

The Rise of E-Wallets and Buy-Now-Pay-Later: Payment Competition, Credit Expansion, and Consumer Behavior

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Abstract

The past decade has witnessed a phenomenal rise of digital wallets, which is further accelerated by the COVID-19 pandemic. Such e-wallets provide not only a conduit to external bank accounts but also internal payment accounts, including the popular Buy-Now-Pay-Later (BNPL). We examine, for the first time, e-wallet transactions matched with merchant and consumer information from a world-leading e-wallet provider, with around one billion users globally and a business model that other providers quickly converge to. We document that internal payment options, especially BNPL, dominate both online and on-site transactions. BNPL serves as “digital cash” in mediating small-valued transactions and the purchases of non-durable goods, while greatly expanding consumer credit access at the extensive margin thanks to its adoption in two-sided payment markets. While BNPL crowds out other e-wallet payment options, it expands FinTech credit to underserved consumers. Exploiting a randomized experiment, we also find that e-wallet credit through BNPL substantially boosts consumer spending without incurring interest charges or delinquent behavior, thanks to the inherent rewards and disciplines within the super-app ecosystem. The insights inform economies transitioning from cash-heavy to cashless or featuring app-driven platforms where digital payments and FinTech credit see the largest growth and potential.

Keywords: Cashless, Consumer Credit, FinTech, Financial Inclusion, Mobile Wallet.

JEL Codes: E42; G20; G23; G51

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1. Introduction

E-wallets, a.k.a, digital wallets, contain software that enables users to make payments on their computers or mobile devices using linked bank cards, balance and savings accounts from wallet providers, or new liquidity and credit products. The past decade saw a phenomenal world-wide rise of PayPal, Apple Pay, the relaunched Google Pay, and super-apps such as WeChat Pay and Alipay.² The combination of digitalization and the contactless payments engendered by the COVID-19 pandemic has further accelerated consumers' adoption of e-wallets. A conservative estimate projects the total number of e-wallet users to be over 5.2 billion globally in 2026, up from 3.4 billion in 2022.³ Meanwhile, Buy-Now-Pay-Later (BNPL), a short-term FinTech credit allowing consumers to defer payments interest free into one or a few installments at the point of sale, has become increasingly popular among e-wallet users. Now a common offering from leading e-wallet providers around the globe, BNPL is projected to account for \$680 billion in global transactions by 2025.⁴

While economists agree that the shift from cash and bank cards toward e-wallets exerts a profound influence on the real economy (Agarwal et al., 2020b, 2022), little is known about how various payment options interact and compete within e-wallets and how BNPL affects consumer credit provision and their spending and borrowing behavior. On one hand, as a conduit to linked bank cards, e-wallets could reduce physical-card-carrying costs and alleviate transaction frictions and costs. Their adoption thus potentially benefits traditional financial intermediaries (e.g., banks) and consumers. On the other hand, e-wallets also offer their own payment options. For example, PayPal provides several internal payment options in addition to external bank-linked accounts or cards: PayPal Balance, PayPal Savings, PayPal Credit, and

² <https://www.pwc.com/gx/en/industries/financial-services/publications/financial-services-in-2025/payments-in-2025.html#macro3>, retrieved on Nov 21, 2022. A super-app offers a wide range of services all in one integrated app.

³ Juniper Research. See <https://www.juniperresearch.com/press/digital-wallet-users-exceed-5bn-globally-2026>.

⁴ "Buy Now Pay Later Digital Spend, Led by Klarna, PayPal, and Afterpay, to Double by 2025: Reaching \$680 Billion," Kaleido Intelligence, September 2020. Alipay's Huabei, PayPal Credit, and PayPal Pay Later are examples of this fast-growing new form of credit which is typically embedded in e-wallets; Apple recently introduced Apple Pay Later in March 2023.

PayPal Pay Later. These internal payment options may circumvent banks, cutting banks off from valuable information related to FinTech lending and cashless payments (Ghosh et al., 2022). Besides the ambiguous effect on social welfare (Parlour et al., 2022), it is unclear whether BNPL as a form of FinTech credit complements or substitutes bank credit—a core issue in the literature (Tang, 2019; Jagtiani and Lemieux, 2019; Di Maggio and Yao, 2021), what role it plays for economies transitioning from being cash-heavy to cashless, and whether it leads to excessive spending and indebtedness (Ponce, Seira, and Zamarripa, 2017; Agarwal et al., 2020b).

We bridge the knowledge gap by opening the black box of e-wallets that contain multiple payment options, and empirically investigating these issues using the most comprehensive and representative data to date from a world-leading e-wallet provider. We also obtain directly matched, transaction-level data on BNPL and credit cards, instead of inferring BNPL activities from bank transactions as is previously done. The sample covers 550,000 online and 550,000 on-site transactions randomly drawn from all transactions in June 2020. We complement the e-wallet data by randomly sampling from a two-month randomized experiment conducted by the same e-wallet provider in June 2017 to study the impact of introducing BNPL credit to consumers. We extend the randomized sample to December 2021 to further understand how the super-app ecosystem disciplines BNPL users' behavior.

Specifically, we (i) describe the various payment choices in e-wallet transactions and their usage popularity, especially how BNPL dominates, (ii) demonstrate how BNPL crowds out other payment options yet complements bank credit cards, serving as a new digital cash for small-value transactions including non-durable purchases, (iii) analyze the expansion of e-wallet credit through BNPL for consumers and regions underserved by banks, emphasizing the adoption in two-sided payment networks, and (iv) document that, different from the findings in the existing literature, BNPL increases consumer spending, but does not lead to greater default or indebtedness owing to the disciplining role of the e-wallet ecosystem.

In addition to providing the first transaction-level analysis of e-wallets, we also join contemporaneous studies (e.g., deHaan et al., 2022; Di Maggio, Williams, and Katz, 2022; Guttman-Kenney, Firth, and Gathergood, 2023) to add to the first canon of knowledge about BNPL and the economic implications of its meteoric emergence. Our study distinguishes itself by drawing evidence from an economy transitioning from being cash-heavy to cashless and tying together the payment and credit functions in e-wallets. We demonstrate that BNPL serves as a “new cash” instead of competing with credit cards heads-on, as documented in earlier studies concerning several other countries. Furthermore, we directly observe BNPL transactions with rich consumer and merchant information, circumventing any noisy inference from bank transactions alone. Given the global convergence of e-wallets towards the ecosystem model and of BNPL towards cash-like usage, our findings not only inform about the Chinese market but also provide valuable insights globally.

We start with summarizing stylized facts regarding the distribution of e-wallet payment options. Internal payment options—particularly BNPL—have become consumers’ predominant way to pay, accounting for more than half of all transactions, whereas the most popular external option—linked debit cards—accounts for less than one-third. As internal options dominate in e-wallet transactions, the rise of e-wallets could disrupt traditional banks’ access to payment data (Ghosh et al., 2022). Given the importance of payment information and digital footprints in lending (Agarwal et al., 2020a; Berg, Fuster, and Puri, 2022), this rationalizes why central banks around the world look into developing their own electronic payment systems (EPSs) or digital currencies to compete for payment flows with FinTech giants (Boar and Wehrli, 2021).

We next estimate a payment choice model to investigate the influence of e-wallet credit expansion on other payment choices after accounting for a set of typical factors such as consumer demographics, payment preferences, merchants’ acceptance, and transaction value. We find that consumer access to e-wallet credit crowds out the usage of other payment options in both on-site and online transactions. In line with the crowding-out effect, we also find that small-value transactions, which form a

substantial share of e-wallet payments, are overwhelmingly settled with e-wallet credit through BNPL. While prior studies (e.g., Klee, 2008) conclude that physical cash is the main payment choice for settling high-frequency and small-value transactions in modern societies, we posit that BNPL is now the most popular payment choice in e-wallet transactions and hence serves as the new digital cash in transition to cashless societies.

Somewhat counterintuitively, BNPL does not compete heads-on with bank credit. Unlike prior studies that examine the relation between FinTech lending and traditional lending (e.g., Jagtiani and Lemieux, 2019; Di Maggio and Yao, 2021), our study features data including borrowers who have access to both e-wallet credit and credit cards (*dual-access* users). We can therefore rule out the potential impact of borrowers' unobservable characteristics. We find that dual-access users use e-wallet credit and credit cards in different payment scenarios, with e-wallet credit for daily, small-value transactions and credit cards for big-ticket purchases. E-wallet credit serves primarily as a potential complement of credit cards, not a substitute, because its adoption by users who already have credit cards leads to increased spending through credit cards as well.

Because our dataset overcomes the empirical challenge in the existing literature concerning whether FinTech credit users have access to bank credit, we can investigate if e-wallet credit (i.e., BNPL) expands credit provision to those with no prior credit access. We document a substantial expansion at the extensive margin. Specifically, 84.14% and 78.38% of on-site and online consumers without credit cards, respectively, can now access e-wallet credit. Moreover, 43.54% of on-site merchants who previously did not accept credit cards now accept e-wallet credit. Additionally, 44.37% of on-site and 90.21% of online transactions that could not be completed using credit cards can now be completed using e-wallet credit. The combination of consumer and merchant demand for BNPL, and the supply by the e-wallet provider, has led to the exponential growth of BNPL usage. The impact of BNPL access on consumer credit usage also appears to be more pronounced in less-developed areas,

such as rural areas and northern regions, as well as among women. Overall, the e-wallet credit seems to benefit those disadvantaged or underserved by banks.

With the wide use of BNPL, a potential concern is that the ease and convenience of this FinTech-based consumer credit may induce consumers, especially those lacking financial literacy, to overborrow and overspend (Berg, Fuster, and Puri, 2022; Bu et al., 2022). We exploit a two-month randomized experiment conducted by the e-wallet provider in June 2017 to examine the impact of the introduction of BNPL on consumer spending. For users who were extended credit in this experiment, we first document a significant consumption-boosting effect consistent with that observed in developed economies such as the United States: an increase equivalent to 4.78% of the average monthly consumption as reported by the National Bureau of Statistics of China. Moreover, we explore the heterogeneity of the consumption-boosting effect by age and the number of bank cards. Although the consumption response of BNPL is higher for younger customers and those with only one bank card, consumption also increases for older customers and those with multiple bank cards. Taken together, these findings are in favor of the buffer-stock explanation (Carroll, 1997; Aydin, 2022), where additional credit reduces consumers' motive for precautionary savings and thus enables them to increase consumption to a new level.

Next, we return to our transaction data and analyze how consumers change their usage of BNPL when they have unpaid debt and incur interest expenses. We distinguish between two types of users according to their credit access: *single-access* users (e-wallet credit users with no linked credit card), and *dual-access* users (as mentioned earlier). While single-access users appear to use e-wallet credit more frequently, they use the credit cautiously, as the proportion of revolvers (those who incur interest charges on unpaid debt) and the unpaid-debt ratio for revolvers are lower. They also reduce BNPL usage in transactions once they incur interest expenses from late payments (which are higher than the rates charged by credit cards). Utilizing the extended randomized sample, we further explore the mechanisms underlying the cautious usage of BNPL. The e-wallet super-app constitutes an all-encompassing

ecosystem where users can purchase wealth management products, hail taxis, book movie tickets, reserve hotels, pay utility bills, order food delivery, among others. We find that the overall benefits users receive incentivize frequent yet responsible usage of BNPL, alleviating the concerns of overuse or irresponsible usage that have been documented in other studies.

Our findings have broad implications. First, given that payment networks have constituted the core products of BigTech giants and FinTech startups, our investigation on the distribution of payment choices in e-wallet transactions provides an initial benchmark for understanding their role in large digital ecosystems. Second, because e-wallet providers have high-frequency and exclusive data on merchants and consumers underserved by banks, discussions on “open-FinTech”—in addition to the “open banking” proposal—can be timely. Third, although BNPL raises concerns about consumer indebtedness worldwide, our study suggests that BNPL users, especially those with no credit access from banks, carefully moderate credit usage in an economy transitioning from cash-heavy to cashless. Credit expansion through BNPL does not necessarily come at the expense of greater consumer indebtedness or default under inclusive, ex-ante screening and ex-post monitoring and incentive provision of the e-wallet provider.

Our data and the Chinese setting have several appealing features well-suited for the economic questions we study. First, China is the largest e-wallet market in the world and currently has the largest number of BNPL users (Section 2.1 contains more details), with mature mobile payment networks.⁵ Second, the e-wallet functionality and BNPL design in our study are reasonably representative, not only in China with its around one billion users but also on the world stage. For example, the BNPL embedded in the e-wallet we study offers a revolving credit line and allows installment payments, thus combining the features of PayPal Credit and PayPal Pay

⁵ The mobile payment in China boomed early in 2011 and the adoption among Chinese adults reached 82% in 2017. The coverage and usage had since stabilized. See <https://idf.pku.edu.cn/docs/20210421101507614920.pdf> and <http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3602384/index.html>; accessed on August 6, 2022.

Later, and is similar to other major BNPL providers such as Affirm in terms of “Pay-in-4” (installments) products and credit lines. Both the representativeness in terms of functionality and the fact that many e-wallet providers around the globe are converging to the Chinese model with small-value transactions, especially in nondurables, and with super-app ecosystems (CFPB, 2022 and Section 2.1) give our findings external validity and implications, even for e-wallets and BNPL providers that initially started as pure-play payment or credit products. Finally, our dataset is likely the only one in the literature that allows direct observations of transactions in e-wallets and involving BNPL, covering both online and on-site transactions and encompassing both merchant and consumer information, thanks to that the e-wallet provider has its own e-commerce platforms and QR code registration system.

Our work relates to several strands of the literature. FinTech firms typically start with payments and then expand into lending, insurance, investment products, etc. (Frost et al., 2019). However, the existing literature appears to focus predominately on lending, largely due to data limitations on payment transactions. As highlighted by Berg, Fuster, and Puri (2022), payment data are fundamental for credit ratings in the lending business. Our study focuses on FinTech payments and provides the first empirical description on a timely and important issue: payment choices within e-wallets.⁶ Although there have been digital payment surveys in advanced economies and numerous studies on (electronic) payment choices (e.g., Arango et al., 2015; Koulayev et al., 2016; Wang et al., 2016; Crouzet, Gupta, and Mezzanotti, 2019; Agarwal et al., 2020b, Cong, Easley, and Prasad 2023), these surveys have always categorized e-wallets, if at all, as an aggregate category. Looking into the black box of e-wallet payment options is important for understanding current changes in payment systems and evaluating e-wallets’ economic impacts. Our analysis of both consumer access to and merchant adoption of BNPL as a payment option also adds to studies such as Higgins (2019) that analyze the coordinated technology adoption in two-sided

⁶ Hong, Lu, and Pan (2020) document that repeated usage of digital payments through super-apps can help users build familiarity and trust, thereby increasing their participation and risk-taking in mutual fund investments offered by super-apps.

markets.

