Journal of Economics, Finance and Sustainability
Vol. 4, No. 1, 19–38
https://doi.org/10.5281/zenodo.20961504
Research Article / Araştırma Makalesi

The Substitution Effect of Peer-to-Peer Lending: Evidence from Indonesian Provinces

Zoubir Boulahbel [a]

ABSTRACT

Purpose – Peer-to-peer (P2P) lending is regarded as a solution to financial exclusion in developing countries, yet robust evidence testing its role as a substitute for traditional banks in these contexts remains scarce. This study provides the first empirical test of this "substitution hypothesis" in Indonesia, examining whether P2P lending per capita is higher in regions with weaker banking infrastructure.

Design/data/methodology – We employ a Two-Way Fixed Effects model on a panel dataset of 31 Indonesian provinces from 2020-2024 (N=1,736). The model identifies the within-province relationship between P2P lending per capita and two banking density measures: bank credit to GRP and bank branches per capita, while controlling for unobserved regional and time-specific factors. Robustness checks replace credit-based banking density with deposit-based density and substitute P2P depth (lending scaled by GRP) for the dependent variable.

Findings – The main results support the substitution hypothesis: P2P lending per capita is significantly higher in provinces with lower bank credit to GRP ($\beta = -0.098$, $p < 0.01$) and fewer bank branches per capita ($\beta = -7.865$, $p < 0.001$). A strong positive time trend confirms sustained sector growth. However, robustness checks reveal that substitution is specific to the credit dimension of banking and to per capita P2P lending. When banking density is measured by deposit mobilization, the relationship becomes positive, suggesting a complementary dynamic. The substitution effect is not robust when P2P activity is scaled by GRP.

Originality/value – This study provides evidence that P2P lending substitutes for bank credit in Indonesia, particularly in underserved regions, while coexisting with broader deposit-based banking infrastructure. It refines the substitution debate by showing context-dependent roles of FinTech, offers guidance for financial inclusion policies, and highlights the need for differentiated regulatory approaches.

Keywords: P2P Lending, Substitution Hypothesis, Financial Inclusion, Banking Density

Kişiden Kişiye Kredide İkame Etkisi: Endonezya Eyaletlerinden Kanıtlar

ÖZET

Amaç – Peer-to-peer (P2P) kredi sistemleri, gelişmekte olan ülkelerde finansal dışlanmaya bir çözüm olarak görülmekle birlikte, bu bağlamda geleneksel bankaların yerini alma rolünü test eden sağlam kanıtlar halen yetersizdir. Bu çalışma, Endonezya'daki bankacılık altyapısının zayıf olduğu bölgelerde P2P kredi büyümesinin daha hızlı olup olmadığını inceleyerek, söz konusu "ikame hipotezi"nin ülke özelinde ilk ampirik testini sunmaktadır.

Tasarım/veri/metodoloji – 31 Endonezya eyaletine ait 2020-2024 dönemi panel verisi (N=1.736) üzerinde Çift Yönlü Sabit Etkiler modeli uygulanmıştır. Model, kişi başına P2P kredi hacmi ile iki bankacılık yoğunluk göstergesi (banka kredisi/GRP ve kişi başı şube sayısı) arasındaki ilişkiyi, gözlemlenemeyen bölge ve zaman etkilerini kontrol ederek tahmin etmektedir. Sağlamlık testlerinde, kredi temelli yoğunluk mevduat temelli yoğunlukla değiştirilmekte ve bağımlı değişken olarak P2P derinliği (GRP'ye göre ölçeklendirilmiş borç verme) kullanılmaktadır.

Bulgular – Sonuçlar belirgin bir ikame ilişkisi göstermektedir. Kişi başına P2P kredi hacmi, bankacılık yoğunluğunun düşük olduğu eyaletlerde anlamlı biçimde yüksektir; hem banka kredisi/GRP oranı ($\beta = -0.098$, $p < 0.01$) hem de kişi başı şube sayısı ($\beta = -7.865$, $p < 0.001$) ile negatif ilişki mevcuttur. Piyasanın büyüme eğilimini doğrulayan pozitif zaman trendi ($\beta = 0.000881$, $p < 0.001$) kaydedilmiştir. Sağlamlık kontrolleri ise ikamenin yalnızca bankacılığın kredi boyutuna ve kişi başı P2P borç vermeye özgü olduğunu; mevduat temelli yoğunlukta ilişkinin pozitife dönerek tamamlayıcılığa işaret ettiğini ve P2P faaliyeti GRP ile ölçeklendirildiğinde etkinin kaybolduğunu ortaya koymaktadır.

Özgünlük/değer – Bu çalışma, Endonezya'da P2P borç vermenin özellikle yetersiz hizmet alan bölgelerde banka kredisini ikame ettiğini, ancak mevduat temelli bankacılık altyapısıyla bir arada var olduğunu göstermektedir. Bulgular, FinTek'in bağlama göre değişen rollerini ortaya koyarak ikame tartışmasını rafine etmekte, finansal kapsayıcılık politikalarına yön vermekte ve farklılaştırılmış düzenleyici yaklaşımların gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: P2P Kredi, İkame Hipotezi, Finansal Kapsayıcılık, Banka Yoğunluğu

Received / Geliş Tarihi: 30.11.2025 Accepted / Kabul Tarihi: 1.05.2026

[a] Université Badji Mokhtar, Annaba, Departmant of Finance, BP 12, Annaba, Algeria;
Corresponding Author: zoubir.boulahbel@univ-annaba.dz

1. Introduction

In many developing countries, traditional banking systems fail to reach vast segments of the population, leaving an estimated 1.3 billion adults globally unbanked (World Bank, 2025). Peer-to-peer (P2P) lending has emerged as a potentially transformative solution to this exclusion, promising to connect borrowers and lenders directly through digital platforms. By leveraging alternative data for credit assessment, P2P lending offers a pathway to credit for those marginalized by conventional finance due to a lack of credit history, high transaction costs, or geographical isolation.

