	Annual z-score: (ROA + CAP) / Standard Deviation of ROA
DLR (%)	Parent company total equity investments in subsidiaries as a percent of the total equity capital of the parent company
DLR_DUMMY (%)	Dummy variable assuming value 1 if DLR>100%, while assuming value 0 if DLR≤100%
CAP (%)	Total equity as a percent of total assets
RISKBASED CAP (%)	Total risk based capital ratio: total capital (tier 1 core capital + tier 2 supplemental capital)/risk-adjusted assets
MKBK (%)	Price as a percent of book value per share
SIZE	Natural logarithm of parent firm total assets
LOANS (%)	Net loans as a percent of total deposits
NONINTEREST INCOME (%)	Total non-interest income as a percent of total assets
NONBANK SUBS (# of)	Parent company total number of nonbank subsidiaries
DEPOSITORY SUBS (# of)	Parent company total number of federally insured banking or thrift subsidiaries owned
EQUITY IN BANKING SUBS (%)	Parent company equity investments in bank subsidiaries and associated banks (common and preferred stock) as a percent of the total equity capital of the parent company. Banking subsidiaries include: subsidiary banks and associated banks, subsidiary bank holding companies and associated bank holding companies.
EQUITY IN NON-BANK SUBS (%)	Parent company equity investments in nonbank subsidiaries and associated nonbank companies (common and preferred stock) as a percent of the total equity capital of the parent company
EQUITYINSUBS_TA (%)	Parent company equity investments in subsidiaries (common and preferred stock) as a percent of the total assets of the parent company.
EQUITYINSUBS_TINV (%)	Parent company equity investments in subsidiaries (common and preferred stock) as a percent of the total investments of the parent company in subsidiaries.

[Back]

Name	Mean	Std dev	1st Quartile	Median	3rd Quartile
Dependent Variables					
stdev (%)	6.704	7.601	2.153	4.564	8.408
zscore (Annual)	85.377	123.369	24.534	54.397	104.126
Regressors					
DLR (%)	108.505	22.453	97.870	100.000	116.570
DLR_DUMMY	0.496	0.500	0.000	0.000	1.000
CAP (%)	9.305	2.939	7.470	8.960	10.650
RISKBASED CAP (%)	15.310	5.359	11.920	14.030	17.050
MKBK (%)	141.741	71.736	91.200	130.100	178.300
SIZE (Natural Log)	11.009	1.560	9.999	10.723	11.553
LOANS (%)	78.871	18.112	67.590	79.290	90.610
NONINTEREST INCOME (%)	1.245	2.492	0.580	0.880	1.300
NONBANK SUBS (N of)	1.582	5.258	0.000	0.000	1.000
DEPOSITORY SUBS (N of)	1.073	0.369	1.000	1.000	1.000
EQUITY IN BANKING SUBS (%)	105.225	25.546	95.611	99.962	115.031
EQUITY IN NON-BANK SUBS (%)	2.056	6.245	0.000	0.000	0.972
EQUITYINSUBS_TA (%)	91.054	14.284	89.236	95.694	98.809
EQUITYINSUBS_TINV (%)	97.493	6.899	98.959	100.000	100.000

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	Risk (Pooled OLS on Matched Sample)	
	(1)	(2)
DLR_DUMMY	0.685***	
	(0.223)	
DLR		0.043***
		(0.008)
SIZE	-0.734*	-0.671*
	(0.405)	(0.387)
MKBK	-0.013***	-0.013***
	(0.002)	(0.002)
RISKBASED CAP	-0.150***	-0.111***
	(0.144)	(0.133)
Constant	18.161***	12.470**
	(5.289)	(5.110)
Quarter Dummies	Yes	Yes
Firm Effects	Yes	Yes
N	20619	20619
R^2	0.329	0.333

	Risk (Model with Endogenous Treatment Effects)	
	Maximum Likelihood	Two-Step
DLR_DUMMY	2.195***	3.133***
	(0.468)	(0.823)
SIZE	0.009	-0.071
	(0.080)	(0.076)
MKBK	-0.009***	-0.008***
	(0.002)	(0.001)
RISKBASED CAP	-0.099***	-0.063*
	(0.024)	(0.034)
Constant	6.496***	6.296***
	(1.168)	(0.546)
Quarter Dummies	Yes	Yes
N	20619	20619
Wald Test(χ^2)	11.730***	
λ		-1.429***
		(0.498)

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	Risk (Pooled OLS)	
	***DLR* ≤ 100**	***DLR* > 100**
stdev (t-1)	0.269***	0.335***
	(0.025)	(0.026)
DLR (t-1)	0.003	0.032***
	(0.008)	(0.011)
SIZE (t-1)	0.220***	0.104*
	(0.079)	(0.057)
MKBK (t-1)	-0.004**	-0.007**
	(0.002)	(0.002)
RISKBASED CAP (t-1)	-0.075***	-0.181***
	(0.016)	(0.052)
Constant	3.481**	4.253**
	(1.554)	(2.128)
Quarter Dummies	Yes	Yes
N	9302	10759
R^2	0.223	0.370
Chow Test for Structural Change		
H_0: Regression Coefficients are not stable at *DLR*=100%		
F(6, 19957)	16.31	
P-Val	0.000	

