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This Version: July 2021

Published as: "Insurance Pricing, Distortions, and Moral Hazard: Quasi-Experimental Evidence from Deposit Insurance" *Journal of Financial and Quantitative Analysis*, March 2024, Volume 59, Issue 2, 896-932. Available online.

FDIC CFR WP 2020-08

fdic.gov/cfr

INSURANCE PRICING, DISTORTIONS, AND MORAL HAZARD: QUASI-EXPERIMENTAL EVIDENCE FROM DEPOSIT INSURANCE[†]

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Current Version: July 13, 2021
First Draft: March 15, 2017

ABSTRACT. Pricing is integral to insurance design, directly influencing firm behavior and moral hazard, though its effects are insufficiently understood. I study a quasi experiment in which deposit insurance premiums were changed for U.S. banks with staggered timing, generating differentials between banks in both levels and risk-based "steepness" of premiums. I find evidence that differentials in premiums resulted in distortions, including regulatory arbitrage, but also provided strong incentives to curb moral hazard. I find that firms that faced stronger pricing incentives to become (or remain) safer were more likely to subsequently do so than similar firms that faced weaker pricing incentives.

Keywords: Deposit Insurance; Ex Ante Moral Hazard; Insurance Premiums; Risk-Based Pricing; Insurance Design.

JEL Classification: G21; G22; G28; D22; D47.

[†] I thank Rosalind Bennett, David Coxon (discussant), Vivian Hwa, Małgorzata Iwanicz-Drozdowska (discussant), Kathryn Judge (discussant), Roni Kisin, Troy Kravitz, Mark Kutzbach, Lynn Shibut, and participants at the FDIC Center for Financial Research seminar series, the 2020 Community Banking in the 21st Century Research and Policy Conference, and the 2021 Biennial International Association of Deposit Insurers (IADI) Research Conference. All errors are my own.

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1 INTRODUCTION

Insurance can weaken the insured party's incentives to self-protect, resulting in increased risk taking and, paradoxically, making losses more likely. This effect on incentives has been referred to in the literature as ex ante moral hazard, and it is present in various contexts. In deposit insurance, for instance, Grossman (1992) finds evidence that in the early 1900s, after thrifts became insured they took on more risk than their uninsured counterparts. More recently, Ioannidou and Penas (2010) find that introducing deposit insurance in Bolivia increased the probability that banks would originate subprime loans.[1] Other research, described below, finds similar moral hazard in other contexts. It has long been known that ex ante moral hazard can in theory be mitigated through insurance pricing, with higher premiums penalizing risk taking (Ehrlich and Becker 1972). This was precisely the reason that, in 1993, the U.S. deposit insurance system moved from flat-rate pricing to risk-based pricing, classifying institutions into several risk groups and charging institutions in higher-risk groups higher premiums.

In practice, however, the relationship between insurance pricing and firm behavior, particularly behavior relating to moral hazard, is unclear, and very few studies address the issue. Firms facing higher premiums (presumably because they are more risky) may not necessarily respond by reducing their risk, and can potentially react in several other ways. They may, for instance, reduce the assessment base on which premiums are charged and use non-assessable funding sources (if any are available).[2] If firms have access to risk-taking opportunities that are not fully priced in the premiums, they may ironically take on even more risk, as a "search for yield" strategy, to increase their profits and offset the negative effects of higher premiums. In addition, the premium differentials may create new arbitrage opportunities that banks may exploit to reduce or eliminate the impact of higher premiums. All these possibilities represent what I call in this paper behavioral *distortions*: rational responses to risk-based pricing through avenues other than the risk-mitigation channel. Such distortions reduce the effectiveness of risk-based pricing.[3] After all distortions are accounted for, it is an empirical question whether the residual negative impact of higher premiums on profitability is

[1] Other studies that find a relationship between deposit insurance and moral hazard include Wheelock and Wilson (1995) and Hooks and Robinson (2002). Some studies, however, do not find evidence of moral hazard associated with deposit insurance, at least in specific contexts (see, for example, Gueyie and Lai 2003 for Canadian banks in the 1960s, and Karels and McClatchey 1999 for credit unions). The focus of the present paper, however, is not whether deposit insurance itself causes moral hazard; instead, the focus is the effects of risk-based premiums, which are prevalent and, by design, are linked to each institution's level of risk.

[2] In the mid-1990s, the assessment base was domestic deposits. The Dodd-Frank Act of 2010 has since expanded the assessment base to include other funding sources.

[3] Furthermore, the regulatory and information environments in which risk-based pricing is implemented are central to its effectiveness. Prescott (2002), for instance, argues that environments in which regulators cannot observe bank risk severely hamper the proper functioning of risk-based pricing.

large enough to countervail any benefits to increased risk-taking that accrue to insured institutions. And even if that is the case, it is a priori unclear to what extent banks actually respond to such incentives by altering their business strategies and reducing their risk appetite; they may, for instance, be constrained from reducing their risk by other factors they deem more important (factors such as competition, location, management expertise, market conditions, and so forth). Very few studies address these issues and explore the empirical relationship between insurance pricing and the behavior of insured firms in the context of ex ante moral hazard.

In the present paper I use a previously-unexplored quasi experiment to study the different effects of insurance pricing on firm behavior, particularly those relating to moral hazard. The results, in brief, point to the effectiveness of risk-based pricing at mitigating ex ante moral hazard, but also indicate a tendency for distortions to arise, highlighting the importance of robust laws and regulations surrounding risk-based pricing. I find evidence of distortionary behavior, including arbitrage. Banks facing higher premiums switched funding sources away from deposits and into Federal Home Loan Bank (FHLB) advances, an alternate funding source that, at the time, was not assessed any premiums. Banks facing higher premiums also reduced their cash and securities holdings and increased their lending, becoming less liquid in the process, potentially as a "search for yield" strategy to offset shrinking net interest margins. In addition, a special class of banks engaged in an intricate form of regulatory arbitrage to re-classify deposits and make them assessable at lower premiums. Despite these distortions, however, I find that the residual impact of higher premiums on profitability is large and economically significant, even after accounting for the many ways banks could have attempted to offset the negative effects of relatively higher premiums. I also find that this cost borne by banks facing higher premiums, in terms of reduced profitability, far outweighs any potential gains from increased risk-taking. Finally, I directly study whether banks respond to pricing incentives through the risk-reduction channel. I find that banks facing stronger pricing incentives to reduce their risk-taking actually responded to those incentives by subsequently taking on less risk; similarly, banks that were classified as low-risk and that faced stronger incentives to remain in that classification were less likely to subsequently increase their risk levels.

The quasi experiment I use was spawned by rules governing the timing of reductions in deposit insurance premiums. In the mid-1990s, the FDIC oversaw two different insurance funds, the Bank Insurance Fund (BIF) and the Savings Association Insurance Fund (SAIF). Emerging from the savings and loan crisis of the 1980s, both funds were undercapitalized, and by law, once each fund reached its target capitalization level, premiums were required to be significantly lowered for the members of that fund. For several reasons explained more fully in section 3 below, the BIF recapitalized faster than the SAIF. The BIF recapitalized in the second quarter of 1995, with the result that insurance premiums for BIF members, but only for BIF members, were lowered in the third quarter of 1995. This disparity of premium between the two funds was highly undesirable, so in 1996 Congress passed a law to recapitalize the SAIF through a one-time special assessment charged to all SAIF members in the third quarter of that year. Starting in 1997, premiums were lowered for SAIF members to virtually match those paid by BIF members. Thus, both before and after the six quarters of the premium disparity, the premium schedules faced by the members of each fund were the same as the schedules faced by the members of the other fund, but during the six quarters of the disparity each fund faced premiums that differed significantly from those faced by the other fund. The differences were not only in level but also in steepness, that is, in the increments with which premiums increased for riskier institutions.

This six-quarter disparity offers a unique window onto the ways deposit insurance premiums influence bank behavior, and several aspects of the disparity uniquely aid in the identification of the results. The disparity generated both time and cross-sectional variation in levels of premiums as well as in the incremental incentives to lower risk. A simple cross-sectional comparison between high-premium payers and low-premium payers within a single risk-based pricing system would typically be plagued with selection issues, but the disparity forced institutions with identical risk profiles to face different premiums (and different risk-based premium schedules), allowing for estimates that credibly isolate the effects of insurance pricing. To further ensure that the institutions from the two funds are comparable, I use a combination of propensity score trimming, sufficiently exhaustive fixed effects, and synthetic control methods. In addition, the timing of the disparity had a plausibly exogenous reason (precise date of recapitalization of the BIF), and so the change is not confounded with other contemporaneous shifts in policy or macroeconomic conditions, in contrast to changes that are born of crises or large-scale changes in regulations. Finally, the changes were economically meaningful and generated large disparities in the premiums paid by similar institutions for the same deposit insurance. In August 1995, in his telling congressional testimony on the disparity, Alan Greenspan, then-chairman of the Federal Reserve Board, notes:

> We are, in effect, attempting to use government to enforce two different prices for the same item—namely, government-mandated deposit insurance...The difference between paying, say, 24 basis points and paying 4.5 basis points for deposit insurance

> translates into about $1.4 billion per year in additional premiums paid for SAIF deposits. For SAIF institutions, this equals roughly 18 percent of their 1994 pretax income. (Board of Governors of the Federal Reserve System 1995.)

This paper uses the different variations created by the disparity, proceeding in several steps (described in the paragraphs that follow) to build an integrated understanding of how institutions respond to insurance premiums.

My first set of results exploit the fact that the disparity forced otherwise similar BIF and SAIF institutions to pay different *levels* of deposit insurance premiums. Using these differentials, I estimate the distortionary effect on funding sources (as one instance of distortions, with others following in later results) and the residual effect of premium differentials on profitability. The residual effect on profitability can be considered the ultimate wedge in profitability created by the differences between BIF and SAIF institutions in premium levels after any response by the banks to the differentials is accounted for. The residual effect on profitability is a pivotal quantity for assessing the effectiveness of risk-based pricing. If there is little difference in profitability between institutions that pay low premiums and institutions that pay high premiums, either because there are ways to evade the differentials or because the differentials are not large enough, then profit-maximizing firms have little incentive to change their risk taking in response to changes in premiums.[4]

In the first set of results I find that institutions facing higher premiums reduced their reliance on deposits (as a ratio of liabilities) immediately before and during the disparity by a total of about 120 basis points and shifted their funding to Federal Home Loan Bank advances, a funding source that was not assessed any deposit insurance premiums. Neither this shift, however, nor any other offsetting strategies high-premium payers may have employed (discussed later), were sufficient to eliminate the effects of the disparity on their profitability. The disparity introduced a large wedge between BIF and SAIF institutions in the return on assets (ROA), a wedge of about 16.7 basis points, or about 20.4% of the ROA of SAIF institutions in the quarter immediately preceding the disparity, with SAIF members having lower relative profitability. Importantly, this wedge implicitly takes into account any distortionary actions the institutions may have taken in response to the disparity, and thus shows the residual effect on profitability that could not be evaded by institutions. However, when

[4]Note that the change in premiums during the six quarters of disparity occurred only for BIF institutions (apart from the one-time special assessment charged to SAIF members): BIF institution premiums were reduced. Despite the lack of change in the premiums for SAIF institutions, it is not surprising if both types of institutions changed their behavior. Because banks compete for deposits, a reduction in BIF members' deposit insurance premiums may be partly passed on to depositors as better deposit rates, which would in turn make deposits more expensive for SAIF members. Because the analysis of profitability is concerned with the residual relative effect of premium differentials on profits (accounting for any response to the differentials by either BIF or SAIF institutions), what is of interest is the ultimate *relative* effect on profitability (see section 2).

one thinks about overall incentives created by risk-based pricing, the question still remains whether a shock to profitability of this magnitude would be sufficient to incentivize a risky bank to change the way it does business and reduce its risk, thereby potentially forgoing some profits. To study this comparison, I estimate the relationship between risk taking and profitability, keeping premiums constant. I find no evidence that higher risk taking is associated with improved profitability. These results suggest that relatively minor differentials in premiums may be sufficient to mitigate moral hazard, and that risk-based pricing provides strong incentives for profit-maximizing banks to curb their risk taking.

So far, however, the results do not necessarily imply that institutions actually do respond to pricing incentives by reducing their risk taking.[5] Because it forced different levels of premiums on members of the two funds, and members of one fund could not simply switch to the other fund by altering their risk levels, the disparity in *levels* of premiums between the two funds cannot be used to identify the extent to which banks respond to premium differentials through the risk-mitigation channel. In the next set of results I directly address this issue by exploiting differences between BIF and SAIF institutions in the *steepness* of the risk-based premiums, an additional source of variation generated by the BIF-SAIF disparity. When the FDIC lowered the premiums for BIF members, it lowered them more aggressively for banks already paying the lowest premiums on the risk-based pricing schedule. Thus, the modifications changed not only the levels of premiums but also the incremental penalties of becoming more risky, thereby altering the incentives for taking on more (or less) risk. Again, these changes occurred a year and a half earlier for BIF institutions than they did for SAIF institutions. I use these time and cross-sectional changes to study the resulting difference between BIF and SAIF institutions in the likelihood of becoming more or less risky before, during, and after the disparity.

I find that when risky institutions had stronger incentives (through larger reductions in deposit insurance premiums) to become less risky, the institutions were in fact more likely to reduce their risk. Similarly, safer institutions that had stronger pricing incentives to remain safe were actually more likely to remain safe in subsequent quarters. During the period of the disparity the incremental risk-based increases in premiums were different for BIF members from what they were for SAIF members, but the differences in those increments between the two groups of banks were not unreasonably large; thus, these results also suggest that relatively small changes in pricing incentives are sufficient to influence banks' risk-taking behavior, consistent with the conclusions reached

[5]As mentioned above, despite the existence of incentives, banks may be constrained not to change their risk appetite by other factors, including, for example, management expertise and location.

above. Overall, these results again point to the effectiveness of risk-based pricing in mitigating moral hazard.

Finally, I use the disparity to study how deposit insurance premiums affect banks more generally and document other relevant distortions. I find evidence that SAIF institutions became relatively less liquid; they reduced their cash holdings and had significantly higher rates of loan growth and lower rates of securities growth relative to similar BIF institutions. I also find that the disparity adversely affected the competitiveness of SAIF institutions by decreasing their net interest margins relative to those of BIF institutions. Thus, the shifting of their asset mix to loans instead of more-liquid assets may have been a "search for yield" strategy. Consistent with this hypothesis, I find that the growth rate of SAIF institutions' interest income rose significantly during the disparity relative to that of BIF institutions. In contrast, I find no strong effects on the interest expense of SAIF institutions relative to BIF institutions (as a growth rate or as a percentage of interest-bearing deposits), suggesting that SAIF members and BIF members continued to offer comparable interest rates on deposits. I find evidence that the so-called Oakar institutions (institutions that held deposits insured by both funds) engaged in regulatory arbitrage to reduce their total assessment burden. Despite rules and controls in place at the time to prevent the movement of deposits from the SAIF to the BIF, the evidence suggests that Oakar institutions, by exploiting an asymmetry in the rules governing deposit sales, migrated some of their deposits from the SAIF to the BIF. This finding highlights the importance of accompanying risk-based pricing with regulatory controls to prevent any form of arbitrage. Arbitrage opportunities, and distortions more generally, directly weaken the effectiveness of risk-based pricing, for the riskier institutions facing higher premiums may find it feasible to evade the premiums without having to reduce their risk taking. In addition, deposit migration is a serious concern for the insurer, for it reduces the assessment base of the fund from which deposits are fleeing, thus weakening the fund. The United States currently has only one deposit insurance fund for banks and savings institutions, but deposit migration may be relevant internationally.[6] Although an international study is beyond the scope of the present paper, the paper's findings concerning deposit migration within the United States highlight the importance of strong regulatory controls that not only discourage arbitrage but also eliminate any loopholes that could allow banks to evade higher premiums within a risk-based pricing system.

[6] There is also a separate fund for insured credit unions. The National Credit Union Share Insurance Fund (NCUSIF), managed by the National Credit Union Administration (NCUA), insures accounts in credit unions.

This paper relates to several strands of literature; the first is on the effects of risk-based (as opposed to flat-rate) deposit insurance pricing. However, the results in the present paper directly estimating the risk-mitigation incentives created by differentials in premiums and the responsiveness of banks to insurance pricing through the risk-mitigation channel, have not been previously studied. Cornett et al. (1998), analyzing the period when banks paid flat-rate premiums, before the implementation of risk-based pricing, concentrate on shocks to bank stock prices in response to events that made the implementation of risk-based pricing seem more likely or less likely. They find that healthy and well-capitalized banks benefited from events that made the implementation of risk-based pricing more likely, and that the opposite was true for risky banks. Hovakimian et al. (2003) use an option-pricing model in a cross-country study and find evidence that in countries with explicit deposit insurance, risk shifting had increased but was attenuated when the insurance was accompanied with other controls, such as risk-based pricing. In another cross-country study, one that uses a different methodology, Demirgüç-Kunt and Detragiache (2002) find evidence that explicit deposit insurance increases the risk of banking crises but that risk-based pricing mitigates excessive risk taking; they also find that the moral hazard associated with deposit insurance is attenuated in countries with stronger institutional environments. More generally, the present paper complements the normative literature on optimal design and pricing of deposit insurance (e.g., Chan et al. 1992, Boyd et al. 2002, Pennacchi 2005, Pennacchi 2006, Acharya et al. 2010, and Allen et al. 2015).

A second related strand of literature is on the effects of deposit insurance premiums, and funding costs more generally, on various aspects of bank behavior and risk-taking. Kim and Rezende (2020) use a kink in the pricing of deposit insurance and estimate that higher premiums incentivize banks to "search for yield" by reducing their reserves and increasing their lending in the interbank market instead. Their results are consistent with the present paper's results on increased risk-taking by SAIF institutions (though the risk-taking mechanism differs), but the BIF-SAIF quasi experiment I use allows for a unique source of identification in which institutions with *identical* risk profiles are charged different premiums. Kreicher et al. (2013) estimate several effects of the change in deposit insurance assessment base instated by the Dodd-Frank Act of 2010. Although their identification strategy and time period differ from the present paper, it is notable that they find a shift in funding sources by US banks towards deposits after the widening of the assessment base—a result consistent with the present paper's finding of a response by banks to deposit insurance pricing through shifting funding sources. Other related papers include Keating and Macchiavelli (2017), Basten and Mariathasan (2018), Heider et al. (2019), Banegas and Tase (2020), Duquerroy et al. (2020), and

Kandrac and Schlusche (2021). Besides differences in the precise research questions and effects estimated, the present paper is unique in using the disparity in deposit insurance premiums between BIF and SAIF members as a quasi experiment to study the effects of the premiums on bank behavior.

In the literature on the economics of insurance more broadly, several studies find evidence of ex ante moral hazard in various contexts. For example, Cohen and Dehejia (2004) find that auto insurance reduces precautions and increases traffic fatalities; Spenkuch (2012) finds that access to health insurance reduces the use of preventive care; and Dave and Kaestner (2009), exploiting exogenous variation in health insurance coverage when people turn 65 and come under Medicare, find that obtaining health insurance reduces prevention and increases unhealthy behaviors. There is also literature, especially within the context of health insurance, on how the design of the insurance contract affects moral hazard (examples of this literature are van Kleef et al. 2009 and Brot-Goldberg et al. 2017). But this literature often differs from the current paper in two important ways. First, unlike the current paper, it focuses on ex post moral hazard, which is the propensity to increase spending on claims (e.g., medical care or unemployment insurance) *after* a loss has already occurred. Second, the focus is typically on other aspects of the insurance contract, such as deductibles. Again, despite the prevalence of risk-based premiums in different insurance contexts (auto, home, property, and so forth), very few studies deal directly with the relationship between risk-based premiums and ex ante moral hazard.

This paper is organized as follows: Section 2 briefly describes the relationship between risk-based pricing and moral hazard, and discusses distortions that may arise, in a simplified theoretical framework to aid in the interpretation of the empirical results. Section 3 details the history and institutional context of the six-quarter disparity. Section 4 describes the data and sample, as well as the propensity score approach that was used in trimming the sample. Section 5 contains the main results of the paper in several subsections: subsection 5.1 studies the shifting of funding sources away from deposits by banks facing higher premiums; subsection 5.2 estimates the wedge in profitability created by differentials in premium and compares that wedge with the relationship between risk-taking and profitability in order to understand whether risk-based pricing can induce high-risk firms aiming to maximize profits to become less risky; subsection 5.3 uses variation in steepness of risk-based pricing from the disparity to study whether institutions facing stronger incentives actually responded by adjusting their risk taking; subsection 5.4 presents evidence of regulatory arbitrage through deposit sales as another example of a distortion that may accompany risk-based pricing; subsection 5.5 discusses the evidence on increased risk taking by SAIF institutions in response to the disparity; finally, subsection 5.6 shows the effects of the disparity on net interest margins, interest income, and interest expense. Section 6 concludes and discusses opportunities for further research. An appendix contains figures and tables showing results of the analysis.