The dynamics of P2P lending are increasingly well-documented in developed economies. Seminal research in the United States has established that P2P lending often expands in areas underserved by traditional banks (Eid and Yang, 2018; Jagtiani and Lemieux, 2018), acting as a partial substitute, particularly in markets with fewer small banks. Studies on platforms like Lending Club and Prosper have further explored its role in consumer credit markets (Tang, 2019; Havrylchyk *et al*., 2020). Similarly, research in the UK and European contexts has examined its fit within the broader credit ecosystem (De Roure *et al*., 2016; Pierrakis and Collins, 2013).

However, a critical gap remains. The findings from mature, highly banked economies cannot be automatically extrapolated to developing countries, where the fundamental structure of the financial system, levels of digital infrastructure, and the demographic profile of the unbanked are fundamentally different. Moreover, the substitution versus complementarity debate has largely focused on credit provision, with limited attention to other dimensions of banking presence, such as deposit mobilization. Whether P2P lending fills credit gaps in underserved regions or complements broader banking infrastructure remains an open question, particularly in emerging economies.

Despite Indonesia's status as a major emerging economy with a rapidly growing FinTech sector, no study has systematically investigated this question in a way that distinguishes between different facets of banking activity. As documented in recent studies, Indonesia's financial inclusion landscape is marked by deep regional imbalances: only 24.3% of rural adults hold a bank account compared to 43.2% in urban areas (Sahputri et al., 2024). These conditions make Indonesia an ideal setting to test whether P2P lending substitutes for traditional banking in underserved regions.

This paper directly addresses this gap by examining the relationship between P2P lending and traditional banking in Indonesia. Our primary objective is to test the substitution hypothesis—whether P2P lending per capita is higher in regions with weaker banking infrastructure—using two distinct measures of banking density: credit depth (bank credit to GRP) and physical branch presence. Recognizing that

banking presence also includes deposit mobilization, we further examine whether the relationship holds when using deposit-based density as an alternative indicator. Additionally, we assess whether results are sensitive to measuring P2P activity per capita versus relative to regional economic product. By employing a rigorous panel data methodology across Indonesian provinces, this study provides the first empirical evidence from a major developing economy on the nature of the relationship between different dimensions of banking density and P2P market penetration. The findings offer crucial insights for policymakers seeking to foster financial inclusion and for platforms designing market-specific strategies, moving beyond assumptions based on Western models to ground-truth evidence from the Global South.

2. Literature Review and Hypothesis Development

2.1. The Concept and Mechanics of P2P Lending

P2P lending has emerged as a disruptive force in the financial landscape, operating as an online marketplace that directly connects borrowers and lenders, thereby disintermediating traditional banks (Eid and Yang, 2018). Since its inception following the 2008 financial crisis, this model has provided a critical source of credit for individuals and small businesses marginalized by conventional institutions (Tang, 2019). Its innovation lies not in creating new financial products, but in revolutionizing the lending process through digital efficiency, leveraging technology to lower operational costs and offer more accessible alternatives to bank credit (Eid and Yang, 2018).

The core function of a P2P platform is that of an information intermediary, not a credit intermediary (Azganin *et al*., 2021). The platform facilitates the transaction by providing borrower information, conducting credit evaluations, and managing the exchange, but it does not assume the liability for loan defaults. This model has seen explosive growth globally, from a nominal financing volume of USD 3.5 billion in 2013 to a projected USD 1 trillion by 2025 (Al-Hashfi and Zusryn, 2020; Bella, 2020). However, it is worthy to note that the most relevant features of this model are its reliance on alternative data for credit assessment and its significantly lower operational overhead, which are the fundamental mechanisms enabling it to potentially serve segments traditionally excluded from formal finance.

2.2. The Substitution versus Complementarity Debate in Developed Markets

The potential of P2P lending to promote financial inclusion is rooted in its structural advantages. By disintermediating traditional banks, P2P platforms can theoretically reduce interest spreads, offering borrowers lower rates and lenders higher returns (Yum *et al*., 2012; Polyzosa *et al*., 2021). Crucially, their use of proprietary, flexible credit risk models—which can incorporate non-standard information—allows them to assess the creditworthiness of "unbankable" borrowers who lack a formal credit history (Yum *et al*.,

2012; Eid and Yang, 2018). This suggests a clear potential for P2P lending to act as a substitute for traditional banks in underserved areas.

Empirical evidence from developed markets, however, presents a nuanced picture, forming a central debate in the literature. A body of research supports the substitution hypothesis. Studies of U.S. platforms like Lending Club find that FinTech lending expands in areas with fewer bank branches and serves higher-risk borrowers who are neglected by the traditional system (Jagtiani and Lemieux, 2018; De Roure *et al*., 2016). This stream of literature positions P2P lending as filling a credit gap left by retracting banks.

Conversely, other studies argue for a complementary relationship. Research in European contexts concludes that P2P lending often supplements, rather than competes with, conventional banking activity, serving niche segments without directly substituting for core banking products (Milne and Parboteeah, 2016; Boitan, 2016). Some findings even suggest a hybrid role; for instance, Tang (2019) finds that P2P lending can substitute for bank credit for some borrowers while complementing it for others, particularly for small-sized loans.

This ongoing debate is almost exclusively informed by evidence from mature, highly banked financial systems. The extent to which these findings apply to developing economies—where banking infrastructure is inherently patchier, the unbanked population is larger, and digital financial services are often a first entry point into the formal system—remains a pressing, unanswered empirical question. Moreover, the debate has largely focused on the credit dimension of banking, leaving open the question of whether substitution holds for other aspects of banking presence, such as deposit mobilization.

2.3. The Indonesian Context: Financial Inclusion, FinTech and the Regulatory Landscape

Indonesia presents a critical case for testing the substitution hypothesis. Despite the government's target of 90% financial inclusion by 2024, data from the World Bank reveals a stark reality: only 62% of Indonesians over 15 hold an account at a formal financial institution, and a mere 5% have borrowed from one (World Bank, 2025). This vast gap underscores the limitations of the traditional banking sector and makes the goal of universal inclusion nearly impossible to achieve using only conventionally available services.