We contribute to the literature on FinTech credit, especially the emergent discussions on BNPL. Earlier studies focus on credit for online merchants, small firms, and entrepreneurs (e.g., Huang et al., 2018; Hau et al., 2019; Hau et al., 2021, Gopal and Schnabl, 2022), whereas we study credit for consumers and households. Within this domain, marketplace lending has been shrinking while BNPL has been growing. Berg, Fuster, and Puri (2022) estimate that new lending in the U.S. marketplace lending market was \$6 billion in 2020; the U.S. BNPL market, by contrast, was about \$25 billion. Compared to the numerous studies on marketplace lending (e.g., Lin, Prabhala, and Viswanathan, 2013; Freedman and Jin, 2017; Jagtiani and Lemieux, 2019; Tang, 2019; Cong, Tang, Xie, and Miao, 2019), the research on BNPL is scarce.

Several contemporaneous articles study BNPL in developed economies where credit cards have already largely replaced cash. Guttman-Kenney, Firth, and Gathergood (2023) describe BNPL usage in the UK, where 19.5% of active credit card users had a transaction with a BNPL firm on their credit cards in 2021, and young users and those living in deprived regions with limited repayment capability had an even higher ratio. deHaan et al. (2022) find that BNPL in the United States plausibly has a negative effect on users' spending habits and financial health. Similarly, Di Maggio, Williams, and Katz (2022) find that BNPL access increases consumers' total spending and the proportion of retail spending in the United States, which is better explained by the "liquidity flypaper effect." These studies provide valuable information, especially time trends, on BNPL, but have to rely on bank and credit card transactions to infer BNPL activities, thus capture only transactions linked to banks, with limited matched merchant or consumer information and primarily cover a small set of pure-play providers.⁷ A more recent study by Berg et al. (2023) studies another BNPL model offered by a furniture merchant in Germany to show, through a randomized controlled trial, that BNPL induces greater consumer spending

⁷ For example, PayPal is excluded because it contains large non-BNPL business, despite also being a major BNPL player. The transactions from omitted BNPL providers are labeled as non-BNPL, leading to classification errors.

and benefits the merchant more than PayPal does. The authors focus on the cost-benefit analysis of a particular type of “pay later” that must occur within 14 days and is typically covering larger transaction amounts, which are different from the typical BNPL model examined in other studies.

We investigate the usage of BNPL and its impact on consumer spending and indebtedness directly using a comprehensive, matched, transaction-level dataset, in a country with drastically different financial development and business ecosystems, while featuring an equally important BNPL market and business model that many markets around the globe are converging to. We highlight the payment nature of BNPL and examine its interaction with other payment options. Furthermore, our data are representative of the population of BNPL users from both sides of the two-sided payment markets because they are not limited to one merchant in a particular product category or merchants working with banks.

Finally, we complement earlier research on mobile payment, consumer credit, and overspending (Aydın, 2022; Gross and Souleles, 2002; Ponce, Seira, and Zamarripa, 2017; Agarwal et al., 2020b). Previous studies document a spending-boosting effect of payment innovations (e.g., mobile payment and e-wallets), which causes concerns about overspending, consumer addiction, and debt traps that have plagued many developed economies (e.g., Manning, 2001; Williams, 2004). Recently, Wang (2023) theoretically and empirically analyzes competition among bank-card-based networks and finds that it leads to overuse of credit and reduced social welfare. We find BNPL, as a new consumer credit, boosts consumption. But it does not increase household indebtedness in China, a phenomenon also documented in the Israeli market (Gelman and Roussanov, 2022), suggesting that the payment competition induced by e-wallets and BNPL in China is rather nuanced: Heterogeneity in payment options leads to different merchant fees, retail prices, and consumer segments, with BNPL serving many consumers without credit card access. Consequently, depending on the payment design and market environment, merchant fees do not necessarily get passed onto retail prices, and consumers do not necessarily overuse the newly available credit. We

should highlight here that the main contribution of our study does not lie in the examination of the impact of BNPL on consumption. Rather, our study delves into the payment function of BNPL and the interaction of BNPL with other payment options within e-wallets, the credit expansion and financial inclusion of BNPL, and the power of the e-wallet ecosystem in disciplining BNPL users.

The rest of this paper is organized as follows. Section 2 provides the institutional background and introduces the data. Section 3 describes the landscape and stylized patterns of e-wallet payments, including BNPL's growing dominance. Section 4 presents the findings concerning e-wallet credit expansion through BNPL. Section 5 investigates how the rise of BNPL affects consumer spending and indebtedness and how the super-app ecosystem disciplines BNPL users' behaviors. Section 6 concludes.

2. Institutional Details and Data Description

2.1 Institutional Background

The emergence of the e-wallet economy. E-wallets allow users to store digital currencies and use them for online and on-site (via scanning QR codes) transactions. They are steadily replacing the use of physical cards and cash by reducing the inconvenience of carrying physical cards or cash. Additionally, e-wallets offer faster and easier payment options relative to bank-based transfers. Consumers use e-wallets on both conventional e-commerce platforms and blockchain-based platforms.

Digital wallets first became popular in developing countries that were considered cash heavy or lacking well-developed credit reference systems.⁸ After taking off in China and India, they were quickly adopted in countries such as Philippines, Thailand, and Vietnam. Australia and Singapore also embraced e-wallets quickly, followed by other developed economies in Europe and North America amidst the COVID-19

⁸ While the technologies behind digital wallets seem new, some have been around for decades. For example, Coca-Cola's vending machines back in 1997 allowed people to pay via text message; Amazon launched 1-click in 1999 and PayPal expedited eBay purchases in 2022.

pandemic because they offer a convenient payment option without physical contact.

Depending on the issuer and the level of acceptance, e-wallets come in three types: closed e-wallets issued by a specific merchant or service provider (e.g., Amazon Pay), semi-closed e-wallets that allow users to make purchases at multiple merchants but lack widespread applicability (e.g., Alipay and Paytm), and open e-wallets that are issued by banks or institutions partnered with banks and allow users to make purchases at any merchant that accepts electronic payments (e.g., PayPal, Apple Pay, and Google Pay).

BNPL around the globe. BNPL, a new FinTech-based consumer credit, has also emerged rapidly together with e-wallets over the past decade and especially during the pandemic. While there is no single definition of BNPL, it is generally defined as a short-term consumer credit that allows users to make purchases in several instalments. With the pandemic limiting household income worldwide and bank lending, BNPL meets the elevated demand for non-contact payments and liquidity. As a result, established e-wallet providers such as Alipay and PayPal, as well as FinTech start-ups such as Affirm and Klarna, have all incorporated BNPL as a core product.

BNPL providers have two distinct strategies to acquire customers: the merchant partner model cooperates with retailers to embed BNPL products on the merchants' checkout page; the app-driven model offers BNPL products either through e-wallets or "pure-play" BNPL apps and allows users to make purchases under a predetermined credit limit (Federal Reserve Bank of Kansas City, 2021; CFPB, 2022). Like credit cards, BNPL provides a line of credit to consumers for online or on-site purchases, but with lower fees and less stringent credit requirements for merchants and consumers.

In general, BNPL products are interest-free, but they may carry interest for late payments or loans with longer terms. For example, a typical BNPL product provides the option to pay in four installments made bi-weekly with no interest charged starting with a down payment of 25 percent. In some cases of large, infrequent purchases with

loan term lengths up to three years, a Point-of-Sale (POS) installment is also categorized as BNPL.⁹ For POS installments, down payments are typically not required, but monthly payments include interest or fixed finance charges. Importantly, and different from traditional payment installments, BNPL or the associated e-wallet providers supply the BNPL credit, not the merchant or store.

The global BNPL market size was U.S. \$103.6 billion in 2022 and is projected to reach U.S. \$467.34 billion in 2026, and even U.S. \$3.98 trillion by 2030.¹⁰ Among the top 20 BNPL nations ranked by the proportion of BNPL transactions in e-commerce market, 12 nations are from the Europe, 7 nations are from the Asia-Pacific regions, and one nation is from North America.¹¹ In the United States, the five leading BNPL providers originated BNPL loans totaling U.S. \$24.2 billion in 2021, with an annualized growth rate of over 200 percent since 2019 (CFPB, 2022).¹² Australia, home to one of the earliest and most successful BNPL provider Afterpay, features more than 6.1 million BNPL users as of June 2019, representing up to 30% of the adult population; the BNPL transaction value increased from \$3.1 billion to \$5.6 billion in 2017-2019, with the growth rate up to 79 percent (ASIC, 2020). In Europe, BNPL accounted for 11.7% of e-commerce share in Denmark, 12.8% in Finland, 18.1% in Norway, 25.2% in Sweden, and 19.7% in Germany, as of the end of 2021.¹³ Asia also records strong BNPL growth. According to the report released by Mordor Intelligence, the transaction value of BNPL in India had reached about U.S. \$7 billion in 2022, with 22% of Indian consumers using BNPL as a payment tool for their purchases.¹⁴

⁹ A report by McKinsey mentioned POS installment as a type of BNPL lending. See <https://www.mckinsey.com/industries/financial-services/our-insights/buy-now-pay-later-five-business-models-to-compete>.

¹⁰ Research and Markets report on global BNPL market. https://www.researchandmarkets.com/reports/5700456/buy-now-pay-later-global-market-report-2022?utm_source=BW&utm_medium=PressRelease&utm_code=tgbvg4&utm_campaign=1793416+-+Buy+Now+Pay+Later+Global+Market+Report+2022%3a+Increase+in+the+Adoption+of+Online+Payment+Methods+Drives+Growth&utm_exec=como322prd.

¹¹ <https://www.paymentscardsandmobile.com/top-20-bnpl-nations-ranked-by-e-commerce-size-and-market-share/>.

¹² The five BNPL providers include Affirm, Afterpay, Klarna, PayPal, and Zip (formerly Quadpay).

¹³ Worldpay from FIS, the global payments report for financial institutions and merchants. Accessed from <https://offers.worldpayglobal.com/rs/850-JOA-856/images/ENGPR2022.pdf>.

¹⁴ Mordor Intelligence, India buy now pay later services market-growth, trends, COVID-19 impact, and forecasts (2023-2028). <https://www.mordorintelligence.com/industry-reports/india-buy-now-pay-later-services-market>.

Although BNPL was initially created to finance customers' big-ticket purchases at the point of sale, an increasing number of BNPL firms around the world have been shifting from the merchant partner acquisition model to the app-driven acquisition model over the past few years. Leading BNPL firms such as Sezzle, Affirm, Afterpay, Klarna, and Zip have launched their own apps or transitioned into super-apps. They issue virtual credit cards and offer credit lines to users upon app registration. The app-driven acquisition model also gives customers more flexibility in transactions: they can make a big-ticket purchase with installments, small-valued purchases with no installment but pay the monthly aggregate bill in installments, or use BNPL like credit cards and make purchases with no installment. For example, the customers in the US are now using BNPL to cover their daily expenses on coffee, gas refills, and grocery shopping, which also manifests in our sample.¹⁵

E-wallets and BNPL in Asia and China. Asia has led the world in e-wallet economy. In 2021, e-wallets accounted for 69% of e-commerce spending and 44% of point-of-sale transactions in Asia-Pacific regions.¹⁶ The underdeveloped payment infrastructure, a high proportion of unbanked population, and fast-growing e-commerce markets contribute to the emergence of e-wallet super-apps such as Alipay and WeChat Pay in China, Grab in Singapore, Gojek in Indonesia, Kakao in South Korea, and Paytm, PhonePe, and Vodafone M-Pesa in India. These e-wallet providers started from scratch and attracted a significant consumer base underserved by banks via apps and QR codes. They provide a range of services, including payments, credit, wealth management, and everyday life services. The frequent use of the payment function helps customers build familiarity and trust with e-wallet super-apps, which facilitates the use of other services (Hong, Lu, and Pan, 2020). As *Financial Times* puts it, the “e-wallet economy” in Asia is a digital financial revolution that has boosted financial inclusion and empowered business by bringing billions of users into

¹⁵ CNN report, Red flag: Consumers are using Buy Now, Pay Later to cover everyday expenses. <https://edition.cnn.com/2022/07/06/economy/buy-now-pay-later-bnpl-inflation-data/index.html>.

¹⁶ Worldpay from FIS, the global payments report for financial institutions and merchants. Accessed from <https://offers.worldpayglobal.com/rs/850-JOA-856/images/ENGPR2022.pdf>.

a quasi-banking ecosystem.¹⁷

Among Asian countries, China has the most developed e-wallet market, with e-wallets being the most popular payment method and accounting for 83% of e-commerce transactions in 2021. The corresponding number in India, Indonesia, and Philippines are 45.4%, 38.8%, and 30.5%, respectively.¹⁸ Alipay and WeChat Pay are the two largest e-wallets in China, serving 1.3 billion and 0.9 billion users as of 2022 respectively.¹⁹ The data for our study come from one of these leading e-wallet providers in China. The permissible credit amounts for BNPL offered through these digital wallets, like credit cards, are based on some form of credit reference systems, which builds on past activities within the ecosystem such as historical transactions.

In contrast, e-wallets initially follow different trajectories in North America and Europe, where bank cards acceptance are nearly universal, and cards still dominate the payment systems. In 2021, e-wallet transactions accounted for only 10% point-of-sale transactions in North America and 7.7% in Europe.²⁰ Several prominent e-wallet providers in the United States, including PayPal, Apple Pay, and Google Pay, used to create a digital interface for physical cards and mainly relied on existing advanced card payment networks to process digital payments. However, as the COVID-19 pandemic has greatly increased the demand for e-wallets, these e-wallet providers are also trying to incorporate more functions such as wealth management and racing to create “super-apps” mimicking those in Asia.²¹

Finally, although the United States has the largest BNPL transaction volume, China is currently the largest BNPL market with over 500 million users as of 2020.²² The BNPL market in China was about U.S. \$30 billion in 2020 and is projected to

¹⁷ Financial Times, “Wallet Wisdom: The Transformative Power of Asia’s “Wallet Economy.” See <https://www.ft.com/partnercontent/mastercard/wallet-wisdom-the-transformative-power-of-asias-wallet-economy.html>

¹⁸ Worldpay from FIS, the global payments report for financial institutions and merchants. Accessed from <https://offers.worldpayglobal.com/rs/850-JOA-856/images/ENGPR2022.pdf>.

¹⁹ Data source: <https://merchantmachine.co.uk/the-countries-most-reliant-on-cash-in-2022/>.

²⁰ Worldpay from FIS, the global payments report for financial institutions and merchants. Accessed from <https://offers.worldpayglobal.com/rs/850-JOA-856/images/ENGPR2022.pdf>.

²¹ PaymentsDive: “Super-apps” are the next evolutionary step for financial services. Accessed from <https://www.paymentsdive.com/news/super-apps-are-the-next-evolutionary-step-for-financial-services/601424/>.

