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**Impact of interoperability regulation on the use of digital
payments in Peru**

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Bilateral Assistance
& Capacity Building
for Central Banks

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Abstract

Interoperability is the characteristic of a payment service (e.g. digital wallets) to allow its users to pay any person or company, regardless of the financial institution providing services to the payer or payee. On October 7, 2022, the Central Reserve Bank of Peru (BCRP) issued the Payment Services Interoperability Regulation to massify digital payments in the country. The main objective of this research is to study the impact of interoperability, promoted through regulation, on the use of digital payments. We analyzed transactional data provided daily by market participants in the interoperability regulation, and data obtained from digital wallet users through a survey. The results suggest that interoperability has contributed to increase the use of digital payments, but there are other factors such as fees, user experience and quality of service that can impact the adoption and use of interoperable payment services. Furthermore, our analysis shows that interoperability benefited more individuals in regions with a higher degree of financial inclusion, i.e. financial inclusion is key to benefiting from interoperability. These results serve as a basis for validating, adjusting, and reorienting the future regulatory strategies of the BCRP, aimed at fostering greater adoption and use of digital payments; as well as to guide other payment authorities seeking to implement effective digital payments regulations, drawing lessons from the Peruvian experience.

Keywords: Interoperability, regulation, digital payments, financial inclusion, Peru.

JEL: E42, E58, E61, E65, G28.

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The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the Central Reserve Bank of Peru (BCRP).

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1. Introduction

Interoperability, a key attribute of payment services like digital wallets, enables users to make payments to any individual or entity, irrespective of the financial institution serving either the payer or payee. Presently, numerous countries are actively adopting strategies to integrate interoperability into retail payments. This approach aims to popularize digital payments by enhancing user convenience and payment efficiency. Notably, there is no universally standardized model for achieving interoperability; instead, initiatives have been instigated either by industry-driven efforts or regulatory mandates, showcasing the diverse approaches taken by different stakeholders.

In August 2022, the Central Reserve Bank of Peru (BCRP) designed the Retail Payments Interoperability Strategy to massify digital payments in Peru. The Strategy consists of four phases with different scope and progressive execution dates for the entities that make up the country's retail payments ecosystem. Hence, on October 7th, 2022, the BCRP issued the Regulation of Interoperability of Payment Services provided by Providers, Agreements, and Payment Systems, Circular No. 0024-2022-BCRP. In Phase 1, the largest digital wallets in the country, known as Yape and Plin, should interoperate. With this, Yape users would be able to make payments with a cell phone number to Plin users, and vice versa. On May 8th, 2023, Phase 1 was deployed to 100% users.

Our research seeks to address whether greater interoperability in payment services, promoted by regulation, generates greater use of digital payments in Peru. Our hypothesis suggests that enhanced interoperability in payment services contributes to increased convenience, positively impacting the adoption of digital payments. Nevertheless, factors like user experience, fees, overall service quality and financial inclusion are expected to be influential in limiting widespread digital payment adoption. Additionally, a secondary hypothesis posits that the advantages of interoperability may be predominantly realized by individuals already integrated into the financial system.

In this study, we rely on two primary data sources: daily transactional data from participants in the interoperability regulation and survey data from digital wallet users. The findings indicate that interoperability has played a role in boosting digital payment usage, though other factors such as fees, user experience, and service quality also influence adoption. Our (statistical) analysis reveals that younger individuals, Plin users, those in regions with higher financial inclusion, and self-employed users experienced greater benefits from the interoperable feature.

The paper is structured as follows:

1. **Theoretical Framework:** Section 2 introduces the theoretical foundation, encompassing research on interoperability and the factors influencing digital payment adoption.
2. **Hypotheses and Procedures:** Section 3 outlines the hypotheses and methodologies employed in the study.
3. **Main Findings:** Section 4 elaborates on the principal findings derived from both transactional and survey data analyses.
4. **Regression Analysis Results:** Section 5 provides insights from the regression analysis conducted.
5. **Policy Implications:** Section 6 discusses the implications of the findings for policymaking.
6. **Conclusions:** The paper concludes in the final section, highlighting conclusions drawn from the study, acknowledging limitations, and suggesting avenues for future research.

2. Theoretical framework

2.1 Determinants of the use of digital payments

There are previous studies related to the determinants of the use of digital payments. For example, in Peru, Aurazo, J. & Vega, M. (2021) used data from Peru's 2015-2018 National Household Surveys (ENAHU) to study how demographic

factors impact how people choose to pay. Their results showed that the use of digital payments is more likely among people between ages 25–40, with higher education levels, higher household spending, formal employment, and those living in urban areas or with Internet access.

In other countries, psychological factors have been explored. For example, in India, Shree, S. et al. (2021) used an online survey-based dataset and concluded that the perception of digital payment instruments vs cash (perception of cost, convenience, privacy, and safety) has a strong and significant impact on which mode of payment is chosen by the individual. Also, a deterioration in consumer trust in digital payment systems worsens the likelihood of paying digitally. Likewise, Liu, G. & Tan Tai P. (2016), in Vietnam, employed results from a survey and the Technology Acceptance Model (TAM) to show that perceived ease of use and perceived usefulness have a significant and positive impact on the intention and thus, actual use of mobile payment services.

Other studies have pointed to other factors, such as the size of the transaction and the level of cash holdings. Bagnall, J. et al. (2014) made a cross-country comparison of payment diary surveys from seven countries and found that the use of cash decreases with transaction size: cash was predominant for the smallest 50 percent of transactions. In contrast, Bouhdaoui, Y., & Bounie, D. (2012) exploited two surveys of the French population from 2005 and 2011 and concluded that in the French economy the payment behavior of the public was more driven by a cash holding rule than by a transaction size rule: agents paid with cash whenever they had enough cash; otherwise, they used another payment instrument.

2.2 Interoperability

The Bank for International Settlements (BIS) defines interoperability as the technical¹, semantic², and business³ compatibility that allows one system to be used in conjunction with others (Boar et al, 2021). Consequently, banks and other payment service providers (PSPs) participating in different systems or jurisdictions can make, clear, and settle payments between systems without participating in multiple systems. In addition, BIS stresses that interoperability is a means and not an end, since the goal is to enable end users to transact with each other seamlessly, regardless of their choice of PSP or geographic location.

The Consultative Group to Assist the Poor (CGAP) mentions that interoperability improves the value proposition of payment services as it allows users to transfer money outside the network created by their PSP (Negre et al., 2021). For example, a person can pay another person who has an account with another PSP, or a merchant that has been acquired by another PSP. Thus, CGAP states that interoperability makes financial services more convenient for customers and encourages them to do more transactions. It also notes that there is no single model for implementing interoperability and that interoperability may be driven by industry or by regulators. In this regard, the World Bank (WB) establishes that interoperability requires technical, legal, and commercial agreements between participants in payment systems, which can be facilitated with the issuance of new regulations (WB, 2021).

Some studies have investigated the impact of interoperability established through the implementation of fast payment systems on the adoption of digital payments. Sruthy et al. (2019) used the TAM model to investigate the adoption of mobile payments and Unified Payments Interface (UPI⁴) technology in India. They concluded that there is a significant and positive influence of simplicity and interoperability on the mobile payment adoption. Likewise, a study in Brazil

¹ Technical compatibility means that the systems use the same technical standards so that their hardware and software infrastructures can be directly connected.

² Semantic compatibility refers to systems speaking and understanding the same language, so that data is interpreted uniformly and consistently between systems.

³ Business compatibility means that the systems agree on the rights and obligations when transferring money between systems (e.g., who can access, how payments are cleared and settled, and how risks are addressed).

⁴ Unified Payments Interface (UPI) is a real-time retail payments system available 24/7. It was launched in 2016 by the National Payments Corporation of India (NPCI), a not-for-profit company set up by the Reserve Bank of India and the Indian Banks Association.