Financial inclusion in Indonesia is characterized by significant regional imbalances in both bank account ownership and credit access. As of 2018, no district had surpassed a 60% adult bank account ownership rate, with a notable urban–rural divide (43.2% vs. 24.3%). The highest ownership rates are concentrated in major urban centres such as DKI Jakarta (54.5%), North Kalimantan (50.7%), and East Kalimantan (50.2%), while the lowest

rates are found in South Sumatra, Lampung, and Papua. Credit access is heavily concentrated in Java, Bali, and Sumatra, where rates exceed 1% of the population, whereas Eastern Indonesia—including Kalimantan, Sulawesi, and Papua—shows substantially lower access at less than 0.25% (Sahputri *et al.*, 2024). Indonesia's status as a sprawling archipelago of over 17,000 islands creates significant logistical hurdles for traditional banking, a problem compounded by a stark digital divide: internet penetration reaches 73% in urban centres but only 48% in rural regions (Pradhipta *et al.*, 2025).

Recognizing this, the Indonesian Financial Services Authority (OJK) has explicitly championed FinTech as a vehicle for financial inclusion. The regulatory framework, particularly OJK Regulation No. 77/POJK.01/2016, catalyzed the rapid expansion of the P2P lending sector. The number of borrowers increased sharply from 38 thousand in 2016 to nearly 16 million by October 2019, demonstrating its rapid market penetration (OJK, 2020). As of February 2024, there were over 131 million borrowers who received loans through Indonesian P2P lending platforms, with outstanding loans reaching IDR 66.9 trillion in August 2024. These platforms are designed to fill the financing gap by opening access to individuals and small business units previously excluded from formal banking services (Atahau *et al.*, 2026). From a regional access perspective, P2P lending platforms in Indonesia have achieved a wider market expansion than traditional banks by serving markets that cannot be penetrated by conventional banking infrastructure (Sari, 2021).

Several mechanisms explain why P2P lending expands in regions with weak banking infrastructure. First, lower transaction costs: digital platforms eliminate the overhead of physical branches and intermediaries, making small loans economically viable (Sari, 2021). Second, mobile penetration: widespread smartphone use and growing internet access allow remote populations to bypass physical bank branches (Pradhipta et al., 2025). Third, lack of branches: the archipelago's geography leaves many areas with no bank presence, creating a natural demand for digital alternatives (Sahputri et al., 2024). Fourth, flexibility in credit scoring: P2P platforms use alternative data (e.g., digital transaction histories, business cash flows) rather than requiring formal collateral, enabling them to serve borrowers rejected by traditional banks (Pradana *et al.*, 2025; Atahau *et al.*, 2026). Shifting digital behaviour is also influenced by a "distrust mindset": consumers who harbour distrust toward traditional banking services are significantly more likely to participate in P2P lending (Atahau *et al.*, 2026).

The industry has seen considerable expansion, with a large portion of loans being disbursed to individuals, but it is important to note that some issues of concern have emerged. Examples are the proliferation of unlicensed lenders, lack of financial literacy among borrowers, and questionable debt-collection methods (Yulisman, 2024). Despite being highly monitored, P2P regulation is noted to be lagging behind the established banking sector; current priorities include user education, consumer protection, data privacy, and monitoring of illegal P2P activities (Atahau *et al.*, 2026).

While P2P platforms in Indonesia have thrived in recent years with rapid developments in mobile technology and the widespread use of smartphones, this rapid growth, set against a backdrop of significant regional variation in banking density, provides a valuable empirical setting to investigate whether P2P lending is primarily growing in the provinces where traditional banks are absent. Supporting the relevance of this inquiry, Sari (2021) finds that P2P lending growth has a significant negative effect on the profitability of 109 OJK-registered banks between 2015 and 2019—particularly for state-owned banks slower to innovate—suggesting a substitutive rather than purely complementary relationship. Thus, the deep regional disparities, low financial literacy, evolving digital behaviour, and still-developing regulatory framework together to create a rich laboratory for testing the substitution hypothesis and exploring the conditions under which P2P lending complements rather than replaces traditional banking.

2.4. Hypothesis Development

The theoretical promise of P2P lending, combined with the specific structural gaps in the Indonesian financial system, leads to a clear and testable prediction. If P2P platforms are fulfilling their promise of serving the financially excluded, their penetration should be highest in regions where traditional banking infrastructure is weakest. Therefore, this study tests the following hypothesis:

> **H1:** *P2P lending acts as a substitute for traditional banking infrastructure in Indonesia. Specifically, P2P lending volume per capita will be significantly higher in provinces with lower banking density, measured by bank credit relative to gross regional product and bank branches per capita.*

We focus on these two dimensions because they directly capture credit availability and physical access, which are the primary channels through which financial exclusion operates. The relationship with other dimensions of banking presence, such as deposit mobilization, is explored separately as a robustness check.

3. Data and Methodology

3.1. Data Sources and Variable Construction

This study utilizes a balanced panel dataset of 31 Indonesian provinces over the period January 2020 to August 2024, yielding 1,736 province-month observations. Seven provinces were excluded due to incomplete data for the study period or because they were newly formed during this time, ensuring a balanced panel. The data is compiled from three primary official sources to ensure reliability and consistency:

a. Financial Data: Provincial-level data on commercial bank credit, branch counts, and third-party funds (deposits) are sourced from the publicly available Indonesia Banking Statistics reports published by the Financial

Services Authority (OJK).

b. FinTech Data: Data on P2P lending disbursements are obtained from the monthly Information Technology-Based Joint Funding Services (LPBBTI) Statistics, also published by OJK.
c. Macroeconomic and Demographic Data: Data on provincial Gross Regional Product (GRP) and mid-year population projections are collected from Statistics Indonesia (BPS, 2025). GRP is reported annually by BPS; to match the monthly frequency of other variables, we linearly interpolated GRP to monthly estimates.

Our empirical analysis centers on the relationship between traditional banking density and P2P lending penetration. The variables are constructed as follows:

- Dependent Variable:
  - P2P_pc: P2P lending per capita. Calculated as the total monthly P2P loan disbursement (in Rupiah) in a province divided by the province's population. This normalization is critical to control for provincial size and to accurately measure per capita credit access, following the approach used in prior research on FinTech lending (e.g., Jagtiani and Lemieux, 2018).

