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PAY NOW, BUY NEVER: THE ECONOMICS OF CONSUMER PREPAYMENT SCHEMES

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ABSTRACT

Prepaid consumption is a common feature of modern consumer markets and is often presented as a mutually beneficial arrangement: consumers receive upfront discounts, and firms secure future sales. We analyze a large-scale Pay Now, Buy Later (PNBL) program in which consumers prepay for restaurant credit with bonuses, and spend the balance later. Using detailed transaction data from over 4 million consumers, we document widespread balance breakage: approximately 40% of prepaid value is never used. Because many consumers underutilize their balances, merchants recover significantly more than the bonus cost. The median firm earns roughly $5.5 in breakage profit for every $1 of bonus credit issued. While PNBL participation does lead to modest increases in consumer spending over time, firms gain substantially more from breakage than from any loyalty-driven revenue. These findings challenge the prevailing win–win narrative: PNBL schemes often result in a significant transfer from consumers to firms. We develop a stylized contract model to illustrate the misaligned incentives firms face, and show through counterfactual analysis that a simple escrow policy with an appropriately chosen deposit requirement can realign firm incentives and generate more consumer-serving outcomes.

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1. Introduction

Prepaid consumption is a widespread feature of modern consumer markets. Businesses across food and beverage, fitness, entertainment, transportation, beauty services, and digital apps increasingly offer "pay now, buy later" (PNBL) contracts that allow consumers to pay in advance for future goods and services, often providing bonuses or discounts for doing so.

PNBL takes many familiar forms. For example, in food and beverage, Starbucks' prepaid card and mobile app ecosystem has more than 120 million global users who load funds in advance for convenience and rewards. Gyms routinely offer lower prices for annual prepayment compared to month-to-month billing. Movie chains such as Cinemark, AMC, and Regal operate subscription programs where customers prepay monthly for bundled tickets and perks. In transportation, companies such as Uber allow riders to pre-purchase discounted bundles of rides to use over time. Measuring the overall scale of the PNBL economy is challenging because prepayment schemes operate under many labels and across both online and offline settings. Nevertheless, available data suggest that PNBL activity is economically enormous. In the United States alone, prepaid cards—one major category of personal prepayment—exceeded $200 billion in 2024 and continue to grow at roughly 5% annually (Paytronix Gift Card Trend Report, 2024).[1] Globally, the prepaid card market, which covers both open- and closed-loop stored-value systems, was valued at approximately $2.2 trillion in 2024 (Global Industry Analysts, 2025). Importantly, a substantial share of these balances reflect individuals prepaying for their own future use rather than gift-giving.

PNBL schemes are often marketed as win-win arrangements: they secure upfront revenue for firms and promise value or convenience for participating consumers. Despite their popularity, the economics of PNBL schemes remain far from clear. A central concern is that a significant share of prepaid value may never be redeemed—a phenomenon often known as *balance breakage*. For example, Starbucks reported that by 2018 it held over $1.6 billion in unredeemed gift card balances (about 8% of the company's annual profit). Starbucks is one of the few firms to openly disclose such figures; the breakage problem is likely widespread but remains largely opaque. A Bankrate survey found that 47% of Americans had at least one unused gift card at home with an

[1] To put this number in perspective, the entire U.S. mobile payments sector (via smartphones and digital wallets) was estimated to be $748.3 billion in transaction value in 2024 (IMARC Group, 2025).

average value of $180, which highlights the potential scale of unused prepaid balances.[2] Yet there is little systematic data or academic research on which consumers participate in PNBL programs and how prevalent breakage is across the economy. If many customers ultimately fail to redeem what they prepaid, then one of PNBL's central promises—to be a consumer-serving value tool—would not hold.

Consumer behavior under PNBL also directly shapes firm incentives. If all consumers redeem their balances, a PNBL program functions much like a business loan: the firm receives cash upfront in exchange for providing additional goods or services later, including any bonus credit. However, when a large share of balances go unused, PNBL becomes a net transfer from consumers to firms, raising concerns about potential exploitation. A deeper issue is the trade-off between short-run breakage gains and long-term customer retention: While breakage provides immediate revenue, it also entails the loss of a customer who might otherwise have generated repeat business. It remains uncertain whether firms could achieve greater long-run gains by actively promoting PNBL as a retention tool rather than relying on breakage profits. Clarifying these incentives is central to understanding how PNBL contracts are designed and the role of potential regulatory oversight in shaping market outcomes.

In this paper, we provide a descriptive analysis of a large-scale digital PNBL program using a dataset that allows us to pin down these underlying economic forces. We leverage rich data from a large digital payment platform in China that enables medium and small businesses (primarily food and beverage merchants) to run store-credit prepayment programs through a mobile app. In this program, merchants typically offer about a 10% bonus on advance payments (e.g. a customer pays $100 and receives $110 in store credit), and the credits carry no expiration. The PNBL scheme grew rapidly in popularity: by the end of our study period, over 90,000 merchants across the country had adopted it, receiving payments from more than 4.6 million consumers. On average, PNBL prepayments account for roughly 10% of total revenue for participating merchants (which is significant compared to a thin net profit margin of about 8% in the industry). Our dataset covers the universe of transactions for these merchants and their customers (including purchases outside the PNBL program), which allows us to track consumers'

[2] See Kelton (2024). As detailed below, we conducted our own online survey of both U.S. and Chinese consumers and found a similar incidence of self-reported unused prepayments.

behavior over time and evaluate how prepayment affects both customer spending patterns and firm outcomes.

We present three main sets of empirical findings. First, we document highly heterogeneous, almost bimodal consumer usage of prepaid balances. In our data, the two most common profiles are those who redeem *nothing* and those who redeem *everything*, each comprising about 17% of PNBL customers. The overall balance breakage is substantial: more than 40% of the total prepaid value remains unused one year after purchase. Nearly all consumers who will ever redeem their credit do so within the first year, which implies that the 17% of users who have not spent a single yuan by the one-year mark likely never will. Importantly, this high breakage rate is not driven by a lack of redemption opportunities such as merchant closures — the pattern holds even among active businesses.

Second, PNBL is an extremely expensive financing tool, but almost every merchant profits from PNBL tremendously because of balance breakage. At the prevailing bonus rates (most commonly a 10% bonus), we estimate that if a customer uses their entire credit, the implicit cost of this financing to the firm is equivalent to an interest rate of over 50% per year—an order of magnitude higher than typical borrowing costs. This means merchants actually lose money on customers who fully redeem their credits. Nevertheless, in our data almost no merchants end up losing money on PNBL due to balance breakage. For the median participating business, each $1 of bonus incentive paid to customers generates about $5.5 in breakage revenue, and roughly one-quarter of merchants obtain an even higher return over 50 times the cost of the incentive.

Third, PNBL participation is associated with meaningful increases in customer loyalty and spending, but this effect is likely too small to rival the profits from breakage. Among the subset of consumers who return to use their prepaid credit, joining a PNBL program roughly doubles their spending at the merchant over the subsequent months (up to 9 months as far as we can see in our data), relative to similar customers who did not prepay. This sustained increase suggests that prepayments can strengthen the customer–merchant relationship for active users. Nevertheless, the incremental revenue from greater loyalty is small in comparison to the windfall from unused balances. Quantitatively, the estimated loyalty effect would need to sustain for an average of at least 1.2 years to outweigh the profits from breakage. This is a demanding requirement, given the short longevity of many small businesses, with the average longevity for

restaurants in China estimated at about 1.3 years. In other words, in current market condition, once a customer has paid in advance, a merchant has little financial incentive to encourage that customer's return if the customer appears likely to forget or abandon their credit.

Taken together, these empirical findings cast doubt on the notion that PNBL schemes are consumer-friendly tools. Neither of the two intuitive justifications for the PNBL model—that consumers profit from upfront discounts and that firms profit by locking in loyal customers—hold in our setting. Instead, PNBL programs function largely as a transfer from consumers to firms.

The striking patterns in our descriptive analysis naturally raise two deeper questions. First, what behavioral mechanisms lead some consumers to prepay but not consume, and do these consumers anticipate such biases ex ante?[3] Our data and setting do not allow a causal identification of these mechanisms, but we provide systematic correlational evidence. We find that unused balances are much more likely when the prepayment occurs on a customer's very first visit to a merchant. Likewise, prepayments made at merchants located farther from the consumer's typical travel radius are more likely to go unused. These patterns are consistent with consumers overestimating their future demand or being overly enticed by the one-time bonus (for example, a "$10 free credit for $100 prepay" that might heuristically appear to be a 10% discount, when it only truly pays off if the customer returns to spend the full $100). Eventual usage rates are also correlated with how long people delay or how much time it takes them to recall their balances, suggesting a role for inattention as well. Though correlational in nature, the evidence is broadly consistent with behavioral frictions such as consumer inertia playing an important role in driving PNBL breakage. A second question is external validity: Do the breakage phenomenon and its behavioral roots extend beyond our specific study context? To do so, we conducted two online surveys of consumers in China and the United States. The responses reveal significant parallels: PNBL experiences are common in both countries; consumers in both settings report similar motivations for participation—most commonly to receive a bonus or discount; both groups recall substantial levels of breakage comparable to those observed in our empirical setting;

[3] Consumer sophistication matters for welfare implications. In settings such as PNBL, welfare depends on whether consumers anticipate their own behavioral frictions ex ante and on the extent to which realized behavior deviates from those expectations. See, for example, Ericson (2011); Tasoff and Letzler (2014); Bronchetti et al. (2023); Miller, Sahni, and Strulov-Shlain (2023); Rodemeier (2025).

and both cite similar reasons for breakage, primarily related to inertia.[4] These findings corroborate our empirical results and suggest that the patterns we document here may not be unique to our study context.

Finally, we consider policy remedies. We develop a simple model of prepaid consumption in which a consumer decides whether to purchase a PNBL contract from a merchant offering a discount, while facing uncertainty in future demand. The firm, aware of consumer loyalty dynamics and the potential for breakage, designs an optimal contract to offer. When calibrated with key empirical moments from our data, our model shows that the status quo market encourages firms to offer large, generous PNBL contracts in the hope of profiting from breakage. We then evaluate a counterfactual escrow policy in which the firm is required to deposit a fraction of each prepayment into an independently/centrally managed escrow fund. The firm regains access to these funds only after the consumer redeems the prepayment, and unused balances are refunded from the escrow to the consumer. We show that with a properly chosen deposit requirement, such a policy realigns the firm's incentives: instead of relying on breakage, the firm benefits from consumer redemption and loyalty. We also examine alternative policies including consumer alerts, usage reminders, and caps on prepayment amounts, but find that these interventions generally have modest effects or introduce distortions that discourage firms from offering substantial PNBL contracts.

To our knowledge, this paper provides one of the first large-scale empirical analyses of consumer prepayment programs in the digital sphere. Our work contributes to several strands of literature in economics and finance. First, we add to the behavioral economics literature that documents inertia in the consumer markets. These settings typically involve consumption commitments, such as enrollment and subscription decisions, where consumers must forecast their future demand, which often leads to suboptimal choices (Esteves-Sorenson and Perretti, 2012; Handel, 2013; Keys, Pope, and Pope, 2016; Reme, Røhr, and Sæthre, 2022; Brot-Goldberg et al., 2023; Miller, Sahni, and Strulov-Shlain, 2023). While we are not aware of prior work examining prepaid spending accounts specifically, our work is most related to DellaVigna and Malmendier

[4] This includes inattention-related factors, such as consumers not noticing expiration dates or simply forgetting they had purchased the prepayment, as well as explanations related to hassle costs. See Andersen et al., (2020), Giglio et al., (2021), and Heiss et al., (2021) for related discussions of these channels underlying consumer inertia.

(2006) who find that gym members overestimate their future attendance, leading them to overpay for unused services; Grubb and Osborne (2015) who show that cell subscribers overestimate their self-control or underpredict usage, often choosing plans with low monthly fees but high overage charges; Einav, Klopack, and Mahoney (2025) who document that subscription services generate significant revenue from consumers' inertia and failure to cancel underutilized plans; Rodemeier (2025) who experimentally studies digital rebates in online retail, documenting a non-redemption rate of about 47% (close to the average breakage rate we find here), and showing that consumers are partially sophisticated: they largely anticipate forgetting but substantially underestimate the hassle costs of redemption.

Second, our study connects to a literature on contract design in the presence of inattentive consumers (e.g., DellaVigna and Malmendier, 2004; Eliaz and Spiegler 2006, 2008; Gabaix and Laibson, 2006; Dubé, Hitsch, and Rossi, 2010; Grubb, 2015; Johnen, 2019; Chen et al., 2021). In particular, DellaVigna and Malmendier (2004) show that firms may exploit consumers' time-inconsistency and overconfidence by designing contracts with distorted pricing—below cost for commitment goods, above cost for temptation goods—and by adding back-loaded fees and switching costs. In our context, firms have the simple, perverse incentive to offer generous PNBL contracts and wait for inertial consumers to let them lapse. We demonstrate that this incentive misalignment can be neutralized by a simple escrow mechanism, which is widely used in other transactional settings to hold funds with a third party until contractual conditions are met (List and Lucking-Reiley, 2002; Antras and Foley, 2015; Hoffmann, Inderst, and Opp, 2022).

Third, our study relates to the emerging literature on fintech and consumer finance. Our analysis of PNBL is most closely related to the emerging literature on the "Buy Now, Pay Later" (BNPL) schemes, which follows the opposite financial logic where consumers delay payment for current purchases.[5] Evidence suggests that BNPL services help some consumers relax liquidity or credit constraints (Di Maggio, Williams, and Katz, 2022; Bian, Cong & Ji, 2023; Berg et al., 2024; Dong et al., 2024). But on the risk side, easy access to BNPL can lead to over-extension, as consumers may underestimate the cumulative burden of multiple installment plans (DeHaan et al., 2024), and regulators have noted that heavy BNPL users often juggle multiple loans and run

[5] By 2021, an estimated 60% of U.S. adults had tried a BNPL service, and BNPL loans accounted for over $97 billion (about 2.1%) of global e-commerce – several times smaller than the PNBL economy.

up high credit card balances simultaneously (Consumer Financial Protection Bureau, 2025). The risk profiles contrast in BNPL and PNBL: the former can lead to debt and downstream repayment issues, whereas the later carries the risk of consumers overpaying for intended consumption that doesn't occur at all. But in both cases, these risks highlight the importance of understanding the role of behavioral frictions in consumer-FinTech interaction and how they may lead to opportunity of exploitation (Heidhues & Kőszegi, 2010). Other related work includes Agarwal et al., (2023), who show, in the context of credit card reward programs, that "sophisticated" consumers (who pay off cards) profit at the expense of "naive" consumers who incur interest and fees. A seemingly win-win product actually redistributes welfare due to consumer mistakes.

The remainder of the paper proceeds as follows. In Section 2, we describe the institutional setting and data. Section 3 documents consumer redemption patterns and explores potential behavioral explanations for breakage. Section 4 examines the business economics of PNBL, quantifying profits from breakage versus loyalty gains. Section 5 presents the PNBL model and analyzes policy counterfactuals. Section 6 concludes.

2. Background and Data

2.1 PNBL Schemes

Prevalence. "Pay Now, Buy Later" (PNBL) schemes have become a ubiquitous marketing and financing strategy in consumer markets. Gift cards are a prominant example of PNBL schemes. A recent survey by the consumer finance company Bankrate found nearly half of U.S. adults currently hold at least one unused gift card or voucher, with an average value of $187 – amounting to roughly $23 billion in outstanding unspent balances (Kelton, 2024). These unused sums represent potential breakage revenue for firms. Estimates suggest 10–19% of gift card balances remain unredeemed at any given time, and around 6% of cards are never used at all (Paytronix Gift Card Trend Report, 2024).

The rise of digital platforms and mobile apps has amplified the role of PNBL schemes in retail and service industries. Starbucks provides an example: by integrating a closed-loop payment system into its mobile app, the company allows consumers load funds in advance onto the Starbucks Card or app and earn rewards for doing so. As of 2021, over 25% of all U.S.

Starbucks transactions were conducted via the mobile app using prepaid balances, and members of the Starbucks Rewards program (who pre-load funds) account for over half of the company's U.S. revenue (Dieu, 2024). This reflects a broader consumer acceptance of prepayment for convenience and perks. Other major U.S. retailers such as Amazon, Target, and Walmart online platforms encourage similar behavior.

In China, PNBL schemes are even more widespread due to the prevalence of super-apps and digital payment integration in everyday commerce. It is common for consumers to purchase prepaid packages or store credits for a wide range of services – from meal and coffee vouchers, to ride-hailing coupons, to fitness club memberships – often via mobile platforms (He and Wu, 2025). Though academic studies on this issue still lack, it is clear that PNBL has become a mainstream element of both Western and Asian digital marketplaces, fundamentally changing how consumers budget and how firms manage customer funds.

Regulation of PNBL. U.S. laws on unredeemed prepaid balances are fragmented. Many states treat unused gift card funds as unclaimed property subject to escheatment to the state after a dormancy period. For example, New York requires turning over dormant gift card balances to the state after 5 years of inactivity (New York State Office of the Comptroller, 2024). By contrast, other jurisdictions explicitly exempt gift cards from unclaimed property laws: California, for example, prohibits expiration dates on gift certificates and exempts cards issued after 1997 from escheatment (La Barrie, 2012). Under U.S. Supreme Court precedent, the state entitled to unclaimed funds is first the state of the owner's last known address, and if that is unknown (as is common for gift cards), then the state of the issuer's incorporation (Kile and Wall, 2008).

Although unclaimed-funds statutes aim to prevent companies from unjust enrichment on unused balances, many retailers still profit from breakage by leveraging the patchwork of state laws and careful corporate structuring that govern prepaid liabilities. In practice, large retailers often establish gift card subsidiaries or choose jurisdictions for their gift card operations that do not require escheat of unused balances. This "giftco" strategy means that if a card isn't redeemed, the remaining balance legally falls under a state that lets the company keep the money (EisnerAmper, 2014).[6]

[6] For example, Macy's Inc. (incorporated in Delaware, a state with aggressive unclaimed property enforcement) was found to be issuing its gift cards through a subsidiary in Ohio, a state with lenient escheat

In China, the legal landscape for PNBL schemes is quickly evolving. National regulations administered by the People's Bank of China and the Ministry of Commerce set strict rules on prepaid cards. Since 2012, the Administrative Measures on Prepaid Cards have required real-name registration for large purchases and capped maximum card values (e.g. an unregistered single-purpose card cannot exceed ¥1,000, about $160) (Berger et al., 2012). However, there have been significant gaps in enforcement and consumer recourse. He and Wu (2025) suggests that survey in China found that nearly half of prepay consumers encountered problems such as non-refundable balances, undelivered services, or businesses disappearing with their money. In response, China's Supreme People's Court issued new nationwide guidelines in 2025 to crack down on prepaid consumption abuses. Under the updated guidance, simply ignoring customers' refund requests can now be treated as fraud, punishable by triple compensation under China's Consumer Rights Protection Law and even criminal charges in egregious cases. Despite these new regulatory measures, voluntary balance breakage remains unregulated and continues to accrue to businesses as pure profit.