(BCB, 2022) analyzed the profile of Pix⁵ users, among other fund transfer users, in the period from November 2019 to December 2021, and found that Pix played a leading role in including a large part of the Brazilian population in the use of digital transfer instruments between different institutions.

Finally, in a pivotal move towards fostering interoperability without an explicit regulation, in 2016, the Electronic Money Payment Agreement (APDE) Bim introduced its digital wallet for electronic money transfers in Peru. This was a collaborative effort involving over 25 financial and non-financial entities to facilitate interoperability among electronic money accounts. However, despite garnering over 1 million downloads, the initiative faced challenges due to poor user experience design, commission-related issues, and a lack of infrastructure for cash-in and cash-out transactions. Consequently, only around 300'000 active customers were reached.

After that, in 2018 and 2019, the BCRP spearheaded efforts to achieve interoperability in Point of Sale (POS) systems in the card payment industry. This endeavor proved successful, leading to reduced costs for merchants, an increase in the number of accepting merchants, and the elimination of exclusive acquiring. Notably, this achievement was realized without the need for additional regulations. Presently, all POS terminals in Peru accept all card brands, showcasing the positive outcomes of interoperability efforts.

2.3 BCRP's Interoperability Regulation

In September 2022, the BCRP designed the Retail Payments Interoperability Strategy (the Strategy) to massify digital payments in the country. The Strategy consists of four phases with different scope and progressive execution dates for the entities that make up the country's retail payments ecosystem. Hence, on October 7th the BCRP issued the Regulation of Interoperability of Payment Services provided by Providers, Agreements, and Payment Systems, Circular No. 0024-2022-BCRP (The Regulation). Subsequently, on July 11, 2023, the BCRP modified the Interoperability Regulation, through Circular No. 0013-2023-BCRP, to guarantee the security and stability of operations during the implementation of Phase 2; as well as to include technology providers within the scope of the Regulation. The amendment included an extension of the deadline for compliance with the implementation of Phase 2 of Interoperability until September 13, 2023; and established the deadlines for the implementation of Phase 3.

The Regulation explicitly outlines interoperability as the attribute of a payment service, including digital wallets, functionalities, or mobile applications, enabling users to make payments to any person or business, irrespective of the financial entity serving the payer or beneficiary. Mandating compliance, the Regulation stipulates that the following entities, termed as Regulated Entities, are obligated to interoperate with each other in their designated phases:

- Entities that provide the following payment services: i) Digital wallets; ii) Payment functionalities in mobile banking applications; iii) Immediate transfers in mobile banking; and iv) Others determined by the BCRP.
- Entities registered in the BCRP's QR Registry (QR Registry)⁶.

Moreover, the Regulation outlines foundational principles of interoperability. In the pursuit of interoperability, entities are mandated to foster competition, efficiency, and security. This encompasses non-discrimination and fair access, ensuring a high level of service, prioritizing a user-oriented approach in service design for an optimal user experience, offering accessible payment services (with criteria for fee collection), and maintaining transparency of information, among other essential considerations.

⁵ Pix is an instant payment scheme available 24/7. It was launched in 2020 by the Central Bank of Brazil in coordination with industry.

⁶ Circular No. 003-2020-BCRP, titled "Quick Response Code (QR) Payment Service Regulation," was issued by the BCRP in January 2020. This regulation introduces the QR coding standard (MVCo) for payments and emphasizes interoperability, accessibility, transparency, and effective risk management within the QR payment service. To ensure compliance, digital wallets and QR code providers have to register in the registry established by the BCRP. This measure is aimed at fostering a standardized and secure environment for QR code payments in accordance with the outlined regulations.

Furthermore, the regulation incorporates user experience guidelines, emphasizing undifferentiated single access to initiate interoperable transfers; transparent disclosure of fees or commissions to the public before confirming transactions; and avoiding additional security validations that may impact the user experience. Additionally, it encompasses a comprehensive framework of sanctions and provides the Central Bank with various monitoring tools that can be implemented as needed.

The Regulated entities must interoperate in three phases:

In Phase 1, the regulatory framework stipulates that the largest digital wallets in the country must achieve interoperability. Specifically, the Yape Payment Agreement, overseen by Banco de Crédito del Perú (BCP), and the Plin Payment Agreement, managed collaboratively by BBVA, Scotiabank, and Interbank⁷, are required to interoperate. This means that users of Yape can make payments to Plin users, and vice versa, utilizing their respective cell phone numbers. The deadline for compliance with this interoperability mandate for Phase 1 was set until March 31, 2023.

In Phase 2 of the regulatory plan, comprehensive interoperability is mandated among various entities. Yape, including all its participants⁸, and Plin, covering all participants' digital wallets and immediate transfer services in mobile banking applications offered by banks, savings banks, and finance companies, are required to interoperate. This phase also extends to banks, municipal savings and credit banks, financial institutions, and entities registered in the QR Registry.

This implementation facilitates seamless transactions between users of immediate transfers in mobile banking applications, such as Banco Falabella, and both Yape and Plin users. The use of cell phone numbers as identifiers streamlines reciprocal transfers, enhancing overall interoperability and user convenience. Moreover, as part of the regulation, entities listed in the QR Registry are obligated to provide interoperable services, ensuring that any QR code registered in the repository can be universally recognized and processed by any of the registered digital wallets. The deadline for compliance with Phase 2 was set for September 13, 2023.

Phase 3 entailed the integration of electronic money accounts provided by Electronic Money Issuing Companies (EEDEs) and the APDE Bim electronic money transfer service. Following the implementation of this phase, users of the APDE Bim digital wallet can seamlessly transfer funds using a cell phone number or QR code to individuals using digital wallets associated with bank accounts, such as Yape and Plin, as well as immediate transfers in mobile banking, and vice versa. This integration enhances the interoperability of digital wallets and facilitates convenient cross-platform transactions. For this phase, the compliance deadline was extended until December 2023 for APDE Bim, and for EEDEs accessing the CCE (Automated Clearing House-ACH) the timeframe was set at 180 calendar days.

The roadmap of the Strategy includes Phase 4, which currently does not have a regulation. In Phase 4, the expansion of the retail payments ecosystem will occur, welcoming new participants such as Fintechs and other non-financial entities (i.e. telecommunication enterprises). This expansion is enabled through an Open Banking and payment initiation model. The anticipated timeline for the implementation of this phase is set for 2024.

During the implementation of the Regulation, as of March 31, 2023, the Regulated Entities successfully implemented interoperability between the Yape and Plin wallets. The go-to-production for Phase 1 of interoperable payment services commenced in the last week of March 2023 with a controlled group, including members of the BCRP's interoperability project team to verify the implementation. Mass deployment to users occurred progressively between April 1 and May 8, ensuring a careful rollout to guarantee the desired user experience and compliance with regulations. Throughout Phase 1, continuous monitoring of progress, developments, and implementations was undertaken to ensure adherence to

⁷ It allows users to transfer money through PLIN functionality included in the mobile banks of participating financial institutions with the beneficiary's mobile number or QR code. PLIN also operates through Visa's payment card infrastructure (via the Visa Direct service through the Niubiz processor) but its user directory is managed by technology provider YellowPepper.

⁸ Yape allows customers of participating financial institutions to transfer money through the Yape digital wallet with the beneficiary's cell phone number or QR code. Yape processes its interbank transactions through the technological infrastructure (or rail) of Visa-branded payment cards (via the Visa Direct service through the Niubiz processor) and has a user directory managed by the BCP. Yape's participants are Mibanco, Caja Huancayo, Caja Ica, Caja Piura, Caja Sullana, Caja Tacna, Caja Trujillo, Banco de la Nación, BCP.

regulatory requirements. This research focuses on analyzing the impact of The Regulation post the Phase 1 implementation.

3. Methodology

3.1 Hypothesis

Our research seeks to ascertain the correlation between heightened interoperability in payment services, as advocated by regulatory measures, and the consequential surge in digital payment usage within the Peruvian landscape. In pursuit of this inquiry, our primary research questions are as follows: To what extent has the recent interoperability regulation, implemented by the BCRP, influenced the adoption of digital payments? Additionally, we seek to identify and scrutinize the array of auxiliary factors that wield influence over the utilization of digital payment methods in Peru.

