Hollow Buffers in U.S. Banking: The Hidden Distribution of Deposit Taxation

Nicholas R. Pusateri

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Has the introduction of interest on reserves eliminated the reserve-requirement tax? Since 2008, U.S. banks have earned interest on reserves and held historically large excess balances. I show that the Bailey-Friedman deposit tax did not disappear; it shifted to the margin. Raising reserve requirements is tax-neutral so long as either reserves earn at least the market rate or banks' excess balances exceed the increase. Federal Reserve aggregates suggest wide tax-neutral capacity: in late 2024, reserves were about 57% of deposits. Call Report microdata, however, reveal a "hollow buffer": reinstating a 10% requirement after 2020 would have exposed roughly 45% of deposits to a new tax. The discontinuity at the buffer boundary highlights a policy trade-off: when reserves are ample or remunerated competitively, requirements are labels; once either condition fails, they operate as taxes.

Keywords: Reserve requirements; interest on reserves; deposit tax; portfolio management.
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Email: `pusaterin@sacredheart.edu`. *Address*: Department of Economics, Sacred Heart University West Campus, 3135 Easton Tpke, Fairfield CT 06825-1081, USA. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

1. Introduction

Since October 2008 the Federal Reserve has paid interest on reserve balances, a change explicitly intended to remove the implicit tax on deposits imposed by reserve requirements (Board of Governors of the Federal Reserve System 2008). With reserves earning interest, many banks have been willing to hold large balances.[1]

Given the large balances and the Federal Reserve's own messaging, it was natural to conclude that the classic reserve-requirement tax had disappeared. Such a conclusion follows a long line of work on reserve requirements, deposit taxation, and the role of reserve remuneration, from Bailey (1956), Friedman (1959), and Cagan (1956) to many later contributions (Fama 1983; Hall 1983; Sargent and Wallace 1985; Goodfriend 2002; Walter and Courtois 2009; Tolley 1957; Poole 1968; Baltensperger 1980; Mitchell 1982).

This paper cautions against such a strong conclusion. Incidence is determined at the margin: simply paying interest on reserves or having a large stock of excess reserves in the system is not sufficient to conclude that the tax on deposits has vanished. Utilizing a simple portfolio model, I show that the tax disappears if and only if the reserve remuneration rate is at least the market rate or the increase fits within the bank's excess-reserve buffer:

$$\text{Marginal tax} = 0 \quad \Longleftrightarrow \quad i_{RR} \geq i_{MR} \ \text{ or } \ \Delta\rho \cdot D \leq ER, \tag{1}$$

where i_{RR} is the remuneration on required (reserve-balance) holdings, i_{MR} is the relevant market return, D is deposits, ρ is the requirement ratio, and ER is excess reserves. When reserves pay the market rate or when a higher requirement can be met from a bank's existing buffer, no reallocation from market-earning assets is needed and no tax arises. However, if either condition fails, the bank must either reallocate from market-earning assets to reserves or suffer a reserve remuneration shortfall, and the tax activates at the margin.

This logic clarifies the post-2008 operating environment, where the banking system holds substantial excess balances earning the interest on reserves (IOR) rate. The operating-framework and implementation literatures explain why: banks willingly accumulate reserves when remunerated near market rates and the system can sit on the flat portion of reserve demand (Ennis and Keister 2008; Armenter and Lester 2017). In the terms above, these map directly to the two conditions: when $i_{RR} \geq i_{MR}$, the rate condition neutralizes the tax; when banks hold positive buffers, the quantity condition neutralizes modest requirement changes. Together, these conditions explain why banks hold large reserves and why changes in ρ can be neutral in aggregate.

[1] While individual banks determine their own reserve holdings, the Federal Reserve sets the aggregate quantity of reserves.

