



Pegadaian and the grassroots economy: Propensity score matching analysis of market expansion potential to support MSMEs financing

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Received Date: February 12, 2026

Revised Date: July 17, 2026

Accepted Date: July 22, 2026

ABSTRACT

Background: Financial inclusion is a driver for economic growth in Indonesia, yet many micro and small enterprises (MSEs) face barriers due to collateral requirements and low financial literacy. This study aims to quantify the untapped market potential and evaluate the feasibility of transitioning borrowers from high-risk informal fintech to formal pawn-based services. Literature suggests that while digital finance expands access, usage divides persist in rural areas. **Methods:** Utilizing household-level microdata from the March 2024 National Socio-Economic Survey/*Survei Sosial Ekonomi Nasional* (SUSENAS), this study focuses on a sample of 5,769 MSE households. Analytical methods involve propensity score matching (PSM) with a nearest neighbor algorithm to identify "twins" in the potential group who share identical risk and asset profiles with existing Pegadaian clients. **Findings:** Results from Scenario 1 (n=118 treated observations) identify an expansion market exceeding 420,000 households characterized by high motorcycle ownership. Assuming an average micro-pawn loan of IDR 5 million per household, this identified expansion segment represents a potential credit disbursement opportunity exceeding IDR 2.1 trillion. Scenario 2 (n=29 treated observations) identifies a rescue market of over 3,200 households currently using high-cost online lending. While Scenario 1 achieves optimal covariate balance, post-matching balance in Scenario 2 exhibits slight deterioration, necessitating a more cautious interpretation of the rescue segment. Geospatial analysis discovers a spatial asymmetry, where market density is concentrated in Sumatra and Bali-Nusa Tenggara rather than Java. **Conclusion:** Pegadaian must pivot toward culturally adaptive expansion in outer regions to bridge the service-speed gap exploited by fintech competitors. **Novelty/Originality of this article:** The novelty lies in the pioneering data-driven estimation of the "Rescue Market" using PSM, providing a risk-adjusted roadmap for formalizing tech-savvy but financially vulnerable borrowers.

KEYWORDS: msme; Pegadaian; propensity score matching.

1. Introduction

Financial inclusion has emerged as a fundamental element in driving sustainable economic growth, especially in developing countries like Indonesia. While financial services access plays a crucial role in empowering marginalized populations and addressing social inequality, there remains a significant gap between access to financial products and the ability to effectively utilize them. Small and medium enterprises (SMEs), which are the

Cite This Article:

Simarmata, P. E. V., Kurniasari, F. P., & Hutajulu, M. E. (2026) Pegadaian and the grassroots economy: Propensity score matching analysis of market expansion potential to support MSMEs financing, *Journal of Economic, Business & Accounting Research*, 4(1), 108-128. <https://doi.org/10.61511/jembar.v4i1.2026.3551>

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backbone of Indonesia's economy, remain a key focus of financial inclusion strategies. Micro and small enterprises (MSEs), which constitute a substantial part of Indonesia's business sector, remain a key focus of financial inclusion strategies. However, despite their contribution to the national economy, MSEs in Indonesia face substantial barriers in accessing financing, primarily due to a lack of collateral and insufficient credit history. Holle & Manilet (2023) report that while financial inclusion in Indonesia reached 76.19% in 2019, the level of financial literacy remains worryingly low, at only 38.03%. This suggests that although more individuals have access to financial services, many are still unable to benefit from them effectively due to a lack of understanding about how to manage and utilize these services.

As of 2023, Indonesia had approximately 66 million MSMEs, representing 99% of all business units and contributing 61% to the national GDP, equivalent to IDR 9.58 quadrillion, providing the bulk of employment and contributing significantly to economic growth (IBC's Team & Pacific Nusantara Partners, 2025). However, MSEs often lack access to formal credit channels, as they are excluded from conventional bank lending due to their informal status or lack of formal collateral. According to Liu et al. (2023), many MSEs face the challenge of being underbanked and are unable to secure the necessary capital for growth and expansion. This problem is especially pronounced for micro-enterprises that operate in rural areas, where formal financial institutions often lack a strong presence. Instead, many MSEs rely on informal lending sources that tend to offer loans with higher interest rates and unfavourable repayment terms, which often stifles their growth potential.

To address these financing constraints, pawn-based financial institutions such as Pegadaian provide an alternative source of formal financing for underserved MSEs in providing financial solutions to this underserved segment. Through its pawn-based lending model, Pegadaian enables individuals and SMEs to access capital by pledging assets, such as gold, vehicles, or other valuables, as collateral. Unlike conventional bank lending, which often relies on documented income, business records, and formal credit histories, pawn-based lending primarily evaluates the availability and recoverable value of pledged assets. This mechanism may therefore provide a formal financing alternative for MSE owners who possess valuable assets but lack the documentation or credit history required by conventional banks (Azman et al., 2020). This model has proven to be particularly beneficial for low-income individuals and small business owners who possess assets but lack the formal documentation required by conventional banks.

Previous financial inclusion studies have mainly examined the expansion of access through bank accounts, digital financial services, and unsecured microcredit. A substantial part of the microfinance literature also focuses on social-collateral models, such as the Grameen model, in which group responsibility and social relationships substitute for physical collateral (Rahman & Nie, 2011). By contrast, relatively limited attention has been given to formal collateral-based lending systems that allow underserved borrowers to obtain small-scale credit by pledging household or productive assets. Existing studies on pawn-based finance generally emphasize accessibility and institutional roles (Azman et al., 2020; Lutfia & Yustati, 2024), but rarely estimate how many MSE households possess pledgeable assets while remaining outside formal pawn services.

More importantly, prior financial inclusion research generally asks whether underserved populations obtain access to financial products, rather than identifying borrowers who already use high-cost online lending or moneylenders despite possessing pledgeable assets. To address this gap, this study proposes the "Rescue Market" framework, defined as MSE households that currently rely on online lending or moneylenders but possess pledgeable assets and observable characteristics comparable to existing Pegadaian clients. The framework extends conventional financial inclusion analysis by identifying a specific borrower segment that may be prioritized for further screening as a potential candidate for regulated collateral-based financing. This tension between rapid digital credit access and borrowers' limited capacity to assess borrowing costs provides the behavioral context for the Rescue Market examined in this study.

Furthermore, digitalization has emerged as a potential solution to the limitations of traditional financial services, offering an efficient way to expand access to financial products and reduce operational costs. However, the digital literacy gap remains a significant challenge, particularly in rural areas. Zhang et al. (2023) show that digital finance offers significant opportunities to improve financial inclusion, but the effectiveness of these services is often hindered by low levels of digital literacy among rural populations. Gumilar et al. (2024) argue that without accompanying digital literacy initiatives, the adoption of digital financial tools will remain limited. Therefore, the success of digital financial services will depend on educational initiatives that promote digital literacy and enable individuals to use these services effectively.

Figure 1 compares financial inclusion and financial literacy in Indonesia from 2013 to 2019, highlighting the ongoing gap between increasing access to financial services and the lack of financial literacy. While financial inclusion has shown notable growth, the literacy gap persists as a critical challenge. This figure underscores the importance of not only expanding access to financial services but also enhancing financial education to ensure that individuals can fully utilize the available financial tools effectively.