2.2 Study Context

We study a leading digital platform in China that delivers integrated operational and financial services to small and medium-sized merchants. The suite of operational tools include payment aggregation and point-of-sale (POS) systems, QR code–based payment processing, and a business management app with accounting features. It also provides financial services such as micro-loans and consumer prepayment programs. By 2024, the platform had several million merchant subscribers across almost all cities in China.

In 2021, the platform introduced a digital menu program. Merchants who enroll receive an online menu for their products, which enables consumers to browse offerings, place orders, and make payments directly through the platform's app. The "Pay Now, Buy Later" (PNBL) functionality—the focus of our study—is embedded within this digital menu system as an

rules; Delaware sued, and Macy's eventually settled and paid millions in unclaimed property liabilities. Starbucks is another notable case – despite states like Delaware and New York mandating escheatment, Starbucks (based in Washington, which exempts gift cards from its unclaimed property program under current law) was able to book $212 million in gift card breakage revenue in 2022 (Wüllner, 2025).

optional feature at checkout. Merchants can choose to activate PNBL on their digital menu, allowing customers to prepay a specified amount to the merchant as a stored-value balance for current and future purchases. In exchange for making a prepayment, the consumer receives a bonus credit (for example, a common promotion is "Receive ¥10 in bonus value for every ¥100 prepaid"). Once a prepayment is completed, the app displays the customer's updated balance, including the prepaid amount, the bonus incentive earned, and a running tally of spending and remaining funds. Figure 1 provides an example of the consumer interface for this PNBL feature.

Several features of the PNBL program in this context are worth highlighting. First, participation in PNBL is entirely at the merchant's discretion. They decide whether to offer prepayment at all and, if so, can customize the menu of prepayment denominations and the corresponding bonus rates. This flexibility means PNBL offerings vary by merchant, though in practice many converge on a few popular designs. For example, a 10% bonus incentive is a typical configuration, as we will show with summary statistics in Section 3.

Second, when a customer makes a prepayment, the funds are immediately credited to the merchant's account just like a normal sales receipt. In effect, consumer prepayments provide merchants with a loan, financed by the promise of future service. The only direct cost to the merchant is the bonus credit, and that cost is incurred only if and when the customer returns and spends the prepaid balance.[7] In other words, if a consumer never redeems the balance, the merchant simply keeps the funds.

Third, merchants are obligated to honor all prepaid balances. A consumer can request a refund of any remaining prepaid balance at any time, which the merchant is expected to fulfill. If a merchant were to go out of business or leave the platform, consumers are in principle entitled to reclaim unused balances. However, the refund process must typically be completed in person at the merchant's physical location. In practice, this means that if a business closes abruptly and the owner cannot be contacted, consumers may face challenges in recovering their funds.

Finally, the PNBL concept is culturally familiar to Chinese merchants and consumers. Even before the digital era, it was common for restaurants, retail shops, and service providers to offer informal prepayment or stored-value schemes. Customers would pay in advance to

[7] The prepayment function is offered to businesses as part of the platform's service package, and the platform does not take any commission or fee from the prepayments made.

establish a personal account or credit line at a favorite business in exchange for a bonus or discount – for example, depositing a sum with a restaurant to receive extra dining credit. The platform's PNBL program essentially digitizes and scales up this traditional practice. Because of this familiarity, consumers generally understand the mechanics and risks of prepaying for future consumption, and the program has been well received in the market. This cultural context, combined with the platform's technological infrastructure, situates PNBL as a FinTech innovation built upon an established consumer behavior norm.

2.3 Data

Our empirical analysis uses three administrative data files provided by the platform company.

Prepayment Event File. This file contains the universe of PNBL prepayment transactions that occurred on the platform between January 1, 2023 and December 31, 2024. Each record in this dataset corresponds to a single prepayment event, and includes the merchant's anonymized ID, the consumer's anonymized ID, the transaction date, the amount the consumer prepaid, and the bonus (gift incentive) amount granted. This dataset allows us to identify every instance of a consumer prepaying value to a merchant through PNBL during the two-year window. In total, there are 96,829 unique merchants who received at least one prepayment in this period, and 4,616,004 unique consumers who made those prepayments. The typical consumer in the data made about 1.9 prepayments over two years; 65% of consumers made only a single prepayment, and 93% of consumers prepaid at only one PNBL-participating merchant. The average prepayment transaction was ¥227 (about 32 USD).

Transaction File. This file covers the universe of point-of-sale transactions recorded on the platform during 2023–2024 for the set of merchants and consumers involved in PNBL. For every merchant that ever accepted a PNBL prepayment and every consumer that ever made a prepayment (as identified in the Prepayment Event File), we obtain all their individual transaction records over the two-year sample period. Each transaction record logs the merchant ID, consumer ID, date, and transaction amount for a purchase. These purchases include both PNBL-related redemptions and ordinary, pay-as-you-go transactions. A crucial feature of this

dataset is that it allows us to observe each participating consumer's spending before *and* after they engage in a prepayment. Because we have the full transaction history of PNBL users at these merchants, we can track how a consumer's spending at a given merchant changes relative to their prepayment date. The average transaction value (across all purchases in this dataset) is relatively modest, about ¥55 (median ¥33), which is typical for the food and small retail purchases that dominate our sample.

Merchant Characteristics File. This file provides background information on each merchant. For each of the 96,829 PNBL-participating merchants, we observe the merchant's name and location, the date the merchant first registered on the platform, the date the merchant enrolled in the PNBL program, and if applicable, the date the merchant closed or unsubscribed from the platform. The Merchant Characteristics File will be used mainly to provide information on merchant location, and to define subsamples (for example, when we focus on merchants that are still operating by the end of our study period).[8]

All merchant and consumer ID variables in our datasets are fully anonymized to protect privacy.

Using these three data files, we construct the analytical samples for our study. Many of the summary statistics and figures in Section 3 are directly computed from the raw transaction-level data or simple aggregations thereof (e.g., total prepayments per merchant, or average spending per consumer). For our event-study analysis of consumer spending before and after making a prepayment, we create a panel dataset at the weekly level by merging the three sources together. In this panel, the unit of observation is a merchant–consumer pair by week. We begin by identifying the universe of merchant–consumer pairs that engaged in at least one PNBL transaction (using the Prepayment Event File). We then retrieve all transactions for each of these pairs from the Transaction File. Next, we aggregate the data to the week level for each pair, computing several key variables that will be used to evaluate consumption behavior changes around the prepayment event.

[8] In most cases, we cannot perfectly distinguish between permanent closure and merchants simply unsubscribing from the platform's service. In our analysis, however, this is less of an issue because we primarily use the data to identify operating firms. That is, if a firm has transaction records in our data, we can be confident it is still operating.

For each merchant–consumer pair in each week, we are able to measure: (1) *Total spending*: the total amount (in yuan) of non-prepayment purchases that the consumer made at the merchant during that week (i.e., the sum of all ordinary transaction amounts, excluding any prepayment purchases); (2) *Prepayment amount*: the total value of any new prepayments that the consumer contributed to the merchant in that week. Most of the time this is zero, except in the week when the consumer actually makes a PNBL purchase; (3) *Gift incentive amount*: the total value of bonus credit (gift money) that the merchant granted to the consumer that week as a result of PNBL purchases. This is typically a fraction of the prepayment amount (e.g. ¥10 if ¥100 was prepaid); (4) *Account balance*: the consumer's remaining prepaid balance with that merchant at the end of the week. We calculate this by taking the previous week's balance, adding any new prepayment plus bonus, and subtracting any spending the consumer redeemed from their balance during the week; (5) *Out-of-pocket payment*: the amount of the consumer's actual cash payments to the merchant that week. This includes any new prepayment amounts (since those are paid out-of-pocket to load the balance) as well as any ordinary purchases made with cash. Conversely, if a consumer pays for a purchase using their existing PNBL balance, that purchase does not count as out-of-pocket spending for that week (because no "new" money changes hands at the time of redemption). In other words, for any week in which the consumer's prepaid balance fully covers their expenses, the out-of-pocket spending is zero. Appendix Figure 1 provides an example illustration of how balances evolve with spending and top-ups.

Two technical clarifications merit note. First, the gift bonus portion is not counted as out-of-pocket payment, since it is an extra value granted by the merchant. When we analyze consumer expenditures, out-of-pocket spending will be used as the key measure of actual revenue flowing from the consumer to the business. Second, it is possible for a consumer to buy a new prepayment before exhausting a prior prepaid balance. In our construction of the account balance, we handle such cases with a first-in, first-out (FIFO) convention. This means that when a consumer has multiple active prepayments, any spending is assumed to draw down the earliest purchased balance first. The remaining balance from a later prepayment stays at 100% of its value until the earlier balance is fully used up, at which point subsequent spending begins to deduct from the next prepayment. This FIFO assumption provides a straightforward way to track the evolution of balances and spending over time, even if customers top up their accounts multiple times.

3. Consumer Behavior

3.1 Descriptive Statistics

We begin by characterizing PNBL transactions. Figure 2A shows the distribution of prepayment amounts across all PNBL transactions. The distribution is highly concentrated at a few common offers, with pronounced spikes at ¥50, ¥100, ¥200, ¥300, and ¥500. The modal choice is ¥100, which alone accounts for nearly half of all prepayment transactions. For context, the average non-prepayment meal transaction at participating restaurants is ¥58 (median ¥34), and the average daily per capita food and beverage expenditure in China is about ¥22 in 2023. In other words, a ¥100 PNBL purchase is roughly two to five times the average person's food spending at any given merchant visit.

Figure 2B plots the distribution of bonus incentive ratios (the gift amount divided by the prepayment amount). This distribution is more diffuse because merchants have discretion in setting bonus rates, but it still exhibits notable focal points. In particular, a 10% bonus (e.g. ¥10 gift on a ¥100 prepayment) is the most common ratio, which constitutes about 35% of cases. Indeed, the single most popular PNBL deal in our data is a ¥100 prepayment for an extra ¥10 credit, which accounts for roughly 24% of all prepayment transactions. Such incentive levels are economically significant: a 10% bonus is larger than the typical net profit margin which is around 8% for small to medium-sized restaurants in China.[9]

Figure 3A shows the total value of prepayments collected each week across the platform. The program took off since 2021, and in 2023–2024 (our study period), consumers purchased about ¥1.75 billion in prepaid credits (about $242 million USD). For individual merchants that joined the program, PNBL has become an important source of revenue. Figure 3B shows that, for the average participating merchant, about 10% of weekly revenue comes from new PNBL prepayments.

[9] See, for example, https://www.chinabaogao.com/detail/654746.html

3.2 Balance Breakage

We define balance breakage as the portion of prepaid value that is never utilized by the consumer. We analyze this by tracking each prepayment and measuring the share of its balance that has been spent. Using transaction records linking each prepayment to subsequent purchases and gift redemptions, we compute for each PNBL transaction the proportion of the balance used by the end of our study period.

The upper-left panel of Figure 4 presents the distribution of usage rates for all prepayments in our sample. We categorize each transaction's outcome into 12 bins: never used (0% spent), 1–10% used, 10–20% used, ..., up to 90–99% used, and fully exhausted (100% used). We find that over 20% of prepayments remain completely unused (0% redeemed), about 7% are fully used by the end of the sample, and a large share of balances see only partial usage. A major share of transactions fall into low-usage categories.

One concern with the above calculation is that some prepayments occurred late in the sample and may simply have not had enough time to be used, rather than being permanently abandoned. To address this, we impose progressively longer windows for observing usage and examine how the distribution evolves. We therefore need to determine how long a window is sufficient. Appendix Figure 2 shows cumulative balance usage hazard among PNBL consumers who eventually use at least some of their prepayments. We find that 98.5% of eventual users initiate spending within 26 weeks and over 99% do so within 52 weeks. This suggests that if we do not see a PNBL consumer use any of the prepaid funds within six months, they likely never will. Using these windows as benchmarks, we restrict the sample to prepayment transactions made at least 6 months (and, in a stricter cut, 12 months) before the end of 2024, and then recompute the usage distribution.

The upper-right panel of Figure 4 shows the outcome with a ≥ 6-month window: even after allowing a half-year for utilization, roughly 20% of these prepayments remain entirely unused. The share of fully exhausted balances does rise compared to the full sample, suggesting that some late-period purchasers simply needed more time, but breakage remains widespread. Pushing the cutoff further, the lower-left panel of Figure 4 uses a ≥ 12-month window. Here we see a modest further increase in complete usage (about 14% of prepayments are fully used with

a one-year window, roughly double the 7% in the unfiltered data), yet still on the order of 20% of prepayments stay completely unused.

Another potential source of bias is merchant attrition: if a business closes down, any outstanding prepaid balance at that merchant would go mechanically unused. To ensure we are measuring voluntary consumer behavior and not usage prevented by merchant exit, the lower-right panel of Figure 4 restricts the sample to prepayments at merchants that were still operational at the end of our study period (i.e., the merchant had transaction records in the final week of 2024). Among this subset of active merchants, we continue to find about 17% of prepayments never redeemed at all, and around 17% fully redeemed, with the rest partially used.

Overall, Figure 4 demonstrates that a substantial fraction of prepaid value remains unspent. Even under the most conservative conditions (long usage windows and merchants known to be open), we estimate an overall balance breakage rate on the order of 40%.

3.3 Correlates of Balance Breakage

Our finding on substantial breakage naturally raises the question of why some consumers abandon their prepaid funds while others fully spend them. Here we explore several dimensions of heterogeneity that could help explain balance breakage.

Prepayment and Incentive Amount. We first examine how balance breakage varies across PNBL transactions by different prepayment amounts and gift incentives. Figure 5, panel A reports average breakage rates for the five most common prepayment tiers previously identified in Figure 2, panel A (¥50, ¥100, ¥200, ¥300, and ¥500). The results suggest that lower prepayment amounts are associated with higher breakage rates. Figure 5, panel B further explores whether, within each prepayment tier, the size of the gift incentive influences the breakage rate. We find no clear evidence of such a relationship. These patterns provide an initial characterization of balance breakage: consumers are more likely to abandon their prepaid balances when the committed amount is relatively small.

A natural explanation is that small residual balances rarely justify a dedicated trip: the fixed hassle of visiting the restaurant (e.g., travel, planning, decision effort) can exceed the benefit

from redeeming only a few yuan. This is indeed one of the reasons listed for breakage in both the China and the USA samples of our survey results.

Prior Visits. Next, we examine whether breakage is more common when the prepayment decision is *impromptu*—made on a first-ever visit—versus when the customer already knows the business. In our setting, the PNBL offer appears at the digital checkout screen (Figure 1) during a visit. This means a first-time visitor has to make the prepayment decision before consuming any product, with little firsthand experience of the venue's quality.

We analyze usage outcomes for consumers with and without prior visits. We focus on prepayments that are at least six months old by the end of our sample (so that any unused balances can reasonably be deemed abandoned given the hazard patterns from Appendix Figure 2). We then aggregate all such prepayments to the consumer–merchant level and construct two measures of breakage for each consumer–merchant pair: (1) the fraction of the prepaid balance used (ranging from 0 if completely unused to 1 if fully used), and (2) an indicator for complete non-use of the balance. We regress these outcomes on indicators of the customer's familiarity with the merchant prior to the PNBL purchase – specifically, a dummy for whether the consumer had ever visited the merchant before, the number of prior visits, or total prior spending at the merchant.

The results in Table 1 support the importance of prior experience. In Panel A, which examines the fractional usage outcome, having visited the merchant at least once before the PNBL purchase is associated with a 10.8 percentage point higher usage rate on average. This represents about a 23% increase relative to the mean usage rate of 46.4%. Similarly, greater experience intensity (more prior visits or higher cumulative previous spending) is significantly associated with higher utilization of the prepaid balance (Table 1, Panel A, columns 2–3). Panel B of Table 1 considers the probability of complete breakage (zero usage). It shows that a prior visit reduces the likelihood of never using the balance by 14.2 percentage points, which is a 65% reduction relative to the baseline incidence of full breakage. These patterns suggest that, consumers who were already patrons of the business exhibit substantially better follow-through in using their prepaid credits. By contrast, those who bought in on their first visit – without prior familiarity – are far more prone to abandon the remaining balance. For example, these customers might be

lured by the apparent "discount" of the bonus credit and optimistically assume they will return to use the remaining balance in the future, even without a clear commitment to do so.

Travel Costs. We next consider whether the distance a consumer must travel to revisit the merchant influences balance redemption. For each consumer, we define their "dining hub" as the frequency-weighted geographic centroid (latitude and longitude) of all merchants that consumer visited in 2023–2024 (including those not offering PNBL). This measure approximates the area where the customer typically dines. We then compute the straight-line distance from the PNBL merchant to this dining hub. The idea is that a merchant located far from a consumer's usual dining area imposes higher travel costs for the consumer to return and redeem the prepaid credit.

Our regression results in Table 1, column 4 show that prepayments made at more distant, out-of-the-way merchants are indeed more likely to be wasted, with both lower usage rates (panel A) and higher odds of total abandonment (panel B). Appendix Figure 3 reports a more detailed version of these findings by allowing breakage to vary by various distance bins. Results show that the breakage rate remains roughly flat for distances within 1 km of a consumer's usual dining hub, but rises sharply beyond 1 km.

Attentiveness. We further investigate differences in how consumers draw down their prepaid balances over time. For prepayments that are at least partially used, we compare the timing dynamics between consumers who eventually utilize most of their balance and those who leave a large portion unused. Appendix Figure 4 plots the usage trajectories for groups of prepayments defined by their ultimate usage level. Each blue line in the figure corresponds to a group of consumers with a given range of final balance remaining (for example, one line tracks those who ultimately used only 1–20% of their balance, another line those who used 80–99%, etc.), plotting the average number of weeks taken for the remaining balance to fall below certain thresholds. The dashed black line represents the trajectory for "complete finishers" (those who redeem 100% of their balance).

Several notable patterns emerge from this analysis. First, consumers who end up leaving most of their balance unused tend to delay the start of their spending significantly longer than those who nearly exhaust their balance. For example, compared to consumers who go on to spend 80–99% of their prepaid value, those who ultimately spend less than 20% of it take on average almost 6 weeks longer to initiate any spending from their balance. Second, once spending does

begin, the pace at which the balance is spent down is broadly similar across groups. In other words, regardless of whether a consumer eventually uses almost all of the credit or leaves most of it untouched, their rate of spending (after the first use) is roughly comparable – the blue trajectory lines have similar slopes. Third, the group who fully use their balance (dashed black line) shows a distinct pattern: they start spending relatively late (later than some moderate-use groups) but then accelerate quickly, drawing down the balance in a much shorter window once they begin.

These patterns are consistent with differences in consumer attentiveness and align with the classic distinction between "sophisticates" and "naifs" in the behavioral economics literature (O'Donoghue and Rabin, 1999). The consumers who ultimately redeem their entire balance appear to be highly attentive – perhaps aware of potential forgetfulness, they make it a point to use up the credit, even if it means a burst of spending after some delay. By contrast, those who leave balances unused behave like naïve consumers who rely on memory and incidental reminders: they only begin to spend much later, and even then fail to fully utilize the funds, effectively abandoning the remaining balance. This attentiveness gap offers one explanation for why a large share of PNBL participants do not follow through on their prepaid consumption plans.