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	Risk (Pooled OLS)		
	(1)	(2)	(3)
stdev (t-1)	0.332***	0.321***	0.341***
	(0.028)	(0.020)	(0.028)
SIZE (t-1)	0.100*	0.090*	0.122*
	(0.060)	(0.053)	(0.069)
MKBK (t-1)	-0.008***	-0.007***	-0.008***
	(0.002)	(0.001)	(0.002)
RISKBASED CAP (t-1)	-0.128***	-0.140***	-0.177***
	(0.030)	(0.021)	(0.028)
EQUITY IN BANKING SUBS (t-1)	0.028***		
	(0.007)		
EQUITY IN NON-BANKING SUBS (t-1)	0.035**		
	(0.014)		
EQUITYINSUBS_TA (t-1)		-0.010	
		(0.006)	
EQUITYINSUBS_TINV (t-1)			0.005
			(010)
Constant	1.972	6.426***	4.687***
	(1.828)	(1.293)	(1.771)
Quarter Dummies	Yes	Yes	Yes
N	11306	20419	11253
R^2	0.301	0.293	0.295

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	Risk (Panel Analysis)		
	(1)	(2)	(3)
SIZE	-0.952*	-0.468	-1.286**
	(0.495)	(0.336)	(0.591)
MKBK	-0.019***	-0.013***	-0.019***
	(0.003)	(0.002)	(0.003)
RISKBASED CAP	-0.150***	-0.176***	-0.209***
	(0.051)	(0.037)	(0.052)
EQUITY IN BANKING SUBS	0.041***		
	(0.009)		
EQUITY IN NON-BANKING SUBS	0.006		
	(0.017)		
EQUITYINSUBS_TA		-0.014	
		(0.009)	
EQUITYINSUBS_TINV			-0.009
			(0.020)
Constant	18.865***	17.908***	28.104***
	(5.654)	(4.301)	(6.681)
Quarter Dummies	Yes	Yes	Yes
Firms Dummies	Yes	Yes	Yes
N	11357	20702	11303
R^2 *(Overall)*	0.178	0.185	0.149

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	zscore (Pooled OLS on Annual Averages)
DLR	-0.723***
	(0.138)
SIZE	2.129
	(1.731)
MKBK	0.282***
	(0.055)
RISKBASED CAP	1.158
	(1.320)
Constant	137.428***
	(38.030)
Year Dummies	Yes
N	14012
R^2	0.099

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	Panel B			
	ΔDLR	*ΔDLR*	*ΔEQUITYINSUBS_TA*	*ΔEQUITYINSUBS_TA*
Tax Increase (t)	0.855*		-0.050	
	(0.464)		(0.823)	
Tax Increase (t-1)		1.019**		-0.082
		(0.519)		(0.268)
Constant	-0.424	-0.424	1.677**	1.677**
	(0.451)	(0.451)	(0.825)	(0.825)
Quarter Dummies	Yes	Yes	Yes	Yes
N	1361	1361	1360	1360
R^2	0.085	0.085	0.084	0.084

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Panel C		
	First Stage	Second Stage
	DLR	*stdev*
DLR		0.809**
		(0.381)
SIZE	-0.096	0.545*
	(0.403)	(0.314)
DEPOSITORY SUBS	0.771	-1.168
	(1.742)	(1.403)
NONBANK SUBS	0.227***	-0.200*
	(0.080)	(0.105)
Constant	106.693***	-84.268**
	(4.562)	(40.421)
Instrument:		
Tax Increase	4.694*	
	(2.400)	
N	22410	22410
F Statistic	9.15***	1.96*
Angrist-Pischke *F* Statistic	3.83*	
C Test		19.986***
Cragg-Donald Wald *F* Statistic		22.4
Critical Values for Cragg-Donald Wald F Statistic	10% max size distortion	16.38
	15% max size distortion	8.96
	20% max size distortion	6.66
	25% max size distortion	5.53

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Assessment of Group-Wide Capital

***x* = 80%**	**HC**	**S**	**Group-Wide Total**
Equity Capital	30	50	80
Deduct Investment in S	-40	0	-40
Capital Required (10%*Assets)	-14	-11	-25
Capital Surplus / Deficit (-)	-24	39	15

***x* = 100%**	**HC**	**S**	**Group-Wide Total**
Equity Capital	30	50	80
Deduct Investment in S	-50	0	-50
Capital Required (10%*Assets)	-14	-11	-25
Capital Surplus / Deficit (-)	-34	39	5