When Banks Actually Raise Equity*

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Abstract

We study bank and firm responses to Armenia's institution of an absolute bank-equity floor, which forced banks below the threshold to raise equity and curtailed incentives to shrink assets. Unlike the leverage ratchet effect associated with capital-*ratio* requirements, banks below the minimum equity *level* requirement expand assets and liquidity, widen deposit spreads, reduce deposit reliance, and reallocate credit toward safer firms. Lending by affected banks contracts modestly relative to less-affected banks within borrower relationships, but affected firms shift borrowing toward unconstrained banks, remain active, and increase investment. A calibrated dynamic banking model shows that requiring recapitalization can preserve assets under moderate ratio increases, while an absolute floor raises the minimum equity needed to enter and reduces banks' deposit franchise benefits.

Keywords: Bank equity requirements, leverage ratchet effect, credit reallocation
JEL Codes: E58, G21, G28

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1 Introduction

How does an increase in bank equity affect banks and the real economy? Policymakers and academics debate whether bank capital requirements are too low and whether low equity ratios encourage excessive risk-taking. The empirical challenge is that increases in ratio-based equity requirements do not necessarily produce substantial increases in bank equity. Banks seeking to preserve leverage can instead reduce assets to satisfy the requirement (Admati et al. (2018); Juelsrud and Wold (2020)), making it difficult to isolate the effects of higher bank equity on the economy. Those effects therefore remain an open empirical question.

In this paper, we address this gap by exploiting a unique non-crisis 2015 reform in Armenia that required banks to maintain a minimum equity of AMD 30 billion (approximately $83 million) while keeping the Basel-mandated 12% capital ratio in place. We use the reform to study how bank balance sheets adjust, how those adjustments affect the real economy, and what costs the reform imposes. We explore the heterogeneity in how far each affected bank was from meeting the requirement.[1] Although a few affected banks merged with larger banks, most Armenian banks raised the necessary equity by the 2017 effective date. We show that affected banks expand assets and liquidity, widen deposit spreads, and reduce their reliance on deposits, unlike the typical response to capital-ratio requirements (Peek and Rosengren (2000); Gropp et al. (2019); Degryse et al. (2021); Corbae and D'Erasmo (2021)). Borrowers of affected banks respond to the modest contraction in credit by expanding their pool of lenders and shifting toward unaffected banks. As a result, they remain active, increase investment, and do not reduce employment. Finally, we calibrate a dynamic banking model to separate the effects of regulatory stringency from the effects of requiring recapitalization rather than allowing deleveraging, and to assess the direct burden of each policy on entry.

Most equity regulations follow the Basel format of a fixed equity-to-assets ratio.

[1] See also companion work by Tarverdyan (2026) that also explores the impact of the Armenian equity regulation on lending expansion in a difference-in-differences setting.

Banks need not raise equity to comply; they can instead liquidate assets or alter their risk weights. Several recent proposals advocate nominal equity floors.[2] In 2015, the Central Bank of Armenia announced a new requirement that banks hold at least AMD 30 billion in equity by 2017. Most Armenian banks were below the threshold, several by a wide margin. Over the following two years, two small banks were acquired, while the remaining affected banks successfully raised equity. Because compliance required banks to increase equity, the reform provides an unusually clean setting in which to study the effects of higher bank equity on banks and the real economy.

We combine credit registry, deposit transactions by branch, firm tax data, and bank balance sheets. Our main explanatory variable is the gap from 30 Bn AMD to banks' pre-reform equity, as a fraction of total assets. This measure resembles each bank's exposure to the new mandate. We start by showing that affected banks comply and raise equity to satisfy the requirement by 2017. The increase is not sudden, but rather gradual. Banks also do not cut assets, as they usually do due to the leverage ratchet effect. We find an increase in the equity-to-assets ratio and in total assets. Banks also hold more liquid assets, and their risk-weighted assets rise.

The fact that banks increase equity to fully satisfy the requirement and do it outside of crisis times creates an excellent setting for identification of the effects of increased equity. We show that banks' deposits-to-assets ratio declines, implying that equity has a relatively larger share in banks' balance sheets. Since raising equity is costlier than deposits, we find that banks increase their deposit spreads. As a result, ROA and franchise value of banks do not decline and even modestly rise.

We then explore the effects on bank lending. To isolate supply from demand, we follow Khwaja and Mian (2008) and Bergman et al. (2025) and study loan originations within borrowers and time. We find that the banks that are more affected by the equity regulation (i.e., the banks with a larger equity gap) moderately reduced lending (both originations and retained amounts) and increased loan rates. We do not find any change

[2]See this ProMarket discussion.

in non-performing loans or defaults. Hence, even though the lending impact is not as severe as following the Basel-type equity constraints, banks raise assets primarily by holding more liquidity, not by originating more loans.

Even though we do not find large lending contractions, we find evidence of lending reallocation given the heterogeneity in banks' exposure created by the reform. We use a firm-level tax panel to study how affected banks change their lending composition and how their borrowers react. First, we find that the borrowers of affected lenders surprisingly do not perform worse. Their size (employment and assets) remains unchanged, the probability of being solvent rises, and investments increase. These results contrast with the findings in the literature that the borrowers are negatively affected (Chodorow-Reich (2014); Gropp et al. (2014)),[3] because, unlike in the case with ratio-based regulations where all banks are treated, Armenian regulation only treated banks whose equity was below 30 Bn AMD.

We then explore reallocation and find that the borrowers of affected banks are more likely to seek new lenders (e.g., the number of lenders increases). Moreover, their share of borrowing from the affected banks declines, while the share of borrowing from unaffected banks increases. Indeed, affected banks offered lower interest rates to the borrowers of unaffected banks than to their current borrowers. So even though affected banks somewhat contracted lending, which could hurt the borrowers, since there were also unaffected banks benefiting from increased concentration, the overall effect on borrowers is positive.

Affected lenders also reallocated where their loans are originated. Specifically, we find that the new loans are more likely to be originated to larger, more bank-dependent, and more levered firms. We do not find any evidence that the new loans are originated to more productive firms. These results imply that the affected lenders choose to lend to safer firms and potentially firms that they have relationships with, rather than to potentially riskier but more productive borrowers.[4] The allocation margin matters for

[3]The investments results are consistent with the channel studied in Amiti and Weinstein (2018).
[4]This result is consistent with the findings in the lending reallocation literature (e.g., Chang et al.

efficiency, as noted by Hsieh and Klenow (2009) and Midrigan and Xu (2014).

We then turn to discuss potentially negative consequences of the reform and possible ways to overcome the challenges. The new equity floor, unlike the ratio-based constraint, created significant barriers for new entry. Any new entrant would need to hold at least 30 Bn AMD, as opposed to 12% of assets. This problem is especially relevant as FinTech lenders are growing to compete with the traditional banks and can improve the speed and elasticity of credit supply (Buchak et al. (2018); Fuster et al. (2019); Irani et al. (2021); Acharya et al. (2026)). We use hand-collected FinTech entry data from countries in Europe and the Middle East to construct a "synthetic Armenia" – the version of the country that is otherwise similar to real Armenia but did not have the absolute equity regulation. The methodology follows the synthetic control literature (Abadie and Gardeazabal (2003); Abadie et al. (2010); Arkhangelsky et al. (2021)). We show that the FinTech entry in real Armenia is lower than in the synthetic Armenia without the equity regulation.

Finally, we quantify the effects of the absolute floor regulation relative to ratio-based regulation by constructing a dynamic banking model. Banks choose deposit rates, loan rates, and equity subject to costly issuance and equity regulation (Corbae and D'Erasmo (2021)). Depositors and borrowers choose banks at these rates, and liquid assets follow from the balance sheet. The model features deposit market power as in Drechsler et al. (2017); DeMarzo et al. (2025) and a leverage-ratchet incentive as in Admati et al. (2018). Under the calibrated model, raising the ratio from 12% to 13% or 14% induces banks to meet part of the requirement by shrinking assets. Requiring equity issuance instead preserves assets and reduces the initial funding contraction. The Armenian floor produces a much larger recapitalization, asset growth concentrated in liquid holdings, and a small lending decline. Compared with a ratio increase generating approximately the same aggregate equity growth, the floor produces smaller deposit and loan contractions. The Armenian policy yields a lower probability of successful entry than ratio-based re-

(2023)).

quirements up to and including 17% on our policy grid; at 18% and above, the ordering reverses. Thus neither the amount of equity raised nor the policy's form alone determines its effects on intermediation and entry.

We also evaluate welfare and banks' exposure to interest rate and credit shocks. The Armenian reform raises discounted banking-sector surplus relative to the pre-reform benchmark, although moderate ratio increases generate larger gains. Following the deposit-franchise logic of Drechsler et al. (2021), we combine pre-reform earnings sensitivities with policy-specific balance sheets. The floor reduces the net interest margin gain from higher rates, particularly for treated banks. A 14% ratio with required equity raising instead produces more similar responses across groups, preserves more deposit funding, and increases the NIM gain relative to 12%. A credit-stress exercise scaled to NPL deterioration during the 2014 Russia/oil shock reveals a different ranking: both reforms reduce loan losses relative to starting equity, but the Armenian floor provides the larger cushion. The floor therefore strengthens loss absorption while reducing the earnings gain from higher interest rates.

We contribute to several strands of the literature. First, prior papers study Basel-style changes in equity regulation and show that higher capital requirements can produce significant contractions in lending, followed by lower employment and revenues among affected borrowers (Peek and Rosengren (2000); Chodorow-Reich (2014); Aiyar et al. (2014); Behn et al. (2016); Jiménez et al. (2017); Gropp et al. (2019); Fraisse et al. (2020); Degryse et al. (2021)). A related literature emphasizes that higher capital requirements can hurt bank-dependent borrowers by limiting banks' ability to create deposits and other liquid claims (Holmstrom and Tirole (1997); Diamond and Rajan (2000); Van den Heuvel (2008); Berger and Bouwman (2009); DeAngelo and Stulz (2015); Khwaja and Mian (2008); Corbae and D'Erasmo (2021); Dempsey (2026)). In contrast, other papers identify safety channels through which higher capital can improve bank performance, reduce funding fragility, and increase lending in general equilibrium (Beltratti and Stulz (2012); Berger and Bouwman (2013); Repullo and Suarez (2013);

Begenau (2020); Bahaj and Malherbe (2020)). We study an absolute equity requirement rather than a Basel-style capital ratio. In our setting, affected borrowers move to unconstrained banks, and their profits do not decline.

Another strand of the literature studies how banks respond when required to fund a larger share of their assets with equity and argues that they often shrink assets rather than issue new equity. Theoretically, the leverage ratchet effect explains why banks are reluctant to raise equity (Admati (2015); Admati et al. (2018); DeMarzo and He (2021)). Empirical work likewise documents balance-sheet contraction and portfolio rebalancing in response to tighter equity requirements (Gropp et al. (2019); Juelsrud and Wold (2020); Favara et al. (2021); Irani et al. (2021)), while Kisin and Manela (2016) estimates the private shadow cost of complying with capital regulation. Beyond shrinking assets, banks engage in regulatory arbitrage by reallocating their portfolios, managing measured risk weights, and retreating from more heavily regulated markets (Acharya et al. (2013); Acharya and Steffen (2015); Begley et al. (2017); Buchak et al. (2018); Behn et al. (2022)). These responses can change equilibrium competition and concentration (Hanson et al. (2011); Allen et al. (2011); BENETTON (2021)). Hence, existing papers either study counterfactual scenarios with high equity ratios (such as Begenau (2020); Begenau and Landvoigt (2022)), or explore banks' endogenous choice to raise equity in crisis times (Berger and Bouwman (2013); Li et al. (2020)). Tarverdyan (2026) is a notable exception that studies lending expansion in Armenia using the same reform. Armenia's reform instead required banks to maintain a fixed minimum level of equity. For banks below the threshold, compliance therefore required raising equity in levels, and we find that their assets increased rather than contracted. Importantly, banks' decision to raise equity is enforced by policy rather than by economic conditions. This setting allows us to study capital regulation when banks comply through equity growth rather than deleveraging, bringing to the data a counterfactual typically assumed in studies of Basel-style equity requirements.

Finally, we contribute to the broader literature on financial intermediation, credit

allocation, and economic dynamism. Changes in banking competition and credit availability affect firm entry, entrepreneurship, industry structure, and growth, in part by changing the allocation rather than merely the volume of credit (Jayaratne and Strahan (1996); Black and Strahan (2002); Cetorelli and Strahan (2006); Kerr and Nanda (2009); Bertrand et al. (2007)). Lending relationships improve firms' access to finance, while multiple relationships can protect borrowers when an incumbent relationship is disrupted (Petersen and Rajan (1994); Degryse et al. (2011)). More broadly, financial frictions and distorted lender incentives can direct capital away from its most productive uses, lowering productivity and slowing restructuring (Hsieh and Klenow (2009); Midrigan and Xu (2014); Gopinath et al. (2017); Peek and Rosengren (2005); Caballero et al. (2008); Blattner et al. (2023)). Prudential regulation can itself trigger such reallocation by changing which banks lend and by shifting intermediation toward less constrained banks or nonbank lenders (Corbae and D'Erasmo (2021); Favara et al. (2021); Irani et al. (2021); Buchak et al. (2018, 2024)). We contribute by tracing this reallocation jointly across banks and firms after a large equity reform. Constrained banks redirect lending toward larger and safer firms, but not toward more productive firms, while affected borrowers add lenders and substitute toward unconstrained banks. At the same time, affected firms remain active and increase investment, suggesting that lender substitution can insulate incumbent borrowers even as lending within constrained banks becomes less productivity-oriented. Our results therefore show that prudential regulation can strengthen bank capitalization without contracting aggregate credit, while still reshaping who receives credit and the economy's allocative dynamism.

The rest of the paper is organized as follows. Section 2 describes the institutional setting, main data sources, and empirical strategy. Section 3 presents the results related to banks' response to the reform. Section 4 shows how the real economy was influenced. Section 5 discusses obstacles for the new entry caused by the regulation. Section 6 builds and calibrates a dynamic banking model to study policy counterfactuals. Section 7 concludes.

2 Institutional setting, data, and empirical strategy

In this section, we first discuss the institutional setting. Specifically, we outline the state of the Armenian economy before and after the reform, the time frame of the regulation, and the main arguments motivating the absolute equity floor as opposed to a Basel-type regulation. Second, we describe our main data sources and provide summary statistics for banks and firms before and after the reform. Finally, we outline the main empirical strategy.

2.1 Institutional setting

Armenia is a small, open economy. Prior to the 2015 reform, 2014 nominal GDP was approximately $11.6 billion ($3,852 per capita). Real GDP growth in 2014 was 3.6%, and annual consumer-price inflation was 3.0%. The financial system was centered on 21 commercial banks; financial-system assets and credit amounted to 82.8% and 48.9% of GDP, respectively.

The reform followed a significant external shock – the Russian oil shock in 2014. After the reform, the Armenian economy was hit by the COVID-19 pandemic and a 44-day war in 2020. Importantly for the analysis, the 2015–2017 implementation period did not coincide with a domestic banking crisis or a system-wide recession: real GDP grew by 11.1% from 2015 to 2017.

On December 30, 2014, the Board of the Central Bank of Armenia (CBA) increased the minimum total regulatory capital required of each bank from AMD 5 billion to AMD 30 billion. Banks had two years to comply, and the floor became effective on January 1, 2017. At the announcement, only 5 of 21 banks met the new requirement. Four held AMD 20–30 billion in regulatory capital, six held AMD 10–20 billion, and six held less than AMD 10 billion. This dispersion generated substantial variation in the equity banks needed to raise. Banks could issue equity, retain earnings, or merge, but could not satisfy the nominal floor merely by shrinking assets.

The CBA presented the reform as a way to deepen financial intermediation, improve

efficiency, and make the banking system more resilient. Its contemporaneous annual report stated that "the raising of the level of capital will enhance the role the banking system plays in developing the economy."[5] The CBA later predicted that "higher capital level assumes an expansion of lending by banks, particularly in terms of long-term and large loans."[6] The Armenian authorities also expected consolidation to increase buffers and generate economies of scale.[7] Thus, policymakers expected more equity not only to increase safety, but also to expand intermediation.

This design differed from the Basel-style regulation already operating in Armenia. Banks were required to maintain total regulatory capital of at least 12% of risk-weighted assets, and this requirement remained after the nominal floor was introduced. A bank can satisfy a higher ratio by increasing equity or by reducing risk-weighted assets through asset sales, slower lending, or portfolio reallocation. This flexibility is central to the leverage-ratchet mechanism and helps explain why ratio increases often produce balance-sheet contraction rather than substantial equity issuance Admati et al. (2018); Juelsrud and Wold (2020). Policymakers abroad recognized the same tradeoff. Lorenzo Bini Smaghi of the European Central Bank described the concern that tighter requirements could produce "active shedding of loans ... something akin to a credit crunch."[8] Michael Barr of the Federal Reserve similarly noted that greater reliance on equity "could raise the private costs of funding to the bank."[9]

The Armenian reform therefore provides a different experiment. For banks below AMD 30 billion, reducing assets could improve the Basel ratio but could not close the gap to the floor. Compliance required an increase in nominal equity or exit through consolidation. We use each bank's distance from the floor at announcement to compare banks facing different required equity increases under the same aggregate conditions.

[5]See here.
[6]See here.
[7]See here.
[8]See here.
[9]See here.

2.2 Data

We combine several administrative data sources for the analysis. We collect bank balance sheet entries and income statements from the Central Bank of Armenia. We observe detailed monthly information on all regulated banks in Armenia from 2009 to 2026. Specifically, we observe equity by tiers, assets, deposits by type, loans by type, reserves, liquid assets, etc. We merge balance sheets with income statements to calculate ROA, profits, and franchise value. We add bank regulatory ratios to the data.

We collect detailed monthly credit registry data on almost 6,500 corporate borrowers from 1995 to 2024. The registry details the contract amounts, dates, disbursed amounts, risk profiles, interest rates, and defaults. Many firms borrow from multiple banks, which allows us to use Khwaja and Mian (2008) fixed effects to isolate loan supply from demand. Some loans are issued to foreigners and are denominated in different currencies. We express all lending quantities in AMDs for comparability.

We collect monthly deposit transaction data on almost 90 thousand depositors starting in 2006 and ending in 2021. The data allows us to observe deposit amounts, types, deposit rates, and currencies at the branch level. Although we use branch-level variation to account for local market power, Figure A.1 in the Appendix shows that Armenian banking is highly concentrated in Yerevan. We supplement deposit transactions with macroeconomic data – importantly, with the Central Bank policy rates. We use the rates to construct deposit spreads as the difference between policy rates and deposit rates, following Drechsler et al. (2017).

Finally, we use tax filings to collect firm-level data on more than 7,111 firms. We cover most firms appearing in the credit registry. For each firm, we observe its active status, assets, employment, investments (measured as fixed assets), revenues, and wages. The data are annual and are available from 2011 to 2024. Combined with credit registry, firm-level data allow us to quantify the impact of the reform on the real economy and track reallocation patterns of the borrowers depending on their characteristics.

Table 1 shows the summary statistics from the data. Bank equity increased after the

reform, including equity-to-assets ratios. Banks' assets have also grown. The number of banks declined from 21 to 17 because 4 of the affected banks were taken over by unaffected banks. We address the mergers by combining merged banks before the reform, but the results are robust if we simply drop the merged banks, as we show in Appendix Figures A.21-A.26.[10] Total bank lending is expanding, and interest rates are falling in the aggregate with limited changes to non-performing loans. Bank deposit amounts also rise, while deposit rates slightly decline. Finally, firm-level outcomes change – employment and revenues rise, while investments fall.

2.3 Empirical strategy

We use several strategies for the analysis. We start by splitting banks into the affected (or treated) banks and unaffected (or control) banks. The treated banks are the ones whose equity was below 30 Bn AMD as of December 2014. The control banks are the banks that already had sufficient equity before the reform announcement. We report the difference-in-differences results in Appendix Figures A.12-A.15.

To evaluate how the amount of raised *equity*, not just the requirement to raise it, affects banks and the real economy, we explore heterogeneity in the banks' treatment. Specifically, we measure how far the bank was from having 30 Bn AMD in equity as of December 2014. We define the variable as

$$Gap_b = \frac{\max\{30\text{Bn} - E_{bk},\, 0\}}{A_{bk}} \tag{1}$$

where E_{bk} is total equity of bank b in month k, which is December 2014. A_{bk} is total assets of bank b in December 2014. The *equity gap* then measures the distance between actual equity and required equity scaled by assets. For unaffected banks, $Gap_b = 0$, by construction.

Our main bank-level specification is a monthly event study:

[10] For this and other robustness tests, we show only robustness of the main results. Other figures are available upon request.

Table 1: Summary Statistics: Main Datasets

	Before reform		After reform	
	Mean	Std. dev.	Mean	Std. dev.
Panel A: Banks				
Total equity (bn. AMD)	25.7	14.0	40.7	14.6
Total assets (bn. AMD)	164.7	108.2	254.1	175.3
Equity to assets (%)	19.6	11.2	21.4	13.2
Deposits to assets (%)	48.2	15.1	52.8	15.7
Loans to assets (%)	55.4	11.8	51.0	13.4
Number of observed banks	21		17	
Panel B: Credit registry				
Contracted amount (mn. AMD)	124.4	2,896.8	231.6	9,780.2
Disbursed amount (mn. AMD)	164.8	2,494.9	186.5	1,202.4
Outstanding balance (mn. AMD)	8.7	280.9	15.8	174.4
Annual interest rate (%)	10.0	6.8	8.1	5.3
NPL indicator	0.0	0.2	0.0	0.1
Number of observed borrowers	6,477		6,265	
Panel C: Deposits				
Deposit amount (mn. AMD)	1.9	62.1	2.0	12.5
Annual deposit rate (%)	12.0	2.0	9.8	2.3
Deposit spread (percentage points)	-4.3	2.1	-3.8	2.3
Number of observed depositors	73,031		89,594	
Panel D: Firms				
Employees	38.0	214.9	46.9	241.9
Revenue (mn. AMD)	845.2	6,671.6	1,275.4	8,429.1
Investment (mn. AMD)	720.3	3,191.4	331.5	3,302.8
Number of observed firms	7,111		7,081	

Note: This table provides descriptive statistics for the four main datasets. Panel A reports bank-month balance-sheet observations for banks with a measured December 2014 equity gap. Panel B reports bank-loan originations from the credit registry after the main identifier and bank-loan restrictions. Panel C reports AMD-denominated deposit contracts and amount-change observations; deposit spreads equal the CBA refinancing rate minus the deposit rate. Panel D reports annual outcomes for firms linked to borrowers with valid pre-announcement credit exposure. Before reform announcement covers January 2013–December 2014; after reform implementation covers January 2017–December 2018. Entity counts are distinct entities appearing at least once in the corresponding period. Monetary variables are expressed in nominal AMD using the units stated in the row labels.

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}, \tag{2}$$

where Y_{bt} is an outcome for bank b in month t, α_b are bank fixed effects, δ_t are month fixed effects, and T_A is January 2015, the first month after the announcement. The omitted period is December 2014, so each β_τ measures how the outcome of a bank with a larger equity gap changes relative to a bank that already met the requirement and relative to December 2014. The pre-announcement coefficients allow us to assess whether banks with different gaps were already following different trends.

The distinction between the announcement and effective dates is important. We refer to January 2015–December 2016 as the *treatment window*. Banks knew the new floor during this period but were not required to satisfy it until January 2017. They could therefore raise equity gradually, retain earnings, or arrange a merger before the requirement became binding. In the figures, event months 0 through 23 capture adjustment during this window, while event months beginning at 24 capture outcomes after implementation. We show ten months before the announcement, the complete 24-month treatment window, and ten months after implementation. Treating the entire phase-in period as untreated would incorrectly assign anticipatory compliance to the pre-period.

We next study deposit pricing and flows. We aggregate AMD deposit contracts to the bank-region-month level and calculate an amount-weighted deposit rate. We define the deposit spread as $S_{brt} = r_t^f - r_{brt}^D$, where r_t^f is the CBA refinancing rate and r_{brt}^D is the deposit rate offered by bank b in region r. Deposit spread changes are ΔS_{brt}, while deposit flows are measured as $\Delta \log(D_{brt})$. For either outcome, denoted by Z_{brt}, our preferred specification is

$$\begin{aligned} Z_{brt} = \alpha_{br} + \delta_t + \rho Gap_b \times \Delta r_t^f \\ + \sum_{q \in \{A,E\}} \left[\beta_q Gap_b \times Post_t^q + \lambda_q \Delta r_t^f \times Post_t^q + \theta_q Gap_b \times \Delta r_t^f \times Post_t^q \right] + \varepsilon_{brt}, \end{aligned} \tag{3}$$

where α_{br} are bank-region fixed effects and δ_t are month fixed effects. $Post_t^A$ equals one beginning in January 2015, and $Post_t^E$ equals one beginning in January 2017. The code enters the complete interactions, including the lower-order terms in Gap_b, $Post_t^q$, and Δr_t^f. Bank-region fixed effects absorb the level of Gap_b, while month fixed effects absorb the terms that vary only over time. The coefficients β_q capture differential changes in spreads or deposit quantities for banks with larger gaps. The coefficients θ_q capture whether the pass-through of policy-rate changes differs with the gap after announcement and implementation. We also report specifications without month fixed effects and repeat the analysis at the bank-month level.

Aggregate changes in bank lending combine credit supply with changes in borrower demand. For example, a reduction in lending by a high-gap bank may reflect a contraction in its supply, weaker demand among its borrowers, or changes in borrower composition. To separate these forces, we follow Khwaja and Mian (2008) and compare lending by different banks to the same borrower in the same month. We restrict the sample to borrowers with multiple lenders, collapse loan records to the bank-borrower-month level, and estimate the monthly event-study specification

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}, \tag{4}$$

where j denotes the borrower, T_A is January 2015, α_{jt} are borrower-by-month fixed effects, and γ_b are bank fixed effects. December 2014 ($\tau = -1$) is the omitted month, and we use the same event window as in the bank-level analysis. Borrower-by-month fixed effects absorb the borrower's total credit demand and any contemporaneous borrower shock common to its lenders, while bank fixed effects absorb permanent differences across banks. Identification therefore comes from comparing banks with different pre-reform equity gaps that lend to the same borrower in the same month. The pre-announcement coefficients provide a direct assessment of differential trends, while the post-announcement coefficients trace the evolution of credit supply over the treatment window and after implementation. We apply the specification to contracted, disbursed, outstanding, and

repaid amounts and shares, as well as loan rates, maturity, non-performing status, and risk scores. For each credit measure, the share is the amount attributable to bank b divided by the borrower's total amount across all lenders in month t.

Finally, we estimate firm-level event studies. A firm's exposure is the weighted average of its lenders' equity gaps immediately before the reform:

$$Exposure_j = \sum_b w_{jb,2014} Gap_b, \qquad w_{jb,2014} = \frac{Credit_{jb,2014}}{\sum_{b'} Credit_{jb',2014}}. \tag{5}$$

The weights use credit relationships that were outstanding in December 2014, including loans originated before 2013 that remained active at announcement. This fixes firms' lender exposure before banks begin adjusting to the policy. We then estimate

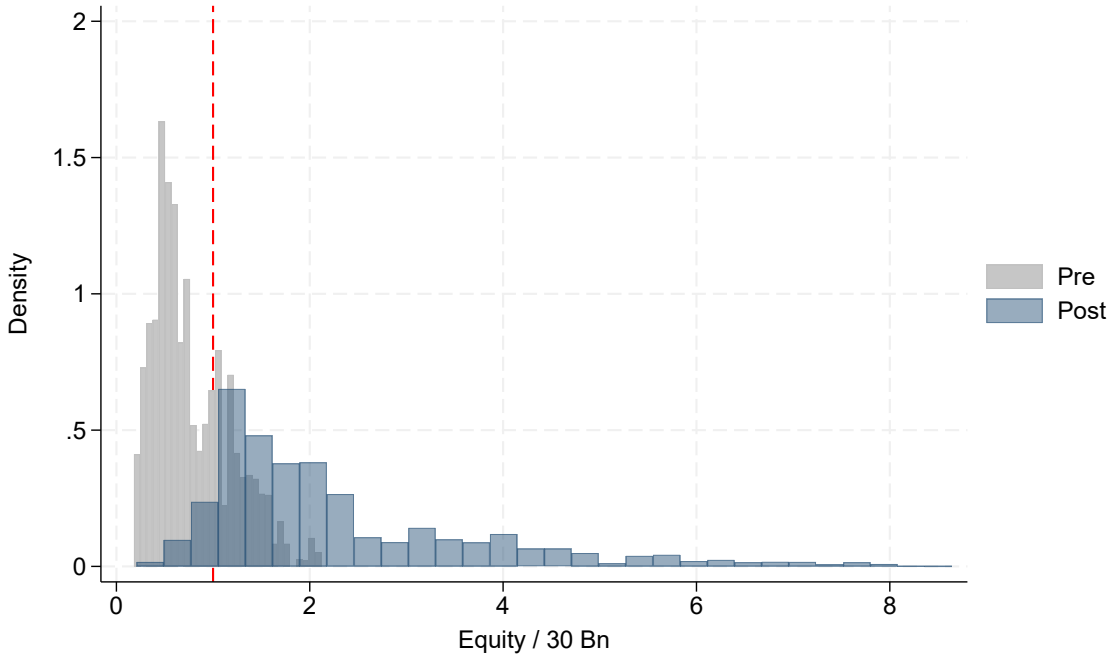
$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}, \tag{6}$$

where Y_{jt} is an annual firm outcome, μ_j are firm fixed effects, and η_t are year fixed effects. The omitted year is 2014. We use this specification for firm activity, employment, hours, wages, revenue, investment, and assets, as well as firm-level credit and lender-substitution outcomes. The pre-announcement coefficients test whether firms with different lender exposure were already on different trends; the post-announcement coefficients trace how their outcomes evolve as exposed banks raise equity.

3 Impact of equity reform on banks

Before exploring how the increased equity impacts the real economy, we ask how banks respond. We first analyze bank balance sheet changes in response to the reform, depending on how far the banks were from complying with the reform. Then, we ask if bank profitability and deposit pricing have changed. Finally, we isolate lending supply using the credit registry and explore how banks' lending has evolved.

Figure 1: Equity Relative to 30 Bn AMD



Note: This figure plots the distribution of equity divided by 30 Bn AMD before and after the reform. The gray bars show the distribution before the reform, while the blue bars show the distribution after the reform. A small number of banks below the required amount after the reform are the banks that merged. We do not include them in our analysis on their own.

3.1 Balance sheets

First, we run bank-level event studies defined in equation (2). Note that the treatment was not staggered and there are no control variables included besides the fixed effects, so it is not necessary to use Callaway and Sant'Anna (2021) or similar methods for estimation. The main explanatory variable is Gap_b defined in equation (1). Figure 1 shows the distribution of equity divided by 30 Bn AMD before and after the reform. It is clear that many banks were far from 30 Bn AMD, but after the reform most banks complied, with the exception of 4 banks that decided to be taken over by larger banks. Interestingly,

Banks raised equity through a variety of strategies, including additional contributions from existing shareholders, share placements with new investors, and public offerings. For example, Converse Bank received approximately AMD 7 billion from existing sharehold-

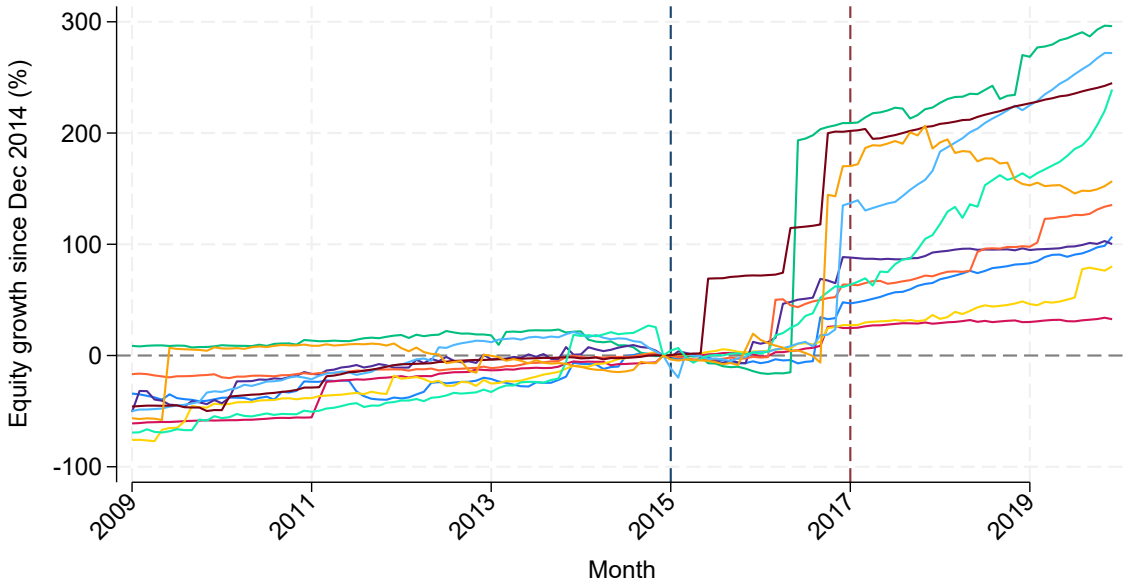
ers in 2016, comprising AMD 6.6 billion from Advanced Global Investments and AMD 0.4 billion from the Armenian Apostolic Church. Anelik Bank instead attracted a new investor, FISTOCO Ltd, whose AMD 21.8 billion subscription to newly issued shares gave it a controlling stake of approximately 59.7%. Financing choices differed across banks: some retained their existing ownership structure, while others accepted substantial ownership changes or accessed public equity markets, as Unibank did through its December 2015 IPO.

Figure 2 accordingly shows the evolution of equity in treated banks. All banks complied within the two-year period between the announcement and the effective date of the reform. Importantly, the transition is smooth for most banks; e.g., banks usually did not raise all the remaining equity at once, but instead did it gradually. As Figure 1 already shows, even unaffected banks raised equity, partly because they acquired some of the affected banks, and partly because of the influx of investors. Figure A.2 in Appendix A shows the evolution of equity for unaffected banks. Importantly, they did not raise equity abruptly within the two years given by the Central Bank, thus creating a natural discontinuity, which we are exploring in the event studies.

We explore the impact of the equity reform on bank-level variables. We start by showing how equity and equity-to-assets change. A ratio-based requirement increase often moves only equity-to-assets but not equity. Figure 3 shows the results. Banks with a larger equity gap increase equity by more, as Panel (a) shows. Similar to the ratio reform, the equity-to-assets ratio also rises, as Panel (b) shows, but this increase is driven by the rise of equity, not by the contraction of assets.

We should note that the standard errors throughout the paper are heteroskedasticity-robust and not clustered. The reason is that we only have 17 banks, which is less than the acceptable minimum number of clusters (Petersen (2009); Abadie et al. (2022)). In Appendix Figures A.19-A.20, we follow Bertrand et al. (2004) and cluster standard errors at the bank level, while also applying a bootstrap. The standard errors unsurprisingly expand and vary more, but the inference remains unchanged.

Figure 2: Equity Growth by Affected Banks



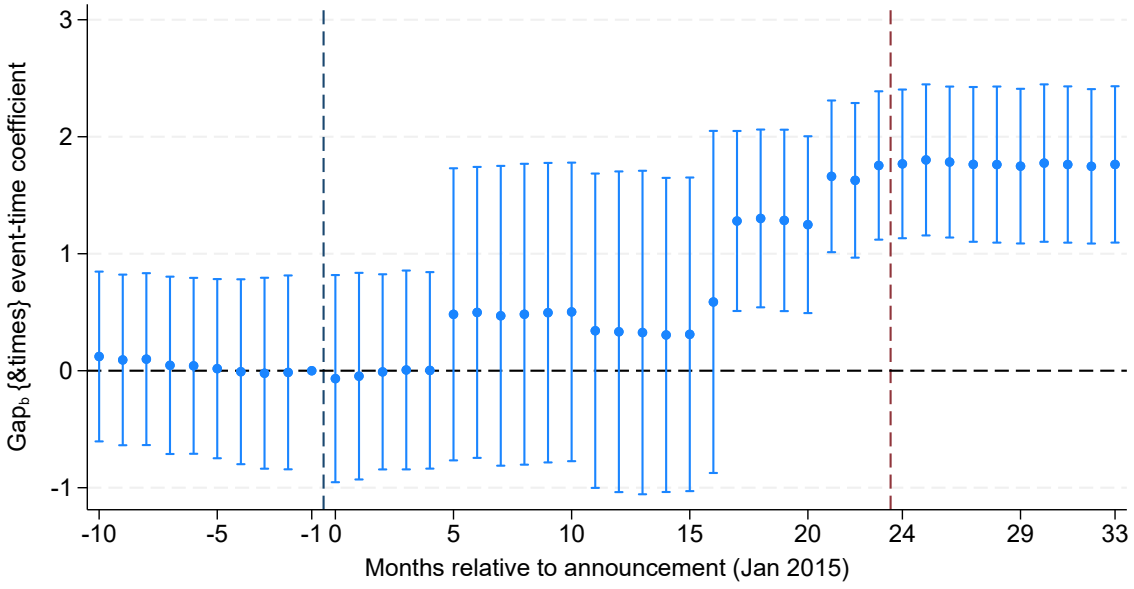
Note: This figure plots the evolution of equity over time for the banks that were affected by the reform. Affected banks are the ones that did not have sufficient equity to comply with the reform as of December 2014. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

An important feature of Basel-type requirements is that they do not simply oblige banks to maintain a 12% equity ratio. They specify the risk level of equity and assign risk weights to assets. This feature usually leads to a rise in the Tier 1 capital ratio. The Armenian reform did not specifically require this, but as we show in Figure A.3 of Appendix A, the Tier 1 capital ratio also increases more for the banks whose total equity was farther from 30 Bn AMD.

