# Frat Boy Financial: Democratizing Low-Interest Credit in Detroit via AI-Driven Decentralized Finance

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**Abstract**

Financial exclusion remains a persistent barrier to economic equity in urban America, with Detroit exemplifying elevated rates of unbanked (18.3% of households) and underbanked populations. This exclusion compels reliance on predatory lending products—such as payday loans, auto-title loans, pawnshop credit, and rent-to-own agreements—that impose effective annual percentage rates (APRs) often exceeding 300%, perpetuating cycles of debt and wealth extraction. This white paper introduces Frat Boy Financial (FBF), a fintech platform that integrates artificial intelligence (AI)-driven risk assessment with decentralized finance (DeFi) protocols to deliver small-dollar loans at 5–10% APR. By leveraging alternative data sources (e.g., rent payment histories, gig economy income, utility bills, and transaction patterns) for underwriting, FBF extends credit to underserved borrowers while sourcing efficient liquidity from Aave's USDC pools on the Arbitrum blockchain and facilitating fiat conversions via Circle. We delineate the platform's architecture, formalize its risk modeling framework—including probability of default (PD), loss given default (LGD), and expected loss (EL) calculations—and present sensitivity analyses for net margins under varying default scenarios. Furthermore, we propose a robust governance structure emphasizing fairness, transparency, and regulatory

compliance. Our contributions encompass an interdisciplinary blueprint for AI-DeFi hybrid lending in U.S. urban contexts, empirical benchmarks demonstrating substantial cost savings relative to predatory alternatives, and a pathway for scalable financial inclusion that aligns technological innovation with ethical imperatives.

# 1 Introduction

Financial exclusion, defined as the lack of access to affordable and reliable banking services, constitutes a multifaceted challenge that impedes household stability and local economic vitality. In the United States, approximately 5.6 million households are unbanked—meaning they possess no checking or savings accounts at federally insured institutions—while an additional 19 million are underbanked, maintaining such accounts but supplementing them with high-cost alternative financial services like money orders or check-cashing outlets (FDIC, 2023). Drivers include prohibitive account fees, income volatility associated with precarious employment (e.g., gig-economy roles), geographic barriers in underserved neighborhoods, and lingering distrust of financial institutions (Baradaran, 2015; Servon & Kaestner, 2008).

Detroit, Michigan, stands as a salient case study. Once a hub of industrial might, the city has grappled with deindustrialization, population decline, and the effects of the 2008 financial crisis, which disproportionately affected minority communities through subprime lending and foreclosures (Sugrue, 2014). Consequently, Detroit's unbanked rate is 18.3% for households—surpassing Michigan's statewide figure of 3.2% and the national average of 4.2%—with individual-level estimates reaching 25–30% in local assessments (FDIC, 2023; City of Detroit, 2024). This exclusion curtails opportunities for savings and investment and pushes residents toward predatory lending ecosystems, where short-term liquidity comes at long-term cost.

Predatory lending encompasses products characterized by opaque terms, excessive fees, and aggressive collection practices that exploit borrowers' limited options (Morse, 2011; Skiba & Tobacman, 2019). In Detroit, as in many urban centers, payday loans, auto-title loans, pawnshop credit, and rent-to-own agreements fill the void left by mainstream banks but extract significant

community wealth, with national fees from payday lending alone totaling $2.4 billion annually (Center for Responsible Lending, 2025). The result is debt traps, asset losses that disrupt daily life, and cycles of instability.

This white paper proposes Frat Boy Financial (FBF) as a targeted intervention. FBF harnesses AI for inclusive underwriting and DeFi for cost-effective capital sourcing, enabling loans at 5–10% APR with risk controls. By abstracting blockchain complexity behind a user-friendly mobile interface, FBF delivers the immediacy associated with short-term lenders while prioritizing transparency and borrower protection. Section 2 reviews pertinent literature; Section 3 analyzes Detroit's exclusion landscape; Section 4 examines predatory lending mechanics; Section 5 outlines FBF's system design; Section 6 details the methodological framework; Section 7 addresses regulatory and ethical dimensions; Section 8 discusses challenges and research directions; and Section 9 concludes with implications for practice.