Interpretation and limitations. A large body of work in behavioral contract theory highlights that superficially similar consumption patterns can arise from distinct underlying mechanisms (Kőszegi, 2014). In our setting, substantial balance breakage, together with systematic heterogeneity across consumers, suggests that behavioral frictions play a meaningful role. Three broad classes of behavioral models can generate the patterns we document: (i) biased beliefs and naïveté, (ii) time-inconsistent preferences, and (iii) limited attention or forgetting. We describe each mechanism, and relate it to our empirical patterns.

Consumers may overpredict their likelihood of returning to the merchant. This naivete about future demand is a common feature in models of biased beliefs. In our context, first-time visitors face the greatest uncertainty about their own return probability, and they also exhibit the highest breakage rates. Likewise, the positive association between prior visits and eventual redemption can be naturally interpreted through the lens of forecast errors: consumers with little experience may optimistically assume a higher probability of future demand than is eventually

realized. Under this interpretation, PNBL breakage may simply reflect miscalibrated expectations (i.e., naivete) rather than a failure to carry out intended actions.

A second possibility is that consumers do intend to redeem their balance but repeatedly postpone doing so due to present-biased preferences. In quasi-hyperbolic discounting models, individuals overweight immediate costs relative to future benefits, leading to procrastination even when the intended action yields positive utility (O'Donoghue and Rabin, 1999). In the context of PNBL, a consumer may plan to return "soon," but the small fixed hassle of visiting the merchant or remembering the balance induces repeated delay. Some of our findings such as the strong relationship between initial delay and eventual breakage are consistent with this mechanism. However, present bias requires a specific form of time inconsistency that we cannot isolate with the available data: for example, we do not observe planned vs. realized timing of redemption or the evolution of intended return dates.

A third explanation is that consumers are time-consistent but inattentive. They may fail to track prepaid balances, lose salience of small remaining credit, or simply forget the existence of the prepayment. This mechanism plays a central role in models of inattention, salience, and memory gaps. Several pieces of evidence align well with this view. First, consumers who delay their first redemption by several weeks are disproportionately likely to never use the balance at all, suggesting a decay in salience. Second, breakage is much higher when the merchant lies outside a consumer's typical travel radius, which is consistent with the idea that redemption becomes less top-of-mind when the location is outside routine behavior. Third, in our consumer surveys, a substantial share of respondents explicitly attribute unused balances to forgetting or lack of awareness. Importantly, this mechanism differs conceptually from present bias: an inattentive consumer may intend to redeem and face no internal self-control conflict but fails to act because the balance is not mentally available at the relevant moments.

These behavioral frameworks offer distinct accounts of why consumers may abandon prepaid balances, yet he correlations in the data including heterogeneity in redemption by experience, travel costs, balance size, and timing fit each of these models to varying degrees. For these reasons, our analysis remains agnostic about the precise behavioral model and focuses on documenting the economic consequences of breakage and the incentives it creates for firms.

3.4 Consumer Surveys

We run two online surveys to gain further insight into the prevalence of PNBL, consumer motivations for participation, as well as reasons underlying balance breakage. We survey a random sample of 1,000 Chinese individuals using the Credamo platform and 1,100 U.S. individuals using the CloudResearch platform. In both surveys, we do not restrict to any specific population subgroups to make the survey responses as generally representative as possible. The two surveys contain the same set of seven questions, with the Credamo survey in Chinese and the CloudResearch survey in English (see Appendix A for survey text).

Figure 6 presents the main findings from the surveys. Start with the U.S. survey findings represented by the green bars of the chart. Panel A shows that 75% of respondents reported having purchased PNBL contracts over the past year. Panel B shows the distribution of prepayment values among those who answered "yes" in Panel A, with about 70% of respondents having bought less than $200. Panel C shows the types of businesses where prepayments are made, with shopping, online services (such as gaming, streaming, and other apps), and food being the most common settings. In Panel D, we asked what motivated prepayments, where respondents could choose up to three answers from a list of seven. The most commonly selected reason is "To get a discount or bonus" (33%), followed by "The product requires a prepayment / subscription to use" (25%) and "For convenience or faster checkout later" (21%). Panel E shows that 52% of respondents reported having unused prepayments that are at least six months old. Panel F tabulates the most commonly cited reasons for the unused balances among those who answered "yes" in Panel E, with "I simply forgot I had them" being the most commonly chosen (30%), followed by "The remaining balance was too small to bother using" (19%) and "I wasn't aware of any expiration or time limit" (12%).

The responses from the Chinese sample are broadly correlated those from the US sample, with several notable distinctions. First, almost all respondents (99.5%) reported to have purchased prepayments over the past year (panel A). This is consistent with our prior of a high prevalence of PNBL schemes in China. Second, in the Chinese sample, the most cited reasons for unused prepayments are "I ran out of time to use them before they expired" (19%), "It's too much hassle or inconvenient to use" (18%), and "I wasn't aware of any expiration or time limit" (18%),

and unlike in the US sample, a relatively small proportion answered "I simply forgot I had them" (7%).

These survey responses also help assess the generalizability of our findings. First, PNBLs are a common consumer experience not only in the Chinese context (our study setting) but also in other countries, such as the United States. Second, consistent with our restaurant-based setting, the primary motivation for consumer prepayment is to obtain a bonus or discount. Third, balance breakage is prevalent: in our estimation sample, the average breakage rate is approximately 40%, while survey responses indicate that around 50% of respondents in both China and the U.S. have unused balances older than six months. Fourth, the most frequently cited reasons for balance breakage relate to inattention (e.g., forgetting about the prepayment or not realizing it would expire) and hassle costs (e.g., difficulty of use or balances too small to justify spending). These reasons align with our econometric findings in Section 3.3, which show strong associations between balance breakage and proxies for inattention and travel costs.

4. Business Profitability

In this section, we examine the economics of PNBL schemes from the merchant's perspective. Theoretically, a Pay-Now-Buy-Later program serves three primary purposes for a firm: (i) it provides upfront liquidity – the prepaid principal – in exchange for a gift incentive (effectively an interest payment), and (ii) it helps lock in customers and fosters consumer loyalty. In practice, our data reveal a third critical function: (iii) merchants can profit by retaining unused prepayment balance. We aim to quantify the financial impact of these three mechanisms in order to clarify the trade-offs firms face and to inform potential solutions for the problem of unused balances. Before proceeding, it is useful to distinguish two notions of "profitability" for a PNBL program: an accounting perspective versus an economic perspective. We clarify each in turn:

Accounting Profitability. In Sections 4.1 and 4.2, we analyze PNBL profitability from a pure accounting standpoint. Under this view, the *benefit* of PNBL to the business is the access to immediate liquidity and any revenue from unredeemed balances (breakage). The corresponding *cost* is the value of any bonus or incentive that the merchant must give the customer in exchange for the upfront payment. This accounting approach tallies the direct financial flows from the

program—cash in (including the windfall from breakage) versus incentives paid out—much as they would appear in a firm's books. Crucially, this perspective ignores "second-use values." That is, it does not ask whether customers who prepaid would have spent money at the merchant anyway even without PNBL, nor whether PNBL attracts a different pool of customers. We begin with this intuitive, bookkeeping definition of costs and benefits because it likely mirrors how businesses initially evaluate PNBL in practice.

Economic Profitability. In Section 4.3, we ask: even if PNBL shows a positive accounting profit, could the firm be losing out in the long run? The idea is that pocketing a customer's unused balance might forfeit future profit from that customer's patronage. In other words, a customer who never returns (yielding breakage revenue now) might have generated more profit over time had they returned and spent their balance. Evaluating this trade-off requires constructing a counterfactual scenario to measure how much additional spending or "loyalty" the PNBL program generates. In Section 4.3, we estimate this loyalty effect – the increase in customer spending due to PNBL – and weigh it against the one-time gain from balance breakage. This economic notion of profitability accounts for the potential long-run benefit of repeat business versus the immediate gain from an abandoned balance.

4.1 Implicit Borrowing Cost

When a consumer prepays for future purchases, they are effectively extending an interest-free loan to the merchant. The merchant receives funds upfront and "repays" them over time as the consumer redeems the prepaid balance for goods or services. The outstanding prepaid balance at any moment represents the portion of the loan still held by the business. In exchange for this upfront funding, the merchant pays a gift incentive (a bonus credit or discount) to the consumer, which can be viewed as the implicit interest on the loan.

To quantify this implicit borrowing cost, we calculate the implied interest rate on each prepayment transaction by tracking how the prepaid balance is drawn down over time. Appendix Figure 5 provides an illustrative example of this balance segmentation method. In that example, a consumer prepays ¥100 and does not spend anything for the first three weeks. In week 4, the consumer spends ¥60, reducing the remaining balance to ¥40. Two weeks later, another ¥25

is spent (balance now ¥15), and the final ¥15 is used one week after that. We treat each interval as a separate loan segment from the consumer to the merchant (in the example: ¥60 for 3 weeks, then ¥25 for 5 weeks, then ¥15 for 6 weeks). Given a gift incentive of, say, ¥10 on this prepayment, we solve for the interest rate r that equalizes the total "interest" paid (the ¥10 gift multiplied by 1 minus the gross profit margin π) with the interest that would accrue on each balance segment.[10] In the example, this entails solving:

$$¥10 \text{ incentive} \cdot (1 - 60\%) = r \cdot ¥60 \cdot 4 + r \cdot ¥25 \cdot 5 + r \cdot ¥15 \cdot 6$$

assuming simple (non-compounding) interest as is standard for business loans in China, and a gross profit margin of 60%, which is typical for food and beverage businesses.[11] The r in the above equation is the implicit interest rate of borrowing per week. More generally, we compute each transaction's interest rate using the formula:

$$r = \frac{\text{gift} \cdot (1 - \pi)}{\sum_t (c_t \cdot d_t)} \qquad (1)$$

where each term c_t is the amount of balance spent in segment t and d_t is the duration (in weeks) that segment remained outstanding. If a consumer makes a new prepayment before exhausting a previous balance, we apply a first-in-first-out (FIFO) assumption to isolate the effective loan periods for each prepayment. Note that prepayments that were not fully used are excluded from this interest-rate calculation.

Applying this methodology to the universe of prepayments, we find that merchants incur extremely high borrowing costs when consumers fully use their balances. The average implied interest rate is about 0.98% per week (median 0.56% per week, standard deviation = 1.37%), which corresponds to an annualized rate on the order of 51%. This far exceeds typical financing costs: for comparison, the average business loan rate in China was roughly 4% per year during our study period. In other words, from a pure lending perspective, PNBL is an extremely expensive way for merchants to raise capital. Our calculations suggest that if every customer returns and

[10] Note that when a PNBL prepayment is fully redeemed, the merchant does not incur the nominal gift incentive cost directly; instead, the merchant pays only the short-run variable cost of providing goods or services equivalent in value to the gifted amount.

[11] Gross profit margin in restaurants is defined as (Revenue – Cost of ingredients) ÷ Revenue. Food and beverage businesses generally have food ingredient costs in the range of 20–40% of revenue, which means gross profit margins around 60% are common.

uses up their entire prepaid balance, a PNBL scheme would not be profitable for the firm: the implicit interest paid via incentives would far outweigh the benefits of receiving cash upfront (relative to the cost of borrowing from a bank).

4.2 Breakage ROI

The above analysis suggests that if all prepaid balances are eventually redeemed, merchants effectively pay a prohibitively high interest rate on the upfront funds, making PNBL unprofitable as a financing tool. We now consider the flip side: many consumers do not use their full balances, leading to balance breakage. In this subsection, we quantify how unused balances alter the financial calculus for merchants.

We define a merchant -level return on investment (ROI) metric to capture the gains from balance breakage relative to the costs of incentives. For each merchant, we compute:

$$\text{ROI} = \frac{\text{Balance breakage}}{\text{Incentives paid}} - 1 \qquad (2)$$

In words, this ROI is the net profit per 1 yuan "invested" in the PNBL program. The numerator is the total value of prepaid balances that were never redeemed (within at least six months of purchase), which can be viewed as the windfall revenue the merchant ultimately pockets. The denominator is the total amount the merchant spent on gift incentives to attract prepayments, excluding any incentives on balances that were later broken, since those were never actually redeemed by customers. By subtracting 1, we interpret ROI = 0 as the break-even point (in which breakage equals incentive costs), and ROI > 0 as indicating net positive returns from the scheme.

Figure 7 plots the distribution of this ROI across merchants. Starting from the left tail of the distribution, only about 1% of participating merchants lost money on their PNBL program over our study period (these are cases with ROI < 0). The vast majority saw large gains: the median merchant realized a net return of 5.5 (i.e. ¥5.5 in net profit per ¥1 of incentive cost), and about 27% of merchants achieved ROI > 50. Around 6% of merchants earned pure profit without paying any incentive at all – essentially selling dollar-for-dollar gift cards that were never redeemed.

Taken the findings from Sections 4.1 and 4.2 together: If every customer fulfills their purchase commitment and uses their entire balance, the merchant actually loses money on the implicit loan (relative to conventional borrowing costs). In reality, however, almost every merchant turns a profit from PNBL due to substantial breakage rates.

4.3 Consumer Loyalty Effects

Our analysis so far shows that abandoned balances are a major source of PNBL profits. However, it does not necessarily follow that businesses *should* simply prefer customers to abandon their balances. By definition, when a balance is never used, the consumer does not return to the merchant. This raises an "opportunity cost" question: Which is more valuable to the firm – the immediate financial gain from breakage, or the potential long-term profit from encouraging the customer to return and spend their balance? In theory, PNBL prepayments might serve as a self-commitment device that increases customer loyalty or habit formation. If so, even though breakage is lucrative, a merchant might earn more in the long run by inducing repeat purchases (and thus forgoing some breakage). In this subsection, we estimate this loyalty effect and weigh it against the opportunity cost of losing the customer's future business.

Loyalty Effect Estimation. To measure whether prepayments boost subsequent consumer spending at the merchant, we conduct an event-study analysis of customer purchase behavior before and after adopting PNBL. We focus on consumers who eventually used their entire prepaid balance during the sample period so that any loyalty effect can be observed without the confounding of incomplete usage. For each such consumer–merchant pair, we compare the customer's spending after the first prepayment to their own spending before the prepayment, using a staggered difference-in-differences framework. Specifically, we estimate a regression of the form:

$$\text{Additional spending}_{ijt} = \beta \cdot \text{Post}_{ijt} + \alpha_{ij} + \alpha_t + \varepsilon_{ijt} \qquad (3)$$

where $\text{Additional spending}_{ijt}$ is consumer i's additional out-of-pocket spending made to merchant j at week t, beyond any spending financed by the prepaid balance. The variable Post_{ijt} is an indicator that equals 1 for periods t's after the consumer made the first prepayment at the merchant j. The term β captures the average change in the consumer's weekly spending at the

merchant after joining the PNBL program. By construction of the outcome, if a customer prepays and then uses that balance for purchases, those purchases do not count as "additional" spending (they generate no out-of-pocket expenditure). Thus, β isolates changes in new money that the customer spends at the merchant on top of using the prepaid funds.[12] We include consumer–merchant fixed effects (α_{ij}) to control for each customer's baseline preference for the merchant and week fixed effects (α_t) to account for time trends, and we cluster standard errors at the consumer–merchant level. ε_{ijt} is the error term. We cluster standard errors at the consumer-merchant pair level.

We estimate equation (3) on a balanced panel of consumer– merchant–week observations over the two-year study period. Because prepayment adoption is staggered, different consumers are observed for varying lengths of pre- and post-treatment periods. Accordingly, we construct three samples: (i) consumers with at least 3 months of observations before and 3 months after their first prepayment, (ii) consumers with at least 3 months before and 6 months after, and (iii) consumers with at least 3 months before and 9 months after. Naturally, those in the longer-post-period samples made their prepayments earlier in our study window. By imposing these sample restrictions, we ensure a consistent event-time horizon for each group and avoid any compositional shifts that could bias the estimated event-study coefficients.

One concern with the two-way fixed effects (TWFE) approach of equation (3) is that PNBL adoption is staggered over time: early adopters are compared to later adopters, which can bias event-study estimates if effects vary over time. To address this, we also implement the debiased DID estimator proposed by de Chaisemartin and D'Haultfoeuille (2024). This method allows us to flexibly estimate dynamic treatment effects in event time; it also allows us to incorporate the intensity of treatment by scaling the post-period indicator with the gift incentive amount. In other words, we can estimate not only whether spending rose after the prepayment, but also whether larger incentive bonuses induce proportionally greater increases in spending. This "amount-weighted" analysis will let us compare the elasticity of additional spending with respect to the incentive to the ROI calculations from the previous section.

[12] For example, if a consumer were to make the prepayment, use up that prepayment, but never come back and spend more at the merchant, the additional spending effect β will be zero.

Results. The estimation results provide evidence of a meaningful boost in customer spending following a prepayment. Panel A of Table 2 reports baseline two-way fixed effects estimates. In the sample of consumers observed for at least three months post-prepayment, a customer's weekly spending at the merchant roughly doubles after the PNBL purchase: the coefficient β implies an increase of about ¥2.7 per week, relative to a pre-PNBL mean of approximately ¥1.3 per week. While a 200% increase sounds large, it is important to note that the baseline spending rate is very low because the typical customer visits a given merchant infrequently (on average about once every 42 weeks). In practical terms, our estimate suggests that post-PNBL, the customer visits and spends at the merchant about twice as often as before – roughly once every 20 weeks.

The loyalty effect persists over longer horizons, though with somewhat reduced magnitude. When we require at least six or nine months of post-period data, the estimated spending increase falls slightly (to around ¥2.3 and ¥2.0 per week, respectively), but remains statistically significant. We also find that larger incentives lead to larger spending responses: in a three-month window, each ¥1 of incentive prompts about ¥0.05 of additional weekly spending (an elasticity of 0.05). Over six- and nine-month windows, this incentive-spending elasticity stabilizes around 0.03. In Panel B of Table 2, we present results using the de Chaisemartin and D'Haultfoeuille (2024) estimator. The qualitative patterns are similar: there is a clear increase in post-prepayment spending that gradually decays over time. The debiased estimates suggest a somewhat faster decay than the TWFE estimates, with the incentive elasticity dropping from about 0.06 in the initial quarter to 0.037 by the nine-month horizon. Overall, the evidence indicates that PNBL participation does generate additional customer expenditure at the merchant, but the effect size is modest in absolute terms and tends to taper off within 6–9 months.

Figure 8 reports event-study coefficients for additional spending from three months before up to nine months after the first prepayment. The dynamics confirm that there are no pre-trends – spending in the weeks leading up to the prepayment is flat – and there is little immediate effect at the moment of the prepayment (week 0 to week 1), since the first purchases are covered by the prepaid balance and do not require new spending. Starting in the second period after adoption, we observe a significant rise in out-of-pocket spending, which then gradually declines over subsequent months. By around 6–9 months post-treatment, the additional spending effect diminishes, consistent with the regression results. For completeness, Appendix Figure 6 shows

similar event-study plots for alternative sample restrictions in terms of different post-period windows.

