Online Appendix for "Consumer-Financed Fiscal Stimulus: Evidence from Digital Coupons in China"

Appendix A.1: Proofs and Derivations

A.1.1. Marginal Propensity to Consume in RCT Setting

Claim: Consider two two types of coupon randomly assigned with different thresholds $\tau' > \tau$ and $\theta = \frac{Inventory_{\tau'}}{Inventory_{\tau}+Inventory_{\tau'}}$. H is a standard tuning parameter that defines the upper bound of the "bunching window". Given the definition of $MPC^{coupon}_{\tau-\tau'}$, the expression for $E[MPC^{coupon}_{\tau-\tau'}]$ can be written as below.

$$MPC^{coupon}_{\tau-\tau'} = \frac{\sum_{j=1}^{H}\left[\theta n^{WAVE}_{j,\tau} - (1-\theta)n^{WAVE}_{j,\tau'}\right]j}{\theta S_\tau - (1-\theta)S_{\tau'}}$$

$$E[MPC^{coupon}_{\tau-\tau'}] = \frac{\theta S_\tau}{\theta S_\tau - (1-\theta)S_{\tau'}}MPC^{coupon}_{\tau} - \frac{(1-\theta)S_{\tau'}}{\theta S_\tau - (1-\theta)S_{\tau'}}MPC^{coupon}_{\tau'}$$

Proof: Start by adding and subtracting $n^{PRE}_{j,\tau}$ terms from the $MPC^{coupon}_{\tau-\tau'}$ definition.

$$MPC^{coupon}_{\tau-\tau'} = \frac{\sum_{j=1}^{H}\left[\theta(n^{WAVE}_{j,\tau} - n^{PRE}_{j,\tau}) - (1-\theta)(n^{WAVE}_{j,\tau'} - n^{PRE}_{j,\tau'}) + (\theta n^{PRE}_{j,\tau} - (1-\theta)n^{PRE}_{j,\tau'})\right]j}{\theta S_\tau - (1-\theta)S_{\tau'}}$$

Simplifying and multiplying by S_τ/S_τ yields the following:

$$\begin{aligned} MPC^{coupon}_{\tau-\tau'} =& \frac{\theta S_\tau}{\theta S_\tau - (1-\theta)S_{\tau'}}\frac{\sum_{j=1}^{H}(n^{WAVE}_{j,\tau} - n^{PRE}_{j,\tau})j}{S_\tau} - \frac{(1-\theta)S_{\tau'}}{\theta S_\tau - (1-\theta)S_{\tau'}}\frac{\sum_{j=1}^{H}(n^{WAVE}_{j,\tau'} - n^{PRE}_{j,\tau'})j}{S_{\tau'}} \\ &+ \frac{\sum_{j=1}^{H}(\theta n^{PRE}_{j,\tau} - (1-\theta n^{PRE}_{j,\tau'})j}{\theta S_\tau - (1-\theta)S_{\tau'}} \end{aligned}$$

Use the MPC_τ definition to simplify as follows:

$$\begin{aligned} MPC^{coupon}_{\tau-\tau'} =& \frac{\theta S_\tau}{\theta S_\tau - (1-\theta)S_{\tau'}}MPC^{coupon}_{\tau} - \frac{(1-\theta)S_{\tau'}}{\theta S_\tau - (1-\theta)S_{\tau'}}MPC^{coupon}_{\tau'} \\ &+ \frac{\sum_{j=1}^{H}(\theta n^{PRE}_{j,\tau} - (1-\theta n^{PRE}_{j,\tau'})j}{\theta S_\tau - (1-\theta)S_{\tau'}} \end{aligned}$$

Given random assignment, the last term equals zero in expectation, completing the proof. ■

Note that when $\theta = 0.5$, we have the special case below:

$$MPC^{coupon}_{\tau-\tau'} = \frac{\sum_{j=1}^{H}\left[n^{WAVE}_{j,\tau} - n^{WAVE}_{j,\tau'}\right]j}{S_\tau - S_{\tau'}}$$

$$E[MPC^{coupon}_{\tau-\tau'}] = \frac{S_\tau}{S_\tau - S_{\tau'}} MPC^{coupon}_{\tau} - \frac{S_{\tau'}}{S_\tau - S_{\tau'}} MPC^{coupon}_{\tau'}$$

A.1.2. Marginal Propensity to Consume Transitory Income

Claim:

$$MPC^{cash} = \frac{\Delta(c_1^A + c_1^B)}{\Delta(y_1)} = \frac{1}{\sum_{t=1}^{T}\left[(1+r)^{\frac{1-\gamma}{\gamma}}(1+\delta)^{\frac{-1}{\gamma}}\right]^{t-1}}$$

Proof: Recall the utility maximization problem in the T-period model:

$$\begin{aligned}
\max_{\{c_t^A, c_t^B\}_{t=1}^T} \quad & \sum_{t=1}^{T}\left(\frac{1}{1+\delta}\right)^{t-1} u(c_t^A, c_t^B) \\
\text{s.t.} \quad & \sum_{t=1}^{T}\left(\frac{1}{1+r}\right)^{t-1}(c_t^A + c_t^B) \leq \sum_{t=1}^{T}\left(\frac{1}{1+r}\right)^{t-1} y_t \\
\text{where} \quad & u(c_t^A, c_t^B) = \frac{1}{1-\gamma}\left[\alpha(c_t^A)^\rho + (1-\alpha)(c_t^B)^\rho\right]^{\frac{1-\gamma}{\rho}}
\end{aligned}$$

Since the consumer's lifetime utility is a linear combination of CES utility functions, which are convex, we know there exists a unique solution to the maximization problem. We solve for the optimal consumption choices using the Lagrangian method as follows:

Lagrangian: $L = \sum_{t=1}^{T}\left(\frac{1}{1+\delta}\right)^{t-1} u(c_t^A, c_t^B) + \lambda\left[\sum_{t=1}^{T}\left(\frac{1}{1+r}\right)^{t-1}(y_t - c_t^A - c_t^B)\right]$

First-order conditions:

$$\begin{aligned}
\frac{\partial L}{\partial c_t^X} &= \left(\frac{1}{1+\delta}\right)^{t-1}\frac{\partial u}{\partial c_t^X} - \left(\frac{1}{1+r}\right)^{t-1}\lambda = 0 \;\forall\, t \in \{1,2,...,T\} \text{ and } X \in \{A,B\} \\
\frac{\partial L}{\partial \lambda} &= \sum_{t=1}^{T}\left(\frac{1}{1+r}\right)^{t-1}(y_t - c_t^A - c_t^B) = 0
\end{aligned}$$

Combining the conditions above, we get the following:

$$\begin{aligned}
\frac{c_t^A}{c_t^B} &= \left(\frac{\alpha}{1-\alpha}\right)^{\frac{1}{1-\rho}} \;\forall\, t \in \{1,2,...,T\} \\
\frac{c_T^X}{c_t^X} &= \left(\frac{1+r}{1+\delta}\right)^{\frac{T-t}{\gamma}} \;\forall\, t \in \{1,2,...,T\},\; X \in \{A,B\}
\end{aligned}$$

Re-arranging c_T^X/c_t^X, we find c_t^X as a function of c_1^X:

$$c_T^X = \left(\frac{1+r}{1+\delta}\right)^{\frac{T-1}{\gamma}} c_1^X \text{ and } c_t^x = \left(\frac{1+r}{1+\delta}\right)^{\frac{t-T}{\gamma}} c_T^X$$

$$\therefore\; c_t^X = \left(\frac{1+r}{1+\delta}\right)^{\frac{t-1}{\gamma}} c_1^X$$

We then plug in c_t^X as a function of c_1^X into the consumption side of the budget constraint and re-write as follows:

$$(c_1^A + c_1^B)\sum_{t=1}^{T}\left[(1+r)^{\frac{1-\gamma}{\gamma}}(1+\delta)^{-\frac{1}{\gamma}}\right]^{t-1} = \sum_{t=1}^{T}\left(\frac{1}{1+r}\right)^{t-1} y_t$$

Therefore, MPC^{cash} is given by the following:

$$MPC^{cash} = \frac{\partial(c_1^A + c_1^B)}{\partial y_1} = \frac{1}{\sum_{t=1}^{T}\left[(1+r)^{\frac{1-\gamma}{\gamma}}(1+\delta)^{\frac{-1}{\gamma}}\right]^{t-1}}$$

■

We now derive the expression for lifetime utility evaluated at the optimum, which will be function of income (i.e., $V(y_t)$). This follows from the above results and will be useful for the subsequent proofs.

$$U(c_t^A, c_t^B) = \sum_{t=1}^{T}\left(\frac{1}{1+\delta}\right)^{t-1} u(c_t^A, c_t^B) = \sum_{t=1}^{T}\left(\frac{1}{1+\delta}\right)^{t-1}\frac{1}{1-\gamma}\left[\alpha(c_t^A)^\rho + (1-\alpha)(c_t^B)^\rho\right]^{\frac{1-\gamma}{\rho}}$$

Since $c_t^B = c_t^A\left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1-\rho}}$,

$$= \frac{1}{1-\gamma}\left[\alpha + (1-\alpha)\left(\frac{1-\alpha}{\alpha}\right)^{\frac{\rho}{1-\rho}}\right]^{\frac{1-\gamma}{\rho}}\sum_{t=1}^{T}\left(\frac{1}{1+\delta}\right)^{t-1}(c_t^A)^{1-\gamma}$$

Since $c_t^A = c_1^A\left(\frac{1+r}{1+d}\right)^{\frac{t-1}{\gamma}}$,

$$= \frac{1}{1-\gamma}(c_1^A)^{1-\gamma}\alpha^{\frac{1-\gamma}{\rho}}\left[1 + \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1-\rho}}\right]^{\frac{1-\gamma}{\rho}}\sum_{t=1}^{T}\left(\frac{1}{1+\delta}\right)^{t-1}\left(\frac{1+r}{1+\delta}\right)^{\frac{(t-1)(1-\gamma)}{\gamma}}$$

Finally, the derivation of MPC^{cash} above implies

$$c_1^A\left[1 + \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1-\rho}}\right] = \frac{\sum_{t=1}^{T}\left(\frac{1}{1+r}\right)^{t-1} y_t}{\sum_{t=1}^{T}\left[(1+r)^{\frac{1-\gamma}{\gamma}}(1+\delta)^{-\frac{1}{\gamma}}\right]^{t-1}}$$

This results in the following expression for $V(y_t)$:

$$V(y_t) = \frac{1}{1-\gamma}\alpha^{\frac{1-\gamma}{\rho}}\left[1 + \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1-\rho}}\right]^{\frac{(1-\gamma)(1-\rho)}{\rho}}\left\{\sum_{t=1}^{T}\left[(1+r)^{\frac{1-\gamma}{\gamma}}(1+\delta)^{-\frac{1}{\gamma}}\right]^{t-1}\right\}^{\gamma}\left\{\sum_{t=1}^{T}\left(\frac{1}{1+r}\right)^{t-1} y_t\right\}^{1-\gamma}$$

A.1.3. Approximation Formula

Claim: The government offers a coupon that pays ¥d if the consumer spends ¥D or more in sector A in period 1. Suppose the consumer accepts the coupon and bunches at the threshold. Define ΔU^{coupon} and ΔU^{cash} as the difference in utility between a scenario with either a coupon or cash offered by the policy maker and a scenario without any policy and Δc_1^A as the difference in consumption at period 1 in sector A between the coupon and the no-policy scenarios. Then, the approximate change in utility from receiving the coupon compared to the change in utility from receiving the equivalent amount in cash is given by

$$\frac{\Delta U^{coupon}}{\Delta U^{cash}} \approx 1 - 0.5(1-\rho)\frac{(\Delta c_1^A)^2}{d * c_1^{A*}}.$$

Proof: Define $c^* = (c_1^{A*}, c_1^{B*}, ..., c_T^{A*}, c_T^{B*})$ as the optimal consumption bundle in absence of coupon, c^{cash} as the optimal consumption bundle with a cash transfer of size ¥d, and c^{coupon} as the optimal consumption bundle given acceptance of the coupon and bunching at the threshold D.