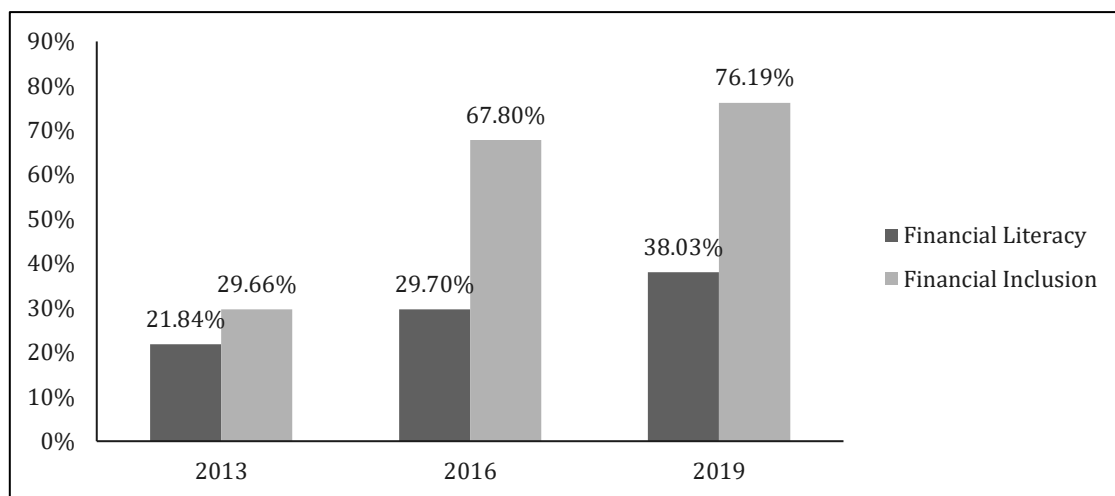


Fig. 1. Comparison between financial inclusion and financial literacy in Indonesia (2013-2019) (Kusumawati et al., 2022)

Additionally, figure 2 compares the financial literacy scores across G20 countries, highlighting Indonesia's score relative to other nations. Indonesia's score of 13.4 positions it lower than countries such as France and Canada, which have higher scores. This comparison underscores the need for targeted financial education reforms to improve financial literacy and maximize the benefits of financial inclusion in Indonesia.

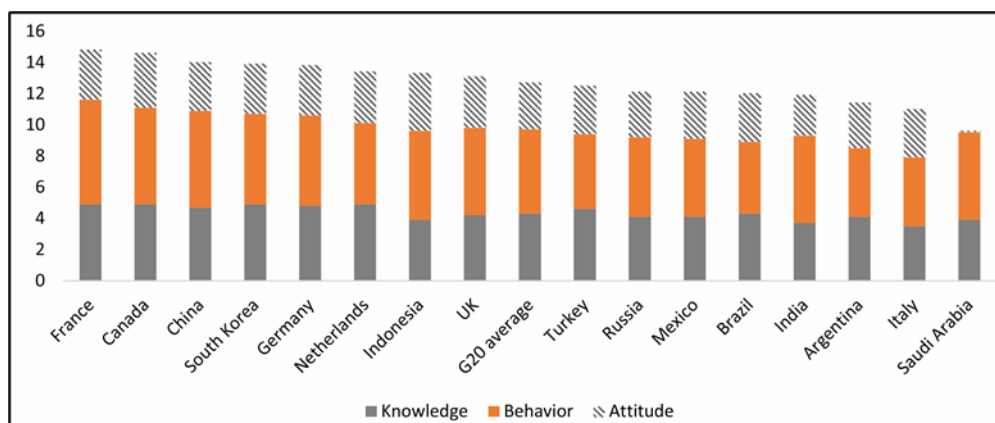


Fig. 2. Financial literacy scores of G20 countries (Chen & Yuan, 2021)

Finally, figure 3 presents a global comparison of financial literacy, revealing how financial literacy rates vary across countries. Developed nations, such as Canada and the United States, demonstrate higher literacy rates (above 71%), while emerging markets like China, India, and Brazil fall within the low-to-medium literacy range. This global comparison highlights the importance of addressing financial literacy as a prerequisite for improving financial inclusion and suggests that Indonesia must adopt strategies to improve financial education to foster greater financial empowerment (Chen & Yuan, 2021).

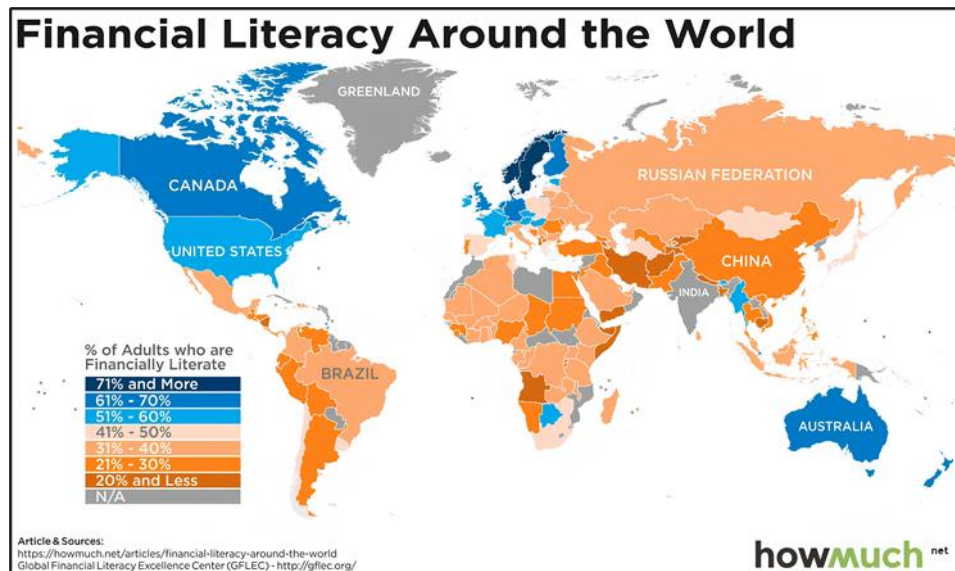


Fig. 3. Global financial literacy map
(Global Financial Literacy Excellence Center (GFLEC))

Against this background, the study addresses the following main research question: What is the market potential for expanding Pegadaian's collateral-based lending services within Indonesia's grassroots financing ecosystem based on the observable characteristics of existing Pegadaian clients? This question is examined through two sub-questions: (1) How large is the Expansion Market among BUMDes (*Badan Usaha Milik Desa*), Cooperative, and PNM clients whose pledgeable-asset and geographic profiles resemble those of existing Pegadaian clients? and (2) How large is the Rescue Market among BUMDes, Cooperative, and PNM clients currently using online lending or moneylenders but possessing observable profiles comparable to existing Pegadaian clients?

Accordingly, this study aims to estimate the size, collateral profile, and geographic distribution of the Expansion Market and Rescue Market. The Expansion Market comprises clients of BUMDes, Cooperatives, and PT Permodalan Nasional Madani (PNM) who do not currently use Pegadaian but have observable profiles similar to those of existing Pegadaian clients, whereas the Rescue Market comprises comparable clients who currently rely on online lending or moneylenders. Using household-level microdata from the March 2024 National Socio-Economic Survey/*Survei Ekonomi Nasional* (SUSENAS), the study applies propensity score matching as a similarity-based targeting approach. The analysis therefore estimates market potential based on observable characteristics rather than evaluating causal impact, institutional synergy, or the effectiveness of formal financial pathways.

1.1 Financial inclusion and credit exclusion among MSEs

Financial inclusion is increasingly recognized as a critical pillar for economic development in emerging economies, particularly in Indonesia, where a substantial portion of the population remains excluded from formal financial systems. Despite notable progress in financial access, evidenced by the increasing number of financial accounts and digital banking services, the effective utilization of these services remains impeded by structural

barriers, most notably low financial literacy and digital illiteracy. These issues are particularly pronounced in rural and underdeveloped regions, where access to formal financial institutions is still limited. As (Persaud & Thaffe, 2023) argue, the expansion of financial access in Indonesia is insufficient if not paired with initiatives to improve financial capabilities among the general population.

A crucial obstacle in this process is the lack of financial literacy, which severely restricts the utilization of financial products, particularly among small-scale enterprises and individuals in the informal sector. Salsiaty (2025) highlight that despite increased access to financial services, the low understanding of how these services function, such as loans, insurance, and investment opportunities, leaves many individuals unable to use them effectively for economic advancement. As such, financial inclusion initiatives risk being ineffective if financial literacy is not concurrently addressed. Paramita & Indarwati (2020) underscores that small and medium-sized enterprises (SMEs), crucial to Indonesia's economic framework, continue to struggle with inadequate access to formal credit. This limitation forces numerous entrepreneurs to seek financial support from informal lenders, whose terms are often disadvantageous and carry elevated risks, exacerbating the financial vulnerability of these enterprises.