²² Accessed from <https://www1.hkexnews.hk/listedco/listconews/sehk/2020/1026/2020102600165.pdf>.

reach U.S. \$750 billion in 2025.²³ While BigTechs such as Ant Group, JD, and Pinduoduo are dominating China's BNPL market, global players including Afterpay and Klarna have entered the market through strategic investment or establishment of subsidiaries. Unlike Australia and Europe where BNPL was usually launched by FinTech startups, a prominent feature in China is that BNPL is launched by leading e-wallets with internal e-commerce systems, such as Huabei in Taobao and Tmall and Baitiao in JD e-commerce platforms. This feature also manifests itself in a major BNPL provider in the United States, PayPal, which incorporates BNPL into its well-established e-wallet payment system. Notably, against the increasing interest rate environment worldwide, the marginal profit of BNPL providers is decreasing, making it more important to rely on a larger user base and cross-selling capacities to ensure sustainability. Consequently, an increasing number of major BNPL providers around the globe are creating their proprietary super-apps and offer BNPL within self-contained e-commerce ecosystem, converging to China's business template for BNPL practices (CFPB, 2022).

2.2 Data

E-wallet data. Our first dataset contains over one million e-wallet transactions from a leading e-wallet provider in China. Supplementing this dataset are consumer- and merchant-level data from the two-sided market: buyers' demographic information and sellers' basic information including sales and industries. This e-wallet was initially launched on one of the world's largest e-commerce platforms as a payment tool to solve the problem of trust between buyers and sellers in online transactions, before growing into a multi-functional app with around one billion users. Its users are required to be at least 16 years old, and the proportion of users aged above 60 is less than 1.5%. The total number of domestic users as of June 2019 is about the same as

²³ Forbes, "Buy Now Pay Later in Asia: The Drivers and Issues." Accessed from <https://www.forbes.com/sites/zennonkapron/2022/11/02/buy-now-pay-later-in-asia-the-drivers-and-issues/>.

(slightly bigger than) the size of the population aged 16-59 in China, based on the 2018 census.

The unit of observation is the checkout transaction, which represents one consumer's total purchase from one merchant at the point of sale. The data sample is comprised of 550,000 on-site transactions and 550,000 online transactions randomly drawn from all checkout transactions through this e-wallet provider in June 2020, whose distribution of payment options and purchase categories most closely mimics annual averages in 2019, 2020, and 2021, and is free from the effects from national holidays.²⁴ We observe information commonly found on most receipts from a purchase online or in a grocery store: the merchant identification number, consumer identification number, date and time of the transaction, transaction value, and payment instrument.

In a typical transaction, consumers face five payment options: e-wallet balance, e-wallet savings, e-wallet credit through BNPL, linked debit cards, and linked credit cards.²⁵ The e-wallet provider offers a positive interest rate on e-wallet savings and indeed reminds users about this option. Users are mandated to link their bank cards to the e-wallet to make daily payments feasible through the e-wallet. We exclude transactions with values lower than RMB ¥1 (approximately US\$0.15), which are mostly from click farming and are a small fraction of all transactions, to avoid biasing our estimation. Furthermore, in the uncommon case of transactions combining multiple payment options, we record the payment option with the highest associated transaction value. Note that when merchants decide whether to accept an e-wallet, they automatically accept linked debit cards, e-wallet savings, and e-wallet balance. However, they have choices on whether to accept linked credit cards and/or BNPL.

²⁴ The e-wallet allows peer-to-peer transfers on a limited scale, which is not included as payment transactions because they are much smaller in scale and the data is not accessible due to the Data Security Law and the Personal Information Protection Law introduced in June and August of 2021.

²⁵ Coupons are associated only with e-commerce or on-site store promotion programs and often have to be combined with other payment options. Though in 2018 and 2019, some coupons were offered to first-time BNPL users, they are negligible in our 2020 data, and most coupons can be combined with any payment option.

The data provider internally matches consumers' and merchants' information to each transaction. Our data therefore contain information on the merchants, including (1) *average monthly sales*, the average value of monthly sales during the last twelve months; (2) *D_Merchant_CC*, a dummy variable that takes value of 1 if the merchant accepts payment by credit card; (3) *D_Merchant_BNPL*, a dummy variable that takes value of 1 if the merchant accepts payment through BNPL; and (4) *Industry*, the industry that the merchant belongs to.

Concerning consumers, our data cover (1) *D_Consumer_CC*, a dummy that takes value of 1 if the consumer has linked credit cards; (2) *D_Consumer_BNPL*, a dummy that takes value of 1 if the consumer has access to e-wallet credit through BNPL; (3) *Female*, a dummy variable that takes value of 1 for females and 0 for males; (4) *Age*, the age of the consumer; (5) *e-wallet average monthly flow in the last year*, a measure that proxies for consumers' activeness in using the e-wallet and also (coarsely) for consumers' financial position in the sense of "cash flow"; and (6) *e-wallet wealth*, the total amount of savings and other wealth products of a user in the e-wallet. Similar to the variable *e-wallet average monthly flow in the last year*, the variable *e-wallet wealth* proxies for consumers' activeness in using the e-wallet and also (roughly) for consumers' financial position in the sense of "balance." We also create variables capturing consumers' payment preferences: how long since each payment option was adopted by a consumer (*Option_adoption_length*), and each consumer's most preferred option, which is set as the default payment option (*D_preferred_option*). They are useful in controlling for behavioral or cognitive biases, e.g., the default payment option gets used while a user would have preferred another option in its absence.

Table 1. Summary statistics of the main variables

Variables	N	Mean	Std	P25	P50	P75
A. Transaction and merchant levels						
Transaction value (log)	1,079,193	3.40	1.32	2.40	3.32	4.26
Average monthly sales (log, in 10,000 RMB)	1,076,689	12.37	3.97	9.22	11.88	14.85
D_Merchant_CC ^d	1,087,826	0.63	0.48	0	1	1
D_Merchant_BNPL ^d	1,100,000	0.75	0.43	1	1	1
B. Consumer level						
D_Consumer_BNPL ^d	1,095,838	0.85	0.36	1	1	1
D_Consumer_CC ^d	1,100,000	0.31	0.46	0	0	1
Female ^d	1,091,673	0.53	0.50	0	1	1
Age	1,071,705	32.74	9.58	25	31	38
E-wallet average monthly flow in last year (log)	1,086,206	9.71	2.98	8.70	10.42	11.61
E-wallet wealth (log)	1,090,573	4.47	3.58	0.43	4.63	7.30

Note: The data are winsorized at the 0.5% level. Superscript *d* indicates the dummy variables.

Table 1 presents summary statistics of the main characteristics of merchants and consumers, weighted by transaction frequencies as in Klee (2008). The sample exhibit significant variations in user demographics, with merchant age ranging from less than a year to over five years, and merchant sales varying substantially, covering a wide range of products and services. For consumers, although e-wallet flow and savings vary, their age is concentrated between 20 and 40, consistent with the overall age distribution of e-wallet users. Finally, merchants' acceptance of and consumers' access to e-wallet credit and credit cards vary substantially.

Data from a randomized experiment. Furthermore, we augment the transaction dataset by incorporating a second dataset derived from an earlier BNPL experiment conducted by the consumer credit department from the same e-wallet provider in June 2017 on millions of users who already met the credit eligibility criteria but had not yet been offered BNPL. Eligibility was determined mainly based on users' payment and consumption histories, which indicated how much consumer credit the users could and would repay. The requirement was much less stringent than that for credit cards, as evidenced by the less than 5% of our randomized sample of eligible users from the experiment having credit card access, and by the fact that more than one third of the Chinese population had utilized BNPL by 2020. Users residing in Beijing, Shanghai, Guangzhou, and Shenzhen were excluded because of the promotional BNPL activities in these large cities prior to the experiment.

On June 1, 2017, the company randomly assigned users to the treatment and control groups. The treated individuals were offered BNPL and were notified of their new credit limits immediately. The individuals in the control group had no access to BNPL and did not anticipate such access in the near future. The experiment ended after two months, in August 2017, when the control group was granted BNPL as well. The e-wallet provider did not notify its users that they were part of an experiment, which eliminated the possibility of treatment group members changing their behavior in response to or anticipation of participation in BNPL experiment in any near term.

Our second dataset is a subsample of users in this experiment, including 700,000 user-month observations for 100,000 users between January and July 2017.²⁶ Specifically, the company randomly drew 50,000 users from the original treatment group and matched 50,000 users from the original control group to treated users based on their consumption and payment histories. Since we do not observe the separate trends for the level of consumption for treated and untreated users, we display the ratio of consumption of treated to untreated users to check for parallel pre-trends (see Figure 1). The ratio was between 0.99 and 1.00 before the experiment, indicating no significant difference in the levels and trends of monthly consumption between the two groups in each month prior to the experiment. We exploit this experiment mainly to study the effect of BNPL access on consumption and debt.

To further understand BNPL users' behavior, we extend this randomized sample to December 2021 with comprehensive ecosystem-based information on other services provided in the e-wallet super-app, including users' credit scores, credit limit of BNPL, credit limit in another lending service, the usage of deposit-free rental services, among others. Notably, for BNPL users with good repayment history, the e-wallet provides another lending service: users apply for it and receive funds in their e-wallet accounts or bank cards linked to the e-wallet once approved. Moreover, in the e-wallet, eligible users can also enjoy the deposit-free rental services, that is, users can

²⁶ Due to the Data Security Law and the Personal Information Protection Law, we are not allowed to access the full sample. Exported variables are typically restricted to unitless ratios.

rent cars, bicycles, umbrellas, portable chargers, smartphones, and other products without the need for a deposit.

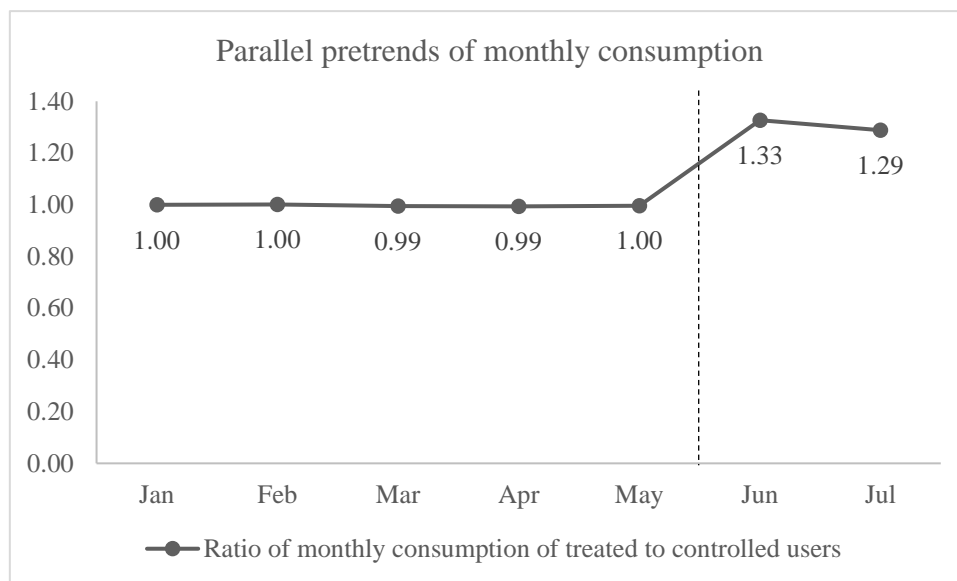


Figure 1. Parallel pre-trends of consumption in the pre-treatment period

3. Digital Payment Competition Amidst the Rise of BNPL

Our data allow us to examine the competitive landscape of payment options, with a particular focus on how the rise of BNPL affects other payment choices, and how BNPL interacts with credit cards, both of which offer short-term consumer credit in addition to being a payment option. We find that expansion of BNPL access has significantly displaced other payment options, but it does not serve as a direct substitute for credit cards. BNPL appears to complement bank credit even for dual-access users—those with both credit cards and BNPL as directly observed in our data—and serve as the new digital cash in transaction scenarios different from credit card transactions.

3.1 Opening the E-Wallet Blackbox: The Distribution of Payment Options

Our data enable us to offer the first empirical description and usage distribution of prominent payment options in e-wallets: linked debit cards, linked credit cards, e-wallet balance (digital cash stored in e-wallet accounts), e-wallet savings (wealth-

management products provided by e-wallet providers that function as interest-bearing demand deposits), and e-wallet credit through the FinTech credit product, BNPL.

How users pay dictates how money and information flow through the plumbing of the e-wallet economy. Table 2a lists the two broad categories: Linked debit cards and credit cards constitute **external** options where the e-wallet functions as a conduit to banks and pass payment information to external ledgers; E-wallet balance, e-wallet savings, and BNPL are **internal** options where the e-wallet functions as an independent ecosystem and payment information stays within the wallet itself.

Table 2a. Payment options within the e-wallet

Types	Options	(1) On-site transactions	(2) Total share	(3) Online transactions	(4) Total share
External (bank-linked) options	Linked debit card	27.2%	36.0%	16.0%	17.9%
	Linked credit card	8.8%		1.9%	
Internal (e-wallet based) options	E-wallet balance	8.0%	62.7%	12.0%	81.6%
	E-wallet savings	10.9%		15.4%	
	BNPL	43.8%		54.2%	

Table 2b. Features of the five payment options

Payment options	Desirable features				
	Free liquidity	Interest-bearing	Wide acceptance	Direct access to bank account funds	Credit building
BNPL	√		√		√
Linked credit card	√				√
E-wallet savings		√	√		
Linked debit card			√	√	
E-wallet balance			√		

Among external payment options, linked debit cards are the most frequently used, which is consistent with the low adoption of credit cards in China. Among internal payment options, the most popular is BNPL, which can be attributed to the opportunity costs associated with different internal payment options (e.g., Santomero and Seater, 1996; Klee, 2008). Specifically, because e-wallet savings offer positive interest rates, users prefer to exploit the free liquidity provided by BNPL for payments while leaving funds in e-wallet savings untouched to earn interest. (Table 2b displays the features of each payment option within the e-wallet.) Note that the e-wallet provider reminds users on the availability of the wealth-management products, hence e-wallet users are well aware of their options. In contrast, users seldom use e-wallet balances, as they provide neither interest earnings nor additional liquidity. Note that Berg et al. (2023) find that BNPL dominates the payment choices (51%) for a large furniture merchant in Germany, which is consistent with our finding.

As shown in Table 2a Columns (2) and (4), the proportion of e-wallet internal payments is significantly larger than that of external payments for both on-site and online transactions. Bank cards constitute only 36.0% and 17.9% of all on-site and online transactions, respectively. These results indicate that internal payment options dominate the e-wallet ecosystem, with e-wallet transactions largely bypassing banks and BNPL being the most frequently used option in the e-wallet. The current landscape is understandable considering that credit card penetration rate is relatively low in China compared with other countries. Although debit card penetration rate is high, overdraft is not allowed in China.²⁷ Thus, for customers with no access to credit cards, BNPL serves as the sole payment tool that can provide free liquidity for their purchases, and in a more privacy-preserving manner than debit card transfers for which data have to be transmitted to banks.

The relative distribution of internal versus external transactions holds important implications for the impact on traditional banking, as payment information is valuable

²⁷ According to a report on the operation of the payment system by China's central bank, as of 2020, the average number of debit cards per capita was 5.84, whereas it was only 0.56 for credit cards.

and essential for other financial services such as credit scoring and origination (Agarwal et al., 2020a; Berg et al., 2022; Ghosh et al., 2022; Parlour et al., 2022). The rise of e-wallets and their dominant internal payment flows has led to banks being cut off from transaction information, motivating central banks worldwide, especially the People’s Bank of China, to explore the introduction of their own digital currencies (known as central bank digital currencies, or CBDCs) to compete for payment flows (Auer et al., 2020; Boar and Wehrli, 2021; Brown et al., 2022; Whited, Wu, and Xiao, 2022). Our findings provide empirical support for these oft-cited motivations for central bank electronic payment systems (EPSs) and CBDCs.