2 Theoretical Preliminaries

Suppose a bank's profits depend on, among other things, both the level of risk taking, $\alpha \in [0, \overline{\alpha}]$, with higher values of α denoting higher risk, and deposit insurance premiums, given by p. To highlight the relationship between risk-based pricing and moral hazard, consider a scenario in which the bank's profit function, denoted by π, is strictly increasing in α when the bank is insured and when there is no risk-based pricing. Under the flat-rate regime, all banks pay the same deposit insurance premium $p = p'$. This illustrative setting is a worst-case scenario for moral hazard, for it implies that deposit insurance (with its associated lack of market discipline) incentivizes the bank to maximize its risk in order to maximize profits.[7] This case is illustrated in panel (A) of Figure 1.

A regulator can attempt to alleviate moral hazard by making the premium dependent on the risk level α, with higher values of α resulting in higher premiums $p'' > p'$. Suppose a regulator wishes to incentivize the bank to move to a lower level of risk, $\alpha' < \overline{\alpha}$. Panel (B) of Figure 1 illustrates the effect of setting two different premiums with $p = p'' > p'$ if $\alpha > \alpha'$ and $p = p'$ otherwise. This new premium structure is successful (i.e., solves the moral hazard problem and incentivizes the bank to lower its risk level to α') if the following condition is satisfied:

$$\pi(\overline{\alpha}, p') - \pi(\overline{\alpha}, p'') > \pi(\overline{\alpha}, p') - \pi(\alpha', p') \tag{1}$$

Simply, as I illustrate in Figure 1, the effectiveness of risk-based pricing hinges on the degree to which higher premiums reduce profitability for a firm that remains risky (the left-hand side of condition (1)), and how that reduction to profitability compares to any potential loss the firm may face by reducing its risk (the right-hand side of condition (1)). If higher premiums sufficiently reduce the firm's profitability (point b in Figure 1), the firm will find it optimal to reduce its risk to α' (point c in the figure). However, if higher premiums do not sufficiently reduce firm profitability, either because the premium differentials are simply not large enough or because the firm can somehow dampen the effect of higher premiums on its profitability, the insurance pricing will not incentivize the firm to reduce its risk; this situation is illustrated by point d in the figure. Several (but not all) of

[7] In reality the profit function need not be strictly increasing in bank risk taking. All that is needed to justify risk-based pricing is that banks' risk levels in the absence of risk-based pricing are higher than the regulator would prefer. Moreover, other regulatory actions besides risk-based pricing can also curb profit taking; examples of such actions are direct rules on capitalization and on levels of risk taking.

the empirical results in this paper revolve around understanding which of these two points in Figure 1, b or d, is more reflective of reality. The BIF-SAIF disparity uniquely aids in this endeavor.

Reliably estimating the effect of premiums on profitability (e.g., whether a firm at point a in Figure 1 would end up at point d or point b when faced with higher premiums) requires observing firms *at the same risk level* but that face *different* deposit insurance premiums; this is typically difficult or impossible to observe without exogenous variation in premiums. The BIF-SAIF disparity forced firms that have identical levels of risk to face different levels of deposit insurance premiums, and this allows me to reliably estimate the elasticity of profits with respect to premiums. Importantly, because firms could not avoid the premiums disparity, the estimates I obtain are of the "residual" effect on profitability. That is, the estimates account for all the ways firms may have attempted to dampen the effect of the premium differentials, or what I refer to as distortions.

Distortionary effects of risk-based premiums are rational responses to pricing through any channel other than reducing risk. Even the simplest models suggest that with differential premiums, high-risk banks compensate in ways that lower the left-hand side of condition (1) and dampen the effect of the high premiums on their profitability.[8] The extent to which distortions exist is purely an empirical question, because distortions are highly contextual and depend on the institutional environment and the laws and regulations surrounding risk-based pricing. If, for instance, the bank has access to an alternative low-cost non-assessable funding source, it is likely to shift its funding sources away from deposits. This follows because the higher premiums directly raise the cost to the bank of funding from deposits. Alternatively, if competitors pay lower premiums and pass on the savings to depositors, the bank could be forced to raise its rates, making deposits more expensive for the bank and, again, incentivizing the bank to shift away from deposits. The bank may also exploit any inefficiencies in the design of the risk-based pricing and become even more risky to offset the effect of premiums on its profits (i.e., may increase some measure of risk not captured by the measurable α). Finally, the existence of differential premiums itself may completely alter the profit function of the bank if

[8] To illustrate one form of this dampening in a highly simplified model, suppose the bank must also decide on $\beta \in [0,1]$ specifying its portion of funding that comes from deposits, with its funding level fixed at some $F > 0$. Let its profit function be of the following form: $\pi(\alpha, p, \beta) = R(\alpha) - \beta F p - E(\beta)$, where R is an increasing function and E is the interest expense of the bank given that it funds a portion β of its total funding F from deposits and a portion $1-\beta$ from other sources. Under flat-rate premiums with $p = p'$ independent of α, the bank always chooses $\alpha = \overline{\alpha}$, the highest risk level, and chooses β to minimize the total cost of funding, $(\beta F p' + E(\beta))$. Consider now a move from flat-rate premiums to risk-based premiums as illustrated in Figure 1 with $p = p'' > p'$ if $\alpha > \alpha'$ and $p = p'$ otherwise. Let β' be the choice of β that minimizes $(\beta F p' + E(\beta))$ and let β'' be the choice that minimizes $(\beta F p'' + E(\beta))$. In the absence of any distortions (that is, if the bank does not alter its level of deposit funding as a result of the premiums), the analogous left-hand-side of condition (1) in this setting is $(\beta' F p'' + E(\beta')) - (\beta' F p' + E(\beta'))$. However, because the bank has the ability to change its funding mix, its choice of β at $p = p''$ is β'', as stated previously. Thus, in reality its left-hand side of condition (1) is $(\beta'' F p'' + E(\beta'')) - (\beta' F p' + E(\beta'))$, which is lower than it would have been in the absence of distortions because, by definition, β'' is the choice of β that minimizes $(\beta F p'' + E(\beta))$.

loopholes or opportunities for regulatory arbitrage allow the bank to expend some costly effort to reclassify some of its deposits at the low premiums.

In my empirical results I find evidence of distortions such as shifts in funding sources, arbitrage, and increases in some forms of risk taking (see subsections 5.1, 5.4, 5.5, and 5.6), but I also find evidence that risk-based pricing provides sufficient incentives to mitigate risk. That is, the evidence suggests that condition (1) holds. In subsection 5.2, I use unique variation from the disparity to estimate the residual effect of premiums on profitability (i.e., the left-hand side of condition (1)), and I compare it to estimates of the effect of risk on profitability (i.e., the right-hand side of condition (1)).[9] I find that the loss to profitability that a high-risk bank would face by paying higher premiums far exceeds any potential loss to profitability that it may experience by reducing its risk. That is, the evidence suggests that point b in the illustrative example in Figure 1 is more representative of reality than point d.

The results mentioned above strongly suggest that risk-based premiums create incentives for banks to lower their risk, but additional variation from the BIF-SAIF disparity allows me to go further and directly estimate whether banks respond to pricing incentives through the risk-mitigation channel. As previously mentioned, even if a bank faces incentives to reduce risk, it may be constrained by management expertise, location, or other factors to maintain its risk-taking levels. In that sense, condition (1) is necessary but not sufficient to conclude that risk-based pricing mitigates moral hazard. The exogenous variation I use to address this issue comes from the steepness of premiums, or how fast the premiums grew as a bank became more risky (BIF institutions faced a steeper risk-based schedule during the disparity; see Figure 2 for an illustration). In section 5.3, I use this variation and find that banks did indeed respond to insurance pricing through the risk-mitigation channel; banks facing steeper penalties were observably more likely to curb risk taking.

3 A Brief History of the 1995-1996 BIF-SAIF Disparity

Before 1989 the FDIC's Permanent Insurance Fund insured commercial banks and some mutual savings banks. The Federal Savings and Loan Insurance Corporation (FSLIC) insured most Savings and Loan Associations (S&Ls). Savings banks and S&Ls can both be classified as thrifts.

The distinctions between thrifts and commercial banks go back to the 19$^{\text{th}}$ century, when thrifts were founded to serve working-class people who were not being adequately served by commercial

[9] Estimating the elasticity of profits with respect to risk-taking, which relates to the right-hand side of condition (1), requires an estimate of the slope of the lines in Figure 1. Estimates of that slope can be obtained from observing firms that pay the same premium but have risk profiles that are different, at least marginally. Premiums in a risk-based pricing system often move up in a step-wise fashion depending on risk, and thus for significant masses of firms they remain constant. Firms that pay the same premiums within each "step" of the pricing can be used to estimate the elasticity; in Figure 1, for instance, firms with $\alpha \leq \alpha'$ can be used to estimate the slope.

banks, which focused on serving businesses. Initially, the charters of thrifts and commercial banks were significantly different: they had different powers, with thrifts being restricted to housing-related lending. In the early 1980s, however, Congress passed laws that expanded the powers of thrifts and virtually eliminated the historical distinctions between them and commercial banks (Lateef and Sczudio 1995). The most important difference that remained was the *extent* to which thrifts could engage in activities unrelated to housing. Thrifts were allowed to hold up to 40% of their assets in commercial mortgage loans, up to 30% in consumer loans, up to 10% in commercial loans, and up to 10% in commercial leases. During the remainder of the 1980s, the practical distinctions between thrifts and commercial banks continued to fade, and by 1992 commercial banks held more mortgage loans than thrifts did (Lateef and Sczudio 1995).

In the middle of the 1980s, however, the thrift industry was in the throes of what came to be called the S&L debacle, to which Congress responded with major pieces of legislation, two of which are particularly relevant to this brief history. The first was the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA), and the second was the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA).

FIRREA abolished the FSLIC, the insurer of most S&Ls, and established a new insurance fund, the Savings Association Insurance Fund (SAIF), which would insure most thrifts and would be managed by the FDIC. In addition, FIRREA established the Bank Insurance Fund (BIF)—also managed by the FDIC—to assume all the assets and liabilities of the Permanent Insurance Fund (Segal 1991) and insure most commercial banks.

FDICIA, passed a little over two years after FIRREA, contained several important provisions affecting deposit insurance premiums (see Federal Deposit Insurance Corporation 1998). Before FDICIA, all banks had paid a flat rate for deposit insurance. FDICIA introduced risk-based premiums: banks (henceforth this word will apply to both commercial banks and thrifts unless specified otherwise) were to be classified into one of nine categories depending on their capital ratios and supervisory risk group. Starting in January 1993, the assessment rate varied between 23 cents per $100 of assessable deposits for banks in the lowest premium category to 31 cents per $100 of assessable deposits for institutions in the highest premium category. These rates applied equally to both BIF- and SAIF-insured banks and are displayed in panel (A) of Table 1 and in panel (A) of Figure 2.

At the time FDICIA was passed, both the BIF and the SAIF were undercapitalized. Under FDICIA, banks in each of the funds were to be charged assessments until the fund under which they were insured was fully capitalized to 1.25% of insured deposits. FDICIA required the FDIC to develop a plan to recapitalize the BIF within 15 years; that plan was adopted in 1992. FDICIA also required the FDIC to develop a plan to recapitalize the SAIF, but the plan was not required until 1998; at the time, nearly half of SAIF assessments were being diverted to other purposes stemming from the S&L crisis, so it was clear that the SAIF would take much longer than the BIF to recapitalize.

In 1993, however, the banking industry was much more profitable than it had been in the immediately preceding years. In the fall of 1992, more than 1,000 institutions had been on the FDIC's list of "problem institutions" (institutions requiring additional attention from regulators), but by year-end 1993, the number had dropped to 472 institutions, leading the FDIC to project substantial reductions in the number of bank failures in 1994 and 1995 (Federal Deposit Insurance Corporation 1994). As a result of the sharp rise in banks' profitability in 1993, the BIF recapitalized in May 1995, much faster than lawmakers had anticipated.

Because the BIF was recapitalized, the FDIC was required to reduce the deposit insurance premiums for its members. In the third and fourth quarters of 1995, therefore, the premiums of BIF-insured banks were reduced to between 4 and 31 cents per $100 of assessable deposits (with excess assessments refunded to BIF members [Federal Deposit Insurance Corporation (1996)]), and starting in January 1996 the premiums were again reduced to range from 0 to 27 cents per $100 of assessable deposits. The three panels of Table 1 show the evolution of premiums for SAIF and BIF institutions throughout the six quarters of the disparity—the period when BIF premiums differed from SAIF premiums. Table 2 shows the percentage of BIF and SAIF institutions in each of the nine categories that determined premiums. By far, most banks were in the "healthiest" category as defined by the FDIC throughout this period. Thus, most BIF-insured banks faced an assessment rate of 4 basis points in the third and fourth quarters of 1995 (before assessment refunds) and 0 basis points in all quarters of 1996. Most SAIF-insured banks, on the other hand, continued to be assessed 23 basis points, according to the earlier risk-based premium schedule. Panel (B) of Figure 2 illustrates the primary premiums structures for BIF and SAIF members during the disparity.

The disparity in premiums was undesirable, and was projected to cause several problems. Thus, Congress responded by passing the Deposit Insurance Funds Act of 1996, which mandated a one-time special assessment of 65.7 basis points that SAIF members would pay in the second half of 1996 to recapitalize the SAIF. Congress decided that the base for the special assessment would be the SAIF-assessable deposits held on March 31, 1995 (Federal Deposit Insurance Corporation 1997).

Because the assessment was paid in the second half of 1996, starting in 1997 both SAIF- and BIF-insured banks faced the same deposit insurance premiums, illustrated in panel (C) of Figure

2—except that an additional premium was charged to members of both funds to finance the Financing Corporation (FICO) bonds (which had been issued during the S&L crisis), and the FICO assessments differed slightly between the two funds.[10] In 2000 the FICO assessments became the same for both sets of institutions. In 2006, pursuant to the Federal Deposit Insurance Reform Act of 2005, the BIF and the SAIF merged to form the Deposit Insurance Fund (DIF).

The focus of this paper is the 1995–1996 six-quarter period of disparity, when the premiums charged to one set of institutions were different from the premiums charged to the other set. The empirical analysis extends from the beginning of 1993, when risk-based premiums were first implemented, through the end of 1997.

4 Data and Sample

The main sources of data are the quarterly Reports of Condition and Income (Call Reports) filed by commercial banks and the quarterly Thrift Financial Reports (TFRs) filed by thrifts. Both reports contain detailed balance sheet and income statement information for the reporting institutions. I also use confidential data on banks' supervisory CAMELS ratings. CAMELS ratings are supervisory ratings between 1 and 5 (1 being the best) assigned to banks by supervisory regulators. A CAMELS rating has six components (**C**apital Adequacy, **A**sset Quality, **M**anagement Quality, **E**arnings, **L**iquidity, and **S**ensitivity to Market Risk), each of which receives a rating between 1 and 5. In addition, supervisory regulators assign the bank a composite CAMELS rating (also between 1 and 5) to summarize the bank's overall health; the composite ratings may differ from the average of the component ratings.

Unless otherwise noted, I use a "trimmed sample" of institutions, which I construct by first imposing several basic restrictions and then by applying a propensity score trimming procedure to keep BIF and SAIF members comparable. This sample includes commercial banks and thrifts that (1) were in business in all quarters between the first quarter of 1993 and the fourth quarter of 1997; (2) for each of those quarters, were classified as a national bank, state member or nonmember bank, savings bank, or savings and loan institution; (3) were headquartered in the contiguous, continental United States; (4) had a positive value for total loans and leases, total deposits, and domestic deposits; and (5) did not experience a change in charter type, ownership structure, insurance fund, or membership status in a holding company. Also excluded were young (de novo) institutions established in 1992 or after.

I then trim this sample of institutions using propensity scores to ensure that the two subsamples in the estimates, one of BIF members and one of SAIF members, are comparable. I run a pooled

[10] SAIF-insured institutions paid FICO assessments of about 6 basis points, while BIF-insured institutions paid FICO assessments of 1 basis point (Federal Deposit Insurance Corporation 2017).

logit model starting in the first quarter of 1993 and ending in the second quarter of 1995, where the dependent variable takes a value of 1 if the institution is SAIF-insured and 0 if the institution is BIF-insured. The covariates for this regression are the log of assets, domestic deposits to liabilities ratio, quarterly return on assets, quarterly efficiency ratio, total risk-based capital ratio, Tier 1 risk-based capital ratio, leverage ratio, the composite CAMELS rating from the most recent examination, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. These covariates include the variables where the distinctions between thrifts and commercial banks are probably most pronounced (like asset composition), as well as variables that are relevant for outcomes of particular interest in the rest of the paper. The predisparity predictions from the pooled logit model result in a time series of propensity scores for each institution. I apply the trimming to the average of each institution's propensity score time series: following the rule of thumb suggested in Crump et al. (2009), I trim institutions whose predisparity average propensity score is less than 0.1 or greater than 0.9. Figure 3 shows the density functions and histograms of propensity scores for both BIF and SAIF institutions after the trimming. As the figure makes clear, the propensity score distributions of the BIF and SAIF institutions that are included overlap significantly, showing that the resulting sample contains many comparable institutions from both funds. The final trimmed sample contains 565 SAIF-member institutions and 539 BIF-member institutions. Table 3 shows descriptive statistics for members of the two funds in the trimmed sample. Depending on the question of interest, some sections in the present paper (most notably sections 5.3 and 5.4) restrict the sample further or use a much larger sample of banks.

5 Main Findings

This section presents the main results in several subsections. Subsection 5.1 examines the responses of banks to the deposit insurance premiums, and specifically the responses that involved changes in funding sources as one example of a distortion (more examples follow in later subsections). Subsection 5.2 studies the incentives created by differences in premiums, particularly whether banks are able to offset the effects of premiums on their profits and whether any remaining effect is sufficient incentive to induce profit-maximizing banks to refrain from excessive risk taking. Subsection 5.3 uses variation from the disparity in risk-based pricing "steepness" to study whether institutions facing stronger pricing incentives to avoid risk taking actually responded to those incentives by reducing their risk. Subsection 5.4 describes a distortion in which banks with both BIF and SAIF deposits engaged in regulatory arbitrage to move deposits to the BIF. Subsection 5.5 tests the "search for yield" hypothesis and whether SAIF institutions responded to the disparity by increasing their risk-taking in various ways. Finally, subsection 5.6 shows the effects of the disparity on net interest margins, interest income, and interest expense.

5.1 Shifts in Funding Sources as a Response to Higher Premiums

As mentioned above, whenever premiums are charged on deposits, institutions can mitigate the effect of higher premiums by shifting funding away from deposits.[11] This strategy is, in a sense, a distortion, and it is undesirable for at least two reasons. First, it may lead the institutions facing higher premiums (the riskier ones) to shift funding away from deposits to funding sources that are less stable, which may in turn *increase* their overall riskiness instead of decreasing it. Second, shifting funding sources to avoid high premiums erodes the effectiveness of risk-based insurance pricing, neutralizing (to whatever degree, depending on the case) its ability to mitigate moral hazard. In the extreme case that risky institutions have free access to nondeposit funding, for instance, risky institutions can completely sidestep the effect of higher premiums by switching their funding source, thereby eliminating any effect of risk-based pricing on their profits and rendering risk-based pricing entirely ineffective at mitigating moral hazard.