While large excess reserves exist in aggregate, usable liquidity is not evenly distributed. Segmentation can make system liquidity look ample while individual institutions face scarcity (Copeland, Duffie, and Yang 2024). The incidence statement here is distinct and purely mechanical: even abstracting from segmentation, a requirement increase becomes a tax exactly where $\Delta\rho \cdot D > ER$ and $i_{MR} > i_{RR}$. A tax can be dormant in aggregate yet activate at banks with sufficiently small buffers.

The empirics reveal this split. Aggregates suggest wide tax-neutral capacity (for example, in 2024:Q4 the banking system had roughly 57% reserve buffers). Yet, bank-level data tell a different story: reinstating a 10% reserve requirement in the no zero required reserve period (post-2020:Q1) would expose roughly 45% of deposits to a new tax. I refer to this pattern as a "hollow buffer": ample in total, scarce for many. The sharp discontinuity at the buffer boundary clarifies policy trade-offs for bank behavior, operating frameworks, and macroprudential design: within buffers or when reserves are remunerated at market rates, requirements are labels; if either condition fails, they are taxes.

These patterns connect to broader discussions of banks' balance-sheet management and macroprudential policy. Mitchell (1982) links requirement design to portfolio risk; recent evidence shows that bank lending, portfolios, and lending standards are responsive to changes in reserve policy and the aggregate quantity of reserves (Islam and Koch 2024; Zhang, Wang, and Song 2024). The two-condition test provides a cross-sectional mechanism for heterogeneity: marginal policy changes bite first where $\Delta\rho \cdot D > ER$ when $i_{MR} > i_{RR}$.

The contribution is therefore twofold. Theoretically, I provide a two-condition incidence test that reinterprets the Bailey–Friedman deposit tax as a margin-activated wedge and that rationalizes post-2008 neutrality when either condition holds. Empirically, I show that aggregate buffers overstate neutrality for a large share of deposits, documenting a hollow buffer that turns requirement changes into taxes at specific banks.

2. Model

I utilize a simple, static, partial-equilibrium bank portfolio model to formalize the tax incidence logic. This model follows the work of Ahmed (1987) and Ennis (2018).

2.1. Setup

Consider a representative bank with deposits, D, allocated between market-earning assets, L, at return i_{MR} and reserves, R, remunerated at i_{RR}. The balance-sheet identity is $D = L + R$. The statutory requirement ratio, ρ, requires $R \geq \rho D$, leaving excess reserves, ER, equal to

$R - \rho D$. The bank chooses L and R to maximize profits, viz,

$$\max_{L,R} \Pi = i_{MR}L + i_{RR}R - i_D D$$

subject to $D = L + R$ and $R \geq \rho D$. The optimization implies that when $i_{RR} < i_{MR}$ the requirement binds, $R = \rho D$ and $ER = 0$; when $i_{RR} > i_{MR}$ the constraint is slack and $ER > 0$.[2]

2.2. A change in requirements and the marginal tax

Suppose the regulator raises the requirement from ρ to $\rho + \Delta\rho$. The bank must reallocate $\Delta R = \Delta\rho \cdot D$ from L to R, but only after exhausting ER. The profit change is

$$\Delta\Pi = -(i_{MR} - i_{RR}) \max\{0, \Delta\rho \cdot D - ER\}. \tag{2}$$

Accordingly, define the marginal deposit-tax rate per dollar of deposits as

$$\tau \equiv (i_{MR} - i_{RR})\, I\{\Delta\rho \cdot D > ER\}. \tag{3}$$

The spread $(i_{MR} - i_{RR})$ is the unit opportunity cost; the indicator records whether the increase forces reallocation beyond the existing buffer.