Building on the concepts outlined in the theoretical framework, our hypothesis posits that increased interoperability in payment services, propelled by regulatory initiatives, leads to heightened convenience, positively influencing the adoption of digital payments and adversely affecting cash users. Moreover, factors such as user experience, fees, and the overall quality of payment services are anticipated to play pivotal roles in potentially limiting the widespread adoption of digital payments.

Finally, a secondary hypothesis asserts that the benefits of interoperability may primarily accrue to individuals already included in the financial system. This assumption suggests that while interoperability may foster financial inclusion, its advantages may be more pronounced for those who are already part of the financially included population.

3.2 Procedures

This study draws insights from two principal data sources. Firstly, we analyzed transactional data provided daily by participants in the interoperability regulation. These encompassed reports detailing the value and volume of daily transactions conducted through interoperable payment services by regulated entities.

Secondly, we gathered, with the help of a research agency, survey data through face-to-face interviews during the period between November 25 and December 2, 2023. The survey targeted a sample size of 1206 respondents, ensuring a sampling error of $\pm 2.8\%$ with a confidence level of 95%. The survey focused on men and women with Peruvian nationality, who are active users of digital wallets (Yape or Plin) and hold responsibility for family or personal purchases or payments. The participants hailed from diverse socioeconomic backgrounds, residing in urban areas across various regions of Peru, classified into macro-regions:

- Lima: Lima and Callao.
- North: Cajamarca, La Libertad, Lambayeque, Piura and Tumbes.
- Center: Ancash.
- Central highlands: Junin.
- South: Arequipa, Ayacucho, Cusco, Ica, Madre de Dios, Puno and Tacna.
- East: Loreto, San Martin and Ucayali.

A snapshot of the sample is given in Annex 1.

4. Results and analysis

4.1 Transactional data

Following the 100% user deployment achieved on May 8, 2023, the interoperable transactions showed rapid growth in Phase 1 of the Strategy (Graph 1 of Annex 2). As of January 5, 2024, there were around 2.0 million transactions per day adding those from Yape to Plin and those originating from Plin to Yape. Furthermore, on December 30, 2023, a peak of 2.5 million transactions was reached. In addition, seasonality was identified on Saturdays, since on this day the number of transactions increases substantially, and then falls on Sundays. Also on public holidays, such as December 25 and January 1, transactions fall substantially. Moreover, as of November 2023, the number of monthly interoperable transactions between Yape and Plin represented 7.6% of all the digital retail payments in the Peruvian market.

On the other hand, the value of daily transactions in Phase 1 has also grown rapidly but with higher volatility (Graph 2 of Annex 2). As of November 14, 2023, the value of the transactions was around S/ 104 million per day; with a peak of S/ 134 million on October 31. The average ticket of the interoperable transfers between Yape and Plin was S/ 66.9 as of November 14, 2023 (Graph 3 of Annex 2).

Broken down by wallet, as of January 5, 2024, transactions from Plin to Yape were close to 1.5 million per day (adding those reported by BBVA, Interbank and Scotiabank). In the case of transactions originating from Yape to Plin, daily transactions were reported to be close to 0.5 million. Although both wallets have a similar number of users (around 13 million each, as of September 2023⁹), Yape has more affiliated merchants¹⁰, which would explain the higher flow and growth of transactions from Plin to Yape than from Yape to Plin. The value of transactions from Plin to Yape was around S/ 69 million per day as of November 14, 2023; and S/ 34 million per day in the case of transactions from Yape to Plin.

4.2 Survey data

4.2.1 Interoperability and digital payments

Survey results suggest that interoperability has contributed to increased use of digital payments, although not as was expected (Annex 3). Most respondents (77%) knew about digital wallets interoperability and 61% had made interoperable payments. In addition, 54% of surveyed users are making more payments with digital wallets after the implementation of interoperability versus 46% who report the opposite. The biggest increase has been among Plin users and those using both wallets, and mostly in the Lima and East macro-regions.

Besides, the results show that interoperability has contributed to the digitization of payments by reducing the use of cash. Following the implementation of interoperability, 44% of digital wallet users stopped using cash as a payment instrument. Users in the Lima and North macro-regions reduced their use of cash the most, with percentages of 51% and 70% respectively. Moreover, 15% of respondents reduced their use of transfers with account number or interbank account codes after interoperability.

The interoperability of digital wallets would have led users to shift their habits towards higher levels of usage and higher monthly transaction amounts. Before interoperability, 43% of respondents made up to 10 monthly payments with digital wallets. After interoperability, this percentage dropped to 28% and more users are reported making between 11 and 20 monthly payments (+6%) and between 31 and 50 monthly payments (+6%), mainly. Similarly, before interoperability, 50% of respondents transferred up to S/ 300 per month with digital wallets. After interoperability, this percentage dropped to 40% and more users are reported transferring between S/ 300 and S/ 1000 per month with digital wallets (+10%).

⁹ Gestión, 2023.

¹⁰ As of December 2023, Yape has around 2.7 million affiliated merchants; meanwhile, Plin has around 1.6 million affiliated merchants.

4.2.2 Factors impacting the use of interoperable digital payments

In our extended analysis, we delved into the factors influencing the adoption of interoperable digital payment services. Our findings highlighted three key determinants: fees, quality of service, and user experience. These factors play a crucial role in shaping user preferences and engagement with digital payment solutions that prioritize interoperability.

First, respondents showed a high sensitivity of monthly transactions with digital wallets to the charging of fees. In this vein, 41% of respondents would reduce their number of monthly transactions if commissions of up to S/. 0.10 per transaction were charged; and more than 90% of respondents would reduce their number of monthly transactions if commissions were higher (up to S/ 1.00, up to S/ 2.00, and more than S/ 2.00). In addition, 21% of respondents would reduce their number of monthly transactions completely if commissions of up to S/. 0.10 per transaction were charged; and this percentage reaches a maximum of 90% if more than S/. 2.00 per transaction were charged. It is important to mention that, currently, Phase 1 interoperable payment services (Yape and Plin digital wallets) do not have user fees for both person-to-person and person-to-merchant payments.

Second, 95% of the surveyed users responded that they have not had any inconveniences or problems when making interoperable payments. However, this percentage is lower in the Center and Central Highlands regions, with 89% and 82%, respectively. The main problems reported by the 5% of users who have had problems are the following: slow system or delay in loading (17%), the transaction did not arrive (13%), the service is not available (7%) and the system crashes (6%). Thus, a poor level of service can negatively impact the use of interoperable payment services.

Finally, respondents highly value ease of use when making interoperable payments with their digital wallets (49% of Yape users and 23% of Plin users), even more than other factors. However, the current user experience for interoperable payments is not preferred by users. When it comes to selecting the target entity, 63% of Yape users and 69% of Plin users surveyed would prefer to choose the target entity in a single step, rather than on two screens.

5. Regression analysis and comments in relation with financial inclusion

To understand who benefited the most from the increased interoperability, we estimated the following regression model:

$$\text{Monthly interoperable payments} = \beta_0 + \beta_1 \text{ age} + \beta_2 \text{ both wallets} + \beta_3 \text{ only Plin} + \beta_4 \text{ financial inclusion} + \beta_5 \text{ selfemployed} + \mu$$

Where:

Monthly interoperable payments: Number of interoperable payments between Yape and Plin that each respondent makes in a month.

Age: Age of the respondent.

Both wallets: Takes the value one (1) when the respondent uses both wallets (Yape and Plin), and zero (0) otherwise.

Only Plin: Takes the value one (1) when the respondent uses only Plin wallet, and zero (0) otherwise.

Financial inclusion: Financial inclusion index, calculated as the proportion of adults with an account (savings, fixed-term, current or CTS account in a bank, finance company, municipal savings bank, rural savings bank or cooperative) in the region where the respondent lives, as reported by the national banking authority (SBS) in June 2023¹¹.