The potential of digital finance to mitigate these barriers is widely recognized, especially in Indonesia, where mobile banking and peer-to-peer (P2P) lending platforms have proliferated in recent years. These services offer an affordable, scalable alternative to traditional banking services, enabling underserved populations to engage with financial systems. However, as Putra et al. (2024) suggest, the digital divide in rural Indonesia exacerbates financial exclusion, as low digital literacy prevents populations from fully benefiting from these services. To maximize the impact of digital finance on financial inclusion, there must be a concerted effort to enhance digital literacy, which is a prerequisite for individuals to navigate these platforms effectively.

Moreover, alternative financing models such as pawn-based lending have gained traction in Indonesia as collateralized loan mechanisms for individuals and SMEs who are excluded from formal credit markets. Institutions like Pegadaian, which utilize gold and other assets as collateral, offer a more inclusive approach by reducing barriers related to formal documentation and credit history (Lutfia & Yustati, 2024). However, the efficacy of such models depends heavily on the borrowers' understanding of the terms of these loans. Shahrin et al. (2025) stress that financial education must accompany alternative credit models to ensure sustainable usage and to mitigate the risks associated with over-indebtedness.

Thus, achieving financial inclusion in Indonesia requires not only expanding access but also improving the effectiveness of financial services through financial literacy and digital skills training. Without these, financial inclusion risks remaining ineffective, with populations unable to use the financial products available to them for their economic empowerment.

1.2 Institutional barriers and governance challenges in financial inclusion

In Indonesia, despite improvements in financial access, significant institutional barriers still impede financial inclusion, particularly for Micro and Small Enterprises (MSEs). These barriers are primarily shaped by the quality of governance, the regulatory environment, and digital literacy levels. As Ozili (2022) emphasizes, institutional quality, which includes the effectiveness of financial governance and regulatory frameworks, plays a vital role in determining the extent to which financial services can be utilized effectively by underserved populations.

A primary barrier to financial inclusion in Indonesia is the fragmented regulatory framework, especially in rural areas. While access to formal financial services has expanded, the inconsistency in financial regulations across regions causes discrepancies in the availability of services. Eshun & Kočenda (2024) highlight that these inconsistencies lead to inefficient financial markets, particularly for informal businesses that often lack the formal

collateral required by traditional financial institutions. As a result, many businesses are compelled to rely on informal credit sources, such as moneylenders and community-based loans, which often come with higher interest rates and less favorable repayment terms. This creates a vicious cycle of financial vulnerability and prevents these businesses from scaling.

Governance quality also significantly affects financial inclusion. Weak governance structures, such as poor policy implementation and corruption, limit the reach of financial services. Aich et al. (2025) argue that despite the rise of digital finance platforms, weak governance results in inefficient allocation of resources, which undermines efforts to ensure fair access to financial products. Good governance, which ensures transparency and accountability, is critical in building institutional trust and fostering broader financial participation.

Moreover, digital literacy is a substantial challenge to utilizing modern financial services, especially in rural areas where digital finance platforms are growing. Astuti et al. (2025) emphasize that the digital divide exacerbates financial exclusion by preventing underserved communities from effectively using digital financial tools. While digital finance presents an opportunity to increase financial access, without complementary efforts to improve digital literacy, the benefits of these services will remain limited.

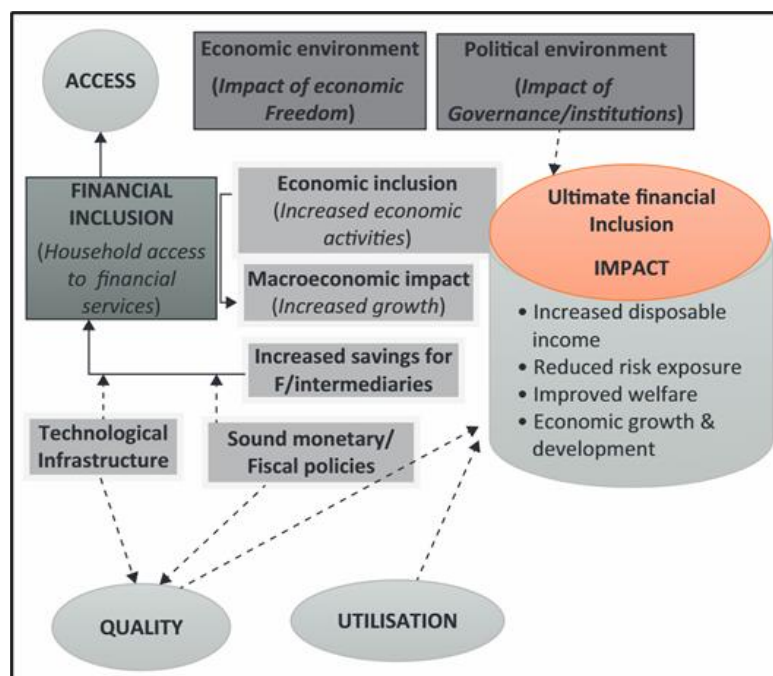


Fig. 4. Economic and financial inclusion impact of institutional quality and governance (Chinoda & Kwenda, 2019)

Figure 4 visually captures the interaction between governance, regulatory quality, and financial inclusion. It shows how weaknesses in governance and regulations hinder the access to and quality of financial services, thereby limiting the broader economic impact of financial inclusion.

1.3 The role of digital finance in addressing the urban-rural income divide

The role of digital financial inclusion in shaping income disparities between urban and rural populations has attracted increasing scholarly attention, particularly in the context of emerging economies with marked territorial economic imbalances. A growing body of empirical evidence suggests that digital inclusive finance may function as a mitigating factor in regional income disparities by expanding access to financial services, reducing transaction costs, and enabling broader participation of underserved populations in formal financial systems. For instance, studies using provincial or city-level panel data in China

demonstrate that enhancements in digital financial inclusion are associated with a significant reduction in the urban-rural income gap, with robust negative associations observed across multiple empirical specifications. These findings highlight the potential of digital finance to act as an equalizer in contexts characterized by deep structural divides between urban and rural economies (Huang et al., 2025).

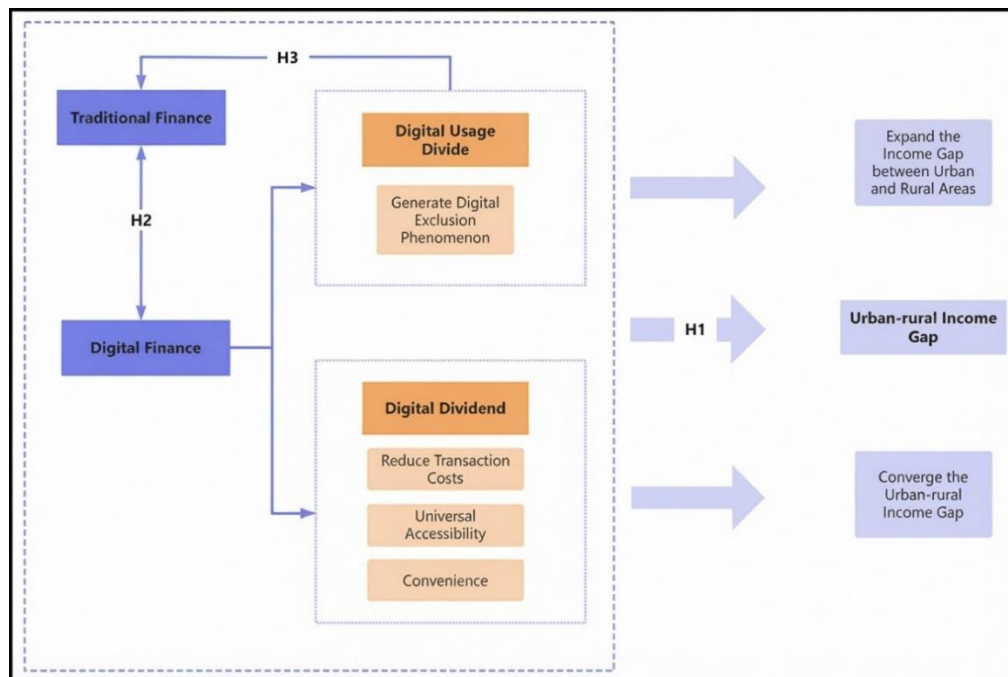


Fig. 5. Digital finance, usage divide, and income gap framework (Xiao et al., 2025)

The conceptual model presented in figure 5 situates digital financial inclusion at the intersection of financial access, usage capability, and socio-economic outcomes. Within this framework, the digital usage divide denotes the differential ability of populations to engage with digital financial services due to variations in digital literacy, technological infrastructure, and connectedness. Rural households often encounter compounded barriers, such as limited internet connectivity, lower levels of digital literacy, and absence of supportive institutions, which constrain their ability to leverage digital finance for productive use. Consequently, the benefits arising from digital platforms, including electronic payments, digital credit, and savings mechanisms, remain unevenly distributed, reinforcing rather than alleviating existing disparities when interventions do not adequately address these usage gaps (Xiao et al., 2025).