  As an alternative measure of P2P lending depth, we also construct P2P_GRP.

  - P2P_GRP: total monthly P2P loan disbursement divided by Gross Regional Product. This variable captures the scale of P2P lending relative to the regional economy, allowing a direct comparison with the banking depth measure described below.
- Independent Variables (Banking Density Measures):
  - BankCredit_GRP: The ratio of total commercial bank credit to Gross Regional Product (GRP). This measure captures the financial depth and lending capacity of the traditional banking sector within a regional economy, a common metric in the finance-growth literature.
  - BankBranches_pc: The number of commercial bank branches per capita. This measure captures the physical accessibility and proximity of traditional banking infrastructure for the local population, a key variable in studies of financial inclusion (e.g., Martinez Peria *et al.*, 2005).

  To capture the overall scale of banking activity beyond lending, we also construct a deposit-based measure:

  - TPF_GRP: The ratio of total third-party funds (demand deposits,

savings deposits, and time deposits) of commercial banks to Gross Regional Product. This variable reflects the size and depth of the deposit base in a region, serving as an alternative indicator of banking presence and financial inclusion.

In robustness checks, we replace BankCredit_GRP with TPF_GRP to test whether the substitution effect holds when banking density is measured by deposit mobilization rather than credit provision. Similarly, we examine the sensitivity of our results by using P2P_GRP as an alternative dependent variable.

3.2. Empirical Strategy

To isolate the relationship between banking density and P2P lending, we employ a Two-Way Fixed Effects (TWFE) panel regression model. This approach is standard in regional economic studies as it controls for unobserved, time-invariant provincial heterogeneity (e.g., cultural norms, geographic constraints) through province fixed effects, and common temporal shocks affecting all provinces (e.g., national policy changes, macroeconomic trends) through time (month-year) fixed effects (Wooldridge, 2010).

The multivariate empirical model is specified as follows:

$$P2P\_pc_{it} = \beta_0 + \beta_1 BankCredit\_GRP_{it} + \beta_2 BankBranches\_pc_{it} + \beta_3 Time_t + \mu_i + \lambda_t + \varepsilon_{it}$$

Where:

- $P2P\_pc_{it}$ is the P2P lending per capita in province i and month t.
- $BankCredit\_GRP_{it}$ is the ratio of bank credit to GRP in province i and month t.
- $BankBranches\_pc_{it}$ is the number of bank branches per capita in province i and month t.
- $Time_t$ is a linear time trend to capture the sustained increase of the P2P sector.
- μ_i represents province fixed effects.
- λ_t represents time (month-year) fixed effects.
- ε_{it} is the idiosyncratic error term.

This multivariate approach allows us to assess the unique contribution of each dimension of banking infrastructure while controlling for the other. The coefficients of interest are β_1 and β_2. A statistically significant negative coefficients ($\beta_1 < 0$; $\beta_2 < 0$) would provide support for the substitution hypothesis, indicating that P2P lending per capita is higher in provinces and during periods where traditional banking density is lower, consistent with findings in developed market contexts (Jagtiani and Lemieux, 2018; Tang, 2019).

While the TWFE model mitigates many sources of omitted variable bias, we acknowledge that a strictly causal interpretation may be limited by potential endogeneity, such as reverse causality. Therefore, we interpret our findings as conditional correlations that are consistent with a substitution effect, rather than as definitive causal evidence. We further assess the robustness of our findings through a series of alternative specifications described in Section 3.3.

3.3. Robustness and Alternative Specifications

To address concerns regarding the measurement of banking density and the depth of P2P lending, we implement two additional specifications. These checks help assess whether the main findings are sensitive to alternative definitions of banking presence and P2P activity.

First, we replace the credit-based banking density measure (BankCredit_GRP) with a deposit-based measure (TPF_GRP), defined as the ratio of total third-party funds to GRP. This specification captures banking presence through deposit mobilization rather than credit provision, reflecting the broader concept of financial inclusion and addressing the point that banks may be active in non-lending services.

Second, we substitute the dependent variable with an alternative measure of P2P lending depth: P2P_GRP, defined as total P2P loan disbursement divided by GRP. This allows us to examine whether the substitution effect holds when P2P activity is scaled to the size of the regional economy, rather than measured on a per capita basis.

All other elements of the model (province fixed effects, time fixed effects, and the branch density variable) remain unchanged. Results of these robustness checks are presented alongside the main findings.

4. Analysis and Results

4.1. Descriptive Statistics and Preliminary Analysis

The empirical analysis, conducted using IBM SPSS Statistics (v.26), employs a balanced panel dataset, free of missing values, comprising 1,736 province-month observations across 31 Indonesian provinces from January 2020 to August 2024. Prior to estimating the main model, the data underwent standard diagnostic checks to ensure the robustness of the results.

An examination of descriptive statistics across all provinces revealed no influential outliers that would unduly affect the estimates. The total sample means and standard deviations, presented in Table 1, indicate substantial variation in the key variables, a necessary condition for testing the hypothesized relationships. The total sample mean for P2P lending per capita was 0.045 (SD = 0.065), indicating significant variation in P2P lending penetration across the country. The key independent variables also showed considerable variation, with the bank credit to GRP ratio averaging 0.241 (SD = 0.147) and

bank branches per capita averaging 0.016 (SD = 0.007). For the robustness checks, we also examined the alternative measures: P2P lending depth (P2P_GRP) had a mean of 0.0006 (SD = 0.0051), and the deposit-based banking scale (TPF_GRP) had a mean of 0.2394 (SD = 0.14611), confirming substantial cross-provincial variation.

Table 1. Descriptive Statistics

	Count	Mean	Standard Deviation
P2P_pc	1736	,04483524	,064537437
P2P_GRP	1736	,0006	,0051
BankCredit_GRP	1736	,24130049	,146823656
BankBranches_pc	1736	,01620288	,007189891
TPF_GRP	1736	,2394	,14611

To test for multicollinearity, Variance Inflation Factors (VIFs) were calculated via an auxiliary ordinary least squares (OLS) regression. The results presented in the Table 2 showed VIFs of 1.434 for bank credit to GRP, 1.438 for bank branches per capita, and 1.004 for the time trend. All values are well below the conservative threshold of 5, indicating that multicollinearity does not pose a concern for the estimation of the fixed effects (O'Brien, 2007).