PROPOSITION 1. *An increase in reserve requirements imposes no positive implicit tax if and only if*

$$i_{RR} \geq i_{MR} \quad \text{or} \quad \Delta\rho \cdot D \leq ER. \tag{4}$$

PROOF. Immediate from (3): $\tau \leq 0$ if $(i_{MR} - i_{RR}) \leq 0$ or $I\{\Delta\rho \cdot D > ER\} = 0$. □

2.3. Economic interpretation

Two margins govern the result: a rate channel and a quantity channel. Under the rate channel, if interest on reserves is greater than or equal to the market rate, $i_{RR} \geq i_{MR}$, holding reserves is not costly at the margin, so the requirement is neutral for any change in reserve requirements, $\Delta\rho$. Under the quantity channel, even if reserves are remunerated under the market rate, $i_{RR} < i_{MR}$, a higher requirement is neutral so long as it fits within excess reserves, ER. The tax "turns on" only once the buffer and key assets begin to earn less than the market rate.

This result nests prior views: the Bailey–Friedman tax corresponds to the case $i_{RR} < i_{MR}$ with $ER = 0$, while the neutrality arguments of Sargent and Wallace (1985) and Goodfriend (2002) correspond to the rate condition $i_{RR} \geq i_{MR}$, and the flat reserve-demand logic of

[2] A compact derivation: $\mathcal{L} = i_{MR}L + i_{RR}R - i_D D + \lambda_1(D - L - R) + \lambda_2(R - \rho D)$ with first order conditions yielding $\lambda_1 = i_{MR}$ and $\lambda_2 = i_{MR} - i_{RR}$. If $i_{RR} < i_{MR}$, then $\lambda_2 > 0$ and $R = \rho D$; if $i_{RR} > i_{MR}$, then $\lambda_2 = 0$ and $R > \rho D$.

Ennis and Keister (2008) and Armenter and Lester (2017) corresponds to the quantity condition $\Delta\rho \cdot D \leq ER$.

2.4. From aggregates to banks

Equations (3) and (4) apply at the system level if R, ER, and D are aggregated. The incidence, however, hinges on where individual banks sit relative to their buffers. A large aggregate buffer, ER/D, can coexist with many banks who do not have sufficient buffers. The empiric investigation below documents both realities: the tax-neutral window from aggregates and the cross-sectional exposure that produces the hollow buffer.

3. Empirical Evidence

This section documents two complementary facts. At the system level, large buffers and near-market remuneration often neutralize reserve requirements and imply deposit tax neutrality. At the bank level, however, buffers are unevenly distributed, leaving many deposits exposed. Together, the evidence shows why aggregates imply wide tax-neutral capacity while cross-sections reveal a hollow buffer.

3.1. Measurement

The market premium is defined as $i_{MR} - i_{RR}$, where i_{MR} is the 1-month Treasury bill yield and i_{RR} is the rate paid on reserve balances. The 1-Month Treasury bill is the relevant market rate as it most closely matches the maturity, risk, and liquidity of reserves. While some have posited loans as the relevant opportunity cost of reserves, conceptually, Treasury bills represent the asset banks can readily arbitrage with reserves, whereas the prime rate embeds credit and term premia that reserves do not earn.

The buffer is

$$\text{Buffer}_t \equiv \frac{ER_t}{D_t},$$

with ER_t denoting excess reserves and D_t demand deposits. Before March 26, 2020, ER_t equals published excess reserves; after that date, reserve requirements were set to zero, so ER_t equals total reserves.[3] Deposits D_t are measured using demand deposits.

FFIEC "Call Report" microdata provide bank-level reserves and deposits for the cross-sectional analysis. Further details on data sources and construction are available in Appendices A.1 and A.2.

[3] With $\rho = 0$, $ER = R$ and the buffer simplifies to R/D.

3.2. Systemwide buffers

Figure 1 plots the market premium. Before 2008, the spread was persistently positive, consistent with nonremunerated reserves imposing an active tax. After IOR began in October 2008, the spread turned near zero or negative, so the rate condition ($i_{RR} \geq i_{MR}$) generally held and requirement changes were neutral at the margin. Beginning in 2023, however, the spread turned positive again, indicating that the rate condition may fail in recent years and that requirement increases could once again act as a tax.

