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Depositor market discipline: New evidence from selling failed banks

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This paper studies depositor behavior following the acquisition of failed banks by healthy banks in FDIC-supervised transactions. Using a US bank branch-based dataset spanning 2007 to 2014 we find that failed bank depositors discipline acquiring banks post-resolution. This appears to be related to features of the acquiring banks' asset quality and loan composition, but it may also be linked to irrational desciplinary behavior or post acquisition integration issues. We also find some evidence that depositor market discipline may have an impact on the competitive fetaures of local banking markets post resolution.

1. Introduction

In recent years substantial attention has been paid to the issue of market discipline in banking (Chesini & Giaretta, 2017; Danisewicz, McGowan, Onali, & Schaeck, 2018; Godspower-Akpomiemie & Ojah, 2021; Hett & Schmidt, 2017). Market discipline in banking refers to a situation in which savers and investors, such as uninsured depositors and subordinated debt holders, take actions against their banks for excessive risk-taking behavior by demanding higher yields or reducing their investment (Berger, 1991; Nier and Baumann, 2006). While the extant literature finds evidence of market discipline at banks, the effectiveness of market discipline relies on the extent to which the bank closure regime imposes losses on uninsured and unsecured creditors (Bennett, Hwa, & Kwast, 2015). During major financial crises, however, bank regulators may be reluctant to impose heavy losses on savers or investors when closing failed bank if they believe such action may lead to potential bank runs and other short-term disruption.

From 2008 through 2010, the Federal Deposit Insurance Corporation (FDIC) disposed of over 300 failed banks mainly using the purchase and assumption (P&A) method.[1] In a typical P&A transaction, the FDIC auctions a failed bank's (insured and uninsured) deposits to a healthy assuming bank. The branches of the failed bank are then reopened by the assuming bank the day after the formal closure of the failed bank by its chartering authority. Customers of the failed institution automatically become customers of the assuming institution and gain access to their deposits. Consequently, insured and uninsured depositors, in most cases, face zero losses and minimum delay in access to their funds access.[2]

Examining P&A transactions during the crisis (over 2008–2010), Bennett et al. (2015) find evidence of *ex ante* depositor market discipline as depositors withdrew their funds well before bank failure. While they conclude that market discipline is alive and well, important questions remain. Does depositor market discipline cease once a healthy bank acquires the branch network of an ailing bank or do such forces remain in place? The answer to this question are important for two main

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[1] The financial crisis that started in late 2007 witnessed a wave of bank failures in the US between 2008 and 2010. Only a total of 29 institutions failed during the seven years prior to 2007, whereas the number of commercial and savings and loan institution failures increased significantly from 2008 and peaked in 2010. The number then dropped sharply afterwards.

[2] Insured deposits are typically the largest claims with an average (at failure) of approximately 90% of total claims, whereas uninsured deposits are only about 2% of total claims (Bennett et al., 2015).

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reasons. First, if depositor market discipline becomes weaker after the P&A transaction, then regulators need to consider the extent to which market discipline can be preserved after such regulatory interventions. Second, if depositor market discipline remains effective, we have lessons to learn about depositor behavior in a regulatory environment where explicit deposit insurance is well established and government involvement in dealing with failed banks is robust.[3]

This paper analyzes the behavior of depositors after their bank failed and their branches are sold to a healthy bank by the FDIC. We track the deposit flows and market shares of these branches post-resolution and use a difference-in-difference (DID) approach to test the hypothesis that depositors who experience bank failure continue to monitor and discipline their new owner bank. We find that both the deposit growth and market share of failed bank branches fall after healthy bank acquisition. While the deposit growth rates of such branches recover after two years, the recovery of deposit market shares remains elusive even after four years. We also find that the first lag of the charge-off ratio has a negative impact on the deposit growth rate, which suggests that failed bank depositors discipline acquiring banks post-resolution due to their concerns relating to the acquiring banks' asset quality and potential similarity in terms of loan composition. There is weak evidence that market discipline imposed by failed bank branch depositors is related to irrational depositor behavior as branches struggle to maintain depositor market share, even though acquiring banks' core capital adequacy level is much improved. The disciplinary force could also be driven by the possibilities that depositors, for various reasons, are unhappy with the way in which the new acquiring bank does business, or there may be various integration issues that result in deposit share declining (Sherman & Rupert, 2006; Williams, 2015). There are also some unintended consequences of these bank resolutions conducted by the FDIC on market competition. We find that failed bank branches with higher deposit market shares suffer most within their Metropolitan Statistical Area (MSA) which may lead to greater competition post-resolution in the banking market.

Our findings make two noteworthy contributions to the literature on depositor market discipline. First, the established literature focuses on depositor behavior in surviving banks during the crises (Berger & Turk-Ariss, 2015) or on the *ex ante* effects prior to bank resolutions (Bennett et al., 2015). Our unique branch-level deposit data sample allows us to analyze the the impact of bank failure on depositor behavior both prior to and after bank resolution. Second, the use of the DID approach allows us to control for time-varying, macro-level factors that affect all branches, irrespective of their involvement in P&A transactions. This approach allows us to analyze depositor behavior based on their reaction to an assuming banks financial fundamentals as well as on broader macroeconomic conditions, something only a handful of prior studies have done (e.g. Levy-Yeyati, Peria, & Schmukler, 2004; Martinez-Peria & Schmukler, 2001).

The paper proceeds as follows. Section 2 presents previous literature on depositor market discipline and our research hypotheses. The next section explains our empirical strategy for testing for depositor behavior post-resolution. Section 4 discusses the construction of our data sample, and Section 5 analyses our results. Section 6 presents additional robustness tests. The concluding section summarizes our findings and discusses policy implications.

2. Literature review and hypothesis development

The research on depositor discipline has two main branches.[4] The first focuses on whether riskier banks or banks in relatively weaker financial condition face higher costs of uninsured deposits. This strand of literature on price market discipline generally concludes that the interest rates paid on uninsured deposits are sensitive to banks' risk profile or underlying condition (Baer & Brewer, 1986; Brewer & Mondschean, 1994; Calomiris & Powell, 2001; Cargill, 1989; Cook & Spellman, 1996; Hannan & Hanweck, 1988; Jagtiani & Lemieux, 2001; Karas, Pyle, & Schoors, 2013; Martinez-Peria & Schmukler, 2001).

The second branch examines quantity market discipline, in other words, whether depositors discipline their banks by withdrawing their deposits if they believe their bank is in distress. Two theories have been advanced to explain depositor withdrawal behavior. The first stresses that depositors are able to discriminate between solvent and insolvent banks, and banks with weaker financial fundamentals experience greater deposit withdrawals (Kane, 1987; Gorton, 1988; Saunders & Wilson, 1996; Calomiris & Mason, 1997). Using bank-level data, evidence shows that depositors adjust their holdings of uninsured deposits in response to deteriorating bank specific fundamentals (Goldberg & Hudgins, 1996, 2002; Billett, Garfinkel, & O'Neal, 1998; Birchler & Maechler, 2001; Maechler & McDill, 2006; Bennett et al., 2015). A number of studies find insured as well as uninsured deposits provide market discipline, albeit with comparatively lower severity, which suggests that insured depositors also are a source of market discipline (Park & Peristiani, 1998; Cook & Spellman, 1996; Martinez-Peria & Schmukler, 2001; Davenport & McDill, 2006; Iyer & Puri, 2012; Iyer, Puri, & Ryan, 2016; Karas et al., 2013). Other studies examining the flow of total deposits find overall consistent results (Barajas & Steiner, 2000; Calomiris & Powell, 2001; Ungan, Caner, & Özyıldırım, 2008; Wu & Bowe, 2012; Berger & Turk-Ariss, 2015). These studies further add that periods of financial crisis may make depositors naturally more vigilant, providing them with a 'wake-up call' that strengthens market discipline (Karas et al., 2013; Martinez-Peria & Schmukler, 2001). Moreover, despite the efforts from the FDIC to sell failed banks to healthy acquirors using P&A transactions, most banks in a systemic financial crisis experience liquidity and budget constraint (Acharya & Yorulmazer, 2007). Therefore, depositors of failed banks may exert more market discipline than those of surviving banks, suggesting *Hypothesis 1a* as follows:

Hypothesis 1a. *Following the sales of failed banks, deposit flows and market shares decrease for failed banks' branches.*

In contrast, Jordan, Peek, and Rosengren (1999) examine deposit level changes following formal action announcements and improved disclosure for problem banks during a banking crisis and find only a moderate decline in deposit levels. Gilbert and Vaughan (2001) find that public announcements of formal enforcement actions for banks in the 1990s did not lead to fall in total deposits. Foregoing analysis thus suggests that as depositors of failed banks experienced minimum disruption as well as losses as a result of regulatory resolution arrangements during the financial crisis, these depositors may lose incentives to scrutinize and discipline acquiring banks. We formulate *Hypothesis 1b* as follows:

Hypothesis 1b. *Following the sales of failed banks, deposit flows and market shares increase or stay constant for failed banks' branches.*

The second theory argues that excessive deposit withdrawals are driven, at least in part, by panic and are unrelated to the solvency of the bank (Calomiris, 2007). One class of models suggests that panics are a result of coordination problems among depositors, namely, bank runs occur simply because depositors believe that others will run (Bryant,

[3] US government, for example, has increased deposit insurance coverage (e.g. Dodd-Frank), used capital injections (e.g. Troubled Asset Relief Program - TARP), bailed out troubled financial institutions (e.g. AIG), increased central bank lending (e.g. Term Auction Facility - TAF), expanded discount window lending authority under Federal Reserve 13(3), introduced more explicit too-systemically-important-to-fail protection of large financial institutions (e.g. Supervisory Capital Assessment Program – SCAP).

[4] Gilbert (1990), Flannery (1998, 2001) and Flannery and Nikolova (2004) provide literature surveys on market discipline of banks.

1980; Diamond & Dybvig, 1983; Waldo, 1985; Postlewaite & Vives, 1987; Goldstein & Pauzner, 2005; Rochet & Vives, 2004). Depositors withdraw indiscriminately from both insolvent and solvent banks because they lack bank-specific information about the soundness of a particular bank. Withdrawal decisions are made on the basis of aggregate or 'noisy' information such as the condition of the economy as a whole, in which case all banks can be perceived to be risky. Consumers then withdraw enough to cause a panic (Calomiris & Kahn, 1991; Chari & Jagannathan, 1988; Chen, 1999; Chen & Hasan, 2008; Jacklin & Bhattacharya, 1988). Empirical evidence of asymmetric information based bank runs has been well documented. Gorton (1988) studies bank panics during the National Banking Era (1865–1914) and finds that bank panics were closely associated with the business cycle. In a related paper, Miron (1986) presents evidence that bank runs tend to be correlated with extreme seasonal fluctuations in the liquidity needs of depositors. Levy-Yeyati et al. (2004) and Martinez-Peria and Schmukler (2001) find evidence of increased depositor sensitivity to macroeconomic risk and reduced sensitivities to bank-specific factors. While Bennett et al. (2015) find that depositors generally seem able to distinguish between very risky and safe banks, they appear to have trouble assessing the risk of moderately risky banks and tend to treat them more like very risky banks. Hasan, Jackowicz, Kowalewski, and Kozłowski (2013) further find that depositor behavior is more strongly influenced by negative press rumors concerning parent companies than by bank fundamentals.

In this study, we assume that it is challenging to discipline banks rationally during a systemic crisis as bank-specific information (i.e., financial fundamentals) can be overwhelmed by 'noise' and all banks are perceived to be risky. Accordingly, depositors discipline banks by withdrawing their funds because of irrational behavior (Levy-Yeyati et al., 2004 and Martinez-Peria & Schmukler, 2001). This possible outcome leads to our alternative *Hypothesis 2a*:

Hypothesis 2a. *Following the sales of failed banks, depositors of failed banks discipline acquiring banks disregarding acquiring banks' financial fundamentals.*

Some studies examine how explicit deposit insurance affects depositor behavior. Depositors are said to be largely uninformed of deposit insurance pre-crises (Bowyer, Thompson, & Srinivasan, 1986; Steiger, Simon, & Montgomery, 2001; Inakura & Shimizutani, 2010; Safakli & Guryay, 2007). Their knowledge about deposit insurance is then swiftly enhanced from the outset of crises, which leads to a rise in market discipline during the crisis and post-crisis periods (Karas et al., 2013; Martinez-Peria & Schmukler, 2001). Based on survey data, Goedde-Menke, Langer, and Pfingsten (2014) find that enhanced knowledge about deposit insurance over the 2008–2010 global financial crisis was short-lived (for only one year).

Early evidence that finds bank fundamentals have a lesser adverse effect on the pricing and growth of insured deposits than larger uninsured deposits, indicates that the difference in disciplining behavior is implicitly related to deposit insurance coverage (Cook & Spellman, 1996; Davenport & McDill, 2006; Park & Peristiani, 1998). Nevertheless, studies on various Latin American countries (Martinez-Peria & Schmukler, 2001) and India (Iyer & Puri, 2012) find that deposit insurance is only partially effective in preventing bank runs. There is stronger empirical evidence that the introduction of explicit deposit insurance reduces depositor discipline (Ioannidou & De Dreu, 2019; Karas et al., 2013; Peresetsky, 2008). Martin, Puri, and Ufier (2018) observe an outflow of uninsured deposits from the bank following negative regulatory news and find that government deposit guarantees, both regular deposit insurance and temporary deposit insurance measures, reduce the outflow of deposits. In a cross-country study of 30 OECD and emerging markets between 1990 and 1997, Demirgüç-Kunt and Huizinga (2004) find that banks with better capitalization, profitability and liquidity are found to be more successful in attracting deposits. In the presence of explicit insurance scheme, this relationship is muted, suggesting weaker market discipline. Berger and Turk-Ariss (2015) suggest that raising deposit insurance coverage limits, reducing co-insurance, and rescuing troubled institutions may have eroded depositor discipline during the global financial crisis in both the US and EU. Studying a sample of banks located in 22 OCED countries covering the period from 2005 to 2014, Chesini and Giaretta (2017), however, find that deposit market discipline is exerted differently in diverse ecnomic conditions.

Despite the potential erosion of market discipline due to deposit insurance scheme, various studies show that both uninsured and insured depositors can use bank financial fundamentals to discipline banks (Kane, 1987; Gorton, 1988; Saunders and Wilson, 1996; Calomiris & Mason, 1997). In this study, we formulate *Hypothesis 2b* as follows:

Hypothesis 2b. *Following the sales of failed banks, depositors of failed banks discipline acquiring banks based on acquiring banks' financial fundamentals.*

3. Methodology

We use a DID approach that allows us to capture differences in deposit flows between branches of failed banks and those of surviving banks. The branch-based panel identification strategy that we employ captures both spatial and temporal dynamics of the dependent variables. Moreover, all regressions control for fixed effects at the branch, metropolitan statistical area (MSA) and time (year) dimensions. Following Petersen (2009), regression statistics are obtained by clustering standard errors across all three named dimensions to ensure that they are unbiased and estimation of confidence intervals is accurate.

We utilize two variables to measure the effects of market discipline at the bank branch level –deposit growth (*DG*) and deposit market share (*DS*) of a branch within the MSA. As the first step of our analysis, we establish the dynamics of the aforementioned variables before and after the completion of the P&A transaction for failed bank branches (the treatment group) relative to branches of surviving banks (the control group). Two following baseline specifications are used for determining these dynamics:

$$Y_{it} = \beta_0 + \beta_1 BPA_{it} + \beta_2 APA_{it} + \mu_i + \nu_t + \epsilon_{it} \tag{1}$$

$$Y_{it} = \beta_0 + \beta_1 BPA_{it} + \sum_{\tau=1}^{4} \beta_2^{t+\tau} APA_{i(t+\tau)} + \mu_i + \nu_t + \epsilon_{it} \tag{2}$$

where subscript i indexes individual branches and t indexes years. Hence, Y_{it} represents the two dependent variables, deposit growth rate (*DG*) and deposit market share (*DS*) for branch i at time t. The two equations represent a DID strategy with two treatments specific to failed bank branches, namely, before the completion of the P&A transaction (BPA_{it}) and after the completion of the P&A transaction (APA_{it}). Specifically, BPA_{it} is an indicator variable which takes the value 1 for failed bank branches before the P&A transaction and 0 otherwise; and for non-failed bank branches it is always 0. Similarly, the variable APA_{it} takes the value 1 for failed bank branches after the P&A transaction in our sample and 0 otherwise; and for non-failed bank branches it is strictly 0. The second specification tracks the evolution of deposit growth and deposit market share on an annual basis for failed bank branches for up to 4 years to measure short-to-medium-term effects post P&A transaction. The variable $APA_{i(t+\tau)}$ is a dummy variable that takes the value of 1 in the year τ after the P&A transaction for branches of failed banks.