Table 2. Multicollinearity Test

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	-31.213	1.342		-23.256	0.000		
	BankCredit_GRP	0.268	0.007	0.609	36.756	0.000	0.697	1.434
	BankBranches_pc	2.160	0.149	0.241	14.513	0.000	0.695	1.438
	Time_t	0.001	0.000	0.322	23.218	0.000	0.996	1.004

a. Dependent Variable: P2P_pc

4.2. Main Results: Two-Way Fixed Effects Estimation

To test the substitution hypothesis, a Two-Way Fixed Effects (TWFE) model was estimated, with P2P lending per capita as the dependent variable. The model included province fixed effects to control for time-invariant regional heterogeneity and time (month-year) fixed effects to account for common temporal shocks. The results, presented in Table 3, are consistent with our central hypothesis.

The estimates for the key explanatory variables are both statistically significant and negative, as hypothesized. First, the coefficient for Bank Credit to GRP Ratio is -0.098 ($p = 0.004$). This indicates that for a one-unit increase in the ratio of bank credit to GRP, P2P lending per capita decreases by 0.098 units, holding all else constant. This finding

suggests that P2P lending per capita is higher in provinces where the traditional banking sector's financial depth is lower.

Second, the coefficient for Bank Branches Per Capita is -7.865 ($p < 0.001$). This highly significant result implies that a one-unit increase in bank branches per capita is associated with a substantial decrease of nearly 7.87 units in P2P lending per capita. This is consistent with the view that P2P lending penetration is strongest in regions with poorer physical access to traditional bank branches.

Furthermore, the model reveals a strong, independent positive time trend ($\beta = 0.000881$, $p < 0.001$), which translates to an average increase of approximately 23% per year. This confirms the sustained and rapid expansion of the P2P lending sector in Indonesia over the study period, even after controlling for the level of banking infrastructure.

Table 3. Two-Way Fixed Effects Regression

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Intercept	-21.186	1.175	1003.058	-18.021	0.000	-23.493	-18.879
BankCredit_GRP	-0.098	0.034	1610.454	-2.850	0.004	-0.166	-0.030
BankBranches_pc	-7.865	1.255	572.184	-6.263	0.000	-10.331	-5.398
Time_t	0.001	4.778	1026.342	18.439	0.000	0.001	0.001

a. Dependent Variable: P2P_pc.

The model's overall fit is indicated by the highly significant Type III F-tests for the fixed effects (Table 4). The F-statistic for the time trend ($F = 340.006$, $p < .001$) confirms the powerful and sustained increase of the P2P sector throughout the study period. More critically for the research hypothesis, the F-tests for both banking density measures were highly significant, with the F-statistic for physical access (bank branches per capita, $F = 39.231$, $p < .001$) being particularly strong, underscoring its pronounced role in the pattern of P2P lending expantion.

Table 4. Fixed Effects

Type III Tests of Fixed Effects[a]

Intercept	1	1003.058	324.763	0.000
BankCredit_GRP	1	1610.454	8.122	0.004
BankBranches_pc	1	572.184	39.231	0.000
Time_t	1	1026.342	340.006	0.000

a. Dependent Variable: P2P_pc.

The variance components reported in Table 5 confirm the appropriateness of the panel data specification. The significant variance of the province-level random intercepts

(σ^2 = 0.0138, p = 0.001) justifies the inclusion of province fixed effects, confirming that unobserved, time-invariant provincial characteristics significantly influence baseline P2P lending levels.

Table 5. Variance Components

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Residual		0.000452	1.554004E-05	29.054	0.000	0.000422	0.000483
Intercept [subject = location_id]	Variance	0.013774	0.004333	3.179	0.001	0.007435	0.025518

a. Dependent Variable: P2P_pc.

4.3. Robustness Checks

To assess the sensitivity of our findings to alternative measures of banking density and P2P lending depth, we conducted two additional specifications as outlined in Section 3.3. The same mixed model structure was used: province random intercept, month-year fixed effects, and a linear time trend.

Specification 1: Deposit-Based Banking Density:

We replaced BankCredit_GRP with TPF_GRP (total third-party funds to GRP). The results (Tables 6 and 7) show that the coefficient for TPF_GRP is positive and highly significant (β = 0.473, p < 0.001; F = 367.239, p < 0.001), indicating that provinces with a larger deposit base have significantly higher P2P lending per capita. This contrasts with the main model, where credit-based banking density exhibited a negative relationship. BankBranches_pc remains negative and significant (β = –5.053, p < 0.001; F = 28.800, p < 0.001), consistent with the main finding that physical branch scarcity drives P2P substitution. The positive association for deposit-based density suggests a complementary dynamic: regions with stronger deposit mobilization may possess more developed financial ecosystems that also support P2P lending.

Table 6. Fixed Effects Estimates: Deposit-Based Banking Density

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	-28.349	0.983	301.598	-28.829	0.000	-30.284	-26.414
TPF_GRP	0.473	0.025	895.243	19.163	0.000	0.425	0.522
BankBranches_pc	-5.053	0.942	89.626	-5.367	0.000	-6.924	-3.182
Time_t	0.001169	0.000040	315.331	29.171	0.000	0.001090	0.001248

a. Dependent Variable: P2P_pc.

Table 7. Fixed Effects – Deposit-Based Banking Density

Type III Tests of Fixed Effects[a]

Intercept	1	301.598	831.117	0.000
TPF_GRP	1	895.243	367.239	0.000
BankBranches_pc	1	89.626	28.800	0.000
Time_t	1	315.331	850.943	0.000

a. Dependent Variable: P2P_pc.