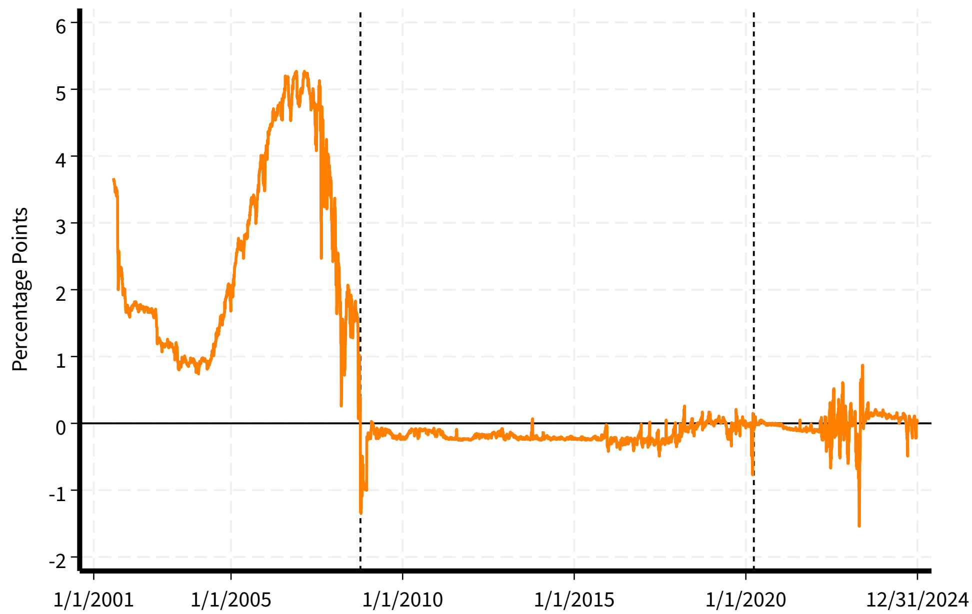

Figure 1. Market rate spread (1-month Treasury minus reserve rate)

Sources: Board of Gov. 2025a; Board of Gov. 2025e; Board of Gov. 2025f. See Appendix A.1 for details.
Note: Author's calculation. Data are from January 1, 2001 to December 31, 2024. Vertical lines mark October 9, 2008 (IOR introduced) and March 26, 2020 (reserve requirement set to zero).

Figure 2 shows the aggregate buffer, ER/D. Prior to 2008, the buffer was close to zero, so any increase in requirements would have bound immediately, activating the tax. The buffer rose dramatically with quantitative easing and remained elevated thereafter. By 2024:Q4, reserves were about 57% of deposits, implying that, in aggregate, requirements up to that level would be neutral under the quantity condition. In systemwide terms, the Bailey–Friedman tax seems absent.

3.3. The hollow buffer

Aggregate capacity masks substantial heterogeneity. Using FFIEC "Call Report" data, Figure 3 shows deposit-weighted survival curves across regimes. The vertical axis records

Figure 2. Aggregate buffer, ER/D (%)

Sources: Board of Gov. 2025b; Board of Gov. 2025c; Board of Gov. 2025d. See Appendix A.1 for details.
Note: Author's calculation. Data are from January 1, 2001 to December 31, 2024. Vertical lines mark October 9, 2008 and March 26, 2020.

the share of deposits at banks with reserves at least ρD for thresholds ρ between 0 and 60%.

Before interest on reserves (Pre-IOR), the survival curve is flat at one, for $\rho\{0, 10\}$ indicating that all deposits were held at banks with at least 10% reserves. Given this was the statutory requirement, such behaviour is expected. The curve falls off steeply around $\rho = 12$ indicating banks had very thin buffers above the required reserves. In this regime, almost any increase in requirements would have imposed a tax on all deposits given the positive market premium.