First, let us derive an expression for ΔU^{cash}. Using the notation above and a first-order Taylor expansion, we have

$$\Delta U^{cash} = U(c^{cash}) - U(c^*) \approx \frac{\partial U(c^{cash})}{\partial d} d$$

Note that to calculate the partial derivative of the maximized utility on the cash transfer scenario we can use the V expression derived in the previous proof, the only difference is that we add d to the income received in period 1. Therefore, we can write

$$\frac{\partial U(c^{cash})}{\partial d} = \frac{\partial V(y_t)}{\partial y_1}$$

$$= \alpha^{\frac{1-\gamma}{\rho}} \left[1 + \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1-\rho}}\right]^{\frac{(1-\gamma)(1-\rho)}{\rho}} \left\{\sum_{t=1}^{T} \left[(1+r)^{\frac{1-\gamma}{\gamma}}(1+\delta)^{-\frac{1}{\gamma}}\right]^{t-1}\right\}^{\gamma} \left\{\sum_{t=1}^{T} \left(\frac{1}{1+r}\right)^{t-1} y_t\right\}^{-\gamma}$$

In the previous proof, we have derived an expression of c_1^{A*} as a function of y_t using c_t^A/c_t^B and c_T^A/c_t^A. The analogous expression for $c_1^{A\ cash}$ can be used here. Rearrange to find the equation below.

$$\Delta U^{cash} \approx \alpha^{\frac{1-\gamma}{\rho}} \left[1 + \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1-\rho}}\right]^{\frac{1-\gamma-\rho}{\rho}} (c_1^{A\ cash})^{-\gamma} d$$

Now, let us derive an expression for ΔU^{coupon}. Recall that in this scenario we are forcing the consumer to accept the coupon and bunch at the threshold. The consumer solves the following maximization problem and we define V^{coupon} as the function that solves this problem given D.

$$\text{Define: } V^{coupon}(D) = \max_{c_1^B, \{c_t^A, c_t^B\}_{t=2}^T} \sum_{t=1}^{T} (\frac{1}{1+\delta})^{t-1} u(c_t^A, c_t^B)$$

$$\text{s.t.} \quad c_1^A = D$$

$$\text{and} \quad \sum_{t=1}^{T} (\frac{1}{1+r})^{t-1} (c_t^A + c_t^B) \leq \sum_{t=1}^{T} (\frac{1}{1+r})^{t-1} y_t + d$$

$$\text{where} \quad u(c_t^A, c_t^B) = \frac{1}{1-\gamma} \left[\alpha(c_t^A)^\rho + (1-\alpha)(c_t^B)^\rho\right]^{\frac{1-\gamma}{\rho}}$$

By our definition and using a Second-Order Taylor Expansion, we can write the expressions below.

$$\begin{aligned}
\Delta U^{coupon} &= U(c^{coupon}) - U(c^*) = \Delta U(c^{cash}) + V^{coupon}(c_1^{A\ coupon}) - V^{coupon}(c_1^{A\ cash}) \\
&\approx \Delta U^{cash} + \frac{\partial V^{coupon}(c_1^{A\ cash})}{\partial c_1^A}(c_1^{A\ coupon} - c_1^{A\ cash}) + 0.5 \frac{\partial^2 V^{coupon}(c_1^{A\ cash})}{\partial c_1^{A^2}}(c_1^{A\ coupon} - c_1^{A\ cash})^2
\end{aligned}$$

Note that the Envelope Theorem allows us to ignore all consumption changes other than the change to $c_1^A = D$, since these are re-optimized after the consumer is forced to bunch at the coupon threshold in period 1 for sector A. Therefore, we can calculate the partial derivatives as follows:

$$\begin{aligned}
\frac{dV^{coupon}}{dc_1^A} &= \left(\frac{\partial u}{\partial c_1^A} - \lambda\right)|_{c_1^B = c_1^B(c_1^A)} = \left(\frac{\partial u}{\partial c_1^A} - \frac{\partial u}{\partial c_1^B}\right)|_{c_1^B = c_1^B(c_1^A)} \\
&= [\alpha(c_1^A)^\rho + (1-\alpha)(c_1^B)^\rho]^{\frac{1-\gamma-\rho}{\rho}} [\alpha(c_1^A)^{\rho-1} - (1-\alpha)(c_1^B)^{\rho-1}]
\end{aligned}$$

$$\frac{dV^{coupon}}{dc_1^A}(c_1^{A\ cash}) = 0 \text{ since at the optimal } \frac{c_1^A}{c_1^B} = (\frac{\alpha}{1-\alpha})^{\frac{1}{1-\rho}}$$

$$\begin{aligned}
\frac{d^2V^{coupon}}{dc_1^{A^2}} &= \left(\frac{\partial^2 u}{\partial c_1^{A^2}} - \frac{\partial \lambda}{\partial c_1^A}\right) - \left(\frac{\partial^2 u}{\partial c_1^{A^2}} - \frac{\partial^2 u}{\partial c_1^A \partial c_1^B}\right)|_{c_1^B = c_1^B(c_1^A)} \\
&= -(1-\rho)[\alpha(c_1^A)^\rho + (1-\alpha)(c_1^B)^\rho]^{\frac{1-\gamma-2\rho}{\rho}} \alpha(1-\alpha)[(c_1^A)^{\rho-2}(c_1^B)^\rho + (c_1^A)^{\rho-1}(c_1^B)^{\rho-1}] \\
&\quad -\gamma[\alpha(c_1^A)^\rho + (1-\alpha)(c_1^B)^\rho]^{\frac{1-\gamma-2\rho}{\rho}} \alpha(c_1^A)^{\rho-1}[\alpha(c_1^A)^{\rho-1} - (1-\alpha)(c_1^B)^{\rho-1}]
\end{aligned}$$

$$\frac{d^2V^{coupon}}{dc_1^{A^2}}(c_1^{A\ cash}) = -(1-\rho)\alpha^{\frac{1-\gamma}{\rho}} \left[1 + (\frac{\alpha}{1-\alpha})^{\frac{-1}{1-\rho}}\right]^{\frac{1-\gamma-\rho}{\rho}} (c_1^{A\ cash})^{-\gamma-1}$$

Plug these equations into our ΔU^{coupon} definition and find the expression below.

$$\Delta U^{coupon} \approx \Delta U^{cash} - 0.5(1-\rho)\left[1 + (\frac{\alpha}{1-\alpha})^{\frac{-1}{1-\rho}}\right]^{\frac{1-\gamma-\rho}{\rho}} \alpha^{\frac{1-\gamma}{\rho}} (c_1^{A\ cash})^{-\gamma-1}(c_1^{A\ coupon} - c_1^{A\ cash})^2$$

Therefore,

$$\begin{aligned}\frac{\Delta U^{coupon}}{\Delta U^{cash}} &\approx 1 - \frac{0.5(1-\rho)\alpha^{\frac{1-\gamma}{\rho}}\left[1+(\frac{\alpha}{1-\alpha})^{\frac{-1}{1-\rho}}\right]^{\frac{1-\gamma-\rho}{\rho}}(c_1^{A\ cash})^{-\gamma-1}(c_1^{A\ coupon}-c_1^{A\ cash})^2}{\alpha^{\frac{1-\gamma}{\rho}}\left[1+\left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1-\rho}}\right]^{\frac{1-\gamma-\rho}{\rho}}(c_1^{A\ cash})^{-\gamma}d} \\ &\approx 1-0.5(1-\rho)\frac{(c_1^{A\ coupon}-c_1^{A\ cash})^2}{d*(c_1^{A\ cash})}\end{aligned}$$

Last, because c_1^A is a significantly small share of total lifetime consumption, we can approximate this consumption in the scenarios with and without a cash transfer, giving us the expression in the main text.

$$\frac{\Delta U^{coupon}}{\Delta U^{cash}} \approx 1-0.5(1-\rho)\frac{(\Delta c_1^A)^2}{d*c_1^{A*}}$$

■

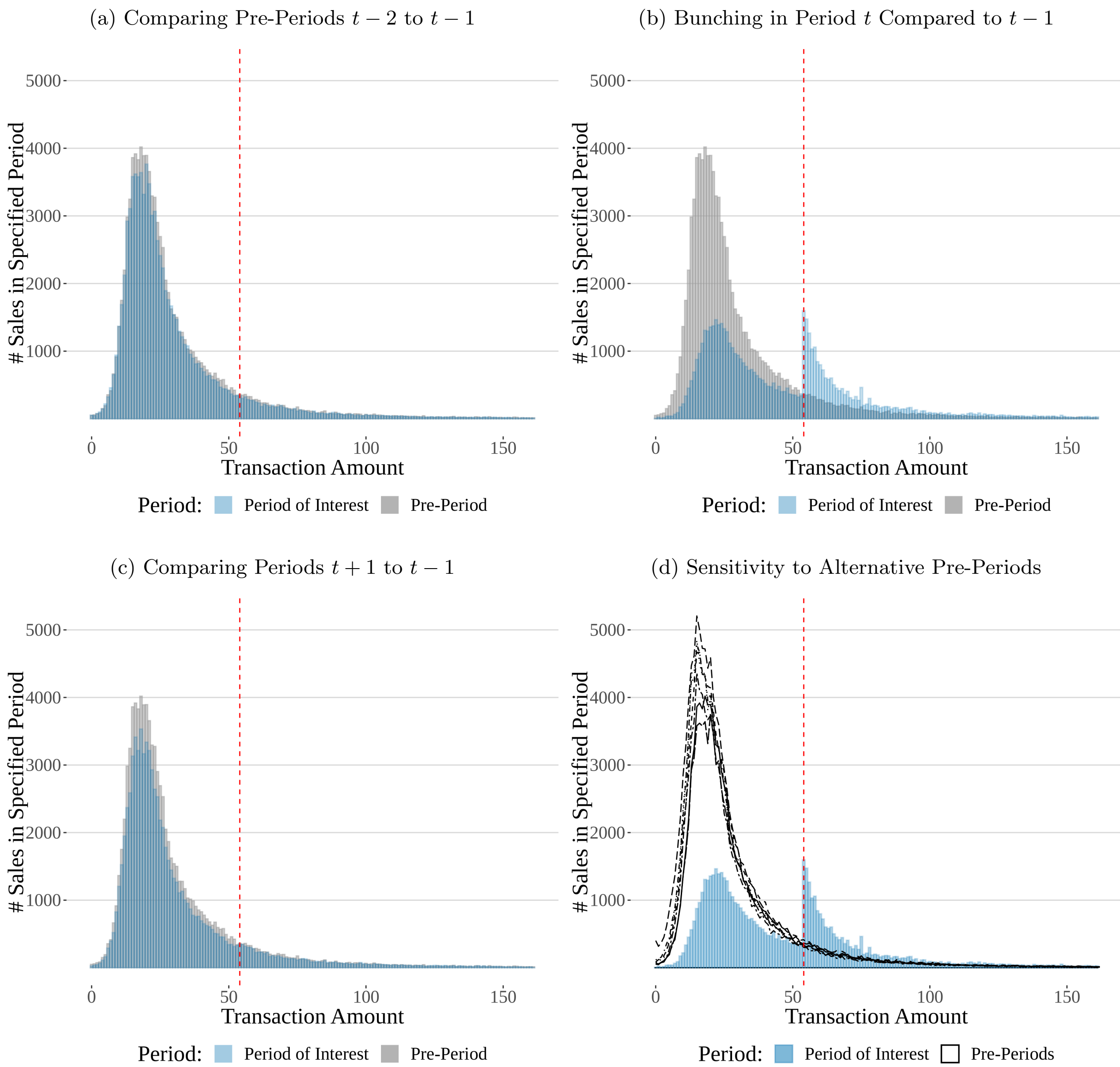
Appendix A.2: Confounding Effects of Spring Festival in Wave 1 in City A

We use all of the coupons in our data except for the Wave 1 coupons in City A. The reason is that the distribution of the Wave 1 food delivery coupons overlapped with the Spring Festival (Chinese New Year). As a result, our bunching estimator is likely to be severely biased by confounding trends from the Spring Festival, when many people travel out-of-town to go back to their hometowns, which reduces spending on food delivery substantially. We show this in Appendix Figure OA.16, which show clear visual evidence of bunching, but a very large "missing mass" that exceeds the "excess mass", implying a large *negative* MPC^{coupon} (i.e. that the effect of the coupons was to reduce spending) that is strongly different from the large positive MPC^{coupon} estimates for all of the other coupons in our data.