3.2 Payment Choice Model Specification

In examining the interaction between BNPL and other payment options and the financial inclusion effect of BNPL (as well as the subsequent analysis regarding the use of BNPL after incurring interest expenses), we need to model the determinants of payment choices. For on-site transactions, we specify the following logit model:

$$\text{Payment_option_dummy}_{jh} = \alpha_h + \beta_1 D_Consumer_BNPL_j + \beta_2 D_Merchant_BNPL_j + \gamma X + \varepsilon_j, \quad (1)$$

where j denotes transaction, and h denotes five alternative payment options:

$$h \in \{e - \text{wallet balance}, e - \text{wallet savings}, \text{BNPL}, \text{linked debit cards}, \text{linked credit cards}\}.$$

Here, the dependent variable is *Payment_option_dummy*, which takes value of 1 when transaction j is completed with payment option h , and 0 otherwise. And α_h is a payment-option-specific constant term. $D_Consumer_BNPL$ indicates whether the consumer in transaction j has access to BNPL, and $D_Merchant_BNPL$ indicates whether the merchant in transaction j accepts BNPL. X represents a vector of control variables: consumer access to credit cards ($D_Consumer_CC$); merchant acceptance of credit cards ($D_Merchant_CC$); whether the used payment option h is the default option of the consumer ($D_preferred_option$); how long the consumer has had access to payment option j ($Option_adoption_length$); the consumer’s age, gender, the logarithm of e-wallet cash flows in the last year ($Ln_cashflow$), and the amount of

wealth in the e-wallet (Ln_wealth); the logarithm of merchant's sales ($Ln_monthly_sales$); the logarithm of transaction value ($Ln_Transaction_value$). Industry fixed effects and daily time fixed effects are also included in the regression.

For online transactions, we adopt a similar econometric specification but omit the variables $D_Merchant_BNPL$ and $D_Merchant_CC$ because over 98% of online merchants accept both BNPL and credit cards:

$$\text{Payment_option_dummy}_{jh} = \alpha_h + \beta_1 D_Consumer_BNPL_j + \gamma X + \varepsilon_j . \quad (2)$$

3.3 Association of BNPL Access with Payment Choices

We first investigate how consumer access to and merchant acceptance of BNPL influence payment choices. Table 3 presents the results for on-site transactions. Note that consumer access to BNPL is significantly and negatively associated with all other payment option usage here, indicating that the expansion of e-wallet credit crowds out the usage of other payment options. Merchant acceptance of BNPL is positively associated with the usage of BNPL, credit cards, and e-wallet savings, but only the coefficient on BNPL usage is economically meaningful.

Table 3. Payment-option choices for on-site transactions

	Payment options				
	E-wallet credit (BNPL) (1)	Credit cards (2)	E-wallet balance (3)	E-wallet savings (4)	Debit cards (5)
D_Consumer_BNPL ^d	0.675*** (0.000)	-0.021*** (0.000)	-0.121*** (0.000)	-0.157*** (0.000)	-0.143*** (0.000)
D_Consumer_CC ^d	0.042*** (0.000)	0.063*** (0.000)	-0.040*** (0.000)	-0.040*** (0.000)	0.014*** (0.000)
D_Merchant_BNPL ^d	0.048*** (0.000)	0.001** (0.039)	-0.002** (0.025)	0.007*** (0.000)	-0.010*** (0.000)
D_Merchant_CC ^d	-0.045*** (0.000)	0.049*** (0.000)	-0.015*** (0.000)	-0.011*** (0.000)	0.045*** (0.000)
D_preferred_option ^d	0.339*** (0.000)	0.021*** (0.000)	0.112*** (0.000)	0.227*** (0.000)	0.268*** (0.000)
Option_adoption_length	-0.000*** (0.000)	0.000 (0.390)	-0.000*** (0.000)	-0.000*** (0.000)	0.000*** (0.000)
Age	0.002*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.005*** (0.000)	0.000*** (0.000)
Female ^d	-0.011***	0.003***	-0.003***	-0.007***	0.005***

	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Ln_transaction_value	-0.033***	0.001***	0.003***	0.003***	0.021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln_monthly_sales	-0.015***	-0.001***	-0.005***	-0.006***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln_cashflow	-0.027***	-0.004***	0.020***	0.012***	-0.013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln_wealth	0.010***	0.000***	-0.024***	0.021***	-0.008***
	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)
Industry FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES
Observations	501,801	501,801	501,801	501,801	501,801
Pseudo-R ²	0.25	0.41	0.20	0.15	0.14

Notes: 1. Subscript *d* indicates dummy variables. 2. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. 3. We report the marginal effects for the logit model.

As for control variables, as expected, consumers' payment-option preference is positively correlated with the payment-option usage, while option adoption length has little explanatory power. Older consumers are less likely to use e-wallet savings, perhaps reflecting that financial experience accumulated over time helps users to recognize the higher opportunity cost of e-wallet savings compared to other options. Female consumers are less likely to use internal payment options and are more likely to use bank-linked external payment options. Debit cards are used more frequently in transactions with merchants that have higher average monthly sales. This is in accordance with economic intuition since debit cards are still the more popular payment instrument accepted by large sellers. The cash flow and wealth variables in the e-wallet show mixed results.

We find that the usage of BNPL is more likely for low-value transactions, while all other payment options are associated with higher-value transactions. Though we have only indirect measures of cash usage, the significant differences in coefficient estimation on transaction value for different payment options suggest how BNPL has become the new cash in the e-wallet ecosystem, managing small on-site transactions. Also note that the results are unlikely driven by the credit limits on BNPL because most e-wallet transactions did not exceed the BNPL credit limits (in the range of RMB ¥500-50,000). The annualized interest rate on delinquent payments for the BNPL credit is 13%-16%, which is slightly higher than the rates charged by most

credit cards in China, ruling out the possibility that consumers embrace BNPL due to lower interest rates.

Next, we turn to online transactions. As shown in Table 4, consumer access to BNPL similarly reduces the possibility of all other payment-option usage, indicating that e-wallet credit access as a payment option crowds out the other options. The results concerning transaction size are more mixed for online transactions than for on-site transactions. The coefficients on transaction value are positive for bank cards, including both credit cards and debit cards, and are negative for e-wallet balance and e-wallet savings. While credit card usage is still positively associated with transaction value, based on the negative but insignificant coefficient on transaction value in Column (1), we find no evidence of e-wallet credit being used for big-ticket purchases.

Table 4. Payment-option choices for online transactions

	Payment options				
	E-wallet credit (BNPL)	Credit cards	E-wallet balance	E-wallet savings	Debit cards
	(1)	(2)	(3)	(4)	(5)
D_Consumer_BNPL ^d	0.603*** (0.000)	-0.102*** (0.000)	-0.079*** (0.000)	-0.099*** (0.000)	-0.149*** (0.000)
D_Consumer_CC ^d	-0.030*** (0.000)	0.311*** (0.000)	-0.063*** (0.000)	-0.062*** (0.000)	-0.130*** (0.000)
D_preferred_option ^d	0.324*** (0.000)	0.130*** (0.000)	0.055*** (0.000)	0.161*** (0.000)	0.321*** (0.000)
Option_adoption_length	0.000*** (0.001)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.005)	0.000*** (0.004)
Age	0.001*** (0.000)	-0.000*** (0.000)	-0.000 (0.143)	-0.002*** (0.000)	-0.001*** (0.000)
Female ^d	-0.010*** (0.000)	0.003*** (0.000)	-0.009*** (0.001)	-0.010*** (0.000)	0.014*** (0.000)
Ln_transaction_value	-0.001 (0.119)	0.002*** (0.000)	-0.009*** (0.000)	-0.010*** (0.000)	0.024*** (0.000)
Ln_monthly_sales	-0.004*** (0.000)	-0.005*** (0.000)	-0.006*** (0.000)	-0.005*** (0.000)	-0.001*** (0.000)
Ln_cashflow	-0.005*** (0.000)	-0.007*** (0.000)	0.016*** (0.000)	0.010*** (0.000)	-0.020*** (0.000)
Ln_wealth	0.010*** (0.000)	0.000*** (0.004)	-0.016*** (0.000)	0.019*** (0.000)	-0.016*** (0.000)
Industry FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES
Observations	512,803	512,803	512,803	512,803	512,803
Pseudo-R ²	0.23	0.42	0.19	0.17	0.16

Notes: 1. Subscript d indicates dummy variables. 2. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. 3. We report the marginal effects for the logit model.

In sum, we provide evidence consistent with the notion that BNPL access displaces other payment options.²⁸ We also find that BNPL usage is not competing with credit cards for large value purchases, even though it resembles a virtual credit card.

3.4 BNPL vs Credit Cards: Competition and Differentiation

BNPL crowds out other payment choices, but the competition between BNPL and credit cards is nuanced and warrants further investigation. In this section, we differentiate between two groups of users: single access users who have access solely to BNPL and do not possess credit cards, and dual access users who have access to both BNPL and credit cards. While most e-wallet users have single access to BNPL and do not involve competition between the two payment methods, an intriguing question remains for dual-access users: given BNPL access crowds out credit cards as payment options, especially on-site, is e-wallet credit a substitute for bank credit?

Previous studies compare the patterns of FinTech borrowers with similar borrowers from traditional financial institutions (e.g., Jagtiani and Lemieux, 2019; Di Maggio and Yao, 2021). The data limitations could result in potential bias due to borrowers' unobservable characteristics; in other words, borrowers who have access to FinTech credit may be inherently different from borrowers with access to credit from traditional financial institutions. The ideal setup is to have detailed information

²⁸ Though not included in the main text, we perform several robustness tests regarding the results in Tables 3 and 4. First, we apply the probit model and ordinary least squares method to estimate the baseline regression. Second, in Eqs. (1) and (2), we use a dummy variable indicating whether the used payment option is the most preferred (default) one ($D_{preferred_option}$) to proxy for consumer preference. We instead use the proportion of transactions using a payment option over the last three months as an alternative proxy. Third, we combine the online and on-site datasets to jointly estimate the regression model following Eq. (1). Our findings remain robust. Fourth, we re-run the regressions with city or province fixed effects. The logit model did not converge due to incidental parameter problems. We instead apply OLS to the model with city or province fixed effects, and our findings remain unchanged. For example, with city fixed effects, the coefficient estimates on $D_{Consumer_BNPL}$ for on-site transactions are statistically significant at the 1% level, with the magnitudes of 0.279, -0.011, -0.192, -0.163, and -0.211 in the five columns respectively. The results are available upon request.

on borrowers who have both FinTech credit and bank credit and compare their usage of these two types of credit, which is the case in the subsample of dual-access users in our study.

Table 5. Consumer credit as payment instruments for on-site transactions: single-access users vs. dual-access users

User type:	Single-access users		Dual-access users
Dependent variable: whether a payment instrument is used in an on-site transaction	BNPL=1 (1)	BNPL=1 (2)	Credit card=1 (3)
D_Merchant_BNPL ^d	0.026*** (0.000)	0.037*** (0.000)	-0.010*** (0.000)
D_Mercent_CC ^d	-0.051*** (0.000)	-0.104*** (0.000)	0.197*** (0.000)
Consumer_preference ^d	0.391*** (0.000)	0.358*** (0.000)	0.105*** (0.000)
Option_adoption_length	0.000 (0.858)	0.000 (0.218)	0.000*** (0.000)
Consumer age	0.003*** (0.000)	0.005*** (0.000)	-0.002*** (0.000)
Female ^d	-0.006*** (0.000)	0.002 (0.359)	-0.001 (0.579)
Ln_transaction_value	-0.029*** (0.000)	-0.048*** (0.000)	0.005*** (0.000)
Ln_monthly_sales	-0.005*** (0.000)	-0.007*** (0.000)	-0.002*** (0.000)
Ln_cashflow	-0.029*** (0.000)	-0.020*** (0.000)	-0.008*** (0.000)
Ln_wealth	0.010*** (0.000)	0.010*** (0.000)	-0.001*** (0.000)
Industry FE	YES	YES	YES
Day FE	YES	YES	YES
Observations	304,137	144,133	144,133
Pseudo-R ²	0.13	0.13	0.38

Note: 1. The superscript *d* indicates a dummy variable. 2. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. 3. We report the marginal effects for the logit model.

In Table 5, we present the determinants of the usage of consumer credit (e-wallet credit through BNPL or bank credit cards) as the payment options in on-site transactions for single-access users and dual-access users, respectively. Dual-access users exhibit a clear pattern of using BNPL for low-value purchases and credit cards for big-ticket purchases (based on the contrasting coefficient estimation on transaction value in Columns (2) and (3)). For single-access users, transaction value is negatively

associated with the usage of BNPL in on-site transactions. Considering this, BNPL appears not to be a direct substitute for bank credit cards but rather serves as cash for a separate segment of transactions.

We repeat the analyses for online transactions and report the results in Table 6. Similarly, for dual-access users, BNPL usage is associated with lower transaction values, while credit card usage is associated with high-value purchases. The results in Table 6 further corroborate the conjecture that BNPL and credit cards have different usage patterns and are not direct substitutes at this stage of development.

There may be multiple reasons for the observed differences in usage patterns between BNPL and credit cards. Note the interest rate differences and rewards in credit cards could not explain the differences in that the BNPL provider charges an interest rate similar to that of traditional commercial banks in China, rather than a lower rate and credit card rewards or perks in China are less common and are of much smaller magnitudes than other countries like the United States. One important factor could be the greater acceptance of BNPL by merchants, particularly those who do not accept credit cards. For users with credit cards being the default payment method in our sample, 59.69% of them have to switch to other payment methods in on-site transactions because merchants do not accept credit cards. However, this factor alone cannot fully explain the differences observed in online transactions, because most online merchants accept both payment methods.

Two other potential factors are: (1) frequent usage of BNPL for small transactions at checkout may spill over to online transactions, resulting in greater use of BNPL for such transactions; (2) BNPL is available for nondurables in this super-app and as we show later in Section 5, BNPL users are motivated to behave responsibly within the e-wallet we study. Over 60% of BNPL users do not use the installment option. Even for those using the installment option, most of them prefer to pool small transactions together into a bill and choose the installment for the monthly bill instead of the installment for a specific product.

The competition between BNPL and credit cards is nuanced. The majority of BNPL users are single-access users who did not have prior access to credit cards. As we discuss in the next section, single access users are generally younger, have less wealth, and make purchases with lower transaction values compared with credit card holders. Transaction size does indeed matter: our analysis indicates that dual-access users primarily utilize BNPL for small payments and prefer credit cards for larger purchases. While competition between BNPL and credit cards may exist for middle-value purchases, BNPL and credit card usage have diverged to cater to users in different purchases.²⁹ In Section 5, we document that BNPL access to credit card holders leads to an increase in credit card consumption—a complementarity between e-wallet and bank credit.