This subsection provides estimates of the extent to which institutions sidestep higher premiums by shifting funding sources. I do this by studying the response of differentially affected institutions to the BIF-SAIF disparity, using the following two specifications:

$$y_{it} = \alpha + \beta(\mathbf{1}_{i \in SAIF} \times \mathbf{1}_{t \geq T_0}) + \gamma \mathbf{x}_{it} + c_i + d_t + \epsilon_{it}, \tag{2}$$

$$y_{it} = \alpha + \sum_{k=1993Q2}^{k=T_f} \beta_k (\mathbf{1}_{i \in SAIF} \times \mathbf{1}_{t=k}) + \gamma \mathbf{x}_{it} + c_i + d_t + \epsilon_{it}, \tag{3}$$

where y_{it} is the dependent variable of interest for institution i in quarter t, $\mathbf{x}_{it}$ includes controls at the institution by quarter level, c_i is an institution fixed effect, and d_t is a quarter fixed effect. The coefficient of interest in specification (2) is β, which provides an estimate of the effect of being in the SAIF starting in quarter T_0, which in this subsection is set to be the third quarter of 1995 (the first quarter in which the disparity was in effect). The sample for these specifications is from the first quarter of 1993 through T_f, which may vary depending on the question under consideration. Specification (3) is a dynamic version of specification (2); the coefficient of interest is β_k, which shows the effect of being insured by the SAIF in each quarter within the sample (with the first quarter excluded). Controls for

[11] The Dodd-Frank Act of 2010 redefined the assessment base for U.S. institutions to be average consolidated total assets minus average tangible equity.

both specifications include the log of the institution's assets as well as the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets; to control for the institution's risk levels, the covariates also include all the capital ratios used in determining premiums (total risk-based capital ratio, Tier 1 risk-based capital ratio, and the leverage ratio) as well as the institution's composite CAMELS rating from its most recent examination. All variables except composite CAMELS ratings are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level.

As a "first-stage," I compare the cost structures of BIF and SAIF institutions during the time of the disparity. Evidence of the disparity in measures of cost would suggest that the disparity did in fact differentially affect institutions and that SAIF members were not able (or not willing) to shift business strategies beforehand in ways that would offset the disparity's direct effects. The dependent variable for this analysis is the ratio of an institution's reported "other noninterest expense" to "total noninterest expense." Noninterest expense includes items like employee's salaries, benefits, and expenses on premises and fixed assets. "Other noninterest expense" includes deposit insurance assessments as well as other items that do not have their own reportable category.[12] The top panel of Figure 4 shows the β_k estimates from specification (3). This panel shows three abrupt changes exactly coinciding with the events of the disparity. In the third quarter of 1995, the dependent variable suddenly becomes relatively higher for SAIF members. It then has a large one-quarter increase for SAIF members (relative to BIF) in the third quarter of 1996. Finally after the end of the disparity, starting in the first quarter of 1997, there is no statistically discernible difference between SAIF and BIF members in the dependent variable. The bottom panel confirms that all three events are driven by the directional shifts in the dependent variable that would be expected to happen as a result of the disparity in premiums. In the third quarter of 1995 there is a sharp decline in the dependent variable for BIF institutions, with the dependent variable for SAIF institutions remaining fairly constant, coinciding with the reduction in BIF members' deposit insurance premiums. In the third quarter of 1996 there is a one-time large increase in the dependent variable for SAIF institutions, coinciding with the one-time special assessment levied on SAIF members to recapitalize the SAIF. Finally, in the first quarter of 1997 there is a sharp decline of the dependent variable for SAIF institutions, with

[12]Examples of other items reportable as "other noninterest expense" are income or loss associated with minority interest ownership of subsidiaries; some fees levied by brokers who supply brokered deposits; payments to nonsalaried employees such as attorneys, accountants, and management consultants; expenses related to employee training and some other employee-support activities, like newspaper subscriptions; gifts or bonuses given to depositors for opening new accounts; expenses associated with other real estate owned; fees and travel expenses paid to directors for attendance at board of directors meetings; legal fees and other costs incurred in connection with foreclosures; and amortization expense of intangible assets. This list is not exhaustive and is based on Call Report preparation instructions from September 1997.

the dependent variable for BIF institutions remaining fairly constant, coinciding with the reduction in SAIF members' premiums to match BIF members' premiums and the end of the disparity.

To study the effect of the disparity on the choice of thrifts' funding sources, I consider next the domestic deposits to liabilities ratio, which shows how much of an institution's funding is through domestic deposits. The first two columns of Table 4 show the estimates from specification (2) on the full sample. The estimates show that the average domestic deposits to liabilities ratio for SAIF institutions was about 0.7% to 0.9% lower relative to BIF institutions starting in the third quarter of 1995, compared with the same difference between the two types of institutions before the disparity. For three reasons, however, these estimates are likely to be a lower bound on the effect of the disparity. First, the time period before the disparity can include anticipation effects, which are likely to influence the estimates of the effect of the disparity in the direction of zero. Second, the time period from the third quarter of 1995 until the end of 1997 includes periods after the disparity ended, which would also typically influence estimates of the effects of the disparity in the direction of zero if institutions reverted to "normal" behavior after the disparity. Finally, trimming based on average propensity scores for all predisparity periods may contribute to including BIF institutions whose predisparity trend in the deposits to liabilities ratio is similar (declining) to that of SAIF institutions, even if such trend in SAIF institutions was in anticipation of the disparity; the BIF institutions included are thus more likely to have a declining deposits to liabilities ratio for exogenous reasons, and if such trends continue postdisparity, the estimates in specification (2) may be further attenuated. To circumvent most of these issues, columns (3) and (4) of Table 4 show estimates from specification (2) after the sample is restricted to include only years 1993 and 1997, and with the propensity-score trimming redone based on only 1993 propensity scores. These estimates suggest that the effect of the disparity on the reduction in SAIF institutions' deposits to liabilities ratio relative to BIF institutions is closer to 1.2%. Further confirming these estimates with specification (3), Figure 5 shows the variation over time in the effect of the disparity on institutions' choices of funding sources. The top panel of Figure 5 shows the β_k coefficient estimates from specification (3), where the dependent variable is the ratio of domestic deposits to liabilities. A reduction in thrifts' relative dependence on deposits is clear before and during the disparity. This trend is reversed immediately following the end of the disparity, where β_k remains stable or slightly increasing until the end of 1997. The bottom panel of Figure 5 confirms that the estimates are indeed driven by a reduction in thrifts' reliance on deposits, with most of the reduction occurring immediately before, and during, the disparity.

Figure 6 shows that the shift away from deposits was made up almost entirely by increased reliance on Federal Home Loan Bank (FHLB) advances for funding. Interestingly, the increased reliance of thrifts on FHLB advances occurs despite no change in thrifts' absolute cost of funding from either deposits or FHLB advances. The absolute level of thrifts' deposit insurance premiums remained the same throughout the disparity (excluding the special assessment), and only the effective *relative* premiums were increased through a reduction of BIF institutions' premiums. However, it was unclear how the disparity would be resolved, and it was also unclear how long the disparity would last. Thus, one can assume it likely that thrifts viewed FHLB advances as a more advantageous source of funding that did not put them at a long-term competitive disadvantage with BIF institutions.

5.2 The Disparity and Profitability: Implications for Risk Taking

Subsection 5.1 shows that when insurance premiums are charged on deposits, institutions can shift at least part of their funding sources to mitigate the effect of higher premiums on their profits. This, however, is only one method banks can use to reduce the effect. Can banks, potentially through other means, completely offset it? How directly do higher premiums translate into lower profits? If premium differentials do in fact lead to significant differentials in profitability, are the magnitudes large enough to incentivize banks to refrain from excessive risk taking? This subsection addresses these questions.

I first estimate the residual effect of higher premiums on profits, accounting for all the ways institutions may attempt to dampen the effect of higher premiums. This quantity is a central measure of the incentives created by risk-based pricing (see section 2). Again, estimating this quantity requires observing similar banks, with similar levels of risk taking, that face different premiums; identification in this subsection uses the disparity as a source of exogenous variation in premiums between BIF and SAIF institutions, and the empirical design ensures that the institutions being compared are similar with respect to their risk profiles and other relevant measures. In addition, I also estimate the relationship between risk taking and profitability to evaluate the likelihood that condition (1) holds in practice and to understand whether the incentives created by risk-based pricing are sufficient to curb risk taking.

Besides using panel data specifications (2) and (3), in this subsection I also use synthetic control methods based on an Interactive Fixed Effects (IFE) model (see Bai 2009, Gobillon and Magnac 2016, Xu 2017, and Athey et al. 2018). The IFE synthetic control model as formulated in Xu (2017), which I follow in this subsection, has several advantages over both panel data fixed effects models and the initial approaches of synthetic control models. Unlike traditional panel data fixed effects models, the IFE synthetic control model relaxes the parallel trends assumption by modeling time dynamics in a data-driven way; in addition, it addresses treatment heterogeneity by providing an estimated treatment effect for each treated unit, allowing for analysis of treatment heterogeneity that would not be possible with aggregated average treatment effect estimates. Also, this approach moves beyond the initial applications of synthetic control methods popularized by Abadie and Gardeazabal (2003) and Abadie et al. (2010). It nests traditional fixed effects models and therefore allows each treated unit to have a unit-specific intercept and includes a time fixed effect; such fixed effects are not typically included in the more traditional synthetic control models (Doudchenko and Imbens 2016). Moreover, it naturally allows for multiple treated units and for intuitive inference based on a valid bootstrap procedure for standard errors. The model is as follows:

$$y_{it} = \beta_{it}(\mathbf{1}_{i \in SAIF} \times \mathbf{1}_{t \geq 1995Q3}) + \gamma \mathbf{x}_{it} + \lambda_i' \mathbf{f}_t + c_i + d_t + \varepsilon_{it}, \tag{4}$$

where y_{it} is the outcome of interest for institution i in quarter t; β_{it} is a heterogeneous treatment effect for institution i in quarter t showing the effect on the outcome variable of being a SAIF member during the disparity; $\mathbf{x}_{it}$ is a vector of covariates containing the same controls used in subsection 5.1; $\mathbf{f}_t = [f_{1t}, \ldots, f_{rt}]'$ is an $(r \times 1)$ vector of unobserved common time factors, and r is the number of factors; $\lambda_i = [\lambda_{i1}, \ldots, \lambda_{ir}]'$ is an $(r \times 1)$ vector of unknown factor loadings; c_i, and d_t are unit- and time-fixed effects; and ε_{it} is an idiosyncratic error term.[13]

To estimate the relationship between insurance premiums and profitability, specifications (2), (3), and (4) are used with return on assets (ROA) as the dependent variable. The sample for these estimates is truncated to include quarters from the first quarter of 1993 through the second quarter of 1996; this isolates the effect of the premiums from distortions of profitability caused by the special assessment that SAIF institutions had to pay in the third quarter of 1996.

Table 5 reports results from specifications (2) and (4). The results show that on average over the course of its first four quarters, the disparity introduced a wedge in ROA between SAIF and BIF institutions of about 16.7 basis points (specification (4)) to 21.3 basis points (specification (2)), with SAIF institutions' ROA being relatively lower. The synthetic control specification with a full set of controls, the preferred specification, estimates a wedge of 16.7 basis points. This wedge is

[13] Note that the term $\lambda_i' \mathbf{f}_t$ is very general and allows the model in specification (4) to nest more-standard models like those with additive unit- and time-fixed effects (even if the terms c_i and d_t were excluded). The term $\lambda_i' \mathbf{f}_t$ can be written as $\lambda_{i1} f_{1t} + \lambda_{i2} f_{2t} + \ldots + \lambda_{ir} f_{rt}$. If f_{1t} is set to 1 and λ_{i2} is set to 1 the model includes unit- and time-fixed effects. As noted by Xu (2017), this model also nests specifications with unit-specific linear or quadratic time trends (e.g., with $f_{1t} = t$ or $f_{1t} = t^2$), autoregressive components, and other possibilities. The number of factors is determined by cross-validation.

economically significant: it is about 20.4% of ROA of SAIF institutions in the quarter immediately preceding the start of the disparity.

Figure 7 shows the dynamic estimates over time of the effect on return on assets (specifications (3) and (4)) of being a SAIF member. There is a clear relative decline in SAIF members' ROA in every quarter starting with the first quarter of the disparity. Again, the estimated effects are both economically and statistically significant. Figure 8 shows the average ROA for BIF and SAIF institutions over time.

One advantage of the synthetic control estimates is that they produce an estimated treatment effect for each treated institution. This allows me to analyze the heterogeneity in the estimates among SAIF institutions and understand which institutions were more affected by the disparity. Figure 9 shows a wide degree of heterogeneity in the effect of the disparity on ROA among SAIF institutions; to ensure that no banks are identified, the points on the figure are perturbed with random noise.[14] As expected, the ROA of most SAIF institutions is affected negatively, relative to BIF institutions. However, Figure 9 shows that the effect is concentrated among the smaller and medium-sized institutions, and is virtually nonexistent among the largest ones.

The heterogeneity in the estimated effect on profitability shown in Figure 9 suggests that risk-based pricing may be less effective for larger institutions than for smaller and medium-sized ones. This is problematic for the insurer, as failures of large institutions can be much more costly than failures of small institutions, though there are many more smaller institutions. The cause of that heterogeneity may be the assessment base that was used in deposit insurance premiums at that time. Because premiums were assessed based on deposits, large institutions might have been less affected simply because they relied less on deposits to begin with. It is also possible that large institutions were more able to engage in arbitrage activities or to shift funding sources to reduce their reliance on deposits. Regardless of the mechanism underlying the heterogeneity between small and large banks, the results highlight the importance of ensuring that the details of the pricing do not allow one class of banks to evade the premiums. If banks in one class can somehow offset the effect of higher premiums on their profitability, charging them higher premiums in a risk-based system may not provide them with sufficient incentives to avoid excessive risk taking. The Dodd-Frank Act of 2010 redefined the assessment base to be average consolidated total assets minus average tangible equity. This change weakened the ability of banks to change their burden by altering their mix of

[14] Any original unperturbed point, (x, y), is perturbed before being displayed on the figure by the addition of two random numbers, r_x and r_y, to result in displayed point $(x + r_x, y + r_y)$, where $r_i \sim \mathcal{N}(0, (\sigma_i/3)^2)$ and σ_i is the i'th axis sample standard deviation, $i \in \{x, y\}$. A best-fit line for the unperturbed points is displayed on the figure.

liabilities. The current risk-based pricing system is also more complex and treats small and large banks differently.

On the whole, the estimates above establish that differentials in premiums cannot be easily evaded by the majority of banks; banks facing higher deposit insurance premiums suffer a reduction in their profitability as measured by ROA. Thus, risk-based pricing provides some incentives for profit-maximizing banks to avoid excessive risk taking. However, the question still remains whether those incentives are sufficiently large to induce banks to change their behavior.

For incentives to be sufficient, the loss to a bank from taking on excessive risk and paying the higher premium must outweigh any gain the bank may generate through the additional risk (see inequality (1) in section 2). Is it worthwhile for a bank to take on additional risk, potentially chasing higher returns, despite having to pay higher deposit insurance premiums?

Answering this question requires estimates of the relationship between risk taking and profitability. Such estimates cannot be obtained simply from a cross-section of all banks, because premiums are set to be higher for riskier banks, potentially resulting in endogenous selection. I use variation in risk taking for banks that face the same premium; specifically, I use all banks in the trimmed sample that pay a premium of 23 basis points from 1993 Q1 to 1995 Q2 (i.e., I drop bank-quarter observations in which the bank faces any premium higher than 23 basis points).[15] I use the following specification:

$$ROA_{it} = \alpha + \beta Risk_{it} + \gamma \mathbf{x}_{it} + c_i + d_t + \epsilon_{it}, \tag{5}$$

where ROA_{it} is the return on assets for institution i in quarter t, $Risk_{it}$ is the set of risk-taking covariates from the set of controls in subsection 5.1 where each covariate is introduced in the regression separately to avoid co-linearity, $\mathbf{x}_{it}$ contains other controls as listed in subsection 5.1, and c_i and d_t are bank and quarter fixed effects.

Table 6 shows that, in the aggregate, there is no evidence that increased risk taking is associated with higher profitability, keeping constant all else, including deposit insurance premiums. In fact, there is some evidence that higher capital ratios, particularly the leverage ratio, are associated with higher returns. These estimates, however, do not necessarily rule out that some banks may find it profitable to take on excessive risk; the estimates in Table 6 are overall averages, and there may be significant heterogeneity among banks. Nevertheless, Table 6 shows that, on average, the incentives

[15] The group of banks kept contains the vast majority of banks in the sample, but it excludes banks that pay higher premiums. Using higher-premium banks in the estimation has the drawbacks that for virtually all groups facing a fixed premium level above 23 bp (i.e., 26 bp, 29 bp, or 30 bp), there is a direct relationship between CAMELS ratings and capital ratios (see panel (A) of Table 1), making the identification of the effects of these two factors on profitability difficult to separate; in addition, in some of these groups there are very few banks, resulting in minimal usable variation (see Table 2).

for banks to take on excessive risk (in terms of lower capital ratios or worse supervisory ratings) in an attempt to chase higher returns are weak.

Combining the results from Tables 5 and 6, the evidence suggests that it is not worthwhile for banks to pay higher deposit insurance premiums in order to chase extra returns through excessive risk taking. In fact, the results suggest that relatively minor differentials in risk-based premiums may be sufficient to incentivize banks to avoid excessive risk taking. This is consistent with the fact that virtually all banks chose to remain in the group paying the lowest deposit insurance premiums (see Table 2).[16] The next subsection presents direct evidence that pricing incentives affect banks' risk-taking behavior.

5.3 Direct Evidence of Moral Hazard Mitigation Through Pricing

The disparity did not only reduce premiums for BIF banks, it also altered the risk-taking incentive structure for BIF banks through the modified premiums structure (see Table 1 and Figure 2), doing so for six quarters before the same thing would be done for SAIF banks. For BIF banks, the disparity raised the penalty for migrating from a low-premium group to a high-premium group. Thus, the disparity strengthened the incentives for risky BIF banks to improve their capital ratios and their CAMELS ratings, and it also strengthened the incentives for safe BIF banks to remain safe and continue paying low premiums. For instance, before the disparity, if an undercapitalized BIF bank in Supervisory Group B became adequately capitalized or moved to Supervisory Group A, it could lower its premiums only by 1bp; following the disparity, these changes would save the bank 14bp in premiums.

Because the new premiums applied to BIF institutions before applying to SAIF institutions, I can use both time and cross-sectional variation in the pricing incentives to study the relationship between pricing incentives and risk taking. I study this issue in two ways. First, for the sample of all institutions with higher-than-minimum premiums, I study the likelihood that the institutions improve their category and move to a lower premium through either the supervisory category or the capital ratios or both. Second, taking the sample of all institutions in the safest bucket, the one with the lowest premium (most institutions fall into this category), I study the likelihood that an institution in that sample moves to a higher premium category. In both studies, the quantity that is of interest will be the difference between BIF and SAIF institutions in the likelihood of moving between premium groups during the disparity as opposed to before it or after it.

[16] There were, however, other benefits to being in the group paying the lowest deposit insurance premiums—benefits accruing from rules such as Prompt Corrective Action (Aggarwal and Jacques 2001).

I first consider the sample of all "risky" institutions—those paying higher-than-minimum premiums. In every pair of quarters $(t-1, t)$, the sample contains all banks that in quarter $t-1$ were *not* in the lowest-premium category and that satisfy other basic criteria.[17] These banks had room for improvement (reduction) in their premiums by improving either their capital ratios or their CAMELS ratings or both. The sample contains both BIF and SAIF institutions, and some of the institutions in this sample were not in the trimmed sample described in section 4. To evaluate the effect of the change in pricing incentives on the likelihood of improvement I use the following logistic regression:

$$\text{P}(\text{Improve}_{i,t-1\to t} = 1) = G(\alpha_t + \beta_t \mathbf{1}^{t-1}_{i\in BIF} + \gamma_t \mathbf{x}_{i,t-1}), \tag{6}$$

where $\text{Improve}_{i,t-1\to t}$ is a binary variable that takes a value of 1 if institution i improved its premium category between quarters $t-1$ and t by improving its capital ratios or its CAMELS ratings or both.[18] The function $G(z) \equiv (e^z)/(1+e^z)$ is the logistic function, $\mathbf{1}^{t-1}_{i\in BIF}$ is an indicator for whether the institution was a BIF member in quarter $t-1$, and $\mathbf{x}_{i,t-1}$ is a vector of controls containing the log of the institution's assets, total risk-based capital ratio, Tier 1 risk-based capital ratio, leverage ratio, composite CAMELS rating from the most recent exam, the number of quarters since the institution has been examined, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets.

The coefficient of interest in specification (6) is β_t; it reflects the effect of being a BIF member on the likelihood of improving premium categories between quarters $t-1$ and t. Again, because the disparity introduced stronger pricing incentives for BIF institutions to become safer, if institutions actually responded to those incentives then β_t should be positive and significant around the time of the disparity, and β_t should be statistically indistinguishable from zero otherwise.