# 2 Literature Review

## 2.1 Financial Exclusion and Urban Inequality

Unbanked and underbanked households face compounded vulnerabilities: limited access to low-cost credit constrains emergency buffering, and reliance on cash or alternatives raises transaction costs and exposure to fraud/theft (FDIC, 2023). Demographic disparities are pronounced, with low-income and minority groups overrepresented—African-American households, for instance, exhibit unbanked rates two to three times those of White households (FDIC, 2023). Spatial inequalities (e.g., "banking deserts") amplify these issues (Baradaran, 2015). Historical drivers include redlining and discriminatory lending that eroded trust (Sugrue, 2014). Contemporary studies link exclusion to labor-market shifts: irregular cash flows from gig and informal work are ill-suited to traditional account and credit qualification rules (Servon & Kaestner, 2008).

## 2.2 Predatory Lending and Economic Extraction

Predatory products—payday, title, pawn, rent-to-own—offer speed but at triple-digit APRs and with structural features that encourage repeat borrowing (Morse, 2011; Skiba & Tobacman, 2019). The CFPB reports that roughly one in five single-payment auto-title loans ends in vehicle repossession (CFPB, 2016). Pawn loans frequently result in collateral forfeiture; rent-to-own agreements imply very high effective APRs (Caskey, 1994; Raycom Media, 2017). CRL (2025) estimates payday fees at $2.4 billion annually.

## 2.3 Alternative Data and Credit Scoring

Alternative data—utilities, telecom, rent, and cash-flow analytics—can improve assessments of repayment capacity for thin-file borrowers. Machine learning models using these inputs have approved 10–20% more borrowers without raising default rates in pilot settings (Jagtiani & Lemieux, 2018). Governance is central: methods such as monotonic constraints, SHAP-based explanations, and bias audits help ensure compliance with fair-lending standards (Hurley & Adebayo, 2016; AFI, 2025; World Bank, 2025).

## 2.4 Decentralized Finance and Inclusion

DeFi democratizes access to lending and other financial primitives via smart contracts (WEF, 2022). Aave, a leading protocol, operates non-custodial liquidity pools with utilization-based rates; Arbitrum (an Ethereum Layer 2) reduces transaction costs and latency relative to L1, making small-value flows economical (Aave, 2025; Arbitrum, 2025). Adoption hurdles include volatility and complexity; OECD (2024) underscores the need for consumer-protective design. Credit delegation on Aave can support undercollateralized extensions when paired with off-chain safeguards (Aave, 2025). Scholars emphasize smart-contract and governance risks that hybrid designs must mitigate (Harvey et al., 2021).

# 3 Financial Exclusion in Detroit

Detroit's unbanked rate is 18.3% for households and 25–30% for individuals—well above state and national benchmarks (FDIC, 2023; City of Detroit, 2024).

**Table 1: Unbanked and Underbanked Rates**

| Geography | Unbanked (Households) | Underbanked (Households) | Unbanked (Individuals) |
|---|---|---|---|
| United States | 4.2% | 14.2% | 4–5% |
| Michigan | 3.2% | 12–15% | 3–4% |
| Detroit | 18.3% | 25–40% | 25–30% |

Table 1: Unbanked and underbanked rates across geographies. Sources: FDIC (2023); City of Detroit (2024).