We then introduce control variables to specifications 1 and 2 to identify key factors influencing these dynamics. Therefore, we estimate regressions of the following form to conduct further analysis:

$$Y_{it} = \beta_0 + \beta_1 BPA_{it} + \beta_2 APA_{it} + \beta_3 CONTROLS_{it-1} + \mu_i + \nu_t + \epsilon_{it} \tag{3}$$

Table 1
Descriptive statistics.

Panel A

Variable	Label	Obs.	Mean	Std. Dev.	P1	Median	P99
Branch Deposits ($' 000)	BD	444,135	101,210.44	1,485,581	1562	41,080	578,229
Branch Deposit Growth (%)	DG	444,135	4.61	20.10	−45.02	2.64	77.16
Branch Deposit Share (%)	DS	444,135	0.52	1.62	0.00	0.09	6.43
Tier-1 Capital Ratio (%)	T1CR	444,135	12.14	3.78	6.51	11.28	26.79
Charge-off Ratio (%)	CoR	444,135	0.59	0.60	0.00	0.43	2.64
Interest Expense Ratio (%)	IER	444,135	0.61	0.53	0.08	0.39	2.15
Bank Assets ($' million)	Asts	444,135	360,000	580,000	63	43,000	1,950,000
Real GDP ($' million)	GDP	444,135	263,000	376,000	3781	105,000	1,430,000
Real GDP Growth (%)	GDPGrth	444,135	0.93	2.76	−6.92	1.33	7.31
Income Per Capita ($)	PPInc	444,135	44,884	9833	28,955	43,415	71,255
Growth in Income Per Capita (%)	PPIncGrth	444,135	2.38	3.31	−6.92	3.19	8.26
Herfindahl-Hirschman Index	HHI	444,135	2.19	6.49	0.05	0.67	39.79

Panel B

Variable	Obs.	Mean	Std. Dev.	P1	Median	P99
Deposits of Helathy Bank Branches ($' 000)	422,059	102,937.39	1,522,542	1488	40,856	594,112
Deposits of Failed Bank Branches Before P&A ($' 000)	4874	87,513.49	583,113	3078	49,489	570,643
Deposits of Failed Bank Branches After P&A ($' 000)	17,202	62,719.81	79,508	5313	44,443	274,041
DG Healthy Bank Branches (%)	422,059	4.76	19.95	−44.21	2.70	77.16
DG Failed Bank Branches Before P&A (%)	4874	4.70	24.34	−51.48	0.82	84.91
DG Failed Bank Branches After P&A (%)	17,202	0.97	22.06	−56.44	1.49	72.92
DS Healthy Bank Branches (%)	422,059	0.53	1.65	0.00	0.09	6.55
DS Failed Bank Branches Before P&A (%)	4874	0.47	1.57	0.00	0.08	6.03
DS Failed Bank Branches After P&A (%)	17,202	0.28	0.87	0.00	0.05	3.76
T1CR Healthy Bank Branches (%)	422,059	12.22	3.76	6.70	11.46	26.87
T1CR Failed Bank Branches Before P&A (%)	4874	7.90	2.90	0.00	0.08	6.03
CoR Healthy Bank Branches (%)	422,059	0.58	0.57	0.00	0.42	2.55
CoR Failed Bank Branches Before P&A (%)	4874	1.66	1.57	0.01	1.56	7.56
IER Healthy Bank Branches (%)	422,059	0.60	0.51	0.08	0.39	2.05
IER Failed Bank Branches Before P&A (%)	4874	1.89	0.39	0.79	2.00	2.44

$$Y_{it} = \beta_0 + \beta_1 BPA_{it} + \sum_{\tau=1}^{4} \beta_2^{t+\tau} APA_{i(t+\tau)} + \beta_3 CONTROLS_{it-1} + \mu_i + \nu_t + \epsilon_{it} \tag{4}$$

Since branch deposit flows can be influenced by both bank-specific and macroeconomic factors, the set of control variables used in this study includes both types of variables. Among the bank specific variables, we follow extant literature (e.g. Karas et al., 2013; Martinez-Peria & Schmukler, 2001) to include *Tier-1 Capital Ratio*, *Charge-off Ratio*, *Interest Expense Ratio*, and *Bank Assets*. Capital adequacy is measured by *Tier-1 Capital Ratio*, which is the tier-1 bank capital expressed as a percentage of risk-weighted bank assets. Capital adequacy is expected to have a positive effect on bank deposits. *Charge-off Ratio* is used as a measure of asset quality. This ratio measures the percentage of loans a bank might have to charge off over its total loans. We expect this variable to have a negative impact on deposits. *Interest Expense Ratio* is calculated by dividing interest expenses in a particular year by the corresponding level of deposits. As this measure is commonly used as a proxy for average annual interest rate that a bank offers on its deposits, we expect it to be positively correlated with branch deposits. The log of *Bank Assets* measures bank size. On the other hand, we include MSA level variables to isolate potential effects arising from MSA-level economic and demographic factors that are the GDP growth rate, the per-capita income growth rate and the Herfindahl-Hirschman Index (*HHI*) that indicates banking market concentration. Granja, Matvos, and Seru (2017) show that the local factors can have an impact on the efficacy of bank acquisition, so the inclusion of these variables in our model is to ensure that our results are not confounded by these factors. We also include first-lagged *DS* (*DG*) as an explanatory variable to estimate branch deposit growth (deposit share) in these two specifications. All variables used in eqs. 3 and 4 are annual figures.

After identifying the respective determinants of deposit growth and deposit share, we interact them with APA_{it} in following regressions to test if the branches of failed banks respond differently to these determinants after they have been sold to healthy banks. In other words, this model investigates the channel through which market discipline manifests itself and takes the following form:

$$\begin{aligned} Y_{it} = & \beta_0 + \beta_1 BPA_{it} + \beta_2 APA_{it} + \beta_3 X_{it-1} + \beta_4 (APA_{it} \times X_{it-1}) \\ & + \beta_5 CONTROLS_{it-1} + \mu_i + \nu_t + \epsilon_{it} \end{aligned} \tag{5}$$

We use *Tier-1 Capital Ratio* and *Charge-off Ratio*, two bank fundamental variables that indicate bank risk level, as our main channel to investigate deposit-market discipline. These two measures, particularly in the wake of the 1988 Basel Accord and the 1996 Market Risk Amendment, have been increasingly used to proxy for risk exposure in prior studies of depositor market discipline (Karas et al., 2013; Martinez-Peria & Schmukler, 2001; Park & Peristiani, 1998). Moreover, these measures are simple to calculate from publicly available information and easy to observe as depositors are hypothesized to react to observable bank-level information (Karas et al., 2013).

4. Data and variables

We acquire annual data for the period 2007–2014 for branches of commercial and savings banks in the U.S. from the Summary of Deposits, available from the FDIC. Our sample period covers the crisis period (2008–2010) and one year prior to and four years post bank resolution in our sample. These data include branch level identifiers, their location details, and deposits on June 30 of each year. The deposits data are then used to calculate deposit growth rates, deposit market shares and Herfindahl-Hirschman Index at the metropolitan statistical area (MSA) level. We complement the branch deposit data with commercial and savings bank level data from the Wharton Research Data Services (WRDS) Bank Regulatory database of the Federal Reserve Bank call

Table 2
Deposit growth dummy variable regressions.