Table 6. Consumer credit as payment instruments for online transactions: single-access users vs. dual-access users

User type:	Single-access users	Dual-access users	
Dependent variable: whether a payment instrument is used in an online transaction	BNPL=1 (1)	BNPL=1 (2)	Credit card=1 (3)
Consumer_preference ^d	0.355*** (0.000)	0.440*** (0.000)	0.407*** (0.000)
Option_adoption_length	0.000*** (0.000)	-0.000 (0.962)	0.000** (0.036)
Consumer age	0.002*** (0.000)	0.001*** (0.000)	0.002*** (0.000)
Female ^d	-0.011*** (0.000)	-0.012*** (0.000)	0.021*** (0.000)
Ln_transaction_value	-0.000 (0.896)	-0.005*** (0.000)	0.019*** (0.000)
Ln_monthly_sales	0.005*** (0.000)	-0.001** (0.011)	0.001 (0.223)
Ln_cashflow	-0.007*** (0.000)	0.000 (0.791)	-0.014*** (0.000)
Ln_wealth	0.011*** (0.000)	0.010*** (0.000)	-0.005*** (0.000)
Industry FE	YES	YES	YES
Day FE	YES	YES	YES

²⁹ To rule out the possibility that the crowding-out effect of BNPL on credit cards is driven by dual-access users who have already exhausted their credit card limits, we repeated the analyses in Column (2) of Tables 3 and 4 using a subsample of users whose e-wallet savings amounts are above the median, and thus have de facto access to credit cards. The results show that the crowding-out effect remains significant at the 1% level, with coefficients on $D_Consumer_BNPL$ of -1.607 and -2.094 for on-site and online transactions, respectively.

Observations	281,300	151,836	151,836
Pseudo-R ²	0.09	0.11	0.08

Notes: 1. The superscript *d* indicates a dummy variable. 2. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. 3. We report the marginal effects for the logit model.

3.5 BNPL as the New Cash?

The long-standing discussion of the “curse of cash” questions whether technological advances can reduce cash usage. Although we do not directly observe individual’s physical cash usage, our findings in aggregate suggest that BNPL is serving as a new cash for conducting daily transactions, especially small-value payments.

While earlier studies document that cash is heavily used when available (Alvares and Argente, 2022) and electronic payment has limited effects on cash demand (Brown et al., 2022), these studies do not cover more advanced electronic payment systems or economies that have transitioned from a cash-heavy society to a cashless society. China, meanwhile, has largely become cashless. As recently as 2006, cash use in China still accounted for 13% of GDP, much higher than that in the US (6.4%) and the UK (3.5%). However, the share of cash used in offline payment transactions at the point of sale (POS) in China has dropped to 10% in 2021, making China one of the most cashless countries.³⁰ Two Chinese commercial banks stopped providing services involving banknotes and coins in March and April of 2022, including over-the-counter deposits and withdrawals and cash services on ATM machines.³¹ Moreover, according to the annual reports on the operation of the payment system by Chinese central bank, the number of ATMs had fallen below one million in 2021 and is continuing falling.

For on-site transactions, most merchants do not or strongly prefer not to accept physical cash. Not only that carrying cash is inconvenient (especially during the COVID-19 pandemic) for consumers, but also changing back cash is inconvenient for

³⁰ Accessed from <https://english.ckgbsb.edu.cn/knowledges/will-china-first-cashless-society/> and <https://www.statista.com/statistics/1277116/share-of-cash-at-pos-worldwide/>.

³¹ <https://www.scmp.com/tech/tech-trends/article/3165809/chinas-fully-cashless-society-step-closer-after-two-private-banks>.

merchants. In fact, many unprepared visitors in China upon arrival complain about being unable to use physical cash and have to set up digital wallets.³² Such situation only eased recently when the top e-wallets allow foreigners to link VISA or MasterCard cards to e-wallet accounts.³³

However, while it is well recognized that the popularity of e-wallets has driven this transition, it is unclear which payment option has replaced physical cash for daily small-value transactions. Our contribution is to document that BNPL is currently fulfilling this role. As shown in Figure 2, the proportion of bank card payments in the e-wallet has decreased from more than 90% at the beginning of 2017 to only over 30% in 2021. In contrast, the proportion of BNPL payments in the e-wallet has increased from nearly zero at the beginning of 2017 to around 50% in 2021. Because e-wallet payments have largely replaced cash transactions and BNPL dominates within the e-wallet, especially for small transactions and non-durables, we conclude that BNPL is currently serving as the new cash in this digital era.

We further demonstrate that BNPL indeed performs the function of cash in settling small-value transactions. To this end, Ho et al. (2022) find that the share of mobile payments has increased over time at the expense of cash payments, attributing this increase to price incentives. We propose additional driving forces with a more recent perspective: expanded consumer access to, and merchant acceptance of, e-wallet credit, which will be discussed in detail in the next section. Within the “super-app” system, which encompasses its various functions and large consumer and merchant base, four factors stand out to justify the use of BNPL in small transactions: the availability of saving options that encourage consumers to choose BNPL; the demographics of BNPL users, who are generally less wealthy than credit card holders and thus more inclined towards small transactions; the widespread acceptance of

³² For example, as the Wall Street Journal reported in 2019, “Foreign tourists in China looking to buy a bottle of water or a taxi ride with cash or credit card are finding themselves out of luck.” <https://www.wsj.com/articles/welcome-to-china-you-probably-cant-buy-anything-though-11573415753>.

³³ <https://www.mastercard.com/news/ap/en/newsroom/press-releases/en/2023/pay-like-a-local-alipay-and-mastercard-offer-international-travelers-another-convenient-way-to-make-cashless-payments-in-china/>.

BNPL by merchants, enabling its use both online and in small brick-and-mortar stores; the combination of installments and credit lines that allows users to use BNPL on nondurables and consolidate small transactions into one monthly bill, with or without installments.

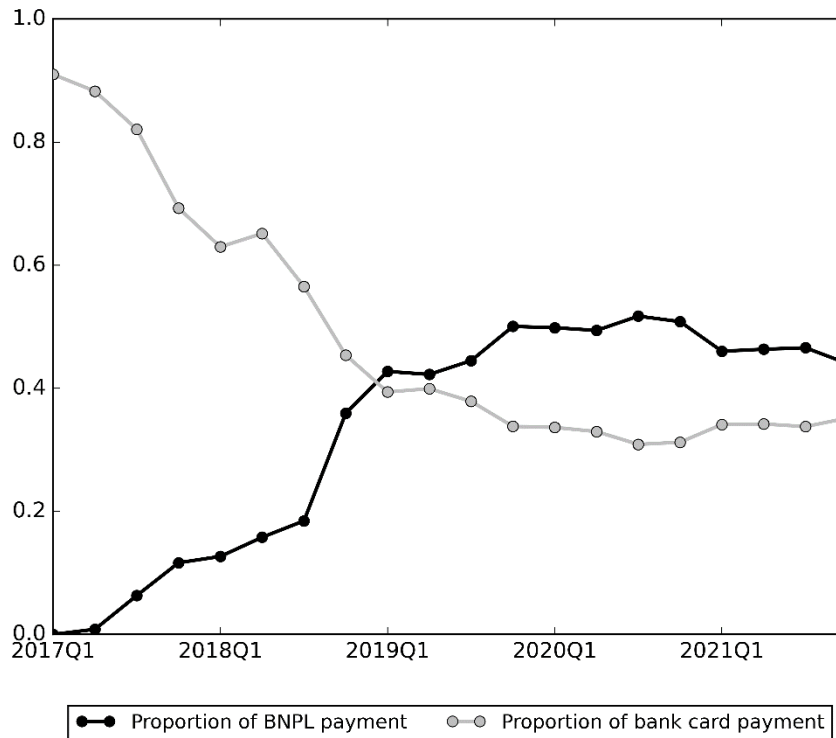


Figure 2. Proportion of e-wallet bank card payments vs BNPL payments

Another important functionality of cash entails avoiding tax payments. Over the past decade, e-wallet usage has also largely served this purpose, as merchants could partially avoid taxes because e-wallets are not “business bank accounts” with direct tax information. That said, there have been lawsuit cases against merchants that reported sales too low to be realistic, and regulators are tightening the scrutiny to require e-wallet providers to report transactions with a single-day-cumulative value larger than certain thresholds for tax purposes. Unlike cash, BNPL and other e-wallet payment options are not as private, leave digital footprints, and cannot be used for various illicit activities. For these reasons, cash will likely continue to be used in situations where privacy and anonymity are required. Whether these situations are harmful to society is a separate question.

4. Financial Inclusion via E-Wallet Credit Expansion

The competitive landscape of payment options documented above raises the question: has e-wallet credit through BNPL displaced incumbents such as traditional banks, or has it filled the gap in an underserved credit market? This section addresses this question. Since e-wallet providers can leverage payment information to evaluate users' creditworthiness, we conjecture that they are expanding credit access to those underserved by traditional banks. In this section, we provide some suggestive evidence for e-wallet credit expansion at the extensive margin.

One core question studied in the FinTech-lending literature concerns whether FinTech credit is offered to inframarginal borrowers or unscorable borrowers with no prior credit access. Due to data limitations, previous studies cannot directly observe bank-credit access and FinTech-credit access for the same individual at the same time. They therefore had to indirectly infer the composition of FinTech borrowers through structural models (Tang, 2019) or characteristic matching (Jagtiani and Lemieux, 2019; Di Maggio and Yao, 2021). We can overcome this empirical challenge because we can directly observe whether FinTech borrowers, i.e., e-wallet users of BNPL, have access to bank credit.

One may argue that e-wallet users may choose not to link their credit cards to e-wallet accounts, which would result in selection bias. We acknowledge this possibility but assuage the concern in several ways. First, e-wallet users are required to link at least one bank card when opening an account. Second, given the prevalence of e-wallets and QR payments in China, users are motivated to link their credit cards to improve their e-wallet credit scores, to enjoy credit card-related services provided by e-wallets, and to enable mobile front-end usage of their credit cards.³⁴ It is therefore highly improbable that users choose not to link credit cards to their e-wallets. Third, in our sample, the fraction of e-wallet users with linked credit cards and the number of

³⁴ For example, one can pay credit card debt through e-wallet apps. And usually, e-wallet apps outperform bank apps in loading speed and user-friendliness.

credit cards linked are similar to the fraction of credit card owners and average number of credit cards owned among Chinese adults overall—around 30% and 0.56, respectively—which means e-wallet users are representative of Chinese credit card ownership.³⁵ Fourth, having an unlinked credit card would not bias against most of our findings. Finally, we compare borrower quality following Tang (2019), if the average borrower quality of those without credit cards is lower compared with borrowers with linked credit cards, we can draw a more reliable conclusion that credit has expanded at the extensive margin.

It is worth noting that the richness of the data enables us to add a new perspective on the expansion of FinTech credit: the merchant's side. Previous studies on FinTech credit did not need to consider the merchant side. This is because they mainly focused on marketplace lending, which is not directly influenced by merchant acceptance. However, the new type of FinTech credit considered here provides credit lines and installment options for purchases made by consumers; hence, merchant acceptance of the payment option is an important factor in evaluating the extent of credit expansion. Consumers' access to credit would be negligible if few merchants accepted BNPL.

We first analyze credit expansion at the extensive margin from the consumer side, and then we analyze the expansion from the merchant side. We also combine the consumer side and the merchant side to determine whether a transaction could be completed with consumer credit (e-wallet credit or bank credit). Based on that, we provide an estimation of efficient credit expansion in this two-sided payment network. Importantly, the indirect network effect implies that the benefits users derive from a payment option depend on supply-side adoption of the technology to accept this payment option, which in turn relies on the number of consumers adopting this payment option and the amount of merchant fees the e-wallet provider charges.³⁶

³⁵ More than two-thirds of adults in China do not have a credit history and credit score. See http://www.gov.cn/xinwen/2015-10/27/content_2954607.htm. Note that e-wallet users tend to link most credit cards they own. The average number of credit cards linked per person in our sample is around 0.55, close to the number held per person as reported by the People's Bank of China, which is 0.56. See <http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/4213347/2021032414491874847.pdf>.

³⁶ Higgins (2019) attempts to study the magnitude of these externalities and resulting spillovers of financial

Moreover, we conduct a user-quality comparison between e-wallet credit and linked credit cards to demonstrate how e-wallets promote financial inclusion at the extensive margin. Last, we compare the utilization of BNPL and credit cards in different regions of China with varying economic conditions, or along other dimensions of user heterogeneity (e.g., gender), which further corroborate the financial inclusion effect of BNPL.

4.1 Credit Expansion for Consumers

Table 7 shows the credit expansion from the consumer side. First, as shown in Panel A, among on-site consumers, 70.43% do not have a credit card linked to their e-wallets. For online consumers, the percentage is 68.31%. However, 84.14% of those with no credit card for on-site consumers and 78.38% for online consumers utilize BNPL as a form of e-wallet credit. This contrasts with some findings about the U.S. FinTech market, in which lenders primarily cater to borrowers who already have access to credit via traditional banks (Tang, 2019; Di Maggio and Yao, 2021).

Table 7. Expansion of e-wallet credit from consumers' side

Consumers	On-site	Online
Panel A: Without credit cards	70.43%	68.31%
% of the above with e-wallet credit (BNPL)	84.14%	78.38%
Panel B: With credit cards	29.57%	31.69%
% of the above with e-wallet credit (BNPL)	94.93%	90.91%
Panel C: With e-wallet credit (BNPL)	87.32%	82.28%
% of the above with credit cards	32.14%	35.02%

Second, as shown in Panel B, among the 29.57% of on-site consumers with linked credit cards, 94.93% also enjoy e-wallet credit access. For the 31.69% of online consumers with linked credit cards, 90.91% have e-wallet credit access. This indicates that e-wallets entice bank customers to adopt the new credit line with BNPL,

technology adoption within and across the two sides of the market using data from a large-scale conditional cash transfer program, Prospera, in Mexico.

in line with the finding of Tang (2019) and Di Maggio and Yao (2021) that FinTech lenders usually increase their market share by extending credit to bank borrowers.

Third, as shown in Panel C, 87.32% of on-site e-wallet users have e-wallet credit, while 82.28% of online e-wallet users have e-wallet credit. However, only 32.14% of on-site users and 35.02% of online users have linked credit cards at the same time. This finding indicates that the majority of BNPL users do not have linked credit cards. Compared to the inframarginal credit expansion documented in Tang (2019), the credit expansion at the extensive margin—that is, expanding credit access to those with no access to bank credit—is more pronounced in our sample.

We attribute the differences between our findings and those of previous studies to the differences in types of FinTech credit providers and their information advantages compared to traditional banks. Tang (2019) and Di Maggio and Yao (2021) focus on FinTech credit provided by online lenders and P2P lenders such as Lending Club. In contrast, our study examines FinTech credit granted by e-wallet providers. While P2P lenders do not have significant information advantages compared to traditional banks, e-wallet providers enjoy rich information from consumers' digital footprints and online purchase histories; thus, e-wallet providers are able to provide credit to those underserved by banks. As such, BNPL providers can have a more pronounced credit-expansion effect than P2P lenders at the extensive margin. The facts we document help assess the implications of the recent structural shift in FinTech lending from P2P lending to new models such as BNPL (Berg, Fuster, and Puri, 2022).