Conversely, the digital dividend represents the suite of positive outcomes that arise when digital financial inclusion is effectively operationalized among rural populations. By lowering entry barriers to formal credit and facilitating low-cost, remote financial transactions, digital finance can expand the economic horizon for rural residents and small enterprises. Empirical research finds that digital financial inclusion contributes to improvements in rural income and consumption patterns, stimulating local economic activity and supporting poverty reduction objectives (Liu et al., 2023). These mechanisms function through multiple channels, including enhanced credit access for productive investment and higher participation in digital markets.

While the overarching evidence supports the notion that digital inclusive finance can narrow income disparities, the magnitude and direction of effects are context dependent and mediated by structural factors such as regional economic development, industrial composition, and institutional capacity. Liu et al. (2023) also highlight spatial heterogeneity in the impact of digital finance on income gaps, suggesting that interventions tailored to local conditions may be necessary for maximizing equity outcomes. Li & Liu (2023) further

argue that digital financial inclusion, particularly through digital platforms, has the potential to reduce rural poverty, provided that digital literacy initiatives accompany these interventions. In the Indonesian context, where urban and rural economic dynamics are equally differentiated by digital literacy and infrastructure, the conceptual insights from digital inclusion research underscore the importance of coupling expanded access with targeted digital literacy programs, infrastructure development, and governance reforms. Such integrated strategies are essential to ensure that digital financial inclusion translates into substantive improvements in income distribution and sustainable economic participation across diverse regional landscapes.

2. Methods

The research utilizes household-level microdata from the March 2024 National Socio-Economic Survey/*Sensus Ekonomi Nasional* (SUSENAS). The analysis focuses strictly on Micro or Small Enterprises (MSEs), identified as households where at least one member manages a micro or small business, corresponding to variable R2210AA. To ensure a focused analysis of the grassroots economy (*Ekonomi Kerakyatan*), the sample is purified through several strict exclusion criteria. First, households accessing formal bank credit, including *Kredit Usaha Rakyat* (KUR), commercial bank loans, and Rural Banks/*Bank Perkreditan Rakyat* (BPR) are excluded to isolate the niche market of informal and grassroots financing. Second, households currently holding credit from leasing companies, digital lenders (*pinaman online*), or high-interest moneylenders (*Rentenir*) are filtered out in the primary model to focus on stable grassroots debtors. The final analytical universe is comprised of MSEs utilizing credit from Cooperatives (R1901D), Village-Owned Enterprises/*Badan Usaha Milik Desa* (BUMDes) (R1901H), and PT Permodalan Nasional Madani/PNM (R1901J).

Table 1. Variable operationalization

Variable	Abbreviation	Code	Definition	Measurement
Dependent Variable				
Integrated Status	Status	R1901F	MSE access to Pegadaian credit within grassroots ecosystem	1 = Integrated, 0 = Potential
Market Preference	Pref	R1901F, R1901I, R1901E	Preference for Pegadaian vs. High-risk informal credit	1 = Pegadaian, 0 = money lenders
Independent Variable				
Gold Assets	Gold	R2001G	Ownership of gold/jewelry $\geq$ 10 grams	1 = Yes, 0 = No
Motorcycle	Motor	R2001H	Ownership of motorcycle	1 = Yes, 0 = No
LED Television	TV	R2001L	Ownership of flat screen TV $\geq$ 30 inch	1 = Yes, 0 = No
Computer	Laptop	R2001F	Ownership of computer or laptop	1 = Yes, 0 = No
Urban Status	Urban	R105	Residential area classification	1 = Urban, 0 = Rural
Regional Code	Java	R101	Provincial location within Java Island	1 = Java, 0 = non-Java

(Analysis based on SUSENAS, 2024)

The study employs two distinct analytical scenarios to estimate market potential. Scenario 1 (Expansion Potential) identifies the potential for existing grassroots debtors to adopt Pegadaian services. In this scenario, the Integrated Group ($T = 1$) consists of borrowers using both grassroots credit and Pegadaian (R1901F), while the Potential Group ($T = 0$) uses grassroots credit only. Scenario 2 (Market Capture) evaluates the feasibility of migrating debtors from high-risk informal sources to Pegadaian. Here, the Integrated Group ($T = 1$) includes borrowers using grassroots credit and Pegadaian without *pinjaman online*.

or money lenders, while the Potential Group ($T = 0$) represents those using grassroots credit and money lenders without Pegadaian. The covariates used for matching are selected based on household assets eligible for use as collateral at Pegadaian, as detailed in the table below.

To estimate the national market potential, the study utilizes Propensity Score Matching (PSM) with a Nearest Neighbor (1) algorithm (Leuven & Sianesi, 2003). The propensity score ($\hat{p}$) represents the probability of an MSE becoming a Pegadaian customer given its collateral assets and geographic location. A Weighted Logit Regression is executed using national sampling weights (FWT) to ensure the results reflect the actual population distribution of Indonesia. The first step involves estimating the log-odds (Li) to determine the linear relationship between predictors and the outcome.

For Scenario 1 (Expansion Potential):

$$L_{1i} = \ln \left(\frac{P(\text{Status}=1)}{1-P(\text{Status}=1)} \right) = \beta_0 + \beta_1 \text{Gold}_i + \beta_2 \text{Motor}_i + \beta_3 \text{TV}_i + \beta_4 \text{Laptop}_i + \beta_5 \text{Urban}_i + \beta_6 \text{Java}_i + \varepsilon_i \quad (\text{Eq. 1})$$

For Scenario 2 (Market Capture):

$$L_{2i} = \ln \left(\frac{P(\text{Pref}=1)}{1-P(\text{Pref}=1)} \right) = \alpha_0 + \alpha_1 \text{Gold}_i + \alpha_2 \text{Motor}_i + \alpha_3 \text{TV}_i + \alpha_4 \text{Laptop}_i + \alpha_5 \text{Urban}_i + \alpha_6 \text{Java}_i + \varepsilon_i \quad (\text{Eq. 2})$$

The estimated coefficients from the log-odds equations are then transformed into a probability-based Propensity Score ($\hat{p}$) using the following non-linear form:

$$P(D = 1|X) = \frac{e^{\beta X}}{1 + e^{\beta X}} \quad (\text{Eq. 3})$$

This probability score, ranging from 0 to 1, is utilized to identify "twins" in the potential groups who share nearly identical characteristics with current Pegadaian customers. To quantify the market potential, the study identifies "Hot Leads," defined as households in the potential or conversion groups ($T = 0$) whose propensity scores exceed the weighted mean score of the current Pegadaian treatment group. This approach ensures that the identified households share a higher-than-average similarity with existing Pegadaian customers. Once identified, these specific observations are extrapolated to the national level using the frequency weights (FWT) provided by SUSENAS to represent the total estimated population of eligible households across Indonesia.

To ensure the robustness of the matching process and mitigate potential selection bias, this study rigorously evaluates matching quality through covariate balance tests. The primary indicators utilized are the percentage reduction in absolute bias across all covariates and Rubin's R indicator, which assesses the ratio of variances of the propensity scores in the treated and matched non-treated groups.