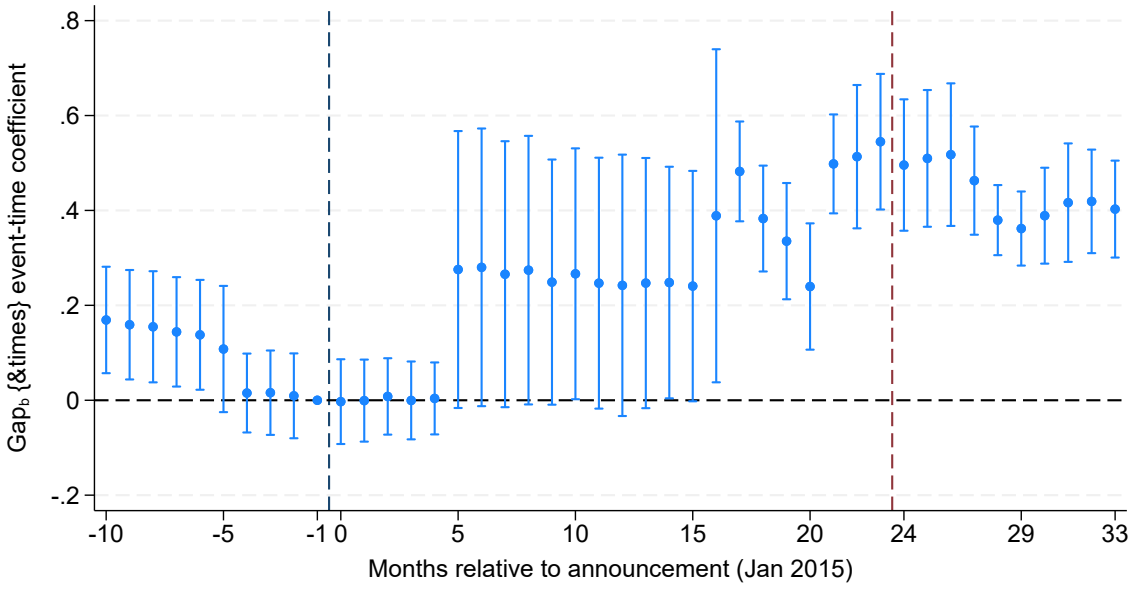
Having established that banks comply by increasing their equity, and that the response of the equity ratio is also qualitatively similar to the Basel-style reforms, we turn to examine the rest of the banks' balance sheets. Previous papers have documented that in response to Basel-type requirements, affected banks can reduce assets (Admati et al. (2018); Juelsrud and Wold (2020) and cut liquidity (Peek and Rosengren (2000); Gropp et al. (2019); Degryse et al. (2021); Corbae and D'Erasmo (2021)). Hence, the natural next step is to show how an increase in equity affects assets and liquidity. Figure 4 shows that both total assets and the liquidity ratio increase more for the banks with a larger equity gap, contrasting the literature related to the Basel-type constraints. Com-

Figure 3: Impact of the Reform on Equity and Equity Ratio

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Equity



(b) Equity-to-assets

Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the log of equity. Panel (b) shows the results for the equity-to-assets ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

bined with Figure 3, the evidence suggests that banks have satisfied the requirement by exclusively raising equity, and that decision was not endogenous – the Central Bank of Armenia required banks to do it, thus limiting the identification concerns.

Finally, we show how the reform impacted deposits and loans, using bank-level balance sheets. Figure 5 shows the results. Panel (a) implies that the deposits-to-assets ratio declines more for banks with larger equity gaps. This is natural in the setting – banks tilt their capital structure from deposits to equity, following the requirement. The absolute floor then limits the impact of the leverage ratchet effect. Appendix Figure A.5 shows that total deposits and deposit growth also decline in Armenia. Note that there are no pre-trends in the months preceding the announcement, but there is a decline in deposits in early 2014, likely related to an outflow of foreign deposits due to the oil shock. Other borrowing, proxied by non-deposit liabilities, does not show a sustained decline and instead rises modestly later in the sample (Appendix Figure A.6). The deposit outflows therefore do not reflect a persistent contraction across all forms of bank funding.

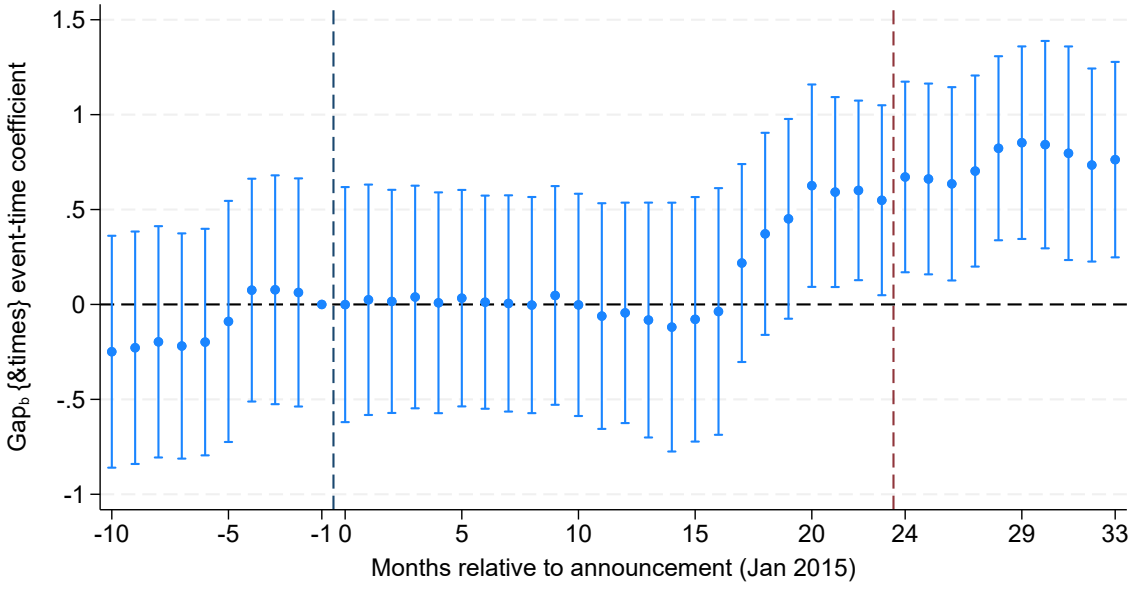
Panel (b) of Figure 5 shows that the loan ratio was steady for the most part, but it declines slightly in 2016. This is also in contrast with the often severe lending contraction observed following the ratio-based equity requirements. The decline is not driven by the reduced number of originated loans, as shown in Appendix Figure A.7. One caveat is that the effects on lending can be driven by both supply and demand. We are addressing this issue in Section 3.3 by including borrower-time fixed effects.

The results above and subsequent findings hinge on having 17 banks in the sample. A relevant concern can be that one or several of the banks are driving most of the results. We produce the estimate after leaving each of the banks out and show that our results are robust and quite tight regardless of the sample. The results are in Appendix Figures A.27-A.32. We also show in Appendix Table A.3 that pre-trends are generally rejected in the event study plots above and in the event study plots in the subsequent analysis.

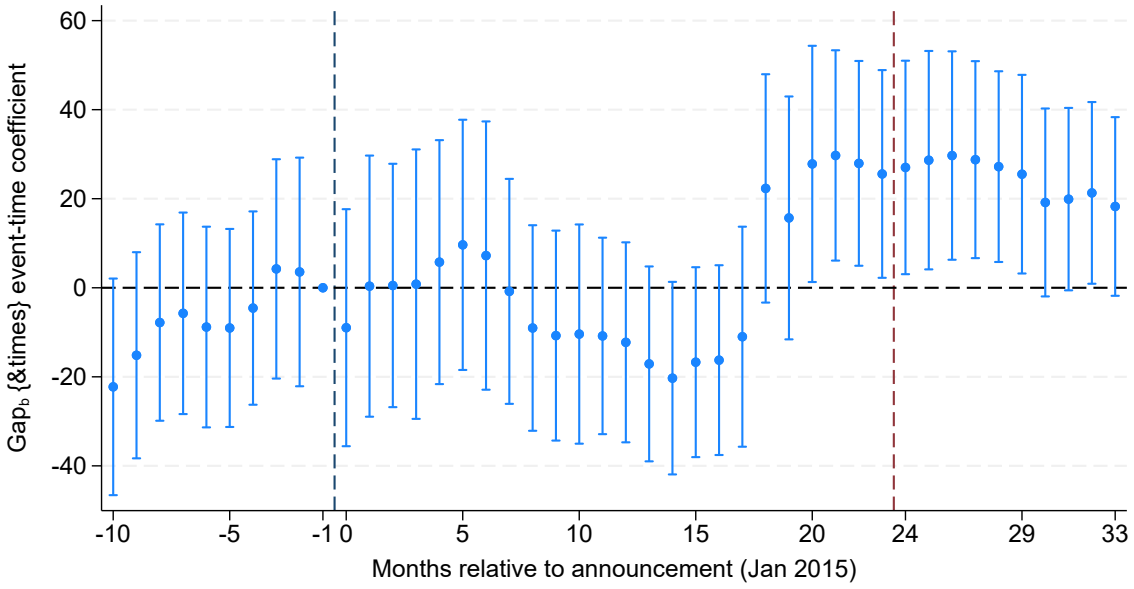
Overall, bank balance sheets respond to the reform. Banks with larger equity gaps

Figure 4: Impact of the Reform on Assets and Liquidity

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Assets

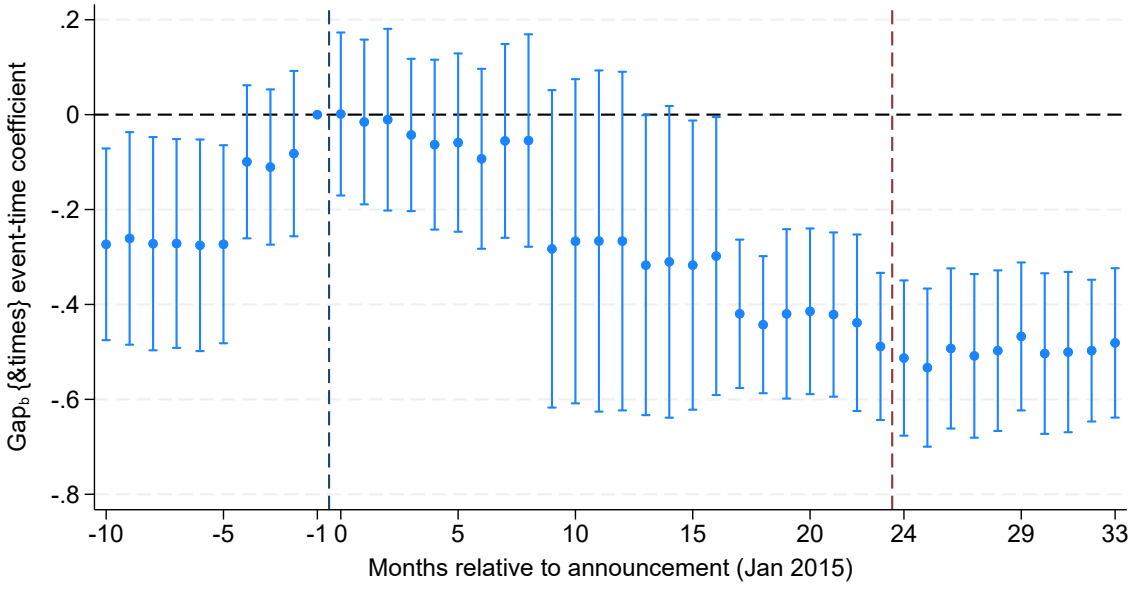


(b) Liquidity Ratio

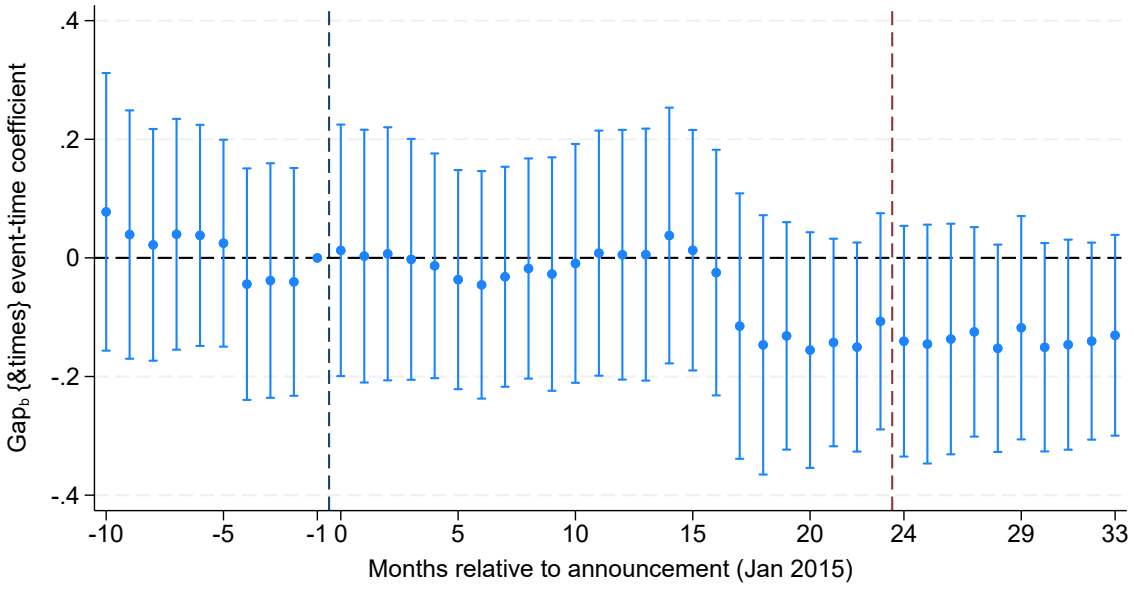
Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the log of total assets. Panel (b) shows the results for the general liquidity ratio, defined as highly liquid assets divided by total assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure 5: Impact of the Reform on Deposits and Loans

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Deposits-to-assets



(b) Loans-to-assets

Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the deposits-to-assets ratio. Panel (b) shows the results for the loans-to-assets ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

raise equity, including relative to assets, but they also increase assets. Furthermore, their deposits-to-assets ratios decline, implying that banks' capital structure is now tilted more heavily towards equity. Finally, there is a relatively limited negative effect on the loans ratio.

3.2 Deposit pricing and profitability

The results in Section 3.1 show that deposits of affected banks decline, while equity rises, thus changing the capital structure of the banks. The ultimate question is whether banks' profitability declines as a result of switching from cheap deposit financing to more expensive equity. This tradeoff is not purely about financing costs: deposits produce valuable liquid claims and deposit-taking can create value jointly with lending (Berger and Bouwman (2009); DeAngelo and Stulz (2015); Egan et al. (2022)). On the flip side of the coin is increased concentration (due to the exit of 4 banks) and increased safety against adverse events.

We start by exploring the effect of the regulation on deposit pricing. Since banks have to raise costly equity, can they compensate by increasing spreads? This can work given the changed competition landscape.[11] We answer the question by exploiting the geographic heterogeneity provided to us by the branch-level deposit transaction data. Table 2 shows that deposit spreads post-announcement start responding moderately more to policy rate changes for banks with a higher equity gap. Importantly, deposits flow out more, but the estimate is statistically insignificant. We do not find comparable effects following the effective date.

Next, we construct two profitability measures to study how banks' profits respond. If safety and higher concentration dominate the more costly capital, the profitability measures should rise. The first measure is banks' ROA, collected from the income statements. The second measure is bank franchise value, following DeMarzo et al. (2025)

[11] Without the changed competition landscape, an increase in deposit spreads would mean that banks were not profit-maximizing before the reform. Since the concentration changes, banks can further increase spreads without losing their depositors (Drechsler et al. (2017, 2021); DeMarzo et al. (2025)).

Table 2: Impact of the Reform on Deposit Spreads and Deposit Flows

$$Z_{brt} = \alpha_{br} + \delta_t + \rho Gap_b \times \Delta r_t^f + \sum_{q\in\{A,E\}} \left[\beta_q Gap_b \times Post_t^q + \lambda_q \Delta r_t^f \times Post_t^q + \theta_q Gap_b \times \Delta r_t^f \times Post_t^q\right] + \varepsilon_{brt}$$

	Deposit spread change		Deposit flows	
	(1)	(2)	(3)	(4)
Δr^f		1.020***		0.063
		(0.041)		(0.041)
Equity gap × Δr^f	−0.202	−0.086	−0.150	−0.065
	(0.810)	(0.812)	(0.809)	(0.817)
Δr^f × PostAnn		−0.851***		−0.227***
		(0.102)		(0.080)
Equity gap × PostAnn	0.692	0.651	−0.665	−0.629
	(0.675)	(0.696)	(0.453)	(0.459)
Equity gap × Δr^f × PostAnn	2.959*	2.518	−0.630	−0.744
	(1.681)	(1.813)	(1.267)	(1.248)
Δr^f × PostEff		0.814***		0.299**
		(0.111)		(0.118)
Equity gap × PostEff	−0.836	−0.785	0.973**	0.969**
	(0.682)	(0.705)	(0.479)	(0.484)
Equity gap × Δr^f × PostEff	−1.254	−0.931	0.485	0.313
	(1.962)	(2.069)	(2.686)	(2.594)
Branch FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Obs.	12,392	12,392	12,402	12,402
R^2	0.112	0.076	0.042	0.004

Note: This table reports the results of the estimation of equation (3). Columns (1) and (2) use deposit spread changes as a dependent variable. Columns (3) and (4) use deposit flows as a dependent variable. Both post-announcement and post-effective dummies are included. Branch and time fixed effects are included. Standard errors are heteroskedasticity-robust and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance levels, respectively.

subject to data constraints. Specifically, we take banks' pre-tax profits, subtract the equity costs, observed from the data, and divide by total assets. Figure 6 shows the results. Neither ROA nor bank franchise value declines, which means the costly capital does not dominate the forces that make affected banks more profitable. If anything, we find a moderate increase in both ROA and bank franchise value without observing significant pre-trends. This result is consistent with evidence that bank capital can be positively related to value (Mehran and Thakor (2011)), while the deposit response is relevant because deposit productivity is a central component of bank value (Egan et al. (2022)). At the same time, increased scale alone need not raise bank value (Minton et al. (2019)), so we interpret the result as reflecting the joint change in safety, deposit pricing, and competition rather than consolidation mechanically. Overall, the evidence points towards banks changing the deposit pricing to adjust to the new capital structure and market concentration, which eventually leads to moderately higher, not lower, profitability.

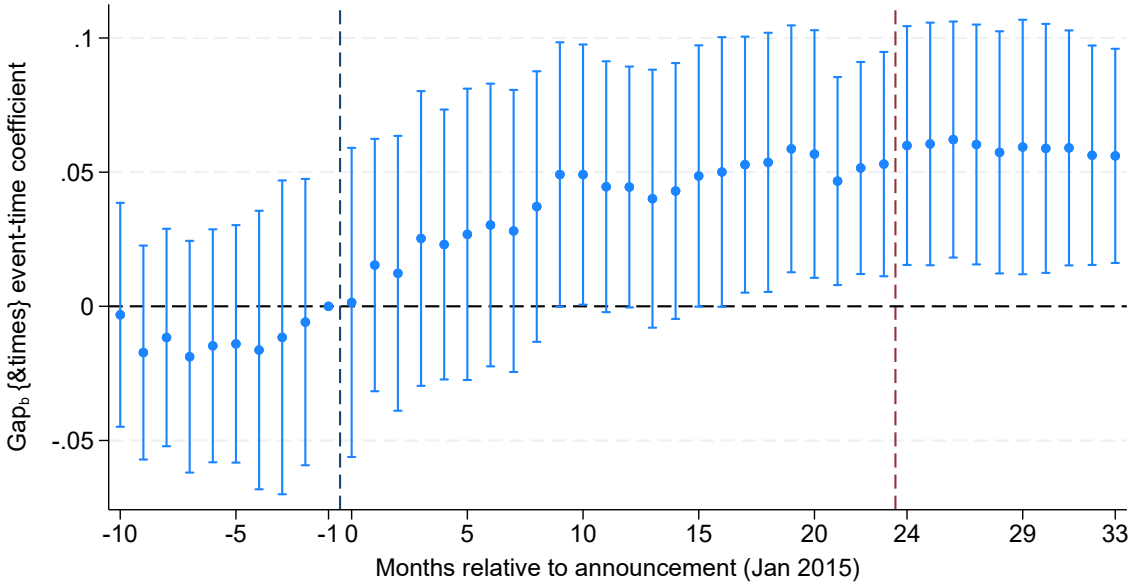
Appendix Figure A.4 reports a complementary measure, return on equity, defined as trailing twelve-month net profit divided by average book equity over the same period. Its post-reform point estimates are positive, although the confidence intervals include zero. Thus, the ROE evidence is consistent with the ROA and franchise-value results, but does not establish a statistically significant increase in returns to shareholders.

3.3 Loan supply

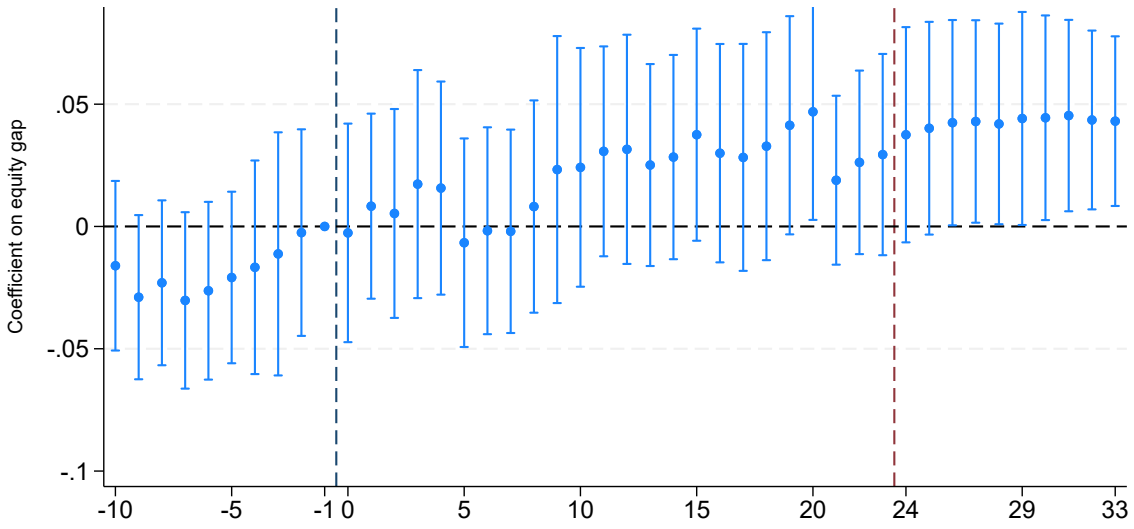
Panel (b) of Figure 5 shows how the loan ratio slightly declines, but not as much as it usually does when equity ratio requirements tighten. That result can be driven by both lending demand and lending supply. In this section, we isolate supply from demand by using the Khwaja and Mian (2008) fixed effects. Identification comes from comparing banks with different pre-reform equity gaps that lend to the same borrower in the same month. This approach is appropriate in our setting because the registry contains substantial and persistent within-borrower-month variation in lenders' equity gaps, as shown in Appendix Figure A.33. We show how the originated (contract) amount and

Figure 6: Impact of the Reform on Profitability

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) ROA



(b) Bank Franchise Value

Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the ROA. Panel (b) shows the results for the bank franchise value, defined as the difference between pre-tax profits and equity costs divided by total assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

disbursed amount change. The latter helps to address the concerns related to changes in undrawn amounts over time.

Figure 7 shows the results. Both disbursed and contracted amounts (in logs) moderately decline after the announcement of the reform in 2015. As before, the decline is not persistent or severe, in contrast with the findings related to Basel-type constraints. We find similar results if we look at loan shares – the amount borrowed by bank b as a share of total borrowing. We show this result in Appendix Figure A.8. We also find a moderate decline in amounts and shares repaid, as we show in Appendix Figure A.9. Finally, Appendix Figure A.10 shows that interest rates charged by banks (controlling for loan demand) moderately rise, while risk scores do not change. This finding points towards the supply explanation.[12]

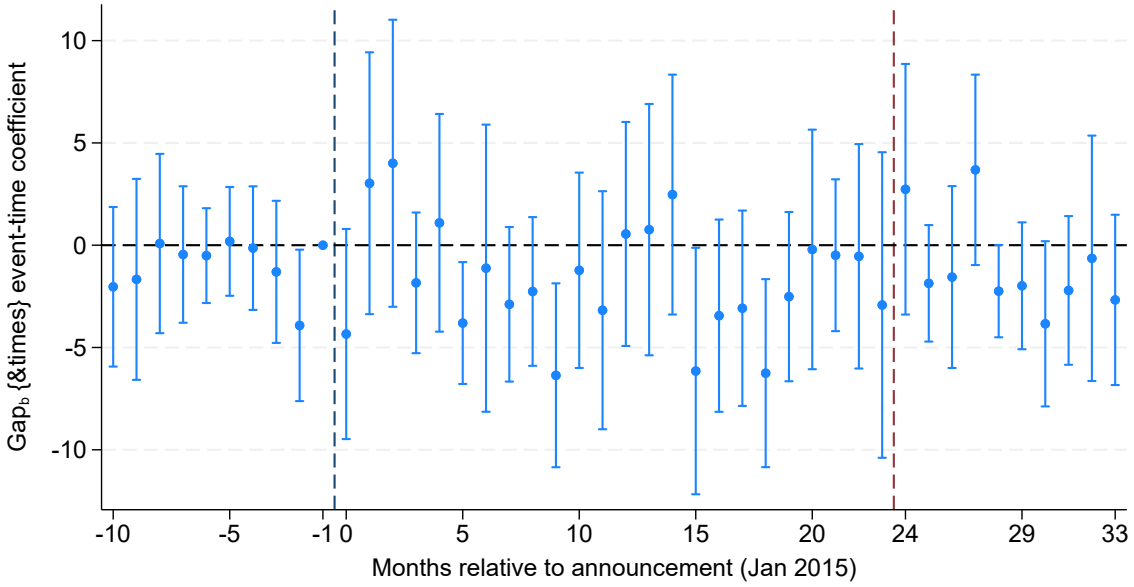
One concern with the standard Khwaja and Mian (2008) estimation is that the sample contains borrower-bank-month observations only when a loan record is observed. It therefore measures the intensive margin conditional on a bank continuing to lend. If a constrained bank stops originating credit to an existing borrower, that borrower-bank-month may disappear rather than enter as zero, potentially understating the contraction and creating selection based on post-reform lending decisions. Appendix Figure A.11 fixes an ex ante set of bank relationships using loans outstanding immediately before the announcement. For months in which a borrower receives credit from at least one pre-existing lender, it retains all of that borrower's pre-existing lenders and assigns zero contracted or disbursed credit to lenders that do not lend that month. We find similar results – even less decline in lending than in Figure 7.

The evidence in this section shows that banks' balance sheets adjust significantly to the equity requirement. Banks tilt their capital structure towards equity, away from deposits. Banks also raise assets and liquidity. Banks' profitability rises, as banks increase deposit spreads to adjust to more concentrated markets with costlier overall capital. Finally, banks reduce lending only moderately, given that there were few incentives to contract assets. In the next section, we consider the impact of the regulation on the real economy by observing the borrowers of the affected and unaffected banks.

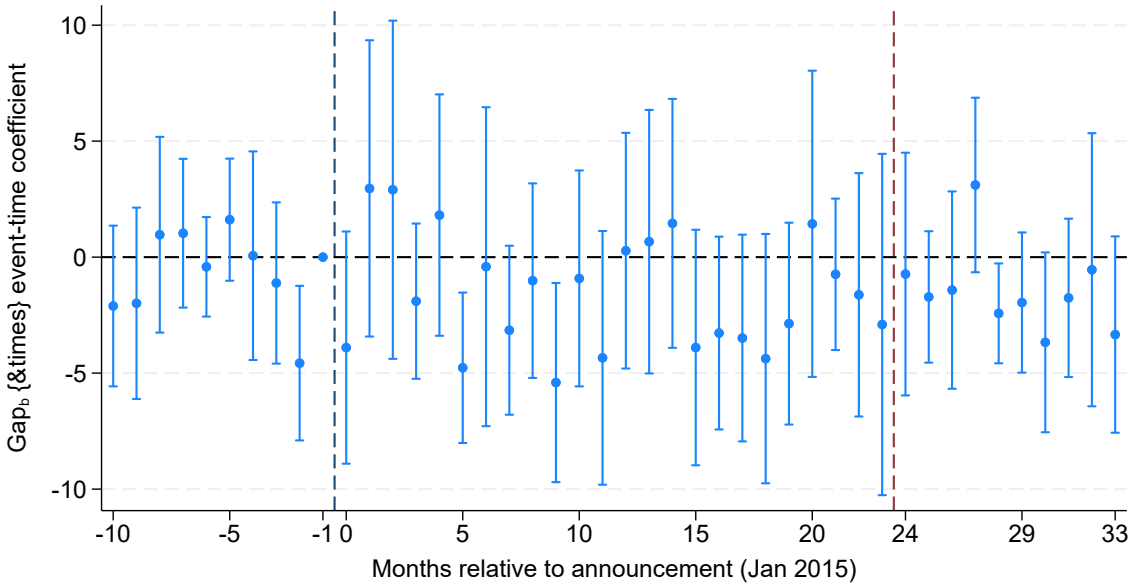
[12] A decline in lending demand would usually lead banks to reduce interest rates.

Figure 7: Impact of the Reform on Loan Supply

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Disbursed Amount



(b) Contracted Amount

Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008). Panel (a) shows the results for the disbursed amount. Panel (b) shows the results for the contracted amount. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

4 Impact of equity reform on real economy

In the previous section, we documented how banks' balance sheets react to the reform. Since there are strong effects on bank funding and asset composition, and seemingly moderate effects on bank lending, a crucial question is the real effects. How does the lending composition of the affected banks change? How do their borrowers respond?

In this section, we answer the questions above by analyzing the firm-level tax data, which allows us to observe the balance sheets and other characteristics of the borrowers from the credit registry. We start by constructing the measure of the borrowers' exposure defined in equation (5). The measure is simply the weighted average of the borrowers' lenders' equity gaps immediately before the reform, so a greater value implies a more intense exposure of the borrower to the reform.

We first test whether borrowers with greater exposure change their borrowing, and then we check how their performance moves. We run the version of equation (6) using the lender shares as a dependent variable. Specifically, we run two regressions – one with the shares of treated lenders and one with the shares of untreated lenders. For both, we use originated lending amounts and include firm and industry-time FEs to account for potential industry differences.[13] We use either the announcement date or effective date as a post dummy. We also include the placebo specification where we assume the announcement date to be in 2013. Note that this specification still includes the real post period, so we expect the results to be significant but much weaker than in the real specifications.

Table 3 shows how the shares of unaffected banks change. The positive coefficients imply that the exposed borrowers increase their share of borrowing from the untreated banks. Table 4 further reveals that the change is a reallocation – banks reduce the relative borrowing from exposed banks and reallocate towards the unaffected banks. This is a unique feature of the Armenian reform – a ratio-based reform might reduce lending more

[13]Note that since the dependent variable is at the firm-time level, we cannot include Khwaja and Mian (2008) fixed effects. In addition, the goal of the firm-level regressions is to show how borrowers reallocate, which isolating loan supply does not allow.

Table 3: Unaffected Bank Lender Shares of Exposed Borrowers

$$Y_{jt} = \mu_j + \eta_{st} + \psi Exposure_j \times Post_t + u_{jt}$$

	Untreated lender share			
	(1)	(2)	(3)	(4)
Firm exposure × Post	1.281***	1.268***	1.269***	0.517***
	(0.083)	(0.079)	(0.085)	(0.093)
Post definition	Ann	Eff	Ann	Placebo
Firm FE	Yes	Yes	Yes	Yes
Sector × Year FE	No	No	Yes	No
Obs.	29,282	29,282	29,059	29,282
R^2	0.021	0.021	0.021	0.002

Note: This table reports the results of the estimation of equation (6) where the dependent variable is the share of unaffected bank loans in total borrowing of the firms. Columns (1) and (3) use the announcement date as the post dummy. Column (2) uses the effective date. Column (4) uses the placebo date of January 2013. Industry-time and firm fixed effects are included. Standard errors are heteroskedasticity-robust and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance levels, respectively.

because all banks are affected. In this case, there are also unaffected banks, which can absorb the remaining lending demand, limiting the negative consequences for the real economy. Importantly, both placebo estimates are much smaller than the real ones, while the difference between the announcement and the effective date is limited, implying the importance of the reform announcement.

The share results alone do not establish whether unaffected banks actively replace the credit withdrawn by affected banks, because the unaffected-bank share could rise mechanically when lending by affected banks falls. Appendix Table A.2 therefore decomposes annual firm disbursements into credit from positive-gap banks and zero-gap banks, using a common sample. Greater pre-reform exposure is associated with a significant increase in disbursements from zero-gap banks, while disbursements from positive-gap banks decline insignificantly. Total disbursements increase at the 10% significance level, and the zero-gap-bank share rises by 1.29 percentage points. Thus, unaffected banks actively expand disbursements to exposed firms rather than merely acquiring a larger share of a shrinking credit pool, helping to reconcile the moderate bank-level lending contraction with the absence of adverse firm-level outcomes.

An increase in borrowing from the unaffected banks can be driven both by an intensive

Table 4: Affected Bank Lender Shares of Exposed Borrowers

$$Y_{jt} = \mu_j + \eta_{st} + \psi Exposure_j \times Post_t + u_{jt}$$

	Treated lender share			
	(1)	(2)	(3)	(4)
Firm exposure × Post	−1.285***	−1.273***	−1.274***	−0.522***
	(0.083)	(0.079)	(0.085)	(0.093)
Post definition	Ann	Eff	Ann	Placebo
Firm FE	Yes	Yes	Yes	Yes
Sector × Year FE	No	No	Yes	No
Obs.	29,282	29,282	29,059	29,282
R^2	0.021	0.022	0.021	0.002

Note: This table reports the results of the estimation of equation (6) where the dependent variable is the share of affected bank loans in total borrowing of the firms. Columns (1) and (3) use the announcement date as the post dummy. Column (2) uses the effective date. Column (4) uses the placebo date of January 2013. Industry-time and firm fixed effects are included. Standard errors are heteroskedasticity-robust and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance levels, respectively.

margin, i.e., an increase in the existing borrowing from the unaffected banks, and by an extensive margin, i.e., borrowing from new lenders. If the explanation is related to reallocation and absorbed demand, we should observe an increase in the share of borrowing from new lenders – banks that did not lend to the exposed borrowers prior to the reform announcement. Table 5 shows the results – the share of borrowing from new lenders increases significantly for more exposed borrowers. The placebo coefficient is much smaller and is insignificant.

To further document that the lending from unaffected banks increases on the extensive margin, we test whether the number of lenders increases. Table 6 shows the results.[14] The number of lenders of more exposed firms rises significantly after the announcement and after the effective date of the reform. We do not find any significant effects in the placebo setting with the post date of January 2013. In Appendix Figure A.16, we also show that the borrowers who moved to unconstrained banks were charged lower rates than the borrowers who were already with unconstrained banks, consistent with the reallocation mechanism. These results complement the relationship-lending evidence:

[14]Since the number of lenders is heavily skewed to one, we use the inverse hyperbolic sine of the measure. Appendix Table A.1 shows that the results are robust to using the log.

Table 5: New Bank Lender Shares of Exposed Borrowers

$$Y_{jt} = \mu_j + \eta_{st} + \psi Exposure_j \times Post_t + u_{jt}$$

	New lender share			
	(1)	(2)	(3)	(4)
Firm exposure × Post	0.156**	0.145**	0.162**	0.014
	(0.069)	(0.067)	(0.070)	(0.081)
Post definition	Ann	Eff	Ann	Placebo
Firm FE	Yes	Yes	Yes	Yes
Sector × Year FE	No	No	Yes	No
Obs.	29,282	29,282	29,059	29,282
R^2	0.000	0.000	0.000	0.000

Note: This table reports the results of the estimation of equation (6) where the dependent variable is the share of new bank loans in total borrowing of the firms. Columns (1) and (3) use the announcement date as the post dummy. Column (2) uses the effective date. Column (4) uses the placebo date of January 2013. Industry-time and firm fixed effects are included. Standard errors are heteroskedasticity-robust and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance levels, respectively.

Table 6: Number of Lenders of Exposed Borrowers

$$Y_{jt} = \mu_j + \eta_{st} + \psi Exposure_j \times Post_t + u_{jt}$$

	Number of lenders			
	(1)	(2)	(3)	(4)
Firm exposure × Post	0.120***	0.153***	0.123***	−0.047
	(0.043)	(0.035)	(0.042)	(0.060)
Post definition	Ann	Eff	Ann	Placebo
Firm FE	Yes	Yes	Yes	Yes
Sector × Year FE	No	No	Yes	No
Obs.	95,318	95,318	94,969	95,318
R^2	0.000	0.000	0.000	0.000

Note: This table reports the results of the estimation of equation (6) where the dependent variable is the inverse hyperbolic sine of the number of lenders. We show the specification with logs in Appendix Table A.1. Columns (1) and (3) use the announcement date as the post dummy. Column (2) uses the effective date. Column (4) uses the placebo date of January 2013. Industry-time and firm fixed effects are included. Standard errors are heteroskedasticity-robust and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance levels, respectively.

concentrated relationships improve credit availability, but access to multiple banks insulates borrowers when an incumbent relationship is disrupted (Petersen and Rajan (1994); Degryse et al. (2011)).

The next step is to see how lending by the affected lenders changes. We find in Section 3.3 that lending declines but only moderately. This means that the affected lenders retain

Table 7: Credit Reallocation of the Affected Lenders

$$Y_{jt} = \mu_j + \eta_t + \psi Exposure_j \times Post_t + u_{jt}$$

	(1) Size	(2) Productivity	(3) Bank dep.	(4) Leverage
Firm exposure × Post	−1.982	1.635	−0.710	−2.440
	(1.694)	(1.648)	(1.626)	(1.802)
Firm exposure × Post × High	4.411**	−0.785	4.146*	5.195**
	(2.161)	(2.114)	(2.223)	(2.315)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Year	Year	Year	Year
Obs.	53,137	56,084	46,133	46,236
R^2	0.000	0.000	0.002	0.003

Note: This table reports the results of the estimation of equation (6) where the dependent variable is the share of affected bank loans in total borrowing of the firms. We interact the explanatory variable with a dummy equal to one if the selected characteristic is above the median. Column (1) uses firm size (employment). Column (2) uses bank dependence, measured as the amount borrowed from banks in the past. Column (3) uses productivity, measured as revenues divided by size. Column (4) uses leverage. Time and firm fixed effects are included. Standard errors are heteroskedasticity-robust and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance levels, respectively.

many borrowers. To understand what type of borrowers is more likely to stay with the affected lenders, we regress the affected lender share (as in Table 4), but we also interact the explanatory variable with the dummy equal to one if the selected characteristic is above the median. We consider the size, bank dependence, leverage, and productivity, defined as revenues divided by employment. The literature (e.g., Chang et al. (2023)) suggests that the affected lenders should reallocate towards "safer" firms, e.g., in our case, larger, more bank-dependent, and levered firms. Table 7 confirms the results – affected lenders reallocate towards larger, more bank-dependent, and more levered firms. They do not reallocate towards more productive firms.