Specification 2: P2P Depth as Dependent Variable:

We substituted the dependent variable with P2P_GRP (P2P lending scaled by GRP). Tables 8 and 9 report the results. BankCredit_GRP is not statistically significant (β = –0.000121, p = 0.677), while BankBranches_pc shows a positive and significant coefficient (β = 0.0236, p = 0.006). However, a convergence warning was issued during estimation, likely due to the very small magnitude of P2P_GRP (mean = 0.0006). This makes the model unstable, and the results should be interpreted with caution. The non-significance of BankCredit_GRP is not robust to this alternative scaling, though the convergence issues preclude strong conclusions. This specification may not be well suited to the data structure given the very small scale of the dependent variable.

Table 8. Robustness Check: P2P Depth as Dependent Variable

Estimates of Fixed Effects[a]

						95% Confidence Interval	
Parameter	Estimate	Std. Error	df	t	Sig.	Lower Bound	Upper Bound
Intercept	-0.3606	0.0092	652.855	-39.119	0.000	-0.3787	-0.3425
BankCredit_GRP	-0.000121	0.000290	653.552	-0.416	0.677	-0.000691	0.000449
BankBranches_pc	0.0236	0.0084	124.417	2.813	0.006	0.0070	0.0402
Time_t	1.4868e-5	3.7642e-7	693.255	39.499	0.000	1.4129e-5	1.5607e-5

a. Dependent Variable: P2P_GRP.

Collectively, the robustness checks are consistent with the view that the substitution effect observed in the main model is specific to the credit dimension of banking presence and to per capita P2P lending. The positive association with deposit-based banking density points to a potential complementary role, though this interpretation requires further investigation.

Table 9. Fixed Effects – P2P Depth as Dependent Variable

Type III Tests of Fixed Effects[a]				
Intercept	1	652.855	1530.301	0.000
BankCredit_GRP	1	653.552	0.173	0.677
BankBranches_pc	1	124.417	7.913	0.006
Time_t	*	*	*	*

a. Dependent Variable: P2P_GRP.

Note: The Type III test for Time_t was not computed due to convergence issues; the model failed to converge, likely because of the very small scale of the dependent variable.

Multicollinearity diagnostics for these robustness models are shown in Table 10. For all estimators, it shows VIF values below (5), confirming that multicollinearity does not affect the estimates.

Table 10. Collinearity Diagnostics for Robustness Models

Variable	Tolerance		VIF
Model 1 (TPF_GRP as IV)	TPF_GRP	0.717	1.395
	BankBranches_pc	0.715	1.398
	Time_t	0.996	1.004
Model 2 (P2P_GRP as DV)	BankCredit_GRP	0.697	1.434
	BankBranches_pc	0.695	1.438
	Time_t	0.996	1.004

Note: All VIFs are well below 5, indicating no multicollinearity issues.

4.4. Interpretation and Synthesis of Findings

The main model yields findings consistent with the substitution hypothesis (H1) when banking density is measured by credit depth (BankCredit_GRP) and physical branch presence (BankBranches_pc). The significant negative coefficients indicate that in provinces where traditional banks lend less relative to regional output and where branch infrastructure is sparser, P2P lending per capita is higher. This pattern aligns with findings from developed markets like the United States (Jagtiani and Lemieux, 2018) and is demonstrated here for the first time in a major developing economy with a large unbanked population. The coexistence of a strong negative substitution effect with a powerful positive time trend reflects a financial system in transition, where FinTech is concurrently expanding the overall credit pie and redistributing its geographical allocation.

However, robustness checks reveal a more nuanced picture. When banking density is measured by deposit mobilization (TPF_GRP) rather than credit provision, the relationship becomes positive and significant, which is consistent with the possibility that regions with a larger deposit base also host more active P2P lending. This could reflect a

complementary role: banks that are strong in deposit collection may contribute to broader financial infrastructure (e.g., payment systems, financial literacy) that also benefits FinTech lenders. Additionally, when P2P activity is scaled by regional economic output (P2P_GRP) rather than per capita, the coefficient for BankCredit_GRP loses statistical significance. This model exhibited convergence issues, likely due to the very small scale of P2P_GRP, indicating that this specification may be less suitable for capturing the substitution effect.

Taken together, the findings are consistent with substitution is most evident in the credit dimension of banking and in per capita P2P lending. The evidence does not support a general substitution effect across all measures of banking presence or P2P activity. Instead, it highlights a context-dependent relationship where P2P lending fills gaps left by bank credit supply, while coexisting with broader banking infrastructure. This complexity underscores the need for future research to disentangle the mechanisms behind these contrasting patterns.

5. Discussion

The primary objective of this study was to provide the first empirical test of the substitution hypothesis between P2P lending and traditional banking within a major developing economy. The main results are consistent with the substitution hypothesis when banking density is measured through credit depth (bank credit to GRP) and physical accessibility (bank branches per capita). In provinces where banks lend less relative to regional output and where branch infrastructure is sparser, P2P lending per capita is significantly higher. This finding allows us to refine and contextualize the existing literature in several important ways.

Most directly, our results confirm and amplify the nascent stream of substitution literature originating in developed markets, but within a context where the effect appears more pronounced. For instance, while Jagtiani and Lemieux (2018) found that U.S. FinTech lenders penetrated areas where banks had retracted, their study described a phenomenon occurring at the margins of a deep and mature financial system. Our findings are consistent with the view that in Indonesia, this is not a marginal adjustment but a large-scale, structural market response. The magnitude and significance of our coefficients, particularly for physical branch density, indicate that P2P lending is not merely filling gaps but is establishing itself as a primary credit channel in regions the formal sector has largely failed to reach. This is in line with the theoretical promise of P2P lending as a tool for financial inclusion (Yum et al., 2012; Polyzosa et al., 2021), moving it from theory to observable, macro-level reality in the Global South.

However, robustness checks reveal that the substitution effect is not uniform across all dimensions of banking presence. When banking density is measured by deposit mobilization (TPF_GRP) rather than credit provision, the relationship becomes positive

and significant. This is consistent with the possibility that regions with a larger deposit base—often indicative of more developed banking infrastructure—also host more active P2P lending. Such a pattern points to a possible complementary role: banks that are strong in deposit collection may contribute to broader financial infrastructure (e.g., payment systems, financial literacy) that also benefits FinTech lenders. Similarly, when P2P activity is scaled by regional economic output (P2P_GRP) rather than per capita, the coefficient for bank credit to GRP loses statistical significance. This specification exhibited convergence issues, likely due to the very small scale of P2P_GRP, indicating that it may be less suitable for capturing substitution. Taken together, the evidence suggests that substitution is most evident in the credit dimension of banking and in per capita P2P lending, while deposit-based banking activity coexists with P2P expansion.