4.2 Merchants' Acceptance of BNPL

Table 8 shows credit expansion from the merchant side. In Column 1 of Table 8, Panels A, B, and C report credit expansion for on-site merchants. As shown in Panel A, among on-site merchants, 81.79% do not accept credit card payments. However, 43.54% of them accept BNPL, possibly because of its convenience and large user base. Next, as illustrated in Panel B, among the 18.21% of merchants who accept

credit cards, 83.42% of them choose to simultaneously embrace BNPL. Lastly, as demonstrated in Panel C, more than half (50.81%) of merchants accept BNPL payments, and only 29.90% of them also accept credit cards. The majority of merchants who accept BNPL in our data do not accept credit cards, and according to the e-wallet provider, they have never accepted credit cards previously, likely because for BNPL they need to neither supply the credit nor pay an exorbitant fee to the intermediaries. In addition, they can enjoy the larger customer base of BNPL. Therefore, the extensive marginal effect, not the intensive marginal effect, dominates the expansion of e-wallet credit for on-site merchants.

Table 8. The expansion of e-wallet credit from merchants' side

Merchants	On-site	Online
Panel A: Do not accept credit cards	81.79%	1.08%
% of the above that accept e-wallet credit (BNPL)	43.54%	80.56%
Panel B: Accept credit cards	18.21%	98.92%
% of the above that accept e-wallet credit (BNPL)	83.42%	99.37%
Panel C: Accept e-wallet credit (BNPL)	50.81%	99.17%
% of the above that accept credit cards	29.90%	99.12%

In Column 2 of Table 8, Panels A, B, and C demonstrate credit expansion for online merchants. Unlike on-site merchants, nearly all online merchants accept credit card payments, as shown in Panel B with a percentage of 98.92%. Although the acceptance ratio of BNPL is high at 99.17%, as shown in Panel C, BNPL's credit expansion at the extensive margin for online merchants is tiny. Since 98.30% of all online merchants accept both types of credit payments, the intensive marginal effect likely dominates the expansion of BNPL for online merchants.

One may be concerned that some merchants accepting credit cards would stop doing so once they adopt BNPL. According to the e-wallet provider, this occurrence is extremely rare, because many consumers, especially the ones with large transactions,

still use credit cards.³⁷ Merchants who find credit cards unattractive would also opt for cash for on-site transactions to start with, rather than switching to BNPL. For online merchants, such a switch is virtually non-existent because 98.92% of them accept credit cards.

4.3 Efficient Credit Expansion: Evidence from Transactions

This subsection discusses efficient credit expansion by combining the merchant side and the consumer side. A transaction can be completed using BNPL only if the consumer has access to it and the merchant accepts it as a payment method. Thus, credit expansion is efficient only when both the consumer's access to a payment method (using credit) and the merchant's acceptance of that payment method are aligned.

To measure efficient credit expansion, we first determine whether a transaction can be completed with credit cards or BNPL based on both merchant acceptance and consumer access. Next, we classify the transactions into those that can be completed with credit cards only, those that can be completed with either BNPL or credit cards, and those that can be completed with BNPL only. When a transaction can be completed with BNPL only, we deem it an effective credit expansion.

Table 9 shows that efficient credit expansion remains significant along various dimensions. First, as illustrated in Panel A, 91.59% of on-site and 68.45% of online transactions cannot be completed with credit cards. However, 44.37% and 77.63% of them can be completed with BNPL. Hence, the extensive margin of efficient credit-access expansion is economically meaningful. Next, as demonstrated in Panel B, among the 8.41% of on-site transactions that can be completed with credit cards, 75.62% can also be completed with BNPL. For the 31.56% of online transactions that can be completed with credit cards, 90.46% can also be completed with BNPL. Lastly,

³⁷ To be specific, less than 1% of the merchants who previously accepted credit cards stopped doing so after their adoption of BNPL in the entire history of the e-wallet provider. Therefore, the observed merchants who adopt BNPL but not credit cards represent an extensive margin for credit expansion through BNPL.

as revealed in Panel C, among the 47.00% of on-site transactions completed with BNPL, only 13.53% can be completed with credit cards. In contrast, among the 81.68% of online transactions completed with BNPL, only 34.95% can be completed with credit cards. The findings suggest that the extensive marginal effect, not the intensive marginal effect, dominates efficient credit expansion at the transaction level.

Table 9. Efficient credit expansion: combining consumers' and merchants' sides

Transactions	On-site	Online
Panel A: Cannot use credit cards	91.59%	68.45%
% of the above that can use e-wallet credit (BNPL)	44.37%	77.63%
Panel B: Can use credit cards	8.41%	31.56%
% of the above that can use e-wallet credit (BNPL)	75.62%	90.46%
Panel C: Can use e-wallet credit (BNPL)	47.00%	81.68%
% of the above that can use credit cards	13.53%	34.95%

Furthermore, we follow Tang (2019) and make a simple comparison of user quality. We have two reasons to believe that e-wallets are expanding credit to users of lower borrower quality compared with bank credit card holders. One reason, mentioned in previous studies like Tang (2019), is that e-wallet providers can adopt laxer lending standards due to several factors such as lower operation costs. Another, somewhat subtler, reason that cannot be ignored in the two-sided payment market is that the merchants who accept credit card payments are usually large malls and well-known e-commerce brands that sell big-ticket products; as a result, young consumers with low income have little chance to make purchases with credit cards. However, e-wallet providers have greatly promoted credit acceptance among merchants, including grocery stores and startup brands. As merchants increasingly accept BNPL, younger consumers with lower income can conveniently use BNPL in their daily shopping activities. Thus, the two-sided nature of the market and the high rate of merchant acceptance provide another explanation of why e-wallet credit is beneficial for users of lower credit quality.

Table 10. User-quality comparison of efficient credit-access expansion

	(1) Dual-access users	(2) Single-access users
Panel A: on-site		
Age	33.77	32.27
Wealth in e-wallet (RMB)	8306.88	5935.97
Average city tier level	2.91	3.22
Panel B: online		
Age	33.12	31.23
Wealth in e-wallet (RMB)	9948.66	6447.88
Average city tier level	2.89	3.40

Notes: “Average city tier level” refers to the average of the city tier level of users’ locations. In China, cities are classified into different tiers based on factors such as population, GDP, and infrastructure development. For example, first-tier cities such as Beijing, Shanghai, Guangzhou, and Shenzhen are among the most developed cities in China, while second-tier cities such as Chengdu are less developed than first-tier cities but more developed than third- or fourth-tier cities.

Table 10 compares the quality of dual-access and single-access users for on-site and online transactions. Panel A demonstrates that dual-access users are older, wealthier, and located in more developed cities than single-access users. This suggests that e-wallet credit is primarily used by consumers who have limited access to bank credit or young consumers with low income. We reach similar conclusions concerning online transactions from Panel B.

4.4 Financial Inclusion Through BNPL? Evidence from Regional Usage

This subsection further corroborates the role of BNPL in credit expansion and financial inclusion. We determine the location of each transaction by identifying the consumer’s place of residence and split the sample into well-developed and less-developed regions of China. We then compare the usage of BNPL and credit cards across these regions to examine the extent to which BNPL has facilitated financial inclusion.

Table 11 presents the comparison results. Panel A shows the results categorized by urban and rural areas, and Panel B examines the comparison between the southern and northern regions. Relative to northern regions, southern regions are more heavily populated areas with better socioeconomic development (Huang et al., 2020).

Table 11. Usage comparison of BNPL and credit cards in different regions

	Fraction of on-site transactions using BNPL and credit cards		Fraction of online transactions using BNPL and credit cards	
	BNPL (%)	Credit cards (%)	BNPL (%)	Credit cards (%)
Panel A				
Urban area (1)	54.30	2.36	43.65	10.97
Rural area (2)	54.30	1.09	44.34	5.24
(1)-(2)	0.00	1.27***	-0.69***	5.72***
P value	0.99	0.00	0.00	0.00
Panel B				
Southern regions (7)	52.17	2.04	43.68	8.91
Northern regions (8)	58.24	1.69	43.91	8.68
(7)-(8)	-6.07***	0.35***	-0.23	0.23***
P value	0.00	0.00	0.10	0.00

Notes: *** p < 0.01; ** p < 0.05; * p < 0.1

As expected, the proportion of transactions using credit cards in more developed regions (urban areas and southern regions) is significantly higher than that in less developed regions (rural areas and northern regions). In contrast, BNPL, as another consumer credit, does not exhibit a similar pattern. The proportion is even higher among on-site transactions in northern regions and among online transactions in rural areas. In this sense, the credit expansion of BNPL alleviates the inequality in access to bank consumer credit between well-developed and less-developed areas in China, consequently promoting financial inclusion.

We further explore the determinants of consumer credit usage (credit cards and BNPL) as a whole, with a special focus on the heterogeneous impacts of consumer access to BNPL in well-developed and less-developed areas. To achieve this, we introduce two dummy variables (*Rural* and *North*) indicating whether a transaction occurs in rural areas or northern regions, and their interactions with consumer access

Table 12. The determinants of consumer credit usage in different regions

	The dependent variable: =1 if a transaction is conducted by consumer credit (BNPL or credit cards)			
	On-site transactions		Online transactions	
	(1)	(2)	(3)	(4)
D_Consumer_BNPL ^d	0.443*** (0.000)	0.437*** (0.000)	0.205*** (0.000)	0.220*** (0.000)

D_Consumer_CC ^d	0.086*** (0.000)	0.083*** (0.000)	0.233*** (0.000)	0.220*** (0.000)
D_Merchant_BNPL ^d	0.018*** (0.000)	0.019*** (0.000)		
D_Merchant_CC ^d	0.030*** (0.000)	0.020*** (0.000)		
D_preferred_option ^d	0.340*** (0.000)	0.342*** (0.000)	0.283*** (0.000)	0.284*** (0.000)
Rural ^d	-0.119*** (0.000)		-0.139*** (0.000)	
D_Consumer_BNPL ^d * Rural ^d	0.113*** (0.000)		0.142*** (0.000)	
D_Consumer_CC ^d * Rural ^d	-0.003 (0.248)		-0.064*** (0.000)	
D_Merchant_BNPL ^d * Rural ^d	0.037*** (0.000)			
D_Merchant_CC ^d * Rural ^d	-0.077*** (0.000)			
North ^d		-0.097*** (0.000)		-0.076*** (0.000)
D_Consumer_BNPL ^d * North ^d		0.116*** (0.000)		0.075*** (0.000)
D_Consumer_CC ^d * North ^d		-0.000 (0.870)		-0.006** (0.024)
D_Merchant_BNPL ^d * North ^d		0.035*** (0.000)		
D_Merchant_CC ^d * North ^d		-0.059*** (0.000)		
Control variables	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Day FE	YES	YES	YES	YES
Pseudo R ²	0.229	0.230	0.219	0.218
Observations	501,598	501,801	512,505	512,803

Notes: 1. Subscript *d* indicates dummy variables. 2. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. 3. We report the marginal effects for the logit model.

to BNPL ($D_Consumer_BNPL$). Additionally, for completeness, we incorporate the interaction terms between *Rural* (or *North*) and consumer access to credit cards ($D_Consumer_CC$), merchant access to BNPL ($D_Merchant_BNPL$), and merchant access to credit cards ($D_Merchant_CC$). Table 12 reports the regression results, where the dependent variable is an indicator representing whether consumer credit (credit card or BNPL) is used in a transaction. First, the coefficients on $D_Consumer_BNPL$ are positive and statistically significant at the 1% level,

indicating that consumer access to BNPL improves the use of consumer credit in transactions in more-developed regions (urban areas and southern regions). Second, the coefficients on the interaction terms on *D_Consumer_BNPL* and *Rural* (or *North*) are also positive and statistically significant, indicating that consumer access to BNPL has a larger impact on consumer credit usage in less-developed regions (rural areas and northern regions).

In sum, considering the user quality and the two-sided nature of the market, we conclude that the expansion of e-wallet credit is economically significant at the extensive margin and BNPL is mostly provided to those with no access to bank credit: about 80% of consumers, 44% of on-site merchants, 44% of on-site transactions, and 90% of online transactions that cannot be completed by credit cards can now be completed with BNPL.³⁸ The credit expansion through BNPL seems to have promoted financial inclusion, especially in less-developed regions and among women.³⁹

5. Consumer Spending and Indebtedness, and E-Wallet Ecosystem

BNPL has displaced other payment choices, exhibited payment usage patterns different from credit cards, and expanded credit at the extensive margin. As a new form of consumer credit, how does BNPL impact consumer spending and indebtedness? Following Gross and Souleles (2002) and Aydin (2022) that rely on exogenous increases in credit supply, we similarly exploit the randomized experiment conducted by the e-wallet provider as an exogenous shock to credit supply to examine the impact of BNPL on consumer spending. We then return to our transaction data to explore the dynamics of indebtedness and BNPL usage. Since the BNPL we study is embedded in an e-wallet super-app, we also investigate the role of the e-wallet ecosystem in disciplining BNPL usage, which helps rationalize the impact of BNPL

³⁸ To take age structure into account, we have also drawn a subsample that has the same median age with Chinese total population and repeated the credit expansion analyses. The conclusion remains unchanged.

³⁹ Though unreported here, we also examine the heterogeneous impact of BNPL access on consumer credit usage in the dimension of consumers' gender. Specifically, the coefficients for the female dummy variable and its interaction with *D_Consumer_BNPL* are significant at the 1% level, with magnitudes of -0.815 and 0.523 for on-site transactions and -1.165 and 1.008 for online transactions. These results indicate that women face disadvantages in credit access and usage, but BNPL access helps them more.

on users' consumption and indebtedness.

5.1 BNPL and Consumer Spending

BNPL provides consumers with access to a new line of credit. There are several competing hypotheses on the impact of extended credit lines on consumer spending. The life-cycle/permanent-income hypothesis states that an increase in predictable income or credit access should have no real effects on consumption. The rule-of-thumb model suggests that consumers do not smooth their consumption, and extended credit lines lead to one-to-one increases in consumption. Aydin (2022) utilizes a randomized credit limit increase in a large retail bank in Turkey to examine the impact of extended credit lines on consumer spending. The results cannot be explained by the life-cycle/permanent-income hypothesis or the rule-of-thumb model, but are consistent with a buffer-stock hypothesis built from Carroll (1997): additional credit increases consumers' spare borrowing capacity and mitigate concerns about future inability to absorb shocks; the extended credit lines add to the buffer, reduce consumers' precautionary savings motives, and thus enables both credit-constrained and non-constrained consumers to increase consumption to a new level.