Effect Size. How large is the estimated loyalty effect? To gauge the effect size, we conduct the following calculation: How long must a returning customer continue to visit the business (at the elevated post-PNBL spending rate) for the cumulative profit from their visits to outweigh the one-time breakage profit the merchant would earn if the customer never returned? This break-even horizon quantifies the opportunity cost of losing a customer to balance breakage.

To fix ideas, consider the revenue and cost flows from a single customer under two scenarios: (a) the customer never returns after the prepayment (the balance is abandoned), versus (b) the customer comes back, uses the prepaid amount (and bonus), and continues to make repeat purchases. We derive the breakeven condition by equating the merchant's profit from these two scenarios. On the left-hand side is the profit if the balance is never redeemed: essentially the merchant keeps the entire prepaid principal P (since no goods or services are delivered). On the right-hand side is the profit if the customer returns and spends: this includes three components – the cost of the bonus incentive, the profit from the customer using the prepaid balance, and the profit from the customer's ongoing loyalty. Formally, the break-even condition can be written as:

$$P = -\delta \cdot P + \pi \cdot (1 + \delta) \cdot P + \pi \cdot (\bar{y} + \beta \cdot \delta \cdot P) \cdot t \qquad (4)$$

where P is the prepaid principal (e.g. ¥100 in a "pay ¥100 get ¥110" offer), and δ is the bonus rate (e.g. $\delta = 0.1$ for a 10% bonus). On the right side, $-\delta \cdot P$ is the upfront cost of the bonus credit given to the customer. The term $\pi \cdot (1 + \delta) \cdot P$ is the merchant's gross profit when the customer returns and uses the entire prepaid amount *plus* the bonus, assuming a gross profit margin π. Finally, $\pi \cdot (\bar{y} + \beta \cdot \delta \cdot P) \cdot t$ represents the gross profit from the customer's continued loyalty over t periods beyond using up the prepaid balance. Here $\bar{y}$ is the customer's baseline weekly spending at the merchant absent PNBL, $\beta \cdot \delta \cdot P$ is the incremental weekly spending induced by the PNBL program (as estimated above), and thus the sum of the two terms is the customer's weekly spending *after* joining the program. For simplicity, this formulation assumes the post-PNBL spending increase is constant over time and scales linearly with the bonus size.[13]

[13] In Appendix Figure 7, we present nonparametric estimates indicating that consumer spending increases monotonically with the size of the bonus. There is suggestive evidence of a convex relationship characterized by outsized increases at higher bonus amounts (e.g., gift incentives exceeding ¥80).

Rearranging equation (4) to solve for t yields the breakeven time – the length of time the customer must keep returning for the loyalty effect to compensate the lost breakage:

$$t = \frac{(1-\pi)\cdot(1+\delta)\cdot P}{\pi\cdot(\bar{y}+\beta\cdot\delta\cdot P)} \qquad (5)$$

Note that equation (5) is dividing the total "cost" to the merchant of the customer returning (rather than disappearing) by the per-period profit from that customer's continued spending, which is an equivalent way to think about the merchant's trade-off.

To gauge the magnitude of this trade-off, we plug in parameters relevant to our setting. We assume a gross profit margin of $\pi = 0.6$ (see earlier discussion in Section 4.1).[14] We take a baseline weekly spending $\bar{y}$ of ¥1.2 (the average per-customer weekly spend at a given merchant in our sample, including consumer-weeks with zero transaction), and use the loyalty spending elasticity $\beta = 0.037$ from our nine-month estimate in Table 2. We then compute the break-even time t for various PNBL offer structures $\{P, \delta\}$ observed in the data.

Appendix Figure 8 plots the average breakeven horizon (in years) for each of the 20 most common PNBL deals in our sample. The breakeven time varies widely with the design of the offer. It rises sharply with the prepaid amount P – larger prepayment principals provide a bigger one-time breakage benefit, which takes longer to offset via loyalty. Conversely, holding P fixed, breakeven time decreases as the bonus rate δ rises, since a higher bonus induces a stronger loyalty response in our setting. Notably, for many popular PNBL offers, the required loyalty duration is very long. For example, the single most common offer ("pay ¥100, get ¥110") requires roughly *47 weeks* of sustained post-PNBL spending at the higher rate to break even. Across all the major offers, the average breakeven time is about 1.2 years. To put this in perspective, the average lifespan of a small or medium restaurant in China is only on the order of 1.3 years (about 500 days) (Reuters, 2025). In other words, a typical merchant would have to retain a PNBL customer for almost the entire remaining life of the business just to recoup the profit it would have made if that customer never returned and the prepaid balance was pure profit.

[14] We use a gross profit margin of 60% instead of net profit margin of 8% in this calculation, because most fixed costs (rent, existing staff, etc.) wouldn't increase for the extra customers from PNBL programs (10% of revenue for the average participating business) – the main cost of an additional transaction is the cost of ingredients and perhaps an incremental labor/utility cost.

It is worth noting that our breakeven estimate is conservative in several respects. We assumed the post-PNBL spending bump (and its profit flow) continues indefinitely, when in reality our estimates show the loyalty effect fades over time. We also based the baseline spending rate on customers who ultimately used their balances; the average customer (including those who abandon balances) likely has an even lower visit rate, which would make the required retention period even longer. These considerations reinforce the conclusion that, from a narrow economic perspective, merchants have little incentive to reduce balance breakage. The immediate profit from breakage vastly outweighs the long-run profit from marginal increases in loyalty under typical conditions.

5. A Model of Prepaid Consumption

Our empirical evidence suggests that, under the status quo system, PNBL leads to substantial balance breakage, likely arising from behavioral frictions that we discussed in Section 3.3, which we will broadly refer to as "consumer inertia" in this section. Businesses benefit from PNBL schemes and prefer consumers to breakage. This raises a natural question: can the market be restructured to better align firm incentives with consumer welfare? More specifically, is there a way to have a PNBL economy in which both firms and consumers willingly engage, where firms are motivated to serve their customers rather than profit from breakage—all without requiring consumers to overcome their own inertia?

We now present a simple model of PNBL contracting in which a consumer decides whether to purchase a PNBL contract from a merchant offering a discount, while facing uncertainty in future demand. The firm, aware of consumer loyalty dynamics and the potential for breakage, designs an optimal contract to offer. We parameterize the model to key empirical moments in our data, characterize the incentive problem, and then conduct counterfactual analyses to explore potential policy remedies.

5.1 Set Up

Consider a firm that sells a single (composite) product at a fixed, per-unit price p. In addition to spot purchases at the regular price, the firm also offers a PNBL scheme: consumers may prepay for q units at a discounted unit price $\gamma \cdot p$, where the price discount factor (i.e., one minus the PNBL gift ratio) is $\gamma \in (0,1)$.

Consumer Utility. A consumer decides whether to enroll in the PNBL scheme. If she opts not to enrol, her demand follows the distribution $D \sim F(\cdot)$. If she does enrol, her demand follows $\bar{D} \sim \bar{F}(\cdot\,|\gamma)$ which is assumed to stochastically dominate $F(\cdot)$:

$$F(\cdot) \preceq \bar{F}(\cdot\,|\gamma)$$

where $\bar{F}$ is stochastically decreasing in γ. These assumptions are motivated by the empirical evidence: PNBL participation carries a loyalty effect that shifts the expected demand upward, and a larger gift ratio induces a greater shift. If the consumer enrols, her realized demand may or may not exceed prepaid quantity q. If demand exceeds q, the consumer purchases the remaining units at the regular price p. Otherwise, we assume any unused prepaid quantity is forfeited by the firm.

To model balance breakage, we assume a possibility of consumer inertia, with a probability η, a consumer who enrolled in PNBL behaves as if she had not, and therefore her demand follows the null distribution $D \sim F(\cdot)$. The consumer chooses to enroll if the expected utility under PNBL scheme is larger than that under spot purchase. Let expected utility from spot purchase be:

$$E[U_{spot}] = E[v(D) - p \cdot D]$$

where $v(D)$ represents the surplus from consumption. With PNBL, consumer's expected utility is:

$$E[U_{PNBL}] = E[v(\bar{D}) - \gamma \cdot p \cdot q - p \cdot (\bar{D} - q)^+]$$

where $(x)^+ = \max\{x, 0\}$ captures any additional units purchased beyond the prepaid quantity. Consumer enrols in PNBL whenever $E[U_{PNBL}] \geq E[U_{spot}]$. Notice that here in our baseline setup,

we assume that ex ante the consumer is unaware of inertia risks, and believes that her demand under PNBL will follow $\bar{D} \sim \bar{F}(\cdot|\gamma)$.[15]

Firm Profit. A firm decides whether to offer PNBL contracts and, if it does, the optimal contract specification (q, γ). If the firm does not offer PNBL, its expected profit is:

$$E[\Pi_{no-PNBL}] = E[p \cdot D - c \cdot D]$$

where c is per-unit production cost. With PNBL offering, firm's revenue comes from prepayment and potential additional purchases:

$$E[\Pi_{PNBL}] = \gamma \cdot p \cdot q + \eta \cdot E[p \cdot (D - q)^+ - c \cdot D] + (1 - \eta) \cdot E[p \cdot (\bar{D} - q)^+ - c \cdot \bar{D}]$$

Firm offers PNBL if $E[\Pi_{PNBL}] \geq E[\Pi_{no-PNBL}]$, and if does, it chooses (q, γ) to maximize $E[\Pi_{PNBL}]$ subject to the consumer's participation constraint: $E[U_{PNBL}] \geq E[U_{spot}]$. In our setting, we assume that firm *does* know that with a likelihood of η, consumer inertia will render, causing the actual spending to fall short.

5.2 Parameterization

We now parameterize our model using either moments observed in the data or econometric estimates from previous descriptive analysis. Our baseline is microdata on all transactions that happened in merchants that offered BNPL during the study period, and we report annualized quantity.

Price. We compute price as the average spending amount per visit which is 54.6 yuan.[16]

Quantity Distribution. We define quantity as the annualized number of consumption trips by a consumer at a given merchant. As discussed in Section 3.3, some consumers bought into PNBL contracts the first time they visited the merchant, which means we cannot observe

[15] In our policy counterfactual analysis, we will consider cases where we correct consumer's ex ante belief about inertia though policy tools such as balance breakage disclosure at enrollment. We acknowledge that consumers can sometimes be aware of their own inertia. For example, Miller, Sahni, and Strulov-Shlain (2023) reports a field experiment with newspaper subscriptions, testing auto-renewal vs. auto-cancellation contract terms. The study finds that making a subscription automatically renew (as opposed to defaulting to cancel at the end of the term) actually deters some consumers from initially signing up, implying that consumers partially anticipate their own future inertia and thus avoid contracts that would lock them in.

[16] The unfiltered median and IQR of transactions are 33 yuan and 41 yuan, respectively.

their pre-PNBL consumption behavior. To credibly estimate quantity distribution, we focus on PNBL consumers who spent up all of their prepayment, and time periods after their PNBL enrollment, and compute annualized consumption trips. Appendix Figure 9 shows the empirical distribution of this statistics. We approximate this arrival process with a Poisson distribution of $\lambda = 11.7$, i.e., an expectation of 11.7 trips per year, which corresponds to the mean of the empirical distribution. This constitutes our estimate of quantity distribution $\bar{F}$. We then use the loyalty effect estimates (i.e., the relationship between PNBL gift ratio and visits) to back out distributions without PNBL or with PNBL but with inertia.

Loyalty Effects. In light of our findings in Section 4.3, among consumers who did come back to spend up their prepayments, the increase in post-PNBL spending is positively correlated with the gift ratio offered by the PNBL contract (See Appendix Figure 7). We estimate that each 10 percent increase in gift ratio is associated with an increase in annual visit by 2.7 trips (SE = 0.018). We then approximate $F \sim \text{Poisson}[\lambda - 27 \cdot (1 - \gamma)]$ where $\lambda = 11.7$ as discussed before.

Consumer Surplus. To characterize consumer utility from consumption trips, we estimate a generic demand curve, relating quantity (average weekly trips of a consumer visiting a given restaurant) and the merchant's price (average spending amount per trip across all trips). To alleviate endogeneity concerns, we use a leave-self-out approach to compute price, where we compute merchant's price using all transactions but from the consumer at question. Appendix Figure 10 reports the empirical relationship. The linear approximation of the demand curve is $P = 65.2 - 19Q$, and given an average price of 54.6 yuan (as mentioned above), we compute that consumer surplus per trip is about 3 yuan.

Per-unit Cost. We assume a gross profit margin of 60% (as we did in Section 4.1), or a cost of 40% of revenue.

Figure 9 provides a numerical characterization of our baseline model. The left panel shows consumer surplus (CS) contours. Several patterns emerge. First, CS tends to increase with the gift ratio γ, as higher rewards make the PNBL scheme more attractive. CS is nonmonotonic in the prepayment requirement q, which peaks at an intermediate level. This reflects a trade-off: if q is too low, realized consumption will frequently exceed the prepaid amount and therefore the consumer must pay for excess usage at the full price (an underage risk); If q is too high,

consumers risk forfeiting unused balance (an overage risk).[17] Finally, the consumer would intuitively avoid contracts in the lower-right region (high prepayment, low gift ratio). The dashed line marks the boundary where CS from PNBL turns negative. Contracts beyond this threshold are rejected by the consumer.

The middle panel plots firm profit contours, which reveals a bimodal structure with two regions of high profitability. One lies in the upper-left, where q is low and γ is high. Here, the firm offers generous rewards at minimal cost due to the small prepaid base, and profits are driven by consumer loyalty gains. The second region is in the middle-right, which feature high q and medium levels of γ. In this area, profit is driven by consumer inertia: although the firm risks paying large gifts if the prepaid amount is used in full, many consumers underuse their balance, which makes the PNBL scheme profitable. The solid line shows the firm profitability contour boundary. PNBL schemes are not profitable (relative to pure spot purchase) in the high-gift, medium-prepayment zone, where the firm can profit neither from the loyalty boost or breakage.

The right panel shows the feasible set of q-γ combinations. That is, where both consumers and firms gain positive surplus and profit from PNBL contract over not enrolling or offering it. To further highlight firm incentive, we color the feasible set based on whether the firm profits more from the consumer actually spend their prepayment or if the consumer slacks (i.e., the inertial outcome). Finally, the circled dot on the panel shows firm's optimal PNBL offering.

Our numerical characterizations provide two useful insights. First, firms have an ill incentive to offer large PNBL contracts in hopes of profiting from consumer inertia. Such contracts are often accepted by consumers who face uncertainty (or hold misperceptions) about their future spending. Second, there exists a region of PNBL contracts, particularly on the left side

[17] To see this formally, take the derivative of consumer expected utility under PNBL $E[U_{PNBL}]$ with respect to q:

$$\frac{\partial}{\partial q} E[U_{PNBL}] = -\gamma \cdot p - \frac{\partial}{\partial q} E[p \cdot (\bar{D} - q)^+]$$

Using the identity:

$$\frac{\partial}{\partial q} E[p \cdot (\bar{D} - q)^+] = -Prob(\bar{D} > q) = -[1 - \bar{F}(q|\gamma)]$$

We get:

$$\frac{\partial}{\partial q} E[U_{PNBL}] = p \cdot \left[\left(1 - \bar{F}(q|\gamma)\right) - \gamma\right]$$

Therefore, consumer expected utility first increases at small levels of q, and reaches a maximum at $\bar{F}^{-1}(1-\gamma|\gamma)$, and then declines. In the language of the newsvendor model (e.g., Arrow, Harris, Marshak, 1951), the turning point occurs when the probability of consuming less than q falls below the critical fractile point $1-\gamma$.

of the charts where the prepayment requirement is relatively low, that functions as intended: consumers return to use their prepayments, and firms benefit through increased loyalty. We regard this as a "healthier" region of the market. However, these options tend to be less attractive from the firm's perspective. In the next stage of our analysis, we use the model to simulate policy counterfactuals and evaluate whether viable policy instruments can help steer the market toward these healthier outcomes.

5.3 Counterfactual Analysis with an Escrow Policy

We now consider policy solutions to neutralize balance breakage as a business profit strategy and help align the business's incentives with actually delivering the service to the consumer. We consider an escrow mechanism where a fixed proportion of consumer PNBL prepayments must be deposited in a centrally managed escrow account. The firm cannot access these reserved funds until redemption takes place: when the consumer uses part of their prepaid credit at the merchant, an equivalent portion of the reserved funds can be released to the company. If the prepayment is never used (or if the company disappears), the consumer can get a refund from this fund. The firm ultimately receives the money for goods and services it actually delivers, while a fixed proportion of still-unused balance remains protected.[18]

Notice that the escrow mechanism is essentially a partial refund guarantee which reduces the firm's gain from consumer inertia. In fact, if the deposit requirement is set to 100%, then the business has to pay back all unused balances and never benefit from breakage.[19] The tradeoff, though, is that a higher deposit rate discourages the firm from offering large, generous (i.e., high

[18] Similar escrow mechanisms have been used in the industry. One example is the travel sector in the UK, where tour operators must arrange trust accounts or insurance to protect customer money paid for package holidays. If a tour operator goes out of business before delivering your vacation, this financial security is used to refund prepayment. Another example is "health club bonds" in several states in the US, where companies that sell long-term memberships must post a surety bond, where if the business fails to honor its commitments, customers can claim against the bond to get their money back.

[19] In this sense, the escrow mechanism functions similarly to escheat laws (Section 2.1), though they differ substantially in implementation. Escheat laws allow firms full access to prepaid funds upfront and require them to refund unused balances only after a dormancy period. This ex post enforcement can be challenging, as firms may abscond with the funds or structure predatory contracts to maximize upfront liquidity, even if refunds are eventually mandated. By contrast, an escrow mechanism requires firms to deposit funds in advance and grants them access only gradually as consumption occurs, which reduces the incentive for opportunistic behavior.

gift ratio) PNBL contracts, because, as we see in our baseline model, those contracts are mostly designed to glean profit from inertial consumers.

To formally see the impact of the escrow mechanism, we augment our baseline model where if the consumer enrols in PNBL but spends less than q, she receives a refund that equals a fraction $\zeta \in (0,1)$ of the unused funds. The consumer's expected utility is now:

$$E[U_{PNBL}] = E[v(\bar{D}) - \gamma \cdot p \cdot q - p \cdot (\bar{D} - q)^+ + \zeta \cdot r \cdot p \cdot (q - \bar{D})^+]$$

and the participation constraint remains:

$$E[U_{PNBL}] \geq E[U_{spot}] = E[v(D) - p \cdot D]$$

The firm's expected profit is:

$$E[\Pi_{PNBL}] = \gamma \cdot p \cdot q + \eta \cdot E[p \cdot (D - q)^+ - \zeta \cdot r \cdot p \cdot (q - D)^+ - c \cdot D] + (1 - \eta) \cdot E[p \cdot (\bar{D} - q)^+ - \zeta \cdot r \cdot p \cdot (q - \bar{D})^+ - c \cdot \bar{D}]$$

and as before, Firm offers PNBL if $E[\Pi_{PNBL}] \geq E[\Pi_{no-PNBL}]$, and if does, it chooses (q, γ) to maximize $E[\Pi_{PNBL}]$ subject to the consumer's participation constraint: $E[U_{PNBL}] \geq E[U_{spot}]$.