The reallocation we document implies that while exposed borrowers move towards unconstrained banks, treated banks lend more to safer but not necessarily more productive firms. This is likely because the funding structure is now heavily tilted towards equity and away from deposits. Deposits are known to have synergies with loans (Kashyap and Stein (2000); Kashyap et al. (2002)), so if banks substitute away from deposits to equity, the synergies likely decline. To match the liquidity profile, banks reallocate towards safer

assets, such as highly liquid securities (as shown in Figure 4) and loans to larger and more bank-dependent firms.

The literature exploring the effects of Basel regulations has demonstrated how borrowers lose from the equity requirements (Chodorow-Reich (2014); Gropp et al. (2014)). This is partly due to the fact that all banks are affected by the change. In the case with an absolute equity floor, however, there are unconstrained banks who absorb parts of the remaining loan demand. We then should not observe negative effects of the reform on borrowers' activity, investments, and employment.

Figures 8 and 9 show the results for the borrowers' active status, employment, and fixed assets, respectively. We find that the exposed firms are more likely to remain active, potentially because they are reallocated to more stable lenders. We also find no adverse impact on employment, unlike Chodorow-Reich (2014). Finally, exposed firms appear to invest more – their fixed assets rise. This result is consistent with the channel studies in Amiti and Weinstein (2018). In Appendix Figure A.17, we also show no adverse impact of the reform on operating revenues and wage funds.

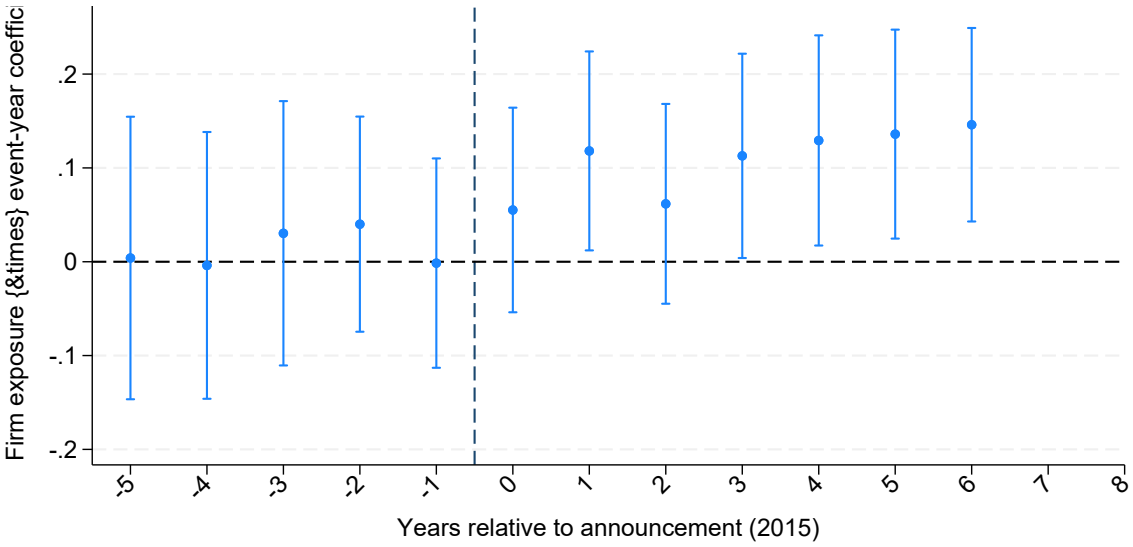
Overall, this section shows how borrowers adapt to changes in the equity composition of banks. We find that the borrowers of affected lenders move to borrow from more lenders and increase their share of borrowing from the unaffected banks. Affected banks, in turn, lend more to larger and more bank-dependent firms, but do not lend more to more productive firms. Finally, the exposed borrowers do not perform worse – their activity and investments rise, and their employment, revenues, and wage funds do not decline. These allocation margins matter for efficiency of the economy, as documented in the literature (e.g., Hsieh and Klenow (2009); Midrigan and Xu (2014)). In the next section, we show one potential adverse consequence of the absolute equity floor.

5 New bank entry

A ratio-based constraint requires banks to hold 12% equity. This means that new entrants with 10 billion AMD of assets will need 1.2 billion AMD of equity to start. The absolute

Figure 8: Impact of the Reform on Borrowers' Activity

$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}$$



Note: This figure plots the results of the event study estimation of equation (6), where the dependent variable is a dummy equal to one if the firm is still active as of 2025. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

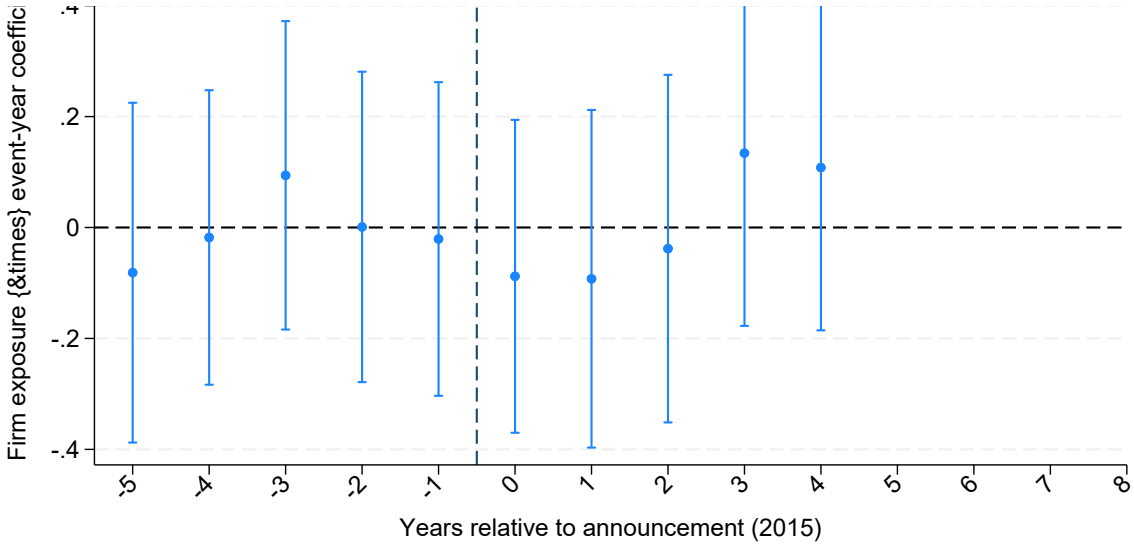
equity floor requirement changes the picture. New entrants would need at least 30 billion AMD of equity to enter, thus creating significant obstacles to entry.

This problem is especially relevant as FinTech lenders are growing to compete with traditional banks (Buchak et al. (2018); Fuster et al. (2019); Irani et al. (2021); Acharya et al. (2026)). Technology-based lenders can process applications faster and respond more elastically to credit demand without necessarily producing worse loan performance (Fuster et al. (2019)). In developed countries, such lenders often opt to undergo regulation to obtain deposit insurance and government protection, rather than operating as a non-bank. A prominent example is Nubank in Brazil, which quickly became one of the largest depositary institutions in Brazil and was responsible for promoting technological development in banking across Latin America.

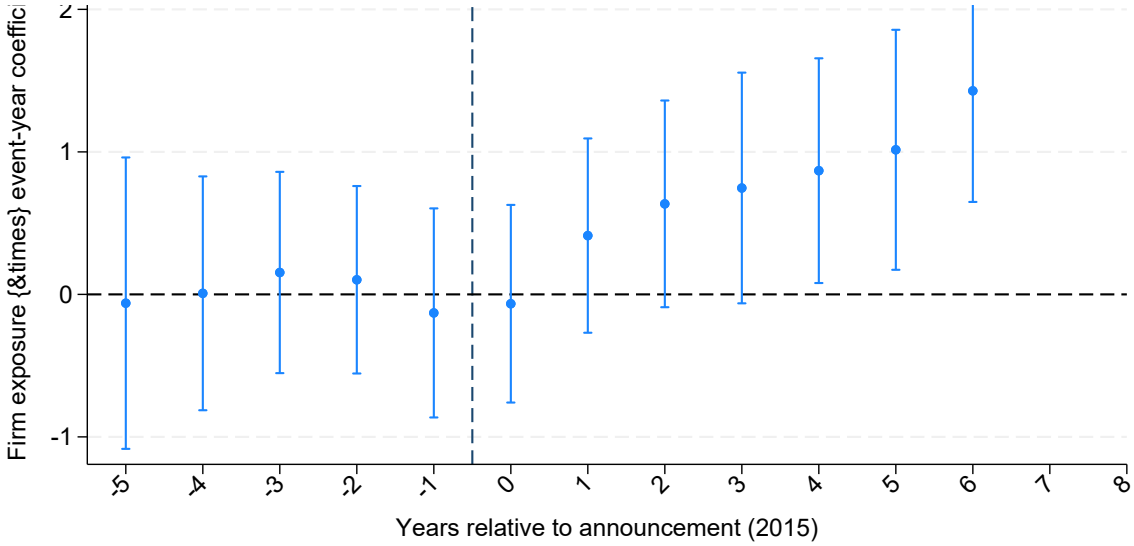
We begin with a broad donor pool of transition economies in Eastern and Southeastern Europe, the Baltics, and the Caucasus, without selecting countries based on

Figure 9: Impact of the Reform on Borrowers' Size and Investments

$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}$$



(a) Log Employment



(b) Log Fixed Assets

Note: This figure plots the results of the event study estimation of equation (6). Panel (a) shows the results for the log of employment. Panel (b) shows the results for the log of fixed assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

their post-2014 FinTech outcomes. Within this pool, comparability is determined by pre-reform economic development, population, banking-sector size, macroeconomic con-

ditions, digital adoption, and FinTech entry. We retain only countries for which we can construct a complete history of FinTech entry and observe the pre-reform predictors; countries with partial or uncollected licensing histories are not treated as having zero entry. The resulting donor pool consists of Albania, Bulgaria, Croatia, Estonia, Georgia, Latvia, Lithuania, Moldova, Montenegro, Romania, and Slovenia.

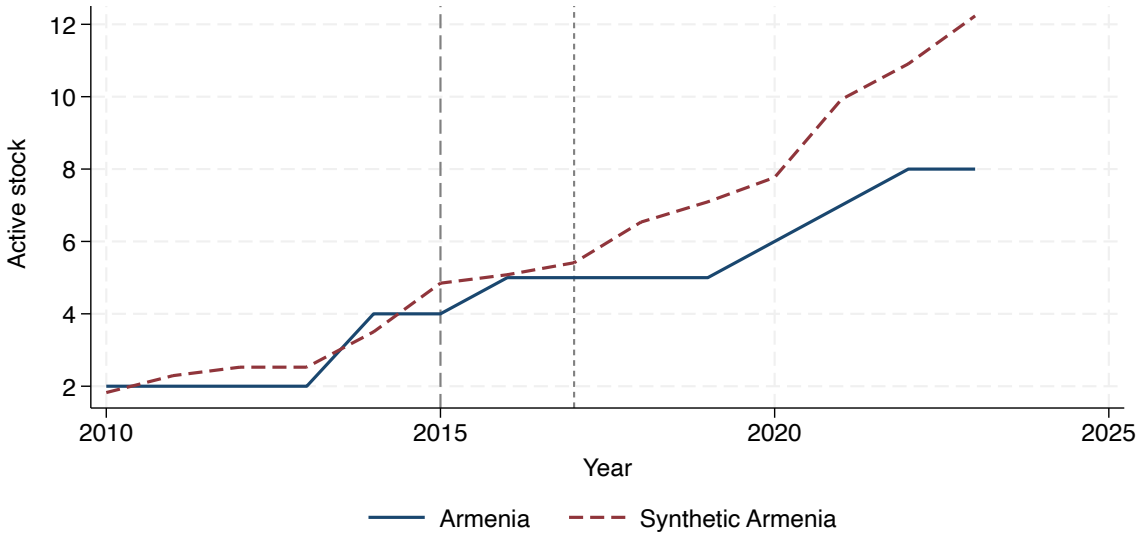
We hand-collect the FinTech outcome from national regulatory registers and the European Banking Authority's register of payment institutions. At the entity level, we record the institution's name and type, authorization date, and, when applicable, revocation date. The outcome in Figure 10 is the year-end active stock of licensed payment institutions, electronic-money institutions, and the corresponding Armenian payment-service organizations. An institution enters the stock in its authorization year and is excluded beginning in its revocation year; narrower regulatory categories, such as small payment institutions and account-information service providers, are not included. GDP per capita, inflation, population, unemployment, and real GDP growth come from the Global Macro Database. Internet use, mobile subscriptions per 100 people, private credit relative to GDP, and exchange rates come from the World Bank's World Development Indicators, while the number of commercial banks comes from the IMF's Financial Access Survey series downloaded through FRED. Exchange-rate depreciation is the annual percentage change in local currency per U.S. dollar.

We estimate the synthetic control using 2010–2014, the period preceding the reform announcement. The predictor vector includes the FinTech stock in each pre-reform year and the 2010–2014 average of each country characteristic listed above. After standardizing the predictors, we choose nonnegative country weights that sum to one and minimize the squared distance between Armenia and the weighted donor countries,

$$\widehat{W} = \underset{w_j \geq 0, \sum_j w_j = 1}{\arg\min} \left\| X_A - \sum_j w_j X_j \right\|^2 . \tag{7}$$

We then hold these weights fixed after 2014 and calculate the counterfactual outcome as $Y_{At}^S = \sum_j \widehat{w}_j Y_{jt}$. This approach follows Abadie and Gardeazabal (2003); Abadie et al.

Figure 10: FinTech Entry in Synthetic Armenia



Note: This figure plots the FinTech entry in real Armenia and compares it to the FinTech entry in the counterfactual Armenia without the absolute floor equity reform. The dashed red line is the FinTech active stock in the synthetic Armenia, constructed from the data from comparable countries, following the methodology of Abadie and Gardeazabal (2003). The solid blue line is the active stock in real Armenia. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

(2010) and is closely related to more recent synthetic comparison estimators such as Arkhangelsky et al. (2021).

Figure 10 shows that synthetic Armenia closely tracks the Armenian FinTech stock before the announcement. The two series also remain close through 2016. They begin to separate around the reform's effective date: Armenia has five active providers in each year from 2017 through 2019, while the synthetic stock rises from 5.4 to 7.1. The difference continues to widen thereafter. By 2023, Armenia has eight active providers, compared with 12.2 in synthetic Armenia. Thus, the figure provides descriptive evidence that FinTech entry would have been higher in the absence of the absolute equity floor, although the comparison cannot by itself rule out other Armenia-specific changes after 2015.

We also show that the results do not depend critically on any of the donors. In Appendix Figure A.34, we take the donors with the largest weights and drop them one by one to recalculate the FinTech entry in synthetic Armenia. We find that the results

are highly robust, indicating that the list of countries selected to resemble Armenia does not explain the results.

This result suggests that a downside of the reform is a higher entry barrier, which can impede FinTech development in Armenia.[15] A ratio requirement instead scales the required equity with an entrant's assets rather than imposing the same nominal minimum at every scale. A natural question is how these different forms of regulation affect incumbent recapitalization and entry. We build a dynamic banking model to study such counterfactuals in the next section.

6 Dynamic banking model

The empirical results demonstrate how banks in Armenia raise equity without cutting assets. Lending contracts modestly within affected borrower relationships, while banks accumulate liquid assets and reallocate credit towards safer borrowers. Since a group of banks is untreated, it absorbs part of the lending demand, implying movements of the borrowers of treated banks to unaffected banks. However, there are also adverse consequences of the regulation, such as higher barriers to entry and lower deposit franchise value of treated banks. In this section, we build a dynamic banking model to consider the effect of the reform relative to counterfactual scenarios where the equity ratio constraint increases or where the equity ratio increases in conjunction with the requirement to raise equity.

6.1 Set-up and solution

The model is a dynamic banking framework where banks choose deposit and loan rates and equity subject to entry/exit frictions, deposit demand, and loan demand, following Corbae and D'Erasmo (2021). We also introduce junior claim retirement and subsequent transfers to shareholders, following Admati et al. (2018), to rationalize the decline in

[15] Our conversations with CEOs of some of the largest banks in Armenia confirm this concern.

assets after the ratio-based requirements are introduced. The goal is to discipline the intensive and extensive margins through which a higher equity requirement affects bank balance sheets, credit, deposit pricing, and borrower reallocation.

Banks and balance sheets. There is a policy asset with gross return $1 + r^0$, a fixed set of incumbent bank identities $i \in \mathcal{I}$, a unit mass of depositors, and borrower segments indexed by their incumbent lender. At the beginning of a period, bank i has net worth k and deposit capacity d. Conditional on operating, it chooses a deposit rate r_i^D, a loan rate r_i^L, and end-of-period book equity E_i. Banks' deposits and loans are determined by the deposit and loan demand given the rates, respectively. Banks' total assets and liquid assets are determined by the balance sheet identity:

$$A_i = E_i + D_i = L_i + B_i, \qquad B_i \geq 0. \tag{8}$$

Regulation imposes an equity-to-assets requirement κ and, in the Armenian reform, an absolute equity floor $\bar{E}$:

$$E_i \geq \kappa A_i, \qquad E_i \geq \bar{E}. \tag{9}$$

When we perform the counterfactual analysis, we will change the value of κ, and we will switch the absolute equity floor requirement on and off.

Deposit demand and deposit capacity. Let ξ_i^D denote bank i's time-invariant deposit-quality intercept and let D_{i0} denote its pre-policy non-equity funding. The intercept reflects time-invariant bank qualities valued by depositors (following Egan et al. (2017), Egan et al. (2022), and Wang et al. (2022)) and it is distinct from the quantity-valued deposit-capacity state d. This demand system captures the idea that deposit production is a valuable banking activity rather than merely a source of cheap financing (Berger and Bouwman (2009); DeAngelo and Stulz (2015)). The state shifts bank i's

deposit utility according to

$$v_i^D(d, r_i^D) = \xi_i^D + \log\left(\frac{d}{D_{i0}}\right) + \alpha_D(r_i^D - r^0). \tag{10}$$

The first term in (10) reflects the time-invariant bank characteristics, the third term reflects the impact of deposit spreads on the demand, and the second term is a demand shifter in line with Egan et al. (2022). With type-I extreme-value preference shocks and deposit-market size M_D, bank i receives

$$D_i(r_i^D; d, \mathbf{r}_{-i}^D, \mathcal{I}) = M_D \frac{\exp\{v_i^D(d, r_i^D)\}}{1 + \sum_{j\in\mathcal{I}} \exp\{v_j^D(d_j, r_j^D)\}}, \qquad D_i \le d. \tag{11}$$

The outside option is the policy asset and has normalized utility zero. The deposit spread is $s_i^D = r^0 - r_i^D$.

The empirical funding process follows Corbae and D'Erasmo (2021) and is estimated monthly. If ρ_m is monthly persistence, the annual persistence used in the dynamic program is $\rho_a = \rho_m^{12}$. The annual state transition is

$$\log d' = (1 - \rho_a)\log D_{i0} + \rho_a \log d + \sigma_i^a \epsilon', \qquad \epsilon' \sim \mathcal{N}(0, 1). \tag{12}$$

There is no aggregate shock. This distinction matters because the model period is one year even though the persistence parameter is identified from monthly data.

Loan demand and lender switching. Borrowers belong to segments $m = 0, 1, \ldots, |\mathcal{I}|$. Segment $m = i$ contains borrowers attached to bank i, while segment zero contains new borrowers and has no incumbent lender. A borrower in segment m obtains deterministic utility

$$v_{i|m}^L = \xi_i^L - \alpha_L r_i^L - \tau \mathbf{1}\{m \neq 0,\ i \neq m\} \tag{13}$$

from bank i. Borrowers' demand reacts to the bank-specific quality shock, ξ_i^L, to loan rates, and to the switching cost, τ, (in line with Crawford et al. (2018)). With segment mass M_m and an outside option normalized to zero, the choice probability and bank-level loan demand are

$$P_{i|m} = \frac{\exp\{v_{i|m}^L\}}{1 + \sum_{j \in \mathcal{I}} \exp\{v_{j|m}^L\}}, \qquad L_i(\mathbf{r}^L; \mathcal{I}) = \sum_m M_m P_{i|m}. \tag{14}$$

The switching cost τ gives incumbent banks market power over relationship borrowers while preserving substitution toward surviving competitors when a lender raises its rate or exits.

Bank i belongs to loan-cost type $\theta_i \in \{f, b\}$, where f stands for "fringe" or small and b stands for "big," and incurs

$$C_{\theta_i}^L(L_i) = c_{\theta_i 0} L_i + c_{\theta_i 1} L_i^2, \qquad c_{\theta_i 0}, c_{\theta_i 1} > 0, \tag{15}$$

as well as a bank-specific fixed operating cost f_i.

Funding risk and liquidity. Before the next funding realization, the bank chooses liquid assets B_i. The annualized funding innovation produces the cash outflow

$$W_i(\epsilon) = D_i \big[1 - \exp\{\sigma_i^a \epsilon\}\big]_+. \tag{16}$$

Liquid assets meet this outflow without disturbing the loan portfolio. Motivated by the evidence from Denbee et al. (2021), Li and Li (2025) and Li et al. (2026), we assume that any uncovered amount requires emergency equity

$$y_i(\epsilon) = [W_i(\epsilon) - B_i]_+. \tag{17}$$

Planned and emergency equity use the same physical issuance-cost function,

$$\zeta(x) = c_E x + \frac{\gamma}{2}x^2, \qquad \mathcal{Q}_i(B_i, D_i) = \mathbb{E}\big[\zeta(y_i(\epsilon))\big]. \tag{18}$$

Thus liquidity is chosen for its reduction in expected future issuance costs. The issuance cost is expected and follows the functional form of the costs in Hennessy and Whited (2007).

Internal funds, dividends, and seasoned equity. Given a target E_i and loan choice L_i, define the net external funding requirement

$$g_i(E_i, L_i; k) = E_i + f_i + C^L_{\theta_i}(L_i) - k. \tag{19}$$

If $g_i \leq 0$, the bank issues no equity and distributes $c_i = -g_i$. If $g_i > 0$, dividends are zero and gross seasoned issuance x_i is the smaller nonnegative solution to

$$x_i - \zeta(x_i) = g_i. \tag{20}$$

Equation (20) is effectively a budget constraint. This formulation allows a bank with abundant internal funds to pay dividends and therefore does not impose $E_i \geq k$.

The leverage ratchet. We follow Admati et al. (2018) to model the junior claim retirement. Let D^{ref}_{i0} denote bank i's deposits in the "status-quo" equilibrium with $\kappa = 12\%$ and let D^J_{i0} denote its stock of junior legacy funding. Policy-induced junior retirement is

$$J_i(D_i) = \min\{D^J_{i0}, [D^{\text{ref}}_{i0} - D_i]_+\}. \tag{21}$$

The priority schedule for the debt retirement is given by $\Delta q_i(\cdot)$. We assume the linear priority schedule for simplicity. This assumption is in the spirit of Hackbarth et al. (2007)

and Gertner and Scharfstein (1991). Then, the transfer to incumbent shareholders is

$$\mathcal{R}_i(D_i) = m_R \int_0^{J_i(D_i)} \Delta q_i(u)du = \mathcal{R}_i(D_i) = m_R \overline{\Delta q}_i D_{i0}^J \left[2\frac{J_i(D_i)}{D_{i0}^J} - \left(\frac{J_i(D_i)}{D_{i0}^J} \right)^2 \right], \quad (22)$$

where $m_R = 1$ in the benchmark and $m_R = 0$ in the no-ratchet comparison. $\overline{\Delta q}_i$ is an average discount across the bank's junior legacy claims. Importantly, this is a one-time reform-date transfer, consistent with Admati et al. (2018). In other words, $\mathcal{R}_i(D_i) = 0$ outside of the reform date.

Dynamic bank problem. Let $G_i(d' \mid d)$ denote the Markov kernel implied by (12). Loan and deposit demand determine L_i and D_i from the bank's rates and the competitors' strategies. Liquid assets and next-period net worth then satisfy

$$B_i = E_i + D_i - L_i \geq 0, \quad (23)$$

$$k_i' = (1 + r_i^L)L_i + (1 + r^B)B_i - (1 + r_i^D)D_i. \quad (24)$$

Define the shareholder financing payoff

$$p_i(g_i) = \begin{cases} -g_i, & g_i \leq 0, \\ -x_i(g_i), & g_i > 0. \end{cases} \quad (25)$$

For a stationary policy environment, the continuation value is

$$V_i(k, d) = \max \left\{ X_i(k), \max_{r_i^D, r_i^L, E_i} \left[p_i(g_i) + \mathcal{R}_i(D_i) - \beta \mathcal{Q}_i(B_i, D_i) + \beta \mathbb{E}_{d'|d} V_i(k_i', d') \right] \right\}, \quad (26)$$

subject to (8)–(9), $D_i \leq d$, and issuance feasibility. $X_i(k) = \max\{k, 0\}$ is an exit option. Given the nature of the Armenian reform, we treat mergers as exits on the part of the small bank as well.

Entry. Following Corbae and D'Erasmo (2021), a potential entrant of type t pays setup cost Υ, chooses initial net worth k^e, draws deposit capacity from the type-specific entrant distribution G_t^e, and has value

$$V_t^e(\mathcal{I}) = \max_{k^e \geq 0} \left\{ -(k^e + \Upsilon) - \zeta(k^e + \Upsilon) + \mathbb{E}_{d \sim G_t^e} V_t(k^e, d; \mathcal{I}) \right\}. \tag{27}$$

The setup cost is normalized to zero mean entrant value at the initial floor-free 12 percent baseline prices and held fixed in the subsequent policy exercises. In the policy exercises, the reported probability of successful entry is the probability that (27) is nonnegative across an empirical distribution of entrant types, holding the baseline incumbent competitive environment fixed.

Solution and equilibrium. We solve the model in two steps. First, for each permanent regulatory regime, we compute a state-dependent approximation to the stationary continuation problem. The joint industry state contains every bank's net worth and deposit capacity; rival-state arguments are suppressed in (26) to simplify notation. At each state, banks simultaneously choose (r_i^D, r_i^L, E_i) and compare continuation with exit. Deposit and loan demand determine (D_i, L_i), while (23) and (24) determine liquid assets and next-period net worth. Equations (19)–(25) determine dividends, equity issuance, and shareholder payoffs. Current allocations therefore respond to the individual choices of all banks, rather than to fixed average competitor rates.

We alternate these joint-market calculations with projected policy evaluation. Bank-specific continuation functions depend on own states and moments of rival states, and are updated on simulated joint states and observed-state and net-worth stress points. Deposit capacity follows the discretized process in (12). When a bank exits, its operating slot is replaced by an entrant of the same type under the model's replacement rule. This keeps the set of potential identities fixed without fixing current bank choices. We iterate until the continuation values and policy rules stabilize. The state approximation makes the dynamic industry calculation tractable while retaining equilibrium feedback

through prices, quantities, and future bank states, following the computational rationale in Corbae and D'Erasmo (2021); Ifrach and Weintraub (2017).

Second, we calculate the response to the reform from the observed December 2014 states, $(k_i, d_i) = (E_{i0}, D_{i0})$. The policy-specific continuation functions enter a simultaneous game in rates, equity, and exit. We recalculate demand over surviving banks and search for profitable unilateral deviations, including across the regions of the leverage-ratchet payoff. The legacy transfer and the equity-raising mandate apply at the reform date; subsequent choices use the relevant permanent capital requirement. Appendix C describes the algorithm, reports the numerical diagnostics for the current calibration, and distinguishes current-action optimization from continuation-value approximation.

Formally, for a given permanent policy, a stationary industry equilibrium consists of bank value functions and policy rules, an invariant joint distribution of bank states, and deposit and loan allocations such that: (i) every bank's policy and exit rule solve (26) given competitors' rules; (ii) depositors and borrowers choose banks according to (11) and (14); (iii) all balance-sheet, financing, and regulatory constraints are satisfied; (iv) the joint distribution is invariant under these policies, the capacity process, and the replacement rule; and (v) rival prices and demand indexes are generated by the same policy rules at the current state. The outside options absorb deposits and loans not allocated to banks. We compute a numerical approximation to these conditions and report its accuracy separately from calibration fit.

6.2 Comparative statics

We present comparative statics below with detailed derivations and proofs in Appendix B. We start by demonstrating that issuing external equity is more expensive than meeting the requirements using retained funds. Proposition 1 shows the result.

Proposition 1 (Marginal cost of external equity)**.** *Suppose* $g_i > 0$, $\zeta'(x_i) < 1$, *and*

issuance is feasible. Then

$$\frac{dx_i}{dg_i} = \frac{1}{1-\zeta'(x_i)} > 1, \qquad \frac{dp_i}{dg_i} = -\frac{1}{1-\zeta'(x_i)} < -1. \tag{28}$$

If $g_i < 0$, then $dp_i/\,dg_i = -1$. Thus an additional unit of required book equity is strictly more expensive in the issuance region than in the dividend region.

This wedge is the model's core recapitalization friction. A higher requirement raises the shadow cost of any balance-sheet choice that requires seasoned equity. The bank can respond by issuing equity, reducing deposits, changing its loan rate, changing its liquidity buffer, or exiting. This friction gives banks an endogenous incentive to avoid issuance, potentially by reducing deposits, assets, or lending. It does not force them to contract; the optimal response still depends on profits, deposit demand, loan demand, liquidity needs, and the leverage-ratchet benefit.

Next, we show how any policy that tightens equity reduces banks' value conditional on the surrounding equilibrium. Proposition 2 shows the result.

Proposition 2 (Direct policy effect)**.** *Fix competitors' strategies and the continuation-value function. Let λ_i and ν_i be the Lagrange multipliers on $E_i - \kappa A_i \geq 0$ and $E_i - \bar{E} \geq 0$. At a regular optimum,*

$$\frac{\partial V_i^0}{\partial \kappa} = -\lambda_i A_i \leq 0, \qquad \frac{\partial V_i^0}{\partial \bar{E}} = -\nu_i \leq 0. \tag{29}$$

These are direct reform-date effects. The total stationary-equilibrium effect also includes changes in continuation values, rival prices, and the active set.

Proposition 2 does not imply that a surviving bank's loans or assets must fall. It says that tightening a binding constraint weakly reduces the bank's value, conditional on the surrounding equilibrium objects. Because exit compares continuation value with liquidation value, this direct effect makes exit more attractive; reduced competition can partially offset it in equilibrium.

Proposition 3 reconciles the leverage ratchet effect and shows how under certain conditions, it is preferable to reduce assets rather than raise equity, in response to the new requirement.

Proposition 3 (Leverage-ratchet wedge)**.** *If* $0 < J_i(D_i) < D_{i0}^J$*, then*

$$\frac{\partial \mathcal{R}_i(D_i)}{\partial D_i} = -2m_R\bar{\Delta}q_i\left(1 - \frac{J_i(D_i)}{D_{i0}^J}\right) < 0. \tag{30}$$

A marginal reduction in deposits therefore creates a positive incumbent- shareholder transfer. The wedge is zero before retirement begins and after the entire junior stock has been exhausted.

The ratchet makes deposit retirement privately more attractive at the reform date. Because $A_i = E_i + D_i$, it strengthens the incentive to contract assets relative to a pure recapitalization when deposits fall with asset contraction. It does not by itself determine whether loans or liquid assets bear the adjustment.

Next, we connect the balance-sheet response to deposit pricing. Proposition 4 shows when a higher equity requirement reduces deposits and raises deposit spreads.

Proposition 4 (Capital requirements, deposits, and deposit spreads)**.** *Consider a differentiable reform-date equilibrium with a fixed active set and fixed deposit capacities. Let* p *denote either* κ *or* $\bar{E}$*, and define the outside-option and competitor deposit index as*

$$R_{-i}^D = 1 + \sum_{j\in\mathcal{I},\, j\neq i} \exp\{v_j^D\}. \tag{31}$$

Then

$$\frac{dD_i}{dp} = \frac{dA_i}{dp} - \frac{dE_i}{dp}, \tag{32}$$

$$\frac{ds_i^D}{dp} = \frac{dE_i/\,dp - \,dA_i/\,dp}{\alpha_D D_i(1 - D_i/M_D)} - \frac{1}{\alpha_D}\frac{d\log R_{-i}^D}{dp}. \tag{33}$$

Thus, if bank i *raises equity by more than it raises assets and the aggregate attractiveness of its competitors does not increase, its deposits decline and its deposit spread rises.*

If the absolute floor binds locally while the ratio requirement is slack, then

$$\frac{dD_i}{d\bar{E}} = \frac{dA_i}{d\bar{E}} - 1. \tag{34}$$

Deposits therefore decline when assets increase less than one-for-one with the required increase in equity. If instead the ratio requirement binds locally and the absolute floor is slack, then

$$\frac{d\log D_i}{d\kappa} = \frac{d\log E_i}{d\kappa} - \frac{1}{\kappa(1-\kappa)}, \tag{35}$$

$$\frac{ds_i^D}{d\kappa} = \frac{1}{\alpha_D}\left[\frac{\frac{1}{\kappa(1-\kappa)} - \frac{d\log E_i}{d\kappa}}{1 - D_i/M_D} - \frac{d\log R_{-i}^D}{d\kappa}\right]. \tag{36}$$

Hence deposits decline under a binding ratio requirement if $d\log E_i/\,d\kappa < 1/[\kappa(1-\kappa)]$. *If competitor attractiveness is also weakly decreasing, the bank's deposit spread rises.*

The proposition describes the mechanism behind the joint decline in deposits and increase in deposit spreads. Under the Armenian floor, the relevant condition is that assets increase by less than equity. Under a ratio-based requirement, the bank may instead preserve deposits by raising sufficient equity. The last term in (33) captures these strategic responses. If competitors become more attractive, bank i must offer a higher deposit rate to retain a given quantity, partially offsetting the increase in its spread. If competitors become less attractive, their response reinforces the increase in the spread.

Finally, we show how surviving and unaffected banks can absorb the remaining lending demand.

Proposition 5 (Borrower reallocation)**.** *For two active banks* $i \neq j$,

$$\frac{\partial L_j}{\partial r_i^L} = \alpha_L \sum_m M_m P_{j|m} P_{i|m} > 0. \tag{37}$$

If bank i exits, the probability that its relationship borrower selects surviving bank j is

$$P_{j|i}^{-i} = \frac{\exp\{\xi_j^L - \alpha_L r_j^L - \tau\}}{1 + \sum_{h \neq i} \exp\{\xi_h^L - \alpha_L r_h^L - \tau\}}, \qquad \frac{\partial P_{j|i}^{-i}}{\partial \tau} = -P_{j|i}^{-i} P_{0|i}^{-i} < 0. \tag{38}$$

Lower switching costs therefore increase the fraction of displaced lending absorbed by surviving banks.

Aggregate lending combines four margins: loan adjustment by unconstrained banks, loan adjustment by directly constrained banks, reallocation following rate changes or exit, and the loss of lending not absorbed by another bank. There is unabsorbed lending demand remaining from the constrained banks that either exited or cut lending supply. The proposition shows that the remaining demand is absorbed by unconstrained and surviving banks.

6.3 Calibration

Table 8 reports the calibrated parameters. The model period is one year. We initialize the 17 banks at their December 2014 balance sheets, immediately before the reform announcement. The single funding liability corresponds to total non-equity funding, and liquid assets equal reported assets less loans. Deposit and loan rates are amount-weighted contract averages over 2013–2014. Deposit rates are observed for nine banks; we assign the system's amount-weighted rate to the remaining eight. Loan rates are observed for all 17 banks. We recover bank-specific demand intercepts from these quantities and rates. The December 2014 refinancing rate, $r^0 = 0.085$, implies an annual discount factor of $\beta = 0.922$.

We estimate the deposit-rate semi-elasticity from monthly flows of newly contracted AMD term deposits over 2013–2018. The regression relates log contracted amounts to the annualized deposit rate, expressed as a decimal, and includes bank and month fixed effects. Rates hold each bank's pre-sample maturity composition constant. We instrument the rate with $Z_{bt} = \overline{NDF}_b \times r_t^{CBA}$, where $\overline{NDF}_b$ is average nondeposit

liabilities over 2009–2012 divided by average assets over the same period, and r_t^{CBA} is the monthly refinancing rate. Nondeposit liabilities equal total liabilities less deposits. Policy-rate changes affect the cost of alternative funding and hence banks' willingness to pay for deposits according to their initial funding structure. Identification assumes that, conditional on bank and month fixed effects, this interaction affects deposit flows through offered rates rather than differential changes in depositor preferences or bank services.

Contracted amounts include renewals assigned new identifiers, rather than measuring net inflows or changes in outstanding balances. For calibration, we apply this flow-based coefficient to stock demand for the model's non-equity funding liability. Following the rate-sensitive deposit-demand framework in Egan et al. (2017), the corresponding own-rate elasticity before the capacity constraint binds is $\alpha_D r_i^D (1 - D_i/M_D)$, where D_i/M_D is the bank's market share.

We calibrate the switching cost, $\tau = 3.736$, to the credit-weighted probability of 0.724 that repeat borrowers remain with their dominant pre-period lender, comparing relationships in 2012–2013 with borrowing in 2014. Funding persistence is estimated from the 2009–2014 monthly bank panel with bank and month fixed effects. The monthly coefficient of 0.935 implies annual persistence of 0.448. Bank-specific twelve-month innovation volatility has a median of 0.160.

We estimate linear and quadratic loan-production costs from annual noninterest expenses over 2009–2014, allowing coefficients to differ between smaller and larger banks and including bank and year fixed effects. Bank-specific fixed costs equal median expenses net of fitted variable costs. The effective liquid-asset return is 0.043 and is held fixed across policies. Liquid assets account for 41.47% of total assets in the 12% baseline, compared with 41.56% in the data.

We parameterize equity issuance costs using Corbae and D'Erasmo (2021). The linear cost is the geometric midpoint of their large- and small-bank coefficients. The quadratic coefficient makes issuance equal to 10% of median bank assets increase

marginal issuance cost by five percentage points. Costly compliance through capital is also consistent with Kisin and Manela (2016). The leverage-ratchet parameters use discounts on uninsured AMD term contracts and the share of funding not covered by deposit insurance. The uninsured-principal-weighted discount is 0.053, and junior legacy funding accounts for 0.250 of total funding.