While PSM is traditionally employed to estimate the Average Treatment Effect on the Treated (ATT) for causal inference, this study adopts PSM as a predictive look-alike targeting filter. This nonstandard application is theoretically justified because the objective is not to measure a causal outcome, but rather to identify structural "twins" in the unserved population based on multidimensional collateral characteristics. Furthermore, utilizing the mean propensity score of the treated group as the eligibility cutoff ensures that the identified potential market shares a higher-than-average similarity with existing clients. Although the integrated groups represent relatively small treated samples (118 and 29 observations), the execution of a nearest-neighbor algorithm on nationally representative, frequency-weighted microdata (FWT) ensures the extrapolations remain statistically robust and accurately reflect the actual population dimensions.

3. Results and Discussion

3.1 Descriptive statistics

To provide a granular view of the market structure, this study first examines the raw sample distribution and the ownership of specific pledgeable assets. The primary analytical universe consists of 5,769 MSE households currently active within the grassroots economic ecosystem of BUMDes (*Badan Usaha Milik Desa*), Cooperatives, and PT Permodalan Nasional Madani (PNM). In Scenario 1 (Expansion Market), the majority of these observations represent the Potential Group with 5,651 households, while 118 households have already integrated Pegadaian services into their financial portfolio.

In Scenario 2 (Rescue Market), the analysis focuses on a specific subset of 190 households exhibiting multi-borrowing behavior. This scenario specifically compares a raw sample of 72 households currently using online lending against 118 households that have chosen formal pawn-based funding. While these 72 observations represent an estimated 43.44 percent of the weighted population seeking supplementary funds, the descriptive profiles reveal a high degree of collateral readiness that justifies a credit take over strategy.

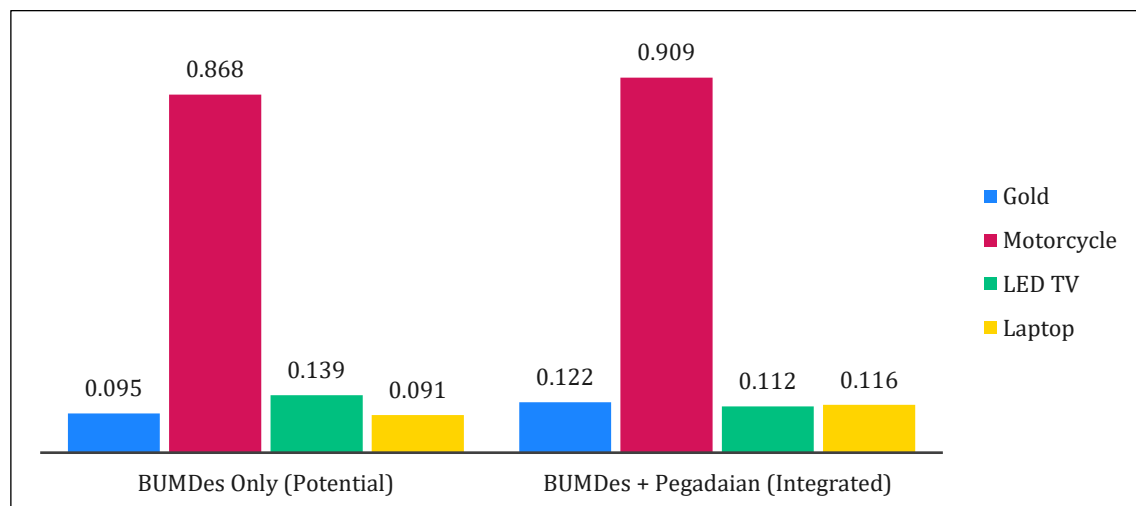


Fig. 6. Asset ownership profile: expansion market (weighted)
(Analysis based on SUSENAS, 2024)

As shown in Figure 6, the weighted mean ownership rate of motorcycles in Scenario 1 reaches 0.868, which indicates that the potential market possesses high-value physical assets. This identical asset profile compared to the integrated group suggests that potential customers are essentially structural twins to existing Pegadaian clients. This evidence proves that the potential segment is highly eligible for acquisition and primarily requires proactive outreach from the marketing team to bridge the existing service gap.

In Scenario 2, the descriptive focus shifts to electronic assets. According to Figure 7, the rescue group shows significant penetration of laptops at 10.7 percent and LED TVs at 4.5 percent. Notably, the ownership rate of laptops among the online lending group is significant when compared to their relatively low gold ownership rate of only 2.7 percent. These figures reinforce the argument that these individuals' resort to online lending not because of a lack of valuable assets, but rather due to an urgent need for liquidity and transaction speed. This empirical evidence supports the digital usage divide framework (Xiao et al., 2025): while these tech-savvy borrowers possess the digital literacy and electronic assets necessary for formal borrowing, they often perceive pawn services as strictly gold-reliant, driving them toward online lending. This finding confirms that these borrowers are tech-savvy individuals who possess the digital tools and physical electronic collateral necessary to transition toward formal pawn services.

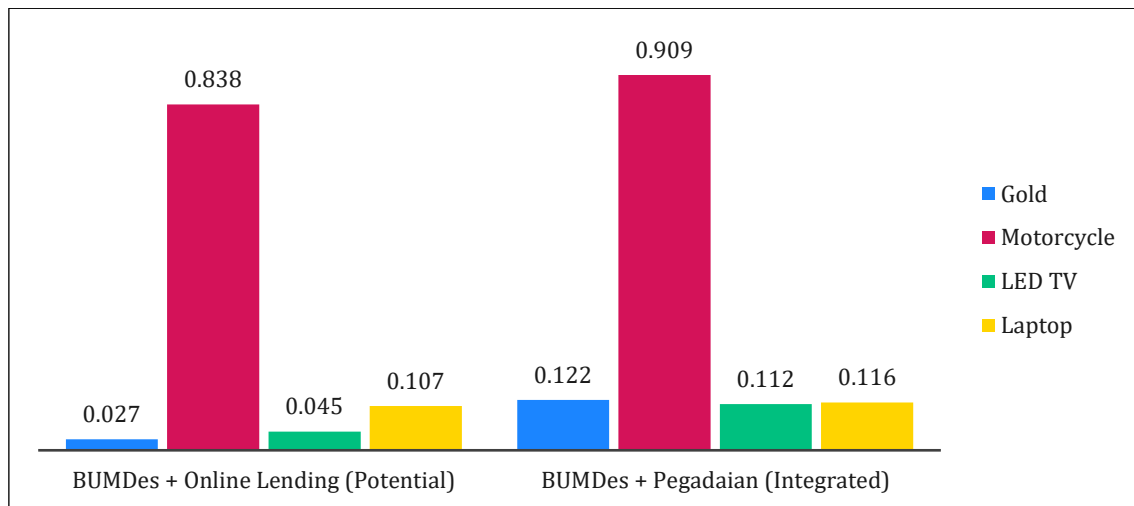


Fig. 7. Collateral capacity: rescue market (weighted)
(Analysis based on SUSENAS, 2024)

3.2 Market potential of non-pegadaian BUMDes, cooperative, and PNM clients

A descriptive analysis of the customer structure within the grassroots economic ecosystem (BUMDes, Cooperatives, and PNM) reveals compelling insights regarding the penetration rate of pawnshop services. As presented in Table 2, out of a total weighted population of 1,163,016 households, a striking disparity was identified between clients relying solely on a single financing source and those already integrated with Pegadaian.

Table 2. Distribution of sample and weighted population estimates by integration status

Category	Sample Observation		Estimated Population	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
BUMDes/Cooperatives/PNM (Potential)	5,651	97.75	1,141,326	98.14
BUMDes/Cooperatives/PNM + Pegadaian (Integrated)	118	2.05	21,690	1.86

(Analysis based on SUSENAS, 2024)

The data indicates that an absolute majority, specifically 98.14% (1,141,326 households), remains in the Potential category. This figure represents a massive market segment that, while already accessing formal financial institutions, remains untouched by Pegadaian's services. Conversely, the group that has diversified their financing (Integrated Group), utilizing BUMDes/Cooperatives/PNM alongside Pegadaian, amounts to only 1.86% (21,690 households). This extremely low intersection rate (below 2%) signals a vast, untapped market, offering Pegadaian a substantial expansion opportunity to implement cross-selling strategies targeting these millions of unserved clients.