In the IOR with requirement regime (2008:Q4 to 2020:Q1), the curve is again flat at one for $\rho\{0, 10\}$, indicating that all deposits were held at banks with at least 10% reserves. The curve falls off more gradually than in the Pre-IOR regime, indicating that banks built larger buffers above the requirement. In this regime, the market premium was near zero or negative, so the rate condition ($i_{RR} \geq i_{MR}$) generally held and any requirement changes would have been neutral at the margin.

Finally, in the IOR with no reserve requirements period (2020:Q2 to present), the curve falls off sharply starting around $\rho = 3$ and roughly 45% of deposits sit at banks with less than 10% reserves. The buffer is hollow: while systemwide reserves are about 57% of deposits, many deposits sit at banks with thin buffers. Given the positive market premium

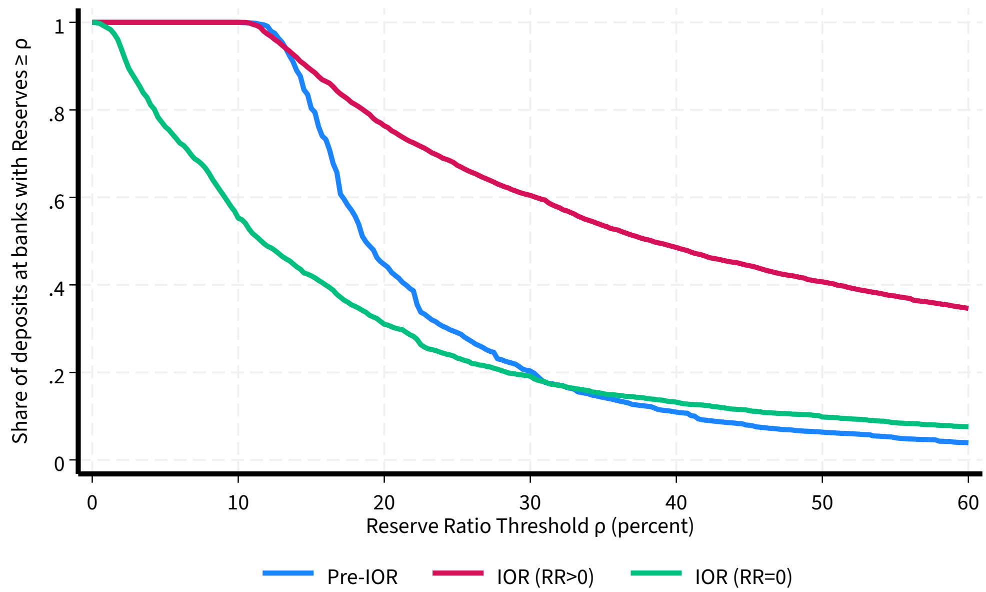

Figure 3. Deposit-weighted survival by regime

Source: FFIEC Reports of Condition and Income (Call Reports). See Appendix A.2 for details.
Note: Author's calculation. Data are from January 1, 2001 to December 31, 2024. Curves show the share of deposits at banks with reserves at least ρD.

in this regime, reinstating a 10% requirement would impose a tax on roughly 45% of deposits.

This is the hollow buffer: systemwide reserves are ample, but incidence is concentrated on deposits held at thin-buffer banks. In the model's terms, these banks fail the quantity test, so any increase in ρ above their buffer activates the tax. The discontinuity is sharp: for well-buffered banks the requirement is a label; for thin-buffer banks it is immediately binding.

Figure 4 splits the post-2020 sample by whether reserves yielded above or below the market rate. When $i_{MR} < i_{RR}$, buffers are thicker and more deposits clear higher thresholds. When $i_{MR} > i_{RR}$, banks economize on reserves, producing thinner buffers and lower survival across most thresholds, especially between 10 and 25%. This matches the opportunity-cost logic in Equation (3): banks respond to incentives, a positive spread erodes voluntary buffers and increases the likelihood that requirements bite.