Figure 10 presents the effects of the escrow mechanism on PNBL outcomes under three levels of deposit requirement ζ: 0.3, 0.6, and 0.9. Two intuitive patterns emerge. First, a more stringent escrow policy (a higher value of ζ that ensures higher fraction of unspent prepayment will be refunded) makes the consumer more willing to enroll in PNBL, as can be seen from the expansion of the feasible contract set (i.e., the L-shaped colored area of the charts) on the lower-right edge which is determined by consumer surplus boundary. Second, a higher ζ means a reduction in the firm's willingness to offer PNBL contracts. This can be seen from the shrinkage of the feasible set on the upper edge which is determined by firm profit boundary. Third, as ζ increases – that is, the firm has to return higher portions of the unused prepayments – the firm's preference for consumer inertia diminishes rapidly, as shown by the shrinking red-colored region of the feasible contract set.

These graphical patterns illustrate the key tradeoff in implementing the escrow mechanism: while a high deposit rate enhances consumer protection and encourages PNBL participation, it reduces the firm's incentive to offer large, generous PNBL contracts. In our numerical example, when $\zeta = 0.9$, the firm no longer profits from consumer inertia, and its

optimal PNBL offering (indicated by the circled dot) shifts to the upper-left corner of the feasible set. In this scenario, because the firm cannot benefit from consumer inertia, its best strategy is to offer only small-value contracts while maximizing consumer loyalty.

We believe that an intermediate level of deposit requirement, such as $\zeta = 0.6$ in our numerical example in Figure 10, strikes a balance between consumer protection and healthy firm incentives. Here, firm finds it optimal to offer large PNBL contracts with reasonable gift rate. Importantly, the optimal contract lies in a region where the firm benefits when the consumer returns and spends, rather than being inertial. In practice, this means that the firm may be motivated to promote balance usage through reminders or additional incentives.

5.4 Other Policy Interventions

Our model can also be used to evaluate counterfactual outcomes under alternative policy interventions. In Appendix B, we explore three natural regulatory approaches:

Inertia Risk Alert. In the baseline model, consumers are assumed to be unaware of their own inertia risk. A plausible regulatory response is to mandate an inertia risk disclosure at the point of PNBL enrollment—for example, a warning that, on average, 40% of prepaid balances go unused—similar in spirit to health warnings on cigarette packaging.

Balance Reminders. We introduce an additional firm-level decision variable: whether to send reminders to consumers with unused balances. If reminded, consumers are assumed to realize their full latent demand $\overline{D}$ with certainty.

Quantity Caps. Given the problematic incentive region of PNBL contract lies in the high-prepayment zone, another natural regulatory response is to enforce a cap on prepayment quantity. That is, the firm must offer PNBL contracts satisfying $q \leq \bar{q}$, where $\bar{q}$ is a regulatory limit on how much prepayment can be made each time period (e.g., month, quarter, or year).

We find that all three policies improve consumer protection and reduce firms' incentives to design predatory PNBL contracts. However, their effects are generally less pronounced than those of the escrow mechanism and may introduce excessive distortions, for example, by

incentivizing firms to offer only small contracts. We refer interested readers to Appendix B for detailed analysis.

6. Conclusion

Our analysis shows that Pay Now, Buy Later prepayment schemes, though often marketed as mutually beneficial loyalty programs, often primarily benefit firms at the expense of consumers. In our data, over 40% of prepaid balances are never redeemed, allowing merchants to effectively pocket those funds. As a result, firms recoup far more than the cost of the upfront bonuses: the median participating merchant earns roughly $5.5 in breakage profit for every $1 of bonus credit issued, and virtually none of these businesses incur a net loss. Prepayment leads to some increase in customer spending and loyalty, but this effect is negligible compared to the windfall that merchants obtain from unredeemed balances. This creates a misalignment of incentives: once a merchant has secured the payment, it has little financial reason to encourage the customer's return, since the firm profits most when the credit goes unredeemed. These outcomes challenge the "win–win" narrative surrounding PNBL programs and instead underscore that they function largely as wealth transfers from consumers to firms. From a policy perspective, our results call for interventions to protect consumers and realign firm incentives. One promising approach is an escrow requirement, under which merchants would be required to hold a portion of each prepayment in reserve until the credit is redeemed. Our analysis shows that such a policy would neutralize breakage gains and effectively align merchants' incentives with actually delivering the service, without discouraging merchants much from offering PNBL contracts.

Our findings point to several directions for further research. First, more empirical work is needed to precisely isolate the behavioral mechanisms driving non-redemption, i.e., whether breakage stems from consumer over-optimism about future usage, simple inattention, or a commitment device that fails to overcome self-control problems. Second, the empirical scope should be expanded to other contexts across different industries, countries, and platform types to assess the generality of the breakage patterns documented here. Finally, more work is needed to identify effective remedies. While we rely on modeling analysis, future work could empirically

test interventions such as reminder notifications, refund guarantees, or interface changes that increase the salience of outstanding credit.

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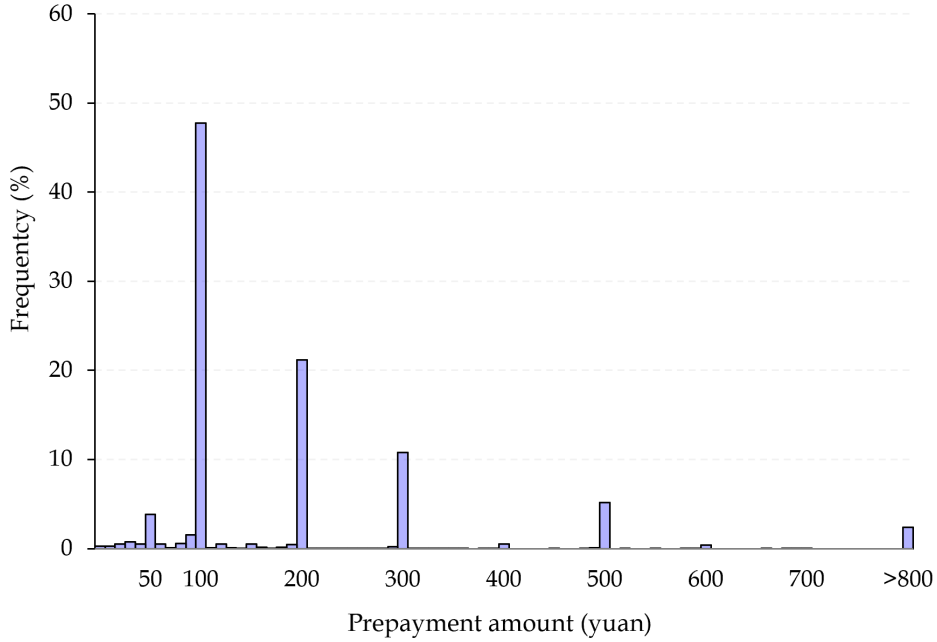
Figure 1. Consumer Interface of the PNBL Program

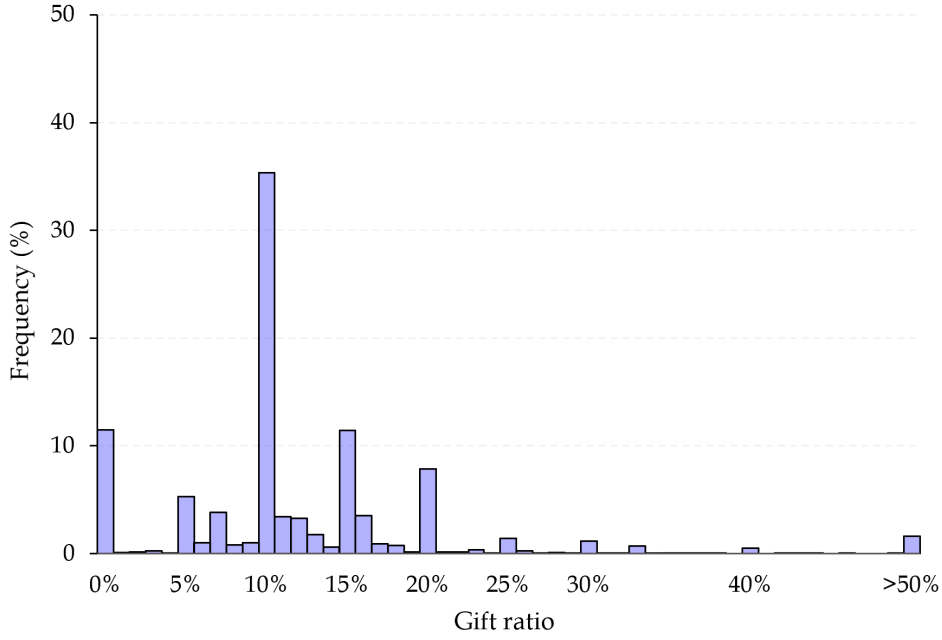
Notes: This figure shows example consumer interface of the PNBL program. The Food Menu Screen shows product offerings and allows users to add items to their cart. Proceeding to the Checkout Screen, users can view their order summary and choose PNBL options. The Payment Screen offers multiple prepayment options (e.g., "Prepay 200 yuan, get 20 yuan bonus"). Once funds are added, the user's balance is updated, as seen in the Balance Screen, which also includes an explanation of the redemption rules.

Figure 2. Prepayments and Gift Incentives

A. Distribution of prepayment amounts



B. Distribution of gift incentive-to-prepayment ratios

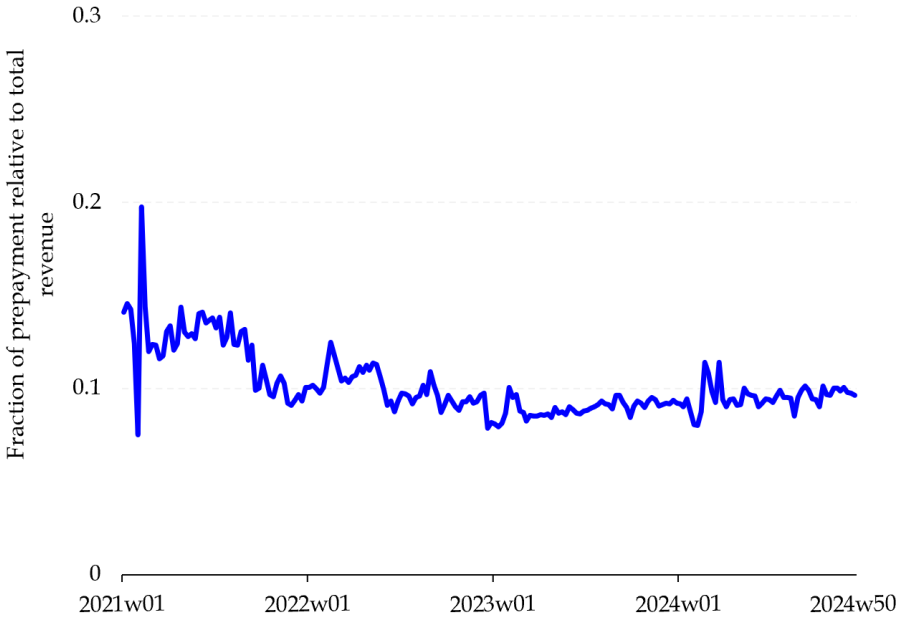


Notes: Panel A shows the distribution of prepayment amounts (in yuan) across individual prepayment transactions. Panel B shows the distribution of gift incentive ratios, defined as the proportion of promotional gift money offered relative to the prepayment amount. Frequency percentages are calculated based on the number of unique transactions for each range.

Figure 3. PNBL Activity and Revenue Share Among Participating Merchants

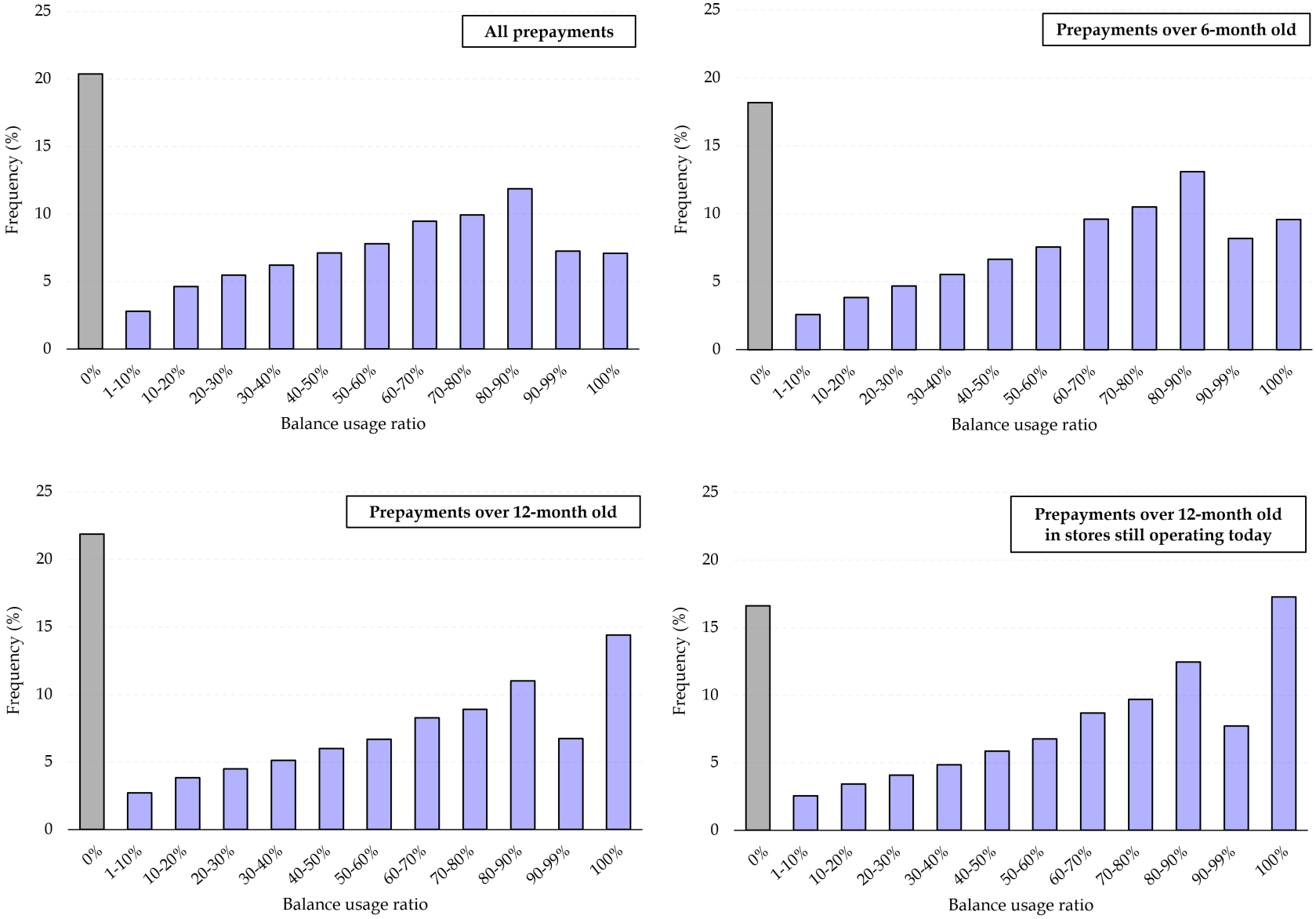
A. Weekly platform-wide prepayments

B. Prepayment share of merchant revenue



Notes: Panel A shows platform wide total prepayment made each week. Panel B reports, out of each week's total sales by merchants who offer PNBL, the percentage derived from PNBL prepayments. In other words, among merchants participating in the program, roughly 10% of their revenue each week comes from PNBL prepayments.

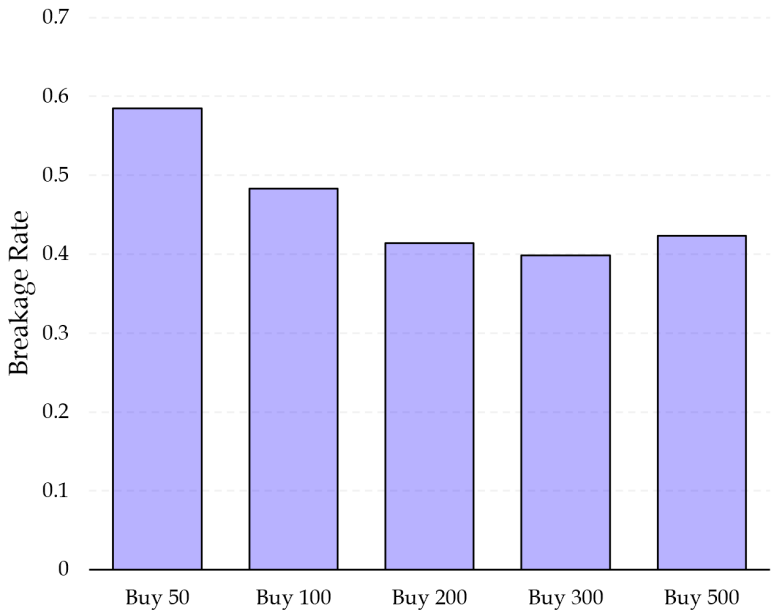
Figure 4. Overall Balance Usage



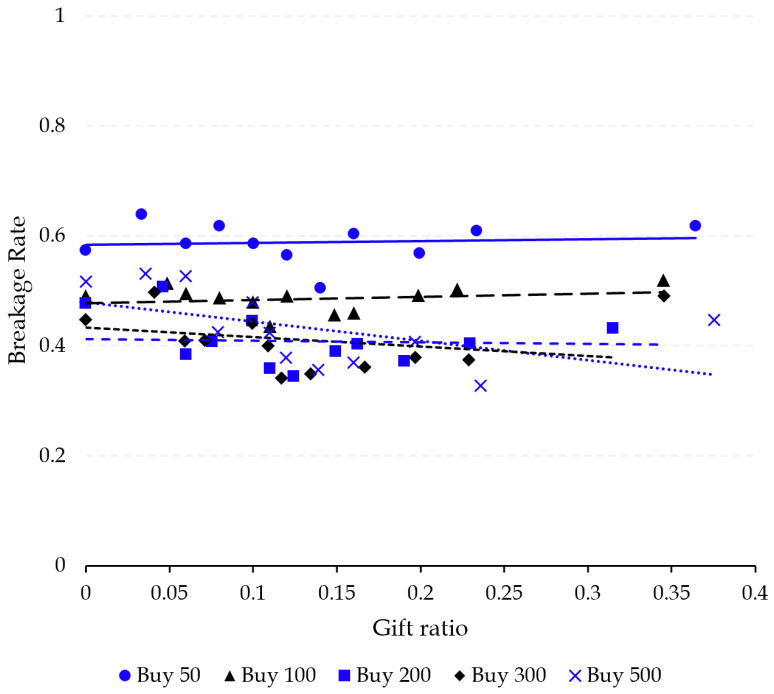
Notes: This figure shows the distribution of balance usage ratios for prepayments across different subsets of transactions. The x-axis represents the balance usage ratio in percentage intervals. Panel A shows the distribution for all prepayments. Panels B and C restrict to prepayments older than 6 and 12 months, respectively. Panel D further restricts prepayments made in merchants still operating by the end of the study period.