Self-employed: Takes the value one (1) when the respondent is self-employed, and zero (0) otherwise.

¹¹ Superintendencia de Banca, Seguros y AFP (SBS). (2023). “Perú: Reporte de indicadores de inclusión financiera de los sistemas financiero, de seguros y de pensiones”.

We used ordinary least square (OLS) to estimate the parameters of the model, using Stata software. The results are shown in Table 1.

Table 1: OLS regression results for monthly usage of interoperable payments

VARIABLES	Dependent variable: Monthly interoperable payments
Age	-0.0709*** (0.0259)
Both wallets	5.996*** (0.935)
Only Plin	5.673*** (0.865)
Financial inclusion	30.94*** (3.604)
Self-employed	3.870* (2.237)
Constant	-8.667*** (2.128)
Observations	1,206
R-squared	0.125

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As can be seen from Table 1, all the coefficients of the explanatory variables are highly statistically significant at the 99% level. Age has a negative sign, which means that younger people used the interoperable feature more. β_2 and β_3 have a positive sign, meaning that Plin users made more monthly interoperable payments than Yape users.

Also, financial inclusion has a positive sign, which means that users from regions with a higher degree of financial inclusion (as of December 2022) is correlated with a higher use of the interoperability feature. In particular, an increase of 100bp (or 1%) in the financial inclusion index of the region of a person increases the number of interoperable payments that this person makes in a month by 0.31 (or 31%). Therefore, financial inclusion is key to explain whether a person benefits from interoperability. Thus, while interoperability promotes greater use of digital payments, its advantages may be more pronounced for those who are already part of the financially included population.

Finally, regarding professional status, we find that the status of “self-employed” uses the most the interoperable payments (versus non-self-employed). This status is the closest associated to merchants. So, we can infer those merchants benefited the most from the introduction of the interoperability features.

Regarding the effect of interoperability on the use of cash, we ran the following probit model:

$$\text{Drop of cash usage} = \beta_0 + \beta_1 \text{age} + \beta_2 \text{both wallets} + \beta_3 \text{only Plin} + \beta_4 \text{financial inclusion} + \mu$$

In this case, the dependent variable (drop of cash usage) is binary and takes the value one (1) when the user stopped using cash after the implementation of interoperability, and zero (0) otherwise. The results are shown in Table 2.

Table 2: Probit regression results for drop of cash usage

VARIABLES	Dependent variable: Drop of cash usage
Age	-0.00524* (0.00299)
Both wallets	0.357*** (0.107)
Only Plin	0.0939 (0.0995)
Financial inclusion	1.551*** (0.421)
Constant	-0.808*** (0.249)
Observations	1,206

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We observe in Table 2 that all the explanatory variables, except for having only the Plin wallet, are statistically significant, however to various degrees. In that sense, being younger, having both digital wallets and living in regions with a higher financial inclusion index increases the probability of reducing cash usage after the introduction of interoperability. Furthermore, the marginal effect of financial inclusion (Table 3) indicates that an increase of 100bp (or 1%) in the financial inclusion index of the region of a person increases the probability that this person drops cash usage by 0.60 (or 60%).

Table 3: Marginal effect of financial inclusion on drop of cash usage

VARIABLES	Marginal effect
Financial inclusion	0.6001296*** (0.1600818)
Observations	1,206

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6. Policy implications

This study underscores the imperative for policy adjustments aimed at fostering increased adoption of digital payment methods within the Peruvian context. The empirical findings of this investigation substantiate the necessity for strategic Central Bank intervention to elevate the prevalence of digital transactions in Peru. To this end, we are proposing a series of meticulously considered policy recommendations, each poised to contribute synergistically towards the overarching objective of promoting digital payment utilization in the country:

1. Regulatory Framework:

- **Issue an Annex of Circular No. 0024-2022-BCRP:** We've noticed that people using both digital wallets (Yape and Plin) pointed out that the user experience could be better. Hence, it would be advisable to add an Annex to improve the user experience:
 - In both Yape and Plin platforms, we propose a simple adjustment to the user interface. Instead of having only two buttons—one for the digital wallet and another for "other entities"—we recommend displaying a complete list of all the places where users have accounts. The current design featuring two buttons tends to guide users toward selecting one entity over the other. With the small change, it eliminated the need for users to choose "other entities" and allows them to easily pick from the full list of connected places. We believe this minor change will make using the digital wallet more straightforward and improve the experience for everyone.
 - Both Yape and Plin received the lowest rating (4.2 out of 5) in their respective dispute resolution systems. It is recommended to implement a consistent online dispute resolution system for both digital wallets to enhance the overall user experience. This uniform approach will contribute to a more streamlined and effective resolution process, fostering increased user satisfaction across both platforms.
 - Establish and enforce stringent security standards for interoperability transactions to instill trust among users. Notably, in the case of Yape, a mere 6% of respondents expressed trust in interoperability payments, while Plin users exhibited an even lower trust level, with only 3% of respondents holding a similar perception. This emphasizes the critical need to prioritize and strengthen security measures, encompassing cybersecurity protocols to thwart fraud and cyber threats. Additionally, the implementation of robust data protection policies is essential to safeguard user's personal information, notably the full name and cell phone number currently disclosed after an interoperable payment. Incorporating these measures is vital for bolstering user confidence in interoperable payment systems.
- **Regulation about service level agreements:** Even though 95% of users reported a trouble-free experience with their digital wallets, the 5% who encountered issues highlighted concerns related to service level agreements. Therefore, it is advisable to enact a regulation aimed at preventing issues such as slow system performance or delays in loading, ensuring swift resolution in cases of transaction non-delivery (including clear error messages for user understanding), averting service unavailability (e.g., scheduling brief maintenance periods at night), and preventing the unavailability of the system. This regulatory framework aims to enhance the reliability and responsiveness of digital wallet services, promoting a more seamless user experience.

2. Public Awareness Campaigns:

- Launch public awareness campaigns to educate the public about the benefits, safety, and convenience of using interoperability in digital payments. As per the survey findings, 23% of respondents indicated a lack of awareness regarding interoperability. A regional breakdown reveals that the Sierra Centro and Sur regions exhibit the lowest levels of familiarity, with 40% and 31% of respondents in these areas, respectively, acknowledging limited knowledge of the subject. Additionally, the survey highlights the significant impact of social media in disseminating information about interoperability. A substantial 40% of respondents reported acquiring knowledge about interoperability through social media channels, contrasting with a comparatively lower 9% who gained awareness through news outlets. This underscores the influential role of social media platforms in shaping public understanding of interoperability concepts.
- Implement programs to enhance digital literacy, especially in underserved and rural areas, to ensure broader adoption of digital payment methods.
- Collaborate with financial institutions, payment service providers, and other stakeholders in a public-private partnership to develop and promote digital payment solutions.

3. Financial Inclusion Initiatives:

- There exists a correlation between interoperability and financial inclusion, primarily driven by the premise that an accessible and positive user experience can catalyze sustained engagement with digital wallets, consequently promoting the adoption of digital payments. It is crucial to acknowledge, however, that the impact of interoperability alone on the surge in digital payments is not pronounced. Rather, the pivotal factor lies in expanding the user base of digital wallets, a metric intrinsically tied to the efforts directed toward enhancing financial inclusion. For instance, the survey data reveals that following the introduction of interoperability, 41% of respondents expressed that they did not cease using alternative payment instruments. Notably, only 44% indicated discontinuation of cash usage after May 2023. Most of the 44% of users are in regions with a high index of financial inclusion. These figures do not unequivocally demonstrate interoperability as a decisive factor in compelling individuals to abandon cash transactions. Instead, they suggest a nuanced landscape where interoperability alone may not be the sole determinant in the shift away from cash usage, indicating the presence of additional factors influencing individuals' payment preferences.