	Full Sample		FBMSA Sample		PSM Sample	
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	−1.833	−0.358	−1.579	−0.047	10.171	0.155
	(−0.50)	(−0.43)	(−0.45)	(−0.07)	(1.19)	(0.14)
APA	−7.747*		−7.835*		−4.327	
	(−2.33)		(−2.35)		(−0.68)	
APA_{t+1}		−27.545***		−27.805***		−28.799***
		(−18.49)		(−17.72)		(−11.69)
APA_{t+2}		−14.892***		−14.786***		−14.897***
		(−11.26)		(−11.13)		(−10.18)
APA_{t+3}		−0.635		−0.471		−0.281
		(−0.51)		(−0.39)		(−0.25)
APA_{t+4}		2.098**		2.242**		3.011**
		(2.88)		(2.91)		(3.21)
Intercept	4.930***	4.837***	5.271***	5.144***	3.633	5.654***
	(33.11)	(177.23)	(27.86)	(161.90)	(0.91)	(15.93)
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	444,135	444,135	347,609	347,609	33,552	33,552
Branches	75,787	75,787	59,746	59,746	8950	8950
MSAs	379	379	196	196	179	179
R-Square	0.247	0.255	0.251	0.262	0.349	0.403
Adj. R-Sq	0.091	0.101	0.095	0.108	0.105	0.179
APA - BPA	−5.91		−6.26*		−14.5**	
APA_{t+1} - BPA		−27.19***		−27.76***		−28.95***
APA_{t+2} - BPA		−14.53***		−14.74***		−15.05***
APA_{t+3} - BPA		−0.28		−0.42		−0.44
APA_{t+4} - BPA		2.46		2.29		2.86

Table 3
Branch deposit share dummy variable regressions.

	Full Sample		FBMSA Sample		PSM Sample	
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	0.144	0.174***	0.144	0.171***	0.013	0.087***
	(1.88)	(6.23)	(1.87)	(6.12)	(1.03)	(5.44)
APA	−0.026		−0.027		−0.076***	
	(−0.32)		(−0.33)		(−4.68)	
APA_{t+1}		0.054***		0.049**		0.013
		(4.07)		(3.68)		(1.18)
APA_{t+2}		0.001		−0.006		−0.016
		(0.09)		(−0.66)		(−1.75)
APA_{t+3}		−0.005		−0.011		−0.015*
		(−0.63)		(−1.54)		(−2.28)
APA_{t+4}		−0.001		−0.005		−0.007
		(−0.11)		(−0.56)		(−1.00)
Intercept	0.520***	0.519***	0.336***	0.334***	0.306***	0.261***
	(133.28)	(1538.40)	(67.08)	(936.54)	(36.54)	(62.73)
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	444,135	444,135	347,609	347,609	33,552	33,552
Branches	75,787	75,787	59,746	59,746	8950	8950
MSAs	379	379	196	196	179	179
R-Square	0.956	0.956	0.954	0.954	0.963	0.963
Adj. R-Sq	0.946	0.946	0.944	0.944	0.949	0.949
APA - BPA	−0.17***		−0.17***		−0.09***	
APA_{t+1} - BPA		−0.12***		−0.12***		−0.07***
APA_{t+2} - BPA		−0.17***		−0.18***		−0.10***
APA_{t+3} - BPA		−0.18***		−0.18***		−0.10***
APA_{t+4} - BPA		−0.17***		−0.17***		−0.09***

reports. We match these bank level data to their respective branches for each year. Moreover, the macroeconomic data pertaining to MSAs included in the sample are obtained from the Bureau of Economic Analysis (BEA). The MSA level data items include real GDP and per capita personal income. Using these data, we calculate real GDP growth rate and per capita income growth rate for each MSA, which are used as control variables in regressions. Overall, this granular dataset provides a nuanced insight into the behavior of depositors during and after the global financial crisis.

Table 1 presents the summary statistics of variables mentioned above. Panel A reports overall figures while Panel B seggregates figures for falied bank branches from those of the surviving banks. The sample for our baseline tests spans the 2007–2014 period and comprises 444,135 branch-year observations corresponding to 75,787 branches. Out of these, 22,076 branch-year observations correspond to 4108 branches of failed banks auctioned using the P&A process and the

Table 4
Branch deposit growth control variable regressions.

	Full Sample		FBMSA Sample		PSM Sample	
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	1.190	1.188	1.564	1.161	9.475	−0.529
	(0.27)	(1.01)	(0.36)	(1.13)	(1.45)	(−0.27)
APA	−6.949*		−7.056*		−6.888	
	(−2.33)		(−2.37)		(−1.08)	
APA_{t+1}		−23.820***		−24.821***		−27.483***
		(−17.73)		(−16.08)		(−6.27)
APA_{t+2}		−14.035***		−14.124***		−13.444***
		(−8.68)		(−8.90)		(−6.43)
APA_{t+3}		−0.234		−0.212		0.601
		(−0.17)		(−0.16)		(0.44)
APA_{t+4}		2.136**		2.242**		3.356***
		(2.60)		(2.66)		(3.81)
DS_{t-1}	−6.627***	−6.535***	−6.322***	−6.159***	−16.913***	−14.264***
	(−5.31)	(−5.34)	(−4.35)	(−4.40)	(−3.80)	(−3.87)
CoR_{t-1}	−3.757***	−2.670***	−3.681**	−2.345***	−6.559**	−2.410*
	(−3.95)	(−5.60)	(−3.28)	(−4.57)	(−3.15)	(−1.96)
$T1CR_{t-1}$	0.022	0.070	0.025	0.088	−0.398	−0.171
	(0.22)	(0.70)	(0.24)	(0.81)	(−1.75)	(−0.70)
IER_{t-1}	−0.519	0.803	−0.529	1.111	−6.055	1.902
	(−0.27)	(0.50)	(−0.25)	(0.72)	(−1.50)	(1.37)
$LnAsts_{t-1}$	0.920	0.275	1.016	0.217	1.210*	−1.170
	(1.48)	(0.78)	(1.57)	(0.53)	(1.98)	(−1.35)
$GDPGrth_{t-1}$	−0.023	−0.028	−0.022	−0.029	−0.325	−0.297
	(−0.57)	(−0.69)	(−0.38)	(−0.51)	(−1.66)	(−1.62)
$PPIncGrth_{t-1}$	0.120**	0.078	0.139**	0.102*	0.218	0.230
	(2.78)	(1.51)	(2.91)	(1.99)	(1.31)	(1.43)
HHI_{t-1}	−0.013	−0.012	0.034	0.034	0.329**	0.267***
	(−0.42)	(−0.38)	(0.68)	(0.63)	(3.40)	(4.54)
Intercept	−5.230	3.372	−8.205	2.582	1.224	32.202*
	(−0.54)	(0.59)	(−0.80)	(0.37)	(0.09)	(2.14)
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	444,135	444,135	347,609	347,609	33,552	33,552
Branches	75,787	75,787	59,746	59,746	8950	8950
MSAs	379	379	196	196	179	179
R-Square	0.263	0.269	0.263	0.271	0.381	0.414
Adj. R-Sq	0.110	0.117	0.109	0.119	0.150	0.194
APA - BPA	−8.14*		−8.62*		−16.36**	
APA_{t+1} - BPA		−25.01***		−25.98***		−26.95***
APA_{t+2} - BPA		−15.22***		−15.29***		−12.92***
APA_{t+3} - BPA		−1.42		−1.37		1.13
APA_{t+4} - BPA		0.95		1.08		3.88

remaining 422,059 branch-year observations correspond to 71,769 unique branches of surviving banks. While the average deposits for individual branches is about $101 million, the range of deposits is substantial with micro branches with less than a million dollars in deposits at the lower end to large branches with more than $600 million at the top end. Similarly, annual deposit growth rates are on average 4.6% also shows great variation across branches with a standard deviation of about 20%. With a mean of 0.52% and median of 0.09%, the branch deposit market share information within the MSA hint at a relatively competitive market for deposits. These statistics concord with statistics reported for the Herfindahl-Hirschman index, which with relatively low values also are suggestive of competitive markets.[5]

As shown in Panel B of Table 1, the overall average of tier 1 capital ratio for surviving banks at 12.22% is higher than the average of 7.9% recorded for the banks that eventually failed, a year before being auctioned. Likewise, branches of surviving banks, on average, have greater deposits, higher deposit growth and larger deposit shares. On the other hand, failed banks, on average, have larger higher interest expense ratios and charge-off ratios. In the years preceding failure, branches of failed banks, however, on average, have deposit growth rate and deposit market share similar to branches of surviving banks. This pattern hints at a deterioration in deposit growth rates and deposit market shares for branches of failed banks following the P&A transactions. The following analysis helps to further investigate this feature of the data.