**Figure 1: Unbanked Household Rate Comparison (Detroit vs. Michigan vs. U.S.)**

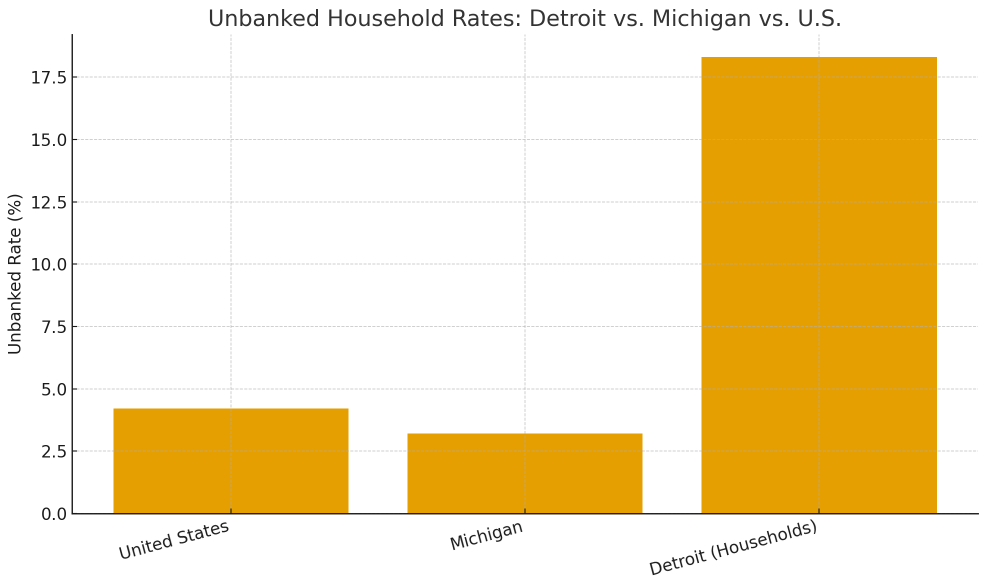


Figure 1: Data from FDIC (2023) and City of Detroit (2024).

Exclusion stems from intertwined factors: economic volatility in a post-industrial labor market, spatial access barriers, and distrust following the subprime crisis (Sugrue, 2014). Underbanked households—estimated at 25–40%—maintain minimal accounts but absorb significant fees from

alternatives (FDIC, 2023). Unbanked individuals often cite insufficient funds for minimum balances or privacy concerns; underbanked households may rely on non-bank services for a substantial share of transactions, incurring hundreds of dollars annually in fees (FDIC, 2023). These patterns align with national disparities but are more acute locally.

# 4 Predatory Lending Landscape

Predatory lending thrives where mainstream credit is inaccessible.

**Table 2: Selected Predatory Products and Outcomes**

| Product | Typical APR | Risks / Outcomes |
|---|---|---|
| Payday loans | $\tilde{4}00\%$ | $\tilde{\$}350$ average fees per loan cycle; serial borrowing common (CRL, 2025). |
| Auto-title loans | $\tilde{3}00\%$ | $\tilde{2}0\%$ end in repossession (CFPB, 2016). |
| Pawn loans | 120–300% | 15–20% lose pledged assets; high effective rates (Caskey, 1994). |
| Rent-to-own | 2–3$\times retail$ | Triple-digit implied APRs; frequent item loss upon missed payments (Raycom, 2017). |

Table 2: Selected predatory products and typical outcomes.

**Figure 2: APR Comparison: Predatory Products vs. FBF Target**

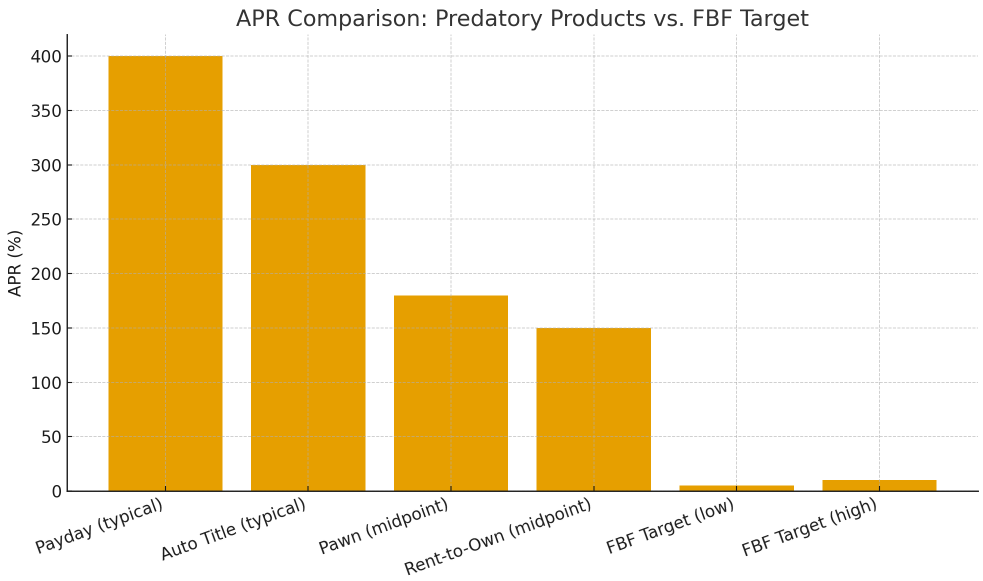


Figure 2: APRs for predatory products vs. FBF's 5–10% target. Sources: CRL (2025), CFPB (2016), Caskey (1994), Raycom (2017).