We therefore cannot rely on the bunching estimator because the pre-period no longer provides a valid counterfactual of the distribution of spending in the absence of the coupons. We can, however, use the random assignment of coupons in this coupon wave to estimate the effects on spending of being assigned an 84-28 coupon instead of a 54-18 coupon. This leads to an MPC^{coupon} estimate of XX, which is within the range of the other MPC^{coupon} estimates for the other coupons that we report in Table 1. If the true coupon-specific MPC^{coupon} estimates for the 84-28 and 54-18 coupons in City A in Wave 1 are similar (across the two coupons), then our identify in main text (equation 3) shows that this is also a valid estimate of each coupon-specific MPC^{coupon} for these two coupons. This shows a benefit of the strict random assignment of coupons for estimating MPC^{coupon} which is that it can deliver valid estimates even in cases where we have strong reason to think that the MPC^{coupon} estimates from bunching estimators will be biased.

Figure OA.1

Illustration of Bunching Estimator for 54-18 Food Delivery Coupon in City A, Wave 1



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$). The analysis for City A's Wave 1 coupons was relegated to the Appendix because the timing coincided with the Spring Festival, a time when food delivery spending fell sharply city-wide.

Appendix A.3: Evaluating Dominated Choices Using Bunching of Consumers' First Transactions

Coupons with the format "Spend at least ¥X, get ¥Y off" create dominated regions: assuming free disposal, it is strictly better to buy ¥X amount of goods at the discounted cost of ¥$X - Y$, than to buy ¥$X - \epsilon$ amount of goods and not use the X-Y coupon.

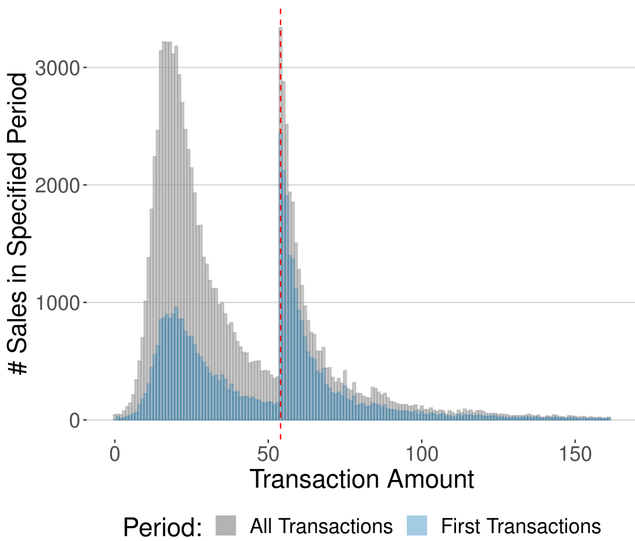
Our baseline results use data on all transactions made by coupon recipients in a given time period. Because many coupon recipients transact multiple times in the coupon category during the time period of interest (for instance, by going to the supermarket twice in one week), our previous graphs cannot distinguish between a transaction that is just below the threshold because the consumer made a dominated choice and a transaction that is just below the threshold because the consumer has already redeemed his or her coupon in a previous transaction.

To illustrate the infrequency of dominated transactions, we present results in this appendix (Figure OA.2) that contrast the distribution the *first* transaction made by each coupon recipient during the specified time period, to the distributions we have previously shown of all transactions made by coupon recipients in the specified period. These figures show that dominated choices are infrequent, which is consistent with our model where consumers make rational choices and do not make dominated choices after they take up a coupon.[11]

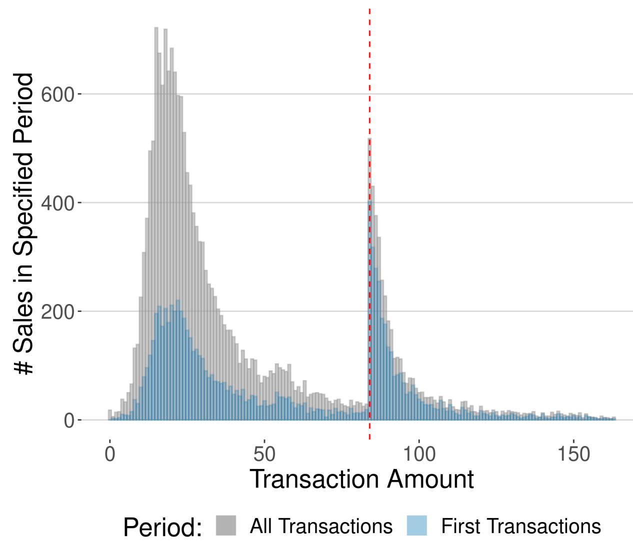
[11] Technically, even when restricting to the first transaction in a coupon wave period, a consumer's choice that appears to be a dominated choice need not be a strictly dominated choice if the consumer has a plan to use the coupon later on in a future shopping trip.

Figure OA.2
First Transaction Food Delivery Spending by City A Coupon Recipients

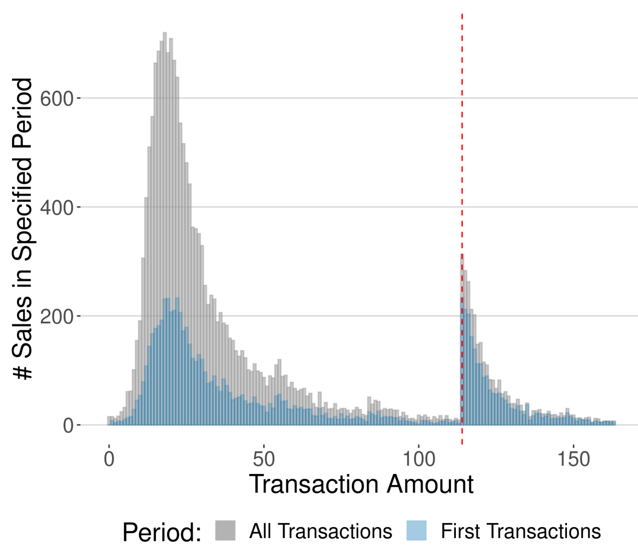
(a) 54-18 Coupon, Wave 2



(b) 84-28 Coupon, Wave 2



(c) 114-38 Coupon, Wave 2



Notes: This figure compares the distribution of the first transaction made by each recipient of a Wave 1 City A Food Delivery coupon to the distribution of all transactions made by these recipients. Transactions are binned into 1-RMB bins.

Appendix A.4: Additional Background on Chinese Digital Coupons from Structured Interviews

This section summarizes what we learned from several conversations with employees of the platform that distributed the digital coupons used in this study. We present notes from our structured interviews in this section.

QUESTION: How were the thresholds and discounts of the coupons chosen?

ANSWER: Typically, coupons are designed by the local government under study. The platform only provides recommendations and suggestions based on their past experience in issuing coupons for the local government's reference. For example, if the government wants to issue food delivery coupons, the platform can also suggest the government to issue supermarket coupons at the same time. Also, if the threshold of the coupon is too high, the platform can suggest the government to set the threshold lower. The local government under study makes the final decision, however.

Once the local government determines the coupon threshold, the discount is set by the platform based on past data covering transactions in the targeted spending category. The goal is to "use up" 100 percent of the government funds. In practice, since the redemption rate is expected to be less than 100 percent, the platform "over-issues" coupons, hoping that the final redemptions are close to the total government budget.

Due to the difficulty in predicting both take-up rate and redemption rate, sometimes the total redemptions could be higher than the government budget because of the initial over-issuance. In this case, the platform would pay the difference.

In some cases, the local governments ask the platform for suggestions about the threshold. In this case, the platform will give suggestions based on the recent local customers' transactions in related businesses. The platform tends to recommend coupon thresholds at 120 percent of the average transaction amount.

Another approach that is sometimes taken is to summarize the total number of transactions in different consumption ranges (e.g., in ¥10 bins up to ¥100), and then set the threshold based on the consumption range with the highest number of transactions. For example, when determining the threshold of one set of coupons, the platform analyzed transactions in the two weeks before the coupons were issued. The platform found the ranges with the highest number of transactions to be 0-10 RMB, 50-60 RMB, and 100-200 RMB. Based on these three intervals, the platform proposed set the threshold to be 5.1 (make adjustment based on (0+10)/2*1.2), 65 (make adjustment based on (60+70)/2*1.2) and 180 (make adjustment based on (100+200)/2*1.2). Then, the platform chose the discounted value to make sure the threshold minus the discount lies in these three intervals. In the final, they designed three types of coupons: 5.1-5, 65-15 and 180-80.

QUESTION: What were the respective roles of the platform, the local governments, and the national government in deciding how many coupons to offer and what the coupon characteristics were?

ANSWER: First, the central government encouraged local governments to stimulate the economy by issuing coupons. The central government didn't participate directly in the coupon program. The local governments allocated a certain amount of budget, say ¥10 million, for the government coupon program. A few projects were funded by provincial governments. Most programs are funded by (prefecture-level) municipal governments.

QUESTION: How were the coupons financed by the government?

ANSWER: The platform tries to issue enough coupons so that the final redemptions are close to the total budget of the local government under study. At the same time, the platform wants to avoid losses from over-issuance. During the program, the platform made payments to consumers and was then reimbursed by the government.

After the end of each wave of coupons, the government audits the project and reimburses the platform. During the project, the platform has to advance part of the funds first.

When the platform undertakes a coupon distribution wave, there is a fixed budget given, and there is no additional budget allocations during the coupon issuance period. If the redemption rate in the first coupon wave is unexpectedly low, it may "roll over" to be used in future waves, but the budget will not be adjusted during the same project. The goal of the government is to spend 100 percent of the budget.

In general, the budget-setting happened before the coupon designs were decided by the local government under study. Not at the same time. The total budget depended on the resources available to the local Ministry of Finance.

QUESTION: Did the national government signal anything to the local government about how large the coupon budgets should be?

ANSWER: No, the central government only gave general guidance. Local governments set up the budget on their own. Additionally, the local governments made decisions on what restrictions to put on the coupons (in terms of spending categories). Different coupons tended to have different targeted spending categories, based on the industries that the government wanted to support through fiscal stimulus.

QUESTION: Would the money be returned to the local government if it went unused for a certain amount of time?

ANSWER: In a sense, yes. The App is only reimbursed from the local government based on actual coupon redemptions.

QUESTION: What were the local government's preferences/considerations when it came to the coupon design?

ANSWER: As discussed above, the local government under study is primarily responsible for designing the coupons. The government wanted "higher leverage", meaning stimulating more consumption with lower spending. Additionally, in some programs, the government decides which industries it wants to stimulate. After the project is over, the government under study requires the platform to issue a project closing report, in which it reports the "leverage ratio" (total spending/government budget) of the coupon project. In addition, the government wants to extend the duration of the program to expand the influence of the policy. Therefore, it prefers to divide coupons into multiple waves.