Figure 10 shows evidence that institutions were indeed responding to pricing incentives in their risk-taking decisions. Institutions that faced stronger incentives to become safer (BIF members) were more likely to do so, and the same institutions were not any more likely to become safer in most periods when the pricing incentives were identical for both BIF and SAIF members. There appears to be some anticipation effect, which is natural considering that banks may get only one chance per year (on being examined), or even less often, to improve their CAMELS ratings; thus, anticipating the

[17] To be included in the sample, institutions must have also been classified as a national bank, state member or nonmember bank, savings bank, or savings and loan institution in quarter $t-1$ and must have been in business in both quarters $t-1$ and t.

[18] Because CAMELS ratings can change only when an exam happens, a bank may not get a chance to improve its CAMELS ratings from one quarter to the next (but it can still change its capital ratios). The infrequency of exams reduces the overall likelihood of improvement for all banks, which is not problematic for this analysis because the main focus is on the difference between BIF and SAIF institutions in likelihood of improvement.

change in pricing, institutions would have an incentive to move to the lower-premium category before the actual change in pricing. Note that the incentives faced by risky BIF and SAIF institutions to move to a safer premium category were identical from 1993 Q1 through 1995 Q2 and after 1996 Q4; Figure 10 shows that in those periods (apart from a few quarters immediately preceding the disparity, and then in the first quarter of 1997) there is not much evidence for a statistically significant difference between BIF and SAIF banks in the likelihood of improving premium categories. (The evidence from the few quarters immediately preceding the disparity could be attributed to anticipation.) The absence of much evidence for the statistically significant difference in those periods is consistent with the hypothesis that institutions were in fact appropriately responding to deposit insurance pricing incentives.

The new premium schedules also introduced stronger pricing incentives for the sample of all safe banks classified in the lowest-premium category to *remain* in this category. In every pair of quarters $(t-1, t)$, the sample for this analysis contains all banks that in quarter $t-1$ were in the lowest-premium category and satisfoed other basic criteria as mentioned above. Again, the sample in each quarter-pair includes both BIF and SAIF institutions. I use the following logit regression:

$$\text{P}(\text{Worsen}_{i,t-1\to t} = 1) = G(\alpha_t + \beta_t \mathbf{1}_{i\in BIF}^{t-1} + \gamma_t \mathbf{x}_{i,t-1}), \tag{7}$$

where $\text{Worsen}_{i,t-1\to t}$ is an indicator variable that takes a value of 1 if institution i worsened its premium category between quarters $t-1$ and t by having worse capital ratios or CAMELS ratings or both; the rest of the components of the regression are as in specification (6).

If the pricing incentives provided by the new premium schedule actually incentivized safe banks (banks already classified in the lowest premium category) to remain in the lowest premium category, then the β_t coefficient on BIF membership status should be negative and significantly different from zero around the time of the disparity.

Figure 11 shows evidence that banks responded to the stronger incentives to remain in the lowest-premium category. The β_t coefficient from specification (7) is negative and significantly different from zero in most quarters during the disparity and in the two quarters immediately preceding the disparity; and it is *only* in those quarters (when BIF and SAIF institutions faced different pricing incentives) that this is the case. BIF institutions in the lowest-premium category were less likely to migrate to a higher-premium bucket precisely during the disparity, when their incentives to remain in the lowest premium category were stronger than those for SAIF institutions. Again, there is some evidence for an anticipation effect.

Overall, the results reported in this subsection provide direct evidence that risk-dependent deposit insurance pricing influences banks' risk taking. Risky banks that could save more in premiums by becoming safer were more likely to become safer, and safe banks that would suffer larger increases in premiums from becoming riskier were more likely to remain safe. These results hold even when one is looking at quarter-to-quarter changes that are more prone to temporary idiosyncratic movements in capital ratios and supervisory ratings. Again, the fact that the vast majority of institutions are concentrated in the category with the lowest premium is consistent with the evidence in this subsection that risk-dependent deposit insurance pricing is effective at reducing risk taking.

5.4 Regulatory Arbitrage Through Migrating Deposits

Any distortion arising in response to risk-based premiums has the potential to erode their effectiveness, for distortions may enable risky banks facing higher premiums to lower their deposit insurance assessments without becoming less risky. Among such distortions is any kind of regulatory arbitrage in which institutions paying higher premiums reclassify their deposits to be assessable at the low-premium rate. This is of particular interest for the deposit insurer, as such arbitrage may erode the assessment base of the fund in question. In this subsection I document an intricate regulatory arbitrage strategy using deposit sales by which some institutions moved deposits from the SAIF to the BIF—despite several regulations in place to prevent deposit migration through deposit sales or by other means.

A moratorium on conversion transactions between the two funds was imposed by FIRREA in 1989; thus, SAIF institutions could not simply change their fund membership from the SAIF to the BIF or move their deposits from the SAIF to the BIF. In addition, even in cases of mergers or acquisitions or deposit sales, SAIF-assessable deposits were intended to continue being classified as such and the acquiring bank would pay their assessments to the SAIF, even if the bank was a member of the BIF. These banks were called "Oakar" banks. Finally, even if a thrift in the SAIF changed its charter from a savings association to a bank, they remained SAIF members with SAIF-assessable deposits; such banks were called "Sasser" banks (Helfer 1995). Nevertheless, the disparity created strong incentives to engage in regulatory arbitrage through deposit migration.[19]

[19] The following news article quotation illustrates the arbitrage incentives created by the disparity: *"TCF and Great Western are two of seven companies that have applied for bank charters to avoid the costly deposit insurance premiums levied by the Savings Association Insurance Fund. The companies plan to open bank branches at their thrift locations and then use higher rates to tempt depositors to shift their funds... William A. Cooper, chairman and chief executive of* $7.5 *billion TCF, said that the 23 cent premium disparity between the Bank Insurance Fund and the thrift fund forced his institution to act. 'We pay $10 million to $12 million a year in premiums on $5 billion of deposits, while Bank of America, which has around $200 billion in deposits, only pays $2,000,' Mr. Cooper said. 'In the absence of congressional action, we need to take the necessary steps to protect our competitive position.'"* (Senerpont Domis 1996)

The form of regulatory arbitrage I focus on here involved deposit sale transactions in which Oakar institutions exploited an asymmetry in the calculation of the amount of SAIF-assessable deposits between the buyer and the seller of deposits in order to migrate deposits from the SAIF to the BIF. The amount of each Oakar institution's deposits that counted as "SAIF deposits" was called the Adjusted Attributable Deposit Amount (AADA), and it was a derived quantity based on historical acquisitions of SAIF-assessable deposits and periodic "growth" adjustments to that base amount. FIRREA had imposed a minimum floor on the growth rate of institutions' AADA. FDICIA modified the Oakar amendment of FIRREA to abolish that minimum floor and instead let the AADA be adjusted proportional to movements in the institutions' overall deposits. So, for instance, if an Oakar bank's overall deposits shrank by 20% over a six-month period, then the bank's AADA would simply also shrink by 20% from its value at the start of the six-month period.

However, from the buyer's perspective in a deposit-sale transaction, deposit sales by BIF-member Oakar institutions were assumed to be sales of primary fund (BIF) deposits until primary fund deposits were exhausted, in which case deposit sales would be considered sales of secondary fund (SAIF) deposits. In its modifications to the Oakar amendment, FDICIA did not explicitly account for deposit sales in adjustments to the AADA. That is, as a result of FDICIA, the seller's AADA declined the same proportion as any shrinkage in the institution's overall deposits, even if such shrinkage was due to deposit sales and even if such sales had not yet exhausted the institution's primary fund deposits (FDIC 12 CFR 327 1996a). To remedy this asymmetry, the FDIC adopted an interpretive rule in December 1996 that codified the treatment of deposit sales by Oakar institutions and that excluded deposit sales from calculations of institutions' AADA (FDIC 12 CFR 327 1996b). Nevertheless, before the adoption of this rule it was possible for a deposit sale transaction between two BIF institutions to result in a net surplus (from reduced deposit insurance assessments) for the two institutions combined, in which the seller's AADA would decline and the buyer's AADA would either not increase or increase by an amount smaller in magnitude than the change in the seller's AADA; in the process, a portion of the deposits sold would migrate from the SAIF to the BIF.

To illustrate the mechanics of deposit migration through deposit sales, consider a hypothetical scenario in which an Oakar BIF member (Bank A) with \$10B in total deposits and an AADA (SAIF-assessable deposits) of \$6B sells \$5B of its deposits to a non-Oakar BIF member (Bank B). As a result of the sale, Bank A's AADA would be adjusted down by 50%, to \$3B, an adjustment proportional to the change in Bank A's overall deposits. Bank B would obtain \$5B in deposits, with only \$1B counting as "SAIF deposits" because such transactions assumed that the seller first exhausts its primary fund

(BIF) deposits; thus, Bank B would become an Oakar bank with an AADA of $1B. Consequently, the transaction would result in the permanent migration of $2B from the SAIF to the BIF. Assuming both institutions pay the lowest premium on SAIF deposits and zero premium on BIF deposits, this transaction would result in a net *annual* surplus of $4.6 million in saved SAIF assessments for both institutions combined. If, instead, Bank A had sold $4B in deposits (its entire "BIF deposits" initially), Bank B would not become an Oakar bank as a result of the transaction and would not pay any SAIF assessments, but Bank A would have reduced its AADA by $2.4B (which would migrate to the BIF), resulting in annual savings for Bank A of at least $5.5 million.

This migration of deposits can be empirically observed (though imperfectly so) in instances where Oakar institutions sold deposits.[20] For instance, Home Savings of America, an Oakar BIF member, sold more than $8 billion in deposits to Greenpoint Financial, a non-Oakar BIF member, in the middle of 1995 (Hansell 1995). Before the sale, Home Savings had $43.5B in deposits (as of June 30, 1995). After the sale, its total deposits as of year-end 1995 were $34.9B. According to its parent's 10-K filings, Home Savings had SAIF-insured deposits of about $38B at the start of 1995, and its year-end SAIF-insured deposits were about $31B, a decline of about $7B; Greenpoint, however, which became an Oakar bank as a result of the transaction, had its SAIF-insured deposits increase by only about $3B following the transaction.[21]

One-time sales of deposits reduced Oakar institutions' AADA permanently and thus resulted in regular annual savings on assessments paid. A one-time reduction in the seller's AADA by $7B, for instance, resulted in annual savings of approximately $16M if the seller paid the lowest possible premiums on the risk-based premiums schedule; savings would be even higher if the seller paid higher premiums. On its 1996 10-K filing, H. F. Ahmanson, the parent of Home Savings of America, reported a reduction in its SAIF assessments to $55.1 million in 1996 from $79.9 million in 1995. This is a reduction of 31%, or $24.8 million, evidently driven in large part by its mid-1995 sale of deposits.

Thus, the disparity created incentives for Oakar members of the BIF to sell deposits. These incentives were strongest during the disparity itself, though Oakar banks may have also sold deposits before the third quarter of 1995 in anticipation of the disparity. To analyze the selling of deposits by

[20] Empirical observations can be made from "snapshots" of total deposits reported on banks' quarterly Call Reports, but those do not perfectly isolate the effects of deposit sales because banks could engage in other operations between reporting periods. In addition, the AADA was adjusted only semiannually.

[21] Figures for Home Savings SAIF-insured deposits are obtained from the 1994 and 1995 10-K filings by its parent, H. F. Ahmanson & Company: the 1994 value is an estimate based on its year-end 1994 total deposits and its percentage of deposits that are SAIF-insured (91%) reported on the 1994 10-K, and the 1995 value is reported directly in its 1995 10-K filing. Greenpoint's SAIF-insured deposits figure is obtained from publicly available Call Report data.

Oakar BIF members more broadly, I use the following logit model specification estimated separately for each quarter t on the sample of BIF members:

$$P(SALE_{it} = 1) = G(\alpha_t + \beta_t \mathbf{1}^t_{i\in Oakar} + \gamma \mathbf{x}_{it}), \tag{8}$$

where $SALE_{it}$ is a proxy for deposit sales by institution i in quarter t; it is equal to 1 if institution i's deposits and number of offices decreased from quarter-end $t-1$ to quarter-end t. The indicator $\mathbf{1}^t_{i\in Oakar}$ is the Oakar status of institution i as of start of quarter t, or quarter-end $t-1$. Controls in $\mathbf{x}_{it}$ are start-of-quarter t values and contain the same set of controls as in subsection 5.1; $G(z) \equiv e^z/(1+e^z)$ is the logistic function. The sample of banks in each quarter consists of all BIF institutions that are in business between quarters $t-1$ and t; that were classified as a national bank, state member or nonmember bank, savings bank, or savings and loan institution for both quarters; and that have more than one office as of quarter-end $t-1$; this sample may contain banks not in the trimmed sample described in section 4. The number of banks in the sample satisfying these criteria varies by quarter; there are at least 6,500 BIF banks in each quarter-pair sample; and there are at least 3,500 BIF banks when the stricter criteria described below are applied.

If Oakar banks sold deposits to exploit the disparity, the coefficient β_t should rise around the time of, and during, the disparity. Oakar banks may have also disproportionately sold deposits beforehand in anticipation of the disparity, but because members in the BIF and SAIF both faced the same premiums before the disparity, any savings on assessments paid could not be realized until after the start of the disparity. Figure 12 shows the estimates of β_t from specification (8) for two different definitions of the $SALE_{it}$ dependent variable. In the top panel the dependent variable is defined as above, and in the bottom panel only reductions in deposits of \$10 million or more are counted so as to exclude noise from normal quarterly fluctuations in institutions' quarterly deposits. The bottom panel also excludes institutions that had less than \$100 million in assets as of quarter-end $t-1$. The top panel of Figure 12 shows a strong relationship between Oakar status and deposit sales during the disparity. The bottom panel shows that this relationship is even stronger when the deposit sales variable is refined to exclude some of the more-minor quarterly fluctuations in deposits. These results suggest that Oakar banks were likely incentivized by the disparity to sell deposits and exploit the fact that deposit sales resulted in migration of deposits from the SAIF to the BIF and resulted in a combined net surplus for both parties in a deposit sale transaction.

The results in this subsection highlight the importance of accompanying risk-based pricing with regulatory controls. The subsection shows that institutions will attempt to exploit available arbitrage opportunities to have their deposit insurance assessments lowered. In addition, the results show that if institutions have access to another insurer (e.g., internationally, or domestically if the country has more than one insurance fund), deposit migration may occur from the insurer or fund with the higher premiums to one with lower premiums, a migration that may erode the assessment base of the higher-premium fund and weaken its deposit insurer.

5.5 Effects of the Disparity on Risk-Taking: Liquidity, Loan Growth, and Security Holdings

There is evidence that SAIF members took on more risk relative to BIF members, potentially as a "search for yield" strategy, in response to facing relatively higher premiums during the disparity. Their increased risk taking was not through a decline in asset quality or a change in loan mix.[22] Instead, it was through a strategy of becoming less liquid: shifting their asset mix towards longer-maturity (and higher-yielding) assets like loans and leases and away from cash and shorter-maturity, lower-yielding assets like securities.

Table 7 shows results from specification (2) for the ratio of loans and leases to deposits (as a measure of liquidity), and several growth variables. Column (1) shows that the ratio of loans and leases to deposits of SAIF members relatively increased as a result of the disparity, suggesting that they became less liquid. Although column (2) suggests that SAIF members' overall assets grew faster than BIF members because of the disparity, I show later that this result is primarily driven by a reduction in asset growth rates of BIF members immediately preceding the disparity. Controlling for asset growth, columns (3) and (4) show a significant relative increase in loan growth for SAIF members and a significant relative decrease in securities growth. Column (5) shows a relative increase in SAIF members' deposit growth rates, controlling for asset growth, but the effect is smaller in magnitude than the effect on loan growth shown in column (3). The results in columns (3)-(5) are similar if asset growth is omitted from the set of controls.

Figures 13 and 14 make transparent the dynamic effects underlying the estimates in Table 7. In addition, figure 13 shows dynamics of BIF and SAIF members' cash holdings (as a ratio of assets). The figures suggest that SAIF members became less liquid: relative to BIF members, SAIF members reduced their cash holdings, increased their loan growth, and reduced their securities growth. The

[22] In results not shown, I find no strong evidence that the disparity caused a shift in SAIF members' loan mix towards high risk loans (sum of commercial and industrial loans, nonfarm nonresidential loans secured by real estate, multi-family 5 or more loans, and construction and land development loans), or that the disparity caused large increases in SAIF members' 30 days past due loans, 90 days past due loans, nonaccrual loans, Other Real Estate (ORE) owned loans, or reserves for loan losses.

figures also show that most of these effects happened immediately preceding the disparity showing, again, evidence of anticipation effects.

5.6 Effects of the Disparity on Net Interest Margin, Interest Income, and Interest Expense

The disparity adversely affected SAIF members' relative net interest margins, hurting their competitive position. This contraction in net interest margins for SAIF institutions was most likely one of the drivers behind the results on increased risk taking by reducing liquidity in subsection 5.5. Figure 15 shows that, relative to BIF members, SAIF members' net interest margin suffered as a result of the disparity. Most of the relative decline in SAIF members' net interest margins occurred immediately preceding the disparity and during its initial months.

To more-fully understand the mechanisms underlying the results on net interest margin, Figures 16 and 17 show several measures related to interest income and interest expense. Figure 16 shows that SAIF institutions grew their interest income faster than BIF institutions as a result of the disparity, supporting the earlier results that pointed to a "search for yield" behavior. However, the figure also shows that, as a ratio to earning assets, the interest income earned by BIF members simply outpaced that earned by SAIF members prior to the disparity, potentially as a result of the growth in SAIF members' loans. Figure 17 suggests that, on average, the disparity did not have a strong effect on the interest expense paid on deposits by SAIF institutions when compared with BIF institutions. The lack of a strong effect on interest expense shows that SAIF members continued to offer rates to their depositors that were comparable to those offered by BIF members.

6 Conclusions and Further Research

This paper provides novel evidence that risk-based pricing is effective at mitigating ex ante moral hazard, but also that it needs to be governed with robust laws and regulatory controls. I study the effects of deposit insurance pricing on banks' incentives and behavior. Using quasi-experimental variation in premiums generated by the disparity between the BIF and SAIF in the mid-1990s, I show that charging banks different premiums resulted in some distortions, such as the shifting of funding sources, deposit migration, and reduced liquidity. But I also show that it provided strong incentives for banks to curb ex ante moral hazard. In addition, I find that banks that faced stronger pricing incentives to avoid risk taking did indeed respond to those incentives by taking on less risk. The evidence points to the effectiveness of risk-based insurance pricing; however, the evidence I find of distortions, such as banks engaging in regulatory arbitrage to lower their assessment burden, also shows the importance of accompanying risk-based pricing with a robust regulatory environment.

To the extent that recent changes in laws and regulations reduced or eliminated some distortionary channels identified in this paper, this paper's results on the effectiveness and importance of insurance pricing become even more relevant. The Dodd-Frank Act of 2010, for instance, expanded the assessment base on which premiums are charged, eliminating the ability of banks to partially offset the impact of higher premiums by shifting their sources of funding. Accordingly, a bank facing higher deposit insurance premiums today has even stronger incentives to mitigate its risk taking than a similar bank in the mid 1990s. Thus, this paper's results on the effectiveness of insurance pricing at mitigating moral hazard may be seen as a lower bound, given the enhancements in laws and regulations since the mid 1990s.

Of interest for future research are event-type studies around the introduction of risk-based insurance pricing estimating its effect on risk taking (both in the banking context and in other contexts). For the U.S. banking system, such studies would be complicated by the fact that FDICIA (1991) required risk-based pricing at the same time that it made other changes (one of which was instituting Prompt Corrective Action), and the same thresholds that were used to determine deposit insurance premiums were also used to determine regulatory treatment for other, contemporaneous regulations, so that it would be hard to isolate the effects of risk-based pricing. International contexts may be a fruitful avenue to pursue in undertaking such studies, especially if risk-based pricing were introduced in a country that already had deposit insurance with flat-rate pricing.

This paper presents evidence that minor differentials in premiums may be sufficient to mitigate moral hazard. Studies of the precise details of deposit insurance pricing would also be of interest. At what point are differentials in premiums too small to incentivize banks to draw away from excessive risk taking? Which measures of health are least likely to be manipulated by banks, and what are the advantages and disadvantages of using particular measures of bank health in determining premiums? What are the implications of using different measures of bank size (or risk to the deposit insurance fund) as a base on which assessments are charged? Though beyond the scope of the current paper, these issues are important for designing effective deposit insurance systems.