Payday loans advance funds against paychecks with biweekly fees (e.g., \$15 per \$100), implying $\tilde{3}91\%$ APR for a single two-week term; rollovers extend indebtedness (CRL, 2025). Auto-title loans often recycle fees without principal reduction, culminating in repossession for one in five borrowers (CFPB, 2016). Pawn loans require collateral and frequently result in forfeiture; rent-to-own contracts lead to 2–3$\times retail prices (Caskey, 1994; Raycom, 2017). In Michigan, payday lending uses a fee sche$
$\$0.50 admin), rather than a single APR cap; effective APRs can therefore be high even when lenders comply wi$

# 5 Solution Overview: Frat Boy Financial

FBF blends (i) AI underwriting using alternative data, (ii) DeFi liquidity from Aave's USDC pools on Arbitrum, and (iii) fiat bridging via Circle for user-friendly USD disbursement and ACH repayment. The UX abstracts on-chain complexity while preserving on-chain auditability.

User flow: mobile onboarding $\rightarrow$ KYC (Onfido) $\rightarrow$ data link (Plaid) $\rightarrow$ risk-model decision and term sheet $\rightarrow$ Aave borrow (USDC) on Arbitrum $\rightarrow$ Circle conversion to USD $\rightarrow$ ACH disbursement; repayments via ACH with monitoring and reminders.

**Figure 3: System Architecture of FBF**

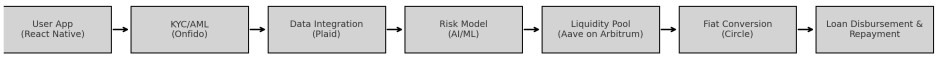


Figure 3: Borrowers interact via a mobile app; KYC/AML verification (Onfido) and data integration (Plaid) feed into the AI/ML risk model. Approved loans draw liquidity from Aave's USDC pools on Arbitrum and use Circle for fiat conversion. Funds are disbursed and repaid seamlessly to the end user.

The architecture centers on a React Native mobile app and Django/Python APIs. Onfido handles KYC/AML; Plaid integrates transaction and alternative-data feeds; Aave on Arbitrum supplies liquidity; Circle converts USDC to fiat. Repayments are orchestrated via backend automation aligned to smart-contract events. The approach minimizes operational overhead by eliminating branches and manual review where safe, while permissionless pools provide round-the-clock access to liquidity (WEF, 2022). Arbitrum offers materially lower fees and higher throughput than L1, making micro-transactions economically feasible (Arbitrum, 2025).

# 6 Methodology

FBF's methodology formalizes an AI–DeFi hybrid for sustainable lending: credit-risk modeling, funding mechanics, cost comparisons, and sensitivity analyses.

## 6.1 Credit Risk Model

We estimate PD (default probability), LGD (loss severity), and EAD (balance at default). Expected loss is:

$$EL = PD \times LGD \times EAD.$$

Pricing covers the cost of funds and operations:

$$APR = r + EL + OC,$$

where $r$ is the funding rate (e.g., Aave borrow APR) and $OC$ is operating cost (1%). For unsecured small-dollar credit, empirical LGDs often fall in the 50–70% range; sensitivity analysis considers this range explicitly.

**Features and governance.** Inputs include cash-flow volatility, inflow regularity, rent/utility timeliness, account tenure, and balance dynamics. We employ gradient-boosted trees with monotone constraints and SHAP explanations (Hurley & Adebayo, 2016). Governance includes periodic bias audits, reason codes, challenger/champion rotation, and human-in-the-loop thresholds (Jagtiani & Lemieux, 2018; World Bank, 2025; AFI, 2025). Operational goal: control realized default rates below $\tilde{1}0\%$ through conservative terming and eligibility.

## 6.2 DeFi Integration (Aave on Arbitrum)

Aave v3 provides non-custodial pooled liquidity with utilization-linked rates; historical snapshots in 2025 show mid-single-digit USDC borrow APRs on Arbitrum (Aave, 2025). Arbitrum lowers per-transaction costs and latency versus L1, supporting small-value flows at cents-level fees (Arbitrum, 2025). Credit delegation can enable undercollateralized extensions under off-chain agreements and conservative limits; FBF treats this as a controlled extension with additional reserves and monitoring (Aave, 2025).