These findings help reconcile the apparent contradiction in the literature between "substitution" and "complementarity." Studies in European contexts often concluded that P2P lending complemented traditional banking (Milne and Parboteeah, 2016; Boitan, 2016), while others in the U.S. noted substitution (Tang, 2019). Our analysis, situated in a developing economy with a large unbanked population, is consistent with the idea that the pre-existing structure of the financial ecosystem is a key determinant. Where banking systems are weak in credit provision, P2P lending steps in as a substitute. However, where banking systems are strong in deposit mobilization, a complementary dynamic may emerge. This context-dependent understanding moves the field beyond a binary debate towards a more nuanced framework.

The powerful, independent positive time trend we documented underscores the explosive increase of the sector. This trend, even after controlling for banking density, is consistent with P2P lending's expansion is driven not only by static gaps in banking infrastructure but also by a dynamic process of market discovery, technological adoption, and potentially, a growing reliance on digital credit. This rapid expansion, however, brings the discussion to a critical juncture, mirroring concerns raised in earlier literature but with greater urgency. The very mechanisms that enable this substitution—disintermediation, use of alternative data, and digital onboarding (Eid and Yang, 2018)—are the same ones that can elevate consumer risk in a less regulated environment (Claessens et al., 2018). The substitution we observe, therefore, is not merely a market transaction; it represents a transfer of both opportunity and risk. The opportunity is greater financial inclusion for the unbanked; the risk is that this new digital frontier, expanding in underserved areas, may outpace the development of corresponding consumer protections and financial literacy, potentially leading to new vulnerabilities like over-indebtedness and data exploitation.

Our finding of a negative relationship between bank credit depth and P2P lending per capita aligns with Sari (2021), who documented that P2P lending growth reduces bank profitability in Indonesia, indicating a substitution effect. However, our robustness check

showing a positive association with deposit-based banking density echoes Pradhipta *et al.* (2025), who noted complementary dynamics in service delivery (e.g., mobile banking leveraging agent networks).

5. Conclusion

This study set out to resolve a critical gap in the financial technology literature by empirically testing whether P2P lending acts as a substitute for traditional banking within a developing economy. The main findings from a comprehensive provincial-level dataset from Indonesia are consistent with the view that P2P lending per capita is higher in provinces where the traditional banking system's credit provision and physical branch presence are weakest. The robust negative relationship with bank credit depth and bank branches per capita offers support for the substitution hypothesis, moving it from a theoretical proposition in developed markets (Jagtiani and Lemieux, 2018) to an empirically verified reality in a context of widespread financial exclusion. The substitution we observe occurs in a context where FinTech literacy remains very low, raising concerns about consumer vulnerability.

However, robustness checks reveal that substitution is specific to the credit dimension of banking. When banking density is measured by deposit mobilization, the relationship becomes positive, which is consistent with a complementary dynamic. Moreover, the substitution effect does not hold when P2P activity is scaled by regional economic output (P2P_GRP), though this model exhibited convergence issues due to the small magnitude of the variable. These nuances indicate that the role of P2P lending is context-dependent, varying with how banking presence and P2P activity are measured.

The contribution of this research is threefold. First, it contextualizes the global FinTech debate, demonstrating that the dynamics of digital finance are not universal. While studies in bank-saturated economies often find a complementary or hybrid role for P2P lending (Milne and Parboteeah, 2016; Tang, 2019), our findings are consistent with its function as a primarily credit-driven substitute in Indonesia. This is consistent with the idea that the economic role of FinTech is intrinsically linked to the development and inclusivity of the pre-existing financial infrastructure, particularly on the credit side. Second, by leveraging a rigorous Two-Way Fixed Effects panel model with robustness checks, we provide strong correlational evidence of this geographic substitution, addressing a significant methodological shortcoming in the literature on developing economies. Third, our findings bridge the gap between academic research and practical policy, offering clear, data-driven insights for key stakeholders.

6. Implication

The implications of these findings are relevant for policy and practice. For Indonesian policymakers and the OJK, our results argue for a differentiated regulatory approach. Provinces identified as high-substitution zones (e.g., Jawa Barat, Jawa Timur) require

intensified consumer protection, financial literacy programs, and vigilant oversight to ensure that the bridge to financial inclusion does not become a trap of over-indebtedness. Conversely, in regions where deposit-based banking is strong and P2P appears complementary, policies might focus on encouraging collaboration between banks and FinTech platforms to enhance overall financial access. Given that low digital literacy and a lagging regulatory framework characterize many underserved provinces, policies should prioritize consumer education alongside financial access. For P2P platforms, the results provide a strategic blueprint, identifying underserved provinces not as marginal territories, but as core markets with validated demand for credit substitution. For traditional banks, this study serves as an indication of market displacement in the credit domain, urging a strategic rethink of service models for excluded segments, potentially through partnerships or digital innovations of their own.

7. Future Research Direction

This study opens several avenues for future research. The logical next step is a deep dive into the demand side of this equation: who are the borrowers in these high-substitution provinces, and what are their lived experiences? Furthermore, while we find evidence of substitution for credit, the positive association with deposit-based banking density deserves further investigation to understand whether it reflects a complementary mechanism (e.g., banks providing payment infrastructure) or a spurious correlation. Research is also needed to quantify the socio-economic impacts of P2P lending on poverty reduction, business formation, and household resilience, and to explore why the substitution effect does not hold when P2P is scaled by GRP. We have provided evidence consistent with P2P lending is filling a credit void; future work must now determine how effectively and equitably it is doing so. In closing, the rise of P2P lending in Indonesia represents a powerful, market-driven experiment in financial inclusion. Its ultimate success will be measured not only by its expansion metrics, but by its ability to empower the unbanked without introducing new forms of vulnerability, a balance that demands continued scholarly and regulatory attention.