Finally, a subtle issue that this paper's results point to as important is bank competition. SAIF-insured institutions clearly responded to the disparity (e.g., by shifting funding sources) despite the fact that the absolute level of their premiums was unchanged (perhaps there was, however, an expectation of future increases in premiums to recapitalize the SAIF). More generally, what role does bank competition play in mitigating moral hazard through risk-based pricing? Banks that are exposed to fiercer competition may be more responsive to risk-based pricing, but they may also generally be more likely to seek risky lending opportunities to improve their competitive position, or they may be more likely to attempt to evade higher premiums by other means (e.g., by taking on even more risk to compensate for having to pay higher premiums, engaging in arbitrage, and so forth). The relationship between bank competition and moral hazard, especially as it relates to risk-based pricing, is an important area for future research.

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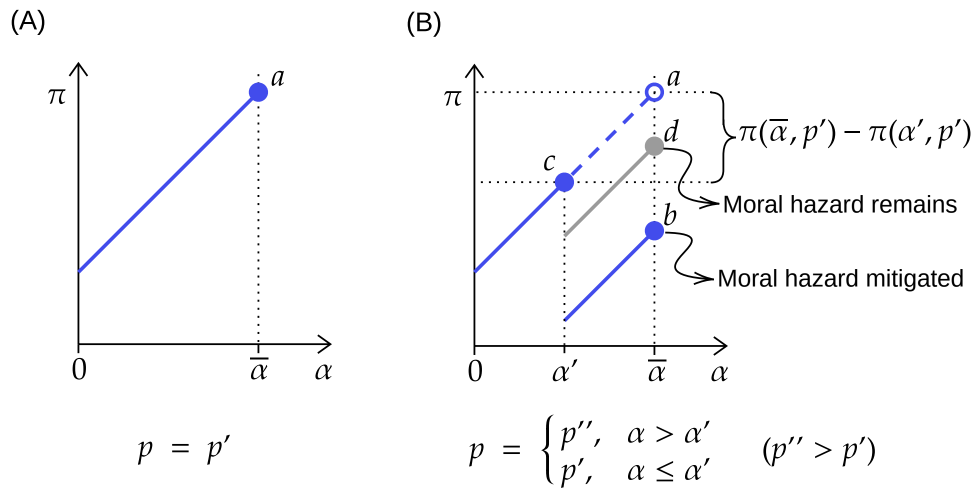
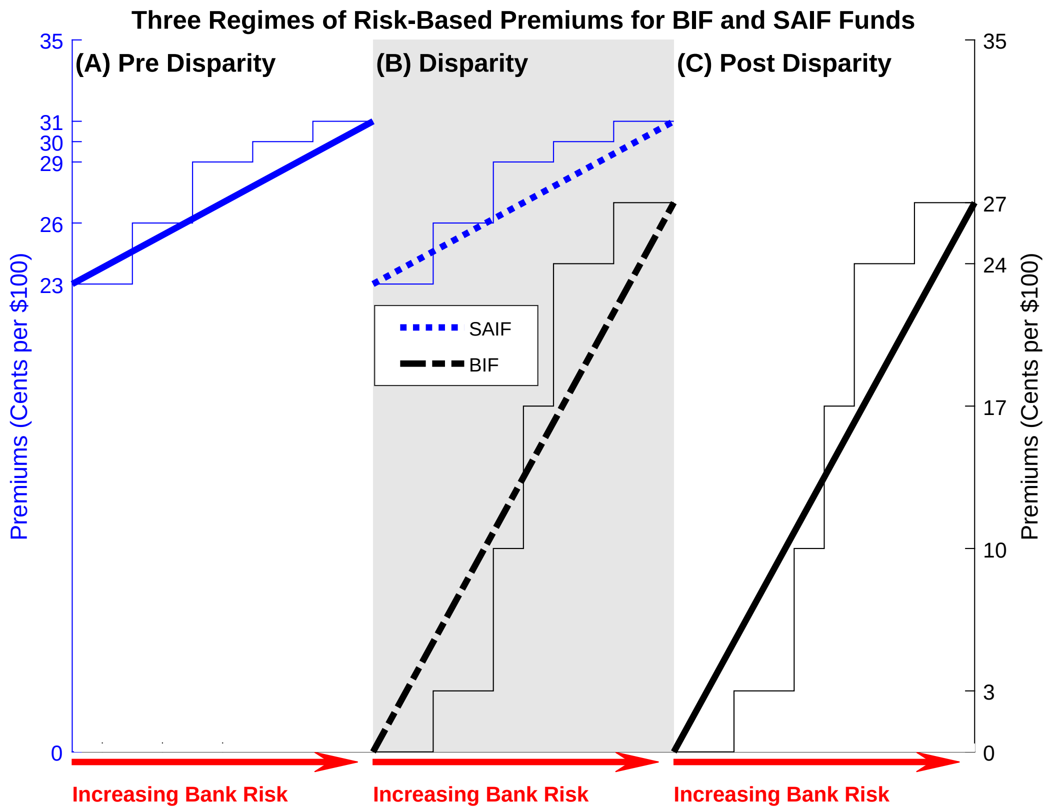
APPENDIX
FIGURES AND TABLES

FIGURE 1. Deposit Insurance Premiums and the Moral Hazard Problem



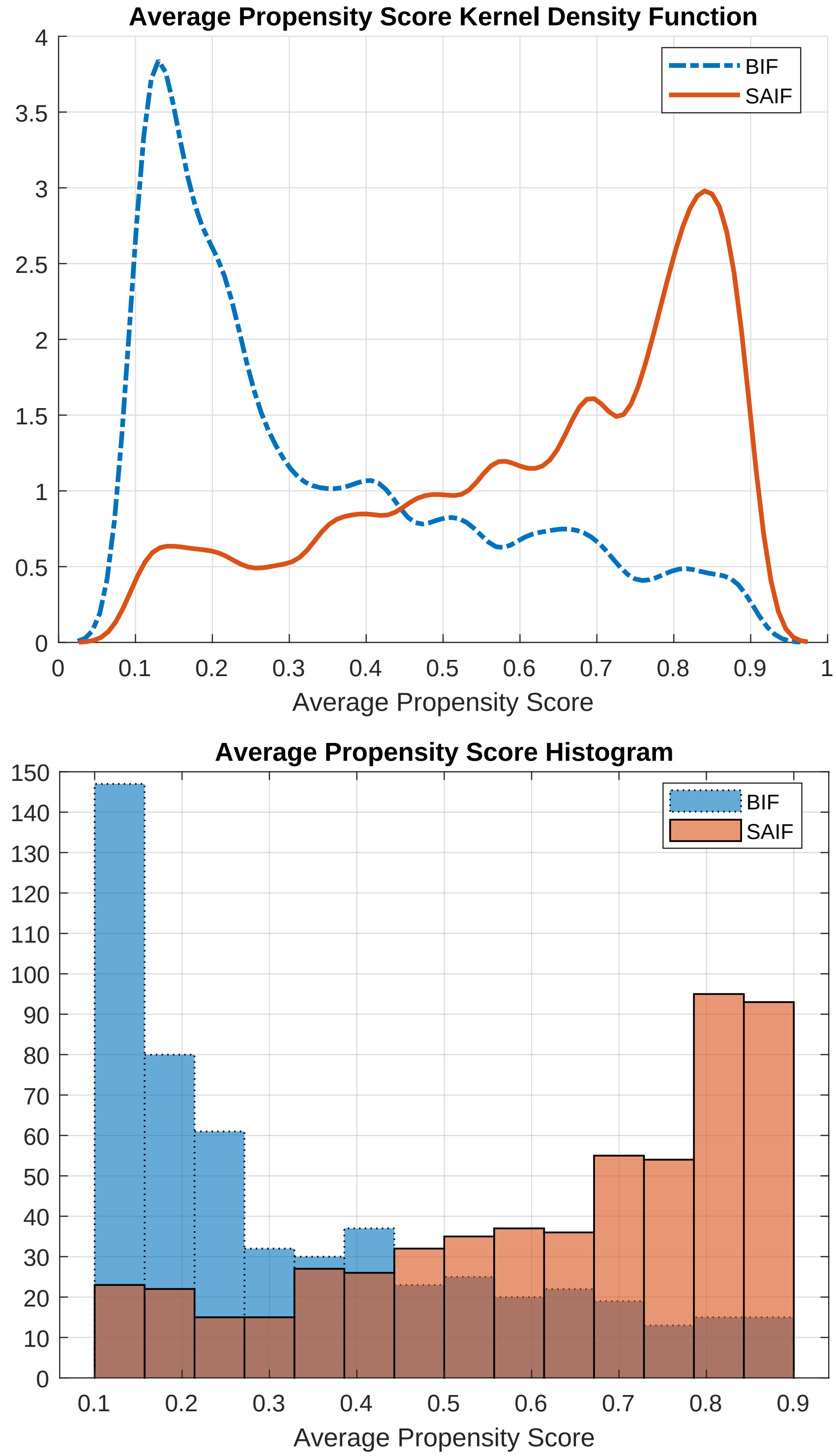
This figure shows how deposit insurance pricing affects moral hazard in a simple, illustrative setting. Panel (A) illustrates a worst-case scenario for moral hazard, where profit (π) is strictly increasing in risk-taking (α) and insurance premiums are a flat-rate set at p'. In Panel (A), an insured firm chooses the maximum risk level, $\overline{\alpha}$. Panel (B) shows the effect of setting a risk-based premium with two levels depending on whether the risk α is above or below some preferred risk level α'. For $\alpha > \alpha'$ the premium is set at p'' and for $\alpha \leq \alpha'$ the premium is set at p', and $p'' > p'$. Whether the pricing structure in panel (B) incentivizes an insured firm to reduce its risk or not depends on the profitability loss to the firm were it to remain at risk level $\overline{\alpha}$, and how that loss compares to any potential loss from moving to α'. Importantly, a firm at risk level $\overline{\alpha}$ that faces increased premiums (p'' instead of p') will rationally respond to these premiums in ways to dampen any effect on its profitability. In panel (B), point b illustrates a scenario where risk-based pricing "works" and incentivizes a firm to reduce its risk to α', but point d illustrates a situation where risk-based pricing does not solve the moral hazard problem. At point d, it remains optimal for the firm to maximize its risk-taking, either because the differentials in premiums are not large enough or because the firm can sufficiently dampen the effect of higher premiums through other means. (In this paper I refer to any such "dampening" behaviors as *distortions*.) Reliably estimating the "residual" profitability loss (i.e., the loss accounting for distortions) to a firm from facing higher premiums is directly informative about which of the two points, b or d, is more reflective of reality. One portion of the empirical work in this paper estimates the residual effect of premiums on profitability, and compares that effect to the effect of risk-taking on profitability (i.e., the relationship between points a and c) to understand whether risk-based pricing provides sufficient incentives to mitigate moral hazard.

FIGURE 2. Illustrated History of Risk-Based Premiums in the Mid 1990s



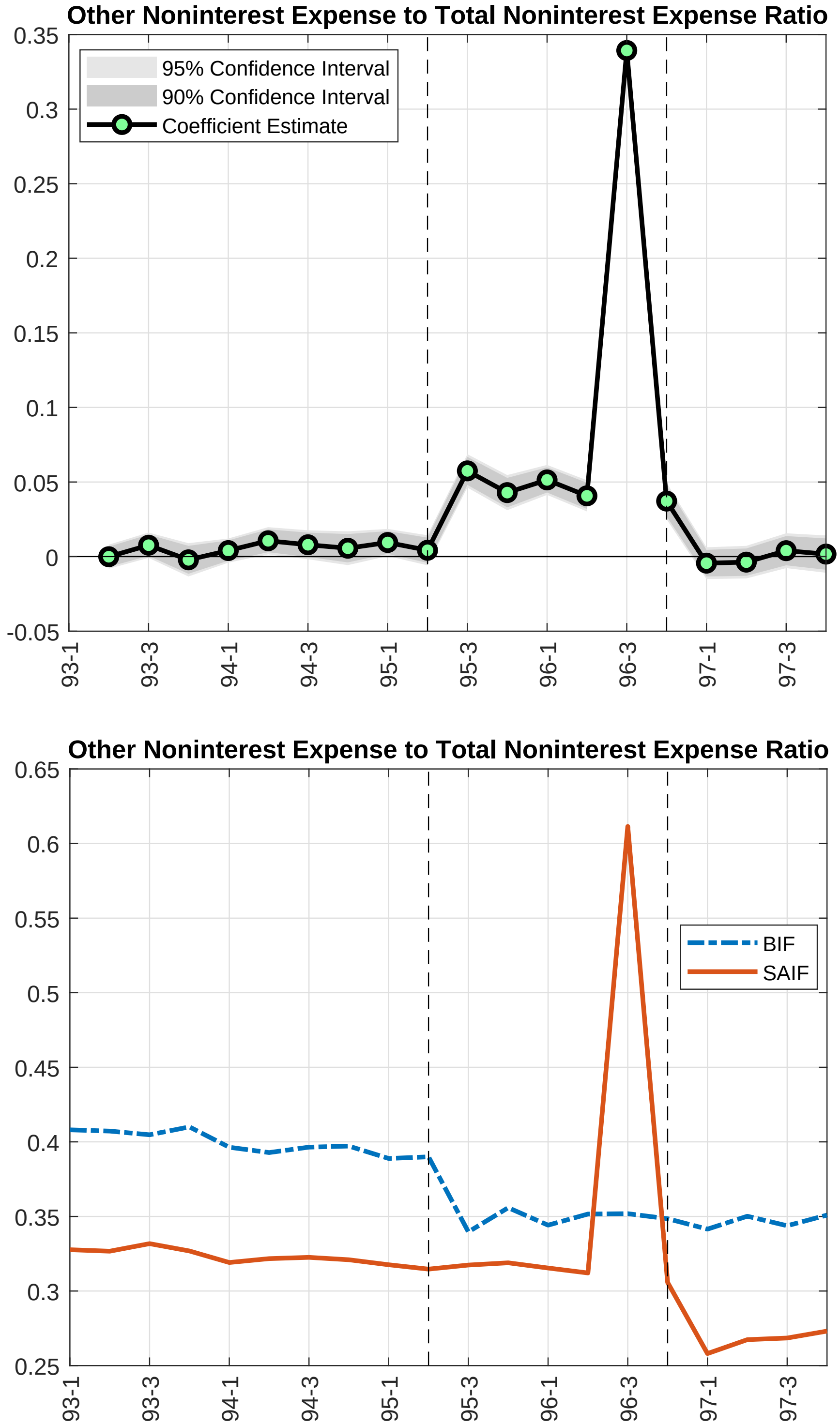
The three panels of this figure show the primary phases in the evolution of risk-based premiums, highlighting the time period around the disparity of the mid 1990's. Solid step-increasing lines show the risk-dependent premiums paid by BIF and SAIF members in the three regimes: pre disparity, disparity, and post disparity. Lines connecting the minima and maxima in each of the premium structures show an illustrated approximation of the risk-dependent slope faced by institutions. Panel (A) shows the risk-based premiums introduced by FDICIA and that were in effect for both BIF and SAIF members before the disparity. Panel (B) shows the primary structure of premiums during the disparity, with some exclusions. Panel (B) excludes the one-time special assessment paid by all SAIF members in the third quarter of 1996; panel (B) also excludes the illustration of BIF premiums paid in the last two quarters of 1995, which were 4 basis points higher than BIF premiums paid after 1995 and which were partially refunded to banks because the BIF had recapitalized (see Table 1 for details). Panel (C) shows the premium structure for both BIF and SAIF institutions after both funds had recapitalized.

FIGURE 3. Resulting Propensity Score Distribution After Sample Trimming



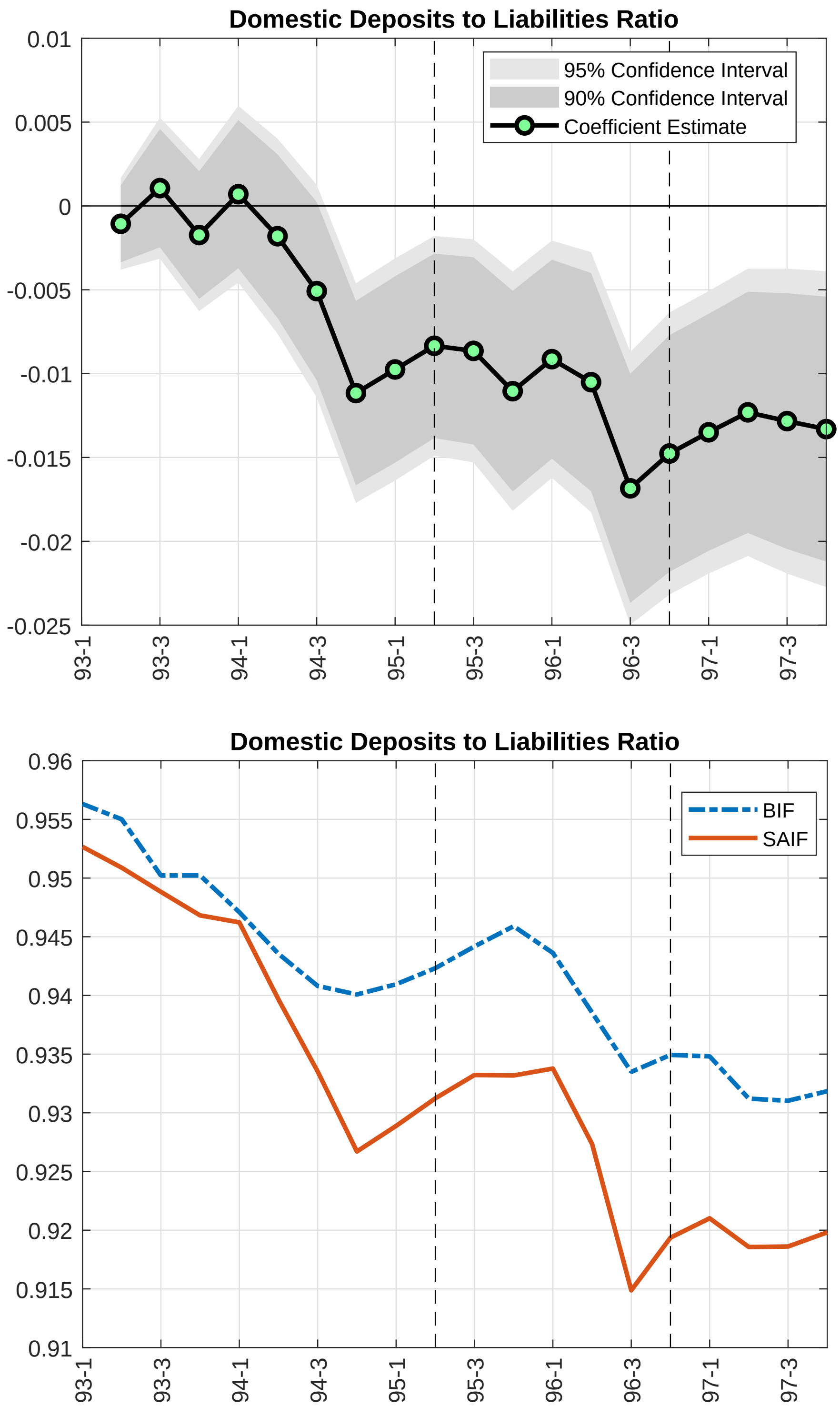
This figure shows the distribution of the average propensity score for BIF and SAIF institutions after trimming based on the procedure described in section 4 to produce a sample with comparable BIF and SAIF institutions. The top panel shows the estimated kernel density functions and the bottom panel shows the histograms of the average propensity scores for the two types of institutions.