We normalize mean entrant value to zero at the initial floor-free 12% baseline prices. The implied setup cost is held fixed when updating the incumbent equilibrium and across counterfactuals. This normalization does not target observed entry. Nor do we target the four post-reform mergers: the reform-date allocations contain no exits and therefore do not reproduce that count.

6.4 Policy counterfactuals

We use the model to ask how the effects of tighter equity regulation depend on the form of the requirement and on the way banks are required to comply. This general-equilibrium perspective is important because capital regulation can change competition, concentration, and the allocation of intermediation rather than only the behavior of an individual regulated bank (Hanson et al. (2011); Allen et al. (2011); BENETTON (2021)). For each policy, we solve the reform-date allocation from the same observed December 2014 bank states, using the continuation values associated with that permanent policy. We raise the required ratio from 12% to 25% and report changes relative to the floor-free 12% allocation at those same initial states, rather than comparing stationary distributions. We then compare these ratio-based requirements with the Armenian policy, which keeps the 12% ratio and adds the AMD 30 billion absolute equity floor. Because an absolute floor cannot be summarized by a point on the ratio axis, the horizontal black line in Figure 11 reports the Armenian outcome at every value of κ. A useful comparison is therefore between the floor and the ratio that produces approximately the same aggregate increase in equity.

We consider three versions of the ratio requirement. In the first, labeled "Ratio with

Table 8: Calibration of the Quantitative Model

Object	Value	Source or target
Policy rate r^0	0.085	December 2014 CBA refinancing rate
Discount factor β	0.922	$(1+r^0)^{-1}$ for an annual model period
Deposit semi-elasticity α_D	1.546	Pre-sample nondeposit funding exposure × CBA rate; AMD term-deposit flows
Loan semi-elasticity α_L	25.000	External calibration
Deposit and loan outside shares (s_D^0, s_L^0)	$(0.100, 0.100)$	External calibration
Switching cost τ	3.736	Repeat-borrower lender persistence of 0.724
Monthly funding persistence ρ_m	0.935	Monthly non-equity-funding panel, 2009–2014
Annual funding persistence ρ_a	0.448	ρ_m^{12}
Annual funding volatility σ_i^a	Bank-specific; median 0.160	Twelve-month accumulated residual volatility
Smaller-bank loan cost (c_{f0}, c_{f1})	$(0.021, 2.060 \times 10^{-10})$	Pre-policy expense regression
Larger-bank loan cost (c_{b0}, c_{b1})	$(0.018, 7.331 \times 10^{-11})$	Pre-policy expense regression
Fixed operating cost f_i	Bank-specific; median 1.944×10^6	Expense net of variable loan cost
Liquid-asset return r^B	0.043	Fixed across policies; residual non-loan asset share target of 0.416
Linear issuance cost c_E	0.071	Geometric midpoint of Corbae and D'Erasmo (2021) coefficients
Quadratic issuance cost γ	3.008×10^{-9}	Five-point rise in marginal cost at issuance of 10% of median assets
Mean junior discount $\overline{\Delta q}$	0.053	Uninsured-principal-weighted AMD term-contract discount
Junior legacy funding share D^J/D	0.250	Insurance coverage and legal-entity deposits
Entrant setup cost Υ	6.130×10^8	Zero mean entrant value at initial 12% baseline prices; held fixed thereafter

Note: Monetary quantities are in thousand AMD and interest rates are annual decimals. Parameters are rounded to three decimals; calculations use unrounded values. Bank-specific balance sheets, rates, demand intercepts, fixed costs, and funding volatilities are not listed individually. Smaller and larger banks correspond to the loan-cost types in equation (15). Annual funding persistence is the monthly coefficient raised to the twelfth power. The loan semi-elasticity and outside shares are externally calibrated. The liquid-asset return and entrant setup cost are common across policies; the entry normalization uses the initial 12% baseline prices.

ratchet," banks choose whether to raise equity, reduce assets, or exit, and incumbent shareholders receive the leverage-ratchet transfer when junior funding is retired. This is the model's counterpart to a conventional Basel-style tightening. In the second, labeled "Ratio, equity required," banks face the same higher ratio but cannot meet it by cutting assets at the reform date. This forces the initial adjustment to occur through equity

issuance, while leaving subsequent balance-sheet choices endogenous. This exercise separates the effect of the regulatory ratio from the effect of the compliance margin. In the third, labeled "Ratio without ratchet," banks again choose their adjustment, but we set $m_R = 0$. Comparing this case with the first isolates the leverage-ratchet incentive to retire funding and contract the balance sheet.

For entry, we compute the share of potential entrant types whose value in equation (27) is nonnegative. We hold the baseline incumbent competitive environment fixed so that this exercise isolates the direct regulatory burden on entry rather than changes in incumbent prices. The three ratio curves coincide in the entry panel: a new bank has no legacy junior claims, and the reform-date restriction on incumbent asset cuts does not apply to a potential entrant. The relevant entry comparison is therefore between a size-proportional equity ratio and the size-independent AMD 30 billion floor.

Figure 11 presents the results. Panels (a) and (b) show the mechanism most directly. Under a conventional ratio-based reform, banks satisfy the initial increases partly by shrinking their balance sheets: assets fall at ratios of 13% and 14%. Raising the ratio from 12% to 13%, for example, increases aggregate equity by 6.6% but reduces assets by 1.5%. Requiring equity issuance changes the response: equity rises by 12.4% and assets increase by 0.4%. Removing the leverage ratchet produces a similar contrast, with equity rising by 9.4% and assets by 1.1%. These results illustrate Proposition 3: a higher ratio does not mechanically require deleveraging, but the option to shrink and the shareholder gain from retiring junior funding can make contraction the preferred adjustment. The asset decline is not universal; aggregate assets rise above baseline from the 15% ratio onward.

The Armenian floor generates a substantially different balance-sheet adjustment. Equity rises by 64.2%, while assets increase by 5.8%. These signs are consistent with the empirical balance-sheet response, although the aggregate model comparison and the bank-level treatment estimates are different objects. An increase in the ratio to approximately 19% produces a similar aggregate equity increase: 64.4% under the conventional

ratio and 64.5% when equity is required. Both ratio policies raise assets by approximately 4.0%. The floor therefore produces more asset expansion than a ratio increase generating a comparable recapitalization. Without the leverage ratchet, assets expand more strongly. Importantly, asset growth need not imply credit growth: under the Armenian floor, liquid assets rise by 15.0% while loans decline slightly.

Panels (c) and (d) show the funding counterpart. The Armenian floor reduces deposits by 2.2% and increases deposit spreads by approximately 487 basis points. These signs are consistent with the empirical decline in deposit reliance and the increase in deposit spreads. The result follows the comparative static in Proposition 4: the increase in equity exceeds the increase in assets in levels, so deposits decline, and equilibrium repricing raises spreads. At a ratio near 19%, the conventional ratio reduces deposits by 4.3% and raises spreads by approximately 976 basis points. The floor therefore produces a smaller funding contraction at a comparable degree of recapitalization. For the initial ratio increases, requiring equity reduces deposit contraction and spread widening relative to the conventional ratio. This advantage diminishes as the requirement rises: at ratios of 20% and above, the two allocations are virtually identical. The reform-date restriction then has little incremental effect on the chosen allocation; this convergence is not driven by exit, since no banks exit in the reported reform-date cases.

Panel (e) shows the lending response. The Armenian floor reduces aggregate loans by 0.7%, compared with approximately 1.8% under either ratio policy at the equity-matched 19% requirement. For a one-percentage-point ratio increase, loans fall by 0.33% under the conventional ratio, by 0.13% when equity is required, and by only 0.01% without the leverage ratchet. Requiring recapitalization therefore limits the lending decline at this initial tightening, but it does not uniformly preserve more lending at every ratio. As requirements rise, loan contraction can coexist with asset expansion because banks shift toward liquid assets. Borrower substitution in Proposition 5 permits other banks to absorb part of the displaced credit. This is a mechanism for the reallocation documented empirically, not a quantitative match between the aggregate loan response

and the within-borrower estimates.

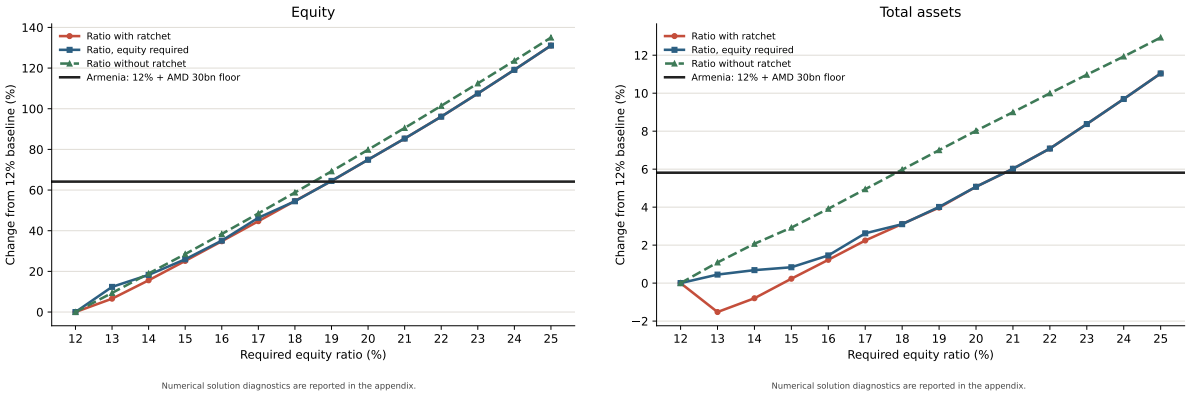
Panel (f) illustrates the entry tradeoff. The probability of successful entry is 46.30% in the 12% baseline and 46.13% under the Armenian floor. A proportional ratio permits the required initial equity to scale with an entrant's balance sheet, whereas the floor requires at least AMD 30 billion regardless of initial scale. The Armenian policy yields a lower probability of successful entry than ratio-based equity requirements up to and including 17% on our policy grid. At 18% and above, the ordering reverses. The model therefore supports an entry burden relative to the pre-reform baseline and moderate ratio requirements, with the ranking depending on regulatory stringency. Its modest probability change is also distinct from the change in the stock of FinTech firms measured in the synthetic-control exercise.

Taken together, the counterfactuals show that neither the level of the capital requirement nor the amount of equity raised is sufficient to predict its effects. A conventional ratio can induce asset contraction because banks choose the least costly compliance margin and because the leverage ratchet rewards funding retirement. Requiring equity preserves assets at the initial ratio increases, but its incremental effect becomes small at higher requirements. The Armenian floor produces a large recapitalization with liquid-asset growth and only a modest lending decline, while shifting funding away from deposits and raising the minimum equity needed to enter. The relevant comparison therefore separates incumbent adjustment from the direct entry burden and compares policies at explicit levels of regulatory stringency.

6.5 Welfare and policy experiments

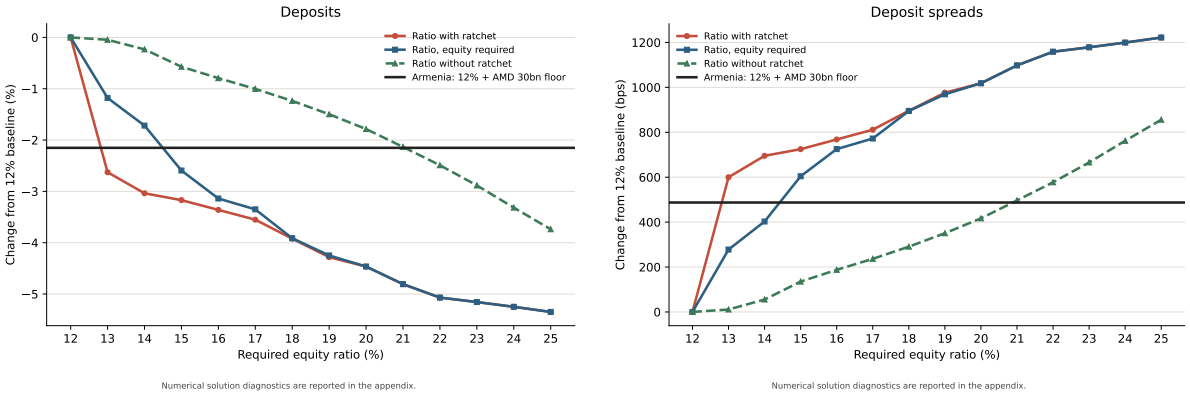
We use the same equilibrium allocations to compare welfare under the Armenian reform with welfare under the pre-reform requirement and alternative ratio-based reforms. Our measure is banking-sector surplus in AMD, assigning equal weight to one AMD accruing to depositors, borrowers, bank owners, or legacy creditors. We calculate customer surplus from the existing logit demands using the money-metric approach of Small and Rosen

Figure 11: Capital Requirements: Model Counterfactuals



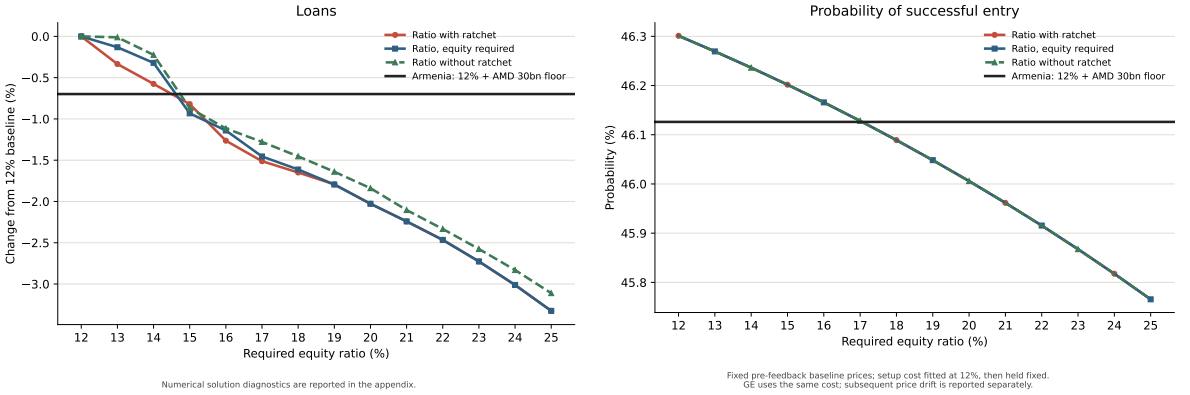
(a) Equity

(b) Assets



(c) Deposits

(d) Deposit spreads



(e) Loans

(f) Probability of successful entry

Note: Reform-date outcomes use common December 2014 bank states and policy-specific continuation values. Changes are relative to the floor-free 12% allocation. Red circles retain the leverage ratchet; blue squares additionally prohibit reform-date asset cuts; green triangles remove the ratchet. The black horizontal line is Armenia's 12% ratio plus AMD 30 billion floor. Panels (a)–(c) and (e) show percentage changes, (d) basis-point changes, and (f) entry probabilities at fixed baseline incumbent prices. Appendix C reports numerical diagnostics.

(1981). Let $\mathcal{I}_t$ denote the active banks at date t. With the utility indexes and market sizes defined above, customer surplus, valued at the end of the year, is

$$CS_t^D = \frac{M_D}{\alpha_D} \log\left(1 + \sum_{i \in \mathcal{I}_t} \exp\{v_{it}^D\}\right), \tag{39}$$

$$CS_t^L = \sum_m \frac{M_m}{\alpha_L} \log\left(1 + \sum_{i \in \mathcal{I}_t} \exp\{v_{i|m,t}^L\}\right). \tag{40}$$

The outside options retain their original normalization, and the common utility constants cancel in policy differences. Exited banks are removed from the choice sets. Borrower switching costs are already included in $v_{i|m,t}^L$ and are not subtracted a second time.

We add the combined surplus of bank owners and legacy creditors, net of the opportunity cost of funds at r^0. Using the model's existing cost functions, its beginning-of-year value is

$$\begin{aligned}\Pi_t = \sum_{i \in \mathcal{I}_t} \Big\{ \beta\big[(r_{it}^L - r^0)L_{it} + (r^B - r^0)B_{it} + (r^0 - r_{it}^D)D_{it} - \mathcal{Q}_i(B_{it}, D_{it})\big] \\ - f_i - C_{\theta_i}^L(L_{it}) - \zeta(x_{it}) \Big\} - \beta K_t^{\text{rep}},\end{aligned} \tag{41}$$

where K_t^{rep} sums the setup and issuance costs, $\Upsilon + \zeta(k^e + \Upsilon)$, of replacements following exit. These costs are zero when no bank exits. Equity principal is financing rather than a resource loss. Likewise, the leverage-ratchet payment is a gain to shareholders and an equal loss to legacy creditors, so it cancels from their combined surplus. The ratchet can nevertheless affect welfare through banks' choices, reflecting the distinction between private financing incentives and efficiency emphasized by Admati et al. (2018). Interest payments also cancel when customer and bank surpluses are combined. We independently verify this accounting against intermediation services net of operating, financing, and opportunity costs.

We value the policy over the adjustment path rather than capitalizing a single year's gain. This distinction between transition and longer-run effects follows Corbae and D'Erasmo (2021). Define beginning-of-year flow surplus as $w_t = \beta(CS_t^D +$

$CS_t^L) + \Pi_t$. For each ratio κ, the comparison in Figure 12 is

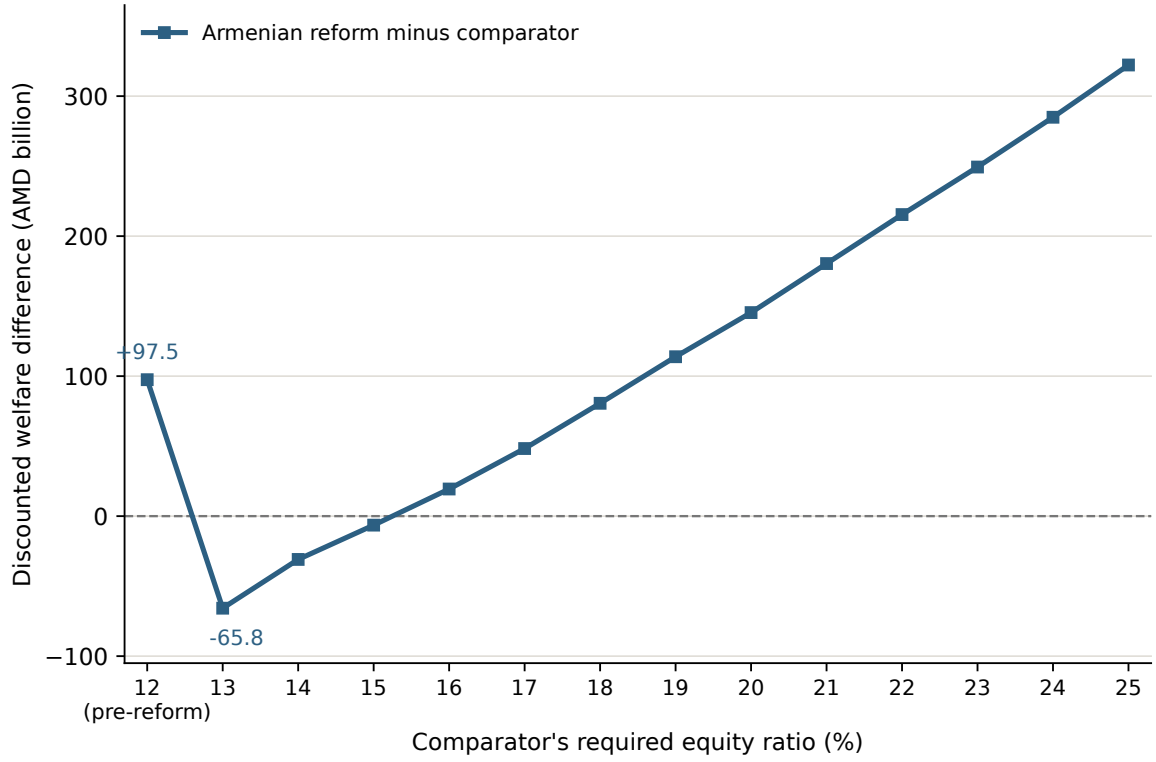
$$\Delta W_H(\kappa) = \frac{1}{N} \sum_{c=1}^{N} \sum_{t=0}^{H-1} \beta^t \left[w_{ct}^{\text{Armenia}} - w_{ct}^{\text{ordinary ratio}}(\kappa) \right], \tag{42}$$

using $N = 8$ histories, $H = 128$ annual periods, and $\beta = 1/(1 + r^0) = 0.922$. The Armenian policy retains the 12% ratio and adds the AMD 30 billion floor. At $\kappa = 12\%$, the comparator is the pre-reform benchmark without the floor; at $\kappa = 13\%, \ldots, 25\%$, it is the ordinary ratio-based reform without an equity-raising mandate. Thus, the first point measures the gain or loss from the Armenian reform relative to no reform, while the remaining points compare alternative reforms. Both policies start from the same observed bank states and use the same innovations within each history. Future market allocations are recalculated at the realized states using policy-specific continuation approximations.

Figure 12 shows that the Armenian reform raises discounted banking-sector surplus by AMD 97.5 billion relative to the pre-reform benchmark. A moderate increase in the ordinary ratio performs better: raising the ratio to 13% yields a gain of AMD 163.2 billion relative to the same benchmark, and raising it to 14% yields AMD 128.4 billion. The corresponding points in the figure are therefore negative, at AMD -65.8 billion and AMD -30.9 billion. The 15% ratio also performs slightly better than the Armenian reform, by AMD 6.4 billion. Further tightening reduces welfare under the ordinary ratio: from 16% onward the Armenian reform yields higher surplus, and from 19% onward the ordinary ratio yields lower surplus than the pre-reform benchmark. The comparison therefore favors moderate ratio increases over the floor, but favors the floor over sufficiently stringent ratio requirements. Among the ordinary ratios on our grid, 13% produces the largest gain.

We next ask how the reform changes banks' earnings response to an interest rate shock. The motivation follows Drechsler et al. (2021): the deposit franchise allows banks to fund assets with deposits whose rates adjust only partially to market rates. Matching the interest rate sensitivity of income and expense stabilizes net interest income. Armenia's reform changes this relationship: treated banks reduce deposits and increase deposit

Figure 12: Welfare under the Armenian Reform



Note: The figure plots discounted banking-sector surplus under the Armenian reform minus surplus under the comparator on the horizontal axis, as defined in equation (42). At 12%, the comparator is the pre-reform benchmark without an absolute floor. At 13–25%, it is an ordinary ratio requirement without an absolute floor or an equity-raising mandate. The Armenian policy retains the 12% ratio and adds the AMD 30 billion floor. Values are in AMD billion and average eight paired histories of 128 years. Positive values favor the Armenian reform. Numerical diagnostics are reported in Appendix C.

spreads while adjusting their assets. We use the calibrated allocations to examine the resulting response of interest income, interest expense, and net interest margin.

We calibrate the earnings response using CBA bank income statements and policy rates before the reform. For each bank, we regress changes in annualized interest income and total interest expense, each divided by average assets, on contemporaneous and three lagged quarterly changes in the policy rate, including calendar-quarter controls. The estimation sample is 2010Q1–2014Q4. We apply the same bank-specific sensitivities to the equilibrium balance sheets under the Armenian floor, the floor-free 12% ratio, and a 14% ratio with required equity raising. The experiment changes the policy rate by between −200 and 200 basis points for one quarter, after which it returns to its initial

level. We sum the resulting earnings changes over the first year.[16]

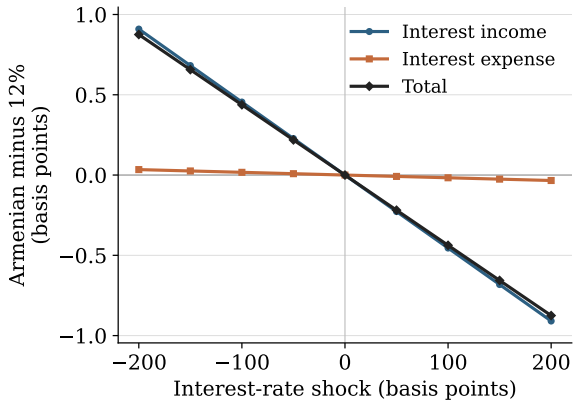
Figure 13 reports the Armenian-minus-12% difference in these shock responses. Panel (a) shows that treated banks earn less additional interest income following a rate increase under the Armenian floor, while the change in their interest expense response is small. For a 100-basis-point increase, the income response is lower by 0.455 basis points of pre-reform assets, compared with a 0.017-basis-point reduction in the expense response. Panel (b) shows a different pattern for untreated banks: their interest income response increases, but their expense response increases by more. Panel (c) brings these effects together. The reform reduces the NIM gain from a 100-basis-point rate increase by 0.438 basis points for treated banks and 0.092 basis points for untreated banks. Thus, the reform-induced change in the NIM response is almost five times as large for treated banks.

This pattern is consistent with the deposit contraction and spread widening documented above. Treated banks earn a larger spread on a smaller deposit base, but their lower incremental funding expense does not offset their lower incremental interest income. In the spirit of Drechsler et al. (2021), the reform changes the matching of asset and funding exposures. Higher capitalization and wider spreads therefore coexist with a smaller NIM gain from higher rates.

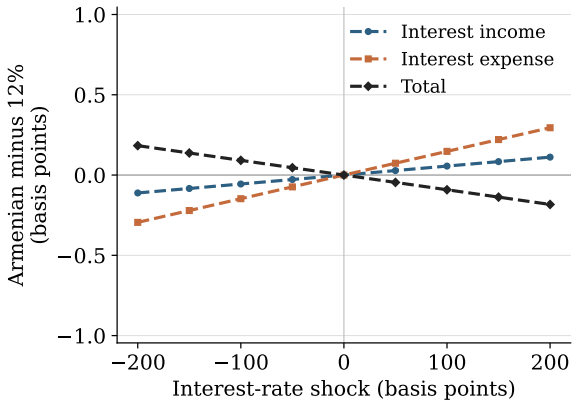
Figure 14 compares a 14% ratio with required equity raising to the floor-free 12% benchmark. Unlike the Armenian floor, this policy requires adjustment by all banks: each bank's equity ratio in the 12% allocation is below 14%. Equity rises by 17.5% among banks classified as treated under the Armenian reform and by 18.6% among untreated banks. Their earnings responses are correspondingly more similar. Treatment labels remain those defined by exposure to the Armenian floor.

[16] Let b_i^I and b_i^X denote the sums of the four estimated income and expense coefficients, and let h be the rate change in annual decimal units. Under policy p, first-year income changes by $hA_i^p b_i^I/4$, and expense changes by $hD_i^p(A_i^0/D_i^0)b_i^X/4$. Here A_i^p and D_i^p are the model's assets and funding, and A_i^0 and D_i^0 are their December 2014 reference values. The factor A_i^0/D_i^0 converts the estimated expense-per-asset sensitivity into a sensitivity per unit of funding; division by four converts annualized yields into quarterly cash flows. We aggregate within fixed treated and untreated groups and divide by each group's December 2014 total assets. Net interest margin in this exercise is first-year net interest income on this common asset base.

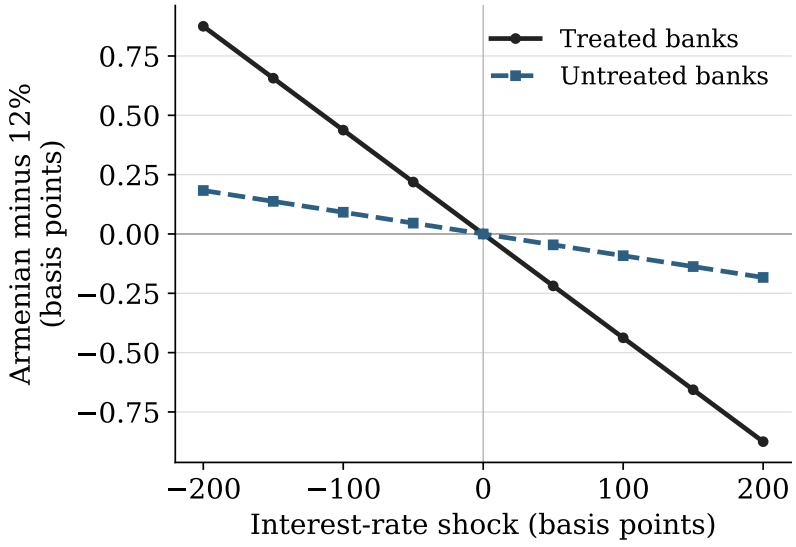
Figure 13: Capital Regulation and Interest Rate Exposure



(a) Treated banks: income and expense



(b) Untreated banks: income and expense

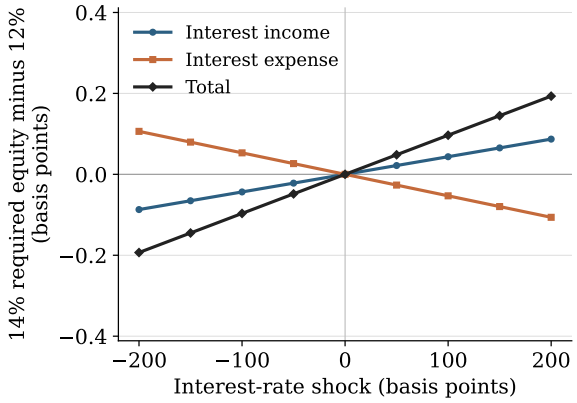


(c) Net interest margin

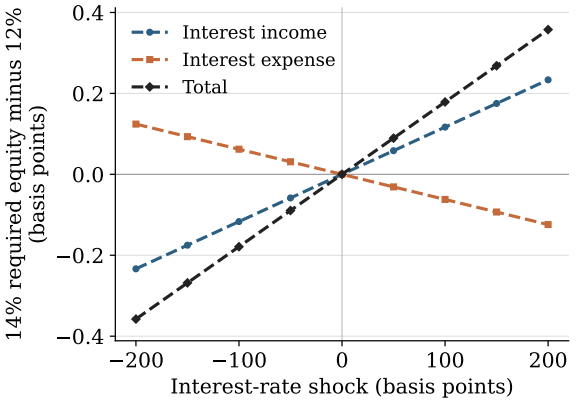
Note: Each panel plots the first-year response under the Armenian floor minus the response under the floor-free 12% ratio to a one-quarter policy rate change. Bank-specific sensitivities are estimated over 2010Q1–2014Q4 and held fixed across policies. Responses are in basis points of fixed December 2014 group total assets. Panels (a) and (b) use the same vertical scale; total equals interest income minus total interest expense. Panel (c) compares this net response for the ten treated and seven untreated banks. Negative values indicate a smaller earnings response under the Armenian floor.

The equity-raising mandate also preserves more deposit funding than the Armenian floor. Deposits decline modestly relative to 12%, without the pronounced shift toward equity funding among treated banks under the floor. Following a rate increase, both groups earn more incremental interest income and incur less incremental interest expense than

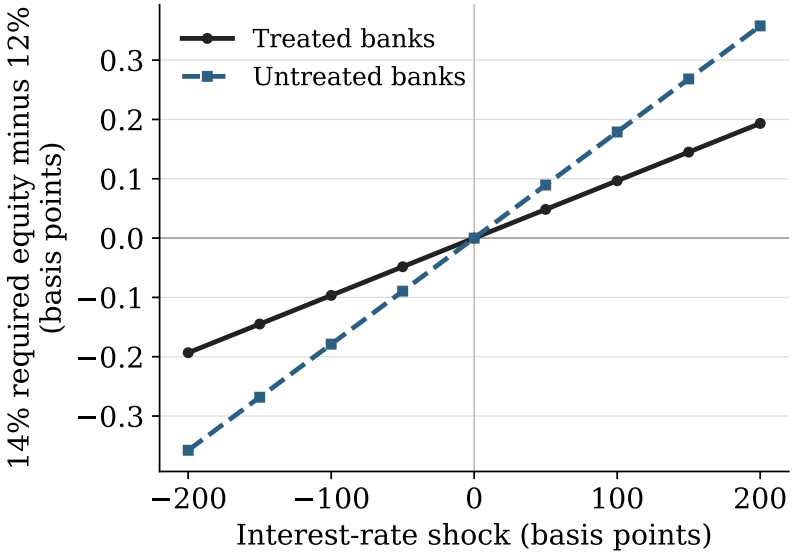
Figure 14: Required Equity Raising and Interest Rate Exposure



(a) Treated banks: income and expense



(b) Untreated banks: income and expense



(c) Net interest margin

Note: Each panel plots the first-year response under a 14% ratio with required equity raising minus the response under the floor-free 12% ratio to a one-quarter policy rate change. Bank-specific sensitivities are estimated over 2010Q1–2014Q4 and held fixed across policies. Responses are in basis points of fixed December 2014 group total assets. Panels (a) and (b) use the same vertical scale; total equals interest income minus total interest expense. Panel (c) retains the ten treated and seven untreated banks classified by exposure to the Armenian floor. Positive values indicate a larger earnings response under the 14% equity-raising mandate.

under the benchmark. A 100-basis-point increase therefore produces an additional NIM gain of 0.097 basis points of pre-reform assets for treated banks and 0.179 basis points for untreated banks. This contrasts with the smaller NIM gains under the Armenian floor in Figure 13.

Finally, we compare the policies' capacity to absorb credit losses using deterioration in loan quality during the 2014 Russia/oil shock to scale the exercise. CBA data report NPL ratios for business, consumer, and mortgage loans, separately in AMD and foreign currency. Holding these six cells' loan shares at their June 2014 values, the system NPL ratio rises by 2.17 percentage points by June 2015. We use this change to set a range of hypothetical loan-loss rates, $\lambda = c\Delta q$ for $c \in [0, 1]$, where $\Delta q = 0.02167$. Under policy p, the loss is $\ell_i^p = \lambda L_i^p$. We hold the reform-date loan portfolios fixed and report $\sum_i \ell_i^p / \sum_i E_i^p$, the aggregate loss relative to starting equity. This isolates the capital cushion available before subsequent earnings, payouts, or balance-sheet adjustment.[17]

Figure 15 shows that both reforms reduce the share of equity absorbed by a common loan-loss shock relative to the 12% benchmark. The Armenian floor provides the larger cushion. A loss equal to 2.17% of loans consumes 10.6% of starting equity under 12%, 8.9% under 14% with required equity raising, and 6.4% under the Armenian floor. The floor generates substantially more equity against a comparable loan book. Its greater loss-absorption capacity contrasts with the smaller earnings gain from higher interest rates in Figures 13 and 14.

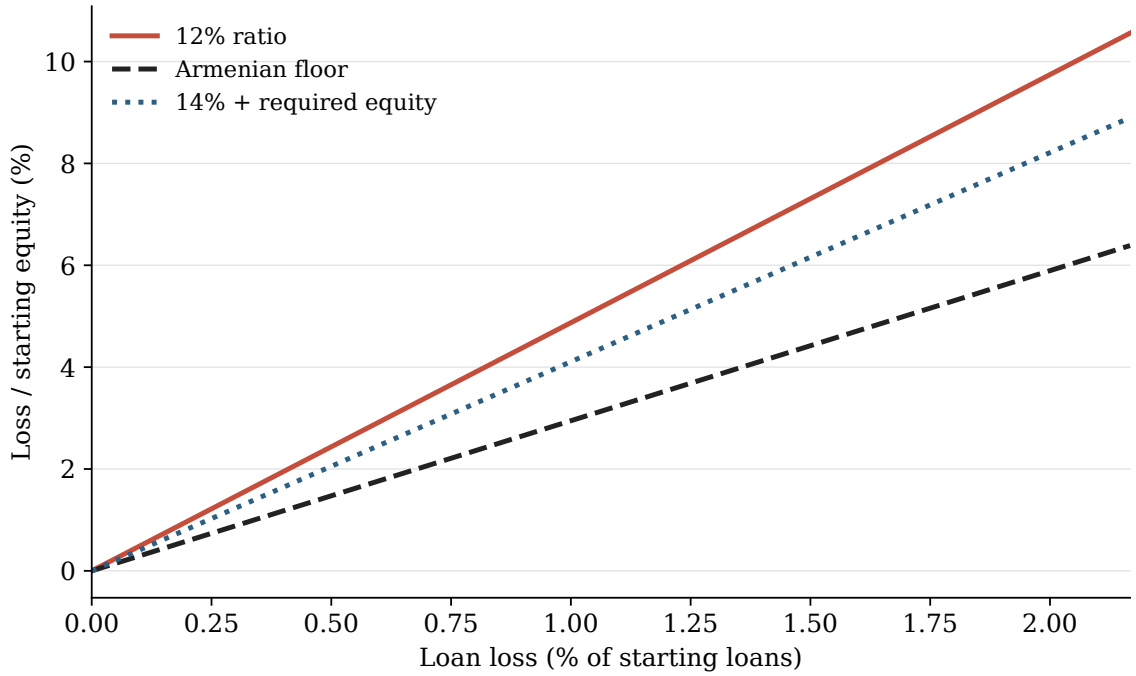
7 Conclusion

This paper studies what happens when regulation makes banks raise equity rather than permitting compliance through asset contraction. Armenia's absolute equity floor generated substantial differences in required equity growth across banks while leaving the existing capital ratio unchanged. Most affected banks raised equity by the implementation date. Their assets and liquid holdings expanded, deposit reliance declined, spreads widened, and profitability and franchise value did not fall.

The reform nevertheless reallocated credit. More constrained banks modestly reduced

[17]The CBA NPL measure is substandard plus doubtful loans divided by the reported loan denominator; loss-classified loans are excluded from the numerator. An NPL stock change does not directly identify realized credit losses, so c is varied as a stress-scenario coefficient rather than estimated as a loss-given-default parameter. The same loan-loss rate is applied to each policy's loan book.

Figure 15: Capital Regulation and Credit-Loss Absorption



Note: The figure plots hypothetical loan losses as a percentage of aggregate starting equity under the floor-free 12% ratio, the Armenian floor, and a 14% ratio with required equity raising. The horizontal axis applies a common percentage loss to each policy's reform-date loan book. The range is scaled by the 2.17-percentage-point increase in the NPL ratio between June 2014 and June 2015, holding June 2014 loan-type and currency weights fixed. The NPL-to-loss conversion is varied rather than estimated. The vertical axis measures loss exposure relative to the starting capital cushion, not the endogenous decline in equity after banks adjust.

lending and charged higher rates within borrower-period. Firms responded by adding lenders and shifting borrowing toward unconstrained banks. Exposed firms remained active and increased investment, while employment did not change. Constrained banks also redirected lending toward larger, more bank-dependent, and more levered firms, but not toward more productive firms. Aggregate resilience can therefore mask substantial reallocation.