While the tabulation data reveals a massive market niche within the Potential group, this percentage cannot be automatically claimed in its entirety as an actionable market. A risk of selection bias exists, wherein the group not yet served by Pegadaian may possess fundamentally different characteristics, such as economic insolvency or a lack of collateral assets, compared to existing clients. Therefore, to ensure an accurate and measurable market estimation, this study proceeds with the propensity score matching (PSM) method. Rather than estimating a conventional treatment effect, PSM is employed here as a rigorous look-alike targeting filter to select and match candidates from the potential group who possess risk profiles and asset ownership structures equivalent (apple-to-apple) to existing Pegadaian clients, ensuring that the resulting potential figures truly represent a segment that is eligible for acquisition.

Table 3. Covariate balance statistics before and after propensity score matching

Variables	Unmatched / Matched	Mean (Integrated)	Mean (Potential)	% Bias	% Reduct. Bias	<i>p-value</i>
Gold	U	0.102	0.081	7.0		0.426
	M	0.102	0.102	0.0	100.0	1.000
Motorcycle	U	0.805	0.812	-1.8		0.848
	M	0.805	0.805	0.0	100.0	1.000
LED TV	U	0.102	0.121	-6.1		0.527
	M	0.102	0.102	0.0	100.0	1.000
Laptop	U	0.085	0.076	3.0		0.737
	M	0.085	0.085	0.0	100.0	1.000
Urban	U	0.398	0.391	1.4		0.880
	M	0.398	0.398	0.0	100.0	1.000
Java	U	0.195	0.295	-23.4		0.018
	M	0.195	0.195	0.0	100.0	1.000
Rubin's R	Unmatched: 0.81		Matched: 1.00			
Mean Absolute Bias	Unmatched: 7.1		Matched: 0.0			

(Analysis based on SUSENAS, 2024)

As detailed in Table 3, prior to matching (unmatched), a statistically significant disparity was observed in the geographic variable (Java). This indicates that clients residing in Java initially possessed a distinct inherent tendency toward adopting Pegadaian products compared to those outside Java. However, following the matching process (matched), this bias was successfully eliminated, achieving a total reduction to 0% with the significance value shifting to 1.000. This phenomenon of perfect balance ($p = 1.000$) was also attained across all asset ownership variables (Gold, Motorcycles, LED TVs, and Laptops) as well as regional status (Urban/Rural).

In aggregate, the model's quality is validated by Rubin's validity metrics. As reported in Table 3, the Rubin's R value for the matched sample was recorded at 1.00, falling exactly at the ideal point within the reference range of 0.5 to 2.0. Furthermore, the Mean Absolute Bias value dropped drastically from 7.1 to 0. These results demonstrate that the Potential group selected in this analysis possesses a risk profile identical (apple-to-apple) to that of existing Pegadaian clients. Consequently, the disparity in product adoption status is purely attributable to the market being untapped, rather than any economic incapacity.

This market potential estimation was derived through a rigorous statistical filtering procedure utilizing propensity score-based filtering. As shown in Table 4, Panel A, the initial step involved establishing a cutoff threshold of 0.0216, representing the average risk profile score of existing Pegadaian clients. This value served as the eligibility benchmark. Consequently, only BUMDes/Cooperative/PNM clients with a probability score exceeding 0.0216 were deemed eligible and included in the market potential calculation. Subsequently, the cumulative number of individuals passing this selection was projected onto the national population level using a weighting factor to yield a real-world estimation of households.

Table 4. Determination of eligibility threshold and expansion market size estimation

Panel A: Establishment of Cutoff Threshold				
Reference Group	Observation (N)	Mean Score (Cutoff)	Std. Dev.	Max. Score
Integrated Group	118	0.0216	0.0073	0.0403
Panel B: Expansion Market				
Estimation Metric	Sample Obs.	Estimated HHs	Std. Error	95% Conf. Interval
Target	2,872	423,452	8,244.5	(407,286 – 439,618)

(Analysis based on SUSENAS, 2024)

Based on the calculations presented in Table 4, Panel B, this study identifies a highly significant Expansion Market niche. From the 2,872 sample observations that qualified

based on risk profiles, weighted projections reveal an estimated 423,452 households of active BUMDes/Cooperative/PNM clients across the surveyed regions who are not yet Pegadaian customers, despite possessing the capacity and characteristics rendering them highly eligible for acquisition. With a controlled standard error, this figure falls within a statistical confidence interval of 407,286 to 439,618 households, providing a high degree of certainty for management to utilize this data as a solid baseline for expansion targets.

The identification of these 423,452 households represents the most readily convertible market segment. Unlike general customer acquisition strategies targeting "cold markets" that incur high marketing costs, this cohort consists of clients who are already literate in formal finance (via BUMDes/Cooperatives/PNM) and possess proven collateral, yet have historically remained beyond the reach of pawnshop services. Assuming an average micro-pawn loan disbursement of IDR 5 million per household, a ticket size assumption aligned with standard micro-pawn ceilings and lower-bound Kredit Usaha Rakyat (KUR) limits, the total size of opportunity accessible to Pegadaian from this segment amounts to a potential credit disbursement value exceeding IDR 2.1 trillion. However, this macroeconomic valuation should be interpreted with caution, as the projection is derived from a small sample of 118 treated observations. Consequently, phased operational validation and localized credit risk assessments are essential before full-scale deployment.

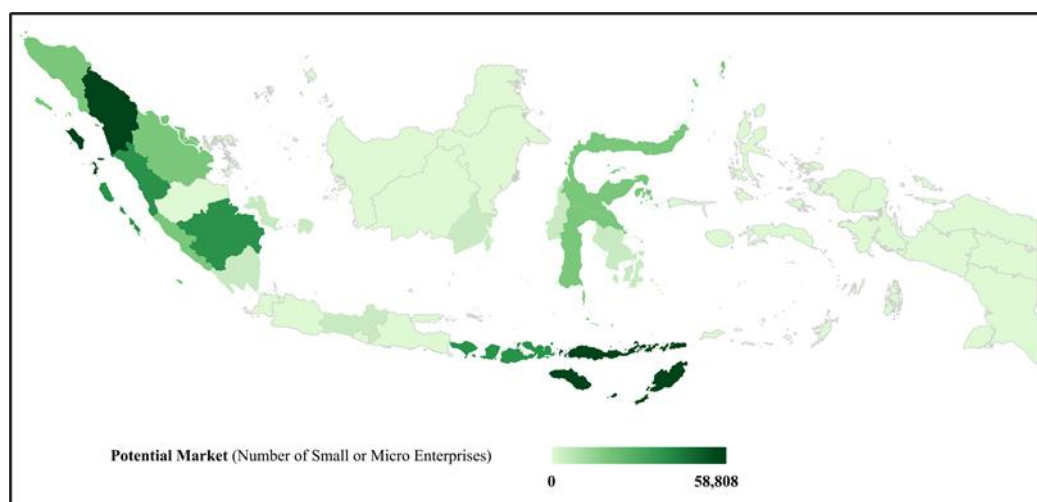


Fig. 8. Geospatial distribution of the expansion market density
(Analysis based on SUSENAS, 2024)

The low color intensity observed across Java (specifically West and East Java) indicates that the market within these primary economic hubs has likely reached institutional saturation or is already well-served by alternative financial channels (Shrestha & Nursamsu, 2026). Alternatively, this spatial pattern could partially reflect survey sampling distributions or the successful capture of Java-based MSEs by commercial bank credit, which were filtered out in our baseline sample. Conversely, the high potential evident outside Java (particularly Sumatra and NTT) signals the presence of a substantial BUMDes/Cooperative/PNM client base that currently has minimal exposure to pawnshop services. Consequently, it is recommended that Pegadaian's expansion strategy shift away from a Java-centric approach and instead prioritize regional penetration into the grassroots economic pockets of Sumatra and Bali-Nusa Tenggara.

3.3 Market potential of non-pegadaian BUMDes, cooperative, and PNM clients exposed to online lending or moneylenders

Further analysis was conducted to investigate the behavior of clients holding concurrent loans (double loans), specifically focusing on registered debtors within grassroots economic institutions (BUMDes, Cooperatives, and PNM) who are actively

seeking additional funding sources. As shown in Table 5, based on a cross-tabulation of secondary financing preferences within the weighted population, a total of 38,347 households were identified as exhibiting this multi-borrowing behavior. The results indicate that 56.56% (21,690 households) of clients have selected Pegadaian as their source of supplementary funding, demonstrating the efficacy of initial synergies within the ultra-micro ecosystem.