FIGURE 4. Effect of the Disparity on Institutions' Noninterest Expense



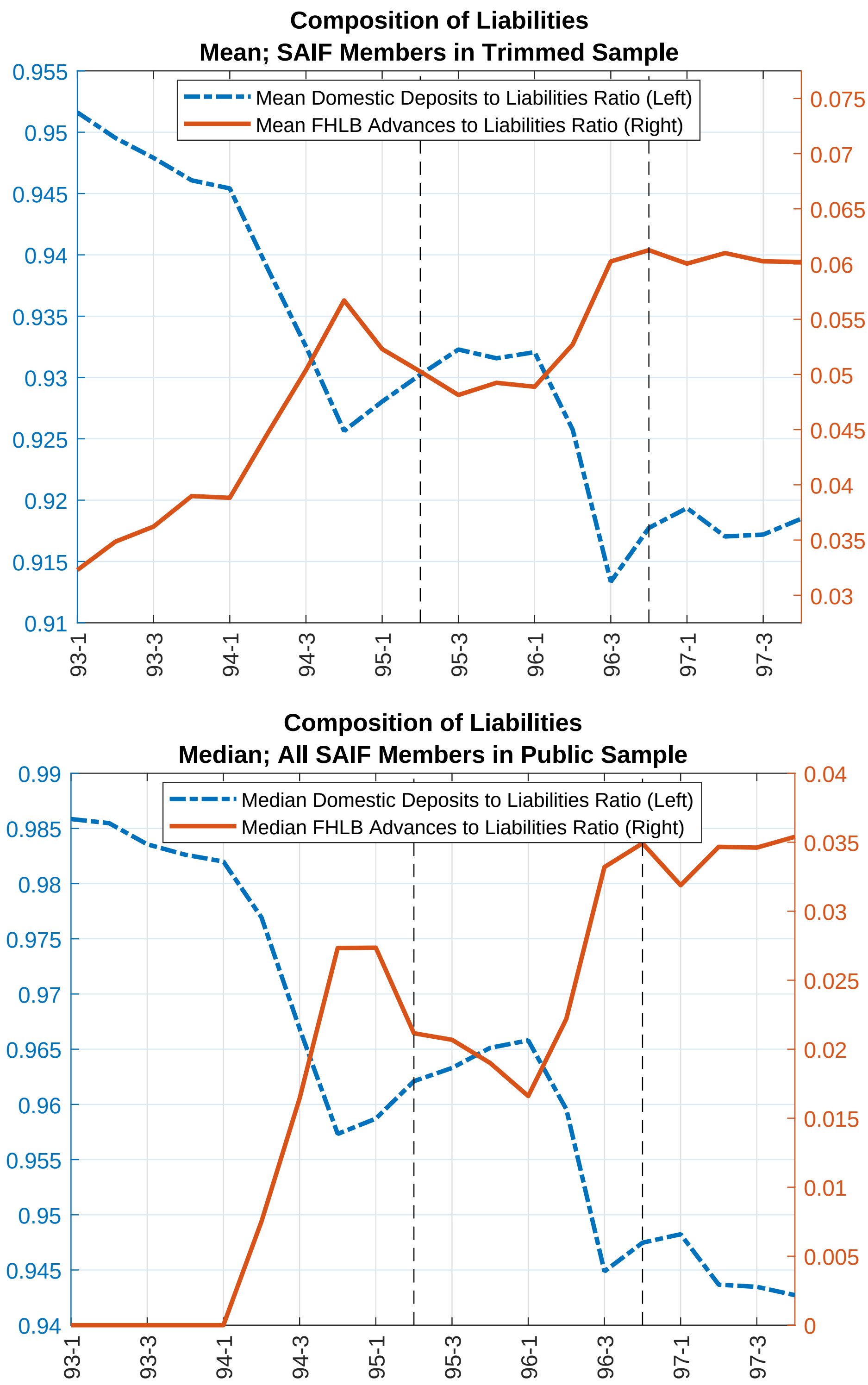
The vertical dashed lines in both panels of this figure denote quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds. The top panel plots the time-dependent coefficient from specification (3). The dependent variable is the ratio of "other noninterest expense" to total noninterest expense. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, composite CAMELS rating from the most recent exam, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables except the composite CAMELS ratings are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level. The bottom panel plots the mean of the dependent variable for BIF and SAIF institutions.

FIGURE 5. Effect of the Disparity on Institutions' Funding Sources



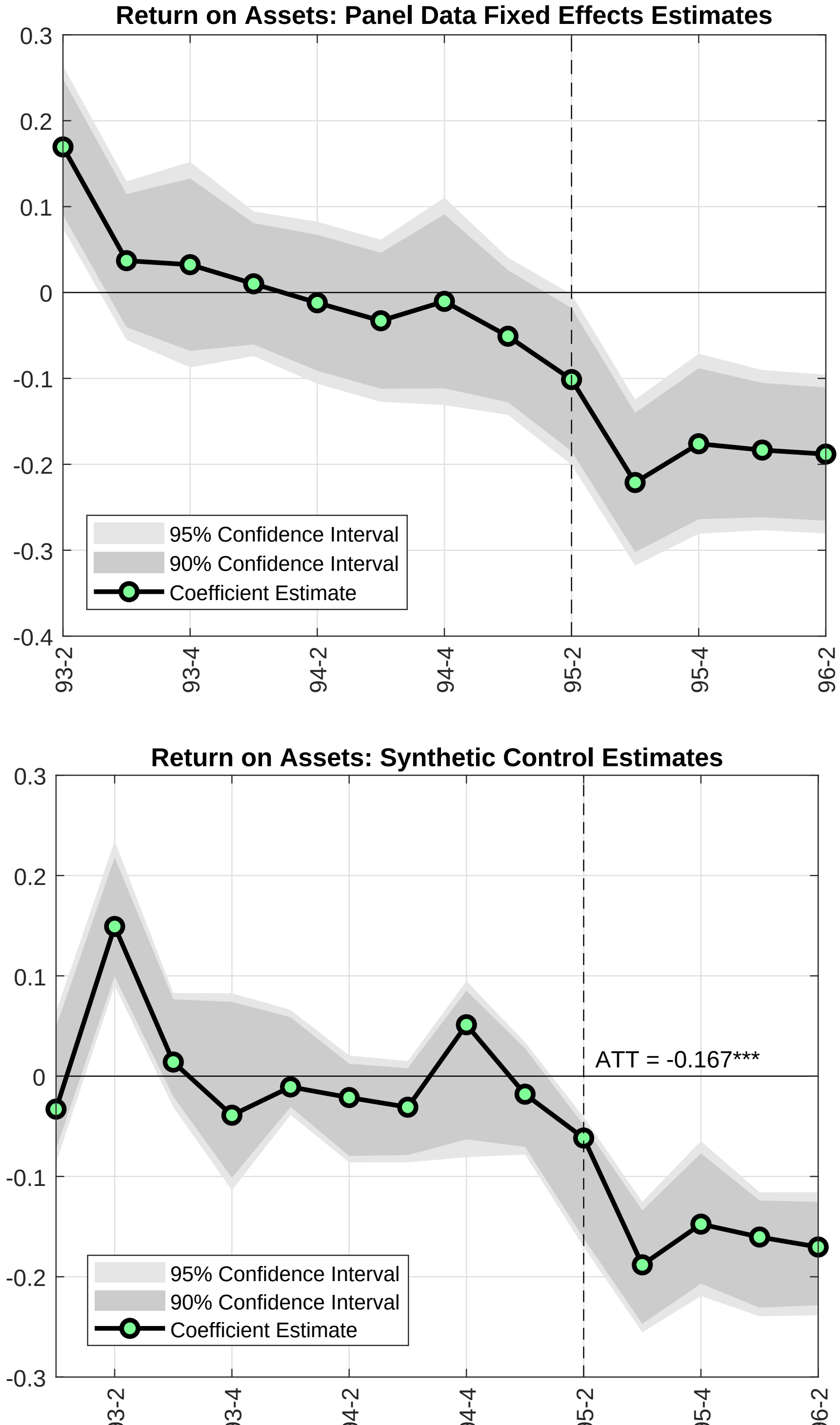
The vertical dashed lines in both panels of this figure denote quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds. The top panel plots the time-dependent coefficient from specification (3). The dependent variable is the ratio of domestic deposits to total liabilities. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, composite CAMELS rating from the most recent exam, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables except for the composite CAMELS ratings are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level. The bottom panel plots the mean of the dependent variable for BIF and SAIF institutions.

FIGURE 6. Shifting Composition of Liabilities for SAIF Institutions



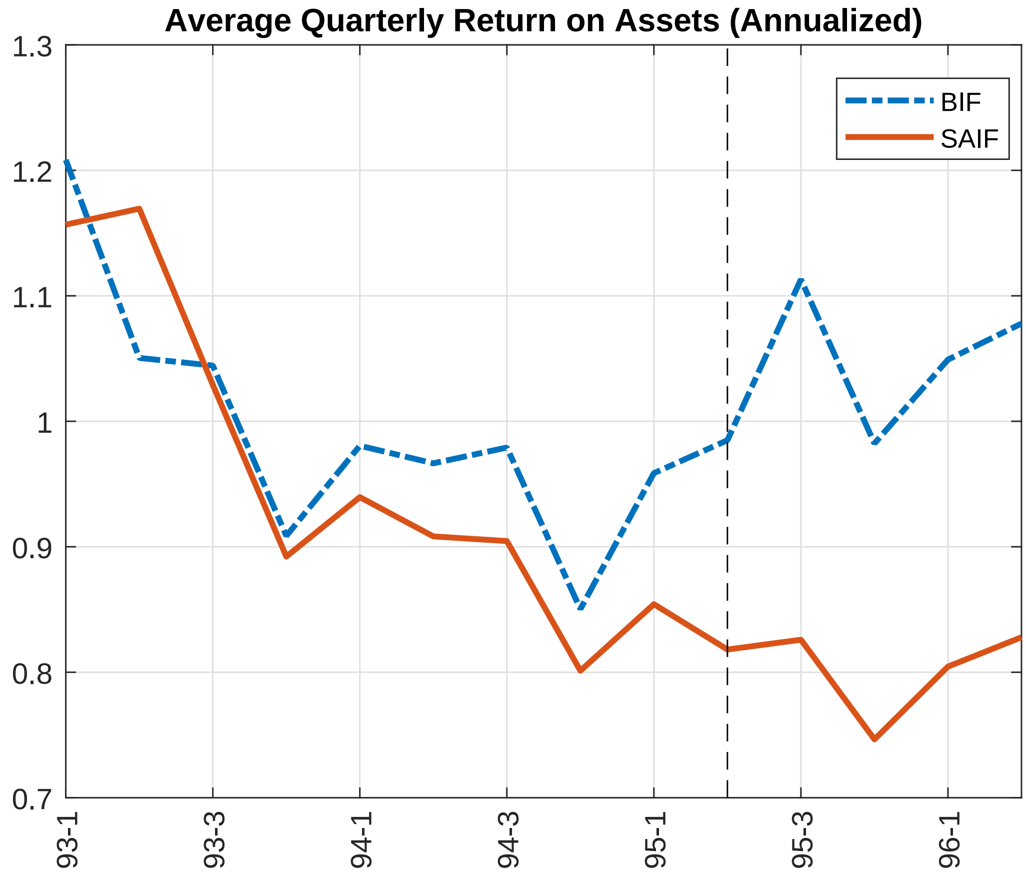
The top panel of this figure shows the average ratio of domestic deposits and FHLB advances to liabilities for SAIF members in the trimmed sample described in section 4. The bottom panel shows medians calculated for all SAIF members using the public Statistics on Depository Institutions FDIC dataset to avoid identification of individual institutions in the trimmed sample. In both panels, the FHLB advances to liabilities ratio in every quarter is calculated for institutions that report some nonnegative value for FHLB advances. The vertical dashed lines denote the quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds.

FIGURE 7. Dynamic Effect of the Disparity on Profitability



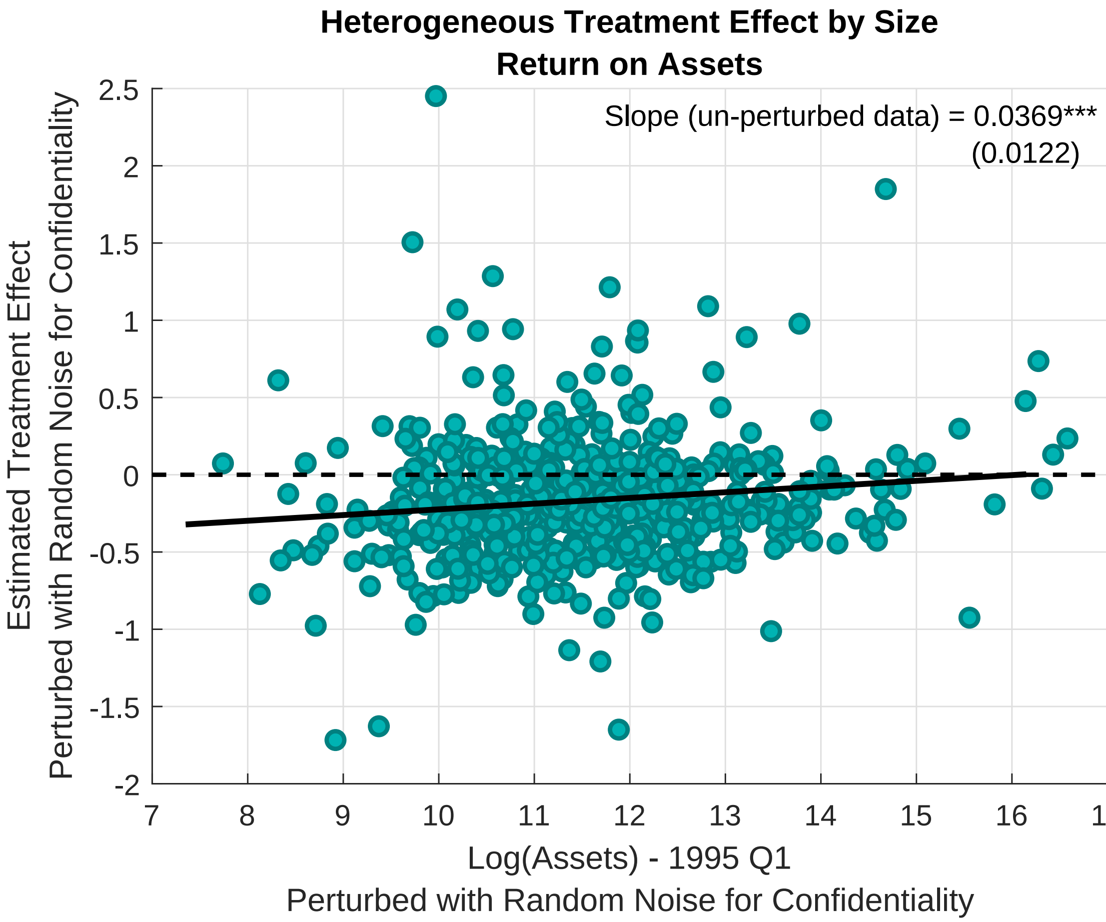
The two panels in this figure show the estimated dynamic effect of being in the SAIF on return on assets using both panel data fixed effects and synthetic control methods (specifications (3) and (4)). The vertical dashed line denotes the quarter immediately preceding the disparity. The sample includes all quarters starting in the first quarter of 1993 through the second quarter of 1996. The dependent variable is the quarterly annualized return on assets. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, composite CAMELS rating from the most recent exam, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables except the composite CAMELS ratings are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level in the top panel; the bottom panel uses a bootstrapping procedure for inference (Xu (2017)), and shows the 95% confidence intervals. The treatment effect of the disparity on SAIF institutions (ATT) is displayed for the synthetic control estimates; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

FIGURE 8. Return on Assets of BIF and SAIF Institutions



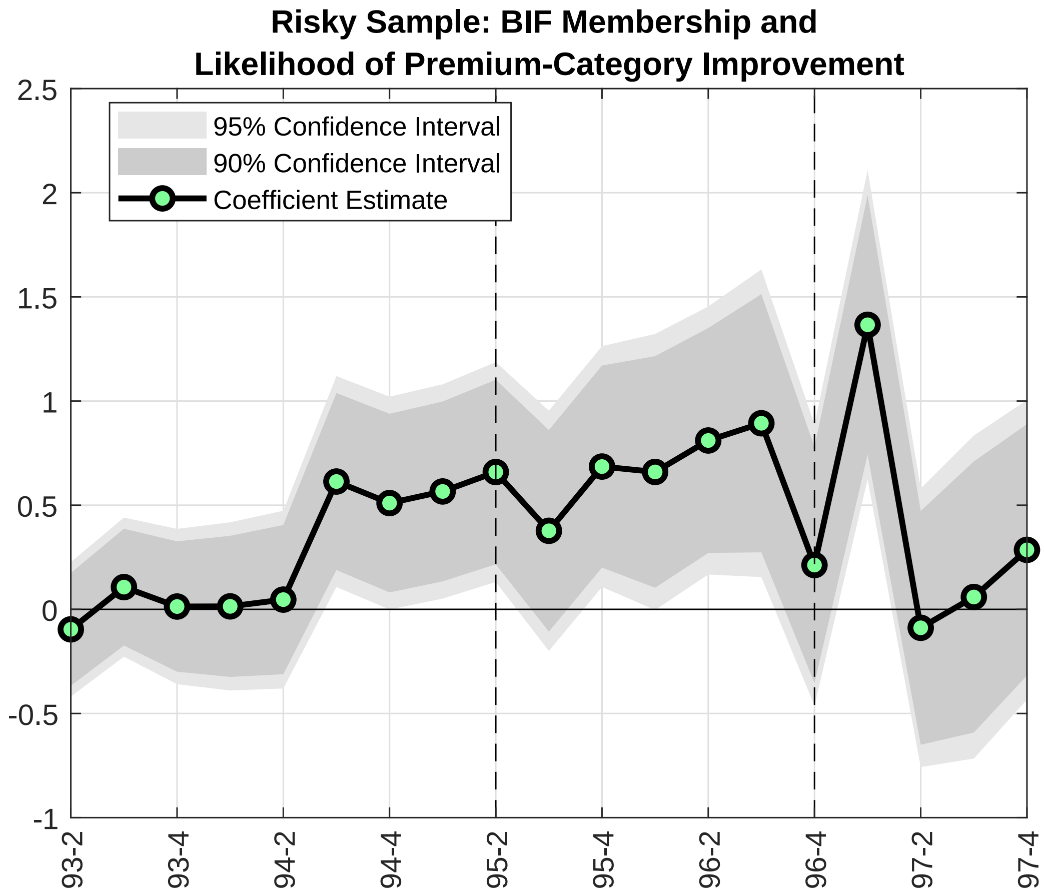
This figure shows the average quarterly annualized return on assets for BIF and SAIF institutions in the sample used in section 5.2 for specifications (3) and (4). The vertical dashed line denotes the quarter immediately preceding the disparity. The sample includes all quarters starting in the first quarter of 1993 through the second quarter of 1996.

FIGURE 9. Heterogeneity in Estimated Treatment Effects



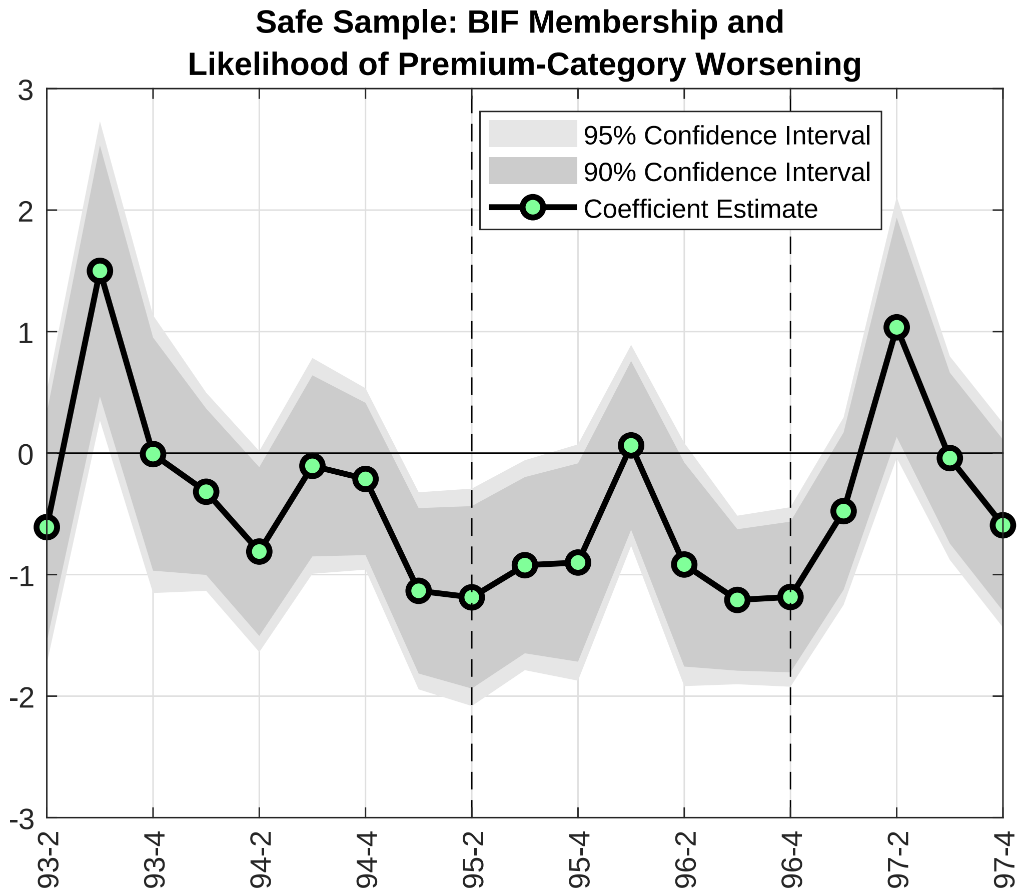
This figure shows the estimated effect of being a SAIF member in the first year of the disparity for each SAIF institution (from synthetic control specification (4)), plotted against the log of the institution's size as of March 31, 1995, on the horizontal axis. The displayed points are perturbed with random noise to preserve confidentiality: any original unperturbed point, (x, y), is perturbed before being displayed on the figure by adding two random numbers, r_x and r_y to result in displayed point $(x+r_x, y+r_y)$, where $r_i \sim \mathcal{N}(0,(\sigma_i/3)^2)$ and σ_i is the i'th axis sample standard deviation, $i \in \{x, y\}$. The figure shows a least-squares-fit line from the unperturbed data with the slope of the line displayed in the top right corner.