3.4. Interpretation

The evidence shows why system averages mislead. At the aggregate level, requirements appear neutral because both the rate and quantity conditions often hold. At the bank level, incidence is highly uneven: thin-buffer banks cross the threshold $\Delta\rho \cdot D > ER$ quickly and

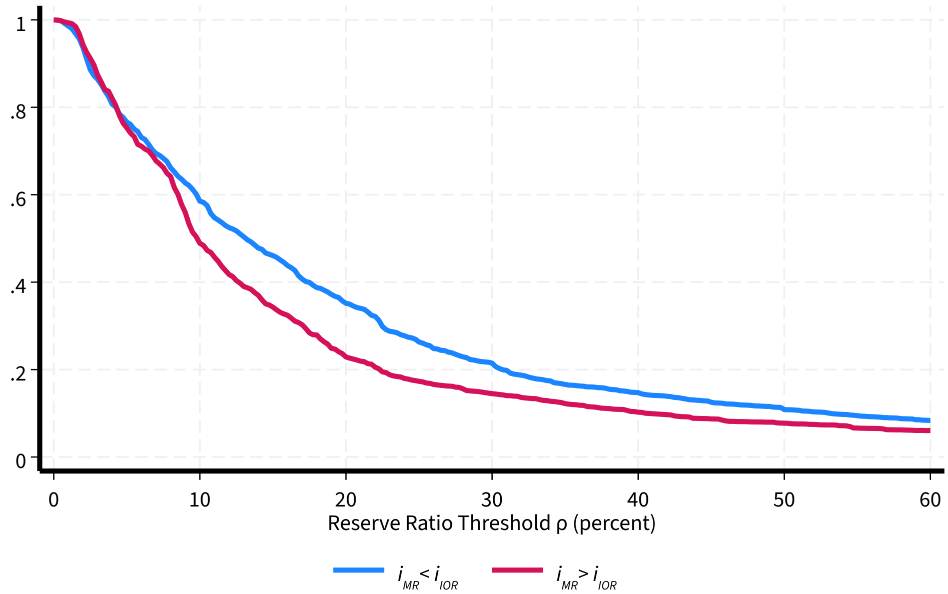

Figure 4. Deposit-weighted survival by cost with no reserve requirement

Source: FFIEC Reports of Condition and Income (Call Reports). See Appendix A.2 for details.
Note: Author's calculation. Data are from March 26, 2020 to December 31, 2024. The sample is split by the sign of the spread ($i_{MR} \lessgtr i_{RR}$). Lower survival under $i_{MR} > i_{RR}$ indicates thinner buffers when reserves under-yield the market rate.

face a deposit tax, while others remain unaffected. This arithmetic incidence is distinct from segmentation, which arises from trading frictions (Copeland, Duffie, and Yang 2024). Segmentation may amplify or mitigate exposure, but it is not required for the hollow buffer to appear.

4. Policy Implications

The results clarify when reserve requirements matter and how their effects are distributed. A requirement increase is neutral when either the rate condition ($i_{RR} \geq i_{MR}$) or the quantity condition ($\Delta\rho \cdot D \leq ER$) holds, but becomes a tax otherwise. At the aggregate level, the conditions often appear satisfied; at the bank level, buffers are uneven, producing discontinuous incidence.

4.1. The "Ample Reserves" Paradox

The hollow buffer finding contrasts with the Federal Reserve's "ample reserves" terminology. While the system holds reserves of 57% of deposits, roughly 45% of deposits sit at banks that would immediately bind if a 10% requirement were reinstated. The Fed's "ample" designation refers to aggregate quantity, but requirement incidence depends on the distribution.

This distinction affects monetary policy implementation. The current framework assumes abundant reserves eliminate frictions associated with requirement management. However, if many banks operate near minimum desired reserves—as the hollow buffer suggests—then requirements constitute binding constraints for substantial portions of the banking system, even when set to zero.

4.2. Heterogeneous Policy Transmission

The uneven distribution of buffers creates discontinuous effects from requirement or spread changes. When $i_{MR} > i_{RR}$ and requirements increase, banks partition sharply: those with $\Delta\rho \cdot D > ER$ face immediate balance sheet adjustments while others remain unaffected.