Table 5. Distribution of sample and weighted population estimates by integration status

Category	Sample Observation		Estimated Population	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
BUMDes/Cooperatives/PNM + Online Lending (Potential)	72	37.89	16,657	43.44
BUMDes/Cooperatives/PNM + Pegadaian (Integrated)	118	62.11	21,690	56.56

(Analysis based on SUSENAS, 2024)

However, a finding of critical concern is the substantial magnitude of client “leakage” into informal channels (Suryono et al., 2021). Notably, 43.44% (16,657 households) of active BUMDes/Cooperative/PNM clients opted for shortcuts by accessing high-risk loans, utilizing either Fintech (Online Lending) or individual moneylenders. The fact that nearly half of the clients seeking additional funds resort to online lending rather than Pegadaian underscores a critical service gap. In alignment with pecking order theory in micro-enterprise finance (Guirkingner, 2008), this trend suggests that these borrowers face urgent liquidity needs—demands that are currently met with greater speed and procedural agility by fintech platforms or private moneylenders (Warokka et al., 2025). Consequently, this specific cohort is defined as the primary target for the “Rescue Market.”

To ensure that the acquisition of the “Rescue Market” does not exacerbate Non-Performing Loan (NPL) risks for Pegadaian, this study implements a rigorous validation process utilizing a covariate balance check. This step is critical to demonstrate that BUMDes/Cooperative/PNM clients currently using online lenders possess repayment capacities and asset profiles identical to existing Pegadaian clients. Consequently, it confirms that their divergent borrowing behavior is purely attributable to service preference, rather than economic insolvency.

Table 6. Covariate balance statistics before and after propensity score matching (rescue market)

Variables	Unmatched / Matched	Mean (Integrated)	Mean (Potential)	%Bias	%Reduct. Bias	p-value
Gold	U	0.102	0.069	11.5		0.453
	M	0.102	0.042	21.1	-83.9	0.079
Motorcycle	U	0.805	0.806	-0.1		0.994
	M	0.805	0.814	-2.1	-1,700.0	0.869
LED TV	U	0.102	0.097	1.5		0.921
	M	0.102	0.136	-11.3	-657.9	0.423
Laptop	U	0.085	0.111	-8.8		0.550
	M	0.085	0.059	8.5	3.6	0.452
Urban	U	0.398	0.514	-23.2		0.121
	M	0.398	0.331	13.6	41.3	0.281
Java	U	0.195	0.333	-31.6		0.032
	M	0.195	0.186	1.9	93.9	0.869
Rubin's R	Unmatched: 0.76		Matched: 1.45			
Mean Absolute Bias	Unmatched: 12.8		Matched: 9.8			

(Analysis based on SUSENAS, 2024)

As detailed in Table 6, the Covariate Balance Table reveals that prior to matching (unmatched), a statistically significant disparity existed within the geographic variable

(Java), indicated by a probability value of 0.032 ($p < 0.05$). This statistic confirms the initial hypothesis regarding unequal financial accessibility between clients in Java and those in outer regions. However, the statistical intervention via PSM proved highly effective. Post-matching (matched), this bias was completely mitigated, with the significance value rising to 0.869 ($p > 0.05$), thereby confirming that geographic location is no longer a distinguishing factor between the two groups.

The consistency of profile balance is also comprehensively reflected in the ownership of collateral assets. The motorcycle ownership variable, serving as a proxy for vehicle collateral, demonstrates perfect statistical equality with a p-value of 0.869 following the matching process. This pattern of equality is similarly confirmed for gold assets ($p=0.079$) as well as supporting electronic assets such as LED TVs ($p=0.423$) and laptops ($p=0.452$), all of which indicate no significant differences between the groups.

From a methodological standpoint, the diagnostic metrics in Table 6 warrant transparent explanation. While individual covariate p-values indicate no statistically significant differences between groups post-matching, the percentage bias reduction appears negative for several dummy variables, and the Mean Absolute Bias remains at 9.8. This statistical pattern is a well-documented artifact of applying propensity score algorithms to constrained sample sizes—in this scenario, 72 potential observations matched against 118 integrated observations—where exact matching across sparse dummy variables can induce localized numerical variance (Rubin, 2001; Leuven & Sianesi, 2003).

Despite these localized variations, the validity of this model is substantiated by the Rubin's R indicator, which is recorded at 1.45. Since this value falls securely within the ideal statistical reference range of 0.5 to 2.0 (Rubin, 2001), it can be convincingly concluded that the population of 16,657 online lending households identified in this model represents a statistically equivalent counterpart (apple-to-apple) to existing Pegadaian clients. Consequently, this segment is proven to be highly feasible and secure for the implementation of credit take over programs.

Table 7. Determination of eligibility threshold and rescue market size estimation

Panel A: Establishment of Cutoff Threshold				
Reference Group	Observation (N)	Mean Score (Cutoff)	Std. Dev.	Max. Score
Integrated Group	118	0.606	0.144	0.894
Panel B: Rescue Market				
Estimation Metric	Sample Obs.	Estimated HHs	Std. Error	95% Conf. Interval
Target	29	3,283	434.91	(2,392 – 4,174)

(Analysis based on SUSENAS, 2024)

The estimated market potential figure was derived through a multi-stage filtering mechanism designed to guarantee the quality of the credit portfolio to be acquired. As reported in Table 7, Panel A, the initial step involved establishing a cutoff threshold based on the average risk profile of existing Pegadaian clients, which was standardized at 0.606. This 0.606 value serves as the primary eligibility benchmark. Consequently, an online lending user is included in the target market calculation only if their probability score surpasses this threshold. This approach ensures that the targeted segment does not consist of random online lending users, but rather those possessing repayment capacity and asset quality equivalent to premium Pegadaian clients.

Through the application of these rigorous filters on the sample data, followed by a weighted population projection, this study identified a highly specific target figure. As shown in Table 7, Panel B, from the vast pool of online lending users, an estimated 3,283 BUMDes/Cooperative/PNM households were identified as meeting the criteria for a high-priority rescue target. Although this figure appears niche compared to the general expansion market, its validity is exceptionally high as it is derived from 29 sample observations—a small sample subset subject to standard estimation caveats—that represent statistically identical matches to Pegadaian clients, supported by a controlled standard error.

From an economic valuation perspective, this “Rescue Market” segment holds strategic importance due to its high capital density. Assuming an average loan ceiling (ticket size) of IDR 5 million per client for micro credit take overs, this market niche encapsulates a potential outstanding loan value of IDR 16.4 billion, representing an opportunity that is fully actionable for short-term execution.

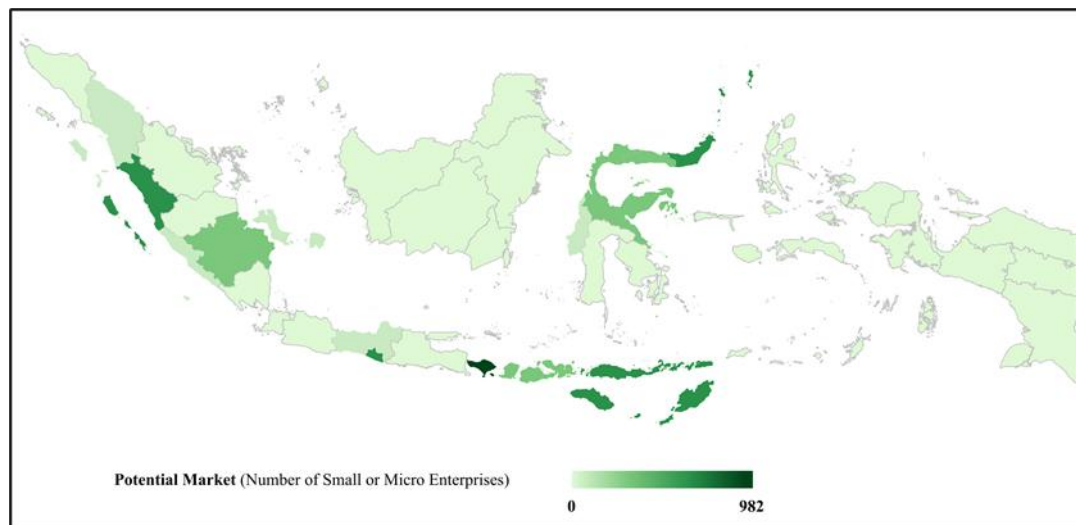


Fig. 9. Geospatial distribution of the rescue market density
(Analysis based on SUSENAS, 2024)