The floor also imposed a minimum initial equity requirement: every entrant had to raise AMD 30 billion regardless of its initial scale. The synthetic-control evidence indicates that FinTech entry fell behind comparable countries. The model connects this entry burden to the balance-sheet evidence. Raising the ratio from 12% to 13% or 14% causes assets to fall because banks can partly comply through deleveraging.

Requiring equity issuance instead preserves assets. The Armenian floor produces a large recapitalization and liquid-asset growth, with smaller deposit and loan contractions than an approximately equity-matched ratio increase. The Armenian policy yields a lower probability of successful entry than ratio-based requirements up to and including 17% on our policy grid; at 18% and above, the ordering reverses.

The form of equity regulation is therefore important alongside its headline stringency. Inducing genuine equity issuance can strengthen capitalization without the asset contraction associated with the leverage ratchet, but a fixed nominal floor burdens smaller institutions and entrants. Policy must balance capitalization and credit intermediation against entry and competition. An explicit equity-raising mandate changes how banks meet a moderate ratio increase; it does not eliminate the costs of higher requirements or establish a single policy ranking at all levels of stringency.

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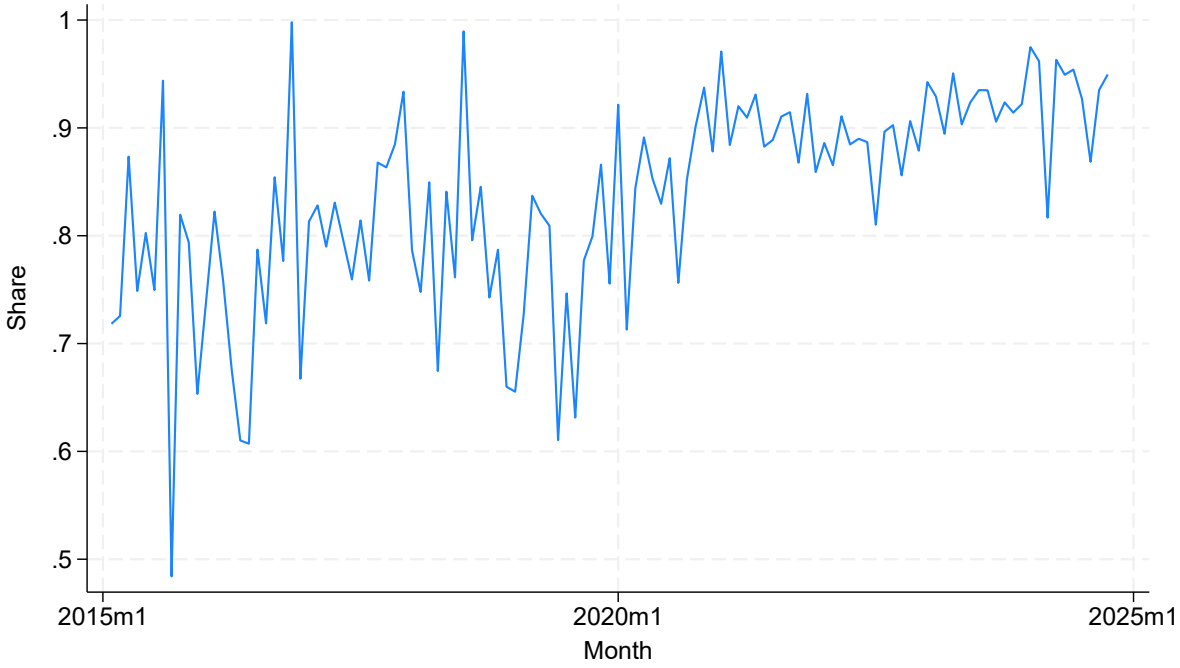
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Internet Appendix

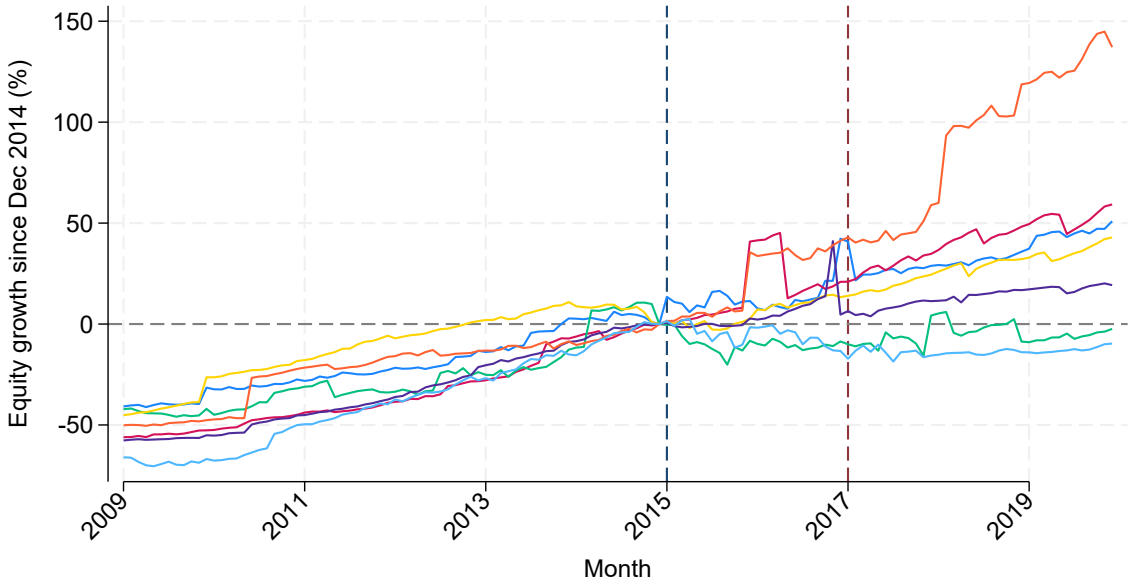
A Additional tables and figures

Figure A.1: Share of Loan Originations in Yerevan



Note: This figure plots the share of loans originated in Yerevan over time.

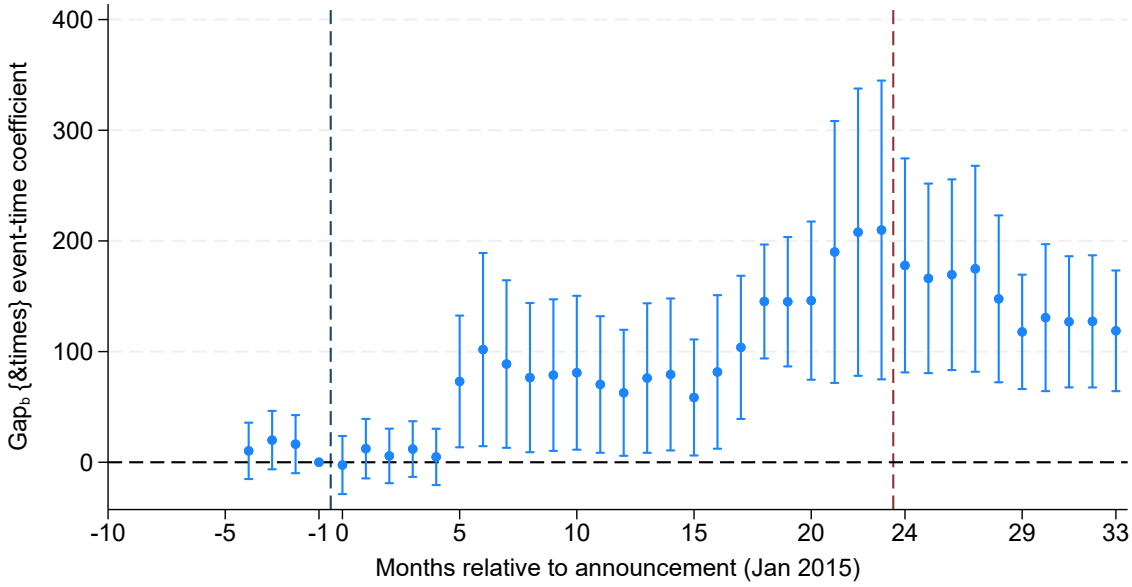
Figure A.2: Equity Growth by Unaffected Banks



Note: This figure plots the evolution of equity over time for the banks that were unaffected by the reform. Unaffected banks are the ones that already had sufficient equity to comply with the reform as of December 2014. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

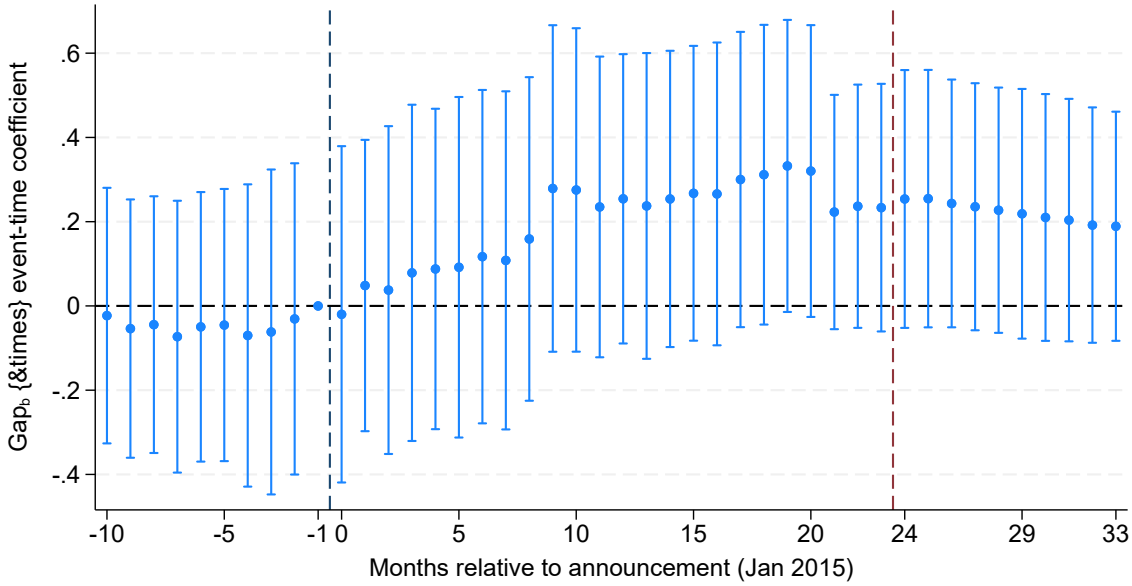
Figure A.3: Impact of the Reform on Tier 1 Capital Ratio

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



Note: This figure plots the results of the event study estimation of equation (2), where the dependent variable is the Tier 1 capital ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.4: Impact of the Reform on Return on Equity



Note: This figure reports the event study in equation (2). Return on equity is trailing twelve-month net profit divided by average monthly book equity over the same twelve months, expressed as a ratio. Monthly profits are recovered from cumulative year-to-date reports. Losses are retained; observations with incomplete twelve-month windows or nonpositive average equity are excluded. Bank and time fixed effects are included. The bars show 95% confidence intervals based on heteroskedasticity-robust standard errors. December 2014 is the omitted reference month. The navy and maroon dashed lines mark the announcement in January 2015 and implementation in January 2017.

Table A.1: Log Number of Lenders of Exposed Borrowers

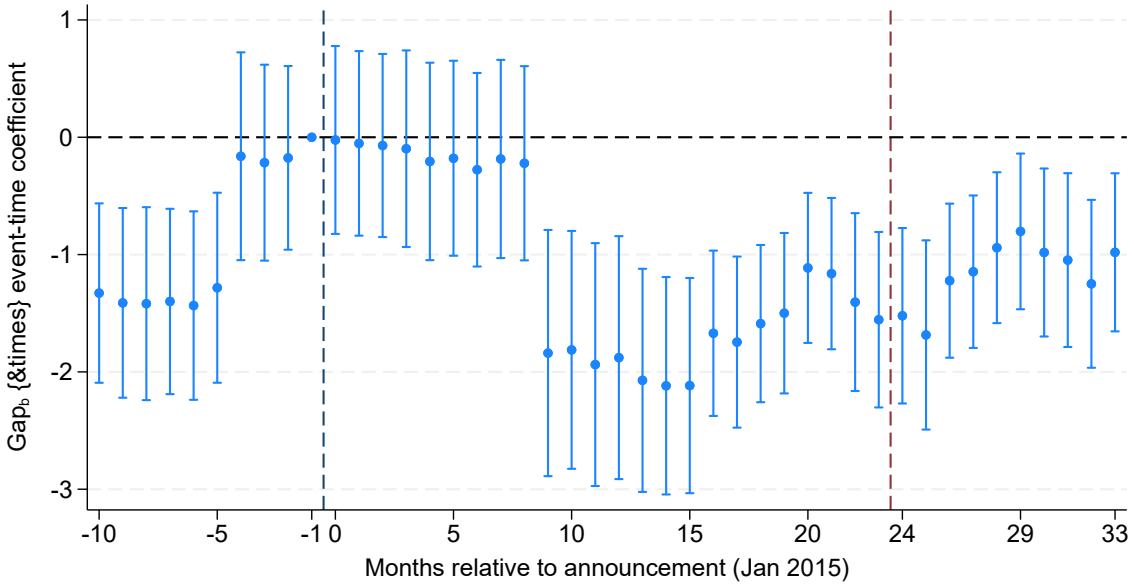
$$Y_{jt} = \mu_j + \eta_{st} + \psi Exposure_j \times Post_t + u_{jt}$$

	(1) Ann.	(2) Eff.	(3) Ann. + sector-year	(4) Placebo
Firm exposure × Post	0.081**	0.115***	0.085**	−0.046
	(0.034)	(0.027)	(0.033)	(0.047)
Firm FE	Yes	Yes	Yes	Yes
Sector × Year FE	No	No	Yes	No
Obs.	95,318	95,318	94,969	95,318
R^2	0.000	0.000	0.000	0.000

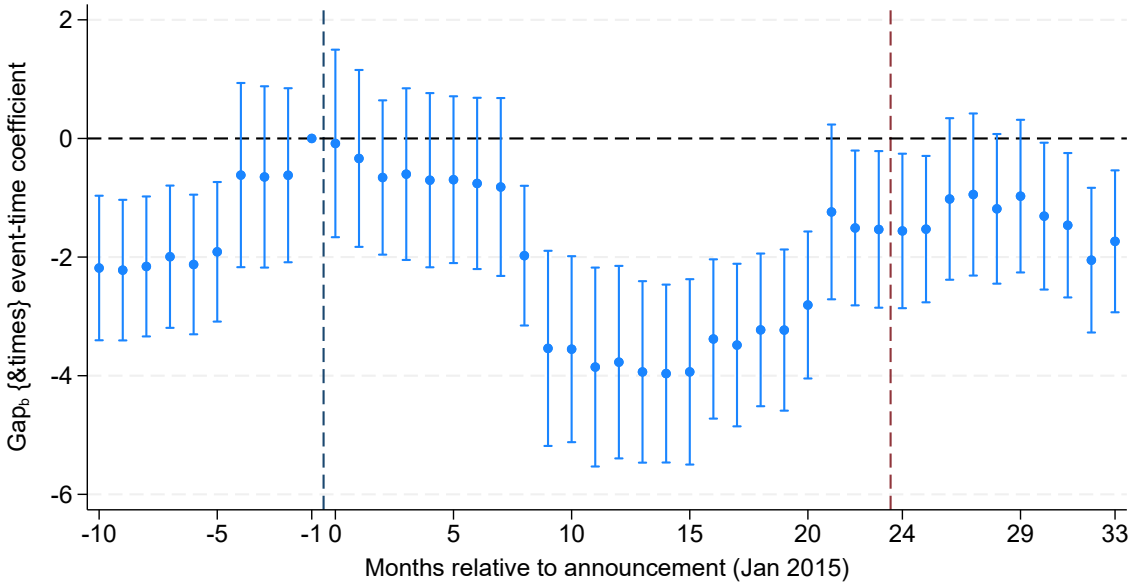
Note: This table reports the results of the estimation of equation (6) where the dependent variable is the log of the number of lenders. Columns (1) and (3) use the announcement date as the post dummy. Column (2) uses the effective date. Column (4) uses the placebo date of January 2013. Industry-time and firm fixed effects are included. Standard errors are heteroskedasticity-robust and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance levels, respectively.

Figure A.5: Impact of the Reform on Deposits and Deposit Growth

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



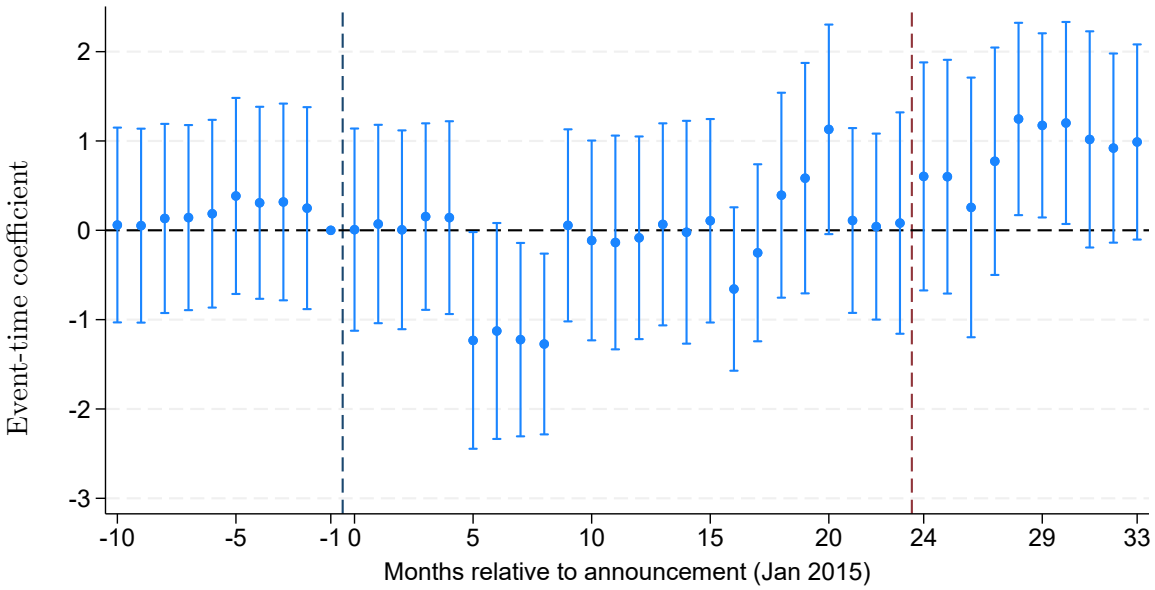
(a) Log Deposits



(b) Deposit Growth

Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the log of deposits. Panel (b) shows the results for the deposit growth. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.6: Impact of the Reform on Other Borrowing



Note: This figure reports the event study in equation (2). The dependent variable is the log of non-deposit liabilities, defined as total liabilities minus customer deposits and used as a broad proxy for other borrowing. Only observations with positive non-deposit liabilities enter the log specification. Bank and time fixed effects are included. The bars show 95% confidence intervals based on heteroskedasticity-robust standard errors. December 2014 is the omitted reference month. The navy and maroon dashed lines mark the announcement in January 2015 and implementation in January 2017.

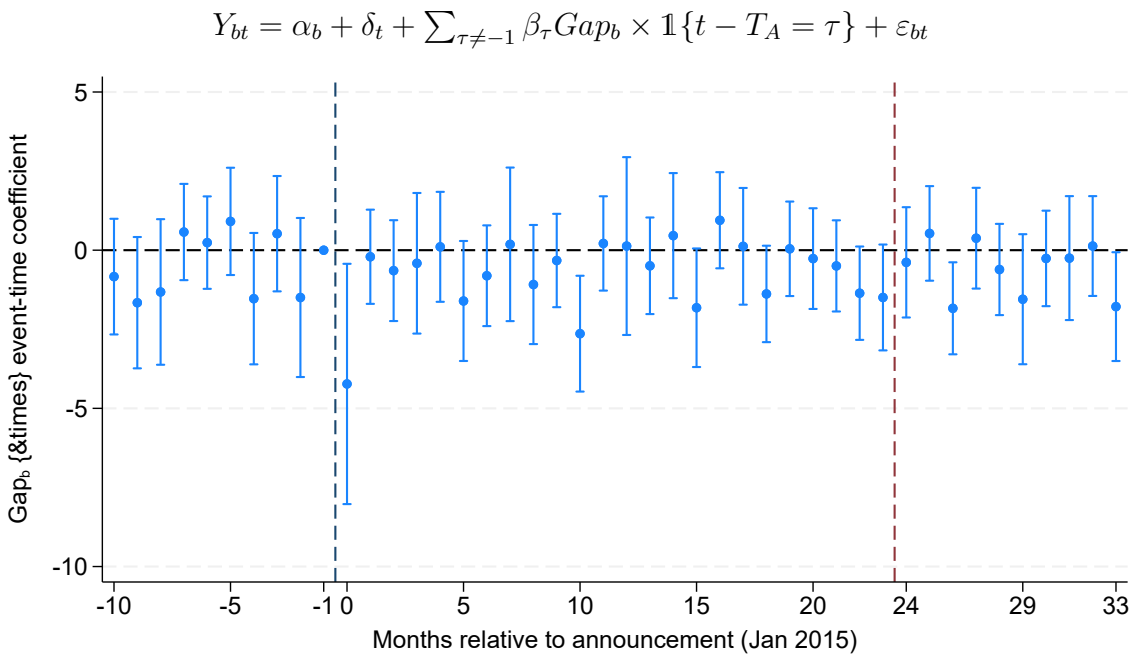
Table A.2: Disbursement Reallocation and Total Firm Credit

$$Y_{jt} = \mu_j + \eta_t + \psi Exposure_j \times Post_t + u_{jt}$$

Outcome	Estimate	Std. err.	p-value	Obs.	Within R^2
Positive-gap banks (million AMD)	-441.915	422.951	0.296	95,318	0.000
Zero-gap banks (million AMD)	3,966.876	1,805.309	0.028	95,318	0.000
Total disbursements (million AMD)	3,525.846	1,904.081	0.064	95,318	0.000
Zero-gap-bank share (percentage points)	1.286	0.082	< 0.001	28,654	0.022
Accounting difference	0.000				

Note: This table reports firm-year regressions of disbursements on pre-announcement firm exposure interacted with a post-announcement indicator. Firm exposure is the weighted average of the December 2014 equity gaps of a firm's lenders and is measured in percentage points. Positive-gap credit, zero-gap credit, and total credit are estimated in levels on the same sample, including zero-credit firm-years. The zero-gap-bank share is defined only for firm-years with positive disbursements. Firm and year fixed effects are included. Standard errors are heteroskedasticity-robust.

Figure A.7: Impact of the Reform on the Number of Loans



Note: This figure plots the results of the event study estimation of equation (2), where the dependent variable is the number of loans. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

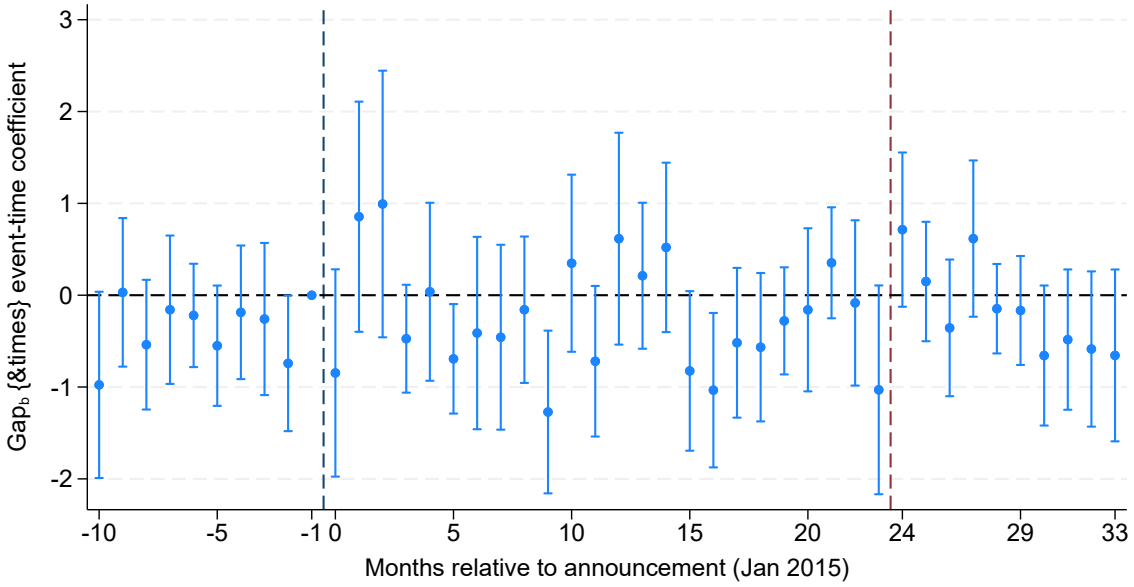
Table A.3: Joint Pretrend Tests for Event Studies

Variable	Joint F	p-value
Equity	0.04	1.000
Equity-to-assets	3.08	0.001
Assets	0.44	0.916
Liquidity ratio	1.15	0.325
Deposits-to-assets	2.10	0.026
Loans-to-assets	0.37	0.951
ROA	0.20	0.994
Disbursed amount of loan supply	0.72	0.689
Contracted amount of loan supply	1.35	0.205
Firm-level activity	0.10	0.958
Firm-level employment	0.21	0.647
Firm-level fixed assets	0.11	0.957

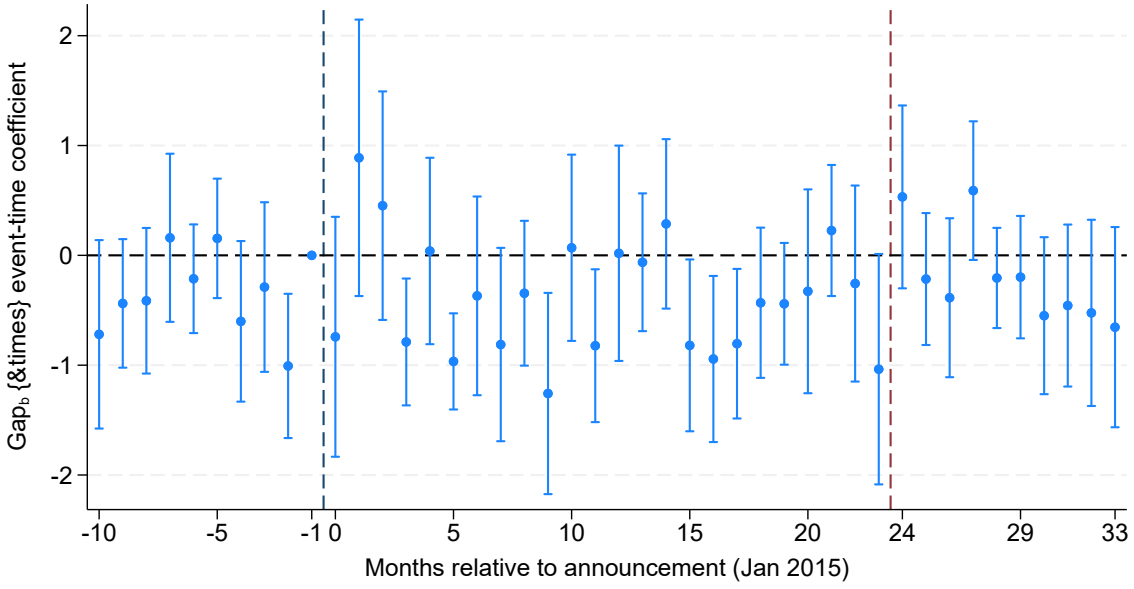
Note: Each row jointly tests that all estimable pre-announcement Gap_b by event-time coefficients shown in the named panel equal zero. The monthly bank and Khwaja–Mian tests cover event months -10 through -2, with December 2014 (event month -1) omitted. The firm tests cover event years -5 through -2, with 2014 (event year -1) omitted. The reported statistic is an F statistic because the null imposes multiple restrictions; a signed t statistic is not defined for this joint hypothesis. Regressions use the same samples, fixed effects, and heteroskedasticity-robust covariance estimators as the main figures.

Figure A.8: Impact of the Reform on Loan Shares

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Disbursed Shares

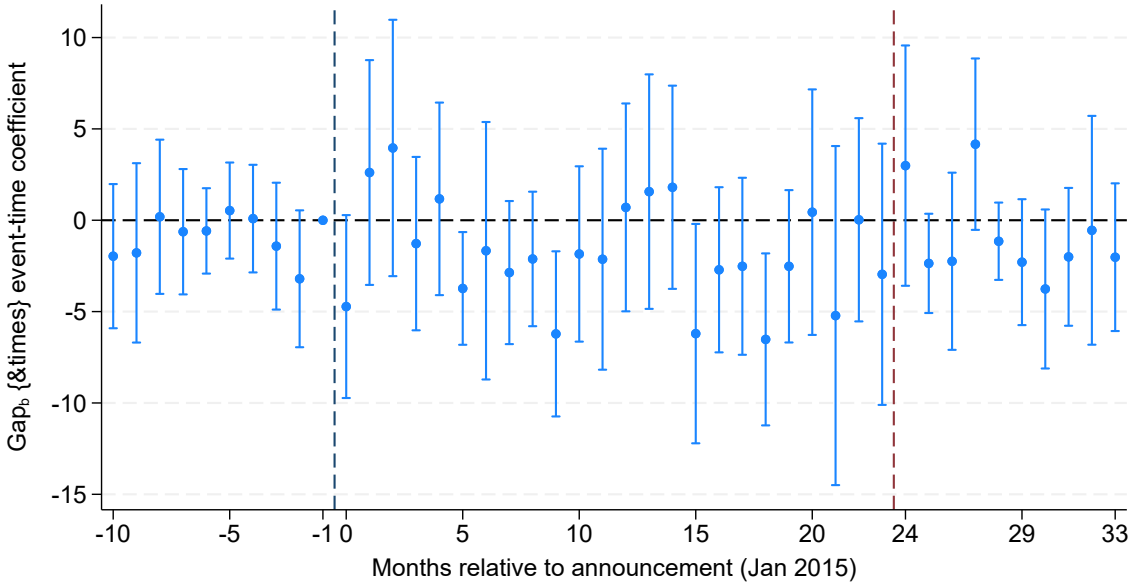


(b) Contracted Shares

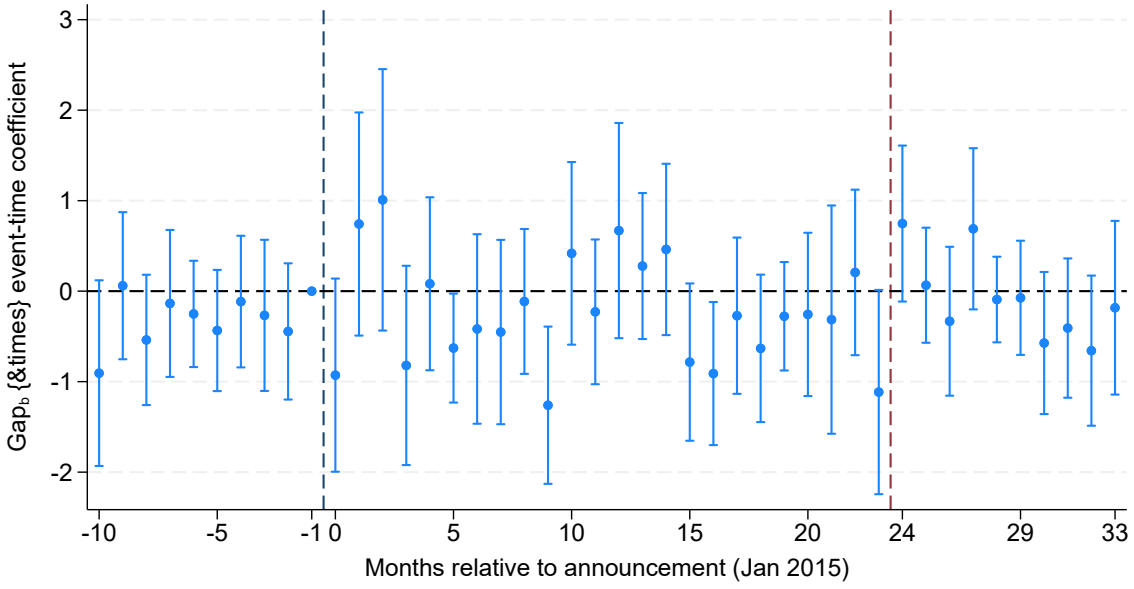
Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008). Panel (a) shows the results for the disbursed shares of loans from the given bank in total borrowing of the firm. Panel (b) shows the results for the contracted shares of loans from the given bank in total borrowing of the firm. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.9: Impact of the Reform on Repaid Amounts and Shares

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Repaid Amount

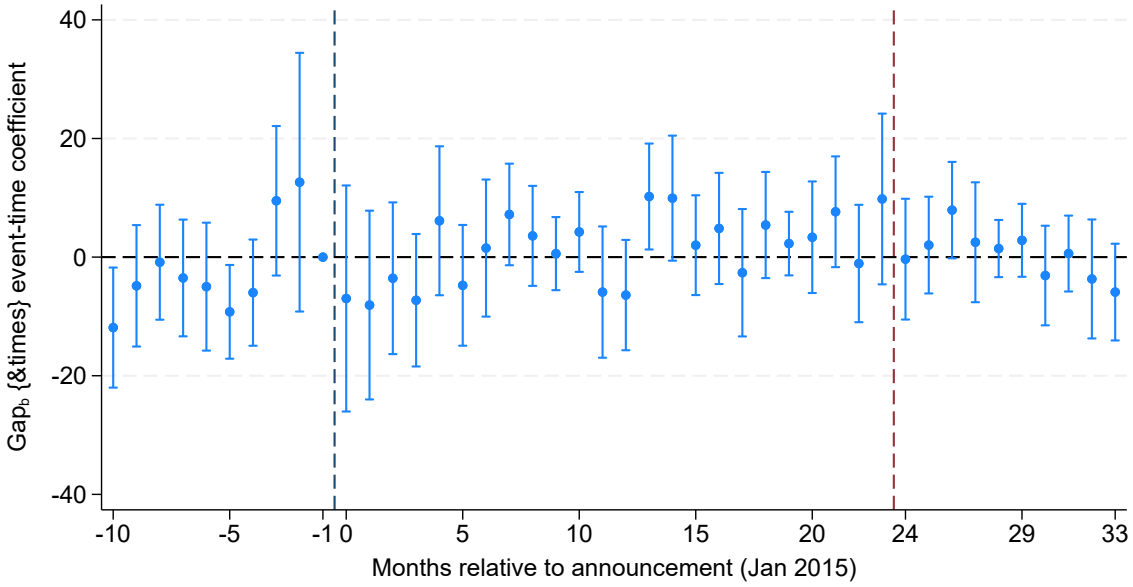


(b) Repaid Shares

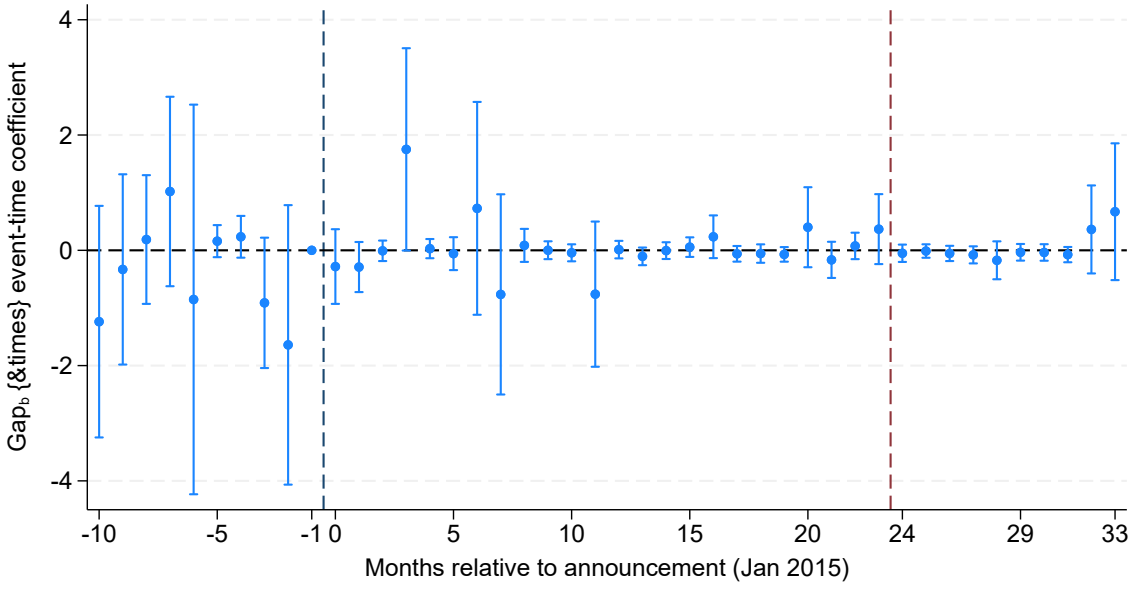
Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008). Panel (a) shows the results for the repaid amounts. Panel (b) shows the results for the repaid shares of loans from the given bank in total borrowing of the firm. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.10: Impact of the Reform on Loan Rates and Risk Scores