Consequently, observations indicate that the augmentation of digital payment transactions is intricately linked to the broadening of the digital wallet user demographic, necessitating a concerted focus on initiatives to bolster financial inclusion. A positive user experience supports interoperability, but to witness a substantial increase in digital payments, the focus should be on strategies promoting financial inclusion. A comprehensive approach, combining user satisfaction with targeted efforts for broader financial participation, is essential for driving the widespread adoption of digital payments.

It is being said that governments in Latin America and the Caribbean recognize not only the importance of advancing digital financial inclusion, but also that fostering competition among financial service providers leads to improved choices, lower costs, and high-quality services for all consumers—including those living in poverty (Sirtaine, 2024), e.g. leveraging interoperable payment systems and open finance to promote a more inclusive and competitive business environment.

Certainly, there are studies that demonstrate that financial inclusion can be furthered through the efforts of fintech companies and other entities targeting clients in rural areas. In addition, well-crafted strategies, and policies, exemplified by India, have played a pivotal role in markedly expanding access to financial services in an economy traditionally dependent on cash transactions. India's experience stands as a notable example of successful initiatives aimed at fostering financial inclusion and reducing reliance on cash-based transactions. The utilization of a digital ID card has notably reduced the costs associated with identity verification. Open-access software standards have streamlined digital payments across banks, fintech firms, and digital wallets. Importantly, personal data access is regulated through consent. The expansion of digital payments, facilitated by this comprehensive approach, has emerged as a crucial driver of economic development in India. This expansion has not only stabilized incomes in rural areas but has also contributed to increased sales for businesses operating in the informal sector (Patnam & Yao, 2020).

In India, the strategy for financial inclusion consisted of three key layers: digital identification, interoperable payments, and trust through consent. The second layer, interoperable payments, played a crucial role in this strategy. While the government expanded access to bank accounts, fintech firms in India experienced rapid growth, introducing digital wallets and mobile money solutions. These innovations simplified and made digital money storage and transfers cost-effective, even for individuals without a bank account. Recognizing this shift, the authorities introduced a new layer to the retail payment system called the Unified Payments Interface (UPI). This addition allowed banks to seamlessly exchange messages and payment orders with nonbank entities, constituting the second layer of the India Stack initiative (Carrière-Swallow et al., 2021).

Finally, Central Banks can also pay special attention to Central Bank Digital Currencies (CBDCs) for financial inclusion. It is being said that CBDC could gain acceptance among the financially excluded if it is designed to replicate some of the desirable properties of cash, as “digital cash.” CBDC could even surpass these desirable properties in certain aspects and offer greater value to users. CBDC should be designed to address the access, cost, privacy, and trust barriers that prevent the financially excluded from shifting from cash to using existing

digital payment services. Considering that, CBDCs could offer key advantages to foster financial inclusion: no bank account needed, no minimum balances, potential exemption from formal identification for small transactions, offline functionality, wide acceptance, easy conversion to cash, and low fees for small transactions (Ashley Lannquist & Brandon Tan, 2023).

By implementing these policy measures, the BCRP can contribute significantly to the promotion and adoption of digital payments, fostering a more efficient and inclusive financial ecosystem.

7. Conclusions

In conclusion, greater interoperability in payment services, promoted through regulation, has contributed to the increased use of digital payments. In addition, interoperability has contributed to the digitization of payments by encouraging less use of cash. However, the results suggest that factors such as fees, user experience and service quality can influence the adoption and usage of interoperable payment services.

Likewise, our analysis further substantiates that interoperability yields greater benefits for individuals in regions characterized by a higher degree of financial inclusion. This highlights the pivotal role of financial inclusion in maximizing the advantages of interoperability. Additionally, the study identifies that younger individuals, Plin users, and the self-employed, particularly those closely associated with merchant activities, are the primary adopters of interoperable payments.

In light of these findings, the study advocates for critical policy adjustments to enhance even more the adoption of digital payment methods in Peru. Suggested policy implications encompass modifications to the existing payments regulatory framework, targeted public awareness campaigns, and initiatives focused on promoting financial inclusion. These measures are envisioned to create an environment conducive to widespread interoperable payment adoption in the Peruvian context.

Finally, the main limitations of the study were as follows:

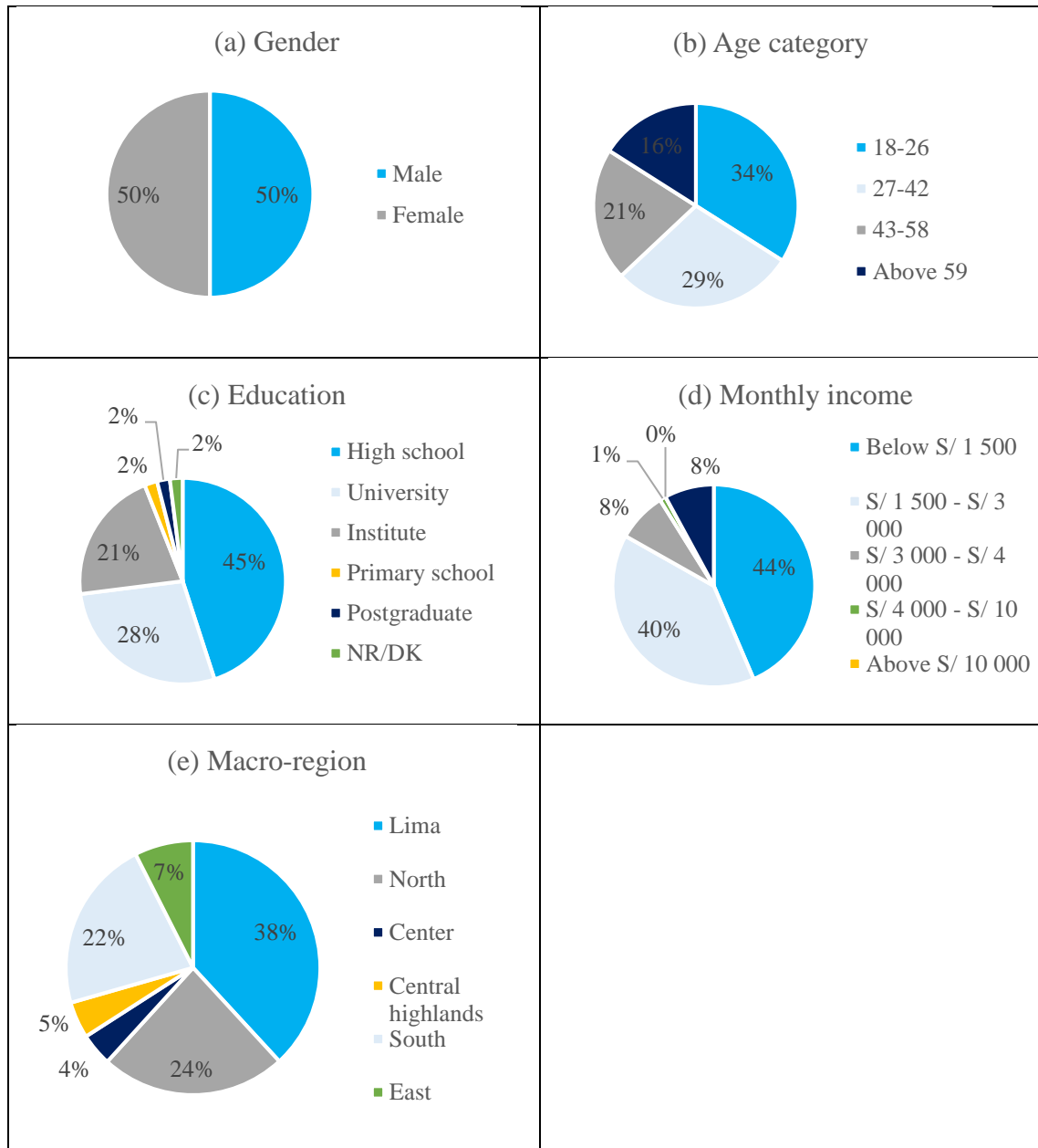
1. **Causation:** The existing data do not allow to establish a causal relationship; while greater interoperability is associated with increased use of digital payments, causation cannot be definitively asserted. Similarly, although interoperability and greater financial inclusion show a positive correlation, causation cannot be inferred. Future research efforts could explore experimental or quasi-experimental methodologies to delve deeper into these relationships.
2. **Target population:** It is important to note that the survey targeted digital wallet users in urban areas of Peru. Future studies may benefit from examining a more diverse population, including users in rural areas and those not currently financially included, to assess potential variations in results across different demographic segments. This broader approach could provide a more comprehensive understanding of the impact of interoperability on digital payment use and financial inclusion in varying contexts.