5. Empirical results

In this section, we analyze the changes in branch deposit growth and deposit market shares. We start with regressions outlined in eqs. 1 and 2 to capture the dynamics of the two dependent variables using indicator variables as explanatory variables. Specifically, BPA_{it} shows average branch deposit growth (branch deposit market share) before the completion of the P&A transaction for the branches of failed banks and APA_{it} does so after the completion of the sale of failed banks' branches. Therefore, these two variables capture the difference in deposit growth (deposit market share) between the branches of failed banks and surviving banks. The variable $APA_{i(t+\tau)}$ presents a picture with more information by tracking annual changes after the P&A transaction for failed bank branches for up to four years. The results of this analysis for deposit growth are presented in Table 2.

To ensure robustness of estimates, this table presents analyses conducted on three alternative samples. The first set of results is obtained using the full sample, whereas the second set of results is based on a

[5] The HHI figures reported here are scaled by 100 to facilitate the ease of interpreting coefficient estimates corresponding to this variable in subsequent regression estimations.

Table 5
Branch deposit share control variable regressions.

	Full Sample		FBMSA Sample		PSM Sample	
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	0.141	0.173***	0.139	0.171***	0.024	0.114***
	(1.80)	(6.24)	(1.78)	(6.28)	(1.46)	(5.84)
APA	−0.011		−0.018		−0.066***	
	(−0.13)		(−0.22)		(−4.26)	
APA_{t+1}		0.059**		0.055**		0.046**
		(2.81)		(2.80)		(3.03)
APA_{t+2}		0.034*		0.018		−0.001
		(2.35)		(1.60)		(−0.19)
APA_{t+3}		0.020**		0.006		−0.002
		(2.84)		(0.71)		(−0.50)
APA_{t+4}		0.004		−0.001		−0.004
		(0.54)		(−0.07)		(−0.55)
DG_{t-1}	0.001***	0.001***	0.000***	0.000***	0.000***	0.000***
	(5.75)	(5.81)	(6.32)	(6.40)	(4.40)	(4.09)
CoR_{t-1}	−0.005	−0.007	−0.002	−0.005	0.003	−0.006
	(−1.05)	(−1.36)	(−0.79)	(−1.71)	(0.60)	(−1.09)
$T1CR_{t-1}$	−0.004***	−0.004***	−0.003**	−0.003**	−0.003*	−0.003
	(−4.43)	(−4.52)	(−3.53)	(−3.57)	(−1.95)	(−1.86)
IER_{t-1}	0.031*	0.028*	0.019	0.015	0.011	−0.004
	(2.21)	(1.95)	(1.45)	(1.14)	(0.79)	(−0.30)
$LnAsts_{t-1}$	0.003	0.004	−0.001	0.001	0.005	0.012**
	(0.82)	(1.05)	(−0.25)	(0.47)	(1.53)	(2.51)
$GDPGrth_{t-1}$	−0.000	−0.000	0.000	0.000	0.001	0.001
	(−0.65)	(−0.56)	(0.07)	(0.07)	(1.06)	(1.04)
$PPIncGrth_{t-1}$	−0.000	−0.000	0.001	0.001	−0.001	−0.001
	(−0.30)	(−0.18)	(1.02)	(1.13)	(−0.27)	(−0.30)
HHI_{t-1}	−0.001	−0.001	−0.001	−0.001	−0.003	−0.003
	(−0.69)	(−0.70)	(−1.20)	(−1.19)	(−1.72)	(−1.63)
Intercept	0.493***	0.473***	0.360***	0.331***	0.224**	0.079
	(8.57)	(7.22)	(8.19)	(6.47)	(2.58)	(0.81)
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	444,135	444,135	347,609	347,609	33,552	33,552
Branches	75,787	75,787	59,746	59,746	8950	8950
MSAs	379	379	196	196	179	179
R-Square	0.956	0.956	0.954	0.954	0.963	0.963
Adj. R-Sq	0.947	0.947	0.944	0.944	0.950	0.950
APA - BPA	−0.15***		−0.16***		−0.09***	
APA_{t+1} - BPA		−0.11***		−0.12***		−0.07***
APA_{t+2} - BPA		−0.14***		−0.15***		−0.12***
APA_{t+3} - BPA		−0.15***		−0.17***		−0.12***
APA_{t+4} - BPA		−0.17***		−0.17***		−0.12***

sample taken only from MSAs with at least one failed bank branch present, and the third sample is defined using propensity score matching (PSM).[6] The variables used for PSM sample selection include log of branch level deposits and MSA-specific variables such as the level (log) and growth rates of the GDP and per-person income along with MSA-level HHI to capture intensity of local competition. We label these samples 'Full Sample', 'FBMSA Sample' and 'PSM Sample' respectively. As Table 2 indicates, these results control for branch, MSA and time related fixed effects, and robust standard errors clustered on these three dimensions have been used in statistical estimations. Even after enforcing these requirements, the results from all three sample are consistent. The coefficients of *BPA* are not statistically significant for any regression estimate, so these results confirm that, before failure, the branches of failed banks had similar annual deposit growth rates as their surviving counterparts. Our results do not seem to support Bennett et al. (2015), who find depositors withdrew their deposits before a bank failed. It may be due to the differences in data as we use branch-level annual data, Bennett et al. (2015), in contrast, employ bank-level quarterly data. The coefficient on *APA* is also barely significant. This indicates that branches acquired by healthy banks experience similar growth rates to other branches, on average, over the four-year period following the acquisition. However, since the coefficient of this variable is negative across all three samples, we further analyze the trajectory of deposit growth for these failed bank branches on an annual basis following the acquisitions.

The results from specification 2 for each sample show a large and statistically significant fall (about −28% and − 15% respectively) in deposit growth rates for the failed branches relative to surviving branches for two years following the auction. The difference in growth rates becomes negligible in the third year after acquisition (about −0.5% but not statistically significant), and in the fourth year failed branches narrowly outperform (about 2%) their surviving peers. For completeness, we also report results of *t*-tests for testing the difference between coefficients of *BPA* and *APA* (along with its yearly variants $APA_{i(t+\tau)}$) for all regressions. These tests can be viewed as DID estimates as the variables *BPA* and *APA* themselves represent difference between failed and surviving branches before and after the P&A process is completed. As is

[6] We use PSM as a robustness test to ensure that the results are not driven by MSA or branch specific factors. The matched sample used in our analysis employs caliper matching technique limited to one match per branch-year. Following Duygun, Sena, and Shaban (2014), we adopt a two-stage PSM procedure, which uses a logit regression to estimate the propensity score in the first stage, and then matches each failed bank branch to a branch of a surviving bank in the second stage. Additionally, we conduct two balance tests for the PSM sample. The details are shown in the appendix.

Table 6
Deposit growth channel regressions.