This concentration produces three mechanical effects. First, policy adjustments affect only thin-buffer banks, amplifying pressure at institutions with minimal liquidity cushions. Second, the discontinuity at the buffer boundary means small requirement or spread changes trigger large adjustments at affected banks. These banks must reallocate portfolios, adjust lending, or seek alternative funding sources to meet requirements, with effects concentrated rather than spread across the system. Third, aggregate responses become less predictable when incidence concentrates rather than diffuses across institutions. This mechanism provides a microfoundation for documented heterogeneity in bank responses to reserve policy (Islam and Koch 2024; Zhang, Wang, and Song 2024).

4.3. Remuneration Design and Operating Frameworks

The two-condition framework maps directly to remuneration design choices. With positive spreads ($i_{MR} > i_{RR}$) and zero requirements, the system relies on voluntary reserve holding. Banks that find reserves costly economize while others accumulate large balances, producing the hollow buffer.

Tiered remuneration—paying market rates on required reserves and less on excess—would ensure the rate condition holds for required balances, eliminating the deposit tax on requirements (Goodfriend 2002; Sargent and Wallace 1985). This design, used by several central banks, separates the reserve requirement function from the interest expense consideration.

Alternatively, maintaining zero requirements acknowledges that requirements no longer serve monetary control functions in administered-rate regimes. This approach, however, provides no mechanism to ensure minimum liquidity distributes across banks rather than concentrating at specific institutions.

4.4. Implications for the Current Framework

The hollow buffer documents that aggregate reserves of 57% coexist with 45% of deposits at banks with less than 10% buffers. This concentration means system-wide reserve requirments changes would bind immediately for many banks, with effects depending on standing facility access and stigma.

The current configuration—positive market premium, zero reserve requirements, and concentrated buffers—can persist indefinitely if these three elements remain unchanged. Any adjustment to one element affects the others: closing the spread reduces the cost of holding reserves and may flatten the distribution; reinstating requirements activates the tax at thin-buffer banks; policies that redistribute reserves would reduce concentration but require active intervention.

From a macroprudential perspective, this concentration of reserves indicates that requirement changes would function as targeted rather than broad-based policy tools, affecting specific institutions rather than the system uniformly.

The two-condition framework provides a diagnostic tool: requirements impose taxes when both $i_{MR} > i_{RR}$ and $\Delta\rho \cdot D > ER$. Current data show both conditions fail for substantial portions of the banking system, indicating that requirement increases would create heterogeneous binding constraints rather than uniform effects.

5. Conclusion

Reserve requirements are neutral only under two conditions: when required balances are remunerated at least at the market rate or when increases fit within existing buffers. Aggregates often suggest wide neutrality, but bank-level data reveal a hollow buffer: ample in total, scarce for many. In 2024:Q4, for example, a 10% requirement would have exposed nearly half of deposits to a new tax despite a systemwide buffer of 57%.

This simple incidence logic recasts the Bailey–Friedman deposit tax as a margin-activated wedge and clarifies why the tax appeared to vanish after 2008 yet remains latent in the cross-section. The results also illuminate policy discussions: incidence falls first on thin-buffer banks, raising questions for bank behavior, macroprudential design, and operating frameworks.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used Open AI's *Chat GPT* and Anthropic's *Claude* in order to brainstorm ideas, edit code, and copy edit prose. After using these tools/services, the author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

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Appendix A. Data

A.1. Aggregate Data

Aggregate time series data are from the Federal Reserve Bank of St. Louis (FRED). These series include the one-month Treasury constant maturity yield (Board of Gov. 2025a), which I use as a short-term interest rate benchmark; total deposits at all commercial banks (Board of Gov. 2025b), providing an aggregate measure of bank deposits; excess reserves of depository institutions (Board of Gov. 2025c), and total reserves of depository institutions (Board of Gov. 2025d). All data are available through FRED and are not seasonally adjusted.