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Interest Rate

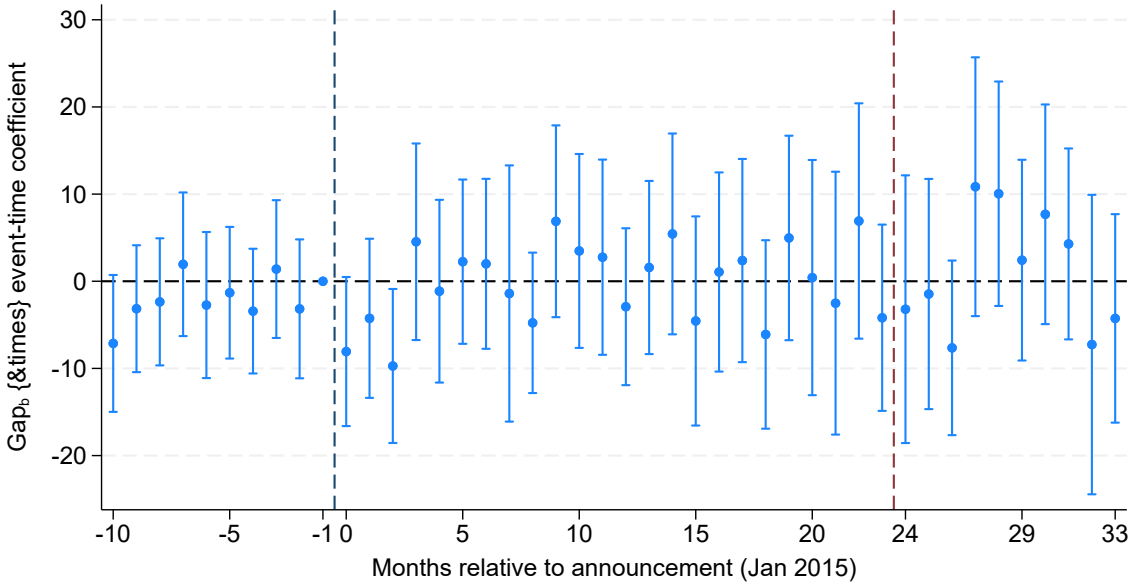


(b) Risk Scores

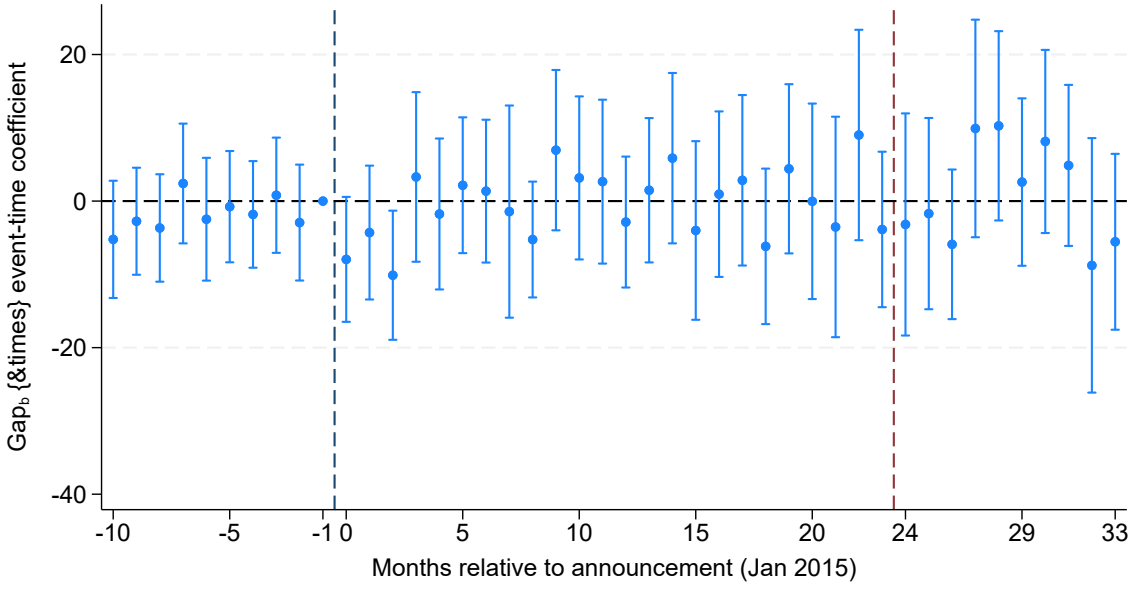
Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008). Panel (a) shows the results for the loan interest rates. Panel (b) shows the results for the risk scores. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.11: Impact of the Reform on Loan Supply: Populated Sample

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Disbursed Amount

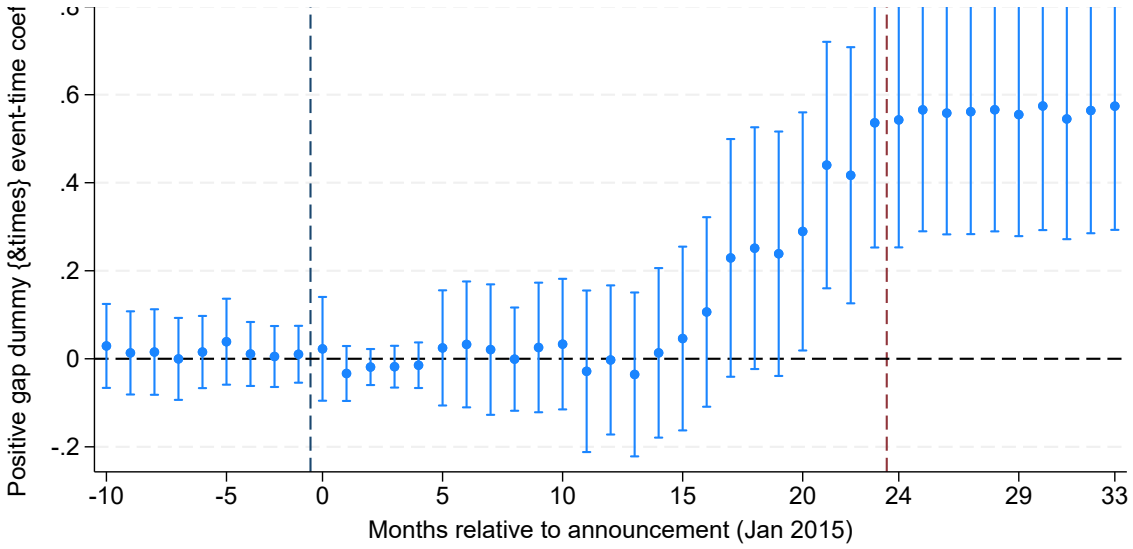


(b) Contracted Amount

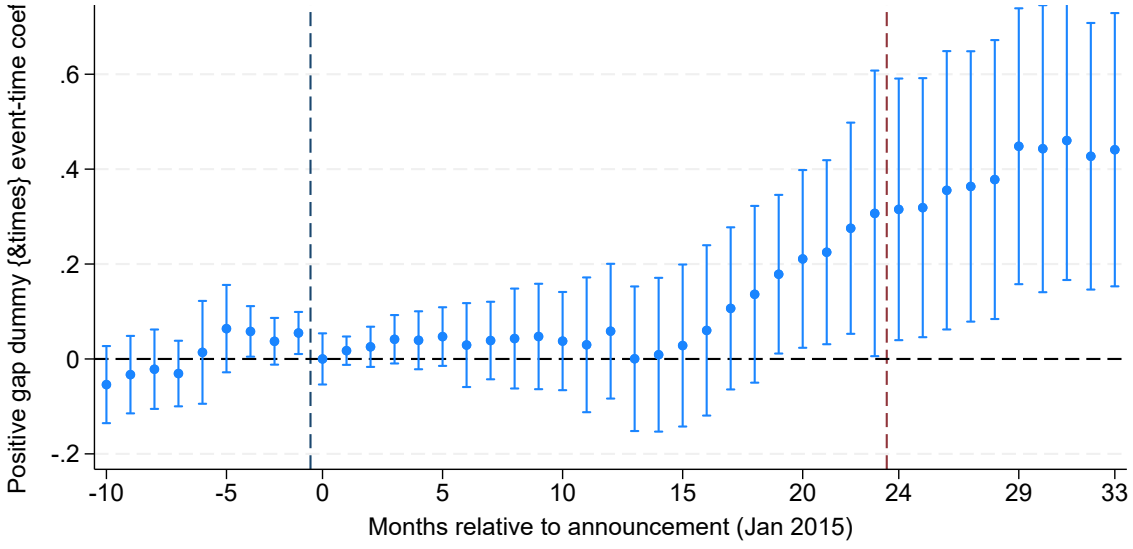
Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008). The sample is populated with the loans already originated before the reform announcement. Panel (a) shows the results for the disbursed amount. Panel (b) shows the results for the contracted amount. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.12: Impact of the Reform on Equity and Assets: Difference-in-Differences

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Treat_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Equity

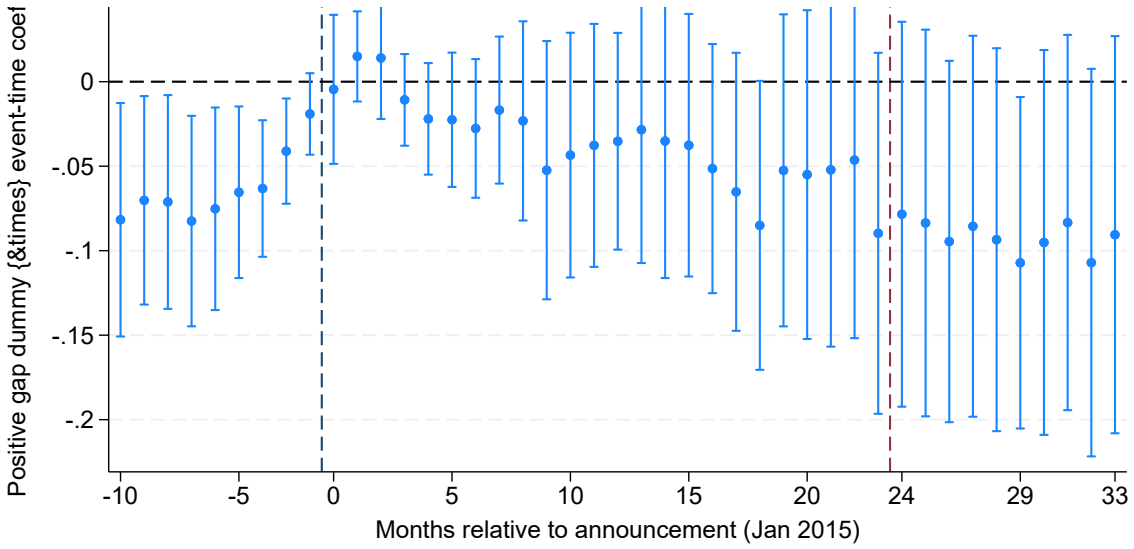


(b) Log Assets

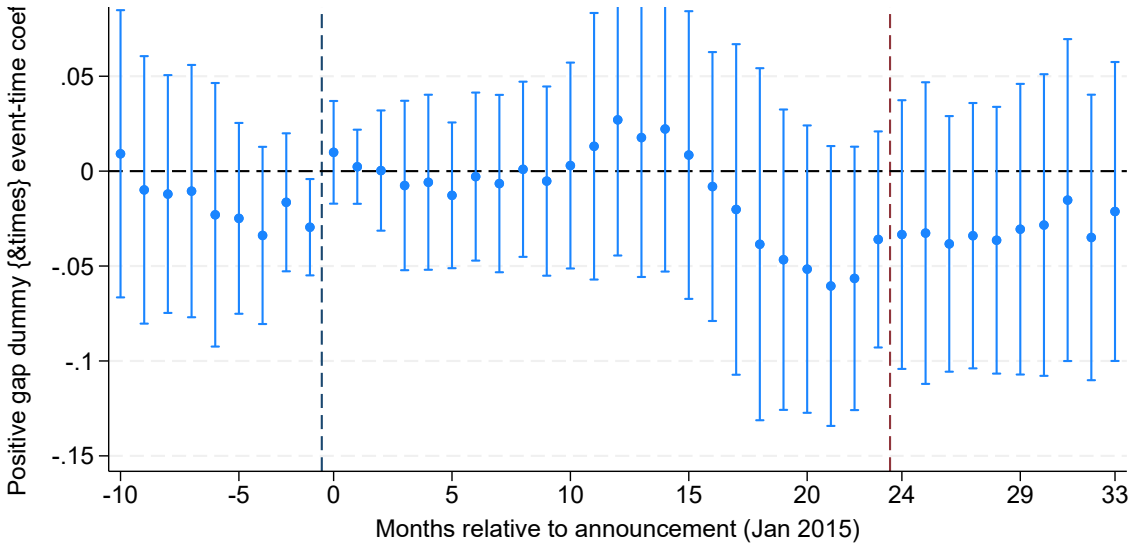
Note: This figure plots the results of the event study estimation of equation (2), but instead of the continuous measure Gap_b, we use a dummy for treated banks. Panel (a) shows the results for the log of equity. Panel (b) shows the results for the log of assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.13: Impact of the Reform on Deposits and Loans: Difference-in-Differences

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Treat_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Deposits-to-assets

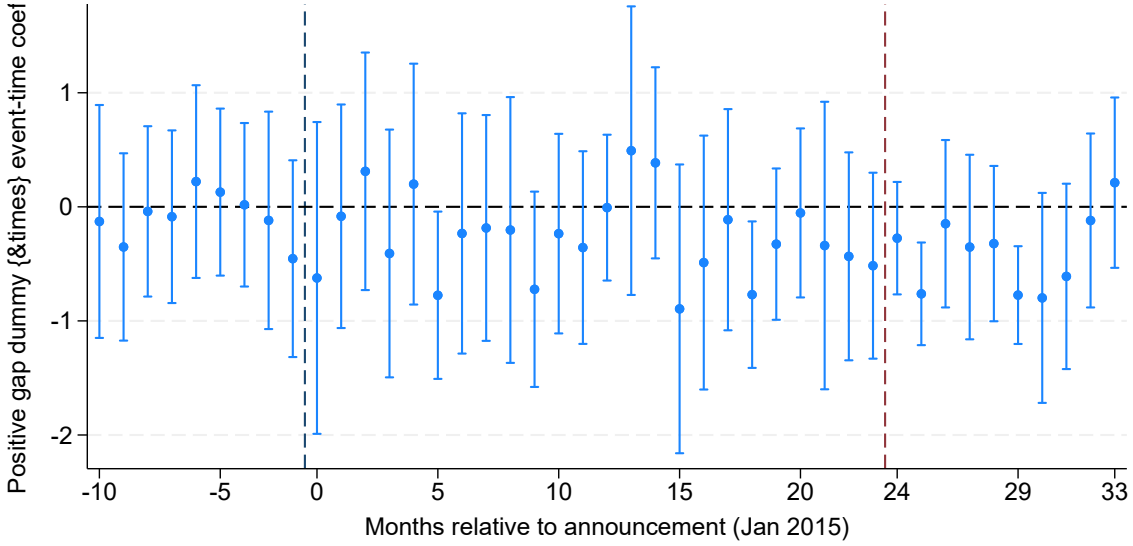


(b) Loans-to-assets

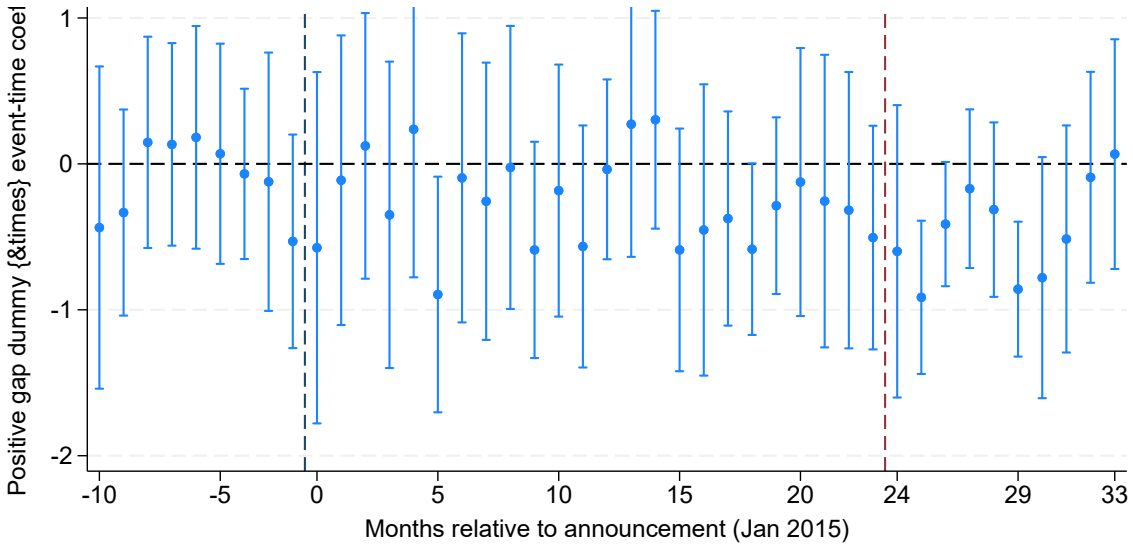
Note: This figure plots the results of the event study estimation of equation (2), but instead of the continuous measure Gap_b, we use a dummy for treated banks. Panel (a) shows the results for the deposits-to-assets ratio. Panel (b) shows the results for the loans-to-assets ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.14: Impact of the Reform on Loan Supply: Difference-in-Differences

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Treat_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Disbursed Amount

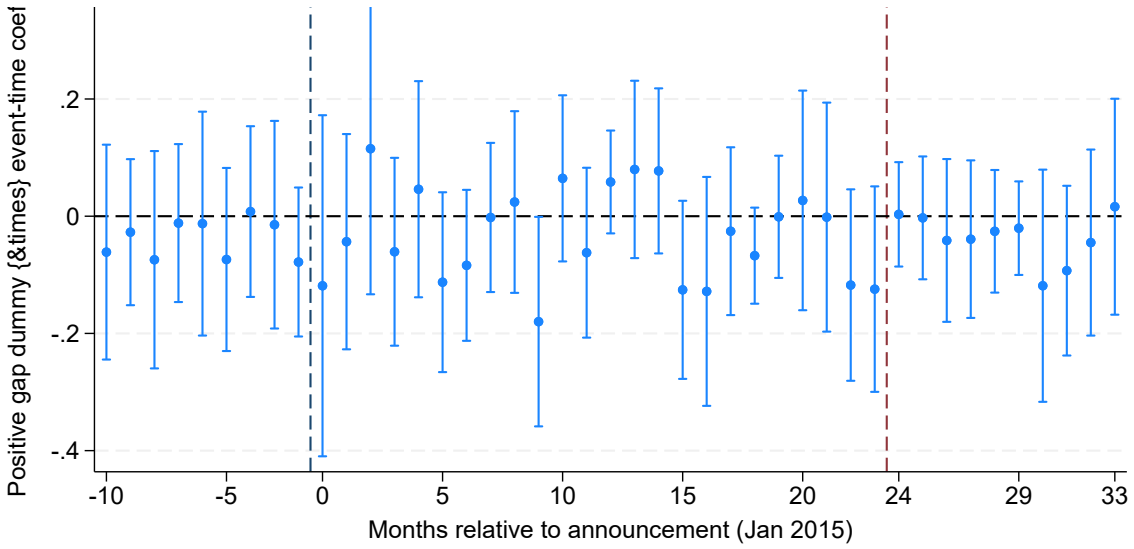


(b) Contracted Amount

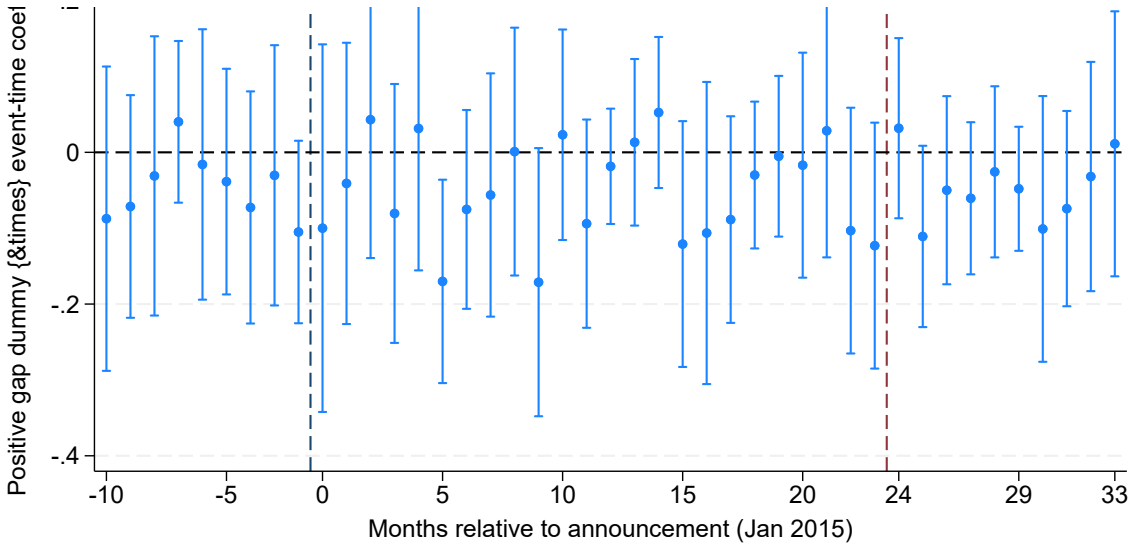
Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008), but instead of the continuous measure Gap_b, we use a dummy for treated banks. Panel (a) shows the results for the disbursed shares of loans from the given bank in total borrowing of the firm. Panel (b) shows the results for the contracted shares of loans from the given bank in total borrowing of the firm. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.15: Impact of the Reform on Loan Shares: Difference-in-Differences

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Treat_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



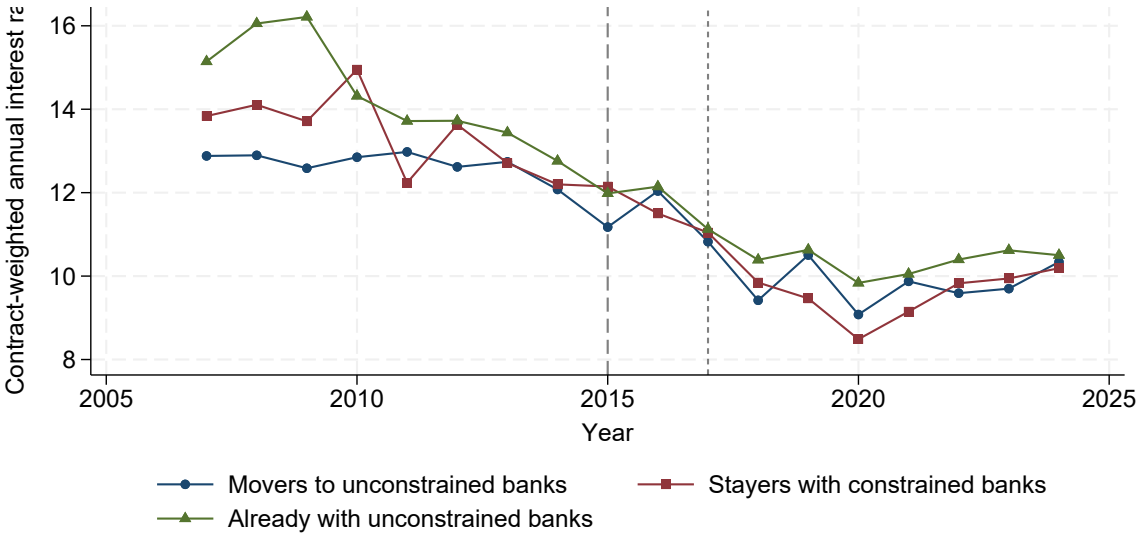
(a) Disbursed Amount



(b) Contracted Amount

Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008), but instead of the continuous measure Gap_b, we use a dummy for treated banks. Panel (a) shows the results for the disbursed amount. Panel (b) shows the results for the contracted amount. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

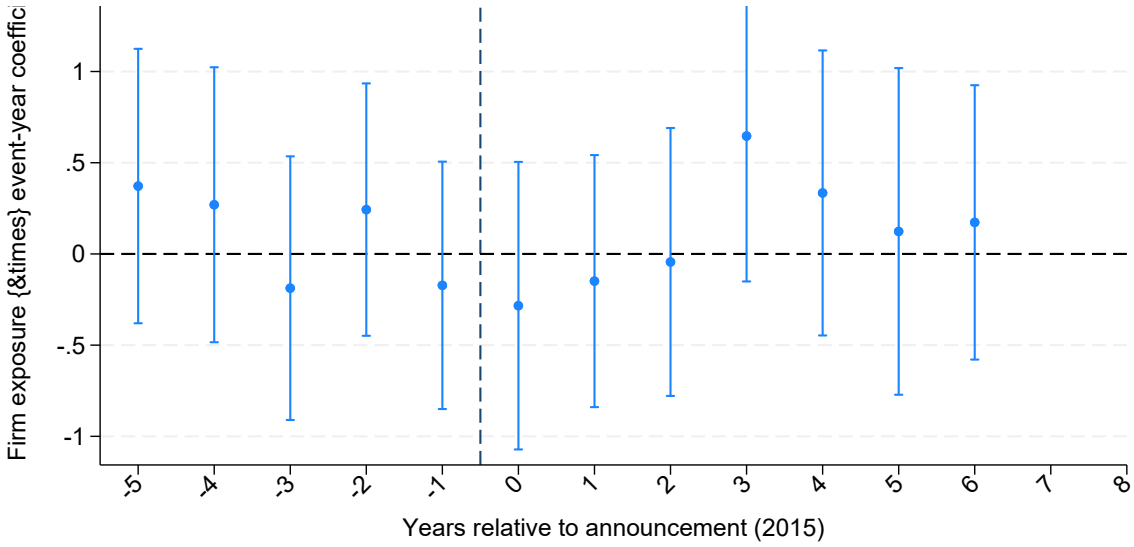
Figure A.16: Lending Interest Rates



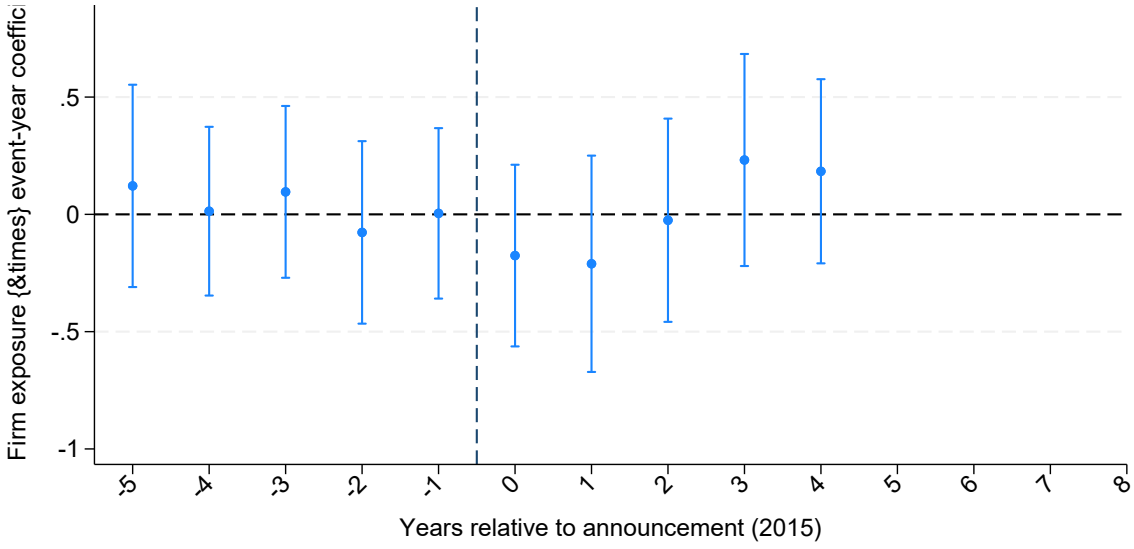
Note: This figure plots the evolution of weighted-average loan rates charged by lenders. The blue circled line shows the rate paid by movers to unconstrained banks. The red squared line shows the rate paid by borrowers who stayed with constrained banks. The green triangular line shows the rate paid by borrowers who were already with unconstrained banks. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.17: Impact of the Reform on Borrowers' Revenues and Wages

$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}$$



(a) Log Operating Revenue

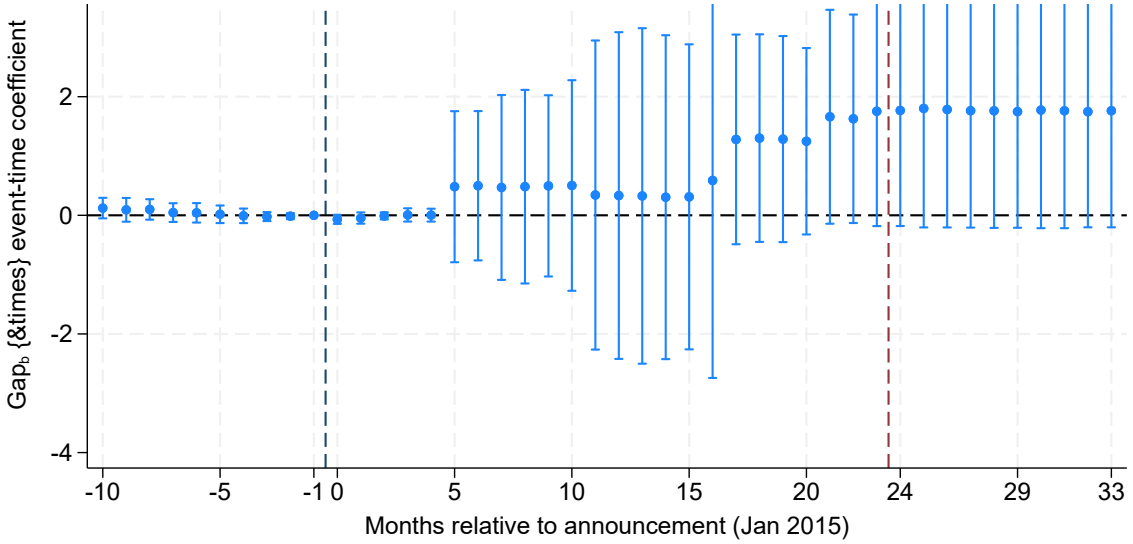


(b) Log Wage Fund

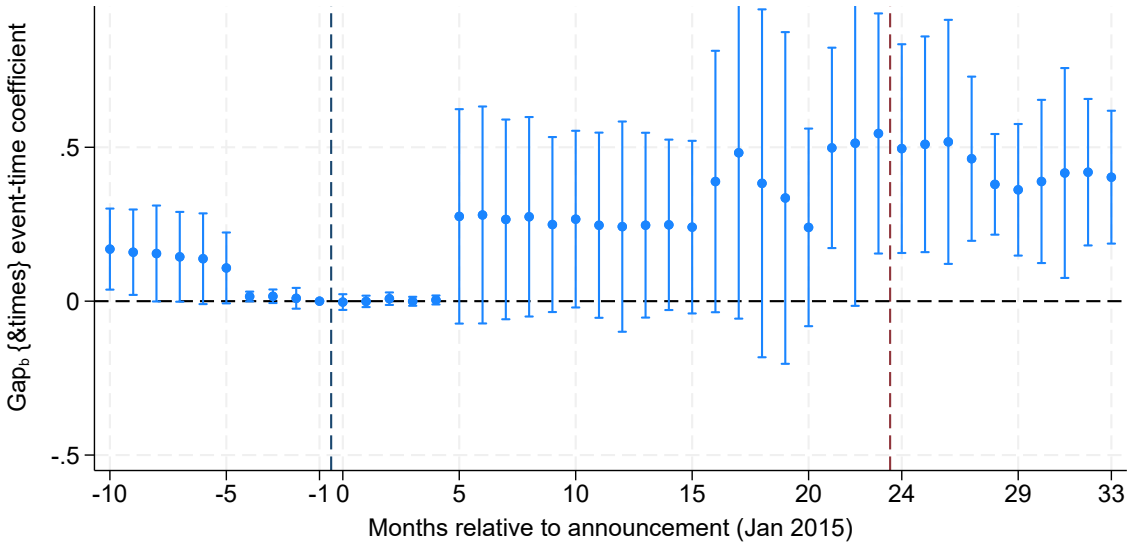
Note: This figure plots the results of the event study estimation of equation (6). Panel (a) shows the results for the log of operating revenues. Panel (b) shows the results for the log of total wage funds. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.18: Impact of the Reform on Equity and Equity Ratio: Clustered Standard Errors

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Equity

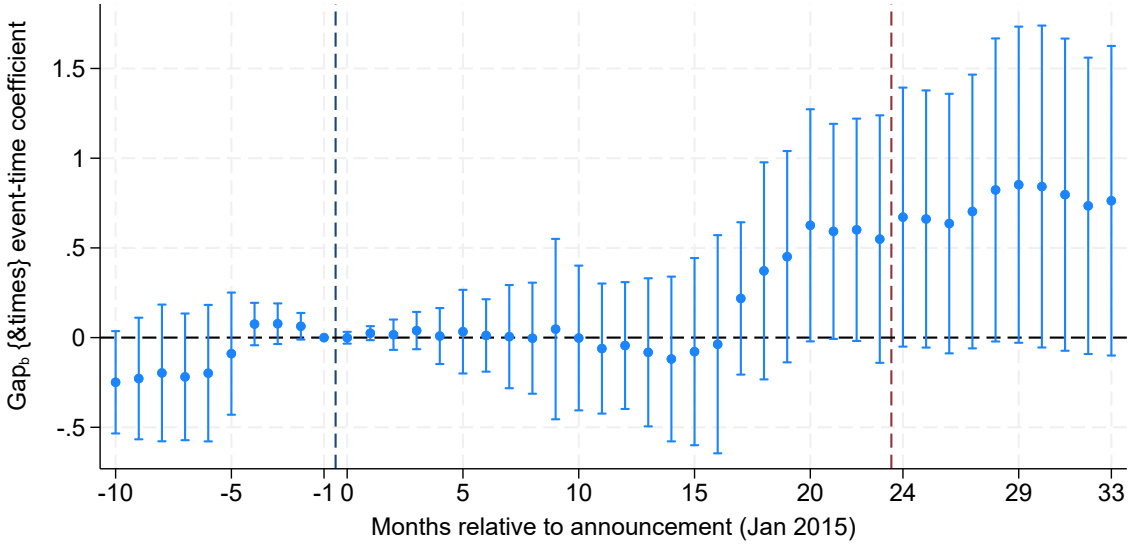


(b) Equity-to-assets

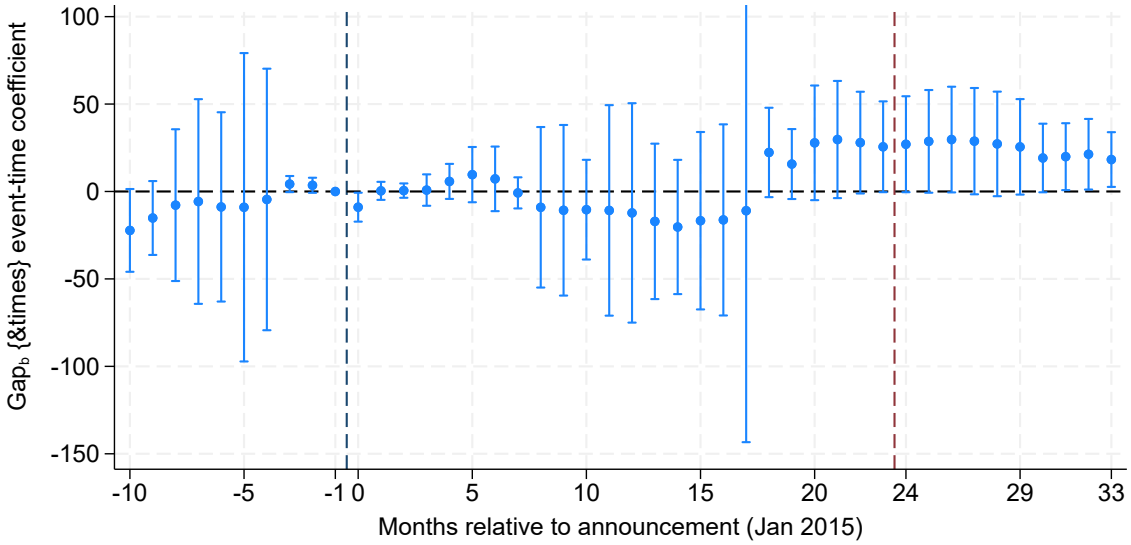
Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the log of equity. Panel (b) shows the results for the equity-to-assets ratio. The 95% confidence intervals are constructed using standard errors clustered at the bank level. Given the small number of clusters, we apply a bootstrap, following Bertrand et al. (2004). Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.19: Impact of the Reform on Assets and Liquidity: Clustered Standard Errors

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Assets

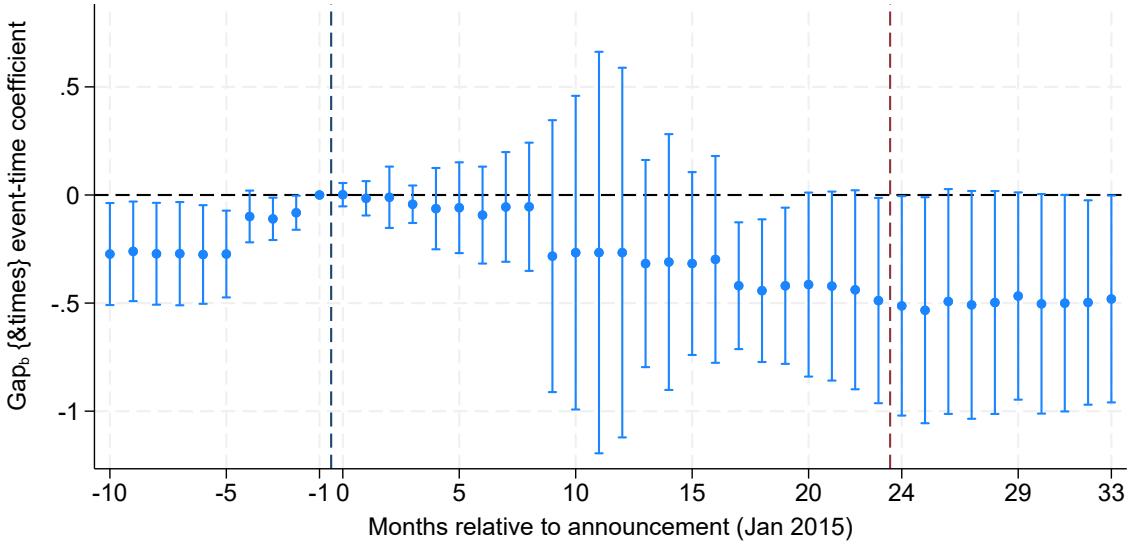


(b) Liquidity Ratio

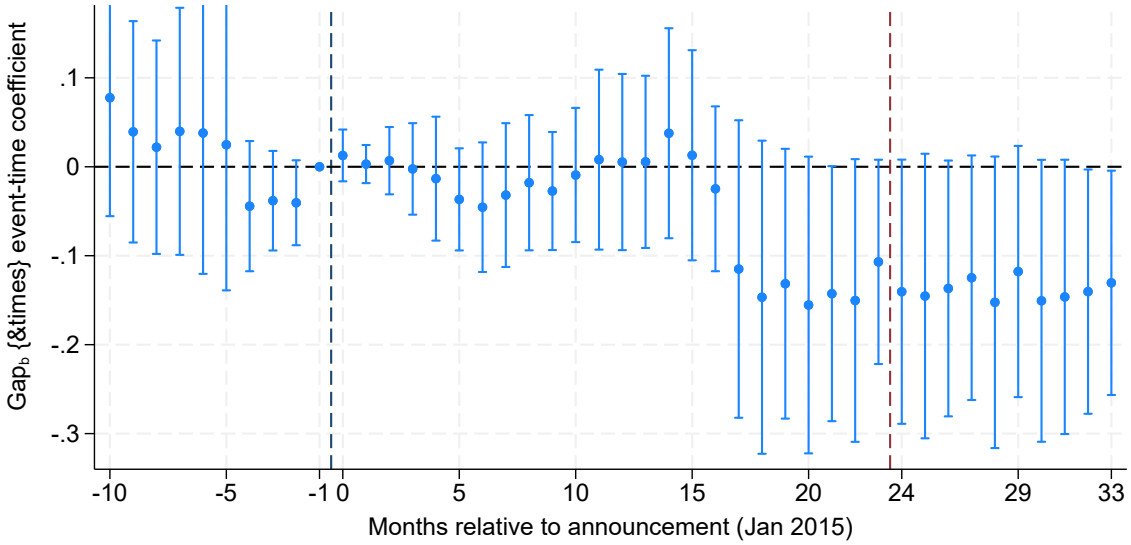
Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the log of total assets. Panel (b) shows the results for the general liquidity ratio, defined as highly liquid assets divided by total assets. The 95% confidence intervals are constructed using standard errors clustered at the bank level. Given the small number of clusters, we apply a bootstrap, following Bertrand et al. (2004). Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.20: Impact of the Reform on Deposits and Loans: Clustered Standard Errors