FIGURE 10. Pricing Incentives and Risk-Taking: Evidence From Risky Banks



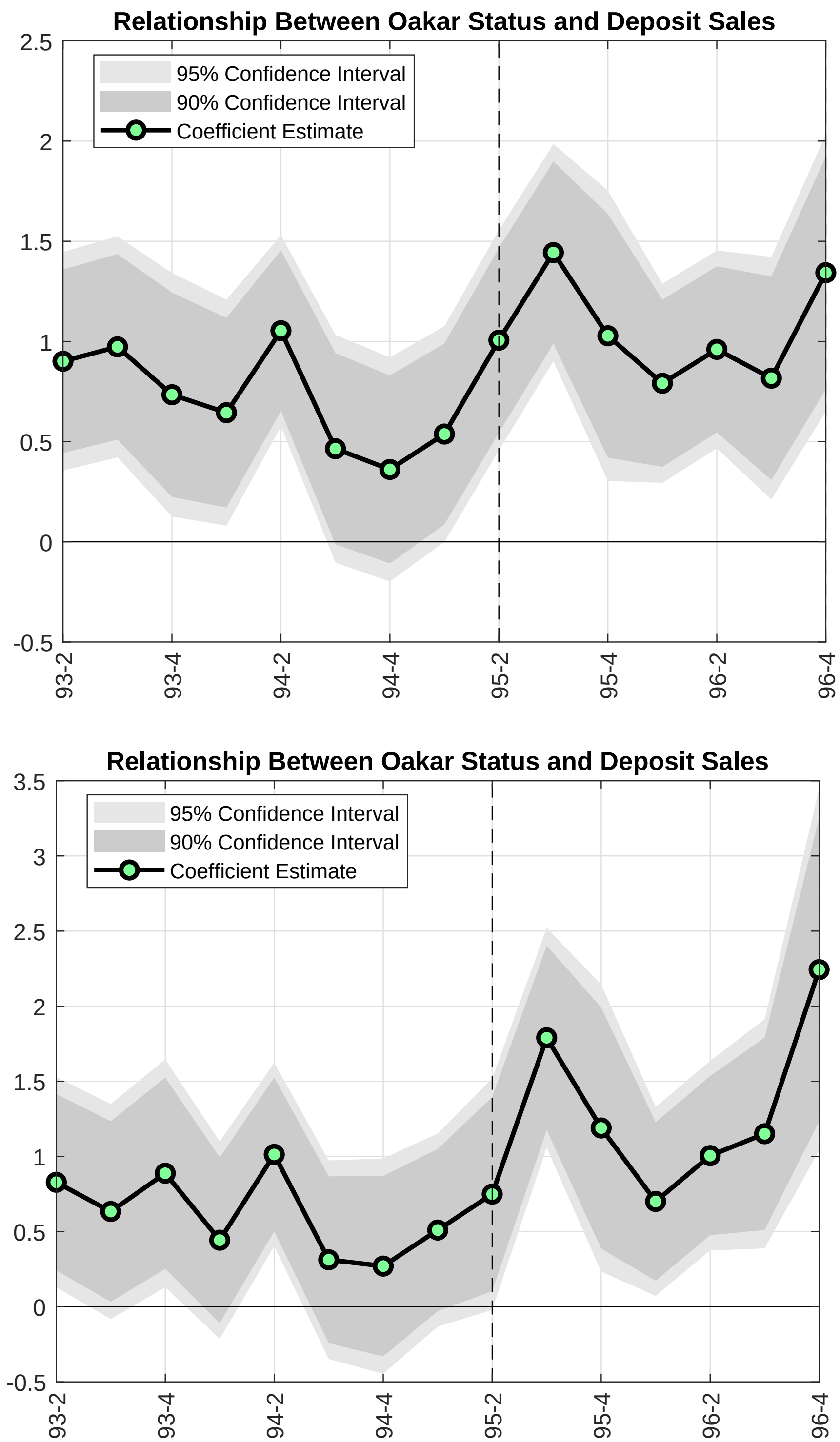
These estimates reflect the effect of being a BIF member on the likelihood that a risky institution (one outside the lowest-premium category) moves to a better premium category. The coefficient estimates are the β_t coefficients on BIF membership status from specification (6); the dependent variable is an indicator with value 1 if an institution improves its premium category between periods $t-1$ to t and zero otherwise. In each quarter t, the sample contains all banks that in quarter $t-1$ were *not* in the lowest-premium category and that were classified as a national bank, state member or nonmember bank, savings bank, or savings and loan institution, and that were operating in both quarters $t-1$ and t. The sample includes both BIF and SAIF institutions, with more than 600 total institutions in every quarter. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, composite CAMELS rating from the most recent exam, the number of quarters since the institution has been examined, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets.

FIGURE 11. Pricing Incentives and Risk-Taking: Evidence From Safe Banks



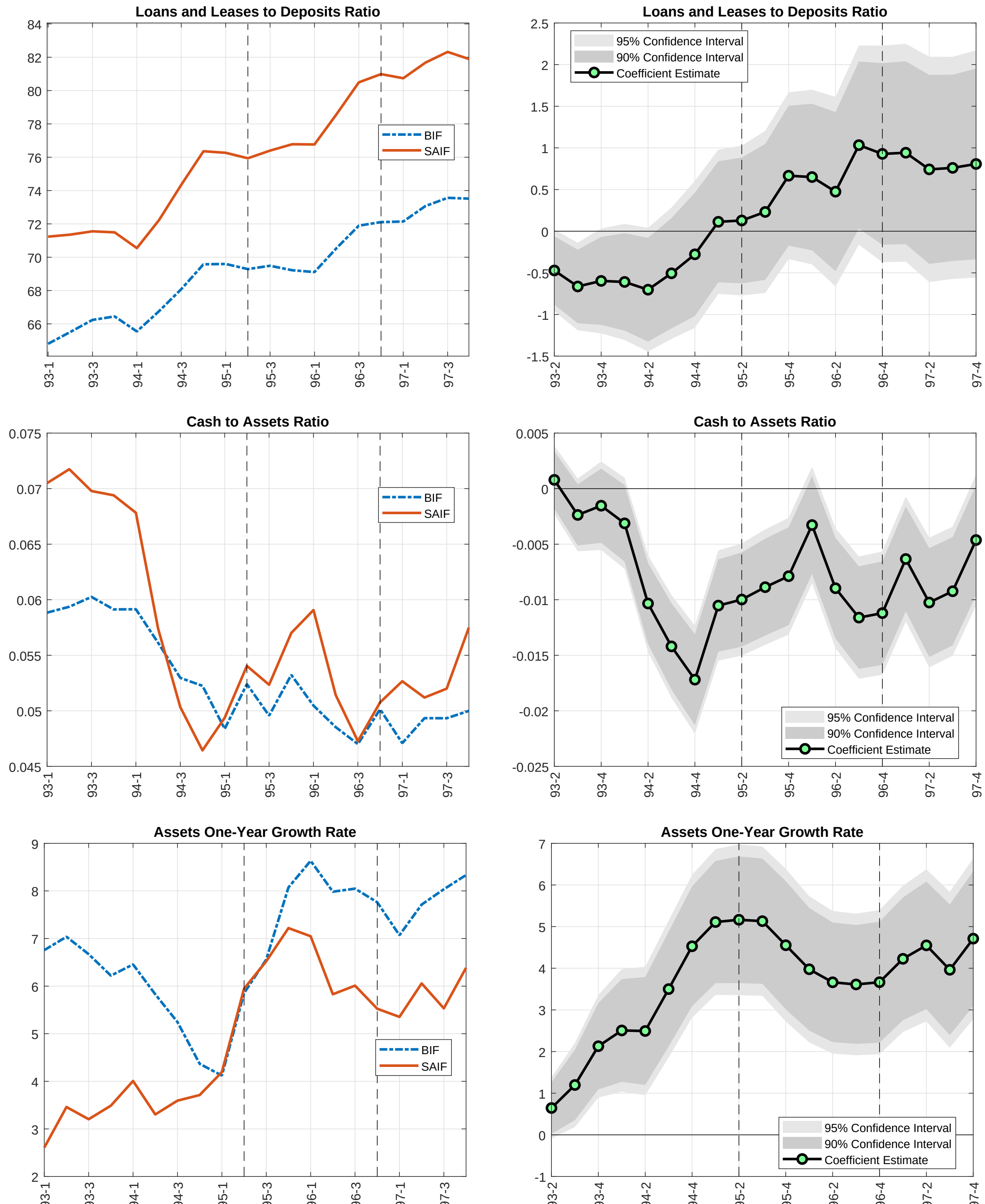
These estimates reflect the effect of being a BIF member on the likelihood that a safe institution (in lowest-premium category) moves to a worse premium category. The coefficient estimates are the β_t coefficients on BIF membership status from specification (7); the dependent variable is an indicator with value 1 if an institution worsens its premium category between periods $t-1$ to t and zero otherwise. In each quarter t, the sample contains all banks that in quarter $t-1$ were in the lowest-premium category and that were classified as a national bank, state member or nonmember bank, savings bank, or savings and loan institution, and that were present in both quarters $t-1$ and t. The sample includes both BIF and SAIF institutions, with more than 10,000 total institutions in every quarter. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, composite CAMELS rating from the most recent exam, the number of quarters since the institution has been examined, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets.

FIGURE 12. Effect of Being Oakar on Deposit Sales—Logit Estimates



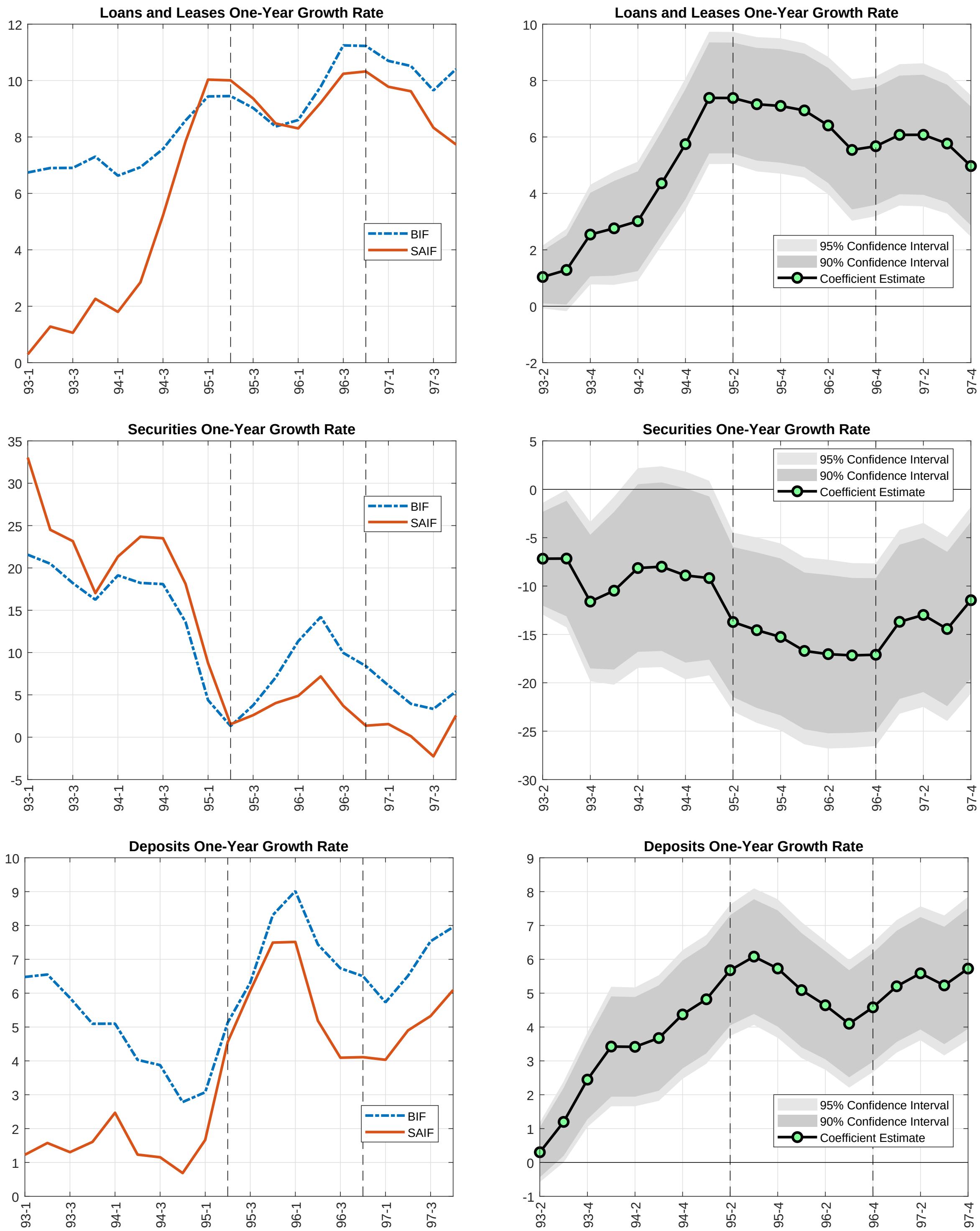
The two panels in this figure show the β_t estimates on the Oakar status indicator from logit specification (8). The dependent variable is a deposit sale binary indicator that takes a value of 1 if a bank had a reduction in both domestic deposits and total number of offices during quarter t. In the top panel all reductions of domestic deposits are counted, and in the bottom panel only reductions by more than $10 million are counted. The sample for each quarter in both panels contains BIF-member banks that were operating in quarters $t-1$ and t; that were classified as a national bank, state member or nonmember bank, savings bank, or savings and loan institution for both quarters; and that had more than one office as of quarter-end $t-1$. The bottom panel excludes banks with less than $100 million in assets as of quarter-end $t-1$. The vertical dashed line indicates the quarter immediately preceding the disparity. Controls include the same set variables used as controls in section 5.1.

FIGURE 13. Effect of the Disparity on Loans-to-Deposits Ratio, Cash to Assets Ratio, and Asset Growth



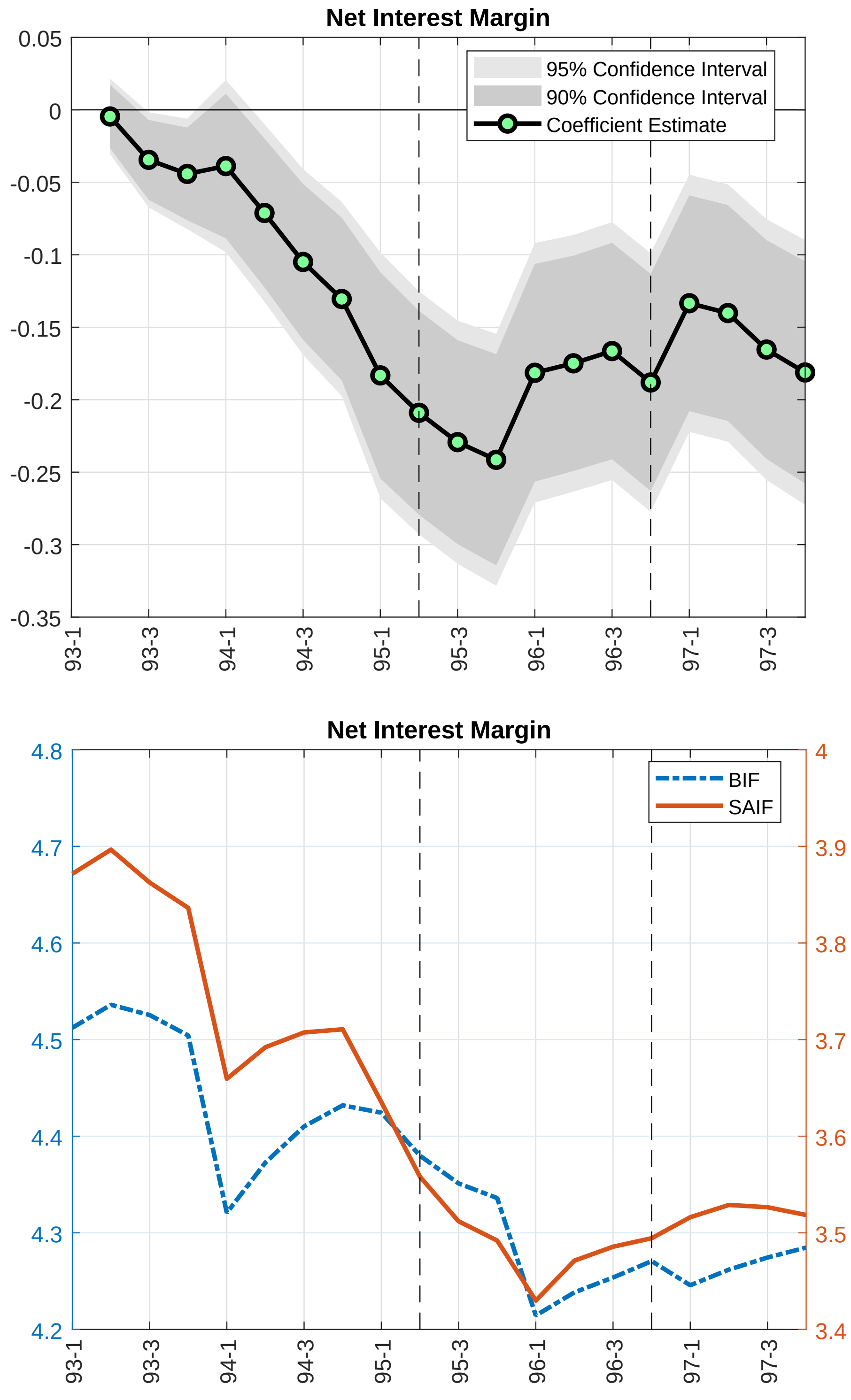
The vertical dashed lines in all panels of this figure denote the quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds. The right panels plot the time-dependent coefficient from specification (3). The dependent variable is listed in the title of each panel. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level. The left panels plot the mean of the corresponding dependent variable for BIF and SAIF institutions.