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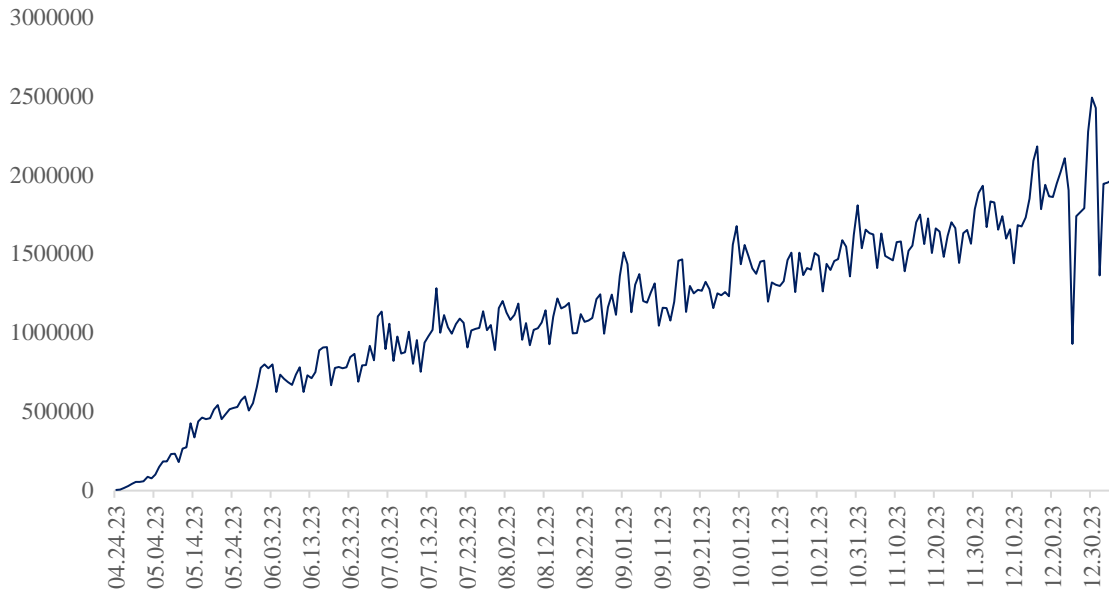
9. Annexes

Annex 1: Demographic characteristics of the sample

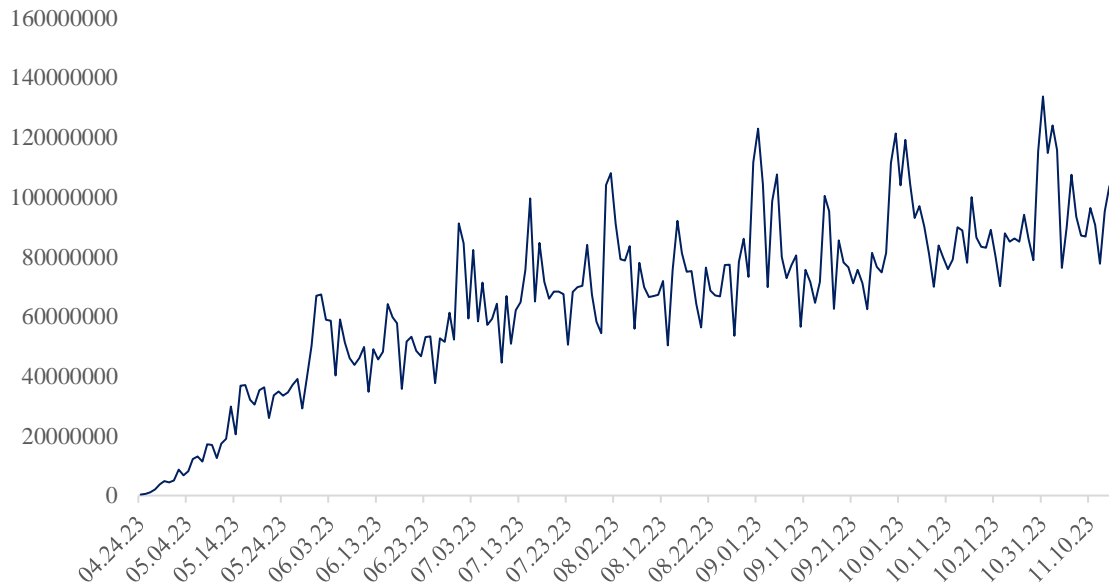


Annex 2: Daily interoperable transactions

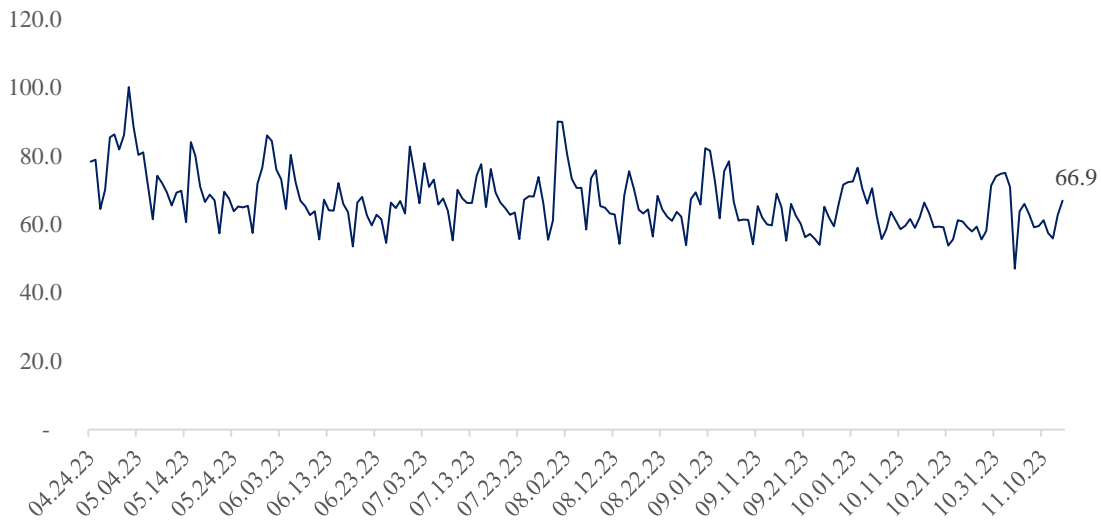
**Graph 1: Number of total daily transactions between Yape and Plin
(as of January 5, 2024)**