Acknowledgements

This study was conducted independently by the author. However, its achievement relies fundamentally on the established body of research in Crowdfunding and Financial Inclusion and the empirical data provided by the Financial Services Authority (OJK) of Indonesia.

Conflict of interest

The author declares that there are no potential conficts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

This study did not require ethical approval from an institutional review board because it did not involve human or animal subjects. The research was conducted solely on publicly available data.

Funding

No funding was received for conducting this study.

ORCID

[a] Zoubir Boulahbel, https://orcid.org/0009-0008-3209-6429

REFERENCES

Al-Hashfi, R. U., & Zusryn, A. S. (2019). Exploring islamic peer-to-peer lending for the unbankable. *Airlangga International Journal of Islamic Economics and Finance, 2*(2), 71–84.

Atahau, A. D. R., Anggara, I. S., & Huruta, A. D. (2026). P2P lending: how does it affect Indonesian bank's profitability? *Asian Journal of Accounting Research*, 11(2), 114-131. https://doi.org/10.1106/AJAR-05-2024-0198

Azganin, H., Kassim, S., & Saad, A. A. (2021). Islamic P2P Crowdfunding (IP2PC) platform for the development of paddy industry in Malaysia: An operational perspective. *Journal of Islamic Finance, 10*(1), 65–75.

Bella, F. I. (2020). Optimization of Islamic Peer-to-Peer Lending for Micro and Small Enterprises (MSEs) after pandemic of Covid-19. *Journal of Islamic Economic Laws, 3*(2), 108–123.

Boitan, I. A. (2016). Crowdlending and financial inclusion evidence from EU countries. *Economic Alternatives, 4*, 418–432.

Claessens, S., Frost, J., Turner, G., & Zhu, F. (2018). Fintech credit markets around the world: Size, drivers and policy issues. *BIS Quarterly Review*, 29–49.

De Roure, C., Pelizzon, L., & Thakor, A. V. (2016). *P2P lenders versus banks: Cream skimming or bottom fishing?* SAFE Working Paper Series No. 146.

Eid, N., & Yang, J. (2018). Online financial inclusion and its implications for borrowers: Evidence from peer-to-peer lending. *SSRN*. https://ssrn.com/abstract=3243499

Havrylchyk, O., Mariotto, C., Rahim, T., & Verdier, M. (2020). The expansion of peer-to-peer lending. *Review of Network Economics, 19*(3), 145–187. https://doi.org/10.1515/rne-2020-0034

Indonesia Banking Statistics. (2025). Otoritas Jasa Keuangan. https://ojk.go.id/en/kanal/perbankan/data-dan-statistik/statistik-perbankan-indonesia/Default.aspx

Information technology-based joint funding services statistics. (2025). Otoritas Jasa Keuangan. https://ojk.go.id/en/kanal/iknb/financial-technology/default.aspx

Jagtiani, J., & Lemieux, C. (2018). Do fintech lenders penetrate areas that are underserved by traditional banks? *Journal of Economics and Business, 100*, 43–54. https://doi.org/10.1016/j.jeconbus.2018.03.001

Martinez Peria, M. S., Beck, T., & Demirguc-Kunt, A. (2005). Reaching out: Access to and use of

banking services across countries. *Policy Research Working*. Paper No. 3754. World Bank.

Milne, A., & Parboteeah, P. (2016). *The business models and economics of peer-to-peer lending* (ECRI Research Report No. 17). European Credit Research Institute.

O'Brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity, 41*(5), 673–690. https://doi.org/10.1007/s11135-006-9018-6

Pierrakis, Y., & Collins, L. (2013). Crowdfunding: A new innovative model of providing funding to projects and businesses. *SSRN*. https://ssrn.com/abstract=2395226

Polyzosa, E., Samitas, A., & Ghulame, R. (2021). The perfect bail-in: Financing without banks using Peer-To-Peer Lending. *International Journal of Finance & Economics, 29*(3), 3393–3412. https://doi.org/10.1002/ijfe.2657

Pradhipta, R. D., Wafdayanti, H., Mawardi, W., & Pangestuti, I. R. D. (2025). Measuring Fintech and digital banking scalability to enhance financial inclusion in Indonesia. *Economic and Business Horizon*, 4(3), 449-458.

Pradana, H. D., Widowati, C. M. D., Hermajiwandini, & Rahmawati, D. (2025). Financial inclusion based on fintech lending (Peer to Peer Lending) in Indonesia. *Amkop Management Accounting Review (AMAR)*, 5(1), 348-358.

BPS, (2025). Statistics Indonesia. https://www.bps.go.id/en/

Sahputri, R. A. M., Sujarwoto, S., Sihombing, S., & Njoman, M. G. (2024). Financial inclusion in Indonesia: An analysis of determinants of bank account ownership and credit access at individual and regional levels. *Economics and Finance in Indonesia*, 70(2), 81-96. https://doi.org/10.47291/efi.2024.06

Sari, D. N. (2021). The effect of the growth of financial technology companies Peer To Peer Lending on the performance of banking in Indonesia. *Bulletin of Fintech and Digital Economy*, 42-60.

Tang, H. (2019). Peer-to-peer lenders versus banks: Substitutes or complements? *The Review of Financial Studies, 32*(5), 1900–1938. https://doi.org/10.1093/rfs/hhz015

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. The MIT Press.

World Bank. (2025). *The Global Findex 2025*. https://globalfindex.worldbank.org/

Yulisman, L. (2024, June 13). Indonesia eyes more oversight of fast-growing peer-to-peer lending industry. *The Straits Times*. https://www.straitstimes.com/asia/se-asia/indonesia-eyes-more-oversight-of-fast-growing-peer-to-peer-lending-industry

Yum, H., Lee, B., & Chae, M. (2012). From the wisdom of crowds to my own judgment in microfinance through online peer-to-peer lending platforms. *Electronic Commerce Research and Applications, 11*(5), 469–483. https://doi.org/10.1016/j.elerap.2012.05.003