FIGURE 14. Effect of the Disparity on Growth in Loans, Securities, and Deposits



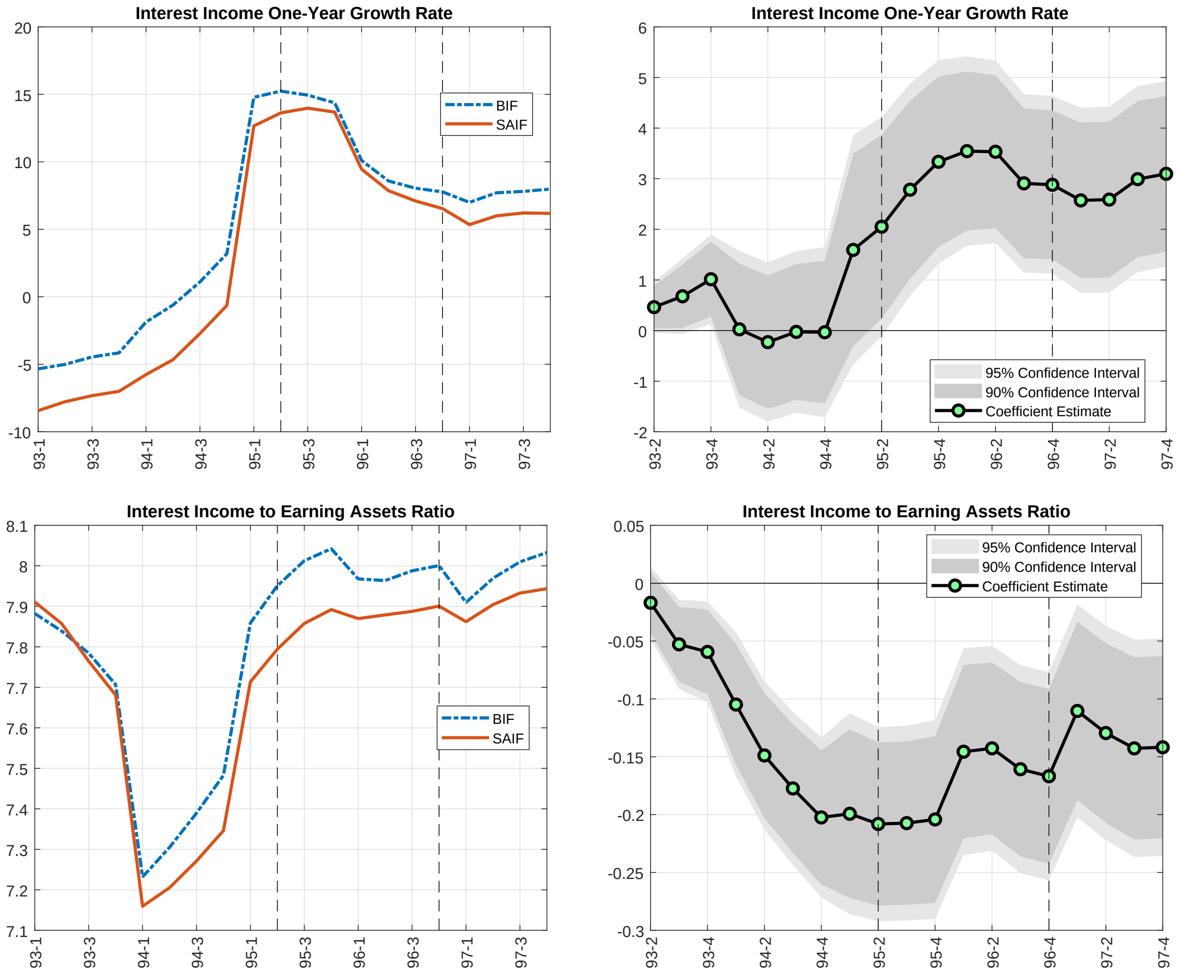
The vertical dashed lines in all panels of this figure denote the quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds. The right panels plot the time-dependent coefficient from specification (3). The dependent variable is listed in the title of each panel. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level. The left panels plot the mean of the corresponding dependent variable for BIF and SAIF institutions.

FIGURE 15. Effect of the Disparity on Net Interest Margin



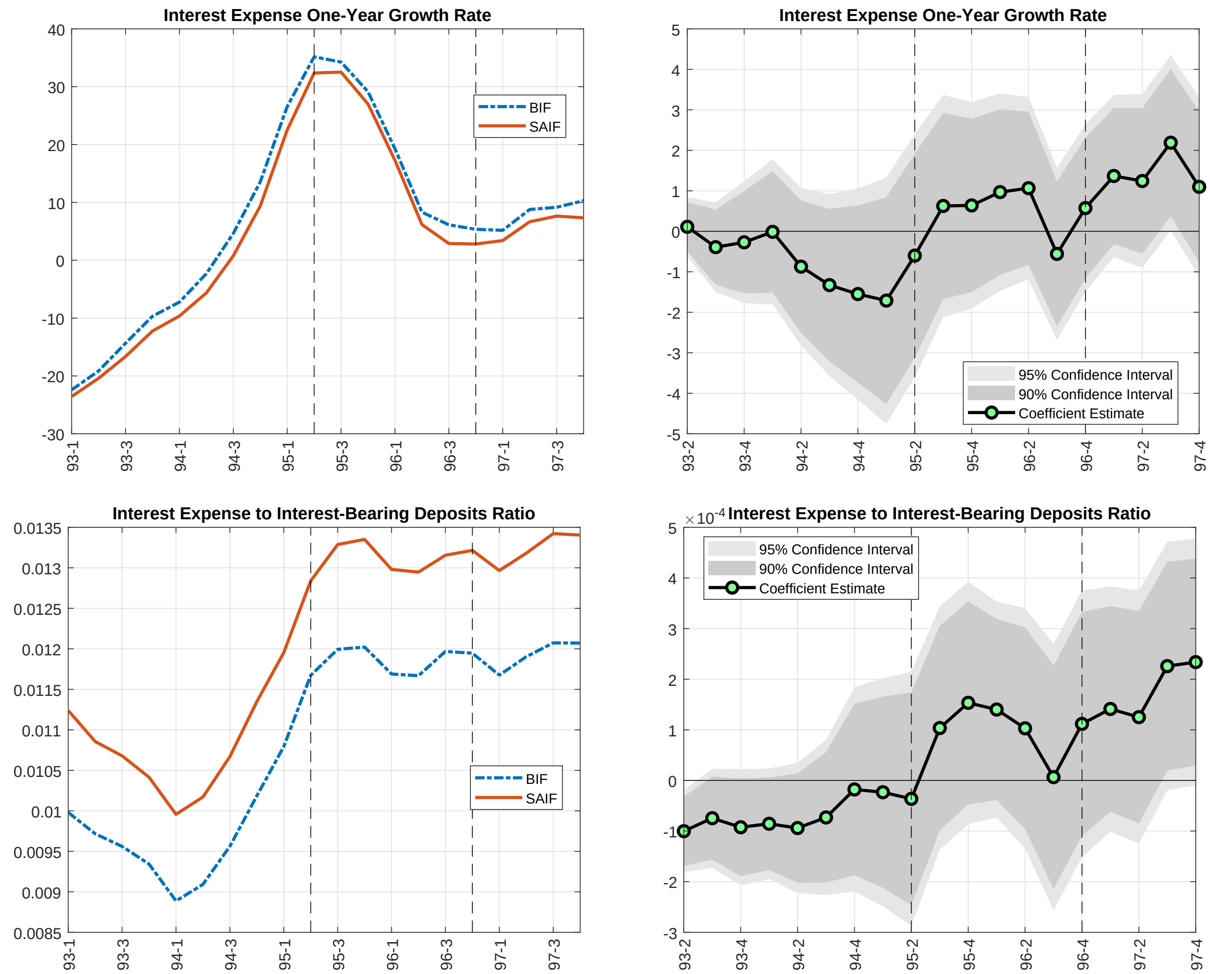
The vertical dashed lines in both panels of this figure denote the quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds. The top panel plots the time-dependent coefficient from specification (3). The dependent variable is the net interest margin. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level. The bottom panel plots the mean of the dependent variable for BIF and SAIF institutions.

FIGURE 16. Effect of the Disparity on Interest Income



The vertical dashed lines in all panels of this figure denote the quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds. The right panels plot the time-dependent coefficient from specification (3). The dependent variable is listed in the title of each panel. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level. The left panels plot the mean of the corresponding dependent variable for BIF and SAIF institutions.

FIGURE 17. Effect of the Disparity on Interest Expense



The vertical dashed lines in all panels of this figure denote the quarter immediately preceding the disparity and the final quarter of the disparity in deposit insurance premiums between the BIF and SAIF funds. The right panels plot the time-dependent coefficient from specification (3). The dependent variable is listed in the title of each panel. Institution and quarter fixed effects are included. Controls include the log of the institution's assets, total risk-based capital ratio, Tier-1 risk-based capital ratio, leverage ratio, and the following terms entered as a ratio to assets: 1–4 family residential loans, commercial and industrial loans, credit card loans, securities, cash, and nonperforming assets. All variables are winsorized at the 1% and 99% levels within each quarter. Standard errors are clustered at the institution level. The left panels plot the mean of the corresponding dependent variable for BIF and SAIF institutions.

TABLE 1. Premiums of BIF and SAIF Institutions (basis points)

(A) BIF and SAIF Predisparity

	Supervisory Group A	Supervisory Group B	Supervisory Group C
Well Capitalized	23	26	29
Adequately Capitalized	26	29	30
Under Capitalized	29	30	31

(B) BIF July 1, 1995, through December 31, 1995 (Before Refunds)

	Supervisory Group A	Supervisory Group B	Supervisory Group C
Well Capitalized	4	7	21
Adequately Capitalized	7	14	28
Under Capitalized	14	28	31

(C) BIF Starting on January 1, 1996, and SAIF Starting on January 1, 1997

	Supervisory Group A	Supervisory Group B	Supervisory Group C
Well Capitalized	0	3	17
Adequately Capitalized	3	10	24
Under Capitalized	10	24	27

The three panels of this table show the differences in premiums between BIF and SAIF institutions before, during, and after the disparity. All values are in annual basis points, or cents per $100, of domestic deposits. Supervisory groups (columns) are classifications of banks by composite CAMELS ratings into three levels, with supervisory group A being the healthiest banks and supervisory group C being the least healthy; similarly, banks are assigned to rows on the basis of their capital ratios. Panel (A) shows the premiums charged to BIF and SAIF institutions before the start of the disparity (i.e., before the third quarter of 1995). SAIF institutions continued to pay the premiums in panel (A) through the fourth quarter of 1996, the last quarter of the disparity. Panel (B) shows that premiums were reduced for BIF institutions in the third and fourth quarters of 1995; in addition, excess assessments paid to the BIF after it reached its target capitalization percentage were refunded (Federal Deposit Insurance Corporation 1996). Panel (C) shows the premiums charged to BIF institutions starting in January of 1996; these premiums are also the postdisparity premiums that both BIF and SAIF institutions paid, but SAIF institutions did not move to the lower premiums in panel (C) until January of 1997.

Table 2. Percentage of BIF and SAIF Institutions in Each Classification

(A) Percentage of BIF Institutions, as of December 31, 1995

	Supervisory Group A	Supervisory Group B	Supervisory Group C
Well Capitalized	93.5%	4.2%	0.9%
Adequately Capitalized	0.7%	0.2%	0.3%
Under Capitalized	0.0%	0.0%	0.2%

(B) Percentage of SAIF Institutions, as of December 31, 1995

	Supervisory Group A	Supervisory Group B	Supervisory Group C
Well Capitalized	90.5%	5.5%	0.8%
Adequately Capitalized	1.1%	0.8%	1.1%
Under Capitalized	0.0%	0.0%	0.2%

The two panels of this table show the percentage of banks in each supervisory group and capitalization level as of December 31, 1995, as reported in Federal Deposit Insurance Corporation (1996). Supervisory groups (columns) are classifications of banks by composite CAMELS ratings into three levels, with supervisory group A being the healthiest banks and supervisory group C being the least healthy; similarly, banks are assigned to rows on the basis of their capital ratios. Panel (A) is for BIF institutions and panel (B) is for SAIF institutions.

TABLE 3. Summary Statistics: Trimmed Sample, Quarter 1, 1995

	BIF Members, 1995 Q1		SAIF Members, 1995 Q1	
	Mean	Std. Dev.	Mean	Std. Dev.
Asset Size ($millions)	432.5	2,635.4	345.5	1,320.5
Deposits/Liabilities (%)	94.1	12.0	92.8	10.3
Loans and Leases/Assets (%)	59.4	18.8	64.0	18.4
1-4 Family Residential Loans/Assets (%)	39.5	17.7	46.5	15.9
Commercial and Industrial Loans/Assets (%)	2.0	2.3	1.1	2.1
Cash/Assets (%)	5.3	6.8	5.0	4.6
Securities/Assets (%)	28.6	16.7	26.5	18.3
Nonperforming Assets/Assets (%)	1.2	2.1	1.2	1.9
Leverage Ratio (%)	10.2	5.7	9.7	4.2
Efficiency Ratio (%)	66.9	17.2	67.3	26.6
Return on Assets (%)	1.0	1.9	0.8	1.0
Return on Equity (%)	10.5	11.9	8.4	10.8
Observations	539		565	

This table shows descriptive statistics for BIF and SAIF members in the first quarter of 1995 for several variables of relevance. The columns for each sample show the mean and standard deviation for each variable. The sample in this table is trimmed based on propensity scores, as described in section 4.

TABLE 4. Effect of the Disparity on Deposits to Liabilities Ratio

	(1)	(2)	(3)	(4)
SAIF * Post-1995Q3	-0.007**	-0.009***	-0.010**	-0.012***
	(0.003)	(0.003)	(0.004)	(0.004)
Log(Assets)		-0.036***		-0.028**
		(0.009)		(0.011)
1-4 Family Residential Loans/Assets		-0.060**		-0.087**
		(0.029)		(0.039)
Commercial and Industrial Loans/Assets		0.062		0.067
		(0.074)		(0.085)
Credit Card Loans/Assets		0.066		-0.434
		(0.374)		(0.370)
Securities/Assets		-0.084***		-0.097**
		(0.027)		(0.039)
Cash/Assets		0.046		-0.018
		(0.033)		(0.050)
Nonperforming Assets/Assets		0.078		0.159
		(0.102)		(0.137)
Total Risk-Based Capital Ratio		0.002		0.006
		(0.004)		(0.005)
Tier 1 Risk-Based Capital Ratio		-0.001		-0.006
		(0.004)		(0.005)
Leverage Ratio		0.003*		0.002
		(0.002)		(0.002)
Composite CAMELS Rating		0.002		0.001
		(0.002)		(0.003)
Observations	22,080	22,080	8,216	8,216
Bank FE	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES

Robust standard errors clustered at the institution level in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Estimates in this table are from specification (2). The dependent variable is the ratio of domestic deposits to total liabilities. Columns (1) and (2) include the full sample from the start of 1993 through the end of 1997. Columns (3) and (4) include only the years 1993 and 1997 to provide more-accurate estimates of the effect of the disparity by excluding anticipation effects and by using only 1993 propensity scores to trim the sample. All variables except the composite CAMELS ratings are winsorized at the 1% and 99% levels within each quarter.

TABLE 5. Impact of the Disparity on Profitability

	(1)	(2)	(3)	(4)
SAIF * Post-1995Q3	-0.209***	-0.196***	-0.170***	-0.167***
	(0.024)	(0.023)	(0.031)	(0.027)
Log(Assets)		0.290***		0.148**
		(0.108)		(0.103)
1-4 Family Residential Loans/Assets		0.598*		0.510*
		(0.321)		(0.302)
Commercial and Industrial Loans/Assets		0.743		1.072
		(0.670)		(0.874)
Credit Card Loans/Assets		-2.340		-4.800*
		(3.000)		(3.090)
Securities/Assets		-0.217		-0.360
		(0.265)		(0.358)
Cash/Assets		-0.163		-0.120
		(0.365)		(0.427)
Nonperforming Assets/Assets		-11.101***		-7.538***
		(1.595)		(2.336)
Total Risk-Based Capital Ratio		0.003		-0.036
		(0.027)		(0.050)
Tier 1 Risk-Based Capital Ratio		0.001		0.055
		(0.027)		(0.049)
Leverage Ratio		0.076***		0.068***
		(0.017)		(0.016)
Composite CAMELS Rating		-0.030		-0.036
		(0.021)		(0.030)
Observations	15,456	15,456	15,456	15,456
Bank FE	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Estimates in columns (1) and (2) are from the panel data fixed-effects specification (2); estimates in columns (3) and (4) are from the synthetic control specification (4). The dependent variable is quarterly annualized return on assets. The sample includes all quarters starting in the first quarter of 1993 through the second quarter of 1996. All variables except the composite CAMELS rating are winsorized at the 1% and 99% levels within each quarter. Standard errors in columns (1) and (2) are clustered at the institution level; standard errors in columns (3) and (4) are bootstrap standard errors.

TABLE 6. Risk-Taking and Profitability

	(1)	(2)	(3)	(4)
Log(Assets)	0.327**	0.324**	0.462***	0.231*
	(0.127)	(0.127)	(0.143)	(0.119)
1-4 Family Residential Loans/Assets	0.808**	0.805**	0.771**	0.804**
	(0.324)	(0.325)	(0.339)	(0.325)
Commercial and Industrial Loans/Assets	0.510	0.496	0.382	0.138
	(0.773)	(0.772)	(0.720)	(0.767)
Credit Card Loans/Assets	0.901	0.957	0.138	0.763
	(3.329)	(3.333)	(3.010)	(3.544)
Securities/Assets	0.235	0.237	0.470*	0.461*
	(0.321)	(0.324)	(0.269)	(0.267)
Cash/Assets	-0.324	-0.324	0.043	-0.136
	(0.429)	(0.431)	(0.377)	(0.405)
Nonperforming Assets/Assets	-6.333***	-6.294***	-6.671***	-6.320***
	(2.051)	(2.059)	(2.085)	(2.074)
Total Risk-Based Capital Ratio	0.016*			
	(0.009)			
Tier 1 Risk-Based Capital Ratio		0.016*		
		(0.009)		
Leverage Ratio			0.088***	
			(0.025)	
Composite CAMELS Rating = 2				0.016
				(0.024)
Observations	9,021	9,021	9,021	9,021
Bank FE	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES

Robust standard errors clustered at the institution level in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This table shows estimates from specification (5), in which the dependent variable is quarterly annualized return on assets. The sample of this regression excludes all quarters after the second quarter of 1995, and excludes bank-quarter observations where the bank's deposit insurance premium was higher than 23 basis points. All variables except the composite CAMELS rating are winsorized at the 1% and 99% levels within each quarter.

TABLE 7. Effect of the Disparity on Loans-to-Deposits Ratio and Balance Sheet Growth Variables

	(1)	(2)	(3)	(4)	(5)
	Loans & Leases to Deposits Ratio	One-Year Growth Rate			
		Assets	Loans & Leases	Securities	Deposits
SAIF * Post-1995Q3	1.079**	1.476***	1.561**	-8.680***	1.032***
	(0.428)	(0.477)	(0.653)	(2.188)	(0.283)
Log(Assets)	1.754	14.388***	-4.153**	-8.366*	1.560*
	(1.587)	(1.711)	(1.986)	(4.959)	(0.920)
1-4 Family Residential Loans/Assets	52.786***	-7.217	37.127***	40.381**	-5.227*
	(5.945)	(5.060)	(5.038)	(17.154)	(2.894)
Commercial and Industrial Loans/Assets	62.091***	-8.990	63.706***	-7.927	-2.382
	(12.927)	(16.702)	(15.495)	(56.457)	(8.533)
Credit Card Loans/Assets	116.843***	-97.968*	113.324	-72.854	9.181
	(44.887)	(59.498)	(99.153)	(256.871)	(65.546)
Securities/Assets	-56.104***	8.773*	-18.353***	235.222***	-5.371*
	(5.567)	(4.572)	(5.394)	(15.686)	(2.852)
Cash/Assets	-68.605***	5.900	-63.675***	8.292	10.741***
	(6.236)	(5.384)	(8.172)	(22.127)	(3.549)
Nonperforming Assets/Assets	-36.344**	-225.892***	-145.609***	456.857***	-6.549
	(17.867)	(21.685)	(21.857)	(87.029)	(11.503)
Total Risk-Based Capital Ratio	0.047	-2.037***	-0.340	6.119***	-0.209
	(0.512)	(0.689)	(0.705)	(1.943)	(0.295)
Tier 1 Risk-Based Capital Ratio	-0.293	1.720**	-0.009	-6.331***	0.149
	(0.546)	(0.704)	(0.713)	(1.946)	(0.297)
Leverage Ratio	0.972***	-0.091	0.472	-0.372	-0.069
	(0.292)	(0.259)	(0.303)	(0.959)	(0.156)
Asset Growth			0.731***	1.351***	0.833***
			(0.032)	(0.101)	(0.022)
Observations	22,080	22,077	22,074	21,721	22,077
Bank FE	YES	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES	YES

Robust standard errors clustered at the institution level in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Estimates in this table are from specification (2). The dependent variable is listed under each column number; dependent variables in columns (2)-(5) are one-year growth rates in percentage terms. The "Asset Growth" control variable is the one-year asset growth rate in percentage. All variables are winsorized at the 1% and 99% levels within each quarter.