## 6.3 Cost Comparison with Payday Rollovers

We compare three-month out-of-pocket costs for payday rollovers versus an amortizing 10% APR loan. Payday fees ($\tilde{\$}15$ per \$100) yield six cycles costing $\tilde{9}0\%$ of principal over three months. For an amortizing loan:

$$PMT = \frac{P \cdot (a/12)\,(1 + a/12)^n}{(1 + a/12)^n - 1}.$$

At $500, payday fees  $450; FBF interest  $12.50 over three months. This disparity scales with principal.

**Figure 4: Three-Month Cost—Payday vs. FBF (10% APR)**

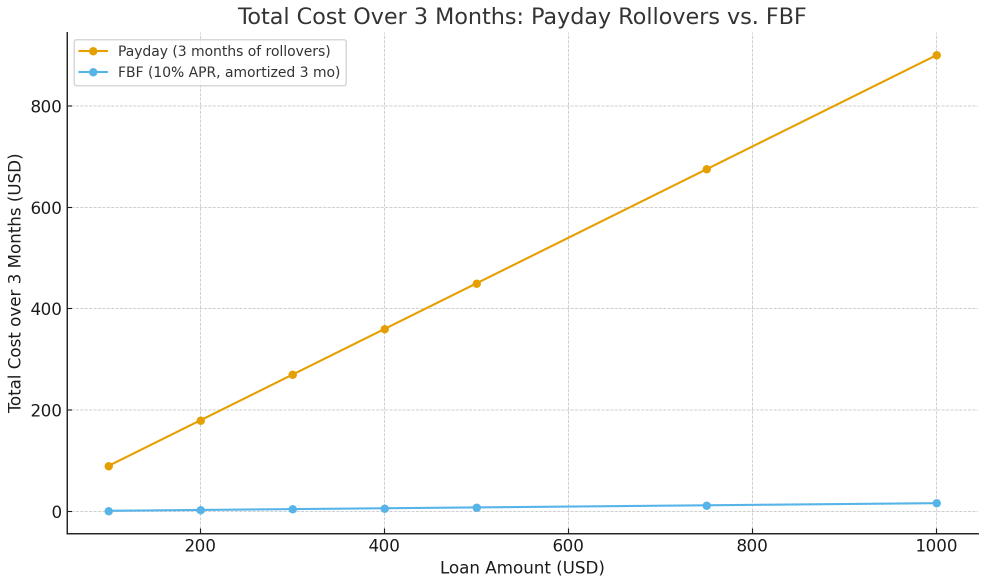


Figure 4: Total cost over three months: payday rollovers vs. FBF 10% APR amortized loan (fee model per cited norms).

## 6.4 Sensitivity Analysis: Net Margin

Define net margin (percentage points):

$$Net\ Margin = APR_{borrower} - r - (Default\ Rate \times LGD) - OC.$$

At borrower APRs of 6%, 8%, and 10%, and six cost-of-funds scenarios, margins remain positive up to ̃10–14% defaults when LGD50% and OC=1%; margins compress as r or LGD rises. This underscores the role of underwriting in capping PD and prudent terming.