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Deposits-to-assets

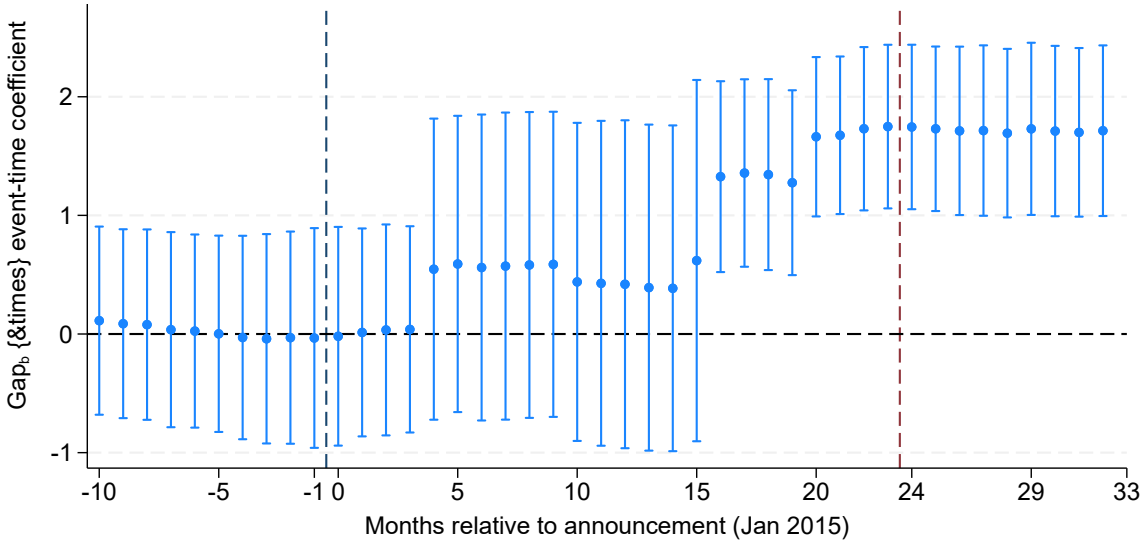


(b) Loans-to-assets

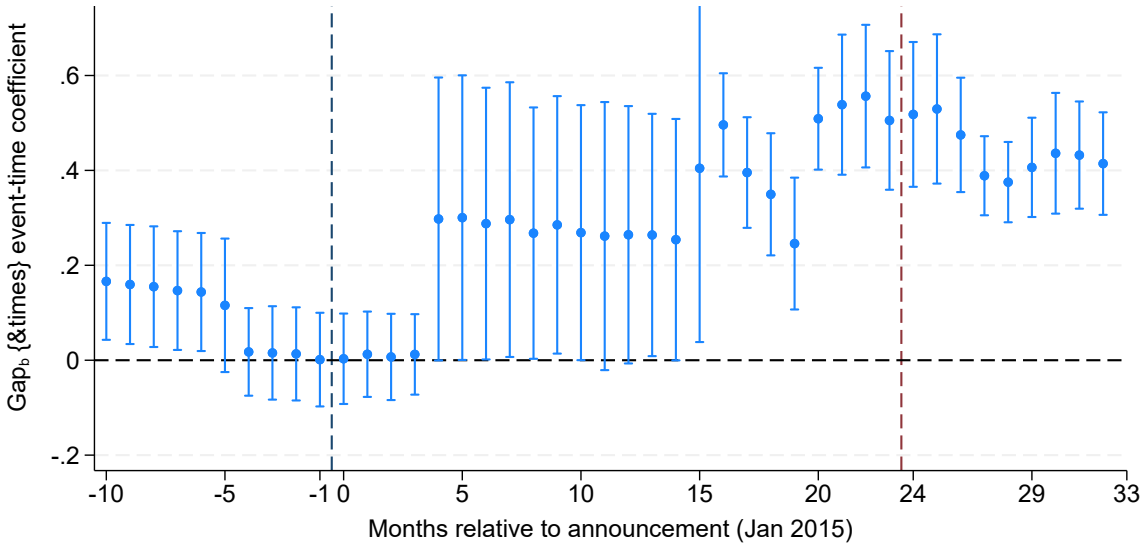
Note: This figure plots the results of the event study estimation of equation (2). Panel (a) shows the results for the deposits-to-assets ratio. Panel (b) shows the results for the loans-to-assets ratio. The 95% confidence intervals are constructed using standard errors clustered at the bank level. Given the small number of clusters, we apply a bootstrap, following Bertrand et al. (2004). Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.21: Impact of the Reform on Equity and Equity Ratio: Dropping Merged Banks

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Equity

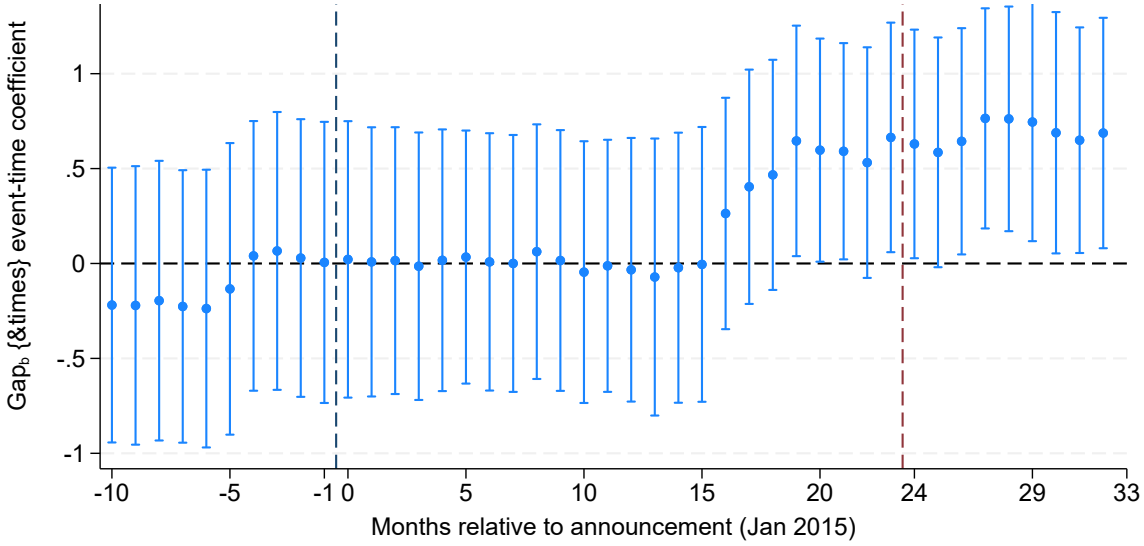


(b) Equity-to-assets

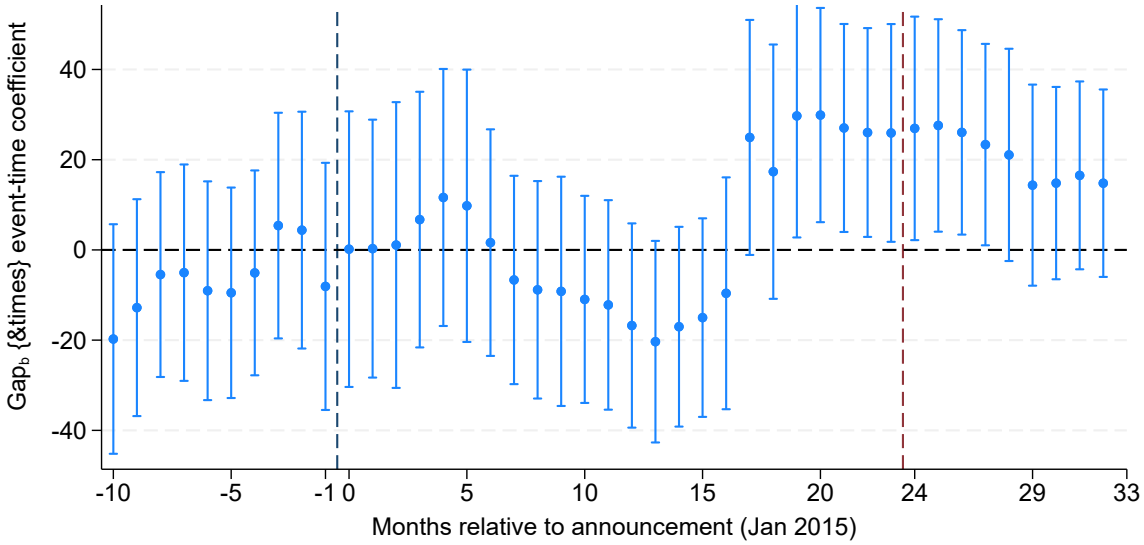
Note: This figure plots the results of the event study estimation of equation (2). Unlike in the main sample, we drop the banks that merged after the reform announcement. Panel (a) shows the results for the log of equity. Panel (b) shows the results for the equity-to-assets ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.22: Impact of the Reform on Assets and Liquidity: Dropping Merged Banks

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Assets

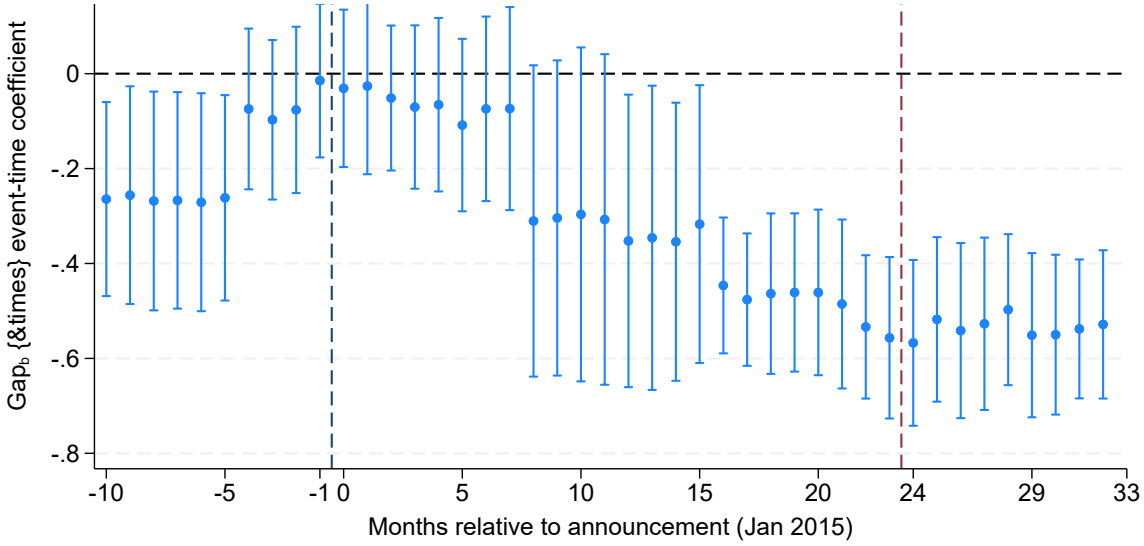


(b) Liquidity Ratio

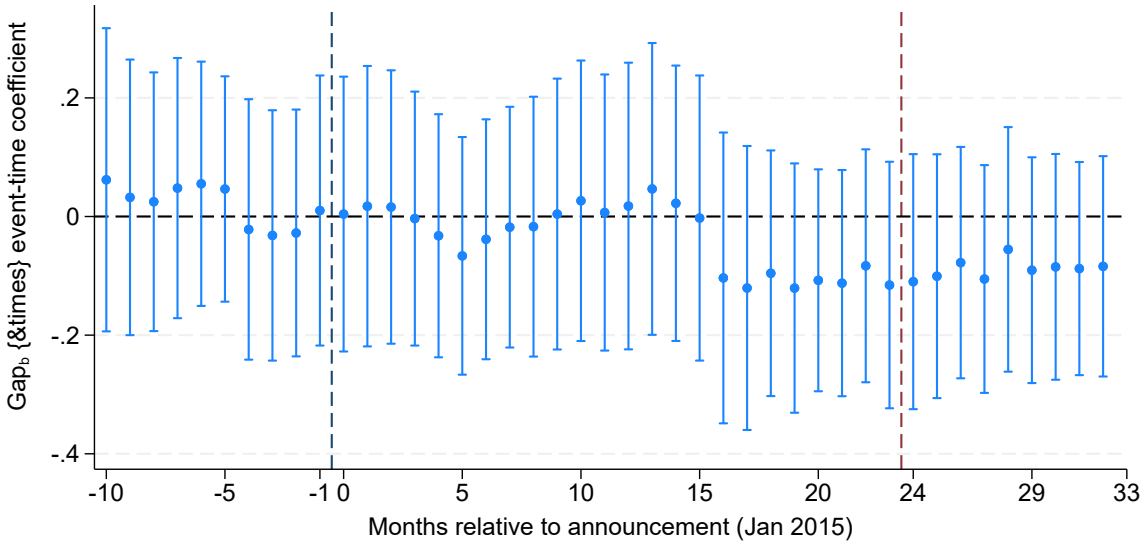
Note: This figure plots the results of the event study estimation of equation (2). Unlike in the main sample, we drop the banks that merged after the reform announcement. Panel (a) shows the results for the log of total assets. Panel (b) shows the results for the general liquidity ratio, defined as highly liquid assets divided by total assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.23: Impact of the Reform on Deposits and Loans: Dropping Merged Banks

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Deposits-to-assets

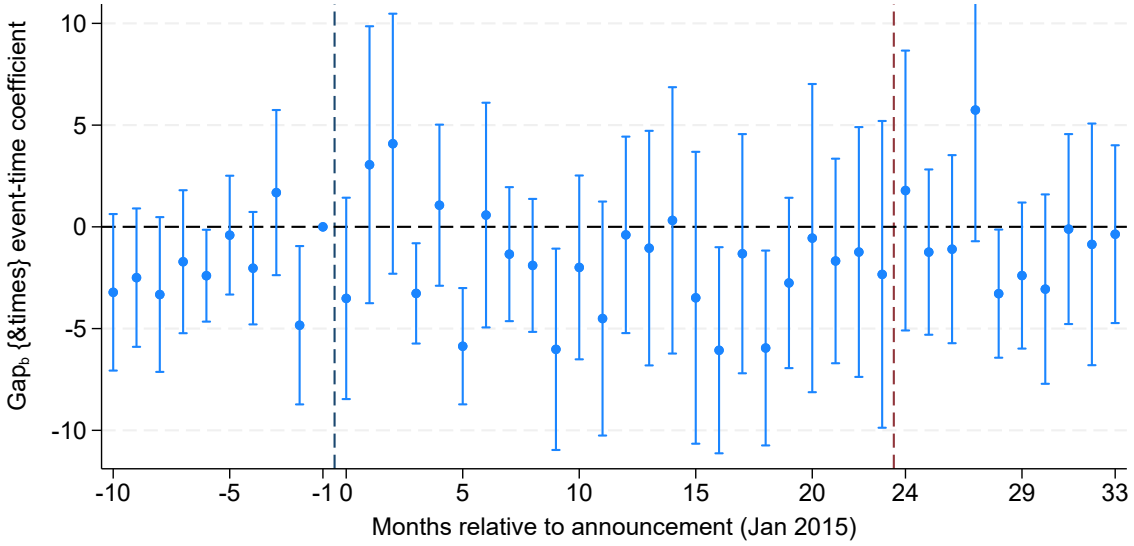


(b) Loans-to-assets

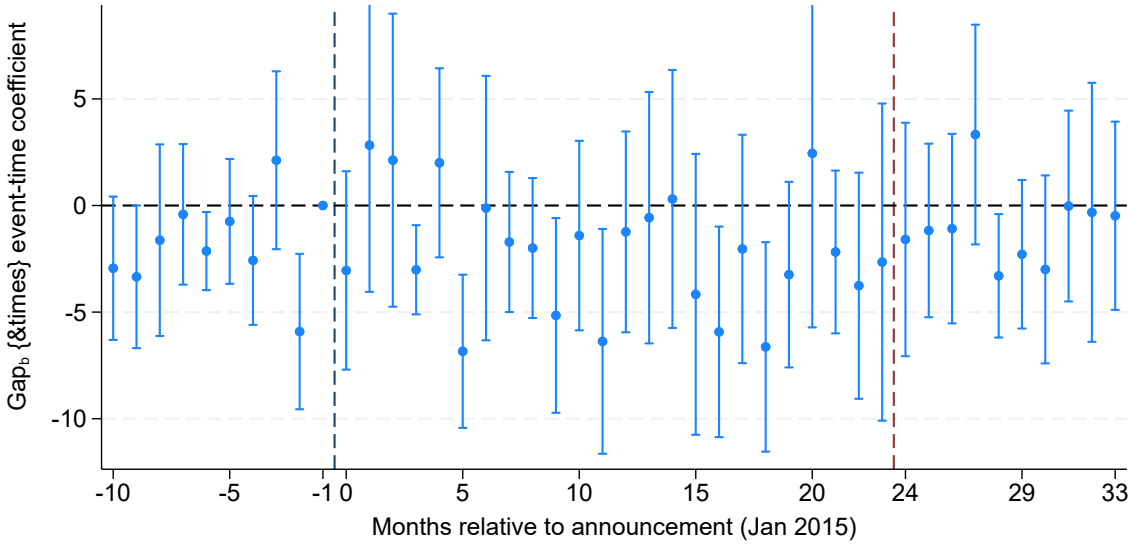
Note: This figure plots the results of the event study estimation of equation (2). Unlike in the main sample, we drop the banks that merged after the reform announcement. Panel (a) shows the results for the deposits-to-assets ratio. Panel (b) shows the results for the loans-to-assets ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.24: Impact of the Reform on Loan Supply: Dropping Merged Banks

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Disbursed Amount

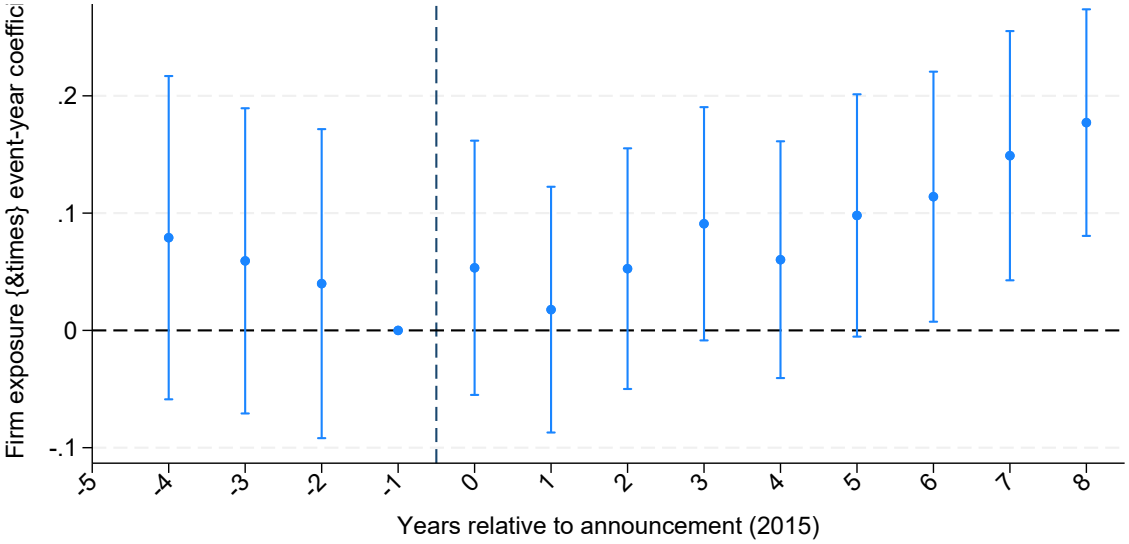


(b) Contracted Amount

Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008). Unlike in the main sample, we drop the banks that merged after the reform announcement. Panel (a) shows the results for the disbursed amount. Panel (b) shows the results for the contracted amount. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.25: Impact of the Reform on Borrowers' Activity: Dropping Merged Banks

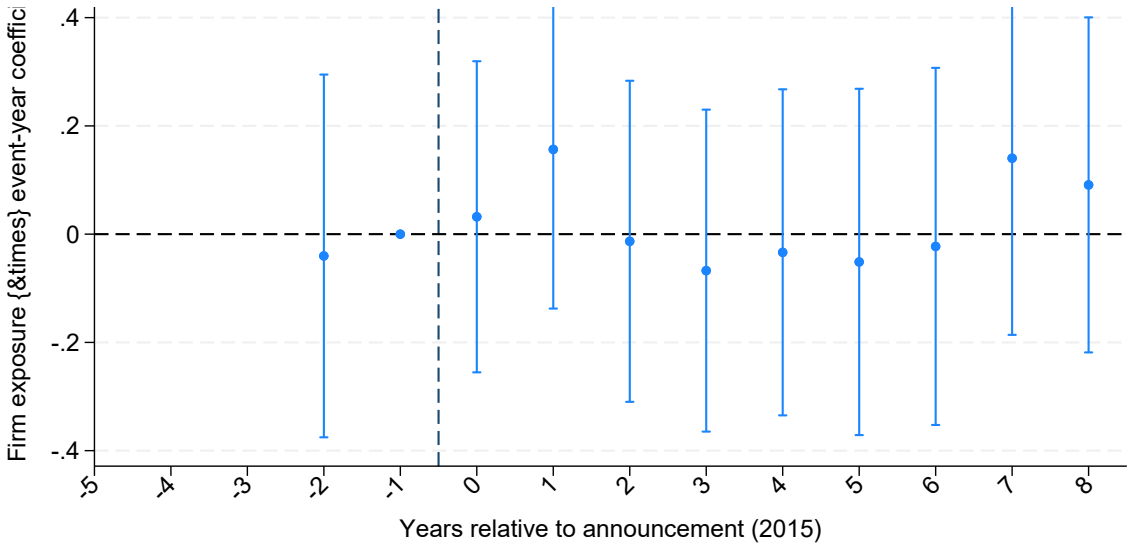
$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}$$



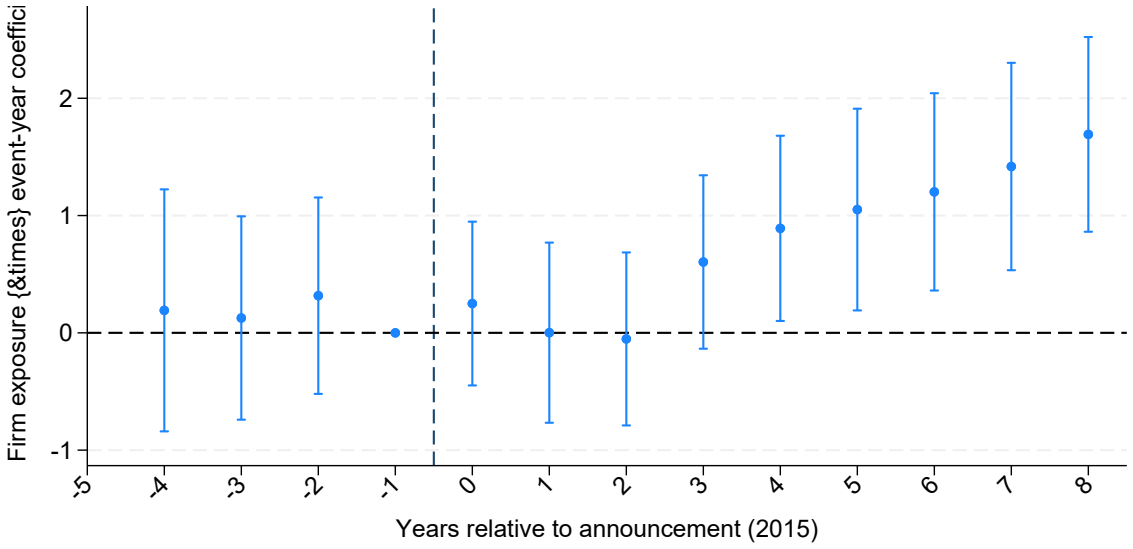
Note: This figure plots the results of the event study estimation of equation (6), where the dependent variable is a dummy equal to one if the firm is still active as of 2025. Unlike in the main sample, we drop the banks that merged after the reform announcement. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.26: Impact of the Reform on Borrowers' Size and Investments: Dropping Merged Banks

$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}$$



(a) Log Employment

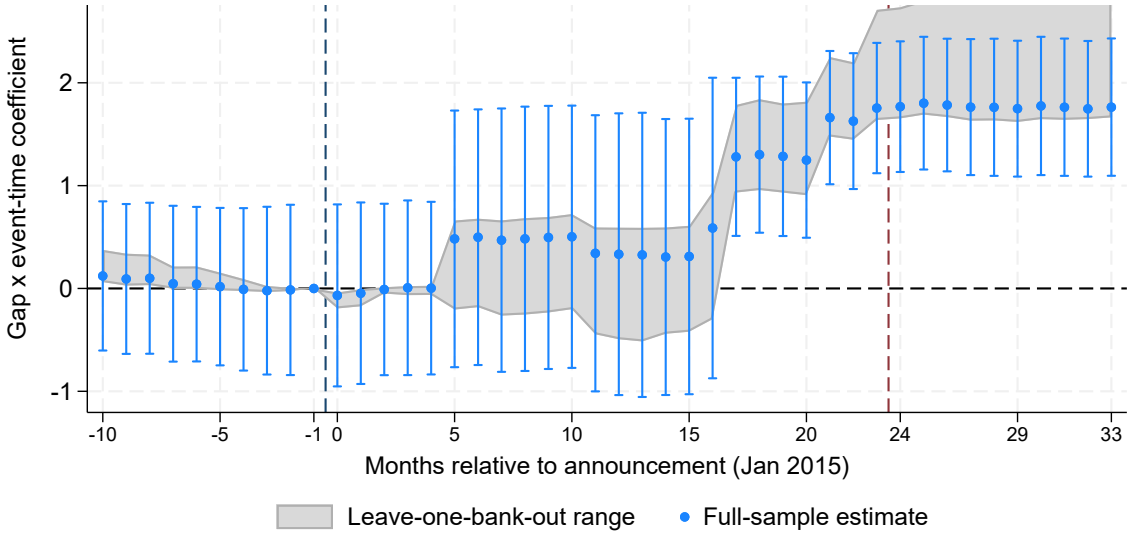


(b) Log Fixed Assets

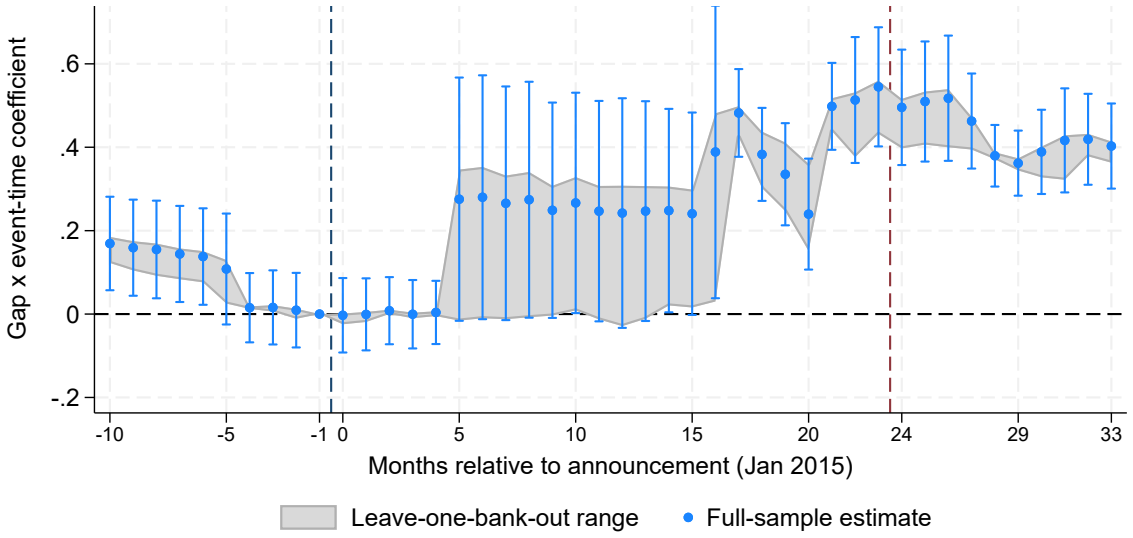
Note: This figure plots the results of the event study estimation of equation (6). Unlike in the main sample, we drop the banks that merged after the reform announcement. Panel (a) shows the results for the log of employment. Panel (b) shows the results for the log of fixed assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.27: Impact of the Reform on Equity and Equity Ratio: Leave-One-Out Estimates

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Equity

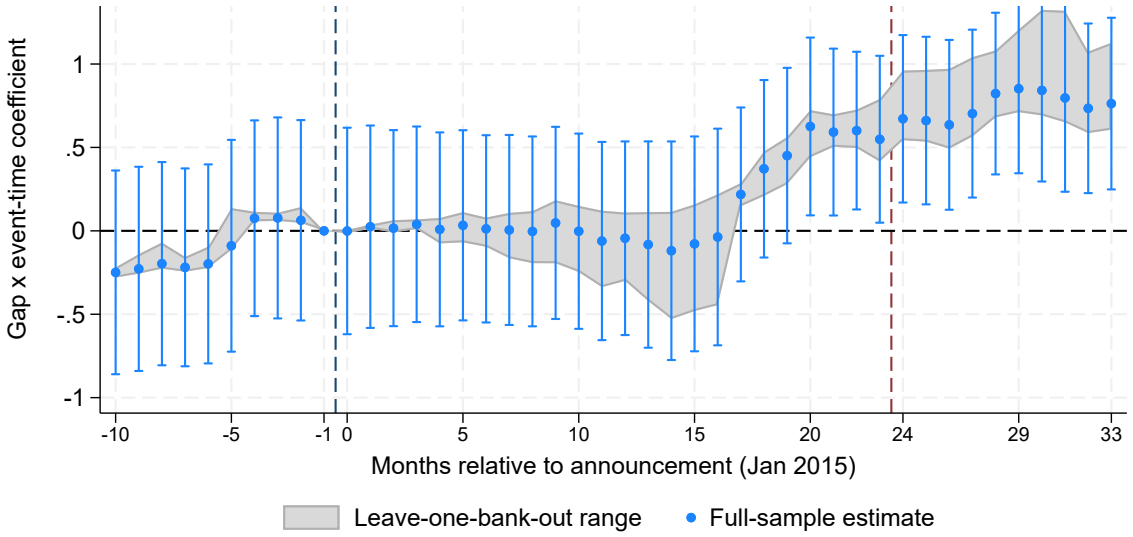


(b) Equity-to-assets

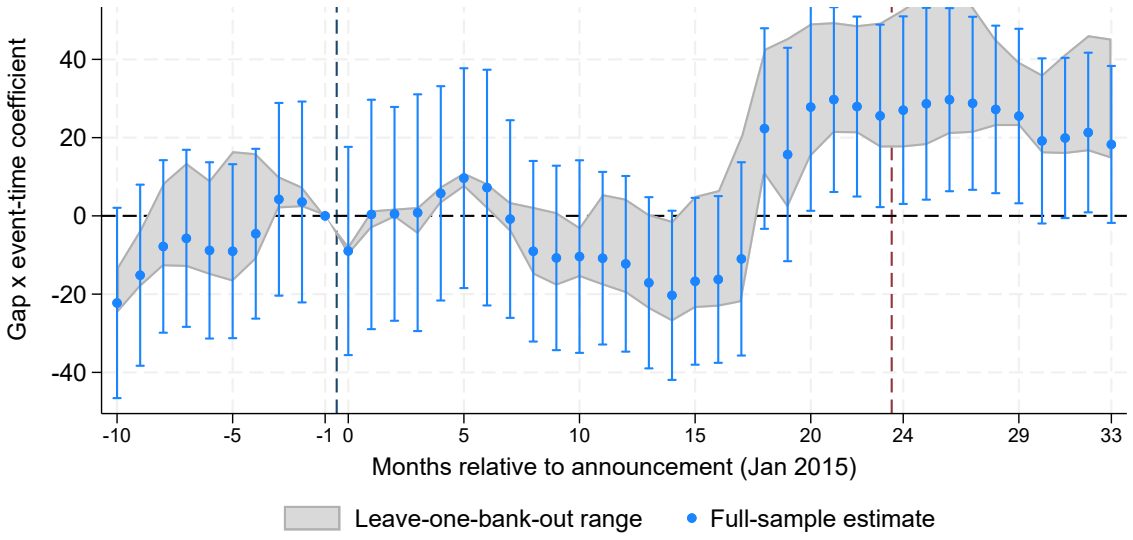
Note: This figure plots the results of the event study estimation of equation (2). For each bank, we remove that bank from the sample and re-estimate the identical event-study specification. At every event date, the gray band reports the minimum and maximum coefficient across all leave-one-bank-out estimates. Panel (a) shows the results for the log of equity. Panel (b) shows the results for the equity-to-assets ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.28: Impact of the Reform on Assets and Liquidity: Leave-One-Out Estimates

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Log Assets

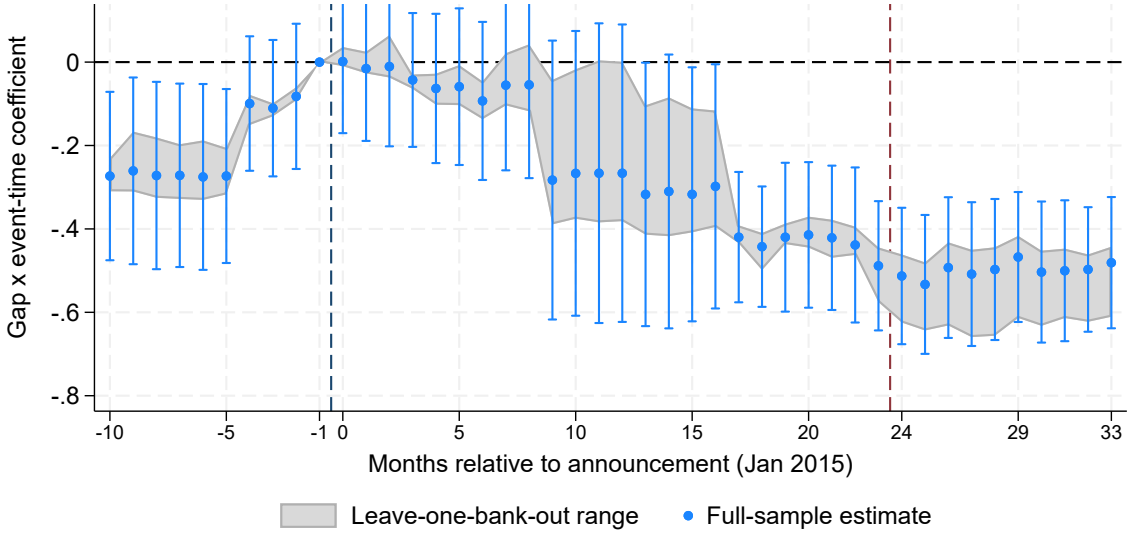


(b) Liquidity Ratio

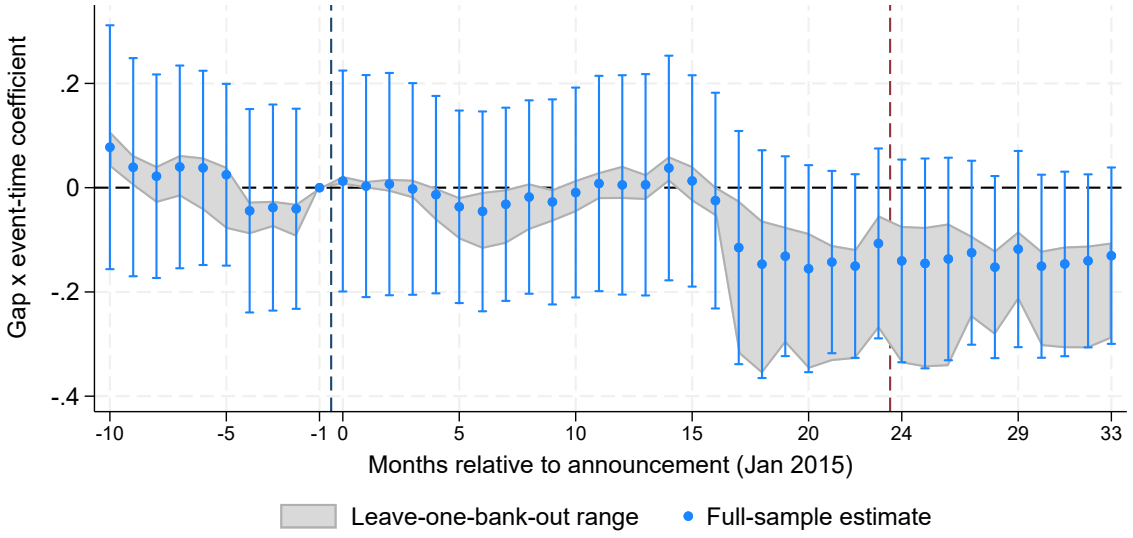
Note: This figure plots the results of the event study estimation of equation (2). For each bank, we remove that bank from the sample and re-estimate the identical event-study specification. At every event date, the gray band reports the minimum and maximum coefficient across all leave-one-bank-out estimates. Panel (a) shows the results for the log of total assets. Panel (b) shows the results for the general liquidity ratio, defined as highly liquid assets divided by total assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.29: Impact of the Reform on Deposits and Loans: Leave-One-Out Estimates

$$Y_{bt} = \alpha_b + \delta_t + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bt}$$