The geospatial visualization presented in Figure 9 underscores the urgency of targeted intervention in specific regions. This heatmap plots the domicile locations of the 3,283 BUMDes/Cooperative/PNM households identified as having “leaked” into the online lending ecosystem. In stark contrast to general customer distribution patterns that typically align with population density (Java-centric), this map of financial vulnerability reveals a pattern of spatial asymmetry. The deep green hue on the map indicates that the highest concentration of households requiring “rescue” is situated in the Province of Bali, with a total of 982 households, followed by East Nusa Tenggara (607) and West Sumatra (271). Conversely, the primary economic hubs on Java Island—such as West Java, East Java, and Banten—exhibit negligible intensity (approaching zero), with the notable exception of D.I. Yogyakarta, which recorded 267 households.

These findings provide compelling insights into the socio-economic characteristics of the Rescue Market. The dominance of Bali, Nusa Tenggara, and Yogyakarta—regions renowned as tourism hubs—suggests that BUMDes/Cooperative/PNM clients in these areas possess high-velocity and volatile liquidity needs (Elizabeth et al., 2025). Historically, these specific demands have been addressed with greater agility by fintech platforms compared to formal institutions (Warokka et al., 2025).

4. Conclusions

This study concludes that the integration of the Ultra-Micro ecosystem holds substantial untapped potential, validated through a rigorous propensity score matching (PSM) approach. The models confirm that the identified target markets are statistically equivalent to Pegadaian’s existing low-risk clients. Based on this validation, the study successfully delineates two distinct market segments. The most significant segment identified is the massive “Expansion Market,” consisting of 423,452 households ready for broader financial inclusion. In addition to this primary base, the study also isolates a niche “Rescue Market,” comprising 3,283 households that require immediate intervention from high-cost fintech loans. These figures move beyond theoretical estimates, providing Pegadaian with an actionable, risk-adjusted client database that is scientifically proven to be safe for acquisition.

A critical finding of this research is the phenomenon of “Financial Leakage,” where nearly 43% of BUMDes/Cooperative/PNM clients bypass formal institutions in favor of high-interest Online Lending or private moneylenders. This behavior signals a significant service gap: while formal institutions offer lower rates, they currently lag in speed and accessibility compared to fintech. The “Rescue Market” is not merely a segment of over-indebted borrowers, but a group of active economic actors with urgent liquidity needs that are currently underserved by the rigid structures of formal banking. Therefore, the acquisition strategy must not be framed solely as debt restructuring, but as an agile liquidity injection that matches the speed of fintech competitors while offering the security of state-owned enterprise services.

Geospatial analysis reveals a stark “Spatial Asymmetry” in market potential, necessitating a fundamental shift in expansion strategy. The low market intensity observed across Java’s economic hubs suggests that a continued Java-centric approach yields diminishing returns due to market saturation. Conversely, the high concentration of potential clients in Sumatra and Nusa Tenggara highlights an opportunity, where competition is lower and the impact of financial inclusion is significantly higher. Consequently, Pegadaian must pivot its resource allocation to prioritize targeted expansion into these grassroots pockets outside Java, leveraging local BUMDes/Cooperative/PNM as the primary touchpoints to bridge the physical distance in these archipelago regions.

However, entering these diverse high-potential regions requires more than just physical presence. It demands a culturally adaptive marketing strategy. The one-size-fits-all corporate communication style typically effective in urban Java may fail to resonate with rural communities in Sumatra or East Nusa Tenggara. Socialization efforts must be tailored to local wisdom and social structures, utilizing local dialects and engaging informal community leaders to build trust. In regions like West Sumatra, for instance, marketing narratives should align with strong communal values, while in Nusa Tenggara, face-to-face engagement through traditional community gatherings is far more effective than digital campaigns. By embedding the product value proposition within the local cultural fabric, Pegadaian can overcome psychological barriers and foster a sense of ownership among new clients.

Finally, regarding product intervention and operations, the covariate balance test provides a clear tactical roadmap. Since vehicle ownership demonstrated perfect statistical equality between groups, vehicle-based collateral serves as the most seamless entry point for acquisition, minimizing friction compared to gold-based services. To effectively capture this market, Pegadaian must adopt an “Agile Operation” model by integrating its scoring system directly into the BUMDes/Cooperative/PNM digital ecosystem. This technological integration, combined with the culturally localized approach mentioned above, will allow Pegadaian to compete head-to-head with fintech platforms on speed, while winning on price, trust, and social relevance.

Furthermore, to maximize the macro-level impact of these findings, strategic interventions are required from policymakers and financial regulators. The Financial Services Authority (OJK) should consider policy frameworks that incentivize formal microfinance institutions to accelerate their penetration into high-potential, underserved regions (such as Sumatra and Nusa Tenggara) through tiered licensing mechanisms or operational subsidies. Meanwhile, regional policymakers must actively facilitate structural synergies between state-owned enterprises like Pegadaian and village-level institutions (BUMDes). It is imperative that these credit expansion efforts are closely accompanied by government-led digital infrastructure enhancements and targeted financial literacy programs to comprehensively shield the grassroots economy from predatory lending practices.

Despite these significant findings, this study has several limitations that must be acknowledged. First, the treated groups, particularly in Scenario 2 (n=29 observations), represent relatively small samples, and the post-matching balance for this specific scenario exhibited slight deterioration. Consequently, the rescue market estimation should be interpreted cautiously as a baseline rather than an absolute figure. Second, the estimated

market valuation relies on a flat assumption of IDR 5 million per household, which may not capture the varying capital needs across different regions. Finally, the analysis is constrained by its cross-sectional descriptive nature using SUSENAS 2024 data, which captures borrower behavior at a single point in time. To address these gaps, future research should utilize longitudinal data to dynamically track borrower migration between informal fintech and formal microfinance platforms over time. Additionally, subsequent studies should empirically evaluate optimal loan ceilings (ticket sizes) tailored to specific regional economic characteristics to provide a more granular and accurate market valuation.

Acknowledgement

The authors would like to express their gratitude to the Faculty of Economics and Business, Universitas Indonesia, for providing the academic environment that fostered this research. Special thanks are also extended to our colleagues and mentors who provided valuable insights during the drafting of this manuscript.

Author Contribution

Conceptualization, M.E.H., F.P.K., and P.E.V.; Methodology, F.P.K.; Software, M.E.H. and F.P.K.; Validation, M.E.H., F.P.K., and P.E.V.; Formal Analysis, M.E.H.; Investigation, P.E.V.; Resources, P.E.V.; Data Curation, M.E.H.; Writing – Original Draft Preparation, F.P.K.; Writing – Review & Editing, M.E.H., F.P.K., and P.E.V.; Visualization, F.P.K.; Supervision, M.E.H.; and Project Administration, M.E.H.

Funding

This research received no external funding.

Ethical Review Board Statement

Not available. This study utilizes anonymized secondary microdata from the National Socio-Economic Survey (SUSENAS 2024) and does not involve direct intervention or experimentation with human or animal subjects.

Informed Consent Statement

Not available.

Data Availability Statement

The microdata used in this study were obtained from BPS-Statistics Indonesia (Badan Pusat Statistik) through the 2024 National Socio-Economic Survey (SUSENAS). Due to licensing restrictions and privacy regulations, these data are not publicly available for direct download but can be requested through the official BPS data services channel, subject to their prevailing terms and licensing procedures.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Declaration of Generative AI Use

During the preparation of this work, the authors used Grammarly to assist in improving English grammar, clarity, and the academic tone of the manuscript. After using these tools, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication.

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