**Figures 5–7: Net Margin vs. Default Rate across APR and r**

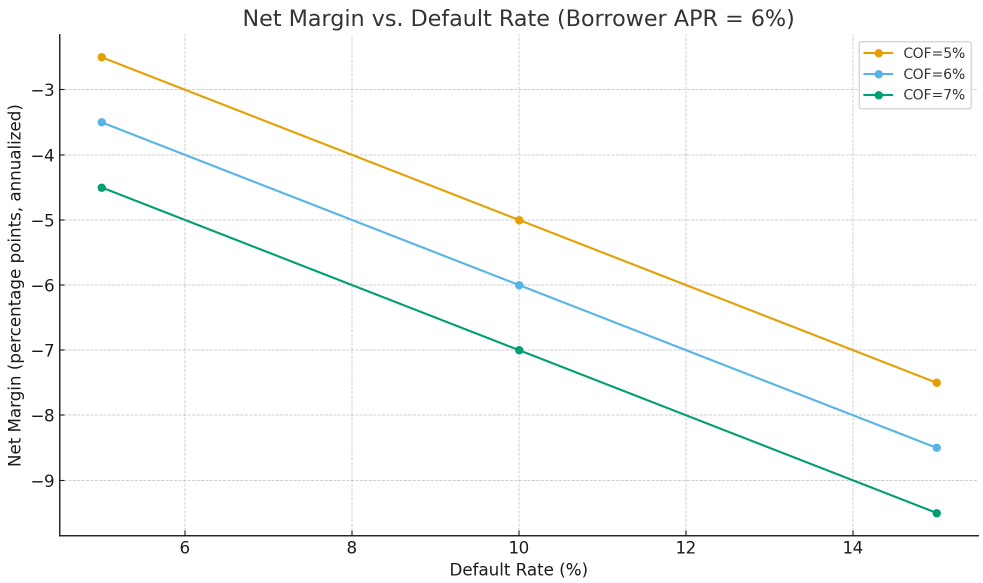


Figure 5: Net margin vs. default rate at borrower APR = 6% under cost-of-funds scenarios.

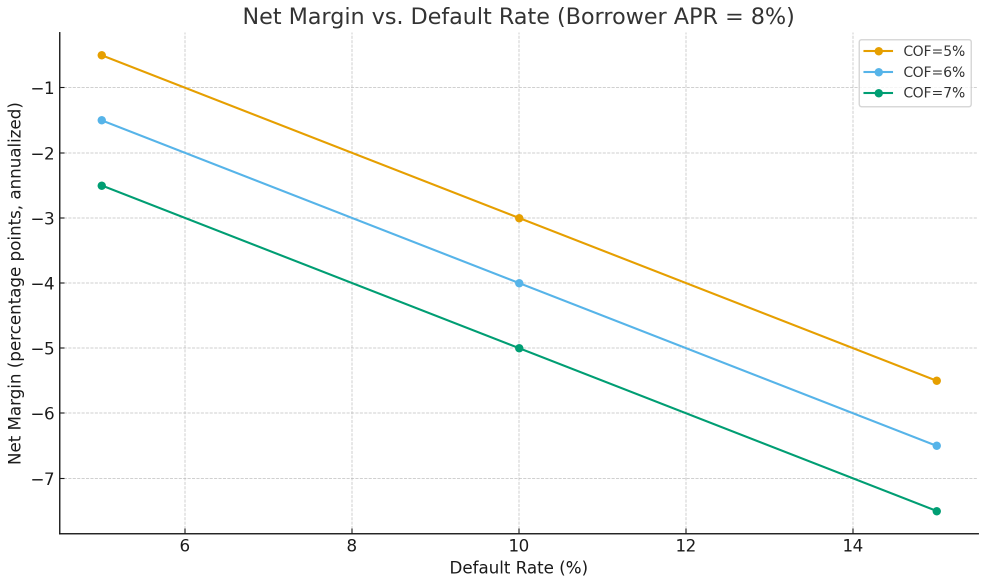


Figure 6: Net margin vs. default rate at borrower APR = 8% under cost-of-funds scenarios.