(a) Deposits-to-assets

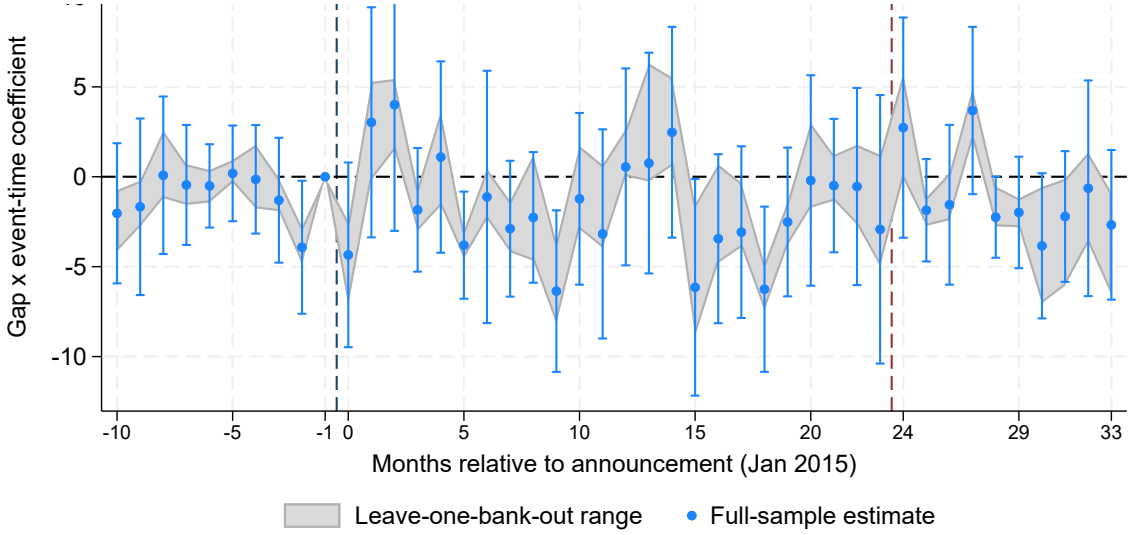


(b) Loans-to-assets

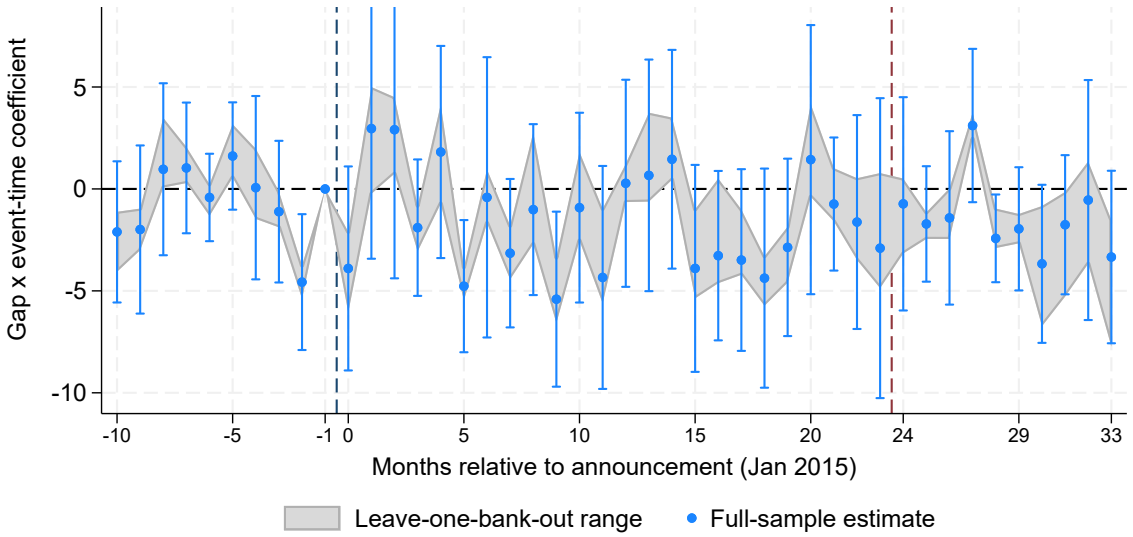
Note: This figure plots the results of the event study estimation of equation (2). For each bank, we remove that bank from the sample and re-estimate the identical event-study specification. At every event date, the gray band reports the minimum and maximum coefficient across all leave-one-bank-out estimates. Panel (a) shows the results for the deposits-to-assets ratio. Panel (b) shows the results for the loans-to-assets ratio. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Bank and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.30: Impact of the Reform on Loan Supply: Leave-One-Out Estimates

$$Y_{bjt} = \alpha_{jt} + \gamma_b + \sum_{\tau \neq -1} \beta_\tau Gap_b \times \mathbb{1}\{t - T_A = \tau\} + \varepsilon_{bjt}$$



(a) Disbursed Amount

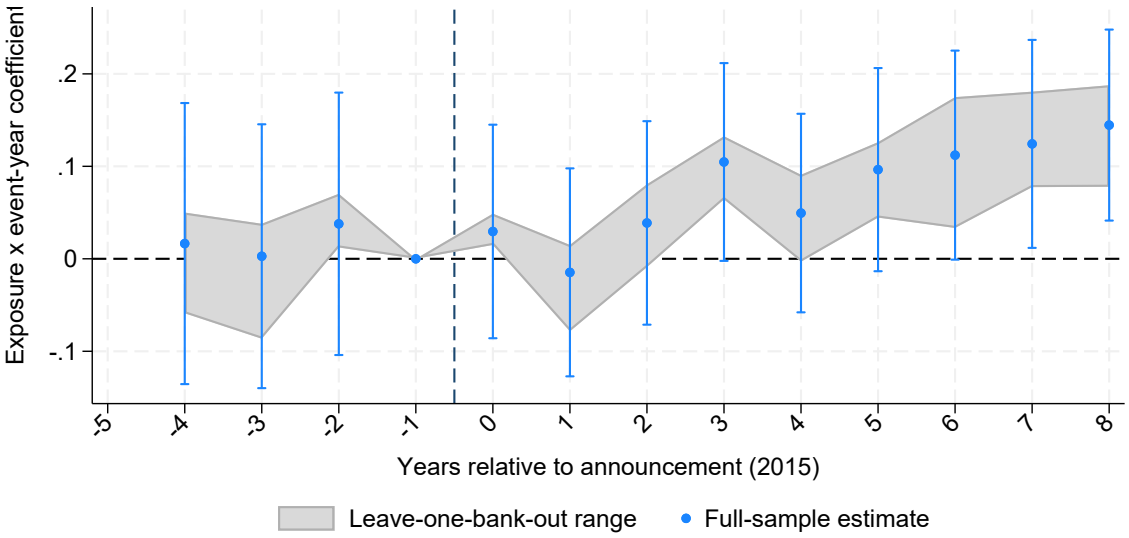


(b) Contracted Amount

Note: This figure plots the results of the event study estimation of equation (4) that uses the methodology from Khwaja and Mian (2008). For each bank, we remove that bank from the sample and re-estimate the identical event-study specification. At every event date, the gray band reports the minimum and maximum coefficient across all leave-one-bank-out estimates. Panel (a) shows the results for the disbursed amount. Panel (b) shows the results for the contracted amount. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower-time and bank fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.31: Impact of the Reform on Borrowers' Activity: Leave-One-Out Estimates

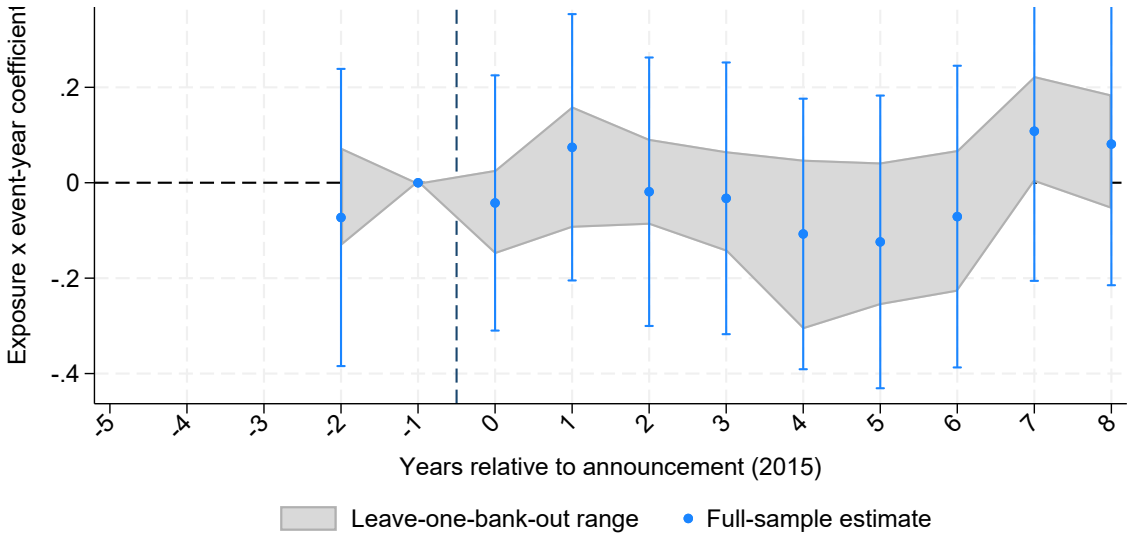
$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}$$



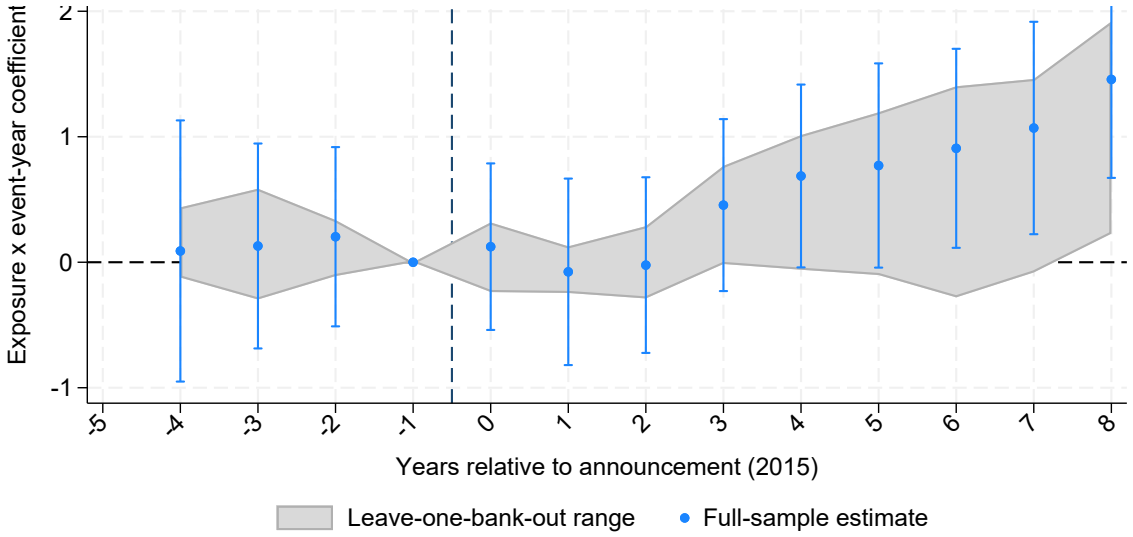
Note: This figure plots the results of the event study estimation of equation (6), where the dependent variable is a dummy equal to one if the firm is still active as of 2025. For each bank, we remove that bank from the sample and re-estimate the identical event-study specification. At every event date, the gray band reports the minimum and maximum coefficient across all leave-one-bank-out estimates. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.32: Impact of the Reform on Borrowers' Size and Investments: No Merged Banks

$$Y_{jt} = \mu_j + \eta_t + \sum_{\substack{k=-5 \\ k\neq -1}}^{8} \psi_k Exposure_j \times \mathbb{1}\{t - 2015 = k\} + u_{jt}$$



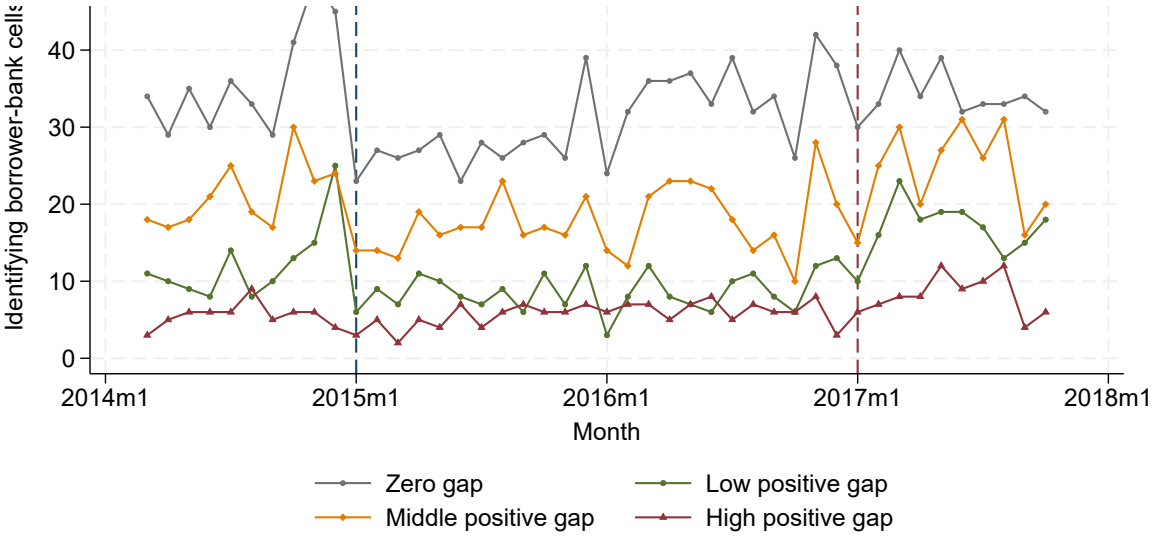
(a) Log Employment



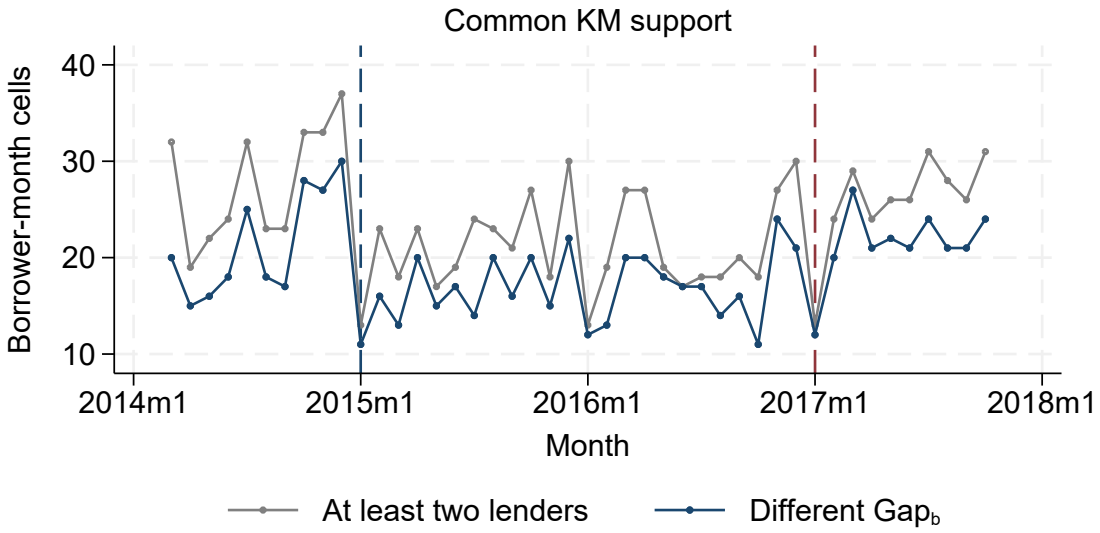
(b) Log Fixed Assets

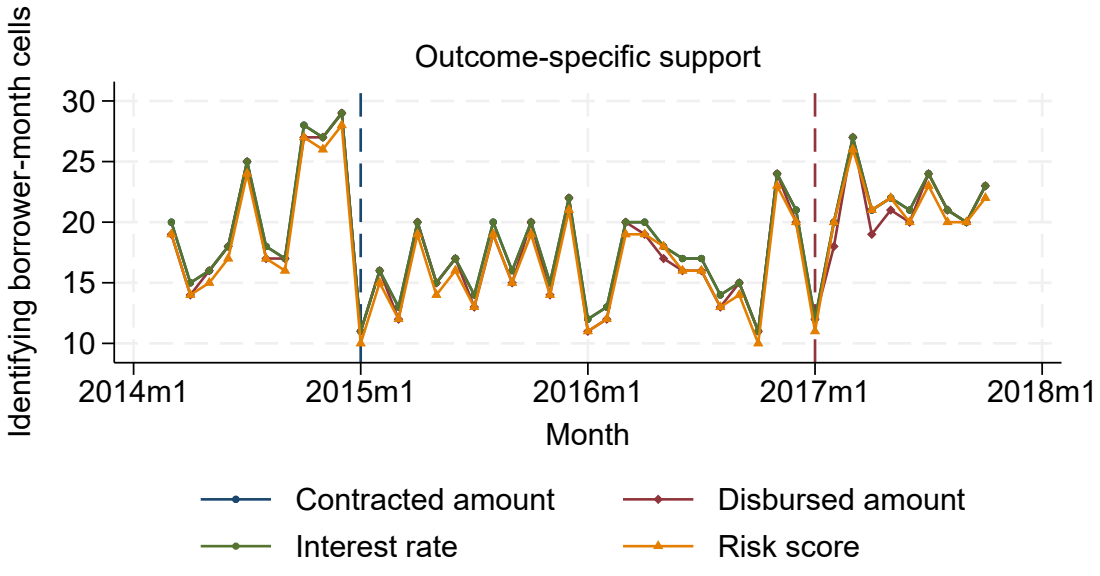
Note: This figure plots the results of the event study estimation of equation (6). Unlike in the main sample, we drop the banks that merged after the reform announcement. Panel (a) shows the results for the log of employment. Panel (b) shows the results for the log of fixed assets. The 95% confidence intervals are constructed using heteroskedasticity-robust standard errors. Borrower and time fixed effects are included. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

Figure A.33: Khwaja and Mian (2008) Support Sample



(a) Exposure

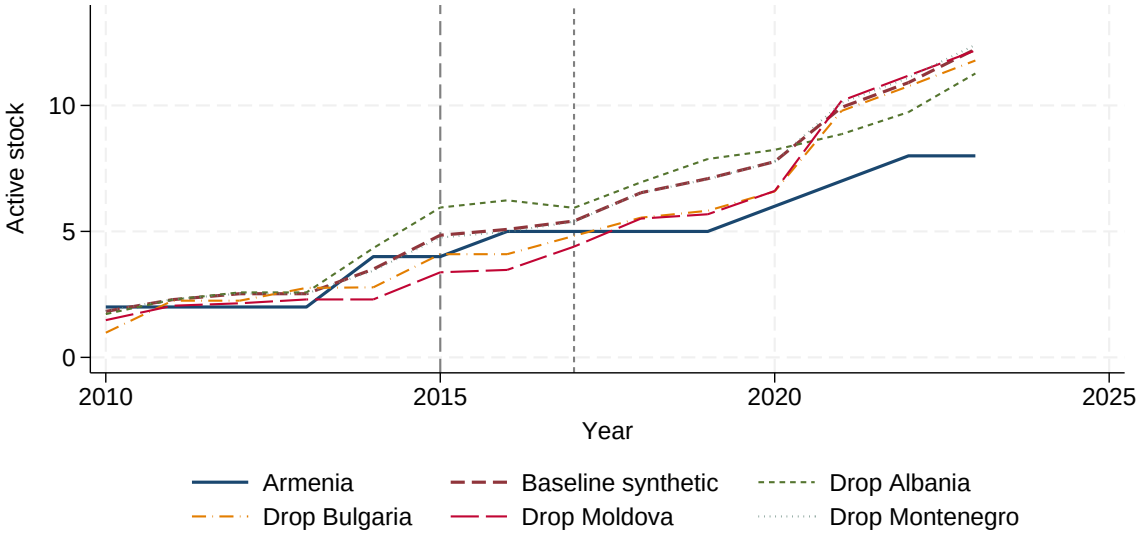




(b) Month

Note: This figure documents identifying support for the within-borrower-month comparisons in equation (4). The sample is collapsed to borrower-bank-month cells and restricted to borrower-

Figure A.34: FinTech Entry in Synthetic Armenia: Leave-One-Out Sensitivity



Note: This figure plots the FinTech entry in real Armenia and compares it to the FinTech entry in the counterfactual Armenia without the absolute floor equity reform. The dashed red line is the FinTech active stock in the synthetic Armenia, constructed from data from comparable countries, following the methodology of Abadie and Gardeazabal (2003). The solid blue line is the active stock in real Armenia. Other lines plot the synthetic Armenia calculated after dropping some of the donors. We select the donors with the largest weights. The navy vertical dashed line is the date of announcement – January 2015. The maroon vertical dashed line is the effective date – January 2017.

B Model derivations and proofs

Proof of Proposition 1. In the issuance region, equation (20) is $x_i - \zeta(x_i) - g_i = 0$. The implicit-function theorem gives

$$[1 - \zeta'(x_i)]\frac{dx_i}{dg_i} = 1.$$

Because $\zeta'(x_i) < 1$, $x_i'(g_i) = 1/[1 - \zeta'(x_i)] > 1$. Shareholder payoff is $p_i(g_i) = -x_i(g_i)$ in this region, which gives the second expression in (28). In the dividend region, $p_i(g_i) = -g_i$, so $p_i'(g_i) = -1$. At $g_i = 0$ the financing payoff has a kink: its left derivative is -1 and its right derivative is $-1/(1 - c_E) < -1$. □

Proof of Proposition 2. Write the reform-date problem with constraints $h_i^\kappa = E_i - \kappa A_i \geq 0$ and $h_i^E = E_i - \bar{E} \geq 0$. Using Lagrange multipliers $\lambda_i, \nu_i \geq 0$, the terms of the Lagrangian that depend directly on the policy parameters are $\lambda_i(E_i - \kappa A_i) + \nu_i(E_i - \bar{E})$. The envelope theorem therefore gives

$$\frac{\partial V_i^0}{\partial \kappa} = \lambda_i \frac{\partial h_i^\kappa}{\partial \kappa} = -\lambda_i A_i, \qquad \frac{\partial V_i^0}{\partial \bar{E}} = \nu_i \frac{\partial h_i^E}{\partial \bar{E}} = -\nu_i.$$

These derivatives hold the continuation-value function and competitors' strategies fixed. If the policy changes the stationary continuation problem, the total derivative adds the corresponding continuation-value and equilibrium-price effects. □

Proof of Proposition 3. For $0 < J_i < D_{i0}^J$, $J_i = D_{i0}^{\text{ref}} - D_i$ and hence $\partial J_i/\partial D_i = -1$. Differentiating (22) first with respect to J_i gives

$$\frac{\partial \mathcal{R}_i}{\partial J_i} = 2m_R \bar{\Delta} q_i \left(1 - \frac{J_i}{D_{i0}^J}\right).$$

Multiplying by $\partial J_i/\partial D_i = -1$ proves (30). If $D_i \geq D_{i0}^{\text{ref}}$, then $J_i = 0$ locally and the derivative is zero. If $D_i \leq D_{i0}^{\text{ref}} - D_{i0}^J$, the junior stock is exhausted, and the derivative is again zero. □

Proof of Proposition 4. Let $z_i = \exp\{v_i^D\}$. Holding the active set fixed, (11) can be written as

$$D_i = M_D \frac{z_i}{R_{-i}^D + z_i}. \tag{B.1}$$

Solving for z_i gives $z_i = R_{-i}^D D_i/(M_D - D_i)$. Combining this expression with (10) yields the inverse deposit-supply equation

$$r_i^D = r^0 + \frac{1}{\alpha_D}\left[\log\left(\frac{D_i}{M_D - D_i}\right) + \log R_{-i}^D - \xi_i^D - \log\left(\frac{d_i}{D_{i0}}\right)\right]. \tag{B.2}$$

At the reform date, d_i, D_{i0}, ξ_i^D, and M_D are fixed. Since $s_i^D = r^0 - r_i^D$, differentiating (B.2) along the equilibrium response to p gives

$$\frac{ds_i^D}{dp} = -\frac{1}{\alpha_D D_i(1 - D_i/M_D)}\frac{dD_i}{dp} - \frac{1}{\alpha_D}\frac{d\log R_{-i}^D}{dp}. \tag{B.3}$$

Differentiating the balance-sheet identity $D_i = A_i - E_i$ gives (32). Substitution into (B.3) gives (33). If the absolute floor binds and the ratio constraint is slack, $E_i = \bar{E}$, which gives (34).

Finally, if the ratio constraint binds and the absolute floor is slack, then $E_i = \kappa A_i$ and

$$D_i = A_i - E_i = \frac{1-\kappa}{\kappa} E_i. \tag{B.4}$$

Taking logs and differentiating with respect to κ gives (35). Substituting this derivative into (B.3) gives (36). The stated sign conditions follow directly from these expressions. □

Proof of Proposition 5. For the multinomial logit, the cross derivative of bank j's probability with respect to bank i's utility is $\partial P_{j|m}/\partial v_{i|m}^L = -P_{j|m}P_{i|m}$ for $i \neq j$. Since $\partial v_{i|m}^L/\partial r_i^L = -\alpha_L$,

$$\frac{\partial P_{j|m}}{\partial r_i^L} = \alpha_L P_{j|m} P_{i|m}.$$

Multiplying by segment masses and summing proves (37). After bank i exits, every surviving bank's index for segment i contains the common factor $e^{-\tau}$, while the outside index does not. Differentiating the resulting logit probability gives $\partial P^{-i}_{j|i}/\partial\tau = -P^{-i}_{j|i}P^{-i}_{0|i} < 0$, proving (38). □

C Numerical solution and accuracy

We approximate banks' continuation values using their own states and moments of rivals' states. Basis-function methods for dynamic oligopoly are developed by Farias et al. (2012), and moment-based approximations by Ifrach and Weintraub (2017). In banking, Corbae and D'Erasmo (2021) summarize the distribution of fringe banks with a finite set of moments. Our implementation retains all individual strategic banks in the current-period game and uses dimension reduction only for continuation values.

Table C.1 reports accounting, optimization, and approximation diagnostics for the benchmark solution. Table C.2 compares this solution with more extensive state coverage under the same calibration and convergence tolerances.

C.1 State-dependent solution

At each industry state $S = (k_1, d_1, \ldots, k_N, d_N)$, banks simultaneously choose deposit rates, loan rates, and equity. The demand equations determine quantities, and liquid assets follow from the balance sheet. Each bank's choices depend on its rivals' current actions as well as the approximated continuation values.

Continuation values combine bank-specific own-state functions with a quadratic correction in four coordinates: own net worth, own deposit capacity, and weighted rival net worth and deposit capacity. The correction has 15 coefficients per bank. Net worth is scaled by initial assets and transformed by the inverse hyperbolic sine; capacity enters in logs. We discretize capacity with five Markov nodes per bank, evaluate liquidity-shock terms analytically, and integrate continuation values under the discretized process. Fol-

lowing the numerical approach in Judd et al. (2011), we use scaled variables and regularized least squares. The regularization coefficient is 10^{-5} and the benchmark update weight is 0.5.

For each permanent policy, we alternate between solving the joint bank game and projected policy evaluation on 161 training states, drawn from simulations and supplemented with the observed state and net-worth stress points. Convergence requires changes in normalized values and controls below 2×10^{-5} in two successive iterations after refreshing the state sample. We solve 15 continuation problems: one for each ratio from 12% to 25% and one for the Armenian floor. The legacy transfer and the restriction on asset cuts apply at the reform date, so these regimes share the permanent continuation problem at a given ratio.

We solve the 43 reform-date policy-regime combinations from the same December 2014 states. The optimization searches across ratchet regions and multiple starting points. Exit decisions determine bank availability in demand, and convergence requires a stable set of operating banks. We verify demands, financing, balance sheets, and policy aggregates independently from the resulting decisions. Alternative numerical best-response orders are evaluated at a common final action profile; the economic game remains simultaneous.

C.2 Numerical diagnostics

We assess constraint feasibility, unilateral deviation gains conditional on the continuation approximation, and Bellman residuals. For initial assets A_{i0}, the latter two statistics are

$$r_i(S) = \frac{\widehat{T}_i \widehat{V}(S) - \widehat{V}_i(S)}{A_{i0}}, \tag{C.1}$$

$$g_i(S) = \frac{\max\{0, \max_{a_i \in \mathcal{A}_i^{\text{test}}(S)} [Q_i(a_i, a_{-i}; \widehat{V}) - Q_i(a_i^*, a_{-i}; \widehat{V})]\}}{A_{i0}}. \tag{C.2}$$

Here $\widehat{T}_i$ evaluates the optimized current game, Q_i is current payoff plus discounted continuation value, and $\mathcal{A}_i^{\text{test}}$ contains the feasible alternatives searched. The deviation-gain

tolerance is 2×10^{-6} of initial bank assets, or 0.020 asset basis points; the feasibility tolerance is 10^{-8}. Searches span payoff regions and alternative starting points. As in Ifrach and Weintraub (2017), deviation incentives provide a criterion for assessing the approximation. Our finite one-period searches differ from their multiperiod deviation bounds. Bellman residuals measure discrepancies in the value equation, not percentage errors in quantities or welfare.

All 15 continuation iterations satisfy their stopping rules, and accounting and constraints meet the specified tolerances. The Armenian reform-date allocation satisfies the optimization criterion. For the ordinary 18% ratio, an alternative update order yields a profile verified by multistart and ratchet-region searches, with a maximum detected gain of 4.61×10^{-12} of initial assets against the 2×10^{-6} tolerance. Relative to the benchmark point, assets, equity, deposits, and loans change by -0.025%, -0.123%, -0.003%, and -0.015%, respectively; the deposit spread changes by 1.99 basis points. Including this alternative solution, 42 of 43 reform-date cases satisfy the criteria. The exception is the 17% equity-required case. The figures use the benchmark profiles throughout.

We examine the largest-residual paths under the baseline, the Armenian floor, and the ratio policy with the largest residual. Independent recalculation reproduces their allocations and surplus. At the peak-error states, deviation gains are below 5.3×10^{-9} of initial assets. Four scrambled integration sequences of 16,384 draws each change expected continuation values by less than 2.7×10^{-5} of initial assets. The largest baseline and counterfactual residuals occur at wealth levels outside the training region, indicating that state coverage and continuation approximation account for the principal tail discrepancies. The computational rate bounds are $r_i^D \in [-0.8, 0.4]$ and $r_i^L \in [-0.05, 0.8]$; Table C.1 reports observations at these bounds.

C.3 Targeted refinement and economic stability

Simulation-based methods approximate the region visited by equilibrium paths rather than a full rectangular state grid (Judd et al. (2011)). We assess sensitivity to state

Table C.1: Benchmark numerical solution diagnostics

Diagnostic	Result	Criterion or scope
A. Policy iteration and reform-date optimization		
Converged continuation problems	15/15	All policies
Largest value-iteration change	5.4×10^{-6}	2×10^{-5}
Largest control-iteration change	1.7×10^{-5}	2×10^{-5}
Reform cases meeting optimization tolerances	41/43	Full policy grid
Largest detected deviation gain (asset bp)	4.931	0.020
Same search: largest gain (% of bank value)	0.00795	Diagnostic
B. Feasibility and independent accounting		
Minimum normalized constraint slack	-9.5×10^{-9}	-10^{-8}
Maximum balance-sheet accounting error	5.3×10^{-15}	10^{-7}
Maximum welfare-ledger discrepancy	8.4×10^{-16}	10^{-7}
C. Continuation approximation and simulation		
Training Bellman RMS: largest across policies (%)	1.044	Asset-normalized
Training Bellman residual: maximum (%)	6.355	Asset-normalized
Pathwise bank-maximum residual: median (%)	1.516	Asset-normalized
Pathwise bank-maximum residual: 95th percentile (%)	35.494	Asset-normalized
Pathwise bank-maximum residual: maximum (%)	63.225	Asset-normalized
Completed histories / failed histories	328 / 0	8×41 histories
State observations at a computational rate bound	629	1.50% of states
Maximum 64–128 year welfare increment	9.546	AMD billion
Independent welfare and quantity replay	Passed	Saved-path audit

Note: Diagnostics cover the benchmark solution used in the figures. Values, constraint slacks, and bank accounting errors are normalized by initial bank assets; welfare accounting errors use aggregate initial assets. Control changes are measured in annual decimal rates and equity relative to initial assets. "Asset bp" denotes basis points of initial assets. Training RMS is calculated across bank-state pairs within each policy. Pathwise statistics summarize the maximum absolute bank residual at each simulated industry state. The three 12% regimes coincide, leaving 41 distinct allocations among 43 cases. The benchmark optimization exceptions are the 17% equity-required case and the ordinary 18% ratio; the latter satisfies the criteria under an alternative numerical update order. All scenarios and realizations are retained.

coverage by extending the training simulations and evaluating the resulting solutions on separately seeded paths. The calibration, equations, five-node capacity process, 15-coefficient correction, regularization, and tolerances are held fixed. Validation states are excluded from fitting.

For the 12% baseline, extended training histories increase the sample from 161 to 1,067 states. On eight independent 128-year histories, the median maximum-bank Bellman residual falls from 2.287% to 1.212% of initial assets, the 95th percentile from 44.249% to 2.874%, and the maximum from 58.576% to 7.956%. To hold the evaluation states constant, we also compare the approximations at 39 selected original-path states, including those with the largest residuals. The maximum falls from 58.576% to 3.030% on this common sample. All 544 bank-state multistart deviation checks satisfy the tolerance; the largest gain is 1.99×10^{-9} of initial assets. Reform-date assets, equity, deposits, loans, and liquid assets change by less than 0.28% in absolute value, and the deposit spread changes by 21.67 basis points.

For the 13% requirement, we use 1,222 fixed training states and accept an outer update only when it reduces the projected fixed-point residual after re-solving the current games. Convergence also requires a small undamped residual and stable controls. All 544 selected bank-state deviation checks and 20,587 additional checks at outside-coverage and previously difficult states satisfy the tolerance. The largest gain in the latter sample is 4.39×10^{-9} of initial assets. Reform-date quantity changes are below 0.41%, and the deposit spread changes by 5.87 basis points. Bellman residuals on independent paths nevertheless increase (Table C.2), despite the improvement in current-period optimization.

Table C.2: Targeted numerical refinements

Diagnostic	Original	Refined
A. 12% requirement: expanded training coverage		
Training industry states	161	1,067
Pathwise residual: median (%)	2.287	1.212
Pathwise residual: 95th percentile (%)	44.249	2.874
Pathwise residual: maximum (%)	58.576	7.956
Maximum residual on 39 common original states (%)	58.576	3.030
Bank-state checks above gain tolerance	6/544	0/544
B. 13% requirement: expanded coverage and safeguarded updates		
Training industry states	161	1,222
Pathwise residual: median (%)	1.385	2.369
Pathwise residual: 95th percentile (%)	3.044	13.936
Pathwise residual: maximum (%)	7.668	31.563
Selected current games missing stopping criteria	9/79	0/79
Bank-state checks above gain tolerance	61/544	0/544
C. Changes in initial-state allocations under refinement		
	12% requirement	13% requirement
Assets (%)	−0.107	+0.031
Equity (%)	−0.219	+0.409
Deposits (%)	−0.091	−0.026
Loans (%)	−0.274	+0.059
Liquid assets (%)	+0.130	−0.009
Deposit spread (bp)	+21.671	+5.874

Note: The calibration is identical to Table C.1. Panels A and B use eight paired, independently seeded 128-year histories, yielding 1,024 industry states per solution. Residuals are maximum absolute bank residuals at each state, expressed as percentages of initial bank assets. Deviation checks use the 2×10^{-6} tolerance on common selected states from benchmark and refined paths, with 544 bank-state checks per solution. The additional 13% stress sample contains 20,587 checks, all below the tolerance. Panel C reports percentage changes in reform-date levels relative to the benchmark; spreads are in basis points. Counterfactual and welfare figures use the benchmark approximation.

The refinements leave reform-date balance-sheet quantities close to the benchmark but have different effects on continuation residuals. These comparisons assess numerical sensitivity for the policies and states tested; they do not provide a uniform dynamic error bound.

C.4 Simulation and welfare precision

Welfare comparisons use eight independent histories of 128 annual periods, with common innovations across policies. The 328 histories cover all 41 distinct allocations. We sum discounted flow surplus along each path and independently reconcile the stakeholder and resource accounts. Equity principal is financing rather than a resource cost, and leverage-ratchet transfers cancel between shareholders and legacy creditors. Welfare is measured as banking-sector money-metric surplus. Fixed-price entry probabilities measure the direct entry burden and do not enter this surplus calculation.

For a paired policy difference ΔW_c in history c, the Monte Carlo standard error is $s(\Delta W_c)/\sqrt{8}$. Pointwise intervals use the Student-t critical value with seven degrees of freedom and measure simulation uncertainty conditional on the calibration and numerical solution. Extending the horizon from 64 to 128 years changes welfare by at most AMD 9.546 billion; $\beta^{128} = 2.917 \times 10^{-5}$. This comparison measures horizon sensitivity, not an infinite-tail bound. No exits occur in the simulated histories. In five high-ratio entry cases, value iteration does not meet the convergence criteria. A positive feasible-policy lower bound nevertheless suffices to classify entry as profitable in each case.