	Full Sample		FBMSA Sample		PSM Sample	
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	0.474	1.155	0.692	1.528	8.605	9.263
	(0.11)	(0.26)	(0.17)	(0.35)	(1.36)	(1.42)
APA	1.827	−5.197	1.979	−5.321	−3.768	−5.695
	(0.59)	(−1.57)	(0.65)	(−1.62)	(−0.52)	(−0.88)
CoR_{t-1}	−2.986***	−3.741***	−2.730***	−3.663**	−4.284*	−6.566**
	(−5.06)	(−3.96)	(−3.83)	(−3.28)	(−2.43)	(−3.23)
APA × CoR_{t-1}	−11.294**		−11.661**		−4.383	
	(−3.45)		(−3.37)		(−1.65)	
DS_{t-1}	−6.587***	−6.674***	−6.254***	−6.402***	−16.721***	−16.896***
	(−5.30)	(−5.37)	(−4.35)	(−4.44)	(−3.75)	(−4.75)
APA × DS_{t-1}		−5.375**		−5.303**		−4.381
		(−3.24)		(−3.19)		(−1.80)
$T1CR_{t-1}$	0.054	0.031	0.069	0.036	−0.340	−0.358
	(0.51)	(0.31)	(0.59)	(0.34)	(−1.39)	(−1.78)
IER_{t-1}	−0.130	−0.429	−0.080	−0.421	−6.351	−5.585
	(−0.07)	(−0.22)	(−0.04)	(−0.20)	(−1.66)	(−1.34)
$LnAsts_{t-1}$	0.644	0.905	0.686	0.999	1.021	1.200*
	(1.53)	(1.46)	(1.60)	(1.55)	(1.75)	(1.98)
$GDPGrth_{t-1}$	−0.031	−0.024	−0.031	−0.023	−0.311	−0.336
	(−0.77)	(−0.58)	(−0.54)	(−0.39)	(−1.62)	(−1.78)
$PPIncGrth_{t-1}$	0.103*	0.119**	0.122**	0.138**	0.205	0.216
	(2.28)	(2.74)	(2.69)	(2.86)	(1.24)	(1.32)
HHI_{t-1}	−0.012	−0.013	0.037	0.035	0.309**	0.337**
	(−0.38)	(−0.41)	(0.71)	(0.67)	(2.74)	(3.40)
Intercept	−1.660	−5.152	−3.938	−8.124	3.092	0.552
	(−0.25)	(−0.54)	(−0.56)	(−0.80)	(0.25)	(0.04)
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	444,135	444,135	347,609	347,609	33,552	33,552
Branches	75,787	75,787	59,746	59,746	8950	8950
MSAs	379	379	196	196	179	179
R-Square	0.265	0.263	0.265	0.263	0.382	0.383
Adj. R-Sq	0.112	0.110	0.112	0.110	0.151	0.152
APA - BPA	1.35	−6.35	1.29	−6.85	−12.37*	−14.96**

clear from these tests, failed branches suffer a significant drop in deposit growth (about −27% and − 15% respectively) relative to their pre-auction growth rate for the first two years after being auctioned. However, this difference disappears in the third and fourth years when failed branches regain their pre-acquisition growth rates. This result suggests that depositors exercise market discipline on the acquirors of their failed branches for at least two years after the auction, a result consistent with the literature that depositors may experience a 'wake-up call' effect in the aftermath of a banking crisis (Karas et al., 2013; Martinez-Peria & Schmukler, 2001).

Relatively large negative deposit growth rates may also indicate that failed bank branches must have experienced a reduction in their deposit share relative to their rivals over the years following the P&A process. However, it remains unclear if these branches managed to reclaim some of their pre-auction deposit shares. Table 3 attempts to provide some insights on this issue:

As is evident from the t-tests presented at the bottom of Table 3, average deposit market share of failed branches fell from their pre-auction level and did not recover even four years after being acquired by healthy banks. This result concords with the descriptive statistics shown in Panel B of Table 1, which shows that the average deposit share of failed bank branches within their MSAs before P&A was 0.47%, but reduced considerably to a cumulative average of 0.28% over four years following the sale. Therefore, although deposit growth rates recover after two years, it is insufficient to regain the lost deposit market share. In other words, depositors seem to have enforced market discipline long after their previous banks had been acquired during the crisis. As a result, branches (under new ownership) experience a deterioration in their market presence for at least four years post-auction. To investigate this issue further, we add several control variables to specifications 1 and 2, and the results of these estimations are presented next.

The results reported in Table 4 support those in Table 2, namely, that the dynamics of deposit growth rates remain unchanged in the presence of relevant explanatory variables. These results also show that the first lag of the deposit share of branches (*DS*) within their MSA is negatively linked to future deposit growth rate across all samples. This result is as expected as realizing a higher (lower) deposit growth would be expected with lower (higher) deposit share because of the lower (higher) base. Noticeably, the *Tier-1 Capital Ratio* does not seem to have any significant impact on deposit growth, yet the *Charge-off Ratio*, exerts a statistically significant influence on deposit growth. As the regression coefficients for the first lag of the *Charge-off Ratio* are consistently negative and statistically significant across all samples, it presents itself as a channel through which depositors discipline banking institutions by monitoring bank fundamental performance – that is asset quality in this case.

Regression results presented in Table 5 concord with those presented in Table 3 and suggest that failed bank branches do not seem to regain their lost deposit market share after being acquired by healthy banks. As expected, deposit growth (*DG*) has a significant positive impact on deposit share of bank branches, but the magnitude of the effect is small with 1 percentage point increase in deposit growth corresponding to only about 0.001% increase in the market share. Therefore, a branch would require an above-average deposit growth rate over a relatively long term to be able to significantly improve its market share of deposits

Table 7
Branch deposit share channel regressions.

	Full Sample		FBMSA Sample		PSM Sample	
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	0.142	0.141	0.141	0.139	0.028	0.021
	(1.83)	(1.80)	(1.82)	(1.78)	(1.70)	(1.29)
APA	0.140	−0.010	0.146	−0.016	−0.022	−0.070***
	(1.41)	(−0.12)	(1.50)	(−0.20)	(−0.76)	(−4.34)
$T1CR_{t-1}$	−0.003***	−0.004***	−0.002**	−0.003**	−0.001	−0.003
	(−4.03)	(−4.44)	(−2.80)	(−3.50)	(−1.18)	(−1.92)
APA × $T1CR_{t-1}$	−0.013*		−0.014**		−0.004	
	(−2.27)		(−2.46)		(−1.52)	
DG_{t-1}	0.001***	0.001***	0.000***	0.000***	0.000***	0.000
	(5.76)	(5.75)	(6.36)	(6.43)	(4.31)	(0.25)
APA × DG_{t-1}		0.000		0.000		0.000
		(0.36)		(0.88)		(1.58)
CoR_{t-1}	−0.006	−0.005	−0.003	−0.003	0.002	0.003
	(−1.17)	(−1.03)	(−1.25)	(−0.84)	(0.43)	(0.57)
IER_{t-1}	0.032*	0.031*	0.020	0.018	0.013	0.010
	(2.42)	(2.13)	(1.71)	(1.36)	(1.14)	(0.67)
$LnAsts_{t-1}$	0.003	0.003	0.000	−0.000	0.006	0.006
	(0.93)	(0.85)	(0.04)	(−0.14)	(1.91)	(1.69)
$GDPGrth_{t-1}$	−0.000	−0.000	0.000	0.000	0.001	0.001
	(−0.61)	(−0.69)	(0.10)	(0.03)	(1.06)	(1.07)
$PPIncGrth_{t-1}$	−0.000	−0.000	0.001	0.001	−0.001	−0.001
	(−0.27)	(−0.31)	(1.01)	(1.01)	(−0.28)	(−0.28)
HHI_{t-1}	−0.001	−0.001	−0.001	−0.001	−0.003	−0.003
	(−0.69)	(−0.69)	(−1.18)	(−1.19)	(−1.71)	(−1.80)
Intercept	0.475***	0.492***	0.335***	0.356***	0.177*	0.221**
	(8.12)	(8.72)	(7.67)	(8.24)	(2.34)	(2.62)
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	444,135	444,135	347,609	347,609	33,552	33,552
Branches	75,787	75,787	59,746	59,746	8950	8950
MSAs	379	379	196	196	179	179
R-Square	0.956	0.956	0.954	0.954	0.963	0.963
Adj. R-Sq	0.947	0.947	0.944	0.944	0.950	0.950
APA - BPA	−0.003	−0.151***	0.004	−0.155***	−0.05*	−0.091***

within an MSA. Table 5 also shows that the *Tier-1 Capital Ratio*, is negatively related to deposit market share, though the association is statistically significant only for the two larger samples. This result seems to suggest that despite the improvement in overall risk levels (of acquiring banks), branches of failed banks struggle to maintain their market share, which may point to evidence of a loss of depositor confidence in the new 'bank' and this maybe linked to post-acquisition integration issues – where the the allocation process of failed bank assets and employees is inefficient (Granja et al., 2017). Depositors of these branches might, to some degree, bear the brunt of the costs of misallocations. Having identified two sets of variables that have a significant impact on each of the dependent variables, we now explore whether the response to these variables differs before and after the P&A transactions for branches of failed banks.