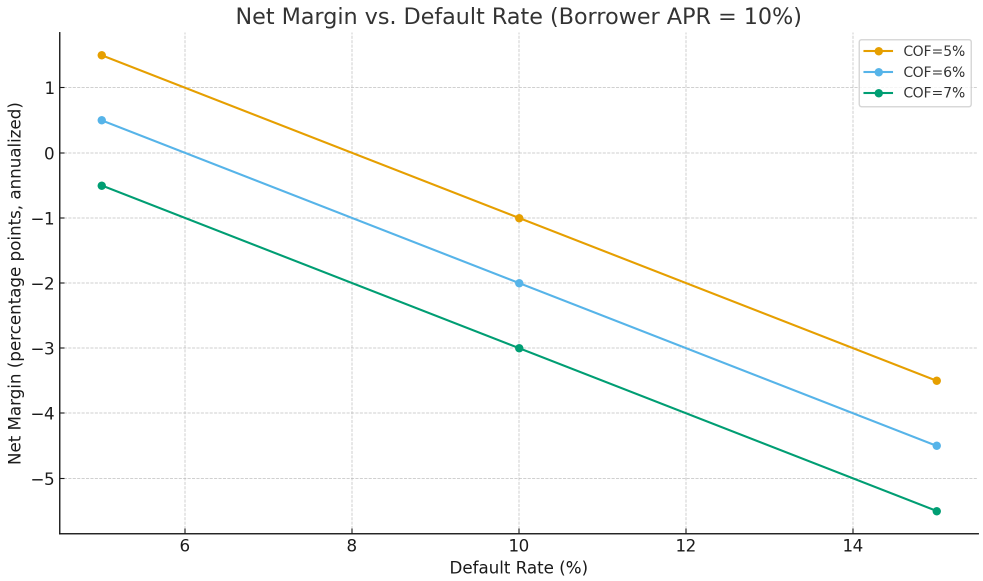


Figure 7: Net margin vs. default rate at borrower APR = 10% under cost-of-funds scenarios.

## 6.5 Adoption and Community Savings

We estimate three-month community savings for an average $400 loan: comparing payday rollovers to FBF at 10% APR. At 10,000 borrowers, savings  $3 million; at 50,000,  $17 million, assuming typical rollover behavior benchmarks (CRL, 2025).

**Figure 8: Aggregate Savings vs. Adoption**

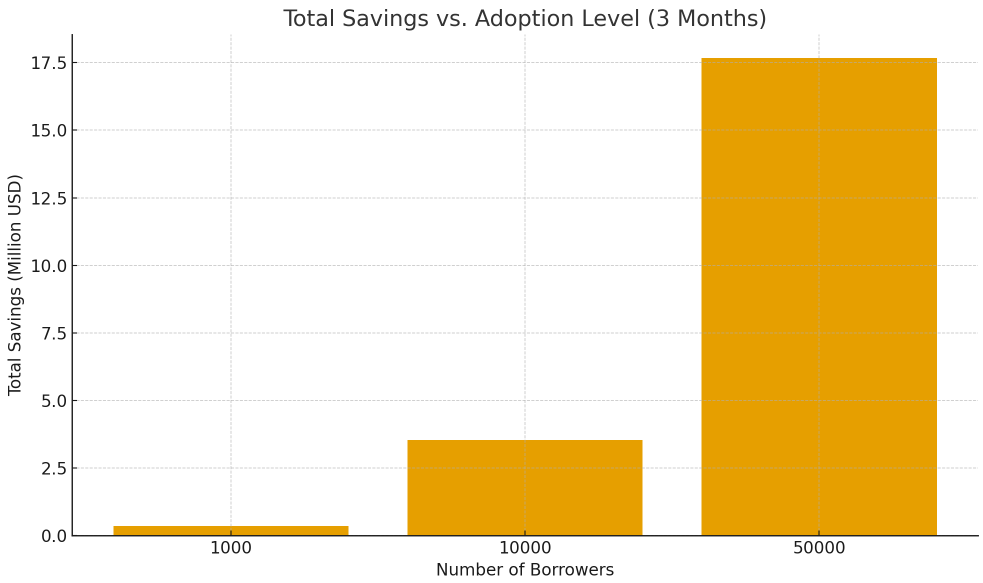


Figure 8: Total savings vs. adoption level over a three-month horizon (Authors' calculations; see Methods).

## 6.6 Risk Distribution (Synthetic PD)

To illustrate portfolio shape, we simulate 5,000 PDs from a Beta(2, 20) distribution (mean  0.091). Most PDs cluster below 0.1, enabling low rates for the majority while reserving higher rates or denials for tails.