Appendix A.5: Additional Tables & Figures

Table OA.1
Coupon Summary Statistics

City	Spending Category	Coupon Wave	Coupon [Threshold-Discount]	Coupons Available	Coupons Taken Up	Coupon Redemptions	Take-Up Rate	Redemption Rate
City A	Supermarket	2	24-8	86,767	49,024	7,639	0.57	0.16
City A	Supermarket	2	54-18	72,306	40,397	10,268	0.56	0.25
City A	Supermarket	2	84-28	130,150	73,243	19,850	0.56	0.27
City A	Multi-Category	2	54-18	194,069	94,690	49,626	0.49	0.52
City A	Multi-Category	2	84-28	41,955	20,735	10,230	0.49	0.49
City A	Multi-Category	2	114-38	42,066	20,732	9,499	0.49	0.46
City B	Food Delivery	1	30-15	100,000	7,198	2,688	0.02	0.37
City B	Food Delivery	2	30-15	46,000	46,000	5,006	1.00	0.11
City C	Multi-Category	1	100-40	40,179	40,179	26,004	1.00	0.65
City C	Multi-Category	1	200-100	6,000	6,000	5,332	1.00	0.89
City C	Multi-Category	2	100-40	19,814	19,814	13,062	1.00	0.66
City C	Multi-Category	2	200-100	3,000	3,000	2,520	1.00	0.84

Notes: This table gives detailed summary information on the coupons analyzed in our paper. “City” is the city that the coupon was available in. “Spending Category” is the category of spending in which the coupon could be redeemed. “Coupon Wave” is a (city-specific) number that sequences each release of coupons. “Coupon” displays the threshold and discount of the coupon. For example, a “24-8” coupon gives its holder 8 RMB off if they spend at least ¥24. “Coupons Available” is the number of coupons made available on our platform for the given coupon in the given wave period. “Coupons Taken Up” is the number of the coupons that were claimed by users of the platform. “Coupons Redeemed” is the number of coupons that were redeemed. “Take-Up Rate” is the fraction of coupons made available on our platform that were claimed by users of the platform. “Redemption Rate” is the fraction of taken-up coupons that were redeemed.

Table OA.2
Effects of Coupons on Spending in Targeted Spending Category and Other Spending Categories

	MPC^{coupon} Estimates for Each Spending Category		
Coupon:	24-8 coupon	54-18 coupon	84-28 coupon
	(1)	(2)	(3)
Supermarket Spending	3.94	3.82	3.50
(Targeted Spending Category)	(0.16)	(0.07)	(0.04)
All Other Spending Categories	0.66	0.28	0.12
	(0.37)	(0.1)	(0.06)
Food Delivery	-0.81	-0.14	-0.15
	(0.22)	(0.09)	(0.05)
Dining	0.13	0.04	0.05
	(0.14)	(0.03)	(0.02)
Entertainment	0.13	0.00	0.02
	(0.07)	(0.02)	(0.01)
Hotel	0.06	0.03	0.00
	(0.05)	(0.02)	(0.01)
Shopping	0.05	0.02	0.01
	(0.04)	(0.01)	(0.01)
Movie	1.23	0.37	0.21
	(0.07)	(0.02)	(0.02)
Beauty	-0.13	-0.02	-0.02
	(0.03)	(0.01)	(0.01)
Total Spending on Platform	4.59	4.10	3.62
	(0.39)	(0.24)	(0.28)

Notes: This table presents coupon *MPC* estimates using the bunching estimator described in equation (1) for each coupon and category of spending separately, focusing on the Wave 2 coupons distributed in City A. Bootstrap standard errors are presented in parentheses, based on 1000 replications of a cluster-based bootstrap procedure that resamples the ¥1 bins of transactions with replacement.

Table OA.3
Validating Bunching Estimates Using Random Assignment

City	Spending Category	Coupon Wave	Coupons, τ | τ' [Threshold-Discount]	Effect of Coupon τ' on Spending Relative to Coupon τ: Effect Based on Bunching Estimates	Effect of Coupon τ' on Spending Relative to Coupon τ: Effect Based on Random Assignment	Difference Between Bunching and Randomized Estimates	Percent Difference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Panel A Coupon-Specific MPC^{coupon} Estimates				
City A	Supermarket	2	24-8 | 54-18	3.77	3.69	-0.08	-2.3%
City A	Supermarket	2	24-8 | 84-28	3.41	3.41	0.00	-0.1%
City A	Multi-Category	2	54-18 | 84-28	2.34	2.34	0.00	-0.2%
City A	Multi-Category	2	54-18 | 114-38	1.58	1.70	0.12	6.9%

Notes: This table presents coupon *MPC* estimates using random assignment. Column (1) reports the anonymized city the coupon was distributed in, and columns (2) through (4) describe additional details of the coupon. Column (5) is calculated following equation (3) using *MPC* estimates from Table 1 and the number of coupons redeemed from Table OA.1

Table OA.4
Coupon MPC Heterogeneity by Age

City	Spending Category	Coupon Wave	Coupon [Threshold-Discount]	MPC^{coupon} Full sample	Age $\geq$ 35	Age < 35
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Panel A Coupon-Specific MPC^{coupon} Estimates				
City A	Supermarket	2	24-8	3.94	4.13	3.72
				(0.16)	(0.22)	(0.15)
City A	Supermarket	2	54-18	3.82	3.81	3.83
				(0.07)	(0.07)	(0.08)
City A	Supermarket	2	84-28	3.50	3.46	3.55
				(0.04)	(0.04)	(0.05)
City A	Multi-Category	2	54-18	3.05	3.13	3.01
				(0.14)	(0.12)	(0.16)
City A	Multi-Category	2	84-28	2.82	2.88	2.78
				(0.15)	(0.14)	(0.16)
City A	Multi-Category	2	114-38	2.37	2.52	2.29
				(0.18)	(0.18)	(0.20)
City B	Food Delivery	1	30-15	2.56	2.67	2.50
				(0.16)	(0.17)	(0.20)
City B	Food Delivery	2	30-15	1.96	1.75	2.07
				(0.25)	(0.25)	(0.29)
City C	Multi-Category	1	100-40	3.33	3.42	3.28
				(0.07)	(0.08)	(0.06)
City C	Multi-Category	1	200-100	1.91	1.95	1.90
				(0.14)	(0.16)	(0.15)
City C	Multi-Category	2	100-40	3.26	3.29	3.25
				(0.09)	(0.08)	(0.09)
City C	Multi-Category	2	200-100	1.93	1.91	1.94
				(0.15)	(0.22)	(0.15)

Notes: This table presents coupon *MPC* estimates using the bunching estimator described in equation (1). Column (1) reports the anonymized city the coupon was distributed in, and columns (2) through (4) describe additional details of the coupon. Columns (5) to (7) report the coupon *MPC* estimates for different age groups. Bootstrap standard errors are presented in parentheses, based on 1000 replications of a cluster-based bootstrap procedure that resamples the ¥1 bins of transactions with replacement.

Table OA.5

Heterogeneity by Pre-Period Platform Usage

				MPC^{coupon} estimate			
City	Spending Category	Coupon Wave	Coupon [Threshold-Discount]	Full sample	Inactive users	Active users	Frequent users
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Panel A Coupon-Specific MPC^{coupon} Estimates				
City A	Supermarket	2	24-8	3.94	2.73	4.47	1.71
				(0.16)	(0.33)	(0.24)	(0.51)
City A	Supermarket	2	54-18	3.82	3.53	3.91	2.92
				(0.07)	(0.10)	(0.09)	(0.22)
City A	Supermarket	2	84-28	3.50	3.34	3.55	2.88
				(0.04)	(0.13)	(0.06)	(0.27)
City A	Multi-Category	2	54-18	3.05	2.96	3.75	1.81
				(0.14)	(0.17)	(0.11)	(0.32)
City A	Multi-Category	2	84-28	2.82	2.79	3.22	2.05
				(0.15)	(0.16)	(0.09)	(0.32)
City A	Multi-Category	2	114-38	2.37	2.36	2.81	1.72
				(0.18)	(0.2)	(0.14)	(0.31)
City B	Food Delivery	1	30-15	2.56	2.04	3.53	0.81
				(0.16)	(0.34)	(0.31)	(1.01)
City B	Food Delivery	2	30-15	1.96	1.49	3.16	-0.44
				(0.25)	(0.26)	(0.49)	(0.40)
City C	Multi-Category	1	100-40	3.33	3.16	3.74	2.46
				(0.07)	(0.07)	(0.16)	(0.18)
City C	Multi-Category	1	200-100	1.91	1.78	2.26	1.28
				(0.14)	(0.15)	(0.21)	(0.27)
City C	Multi-Category	2	100-40	3.26	3.11	3.77	2.17
				(0.09)	(0.10)	(0.13)	(0.27)
City C	Multi-Category	2	200-100	1.93	1.88	2.07	1.58
				(0.15)	(0.15)	(0.20)	(0.22)

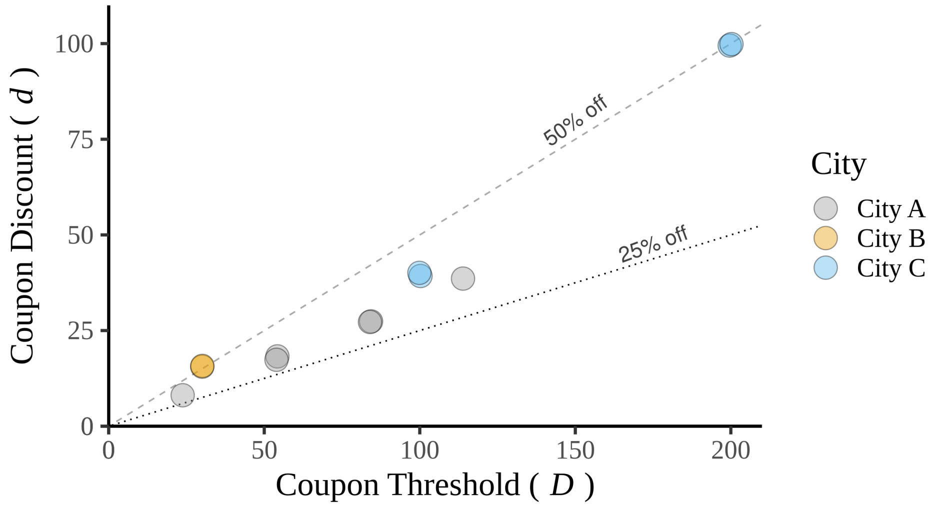
Notes: This table presents coupon MPC estimates using the bunching estimator described in equation (1). Column (1) reports the anonymized city the coupon was distributed in, and columns (2) through (4) describe additional details of the coupon. Columns (5) to (8) compare our baseline wave-period MPC estimates ("Full sample") to MPCs estimated on particular subpopulations. "Active users" refers to coupon recipients who were active on the platform in the coupon's spending category during the pre-periods, and "Inactive users" refers to coupon recipients who had not been active. "Frequent Users" refers to users who were at or above the 95th percentile of user spending on the platform within the designated category prior to receiving a coupon, except for the "Multi-Category" rows, which have the cutoff at the 90th percentile. The weighted averages for frequent users follows the 95th percentile cutoff. Bootstrap standard errors are presented in parentheses, based on 1000 replications of a cluster-based bootstrap procedure that resamples the ¥1 bins of transactions with replacement.