We exploit a randomized experiment conducted by the e-wallet provider to examine the impact of BNPL on consumer spending. BNPL has several unique features enriching our understanding of the impacts of credit increases on consumption and indebtedness beyond traditional credit lines increases on credit cards. First, the BNPL in point targets young consumers with low income and no credit card, who are most likely to be financially constrained. As shown in Section 4, BNPL achieves higher credit coverage for consumers than credit cards do. In our sample, 68.31% of consumers lack credit card access for online transactions and 70.43% for on-site, while 78% and 84.14% of them have access to BNPL for online and on-site transactions, respectively. Second, the BNPL service provides more options and flexibility for consumers and is particularly attractive for those who are uncomfortable carrying credit card balances but comfortable borrowing for specific

purchases. These features of BNPL could have profound impacts on consumer spending. Moreover, as demonstrated in Section 3, BNPL is frequently used for low-value purchases as the new digital cash in e-wallet transactions, which may lead to different results on household indebtedness relative to the results from overuse of credit cards.

To formally check the impact of introducing BNPL on consumer spending, we employ a difference-in-differences specification, thanks to that our dataset covers both the pre-treatment and post-treatment periods from January to July 2017. Specifically, we compare the outcomes of the treated users after gaining access to BNPL relative to the time before they had credit access and relative to users in the control group:

$$Consumption_{it} = \beta_0 + \beta_1 treat_i * post_t + \gamma \ln_cashflow_{it} + \lambda_i + \delta_t + \varepsilon_{it} . \quad (3)$$

Here, $Consumption_{it}$ is the amount of spending through the e-wallet for consumer i in month t ; $treat_i$ is a dummy variable that equals 1 for treated users and 0 for untreated users; $post_t$ is a dummy variable that equals 1 for user-month observations in June and July during the two-month experiment and 0 otherwise. The control variable $\ln_cashflow_{it}$ is the logarithm of e-wallet cash flows in the last year to proxy for users' financial position. We also include both user fixed effects (λ_i) and month fixed effects (δ_t) in the regression to control for the impacts of unobserved time-invariant user characteristics and macroeconomic factors.⁴⁰ ε_{it} is the error term.

The aggregate consumption effect in the full sample is reported in Table 13 Column (1); the heterogeneous effects of BNPL on single-access users and dual-access users are shown in Columns (2) and (3). In addition to aggregate consumption, Column (4) focuses on dual-access users' credit card consumption response to BNPL access.

In all columns, the interaction term between the treatment and the time indicator,

⁴⁰ Since user fixed effects are included in the regression, we do not report the coefficient estimates on users' age and gender. These two variables are fully absorbed by user fixed effects.

$treat_i \times post_t$, is positive and statistically significant, implying that the introduction of BNPL increases consumer spending. In the full sample, compared with the average monthly consumption of untreated users, consumption of the treated group increases by RMB ¥86, corresponding to approximately 5.62% of total average monthly consumption (0.086/1.53) as reported by the National Bureau of Statistics of China.⁴¹ For single-access users in Column (2), the average monthly consumption increases by RMB ¥85 after gaining access to BNPL; for dual-access users in Column (3), the average consumption increases by RMB ¥204.⁴²

In Column (4), credit card consumption also increases for treated dual-access users, consistent with findings in Section 3 that BNPL access reduces credit card usage in transactions but do not completely substitute credit cards in the big-ticket purchases, corroborating our claim that BNPL plays the role as digital cash rather than credit cards.

Table 13. The impact of BNPL on consumer spending

	Dependent variable: consumption (monthly, thousand RMB)			
	(1) Full sample	(2) Single-access	(3) Dual-access	(4) Dual-access (credit card consumption)
Treat×Post	0.086*** (0.002)	0.085*** (0.002)	0.204*** (0.047)	0.038*** (0.009)
Ln_cashflow	0.014*** (0.0003)	0.014*** (0.0003)	0.044*** (0.005)	-0.0008 (0.001)
User fixed effects	YES	YES	YES	YES
Month fixed effects	YES	YES	YES	YES
Observations	700,000	695,149	4,851	4,851
R ²	0.225	0.226	0.199	0.276

Notes: ***p < 0.01; **p < 0.05; *p < 0.1.

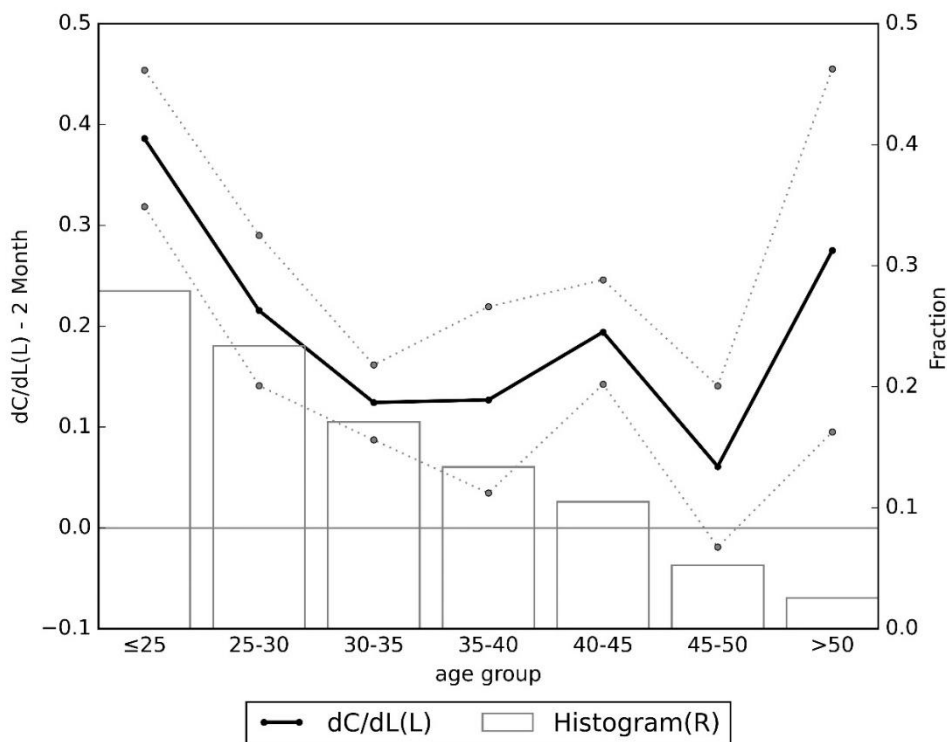
Following Aydin (2022), we further examine the cross-sectional heterogeneity of the consumption response of users by age and bank cards, two months after the

⁴¹ Average yearly consumption by Chinese people was RMB ¥18,322 in 2017. See http://www.stats.gov.cn/tjsj/zxfb/201801/t20180118_1574931.html; accessed on August 5, 2020.

⁴² The higher effect for dual-access users may be attributed to their higher average wealth. This coefficient estimation for dual-access users should be interpreted with caution due to its limited sample size and much higher standard error. The 95% confidence interval of $Treat \times Post$ in Column (3) is (0.1124, 0.2952). In comparison, the 95% confidence interval of the coefficient estimate for $Treat \times Post$ in Column (1) is (0.0818, 0.0903). Though unreported, we also explored the effect of BNPL access on BNPL consumption. The coefficients on $Treat \times Post$ are 0.029 for single-access users and 0.054 for dual-access users.

introduction of BNPL in June of 2017 (see Figures 3 and 4). Although the consumption response of BNPL is higher for younger customers and those with only one bank card, consumption also increases for those with lower chance to hit their credit limits, i.e., older customers with relatively more wealth and those better served by the banking system (with more than one bank cards).⁴³

Neither the life-cycle/permanent-income hypothesis nor the rule-of-thumb model can rationalize our findings, especially those concerning cross-sectional heterogeneity. The buffer stock hypothesis, however, emphasizes the effect of additional credit on increasing spare borrowing capacity, which is highly consistent with the aforementioned results. Access to BNPL helps to mitigate concerns about future inability to absorb unexpected income or consumption shocks, which would reduce the consumers' precautionary savings motive, thus enabling them to increase current consumption. The effect is also heterogeneous, depending on the demographics and level of constraints, among other individual characteristics.



⁴³ The consumption response of customers aging above 50 is also high, likely because they did not fully benefit from the rapid economic development following China's accession to the WTO in 2001 during their prime working years, and thus have not accumulated sufficient wealth. The small sample size of the elderly group may also limit the accuracy of estimation on consumers aging above 50.

Figure 3. Consumption response of BNPL across different age groups

Note: we first estimate the following model specification $Consumption_{it} = \beta_0 + \sum_{j=0}^{T-t} \theta_j treat_i * post_t + \gamma \ln_cashflow_{it} + \lambda_i + \delta_t + \varepsilon_{it}$, where θ_j is the number of periods since the experiment started. The solid line represents the marginal propensity of consumption out of liquidity after two months since the experiment. The bar represents the fraction of each age cohort.

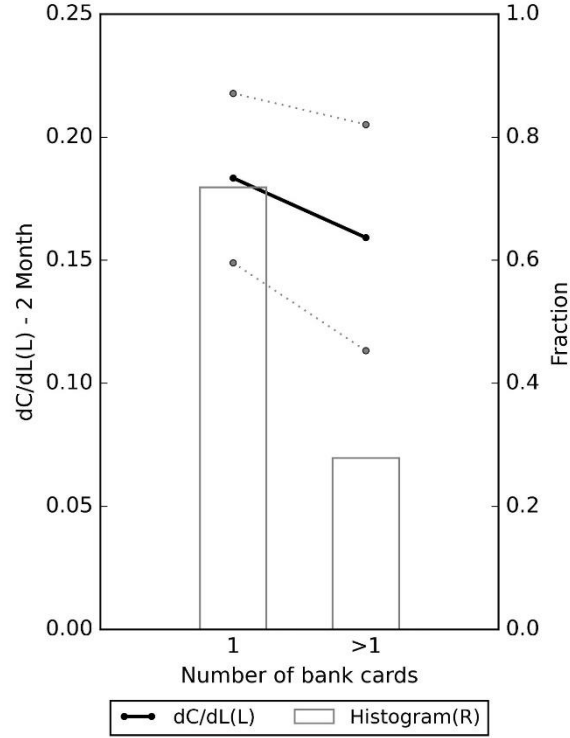


Figure 4. Consumption response of BNPL across users with different numbers of bank cards

Note: we first estimate the following model specification $Consumption_{it} = \beta_0 + \sum_{j=0}^{T-t} \theta_j treat_i * post_t + \gamma \ln_cashflow_{it} + \lambda_i + \delta_t + \varepsilon_{it}$, where θ_j is the number of periods since the experiment started. The solid line represents the marginal propensity of consumption out of liquidity after two months since the experiment. The bar represents the fraction of users with varying number of bank cards.

5.2 BNPL, Default, and Consumer Indebtedness

Some may argue that BNPL boosts consumer spending, which then induces overspending and increases consumer indebtedness or default, especially for single-access users who are underserved by banks but have now received consumer credit for the first time. To empirically test the claim, we first compare single-access and dual-access users in Table 14 concerning the BNPL usage as a means of payment and repay the balance each month (transactors) or the usage as a source of credit and incur interest charges for unpaid debt (revolvers). Note that the overall default rate is below

1% in our sample and below 2% among all BNPL users in the population.⁴⁴ But revolvers are common. About two-thirds of single-access consumers use BNPL as a means of payment; the fraction of revolvers is 32.33%, which is significantly lower than the fraction for dual-access users (40.78%). In addition, the ratio of unpaid BNPL credit to used credit balance is 28.13% for single-access revolvers, which is also slightly lower than that for dual-access revolvers (31.48%). Moreover, single-access users choose to pay with BNPL for 58.24% of their transactions, while dual-access users use BNPL for 56.97% of their transactions. Since the differences in Unpaid BNPL debt/used credit and BNPL/all transaction are economically negligible, the lower fraction of revolvers in single-access user group are not driven by their less-frequent BNPL usage.

Table 14. BNPL usage for different purposes between single-access users and dual-access users

	All e-wallet credit users (1)	Dual-access users (2)	Single-access users (3)	(2)–(3)
The fraction of revolvers %	35.16	40.78	32.33	8.45***
Unpaid BNPL debt/used credit %	29.32	31.48	28.13	3.35***
BNPL transactions/all transactions %	57.81	56.97	58.24	-1.27***

Notes: 1. The last column shows the difference between columns (2) and (3). 2. ***p < 0.01; **p < 0.05; *p < 0.1.

Single-access users appear to use BNPL more frequently and more cautiously, as demonstrated by a lower proportion of revolvers and a lower unpaid-debt ratio for revolvers.⁴⁵ This behavior is voluntary as the e-wallet provider benefits from receiving interest payments and would not require BNPL users to reduce usage or impose penalty without default. To some extent, this alleviates our concern that single-access users who receive consumer credit for the first time may overuse BNPL due to the oft-cited lack of financial literacy and budgeting education.

We return to the transaction-level payment data and analyze how consumers

⁴⁴ Data source: the 2020 prospectus from the data provider. The e-wallet provider also carefully manages default risk: in addition to the diversification of borrowers across demographic groups, the provider reduces a user's credit score within the e-commerce ecosystem if a user defaults, and utilizes proprietary data to screen for eligible and trusted borrowers.

⁴⁵ The overall debt level of dual-access users is inferred to be higher than that of single-access users because of the higher BNPL debt ratio. Given our findings in Table 13 that BNPL access increases credit card consumption, it is unlikely that dual-access users would engage in debt restructuring by turning credit card debt into BNPL debt.

change their usage of BNPL when they have unpaid debt and incur interest charges. It is important to consider the impact on the usage of BNPL as the payment method when an e-wallet user faces interest charges. If users choose to use more BNPL after incurring interest, they are likely to develop into deep revolvers bearing a heavier debt burden and a default can hurt their credit building effort within the e-commerce system. In contrast, if e-wallet users reduce their BNPL usage once faced with interest expenses, then they are temporarily revolvers and likely to become transactors again in the future, alleviating the concern of excessive indebtedness.

Here we examine the relationship between BNPL usage and interest expenses. We have four proxies to measure the extent to which a user incurs unpaid debt and interest charges in e-wallet credit: (1) a dummy variable indicating whether a user has unpaid debt (*D_Unpaid_BNPL*); (2) the logarithm of one plus the unpaid debt balance (*Ln_unpaid_BNPL_debt*); (3) the fraction of unpaid debt in used e-wallet credit (*Unpaid_BNPL_debt%*); (4) three dummy variables indicating whether the unpaid BNPL debt belongs to low-level, medium-level, or high-level groups (*Unpaid_BNPL_debt_Low/Middle/High*). We separately include these four proxies in Equations (1) and (2), which examine the determinants of the usage of BNPL as the payment instrument in on-site and online transactions. To differentiate the behavior of single-access users and that of dual-access users, we also include the interaction terms between the first three proxies and the dummy variable indicating whether a user has access to a credit card (*D_Consumer_CC*).