**Figure 9: Illustrative PD Distribution**

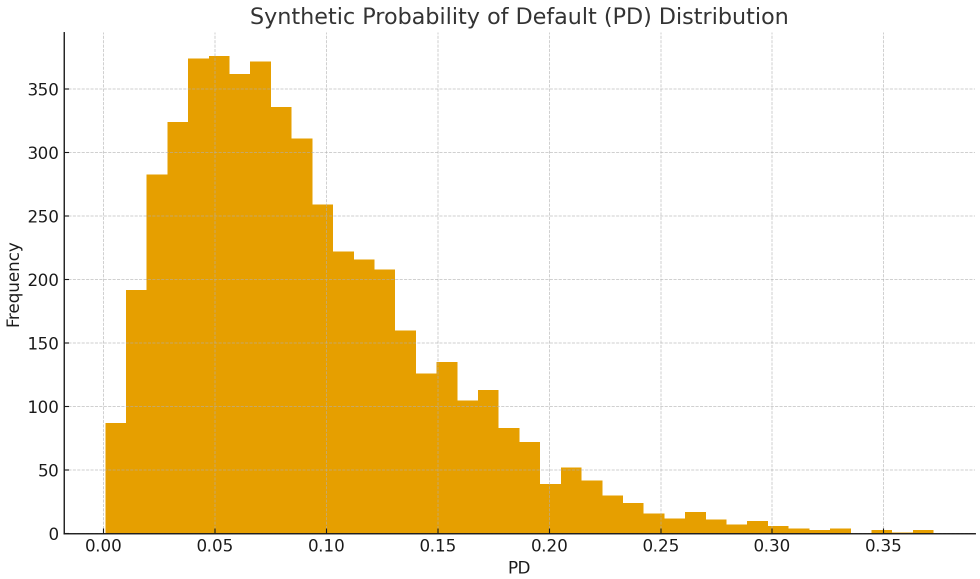


Figure 9: Synthetic probability of default (PD) distribution (n=5,000).

# 7 Regulatory and Ethical Considerations

FBF embeds compliance: Michigan lending licensure; KYC/AML onboarding (Onfido), sanctions screening, and SAR filing as applicable; GLBA/CCPA-aligned privacy; and fair-lending audits with explainability (FDIC, 2023). In Michigan, payday lending uses a **fee schedule** (e.g., $15 per $100 for a two-week advance; e.g., $76 maximum fee on a $600 loan), rather than a single APR cap; effective APRs can thus be high even when lenders comply with fee limits. FBF's 5–10% APR target is well below typical small-loan usury thresholds in many jurisdictions and is designed to eliminate rollovers and hidden charges.

**Table 3: Regulatory and Consumer-Protection Alignment**

| Requirement | FBF Implementation |
|---|---|
| KYC/AML | Onfido identity verification; watchlist screening; SARs where applicable. |
| Consumer Protection | Plain-language terms; no hidden fees; hardship forbearance; no rollovers. |
| Data Privacy | GLBA/CCPA policies; encryption at rest and in transit; user consent for data. |
| Fair Lending | Fairness audits; explainable AI; adverse action reasons provided transparently. |

Table 3: Regulatory and consumer-protection alignment.

Ethical AI follows CFPB-aligned expectations: minimize proxy discrimination (e.g., ZIP-code effects) via debiasing and human review for edge cases (Hurley & Adebayo, 2016). Governance includes independent audits and stakeholder input from community groups, ensuring alignment with inclusion goals (AFI, 2025).

# 8 Challenges and Research Directions

DeFi for inclusion offers opportunities like democratization and efficiency but faces challenges in security, regulation, and usability (WEF, 2022; OECD, 2024).

1. **Regulatory evolution.** DeFi-credit hybrids require careful disclosures and jurisdictional analysis; emerging guidance may shape custody, disclosures, and reporting (OECD, 2024).

2. **AI bias and discrimination.** Proxy effects can skew outcomes; mitigations include diverse training data, debiasing algorithms, and continuous audits (Hurley & Adebayo, 2016). Research: longitudinal fairness monitoring in live pilots.

3. **Undercollateralized credit risk.** Defaults threaten liquidity; mitigations include exposure caps, reserves (e.g., 10–20% of portfolio), and hybrid recovery strategies. Research: optimal

LGD estimation calibrated to DeFi–CeFi hybrids.

4. **Adoption barriers.** Distrust and digital divides hinder uptake; strategies include partnerships (e.g., Bank On) and education (WEF, 2022). Research: randomized evaluations of trust-building interventions.

These areas offer research opportunities like longitudinal fairness monitoring in live pilots.

# 9 Conclusion

Frat Boy Financial offers a practical and ethical blueprint for lowering the cost of small-dollar credit in Detroit using AI-enhanced underwriting and DeFi liquidity. By matching the speed and convenience of payday products while offering 5–10% APR and clear consumer protections, FBF aims to deliver immediate and measurable benefits. Future work includes pilot partnerships, third-party fairness and compliance reviews, and impact evaluations to validate outcomes and refine the model.

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