Table OA.6
Coupon MPC Heterogeneity by Different H

City	Spending Category	Coupon Wave	Coupon [Threshold-Discount]	MPC^{coupon}			
				$H = \bar{\tau} + 30$	$H = \bar{\tau} + 50$	$H = \bar{\tau} + 70$	$H = \bar{\tau} + 100$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A Coupon-Specific MPC^{coupon} Estimates							
City A	Supermarket	2	24-8	3.96	3.94	3.43	3.04
				(0.14)	(0.16)	(0.24)	(0.30)
City A	Supermarket	2	54-18	3.75	3.82	3.74	3.68
				(0.07)	(0.07)	(0.07)	(0.08)
City A	Supermarket	2	84-28	3.34	3.50	3.52	3.51
				(0.07)	(0.04)	(0.04)	(0.04)
City A	Multi-Category	2	54-18	2.93	3.05	3.20	3.37
				(0.15)	(0.14)	(0.12)	(0.10)
City A	Multi-Category	2	84-28	2.63	2.82	2.98	3.15
				(0.17)	(0.14)	(0.12)	(0.10)
City A	Multi-Category	2	114-38	1.97	2.37	2.79	3.21
				(0.22)	(0.18)	(0.15)	(0.09)
City B	Food Delivery	1	30-15	2.50	2.56	2.59	2.55
				(0.17)	(0.16)	(0.16)	(0.17)
City B	Food Delivery	2	30-15	1.89	1.96	1.93	1.83
				(0.26)	(0.27)	(0.26)	(0.28)
City C	Multi-Category	1	100-40	3.29	3.33	3.37	3.39
				(0.07)	(0.06)	(0.06)	(0.07)
City C	Multi-Category	1	200-100	1.64	1.91	2.16	2.34
				(0.21)	(0.14)	(0.09)	(0.09)
City C	Multi-Category	2	100-40	3.23	3.26	3.30	3.31
				(0.09)	(0.08)	(0.08)	(0.08)
City C	Multi-Category	2	200-100	1.56	1.93	2.24	2.44
				(0.20)	(0.15)	(0.11)	(0.10)

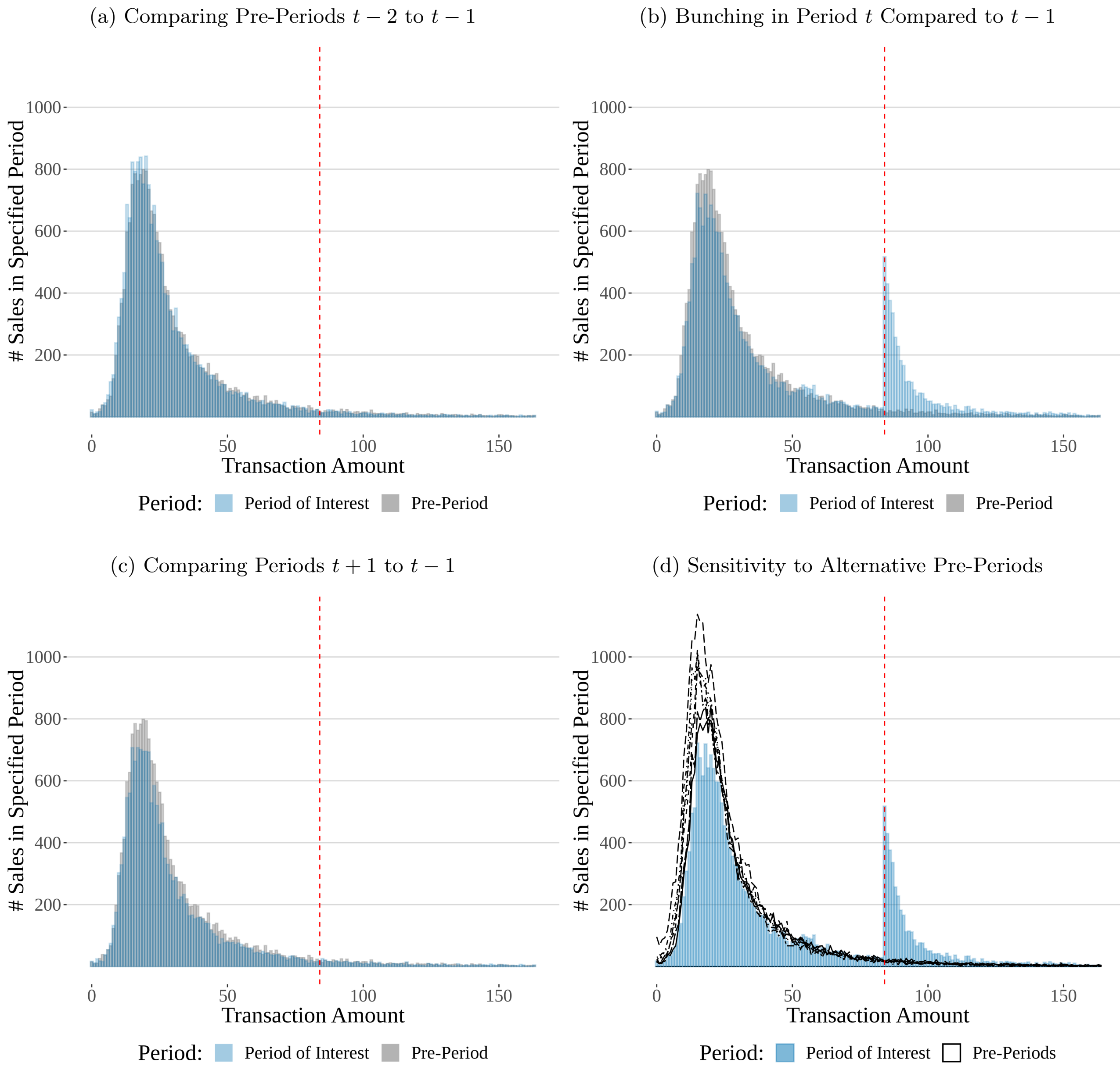
Notes: This table presents coupon MPC estimates using the bunching estimator described in equation (1). Column (1) reports the anonymized city the coupon was distributed in, and columns (2) through (4) describe additional details of the coupon. Columns (5) to (8) report the coupon MPC estimates for different thresholds where $\bar{\tau}$ is the highest threshold coupon in a city and category (e.g., $\bar{\tau} = 84$ for the supermarket coupons in City A distributed in wave 2). Bootstrap standard errors are presented in parentheses, based on 1000 replications of a cluster-based bootstrap procedure that resamples the ¥1 bins of transactions with replacement.

Figure OA.3
Heterogeneity in Coupon Design: Variation in Thresholds and Discounts



Notes: This figure shows the distribution of coupon thresholds and discounts in our data. The dashed lines indicate the set of coupon discounts that corresponds to 25 percent and 50 percent of the coupon thresholds. All of the coupons lie between the two rays, which implies that when municipalities chose higher coupons, they chose higher coupon discounts to keep the ratio of the discount to the threshold between 25 and 50 percent. All values are in ¥.

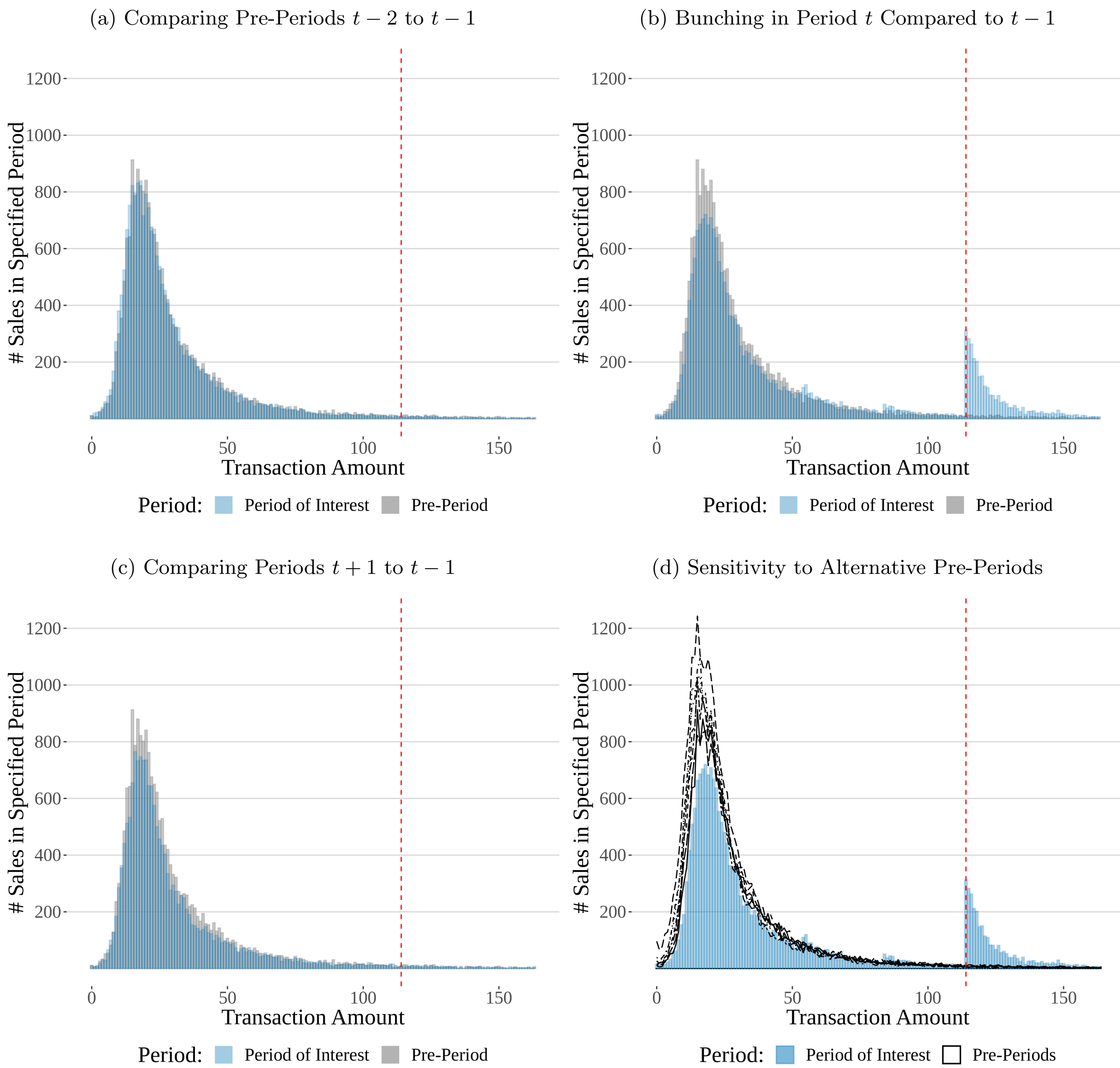
Figure OA.4
Illustration of Bunching Estimator in Food Delivery Spending for 84-28 Multi-Category Coupon in City A, Wave 2