Table A1. Aggregate Data from FRED

Series	FRED ID
1 month Treasury Rate	DGS1MO
Total Deposits	WDDNS
Excess Reserves	EXCSRESNW
Total Reserves	TOTRESNS
Interest on Required Reserves	IORR
Interest on Reserve Balances	IORB

A.2. Call Report Micro Data

I construct a quarterly panel of U.S. commercial banks from 2001:Q1 through 2024:Q4 using Call Report micro data. The raw files are published each quarter by the Federal Financial Institutions Examination Council (FFIEC) and are publicly available through the *Central Data Repository* (`https://cdr.ffiec.gov`). From each quarterly release, I extract standard balance-sheet and deposit information (assets, deposits, reserves, cash, transaction accounts, time deposits, account counts, trading assets, and trust/IBF items) together with institution identifiers. These are merged into a single bank–quarter panel.

A.2.1. Retail Bank Sample Selection

This paper focuses on banks with genuine retail deposit-taking operations, as reserve requirements applied only to retail institutions. To exclude custodians, trust banks, and monoline entities, I implement a conservative multi-step filter:

1. **Retail footprint.** A bank is classified as retail if it reports either at least 1,000 small accounts (≤ \$100,000) or if such small deposits represent at least 30% of total deposits. Banks meeting this test are always kept.

2. **Trust and custodial markers.** Among the remaining banks, I drop those with uninvested trust funds, any International Banking Facility (IBF) activity, or a dealer-like balance sheet (trading assets above 5% of assets and very few small accounts).

3. **Persistent non-retail profile.** I flag a bank as non-retail if, for two consecutive quarters, it reports negligible vault cash, negligible transaction accounts, and either a very low small-deposit share or very few small accounts. Such banks are excluded.

4. **Borderline rescue.** Banks not yet classified are retained if they hold at least 2% of assets in transaction accounts or at least 20% of deposits in small time deposits.

5. **Extra custody drop.** I exclude banks that in any quarter simultaneously show negligible cash, negligible transaction accounts, and minimal small-deposit activity. This captures custody-like institutions with no branch presence.

6. **Name-based exclusions.** Finally, I drop institutions clearly identified in their legal names as custodians, card banks, or finance affiliates (e.g. Ally/GMAC, State Street, BNY Mellon Trust, Capital One (USA), Toyota Financial Savings Bank, and similar cases).

The resulting sample conservatively retains banks with clear retail operations and excludes custodial giants and monoline specialists.

A.2.2. Reserve Requirement Construction

For each bank–quarter, I compute statutory reserve requirements. Prior to March 26, 2020, net transaction accounts were subject to a 10% reserve ratio; after that date the requirement was set to zero. I construct the *statutory base proxy*, applying the ratio to net transaction accounts (transaction accounts less due-from balances and cash items in collection), truncated at zero. I then calculate excess reserves and buffer ratios relative to each base.

Table A2. Call Report Variables Used in Construction and Filtering

Mnemonic	**Definition (thousands of USD)**
RCON2170	Total assets
RCON2200	Total deposits
RCON3545	Trading assets
RCON0081	Non-interest balances due from U.S. banks
RCON0071	Due from depository institutions, total
RCON0083	Interest-bearing balances due from U.S. banks
RCON0085	Interest-bearing balances due from foreign banks
RCON0080	Vault cash
RCON0090	Balances due from Federal Reserve banks (reserve balances)
RCON0020	Cash items in process of collection
RCON2210	Transaction accounts
RCON6648	Time deposits of $100,000 or less
RCON2702	Deposits of $100,000 or less, total
RCON3779	Number of deposit accounts of $100,000 or less
RCON3520	Uninvested trust funds
RCFN2133	International Banking Facility (IBF) assets
RCFN2898	International Banking Facility (IBF) liabilities
RCON8274	Tier 1 capital (location varies by year/schedule)