Figure 5. Balance Breakage Rate by Prepayment Amount and Gift Incentive Ratios

A. By prepayment amounts

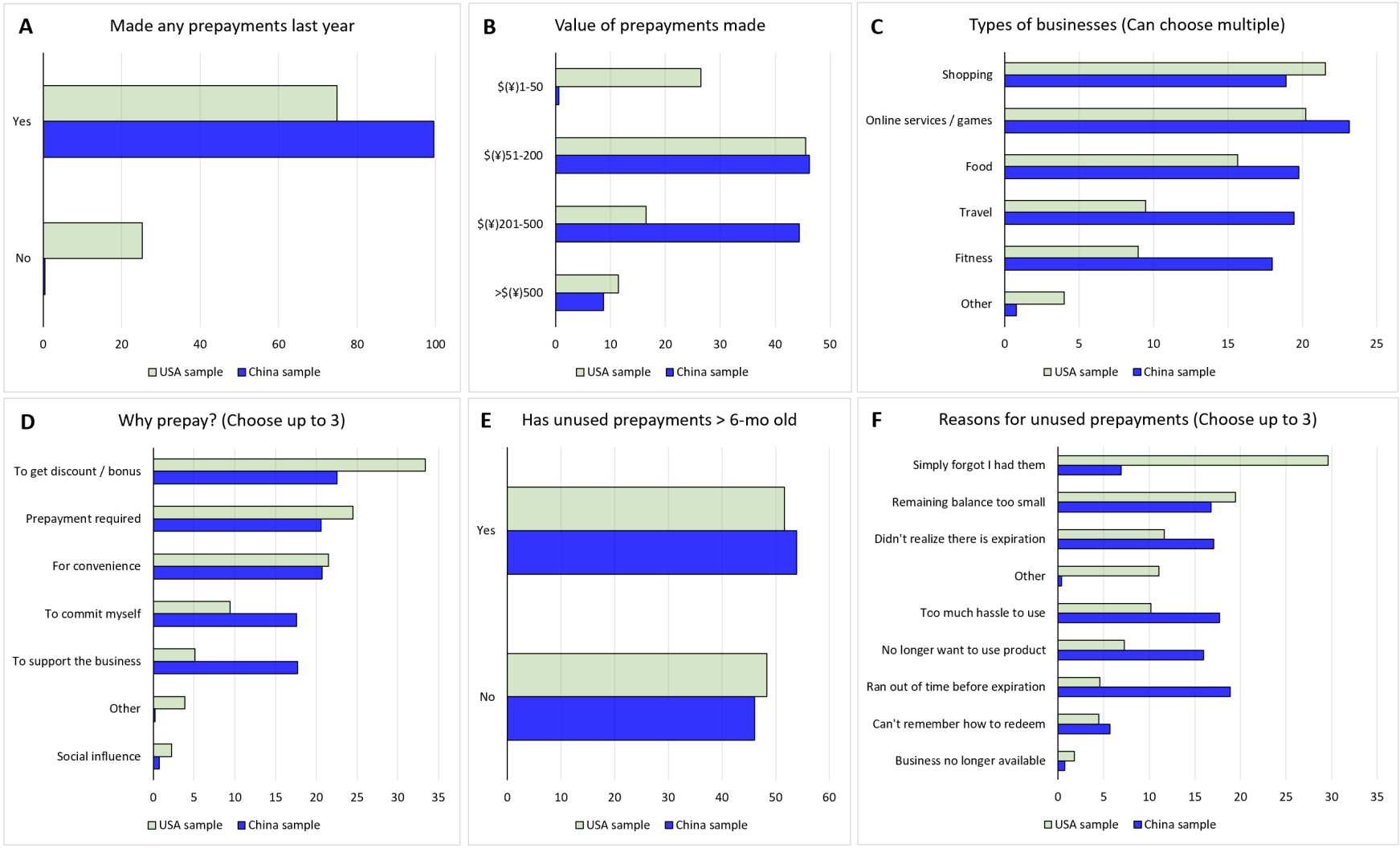


B. By gift incentive-to-prepayment ratios



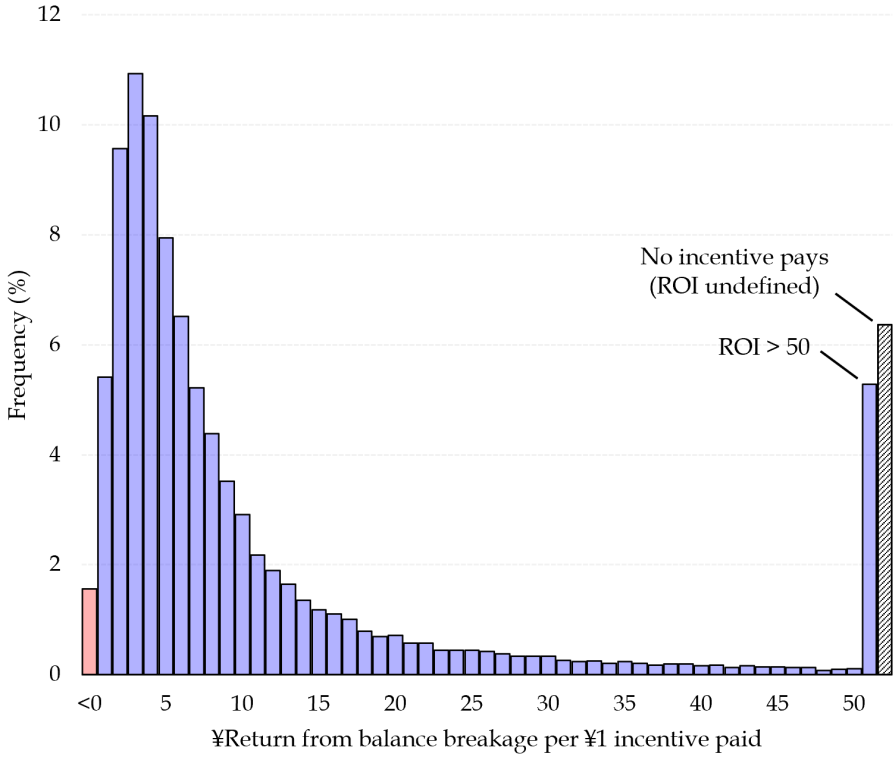
Notes: Panel A shows the average balance breakage rate (the fraction of prepaid funds unused at least six months after purchase) across five prepayment tiers (¥ 50, 100, 200, 300, and 500). Panel B shows binscatter plots of breakage rate against the gift incentive-to-prepayment ratio. All bin means are weighted by transaction count.

Figure 6. Consumer Surveys on Prepayment Behaviors



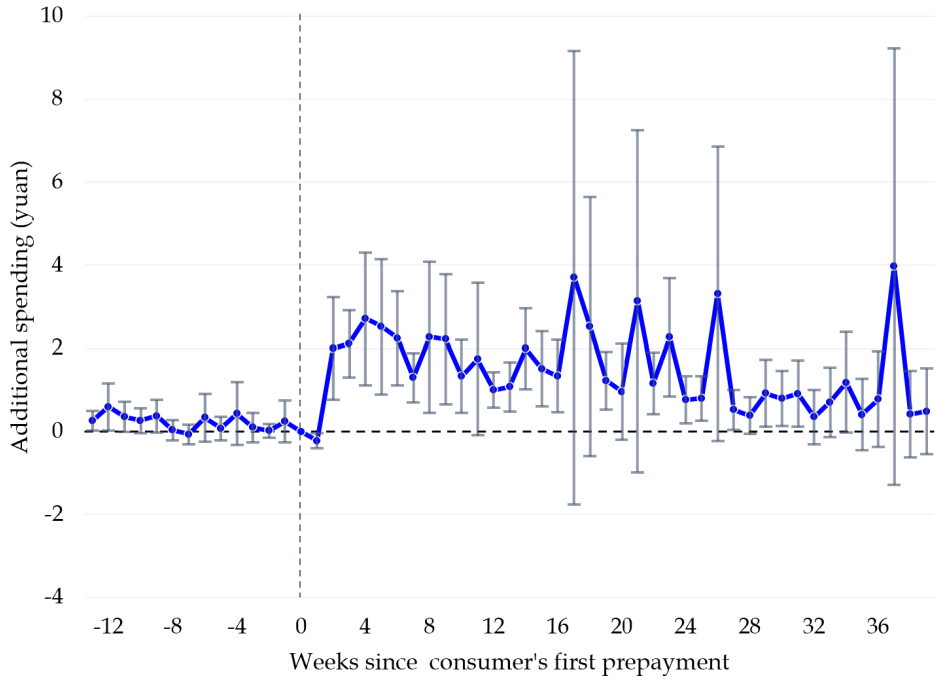
Notes: This figure presents responses from U.S. (green) and China (blue) survey samples on: (A) Whether the respondent made any prepayments in the past year; (B) Total value of prepayments made; (C) Types of businesses where prepayments were made (multiple selections allowed); (D) Reasons for choosing to prepay (up to three options allowed); (E) Whether the respondent has any unused prepayments older than six months; (F) Reasons for having unused prepayments (up to three options allowed).

Figure 7. Merchant-Level Return on PNBL Gift Incentives Paid



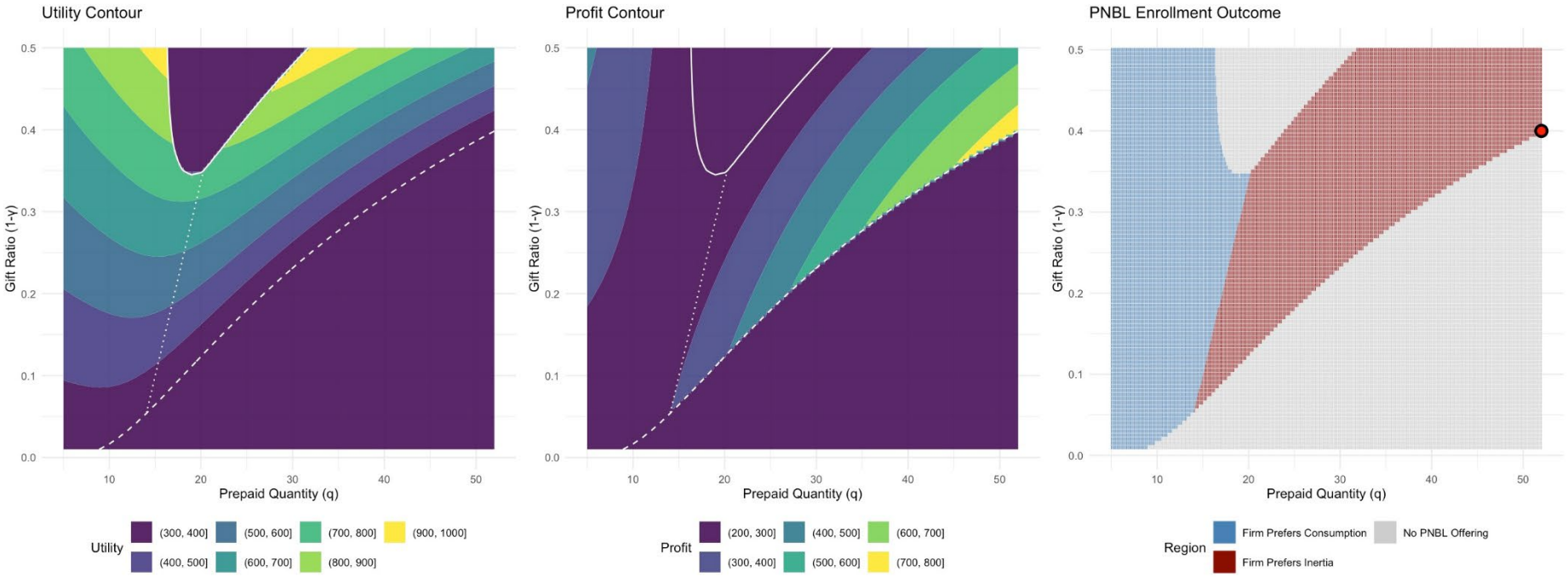
Notes: This figure displays the distribution, across all participating merchants, of net return per 1 yuan of gift incentive paid. For each merchant, we calculate the total balance breakage (the value of prepaid funds never redeemed) minus the total gift incentives paid to consumers who did redeem their prepayments. Dividing this net balance breakage by the sum of gift incentives yields an ROI measure for every 1 yuan of PNBL incentive. The single red bar at the far left represents merchants with negative ROI (i.e., those that lost money by participating in the PNBL program). The shaded bar labeled "ROI > 50" groups all merchants earning more than 50 yuan of breakage for each 1 yuan incentive paid. The rightmost dashed bar indicates merchants that did not offer any gift incentives (hence their ROI is undefined, as they keep abandoned balances at no cost).

Figure 8. PNBL Participation and Consumer's Additional Spending at the Merchant



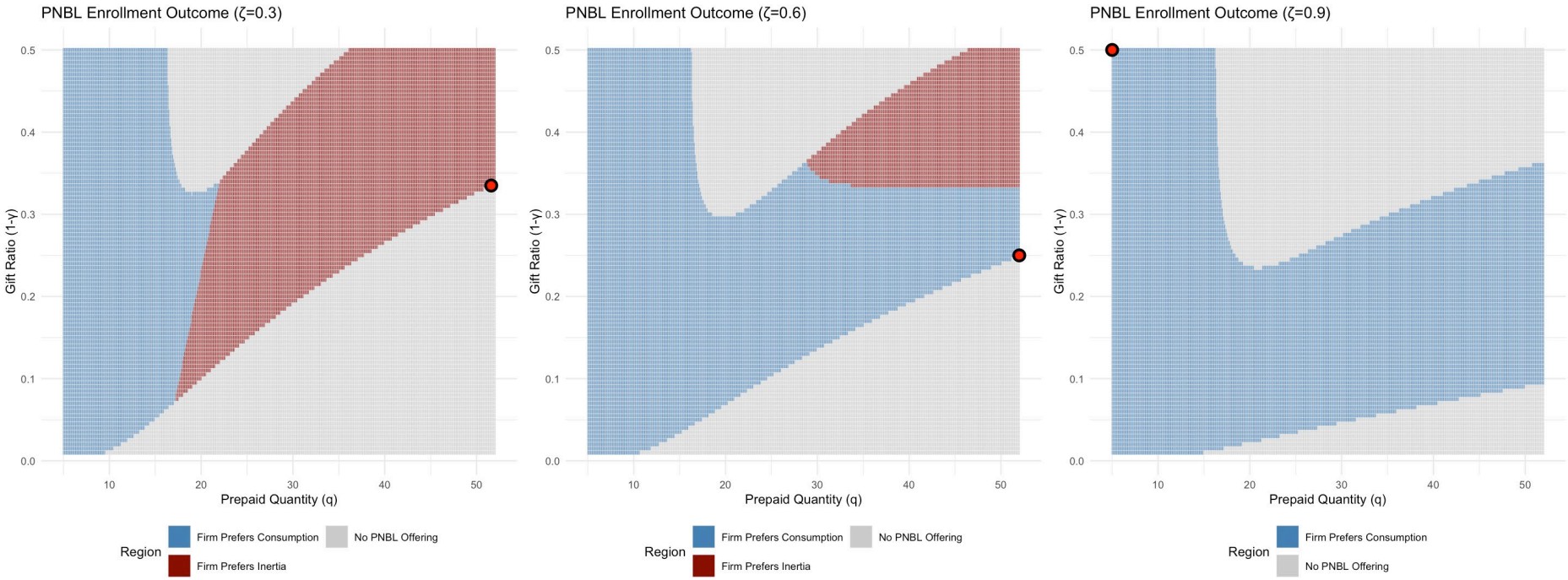
Notes: This event-study figure shows customers' extra expenditures—beyond the initial prepayment made at week 0—at the merchant in the weeks surrounding their first PNBL transaction. The sample is restricted to consumers who ultimately redeemed their entire prepaid balance. By construction, "additional spending" excludes the initial prepayment itself and measures only direct out-of-pocket spending at each point (i.e., when a user's prepaid balance is positive, there is no additional out-of-pocket spend). The vertical dashed line marks the week of the first PNBL transaction, and the horizontal dashed line indicates zero additional spending. Coefficients are estimated using the methodology of de Chaisemartin and D'Haultfoeuille (2024), with standard errors clustered at the consumer level. Shaded bars show 95 percent confidence intervals around each coefficient.

Figure 9. Numerical Characterization of the Baseline Model



Notes: This figure shows a numerical characterization of consumer surplus (left), firm profit (middle), and the feasible PNBL contract space (right). In the left and middle panels, the dashed line at the bottom indicates the boundary below which consumer surplus from PNBL becomes negative, while the solid line at the top marks the boundary where firm profit turns negative. The feasible PNBL contract space is thus the region bounded between these two lines. In the right panel, the blue region represents contracts where the firm profits more when the consumer fully spends the prepayment (i.e., the consumption outcome), while the red region reflects contracts where the firm profits more from consumer inertia (i.e., when the prepaid balance goes unused). The circled dot denotes the firm's optimal PNBL contract offering.

Figure 10. Counterfactual Simulation: Effects of an Escrow Mechanism



Notes: This figure shows the impact of the escrow mechanism with different deposit proportion requirement: 30% on the left panel, 60% on the middle panel, and 90% on the right panel. The colored area in each panel is the feasible PNBL contract space. The blue region represents contracts where the firm profits more when the consumer fully spends the prepayment (i.e., the consumption outcome), while the red region reflects contracts where the firm profits more from consumer inertia (i.e., when the prepaid balance goes unused). The circled dot denotes the firm's optimal PNBL contract offering.

Table 1. Correlates of Balance Breakage

	(1)	(2)	(3)	(4)
A. Dependent variable: Prepayment balance usage rate				
1(Visit prior to PNBL)	0.108***			
	(0.003)			
#Visits prior to PNBL		0.024***		
		(0.001)		
Spending prior to PNBL (1,000s)			0.052***	
			(0.013)	
Log(Distance to dining hub+1m)				-0.0064***
				(0.0006)
Mean dep. var.	0.464	0.464	0.464	0.490
Observations	3,329,784	3,329,784	3,329,784	2,964,803
B. Dependent variable: 1(Never using balance)				
1(Visit prior to PNBL)	-0.142***			
	(0.003)			
#Visits prior to PNBL		-0.026***		
		(0.001)		
Spending prior to PNBL (1,000s)			-0.0059***	
			(0.015)	
Log(Distance to dining hub+1m)				0.0069***
				(0.0009)
Mean dep. var.	0.219	0.219	0.219	0.178
Observations	3,329,784	3,329,784	3,329,784	2,964,803

Notes: Each panel-column is a separate regression. The unit of observation is a consumer–merchant pair. In Panel A, the dependent variable is the rate at which a consumer's prepayment balance is used for that merchant; in Panel B, the dependent variable is an indicator equal to 1 if the prepayment balance is never used. The regressors describe consumer–merchant activity before the first prepayment: "1(Visit prior to PNBL)" is an indicator equal to 1 if the consumer visited the merchant before using PNBL), "#Visits prior to PNBL" is the total number of visits, and "Spending prior to PNBL" is customer's total out-of-pocket spending in thousands of yuan. "Log(Distance to dining hub+1m)" is the natural log of (d + 1), where d is the straight-line distance (in meters) between the prepayment merchant and the consumer's "dining hub"—defined as the frequency-weighted geographic centroid (average latitude and longitude) of all merchants visited by that consumer during 2023–2024. Sample is restricted to prepayments that have not been spent down six months after prepayment. Standard errors are clustered at the merchant level. $*$: $p < 0.10$, $**$: $p < 0.05$, $***$: $p < 0.01$.