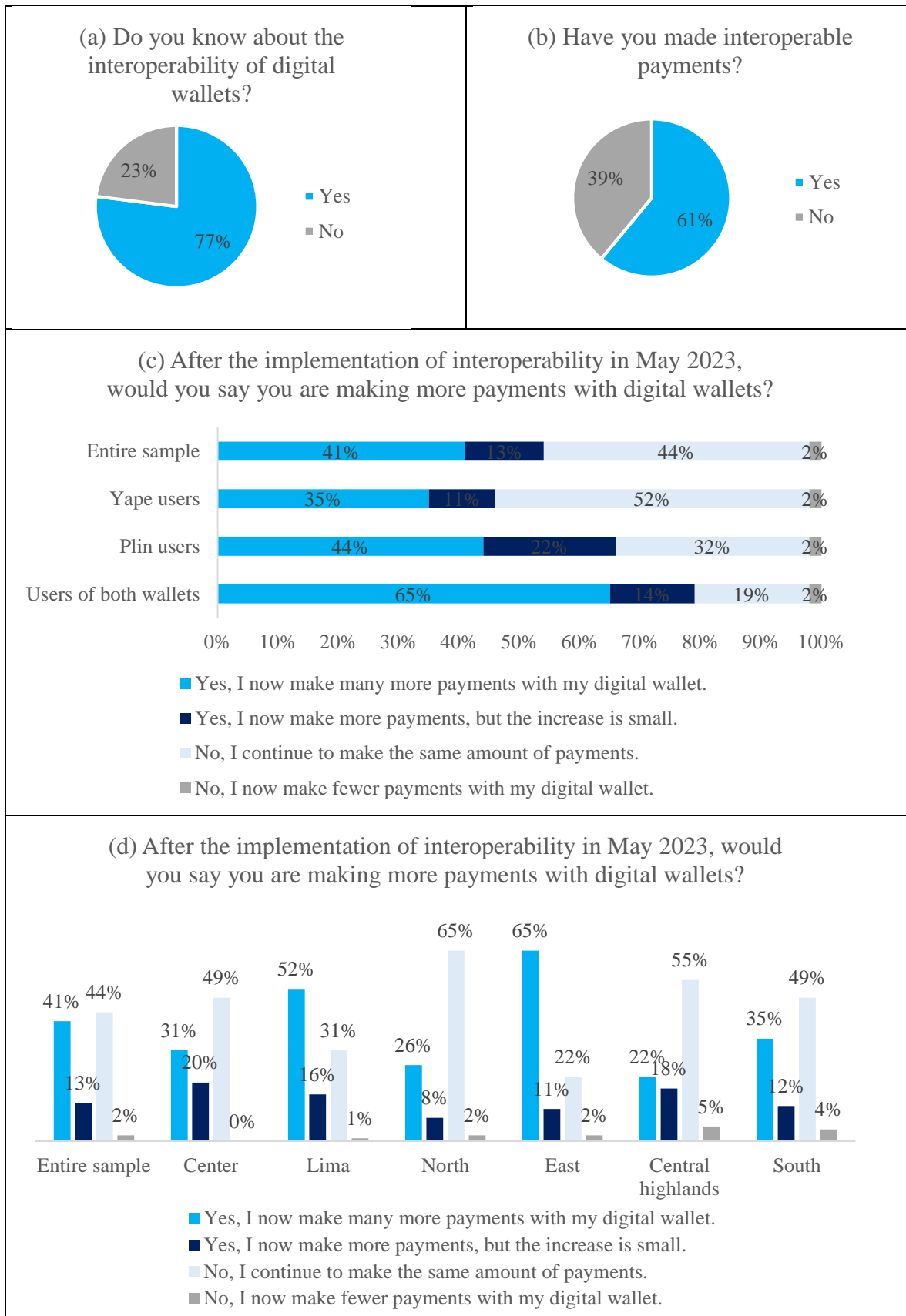
**Graph 2: Value of total daily transactions between Yape and Plin
(as of November 14, 2023)
*expressed in soles (S/)***



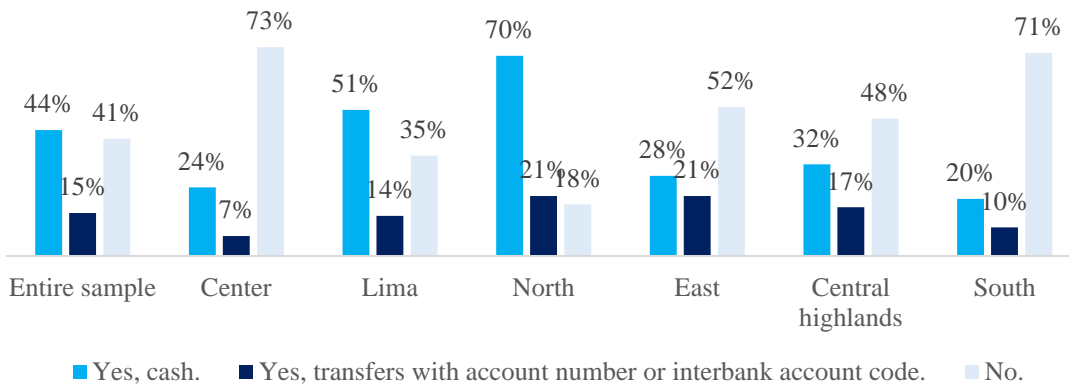
**Graph 3: Average ticket of total daily transactions between Yape and Plin
(as of November 14, 2023)
expressed in soles (S/)**



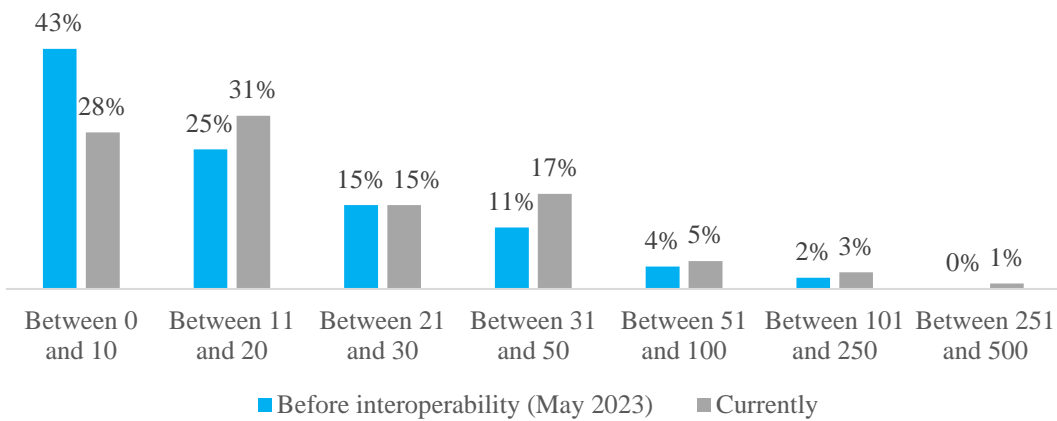
Annex 3: Summary of survey data



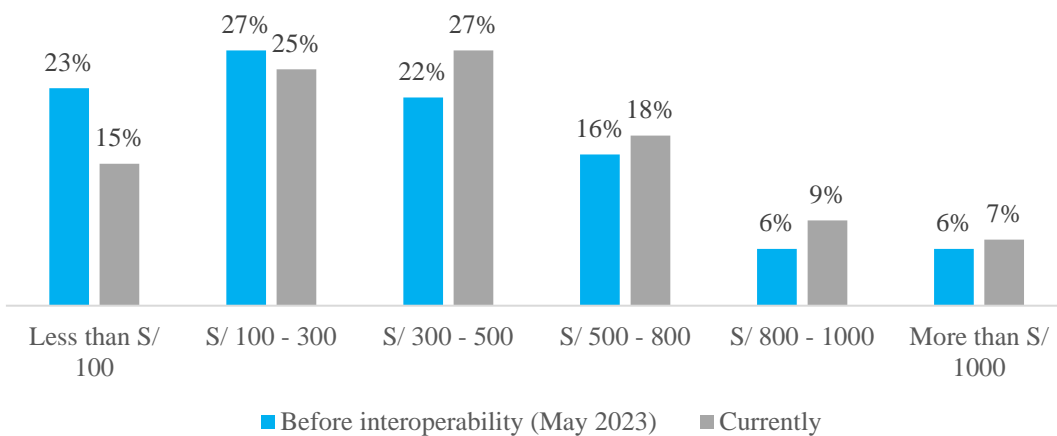
(e) After the implementation of interoperability in May 2023, would you say that you have stopped using other payment instruments?