To capture the changes in response of deposit growth to the *Charge-off Ratio* after the P&A transaction, we interact this variable with the indicator variable *APA*. Regression results reported in Table 6 suggest that the *Charge-off Ratio* has a statistically significant negative impact on deposit growth across all regressions, but the interaction term is significant only for the first two samples. For these two samples, the coefficients obtained for the interaction term are negative and large in magnitude, which indicates that the *Charge-off Ratio* has a large negative impact on the deposit growth of failed bank branches. Crucially, the negative impact of a rise in the *Charge-off Ratio* is experienced even after a branch starts operating under new management, indicating a hightened axiety among depositors of those failed bank branches regarding their new owner's risk level. This behavior can be understood as failed banks are significantly more likely to be auctioned to potential acquirers via P&A process whose loan portfolios have a similar composition (Granja et al., 2017). The DID estimates (*APA-BPA*) reported at the bottom of Table 6 are not statistically significant in the presence of the interaction between *APA* and the *Charge-off Ratio*, which suggests that the deposit growth rate does not differ significantly for failed bank branches before and after they are auctioned. Thus, the combination of large and statistically significant coefficient on the interaction term and disappearance of statistically significant difference between *BPA* and *APA* suggests that the *Charge-off Ratio* is an important channel to explain the dynamics of deposit growth rates post-resolution.

Deposit market share (*DS*) also has a negative impact on deposit growth. Accordingly, the corresponding coefficients and the coefficients of their interaction with *APA* are negative and significant for the first two samples. Therefore, failed branches with a higher deposit share suffer a larger decline in deposit growth after being acquired.

Table 7 reports results of regressions analyzing the *Tier-1 Capital Ratio* as well as deposit growth (*DG*) as possible channels for explaining the dynamics of branch deposit market shares within their MSAs. The *Tier-1 Capital Ratio* does seem to have a greater negative impact on deposit market share of failed branches following the transaction as evidenced by coefficients of greater magnitude being obtained for the interaction term in comparison with the coefficient for *Tier-1 Capital Ratio*. This pattern is observed for all three samples, though the coefficients are not always significant. Moreover, the difference between the coefficients of *BPA* and *APA* indicators reported at the bottom of the table are not statistically significant for regressions that include the

Table 8
Heckman selection regressions for branch deposit growth and share.

	Deposit Growth	Deposit Growth	Market Share	Market Share
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	0.989	0.378	0.128	0.157***
	(0.21)	(0.31)	(1.64)	(5.99)
APA	−7.029*		−0.016	
	(−2.34)		(−0.20)	
APA_{t+1}		−25.587***		0.025
		(−17.94)		(1.11)
APA_{t+2}		−14.226***		0.030*
		(−8.65)		(2.26)
APA_{t+3}		−0.415		0.016*
		(−0.31)		(2.39)
APA_{t+4}		2.050**		0.002
		(2.50)		(0.29)
IMR_{t-1}	−0.346	−1.093	−0.022***	−0.021***
	(−0.35)	(−1.30)	(−4.40)	(−4.42)
IER_{t-1}	−0.755	0.175	0.016	0.016
	(−0.34)	(0.08)	(1.08)	(1.00)
CoR_{t-1}	−3.782***	−2.669***	−0.006	−0.007
	(−3.98)	(−5.69)	(−1.05)	(−1.08)
$T1CR_{t-1}$	0.021	0.068	−0.004***	−0.004***
	(0.21)	(0.65)	(−4.73)	(−4.87)
$LnAsts_{t-1}$	0.886	0.112	0.000	0.001
	(1.33)	(0.35)	(0.12)	(0.22)
$GDPGrth_{t-1}$	−0.019	−0.014	0.000	0.000
	(−0.42)	(−0.29)	(0.35)	(0.44)
$PPIncGrth_{t-1}$	0.130**	0.106*	0.000	0.000
	(2.81)	(1.99)	(0.55)	(0.59)
HHI_{t-1}	−0.008	0.003	−0.001	−0.001
	(−0.20)	(0.08)	(−0.53)	(−0.53)
DS_{t-1}	−6.634***	−6.554***		
	(−5.36)	(−5.40)		
DG_{t-1}			0.001***	0.001***
			(5.81)	(5.87)
Intercept	−3.651	9.171	0.594***	0.586***
	(−0.30)	(1.44)	(8.08)	(7.94)
Branch FE	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	444,135	444,135	444,135	444,135
Branches	75,787	75,787	75,787	75,787
MSAs	379	379	379	379
R-Square	0.263	0.269	0.956	0.956
Adj. R-Sq	0.110	0.118	0.947	0.947
APA - BPA	−8.171*		−0.144***	
APA_{t+1} - BPA		−25.97***		−0.132***
APA_{t+2} - BPA		−14.60***		−0.127***
APA_{t+3} - BPA		−0.793		−0.141***
APA_{t+4} - BPA		1.672		−0.155***

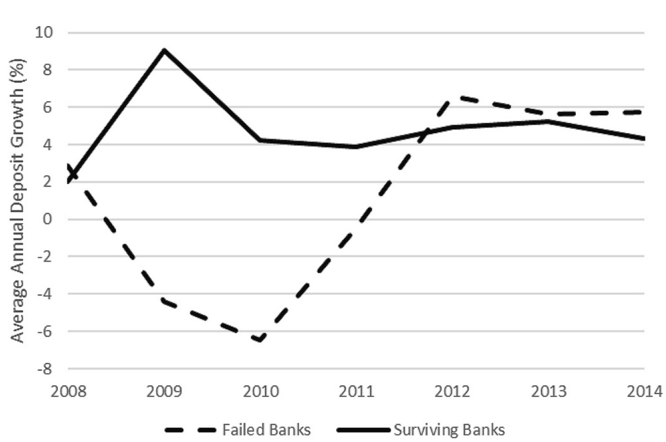

Fig. 1. Average annual branch deposit growth.

interaction between the *Tier-1 Capital Ratio* and *APA*. These observations suggest that the *Tier-1 Capital Ratio* has some impact on deposit market shares, though the size of the effect is not economically large. In contrast, the interaction term involving deposit growth (*DG*) is not significant for any of the regressions, and the difference between *BPA* and *APA* persists in the presence of this interaction. Hence, the effect of deposit growth on deposit share doesn't seem to differ across failed and surviving branches.

6. Further robustness tests

6.1. Heckman 2-step procedure

The analysis presented above suggests that bank sepcific variables, such as the charge-off ratio and the tier 1 capital ratio, can differ systematically across failed and surviving banks. Selection bias can result in spurious regression when treated and untreated groups differ from each other sytematically. To ascertain the robustness of our results to potential bias induced by these differences, we use Heckman's (1979) 2-step procedure. The first step of this procedure involves estimating a probit model where we regress an indicator variable, taking value 1 for failed banks and 0 otherwise, on all control variables used in specifications 3 and 4. These include four bank-specific variables such as the *Interest Expense Ratio*, the *Charge-off Ratio*, the *Tier-1 Capital Ratio*, and the log of *Bank Assets*; and three MSA level variables, namely, GDP growth rate, per-capita income growth rate and the Herfindahl-Hirschman Index (*HHI*). The predicted probabilities from the first stage are then used to obtain the Inverse Mill's Ratio (IMR). In the second stage we augment the regression eqs. 3 and 4 by including the IMR as an explantory variable. Table 8 reports the results from these second stage regressions.

According to Table 8, IMR is not statistically significant for deposit growth regressions, which suggests that these results are not plagued by the selection bias. On the other hand, we notice that statitically significant coefficients are obtained for IMR in deposit share regressions, which hints at these reuslts being biased. However, coefficients obtained for other variables in the regression remain virtually unchanged from those reported for full sample in Table 5. Hence, we argue that selection bias is not a significant issue in the case of deposit share regressions either. Nevertheless, to allay any doubts about biased coefficients, we present the following graphical trend analysis for both branch deposit growth and deposit share.