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.5

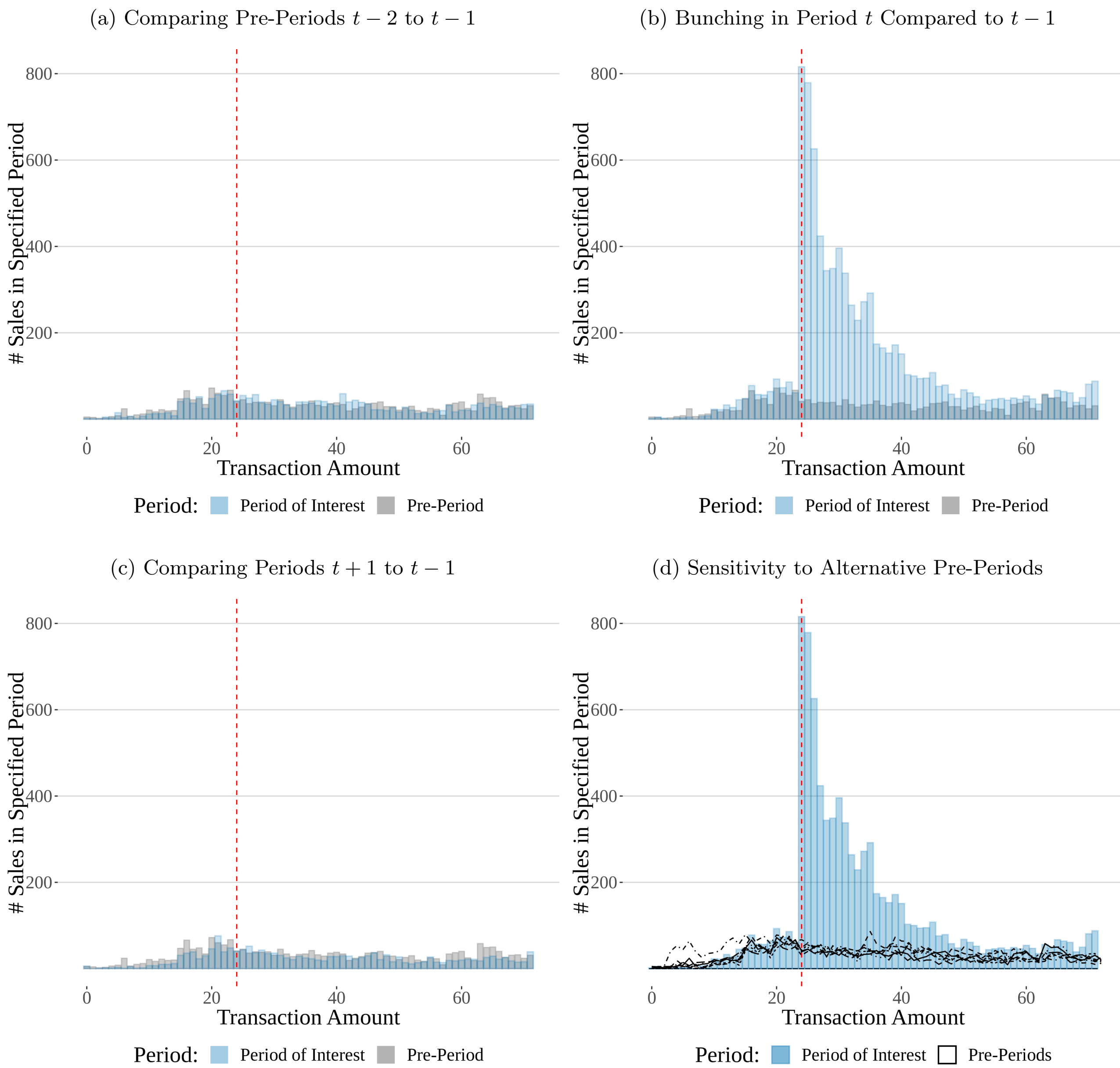
Illustration of Bunching Estimator in Food Delivery Spending for 114-38 Multi-Category Coupon in City A, Wave 2



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

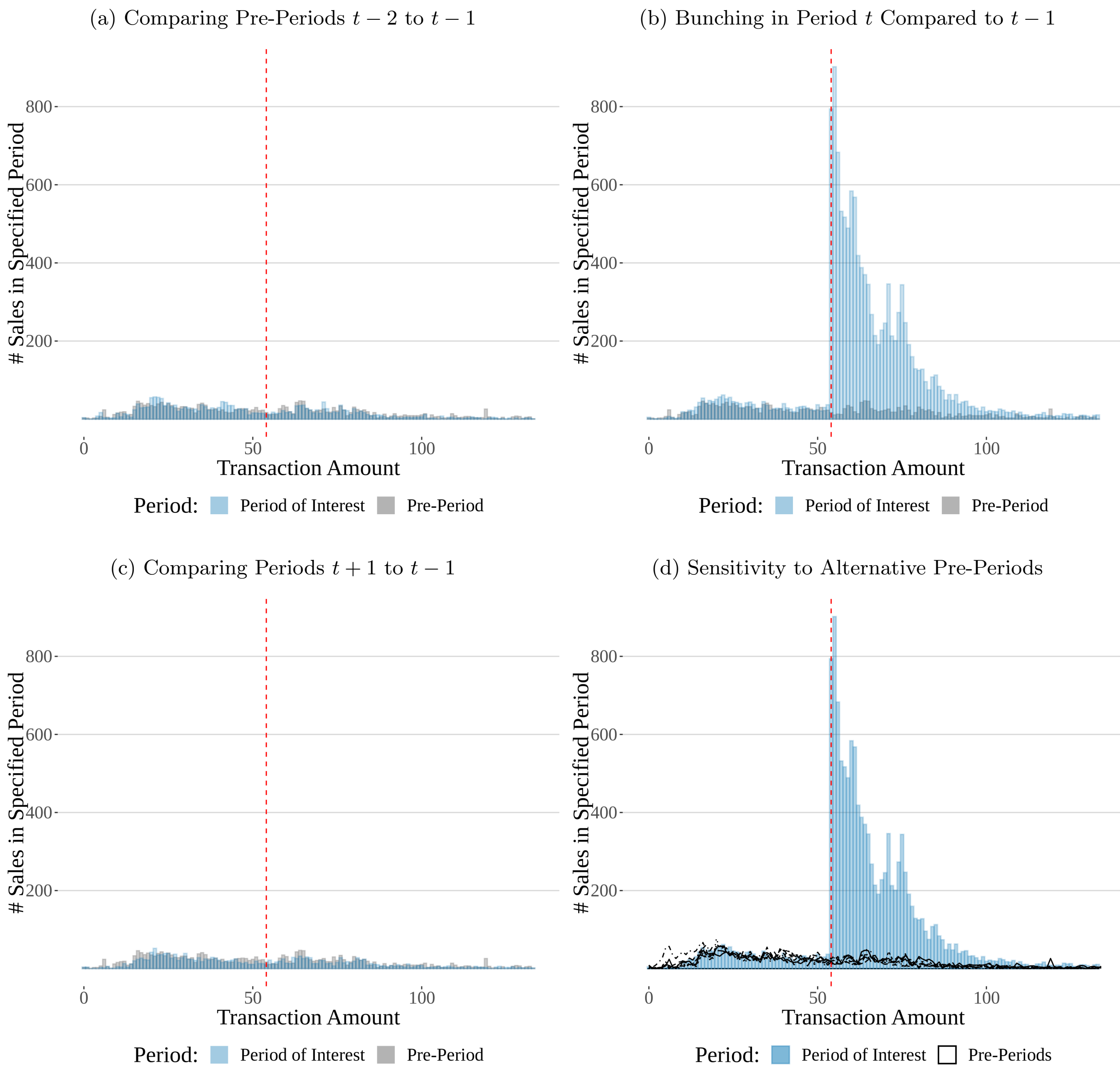
Figure OA.6

Illustration of Bunching Estimator for 24-8 Supermarket Coupon in City A, Wave 2



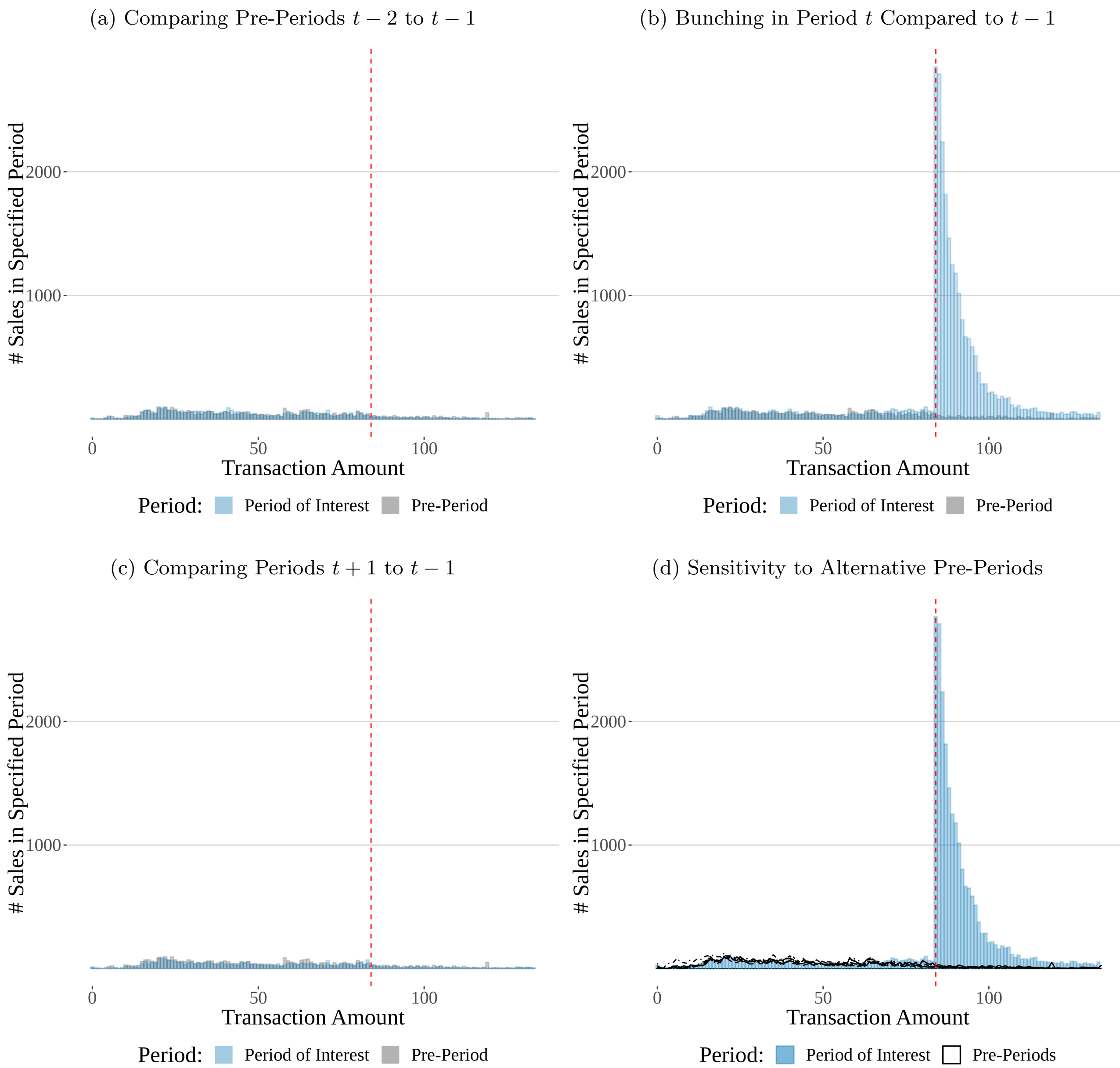
Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.7
Illustration of Bunching Estimator for 54-18 Supermarket Coupon in City A, Wave 2