Table 15. The impact of incurring interest on the usage of BNPL as the payment instrument in on-site transactions

	The dependent variable: a dummy variable indicating whether BNPL is used in an on-site transaction			
	(1)	(2)	(3)	(4)
<i>D_Consumer_CC</i> ^d	0.039*** (0.000)	0.043*** (0.000)	0.026*** (0.000)	0.033*** (0.000)
<i>D_Merchant_BNPL</i> ^d	0.028*** (0.000)	0.033*** (0.000)	0.030*** (0.000)	0.034*** (0.000)
<i>D_Merchant_CC</i> ^d	-0.071*** (0.000)	-0.070*** (0.000)	-0.060*** (0.000)	-0.074*** (0.000)
<i>Consumer_preference_BNPL</i> ^d	0.391***	0.383***	0.270***	0.382***

	(0.000)	(0.000)	(0.000)	(0.000)
D_Unpaid_BNPL ^d	-0.060***			
	(0.000)			
D_Unpaid_BNPL ^d ×D_Consumer_CC ^d	-0.010***			
	(0.000)			
Ln_unpaid_BNPL_debt		-0.008***		
		(0.000)		
Ln_unpaid_BNPL_debt×D_Consumer_CC ^d		-0.002***		
		(0.000)		
Unpaid_BNPL_debt %			-0.184***	
			(0.000)	
Unpaid_BNPL_debt %× D_Consumer_CC ^d			-0.006*	
			(0.077)	
Unpaid_BNPL_debt_Low ^d				0.034***
				(0.000)
Unpaid_BNPL_debt_Middle ^d				-0.068***
				(0.000)
Unpaid_BNPL_debt_High ^d				-0.172***
				(0.000)
Control variables	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Day FE	YES	YES	YES	YES
Observations	448,270	442,493	393,482	448,270
Pseudo-R ²	0.13	0.13	0.11	0.14

Notes: 1. Unpaid_BNPL_debt %=unpaid debt / used e-wallet credit. 2. The superscript d indicates a dummy variable. 3. *** p < 0.01; ** p < 0.05; * p < 0.1. 4. We report the marginal effects for the logit model.

Table 16. The impact of incurring interest on the usage of BNPL as the payment instrument in online transactions

	Dependent variable: a dummy variable indicating whether BNPL is used in an online transaction			
	(1)	(2)	(3)	(4)
D_Consumer_CC ^d	-0.075***	-0.053***	-0.077***	-0.055***
	(0.000)	(0.000)	(0.000)	(0.000)
Consumer_preference_BNPL ^d	0.376***	0.383***	0.276***	0.374***
	(0.000)	(0.000)	(0.000)	(0.000)
D_Unpaid_BNPL ^d	-0.026***			
	(0.000)			
D_Unpaid_BNPL ^d ×D_Consumer_CC ^d	0.041***			
	(0.000)			
Ln_Unpaid_BNPL_debt		-0.003***		
		(0.000)		
Ln_Unpaid_BNPL_debt×D_Consumer_CC ^d		0.002***		
		(0.000)		
Unpaid_BNPL_debt %			-0.180***	
			(0.000)	

Unpaid_BNPL_debt % \times D_Consumer_CC ^d				0.057*** (0.000)
Unpaid_BNPL_debt_Low ^d				0.083*** (0.000)
Unpaid_BNPL_debt_Middle ^d				-0.027*** (0.000)
Unpaid_BNPL_debt_High ^d				-0.124*** (0.000)
Control variables	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Day FE	YES	YES	YES	YES
Observations	433,136	425,028	352,403	433,136
Pseudo-R ²	0.10	0.09	0.07	0.11

Notes: 1. Unpaid_BNPL_debt % = unpaid debt / used credit e-wallet credit. 2. The superscript *d* indicates a dummy variable. 3. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. 4. We report the marginal effects for the logit model.

Tables 15 and 16 present the regression results for on-site transactions and online transactions, respectively. The coefficients on the first three proxies are all negative and statistically significant, suggesting that single-access users reduce their usage of BNPL as the payment tool in both on-site and online transactions when they incur unpaid debt and interest charges. Relative to single-access users, dual-access users reduce their usage of BNPL as a payment tool in on-site transactions to a greater extent, while they reduce their usage of BNPL to a lesser extent in online transactions. According to the results in Columns (4) in Tables 15 and 16, whilst BNPL users exhibit a slight increase in BNPL usage when faced with low-level unpaid debt, potentially to address their liquidity needs, their usage of BNPL significantly decreases as their debt levels enter the middle or high terciles. This could be intuitively attributed to the higher delinquent interest rate charged by BNPL providers compared to credit cards.⁴⁶

Taken together, the results show that single-access users are careful in using BNPL even though they receive consumer credit for the first time. They have a lower fraction of revolvers and a lower ratio of unpaid debt to used e-wallet credit; they also voluntarily reduce their usage of BNPL as the payment tool in both on-site and online

⁴⁶ This is consistent with the common critique that BNPL is “inclusive but expensive” relative to credit cards. See <https://m.21jingji.com/article/20201102/herald/62dfca7696f0148a9353a88dbd9eedf5.html>.

transactions after they incur unpaid debt and interest charges. Our findings are in line with those of Agarwal et al. (2021), who exploited a large-scale microcredit program in Rwanda. They found that a sizable share of first-time borrowers, who demonstrated lower default risks, successfully switched to bank credit later.

5.3 The Power of Super-Apps and the E-wallet Ecosystem

Our findings that BNPL boosts consumption without necessarily increasing indebtedness contrast sharply with the findings concerning developed countries documenting how BNPL leads to more defaults and delinquencies. There could be multiple drivers for these observations. First, because e-wallets contain information about borrowers' (including micro, small, and medium-sized enterprises) real-time, high-frequency transactions, as well as complementary financial and behavioral data (e.g., gross merchandise volume, authenticity/illegal sales, customer ratings, credit card payments, online shopping payments, fund transfers, utility payments, etc.), BigTech firms providing e-wallets can learn clients' characteristics (Gambacorta, et al., 2023) and develop proprietary credit-reference systems to screen eligible consumers effectively while still remaining more inclusive than banks (Chen, Huang, Lin, and Sheng, 2022). Culture and tradition can play a role too. Tajaddini and Gholipour (2017) document that borrowers from countries with a culture of individualism default more on their mortgages. Among the 42 countries examined from 2010 to 2013, China has low individualism and the lowest mortgage default rate. Recently, Zhang (2022) uses data from a large peer-to-peer lending platform to document that borrowers from regions with stronger moral norms have lower loan default probabilities.

However, they are unlikely to be the main drivers. As demonstrated in Section 4, the credit expansion through BNPL is substantial at the extensive margin, where screening using existing data is limited or infeasible. Moreover, those more reliant on BNPL (i.e., single-access users) behave more cautiously compared to dual-access users, as evidenced in Tables 15 and 16, despite sharing common cultural

backgrounds. We propose and investigate a new economic channel: Given that the BNPL we study is integrated with an e-wallet ecosystem, it is natural to expect that this super-app model plays a vital role in disciplining BNPL users' behavior.

Specifically, the e-wallet we study was initially launched by China's leading e-commerce company to resolve the issue of distrust between buyers and sellers in an online transaction on its platform. It has gradually evolved from a mere payment tool to a super-app where users can purchase wealth management products, hail taxis, book movie tickets, reserve hotels, pay utility bills, order food deliveries, among other things. This e-wallet has permeated in almost every aspect of people's life and it is extremely inconvenient to conduct daily activities without it. Within this powerful ecosystem, users' digital footprints help the e-wallet in assessing their eligibility and trustworthiness. This, in turn, motivates users to leave more digital footprints and behave well in order to reap more benefits and avoid potential penalties within the ecosystem. For example, the e-wallet provider could temporarily suspend access to certain advanced services on the platform, and it can deduct balances from their digital wallets for repayment purposes (Chen, Huang, Lin, and Sheng, 2022; Gambacorta et al., 2023). This reduces borrower moral hazard because of the large network effects in the super-app and the high cost of switching between e-commerce platforms. Consumers also value the opportunity to improve their credit score within the super-app ecosystem, as it allows them to access a wider range of features and services. A parallel in the U.S. is PayPal Credit, where users with higher credit scores access more platform features, such as lower fees and special offers. This motivates individuals to improve creditworthiness, strengthening their commitment to responsible borrowing.

Following Gross and Souleles (2002) and Aydin (2022) that rely on exogenous increases in credit supply to identify the effect of credit usage, we similarly leverage the randomized experiment conducted by the e-wallet provider in 2017 to examine whether the frequent usage of BNPL serve as a ladder to access other services within the e-wallet ecosystem in the long run. To do it, we extend the randomized experiment

sample to December 2021, with a special focus on four popular services offered by the e-wallet: internal credit scores, BNPL, another lending service for qualified BNPL users, and deposit-free rental services. We examine the impact of BNPL usage on the access and usage of other services within the e-wallet ecosystem, utilizing an instrument with the interaction term between a dummy variable ($Treat_i$) indicating whether a user is in the treatment group for the randomized experiment in 2017 and the number of months since the inception of the experiment.

The dependent variables include users' credit scores, credit limit of BNPL, credit limit in another lending service, and the usage of deposit-free rental services. The primary independent variable comprises both the *BNPL usage* and its interaction with the *High_Debt* indicator, which is assigned a value of one if a user's unpaid debt falls within the top 25% among all users, and zero otherwise. Due to variations in the initiation of the business and data privacy concerns by the e-wallet, the dependent variables have different time horizons in our sample: the data on deposit-free rental services starts from July 2020; the data on credit scores starts from January 2017; the credit limits of BNPL and another lending services are cross-sectional data in December 2021. Given this, we extend our initial randomized sample to December 2021 to examine the impact of BNPL usage on the utilization of these services. When the dependent variables are cross-sectional data, BNPL usage is instrumented by the indicator variable $Treat_i$.

Table 17 reports the results of the two-stage least squares regression. More frequent BNPL usage is associated with higher credit scores, higher credit limits of BNPL and another lending service, and access to more services within the ecosystem. The access and usage of BNPL helps users enjoy more services within the e-wallet system, which motivates them to behave well in BNPL usage. However, the coefficients for the interaction term between BNPL usage and high debt are significantly negative for credit scores and credit limits of the two lending services, and negative yet less significant for deposit-free rental services. This suggests that frequent BNPL usage coupled with high debt may restrict users from fully utilizing

the ecosystem, especially in credit-related services. Taken together, these findings help us understand why consumers use BNPL cautiously.

Table 17. The impact of BNPL usage on users' utilization of other services in the e-wallet

	(1) Credit Scores	(2) Credit limit in another lending service (2021average)	(3) Credit limit in BNPL (2021average)	(4) Deposit-free rental services
BNPL usage	0.0279*** (0.000)	0.5569*** (0.000)	0.2277*** (0.000)	0.0041* (0.0505)
BNPL usage × High_Debt	-0.0257*** (0.000)	-0.5443*** (0.002)	-0.2165*** (0.000)	-0.0041* (0.0513)
User fixed effects	YES	NO	NO	YES
Month fixed effects	YES	NO	NO	YES
Observations	2,903,771	40,384	62,655	449,534

Notes: *P* values in parentheses. ****p* < 0.01; ***p* < 0.05; **p* < 0.1. The credit score data starts from Jan 2017, the rental services data starts from Jul 2020; the credit limit data is a cross-sectional level data of Dec 2021.

Furthermore, since an e-wallet super-app ecosystem fundamentally differs from a pure-play payment network based on bank cards, different payment options may lead to different merchant fees, retail prices, and consumer usage segments. As a result, in contrast to the findings documented in Wang (2023), which uses U.S. bank card data and focused on more homogenous payment networks, merchant fees do not increase or get passed onto retail prices, and consumers do not appear to overuse the newly available credit. In an economy transitioning from a cash-heavy to cashless system, the introduction of e-wallets and BNPL appears to facilitate financial inclusion rather than reduce welfare.

6. Conclusion

Digital wallets and Buy-Now-Pay-Later (BNPL) have seen exponential growth around the globe, especially during the COVID-19 pandemic. Yet, their inner workings, the link between digital payments and consumer credit, and the effect of BNPL on consumer behavior are little understood, especially in economies transitioning from being cash-heavy to cashless, which have seen the largest market growth and potential.

We conduct the first investigation into the hitherto black box of e-wallets to better understand digital payment competition, FinTech credit provision to households, and their implications for consumer spending and debt management. Internal payment options in e-wallets dominate external options, with BNPL crowding out other payment choices while complementing credit cards for small-value purchases. The e-wallet in our study has a pronounced credit-expansion effect for underserved consumers through BNPL adoption by both consumers and merchants, and in less developed regions and for individuals underserved by banks.

Utilizing the large-scale, matched BNPL transactions that we observe directly and for the first time in the literature, as well as the randomized control experiment conducted by the e-wallet provider, we also find that BNPL significantly boosts consumption; yet, consumers—especially those who rely solely on BNPL for credit access—are careful with overspending and indebtedness. Contrasting with studies on BNPL using bank data or surveys from developed countries where BNPL providers often started with pure-play merchant partner models, our paper highlights that introducing BNPL through super-apps with proper screening and well-designed incentives can lead to opposite outcomes in consumer indebtedness and loan defaults.⁴⁷ Overall, our findings suggest that e-wallet credit in the form of BNPL is becoming a new form of cash and credit, and appears to facilitate financial inclusion without inducing excessive indebtedness or defaults.

The payment landscape of China differs from that of Western developed economies such as the United States in the emergence of e-wallet super-apps and the lack of mature credit reference systems or widespread adoption of bank credit cards. That said, an increasing number of BNPL firms around the world have been transforming from the merchant partner acquisition model to the super-app-driven

⁴⁷ Arguably, after 2020, regulatory changes in China's FinTech consumer credit services, such as tightened requirements for BNPL providers to report credit information to the central bank's credit reference system and reduction in credit limits for young adults, especially college students, further reinforce our findings regarding the consumer caution with BNPL usage and debt management. For more details, see https://www.wsj.com/articles/jack-mas-ant-group-slashes-credit-limits-for-some-younger-borrowers-in-china-11608738467?mod=article_inline and <https://www.wsj.com/articles/ant-to-fully-share-consumer-credit-data-with-chinas-government-11632310975>.

model, establishing their proprietary ecosystem.⁴⁸ Our insights into the role of e-wallets and BNPL in facilitating transactions, expanding consumer credit, and incentivizing responsible borrowing likely apply beyond the Chinese setting. For one, the rising popularity of e-wallets and the advent of super-apps may significantly alleviate concerns about overspending and consumer indebtedness and allow BNPL providers to survive the high-interest-rate environment in many countries.

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⁴⁸ On January 26, 2022, Affirm announced that it had turned its app into a super-app, integrating Affirm’s shopping, payment, and financial services into a single destination. See, e.g., <https://investors.affirm.com/news-releases/news-release-details/affirm-launches-superapp-and-browser-extension/>. In a similar vein, Peloton collaborated with Affirm to offer customers the option to rent one of its internet-connected stationary bikes instead of outright purchase. See, e.g., <https://news.crunchbase.com/business/bnpl-startups-challenges-affirm-peloton-pton>. In October 2021, native checkout company Bonsai and BNPL provider Afterpay announced their partnership, allowing online shoppers to choose Afterpay’s BNPL whenever they make their purchases. As noted by Saad Siddiqui, co-founder and CEO at Bonsai, they aim to build “a native commerce ecosystem that brings publishers like BuzzFeed, merchants and consumers together at the right moment, and with the right payment options available to them, to make online purchasing truly seamless.”

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