6.2. Trend analysis

Fig. 1 shows average annual deposit growth rate for branches that underwent the P&A process and those that didn't. This figure clearly shows that branches of failed banks suffered negative deposit growth during the financial crisis, but the growth subsequently rebounded to the average deposit growth rate of branches that were not subject to the P&A process.

Fig. 2 shows the average annual deposit market share of branches of failed banks that were auctioned and corresponding average annual deposit shares of branches that survived. As is clear from this figure, the branches that were acquired by healthy banks suffered a loss in market share and didn't manage to recover their lost share over the period analysed. On the other hand, market shares of surviving bank branches did not fluctuate much during this period. So in sum, this figure corroborates the conclusions drawn from the regression analysis presented in this paper.

6.3. Regulatory diversity

Although our anlysis controls for regional variation across bank branches, banks may also differ in terms of the regulation they are subject to. For instance, about half of the bank branches analysed in this

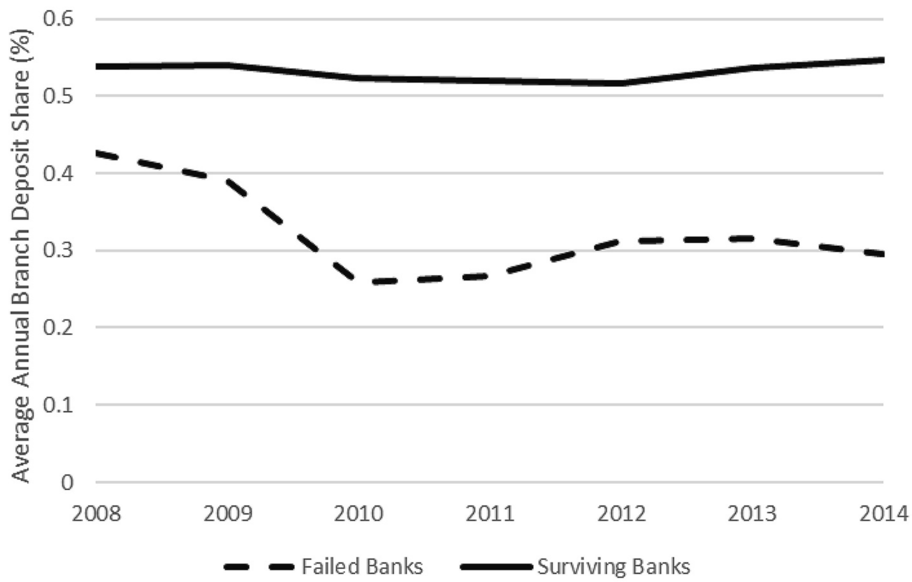

Fig. 2. Average annual branch market share.

Table 9
Regressions by regulatory authority.

	FDIC Regulated	OCC Regulated	FDIC Regulated	OCC Regulated
	Deposit Growth	Deposit Growth	Market Share	Market Share
	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)	Coef./(t-stat)
BPA	2.688*	9.034*	0.284***	0.164**
	(2.04)	(2.04)	(4.15)	(3.44)
APA_{t+1}	−17.252***	−22.262***	0.166***	0.048**
	(−4.28)	(−10.91)	(4.80)	(3.33)
APA_{t+2}	−14.834***	−12.036***	0.035	0.040**
	(−6.28)	(−6.19)	(1.04)	(3.52)
APA_{t+3}	−1.766	1.707	0.022	0.027***
	(−1.84)	(1.62)	(0.73)	(4.12)
APA_{t+4}	1.390	2.840**	0.014	0.011*
	(1.26)	(2.99)	(0.51)	(2.20)
DS_{t-1}	−10.410***	−5.165***		
	(−4.93)	(−4.68)		
DG_{t-1}			0.000***	0.001**
			(5.96)	(3.56)
Intercept	22.959***	−10.099	0.463***	0.315*
	(4.55)	(−1.44)	(4.85)	(2.43)
Controls	Yes	Yes	Yes	Yes
Branch FE	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	121,073	233,277	121,073	233,277
Branches	22,455	42,892	22,455	42,892
MSAs	376	379	376	379
R-Square	0.293	0.296	0.971	0.946
Adj. R-Sq	0.128	0.136	0.965	0.934
APA_{t+1} - BPA	−19.94***	−31.3***	−0.118	−0.116**
APA_{t+2} - BPA	−17.52***	−21.07***	−0.249**	−0.124**
APA_{t+3} - BPA	−4.45**	−7.327	−0.262**	−0.137**
APA_{t+4} - BPA	−1.298	−6.194	−0.27**	−0.153**

study are regulated by the Office for the Comptroller of Currency (OCC) and approximately quarter of the bank branches are regulated by the FDIC. To ensure that the results of our study are robust to this regulatory diversity, we re-estimate eqs. 3 and 4 using two distinct sub-samples corresponding to OCC supervised bank branches, and those supervised by the FDIC.

The results reported in Table 9 are broadly in agreement with results reported in Tables 5 and 6. As shown by DID coefficients reported at the bottom of Table 9, failed bank branches expereince negative deposit growth in years immediately following the aution, but regain positive growth after a couple of years. On the other hand, irrespective of the regulatory body involved, deposit shares of failed bank branches never recover once they drop below their pre-auction levels.

7. Conclusion

Based on a difference-in-difference framework and utilizing a US bank branch-based dataset compiled from various sources and spanning years 2007 to 2014, we study how depositors impose discipline on bank branches during and after resolution. Specifically, changes in the branch-level deposit growth and deposit market share around P&A transactions supervised by the FDIC are examined. To alleviate concerns regarding unobserved heterogeneity associated with branch, MSA and time dimensions, all regressions control for fixed effects across all three dimensions and the standard errors used in estimation too are clustered along these dimensions.

We find that both deposit growth and deposit market shares of failed bank branches decrease after being acquired by healthy institutions. While deposit growth rates of such branches subsequently recover in two years' time, the recovery of deposit market shares remains elusive even after four years. Furthermore, we find that excessive deposit withdrawals in the aftermath of bank resolution suggests either that market discipline is at play post resolution due to asset quality and loan composition concerns. It may also be a result of irrational depositor disciplining or integration issues post acquisition. Additionally, we find that branches with greater deposit market shares are punished more severely than those with a lower deposit share within their MSAs, which potentailly indicates greater competition for deposits post-resolution.

Declaration of Competing Interest

None.

Data availability

Data will be made available on request.

Appendix A. Appendix

A balance test is usually conducted for ensuring the validity of the sample obtained using propensity score matching (PSM). Since some of the regressions presented in this paper use the PSM for sample selection, we provide two measures of 'balance' in the following table:

Variable	Failed Banks			Surviving Banks			T-test	SMD
	Obs	Mean	SD	Obs	Mean	SD	*p*-value	
LnBrDep	21,438	10.71	0.88	21,438	10.71	0.88	0.91	0
LnGDP	21,438	18.92	1.48	21,438	18.92	1.48	1.00	0
GDPgrth	21,438	0.89	3.08	21,438	0.89	3.08	1.00	0
PPIncGrth	21,438	2.19	3.87	21,438	2.19	3.87	1.00	0
PopGrth	21,438	1.06	0.63	21,438	1.06	0.63	1.00	0
HHI	21,438	1.11	4.45	21,438	1.11	4.45	1.00	0

The balance tests are reported for each of the variable used for PSM. These include log of Branch Deposits (*LnBrDep*), log of MSA-level GDP (*LnGDP*), MSA-level GDP growth rate (*GDPgrth*), per-person income growth rate in the MSA (*PPIncGrth*), population growth rate of the MSA (*PopGrth*) and the Herfindahl-Hirschman index for the MSA (*HHI*). The *p*-values of the t-tests for equality of means, as well as the standardized mean difference scores (SMD) are shown in the last two columns, respectively. These results suggest that there are no significant differences between failed bank branches and surviving bank branches on the basis of these variables in the matched sample.

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