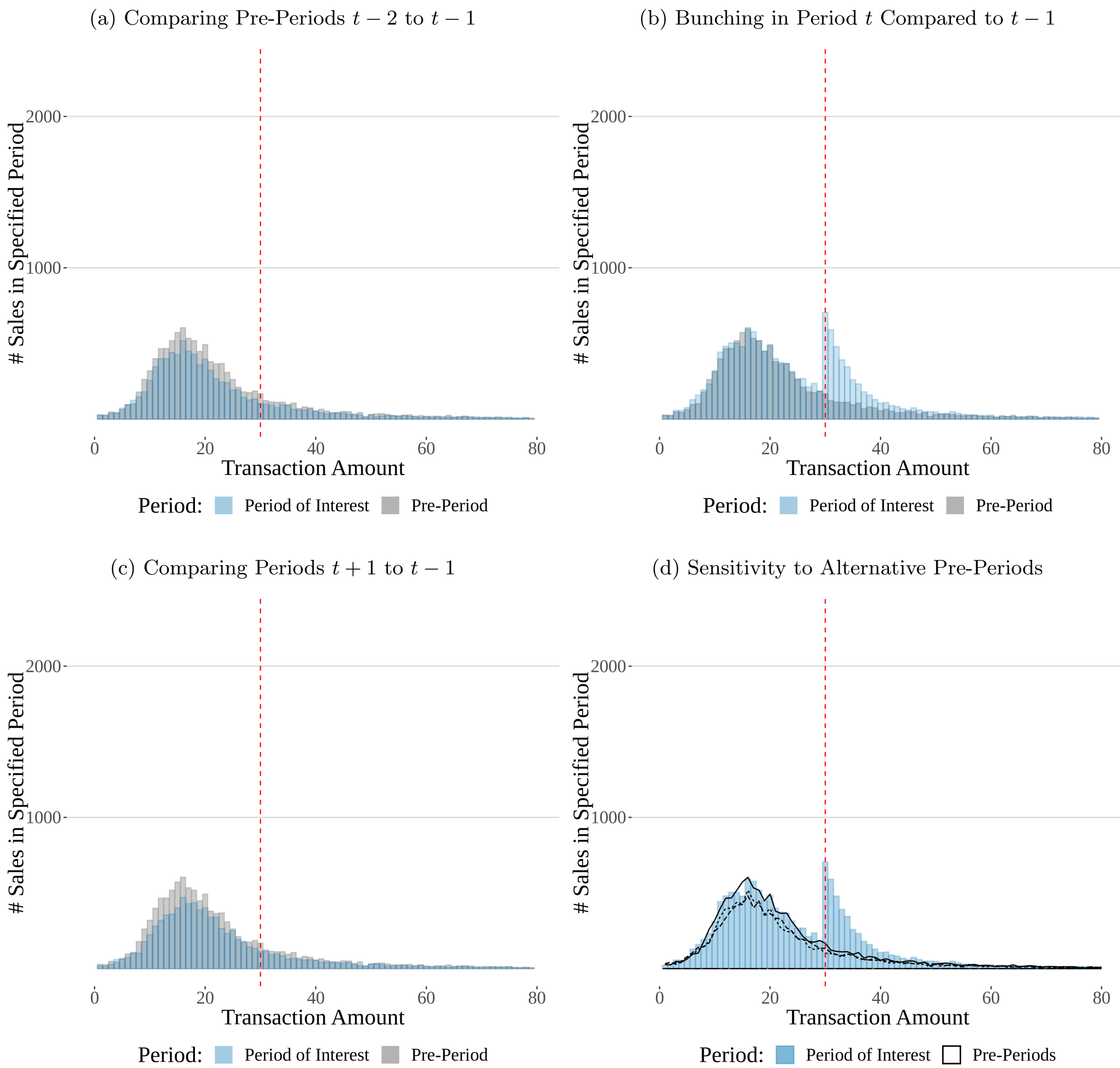
Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.8
Illustration of Bunching Estimator for 84-28 Supermarket Coupon in City A, Wave 2



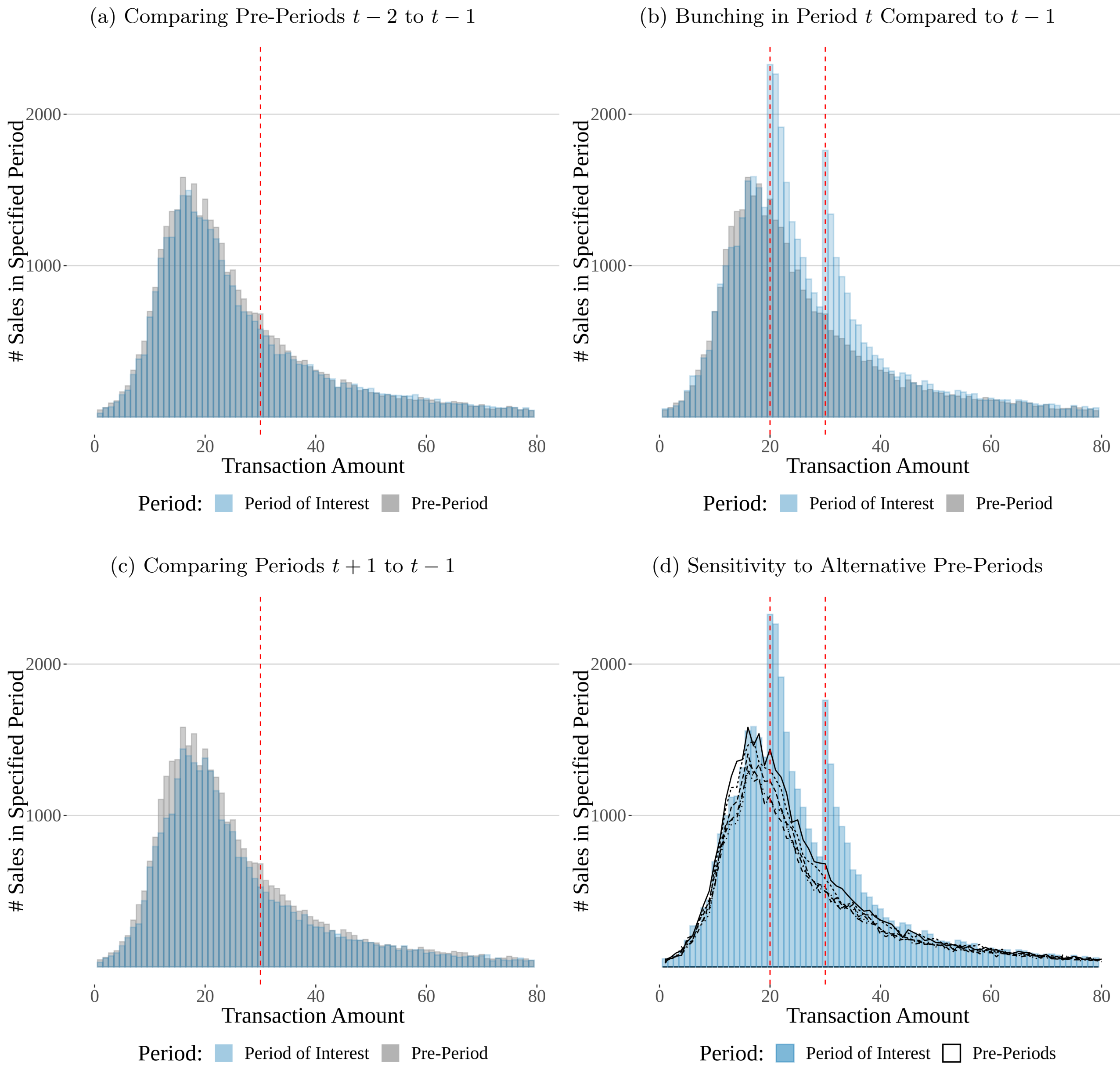
Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.9
Illustration of Bunching Estimator for 30-15 Food Delivery Coupon in City B, Wave 1



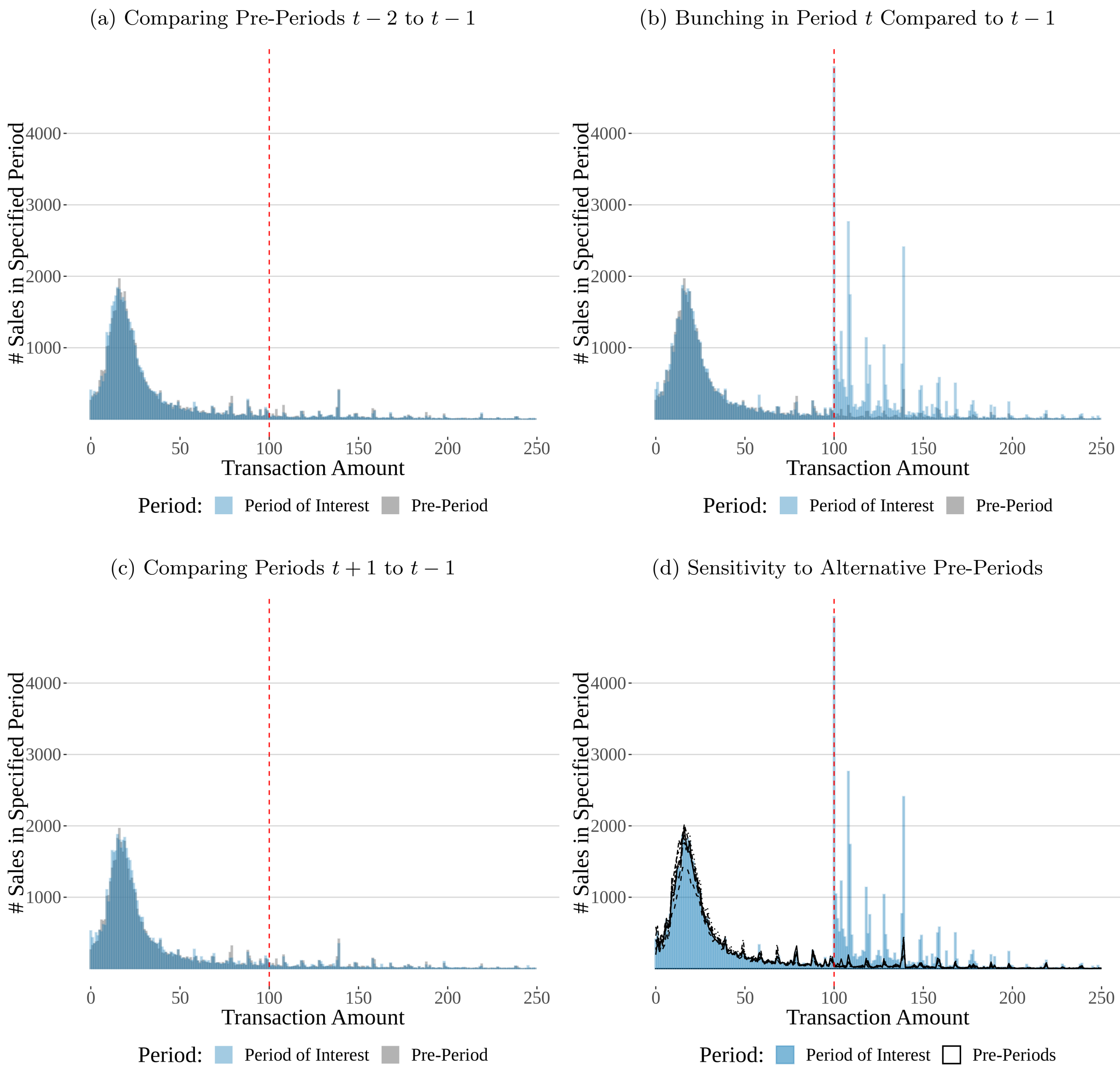
Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.10
Illustration of Bunching Estimator for Food Delivery Coupon Bundle (20-10 and 30-15) in City B, Wave 2



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Note that this figure (unlike the others in this draft) analyzes the receipt of multiple coupons at once: each wave 2 coupon recipient in this city received a 20-10 and a 30-15 coupon simultaneously. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