Table 2. PNBL Participation and Consumer's Additional Spending at the Merchant

	(1)	(2)	(3)	(4)	(5)	(6)
	3-month	6-month	9-month	3-month	6-month	9-month
A. Estimator: Classic two-way fixed effects						
1(PNBL)	2.653***	2.285***	2.325***			
	(0.299)	(0.290)	(0.394)			
PNBL gifts received (yuan)				0.048***	0.030***	0.031***
				(0.014)	(0.008)	(0.009)
B. Estimator: de Chaisemartin and D'Haultfoeuille (2024)						
1(PNBL)	2.260***	1.766***	1.325***			
	(0.336)	(0.313)	(0.347)			
PNBL gifts received (yuan)				0.061***	0.042***	0.037***
				(0.009)	(0.007)	(0.007)
Mean dep. var.	1.275	1.204	1.201	1.275	1.204	1.201
Observations	1,099,525	930,176	725,709	1,099,525	930,176	725,709

Notes: Each panel-column is a separate difference-in-differences regression. The unit of observation is a consumer-merchant-week. In all regressions, the dependent variable is the consumer's spending in that merchant-week, including prepayments but excluding the initial prepayment; therefore, it captures spending in addition to the first prepayment. We compute spending from an out-of-pocket perspective: if the consumer's prepaid balance is positive, a purchase reduces that balance and generates zero additional out-of-pocket spending. Row "1(PNBL)" measures the average change in spending in the post–prepayment periods, and "PNBL gifts received" measures the incremental effect of each unit of PNBL gift incentive actually paid by the merchant. The sample is restricted to consumers whose very first PNBL prepayment at the merchant is eventually fully spent. Columns (1) and (4) include consumers with a balanced 3-month before and 3-month after window; Columns (2) and (5) use a 3-month "before" and 6-month "after" window; Columns (3) and (6) use a 3-month before and 9-month after window. Panel A reports classic two-way fixed-effects estimates, and Panel B reports estimates from the de Chaisemartin and D'Haultfoeuille (2024) debiased treatment-effect heterogeneity estimator. Standard errors are clustered at the consumer level. ∗: $p < 0.10$, ∗∗: $p < 0.05$, ∗∗∗: $p < 0.01$.

Appendix A. Consumer Survey Text

Q1. In the past 12 months, have you paid in advance for any product or service that you used later? Examples: restaurant or retail gift cards, gym class packs, mobile app credits

- Yes
- No

(If "No", skip to Q5. If "Yes", continue with Q2–Q3.)

Q2. Approximately how much in total have you spent on such prepayments in the last 12 months? (Select a range.)

- $1–$50
- $51–$200
- $201–$500
- >$500

Q3. What types of businesses or services did you prepay for? (Select all that apply.)

- Restaurants or cafés
- Retail stores or shopping
- Fitness or gyms
- Online apps, games or streaming services
- Travel (e.g. airline or hotel credits)
- Other

Q4. What were your main reason(s) for paying in advance (prepaying) for products or services? (Select up to 3 that apply.)

- The product requires a prepayment / subscription to use
- To get a discount or bonus (e.g. extra value or free credit for prepaying)
- For convenience or faster checkout later
- To support the business
- To commit myself using it
- Because of social influence (e.g. friends/family recommended it)
- Other

Q5. Do you currently have any prepaid balances or credits that you have not used for at least 6 months? This could be an unused gift card, a subscription or membership you paid for but aren't using, or store credits sitting in an account.

- Yes
- No

(If "Yes", continue with Q6.)

Q6. If yes, roughly how much total value do you estimate those unused credits are worth? (Select a range.)

- $1–$50
- $51–$200
- $201–$500
- >$500

Q7. What are the main reasons you have not used your prepaid credits? (Select up to 3 that apply.)

- The business or service is no longer available
- I simply forgot I had them
- I couldn't remember how to redeem them (e.g., lost a gift-card/code or login info)
- It's too much hassle or inconvenient to use (e.g., long lines, out of the way)
- I no longer want or need that product/service
- The remaining balance was too small to bother using
- I wasn't aware of any expiration or time limit
- I ran out of time to use them before they expired
- Other

Appendix B. Other Policy Interventions

Inertia Risk Alert. In our baseline model, the consumer is assumed to be unaware of her own inertia risk. A plausible regulatory response would be to require an inertia risk disclosure at the point of PNBL enrollment—for example, a mandatory warning stating that, on average, 40% of prepaid balances go unused—similar to health warnings on cigarette packaging.

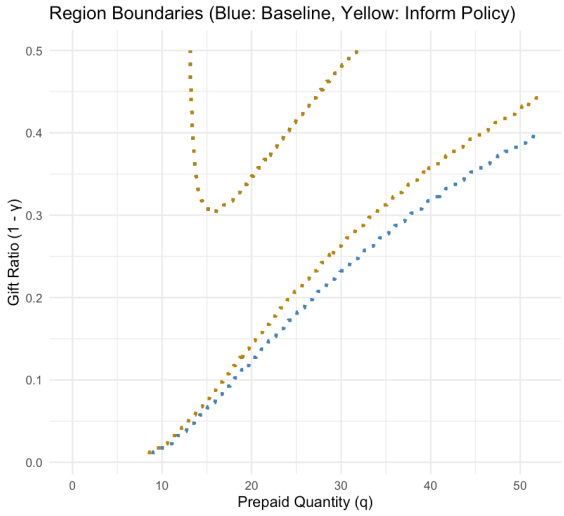
Suppose a consumer is informed of inertia risk, who now recognizes that her realized demand may follow a mixture distribution if PNBL is purchased:

$$D^{\text{realized}} = \begin{cases} D \sim F(\cdot), & \text{with probability } \eta \\ \bar{D} \sim \bar{F}(\cdot \mid \gamma), & \text{with probability } 1-\eta \end{cases}$$

Her expected utility from PNBL becomes:

$$E(U_{PNBL}) = \eta \cdot E[v(D) - p \cdot (D-q)^+] + (1-\eta) \cdot E[v(\bar{D}) - p \cdot (\bar{D}-q)^+] - \gamma \cdot p \cdot q$$

The impact of the alert policy is straightforward to see. Because of assumed stochastic dominance $F(\cdot) \preceq \bar{F}(\cdot \mid \gamma)$, consumer expected utility is smaller with the same PNBL contract specification (q, γ). This leads to a reduced likelihood of PNBL participation. Graphically, this is reflected in a tighter boundary of the region where the consumer derives positive utility from PNBL relative to spot purchasing. In our numerical example, the effect of this policy is small in magnitude.



Unused Balance Reminder. We introduce an additional firm-level decision variable: whether to send reminders to consumers with unused balances. If reminded, consumers are assumed to realize their full latent demand $\bar{D}$ with certainty.

Notice that consumer utility under PNBL remains the same:

$$E[U_{PNBL}] = E[v(\bar{D}) - \gamma \cdot p \cdot q - p \cdot (\bar{D} - q)^+]$$

If the firm does not offer PNBL, its expected profit is:

$$E[\Pi_{no-PNBL}] = E[p \cdot D - c \cdot D]$$

where c is per-unit production cost. With PNBL offering, firm's expected profit now differs depending on whether a reminder is sent:

$$E\left[\Pi_{PNBL}^{reminder}\right] = \gamma \cdot p \cdot q + E[p \cdot (\bar{D} - q)^+ - c \cdot \bar{D}]$$

and if it chooses to not send a reminder:

$$E\left[\Pi_{PNBL}^{no-reminder}\right] = \gamma \cdot p \cdot q + \eta \cdot E[p \cdot (D - q)^+ - c \cdot D] + (1 - \eta) \cdot E[p \cdot (\bar{D} - q)^+ - c \cdot \bar{D}]$$

Firm chooses whether to offer PNBL contracts and if does, it chooses (q, γ) and a reminder decision to maximize expected profit subject to the consumer's participation constraint: $E[U_{PNBL}] \geq E[U_{spot}]$.

To see when would firm sends a reminder, we assess the profit gain from the action:

$$\Delta\Pi(q) = E\left[\Pi_{PNBL}^{reminder}\right] - E\left[\Pi_{PNBL}^{no-reminder}\right]$$

From earlier expressions, one can derive:

$$\begin{aligned}\Delta\Pi(q) &= \eta \cdot \{E[p \cdot (\bar{D} - q)^+ - c \cdot \bar{D}] - E[p \cdot (D - q)^+ - c \cdot D]\} \\ &= \eta \cdot \{E[p \cdot (\bar{D} - q)^+] - E[p \cdot (D - q)^+] - c \cdot [E(\bar{D}) - E(D)]\}\end{aligned}$$

With small q, most realizations of $\bar{D}$ and D exceed q, so $(D - q)^+ \approx D - q$. Then:

$$\Delta\Pi(q) \approx \eta \cdot \{p \cdot [E(\bar{D}) - E(D)] - c \cdot [E(\bar{D}) - E(D)]\} = \eta \cdot [E(\bar{D}) - E(D)] \cdot (p - c) > 0$$

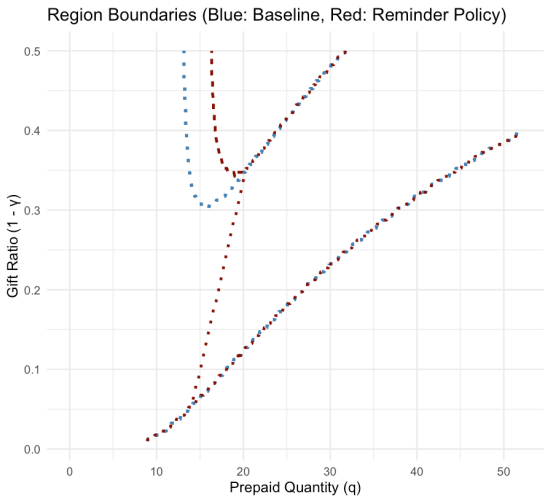
whereas with large q, most realizations of $\bar{D}$ and D fall below q, so $(D - q)^+ \approx 0$. Then:

$$\Delta\Pi(q) \approx -\eta \cdot c \cdot [E(\bar{D}) - E(D)] < 0$$

Take derivative with respect to q:

$$\frac{\partial}{\partial q}\Delta\Pi(q) = -\eta \cdot p \cdot [Prob(\bar{D} > q) - Prob(D > q)] = \eta \cdot p \cdot [\bar{F}(q|\gamma) - F(q)] \leq 0$$

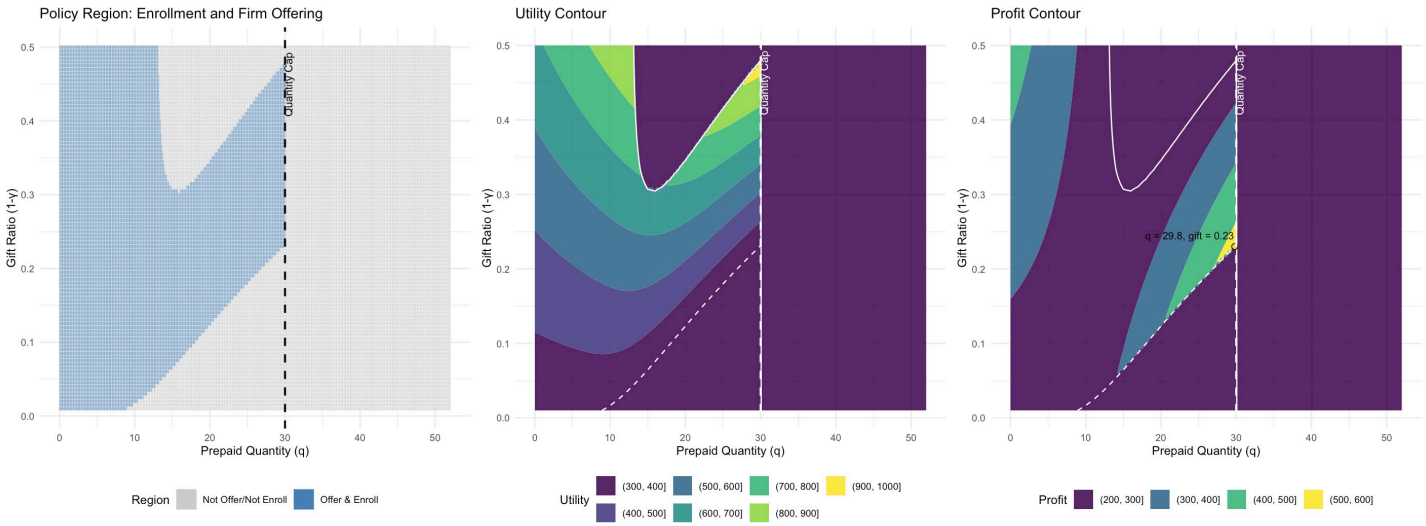
where the last inequality follows from assumed stochastic dominance. The marginal benefit of sending reminders is therefore decreasing in q. When q is small, reminders increase both revenue and consumption. As q increases, overage becomes rare, and the profit impact of reminders declines. As can be seen from the chart below, the main limitation with a voluntary reminder policy is that the firm will not find it profitable to send reminders at large q.



Prepayment Cap. Given the problematic incentive region of PNBL contract lies in the high-prepayment zone, another natural regulatory response if to enforce a cap on prepayment quantity. That is, the firm must offer PNBL contracts satisfying $q \leq \bar{q}$, where $\bar{q}$ is a regulatory limit on how much prepayment can be made each time period (e.g., month, quarter, or year). With this regulation, the firm now solves:

$$\max_{\gamma, q \leq \bar{q}} \Pi(\gamma, q) \quad \text{subject to} \quad E[U_{PNBL}] \leq E[U_{spot}]$$

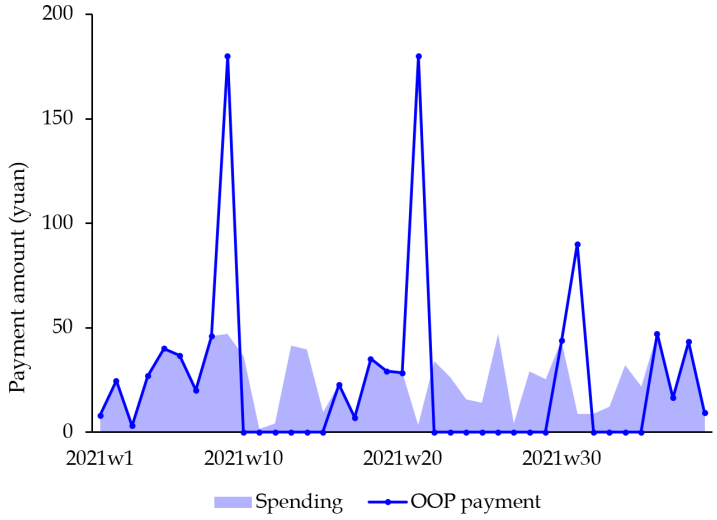
The graph below shows the impact of the regulation on PNBL enrollment, consumer utility, and firm profit. By construct, prepayment cap regulation removes bad incentives for firms to offer large contracts and hope for inertia. However, a mechanical consequence of such a policy is that it substantially reduces the size q and generosity γ of the PNBL contracts firm offer.



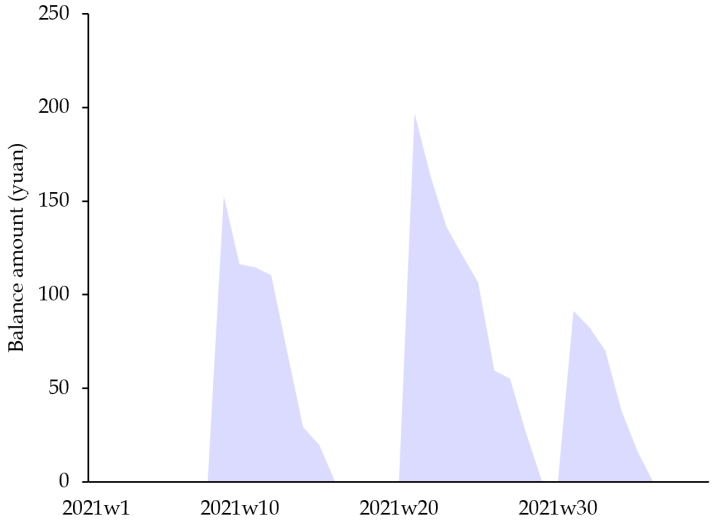
Appendix C. Additional Figures and Tables

Appendix Figure 1. Illustration of Variable Construction

A. Spending and out-of-pocket payments

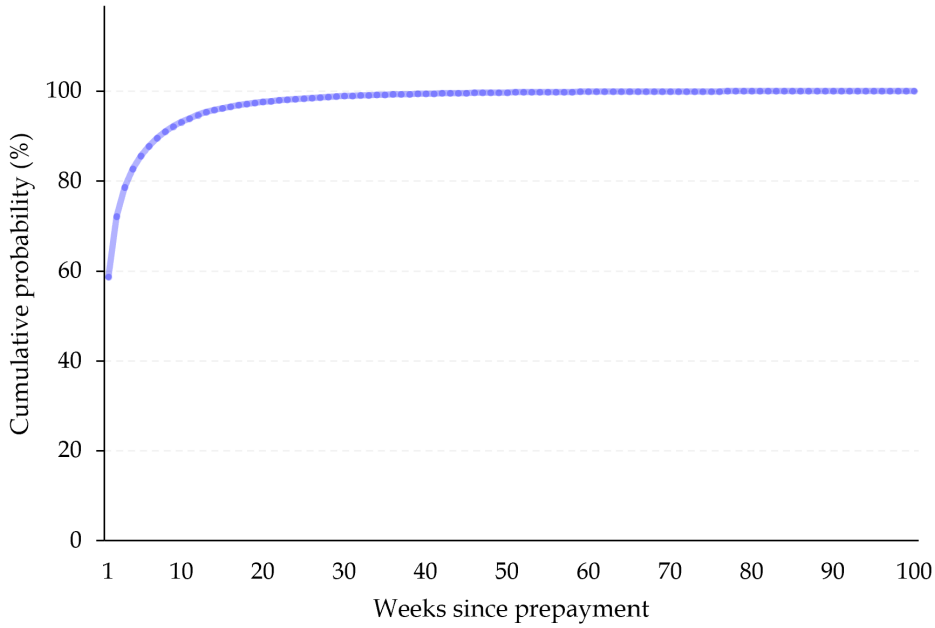


B. Remaining Balances



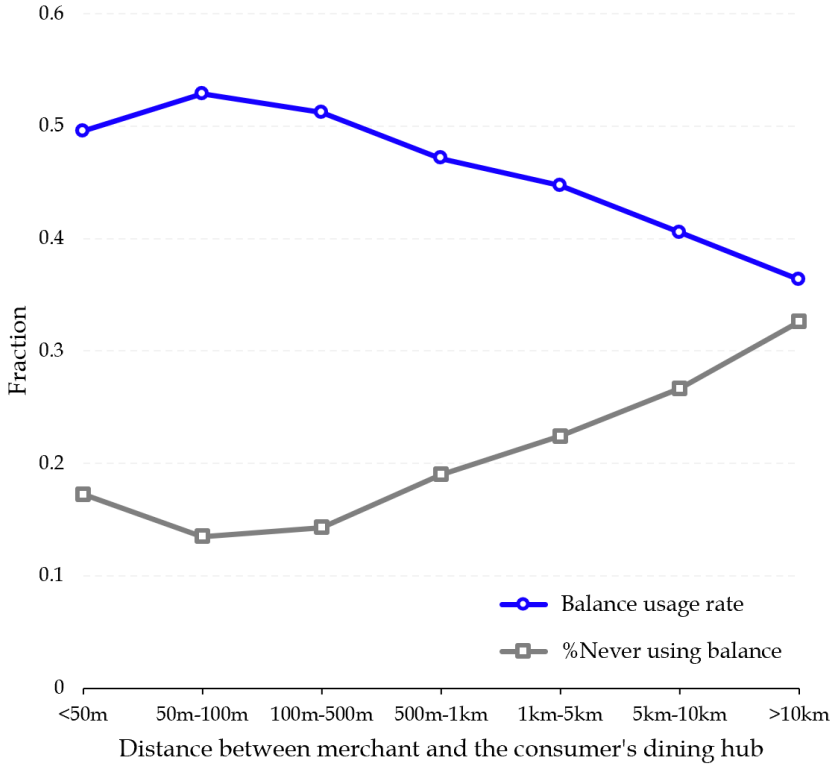
Notes: Panel A shows weekly spending (shaded area) and out-of-pocket payments (line plot) at a merchant. Peaks in the spending line correspond to prepayment transactions. Panel B shows the remaining prepayment balances over time that correspond with the payment and spending profile shown in panel A.