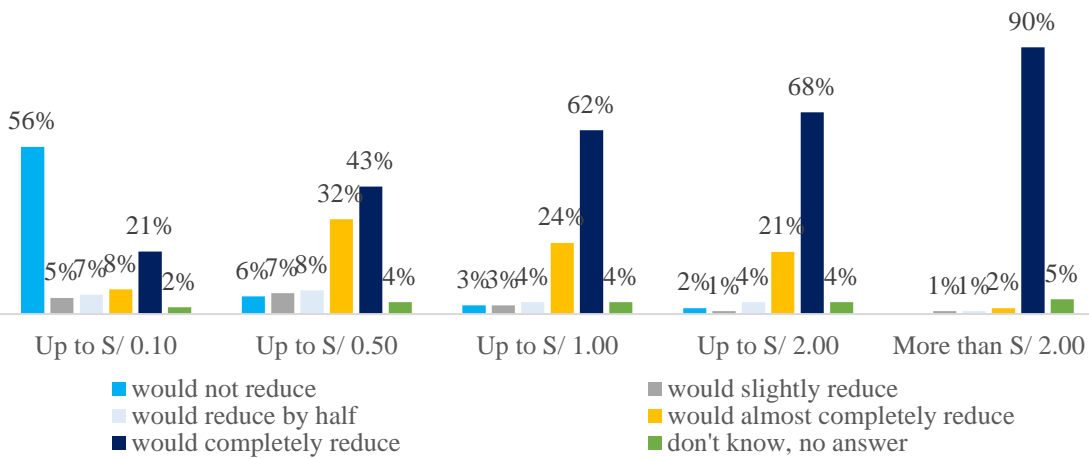
(f) Per month, how many payments do you make with digital wallets?



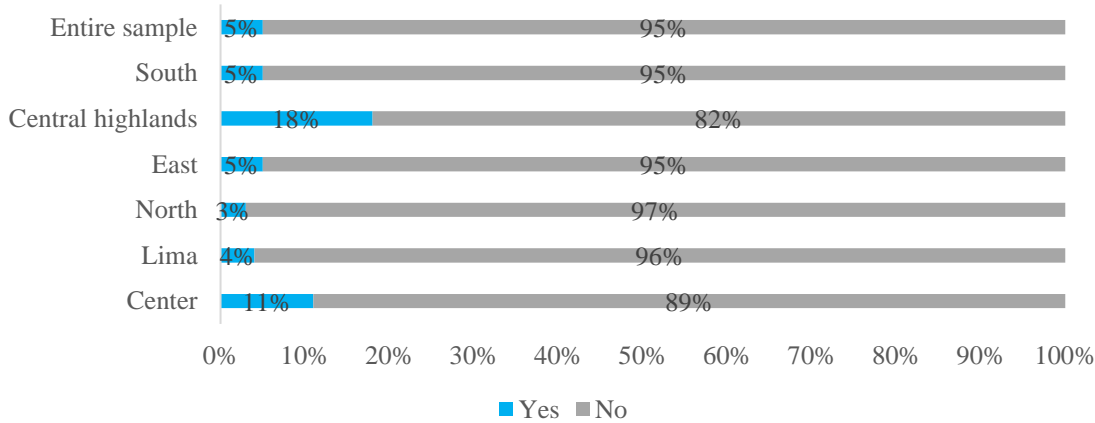
(g) Per month, how much money do you transfer with digital wallets?



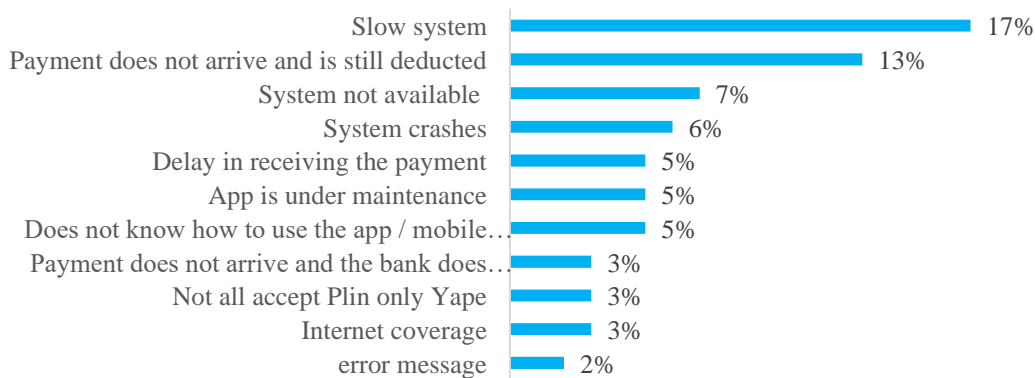
(h) How would your number of monthly digital wallet transactions change if transaction fees were charged?



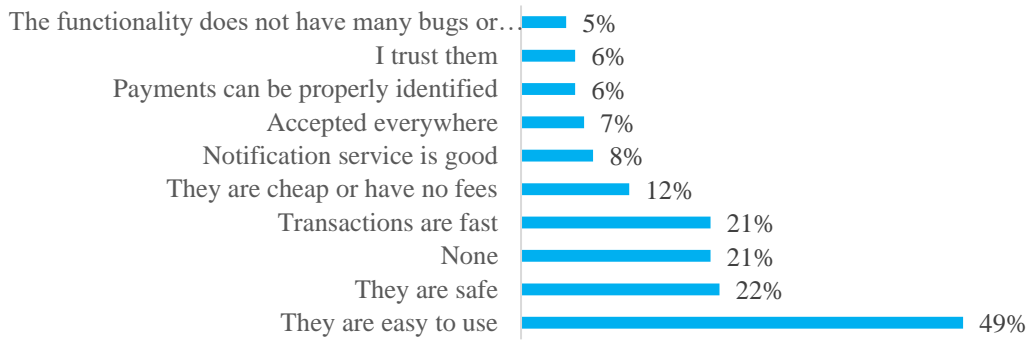
(i) Have you had any inconvenience or problem making interoperable payments?



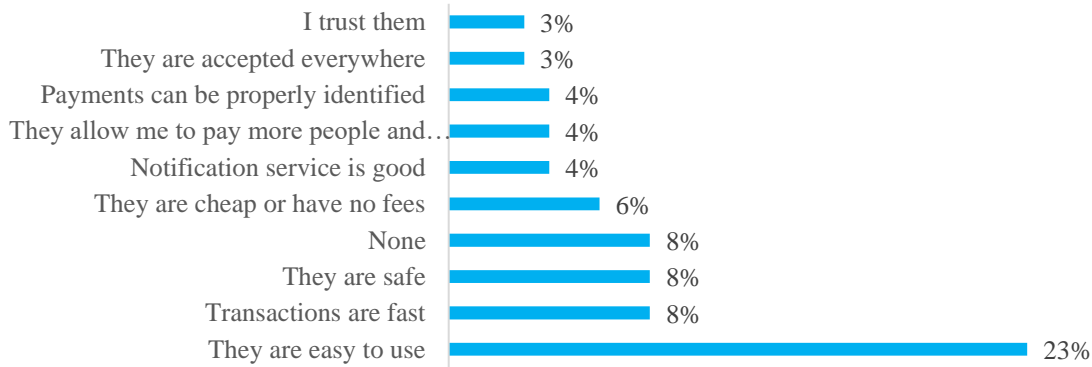
(j) Inconveniences or problems when making interoperable payments



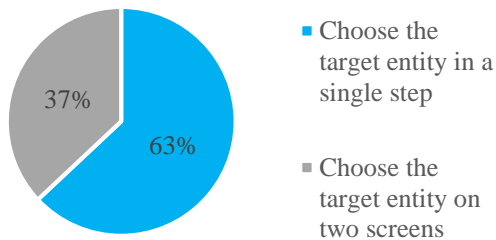
(k) (Yape users) What do you value about Yape's payments to Plin?



(l) (Plin users) What do you value about Plin's payments to Yape?



(m) (Yape users) When paying Plin users, which user experience do you find best?



(n) (Plin users) When paying Yape users, which user experience do you find best?