Appendix Figure 2. Cumulative Probability of Spending Any Prepaid Balance



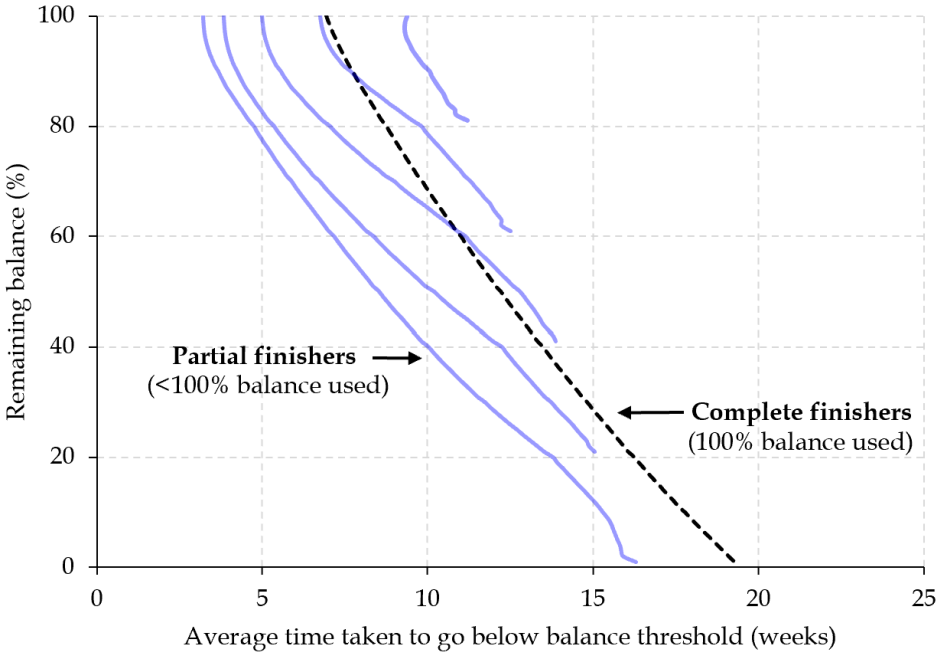
Notes: This figure plots the cumulative probability that a consumer makes any purchase at a merchant as a function of weeks since their prepayment. The analysis is restricted to consumers whose prepaid balance was at least partially used by the end of our study period.

Appendix Figure 3. Balance Breakage and Distance



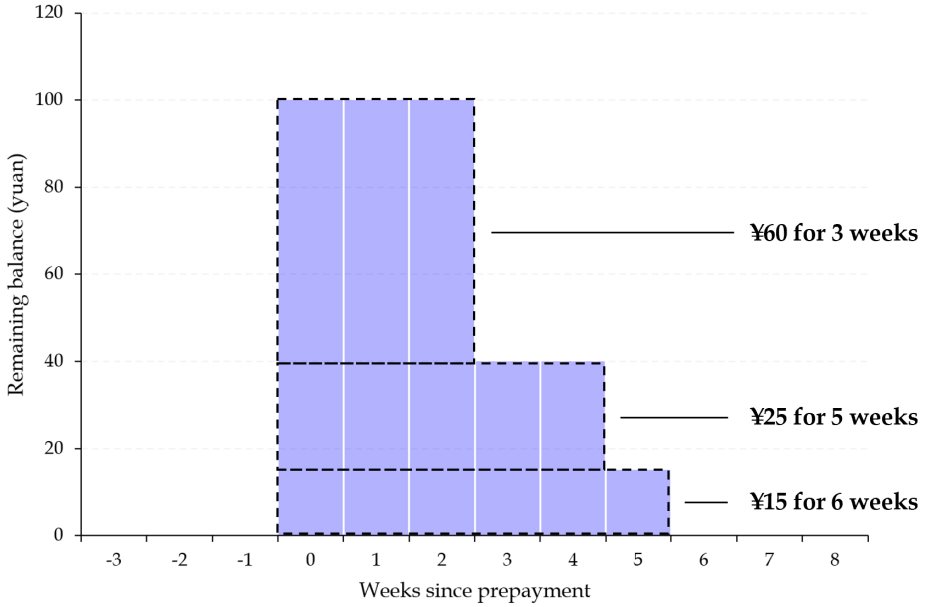
Notes: This figure shows the average prepayment balance usage rate and fraction of abandoned prepayments as a function of the straight-line distance (in meters) between the prepayment merchant and the consumer's "dining hub"—defined as the frequency-weighted geographic centroid (average latitude and longitude) of all merchants visited by that consumer during 2023–2024. Sample is restricted to prepayments that have not been spent down six months after prepayment

Appendix Figure 4. Balance Usage Dynamics



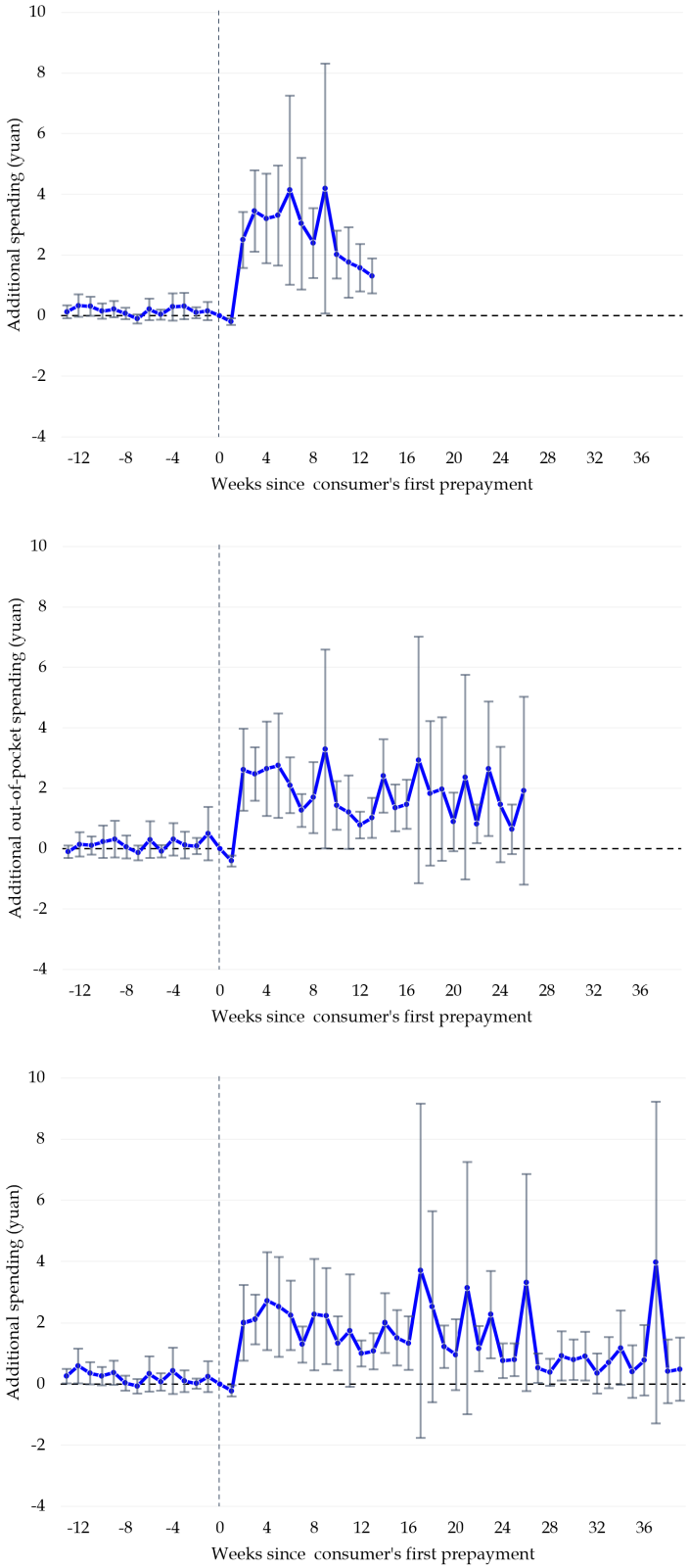
Notes: This figure shows the dynamics of balance usage over time for prepayments, categorized by their final remaining balance thresholds. The x-axis shows the average time (in weeks) taken for prepayments to fall below a specified balance threshold. The y-axis represents the remaining balance. Each blue line corresponds to a group of prepayments, with shorter lines in the top-right region representing those that retain higher balances (e.g., prepayments that eventually spend down to 80% remaining). The dashed black line represents complete finishers where 100% of the balance is used.

Appendix Figure 5. Illustration of Balance Segmentation for Implicit Borrowing Interest Rate Calculation



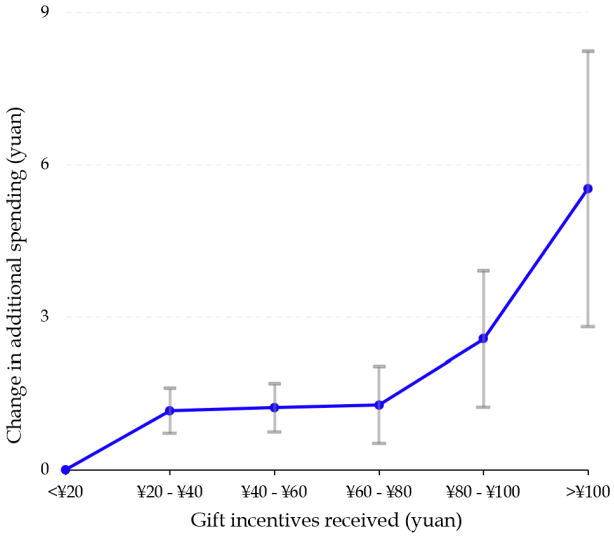
Notes: This figure illustrates the segmentation of a consumer's prepayment balance over time, which is used to compute the implicit borrowing interest rate for merchants. In this hypothetical example, a consumer made an initial prepayment of ¥100, which remained unused for the first three weeks. At week 4, the consumer spent ¥60, reducing the balance to ¥40. Two weeks later, an additional transaction of ¥25 occurred, further lowering the balance to ¥15. Finally, the remaining ¥15 was fully depleted in the subsequent week. The merchant's borrowing from the consumer is divided into three segments: ¥60 for 3 weeks, ¥25 for 5 weeks, and ¥15 for 6 weeks.

Appendix Figure 6. PNBL Participation and Consumer's Additional Spending at the Merchant: Robustness



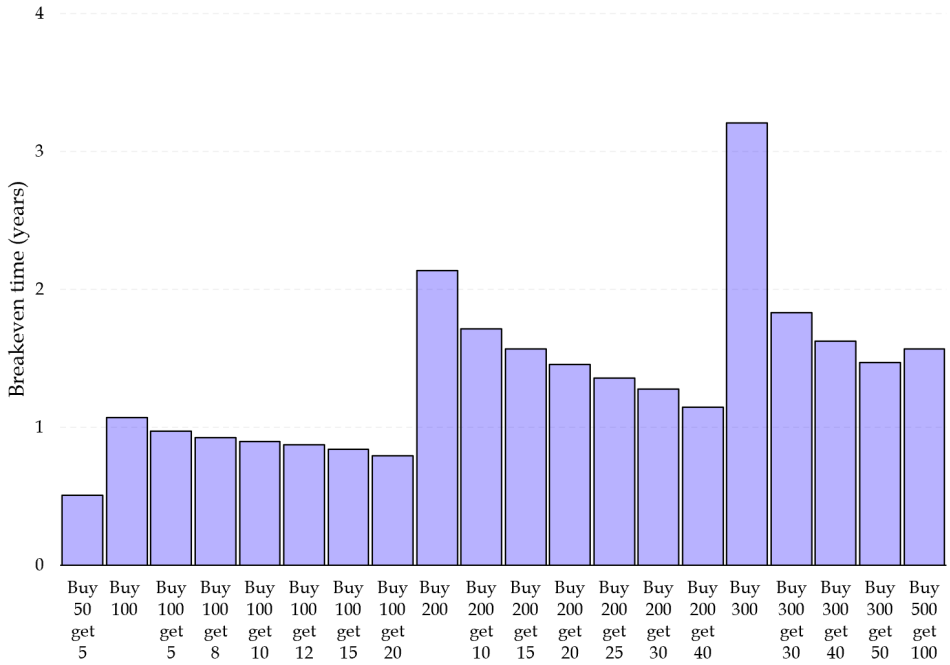
Notes: Panels show event study plots from three sample restrictions: those with a balanced 3-month before and 3-month after first prepayment (top), a balanced 3-month before and 6-month after (middle), and a balanced 3-month before and 9-month after (bottom). Estimation follows the de Chaisemartin and D'Haultfoeuille (2024) debiased treatment-effect heterogeneity estimator. Standard errors are clustered at the consumer level.

Appendix Figure 7. PNBL Participation and Consumer's Additional Spending at the Merchant: Nonlinear Effect of Gift Incentives



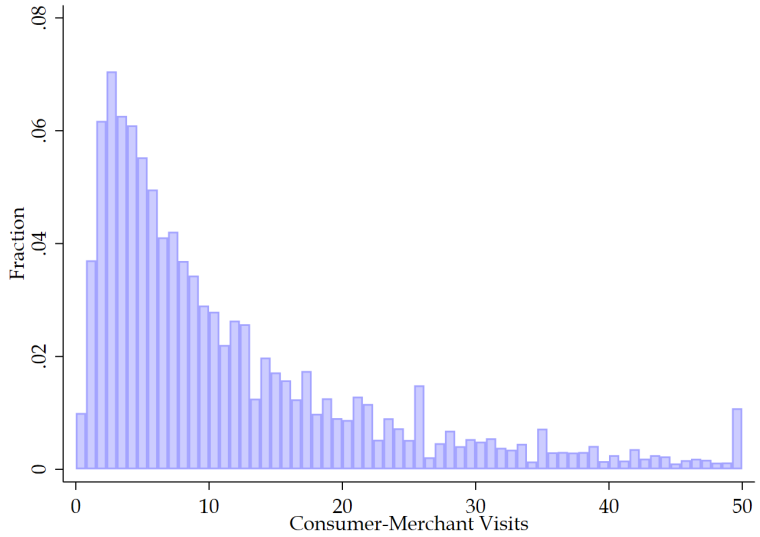
Notes: This figure shows estimated changes in consumer spending at merchants, segmented by the size of the PNBL gift incentives received. The baseline category includes consumers receiving gift incentives below ¥20. Estimation approach and underlying sample is the same with Table 2, Panel A, Column 6. Error bars represent 95% confidence intervals, with standard errors clustered at the consumer level.

Appendix Figure 8. Average Time Required for PNBL-Driven Loyalty to Outweigh Balance Breakage



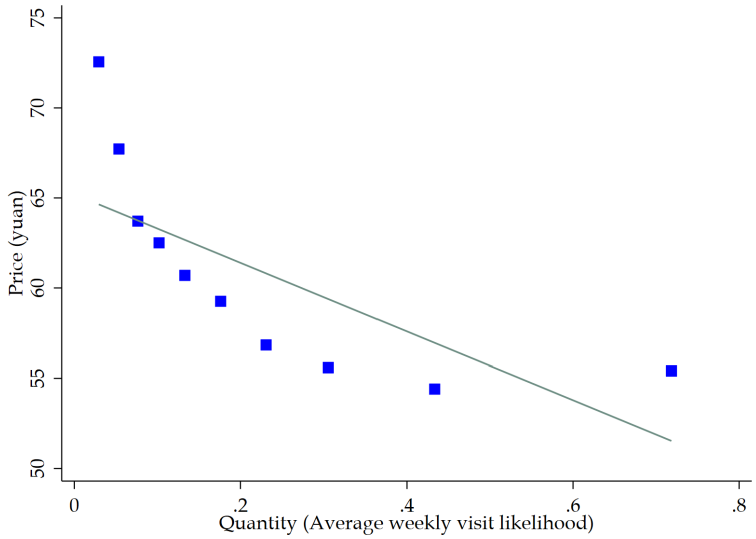
Notes: This figure shows, for each of the 20 most common PNBL offers in our dataset, the average breakeven horizon (in years) at which the incremental spending generated by a PNBL bonus equals the cost of unredeemed balance. Each bar corresponds to a specific PNBL package (e.g., "Buy ¥50, get ¥5" indicates a ¥5 bonus upon a ¥50 prepayment). Breakeven time is defined as the minimum number of years over which the observed loyalty effect—measured as additional consumer spending—must persist before it becomes more profitable for the merchant than retaining the bonus value as breakage. All calculations assume a 60% gross profit margin and an average weekly spend of ¥1.20 at the consumer–merchant level.

Appendix Figure 9. Empirical Distribution of Consumer-Merchant Trip Frequencies



Notes: This figure shows the empirical distribution of weekly trip counts at the consumer–merchant level. The sample includes all consumer-merchant-week observations for individuals who made any positive PNBL purchase between 2023 and 2024, restricted to weeks following PNBL participation. Observations with more than 50 visits are grouped in the final bin.

Appendix Figure 10. Empirical Price-Quantity Relationship



Notes: This figure presents a decile binscatter plot of the empirical relationship between price and quantity. Quantity is defined as the average weekly visit probability at the consumer-merchant level over the study period. Price is the average spending per visit at the merchant, computed using all visits except those made by the focal consumer to mitigate endogeneity). The superimposed line represents the estimated linear regression.