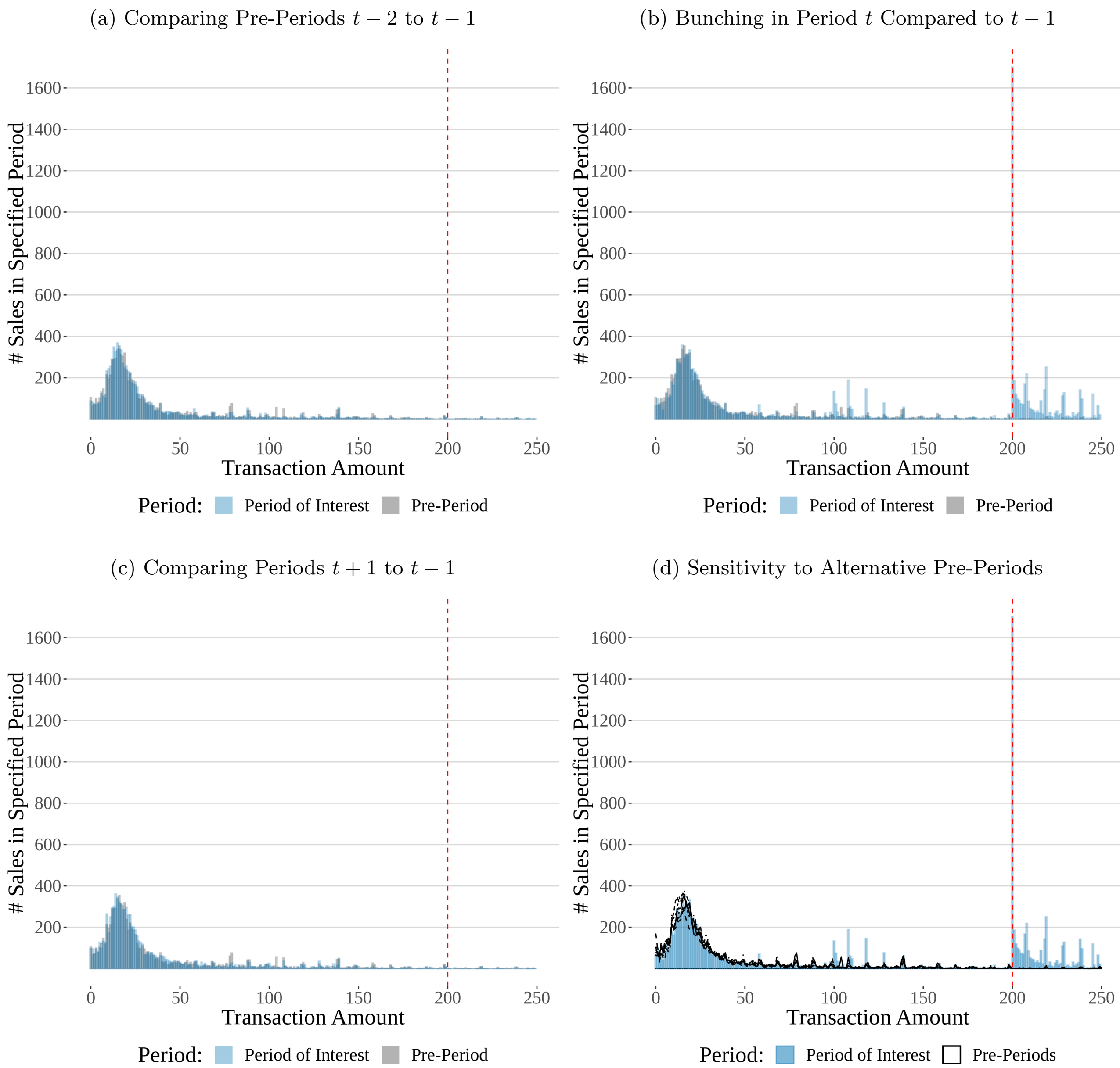
Figure OA.11
Illustration of Bunching Estimator for 100-40 Multi-Category Coupon in City C, Wave 1



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.12

Illustration of Bunching Estimator for 200-100 Multi-Category Coupon in City C, Wave 1

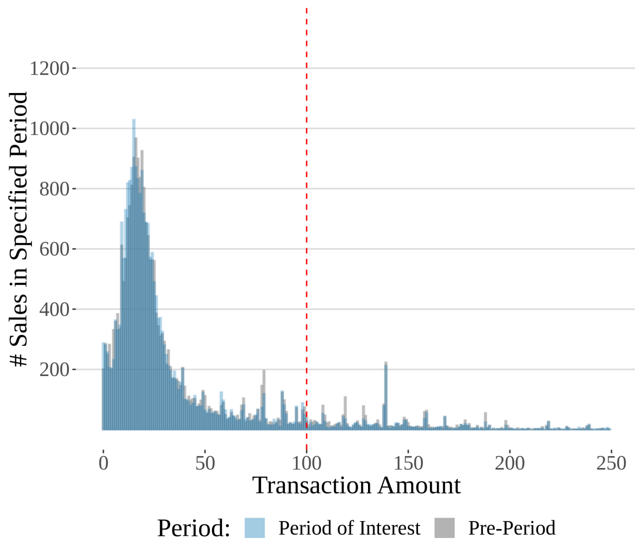


Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

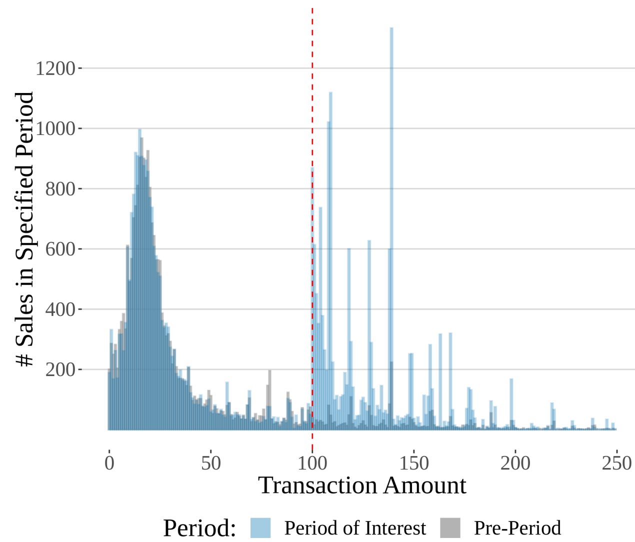
Figure OA.13

Illustration of Bunching Estimator for 100-40 Multi-Category Coupon in City C, Wave 2

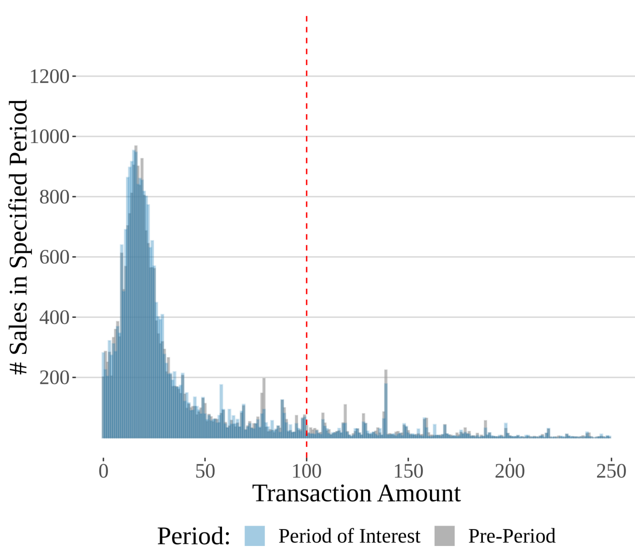
(a) Comparing Pre-Periods $t-2$ to $t-1$



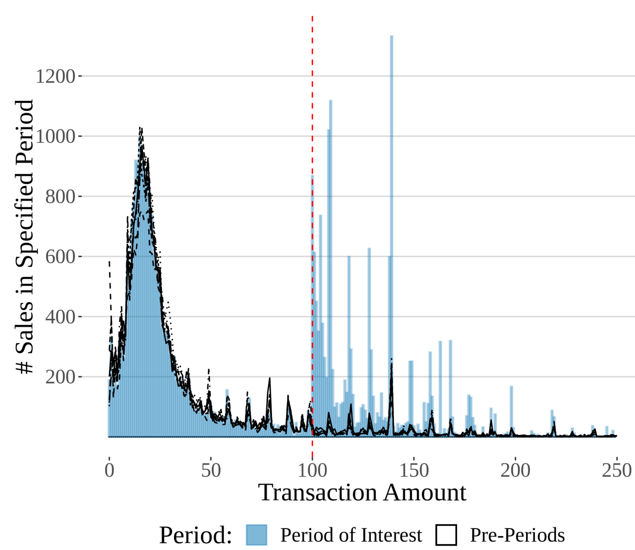
(b) Bunching in Period t Compared to $t-1$



(c) Comparing Periods $t+1$ to $t-1$



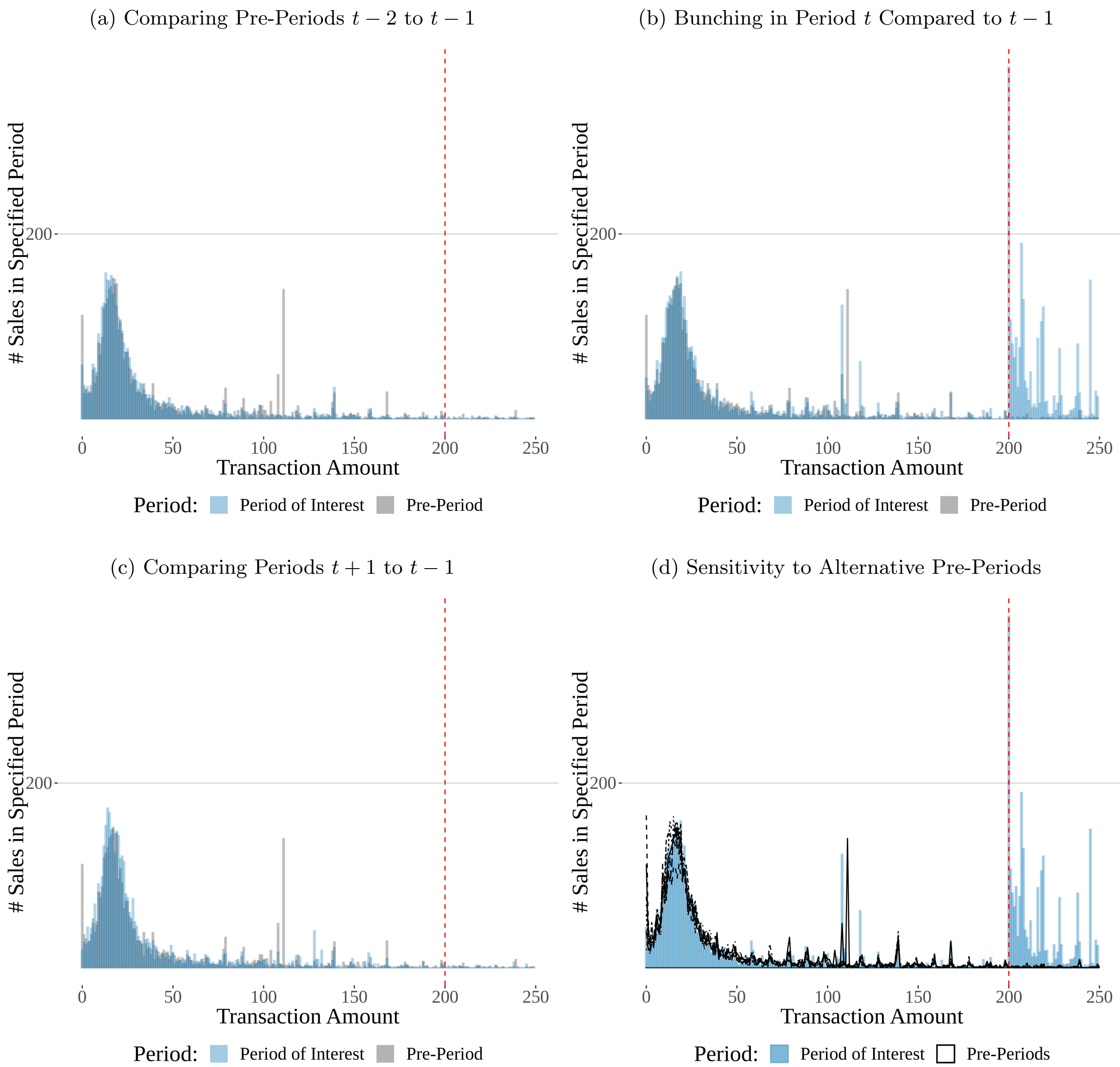
(d) Sensitivity to Alternative Pre-Periods



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

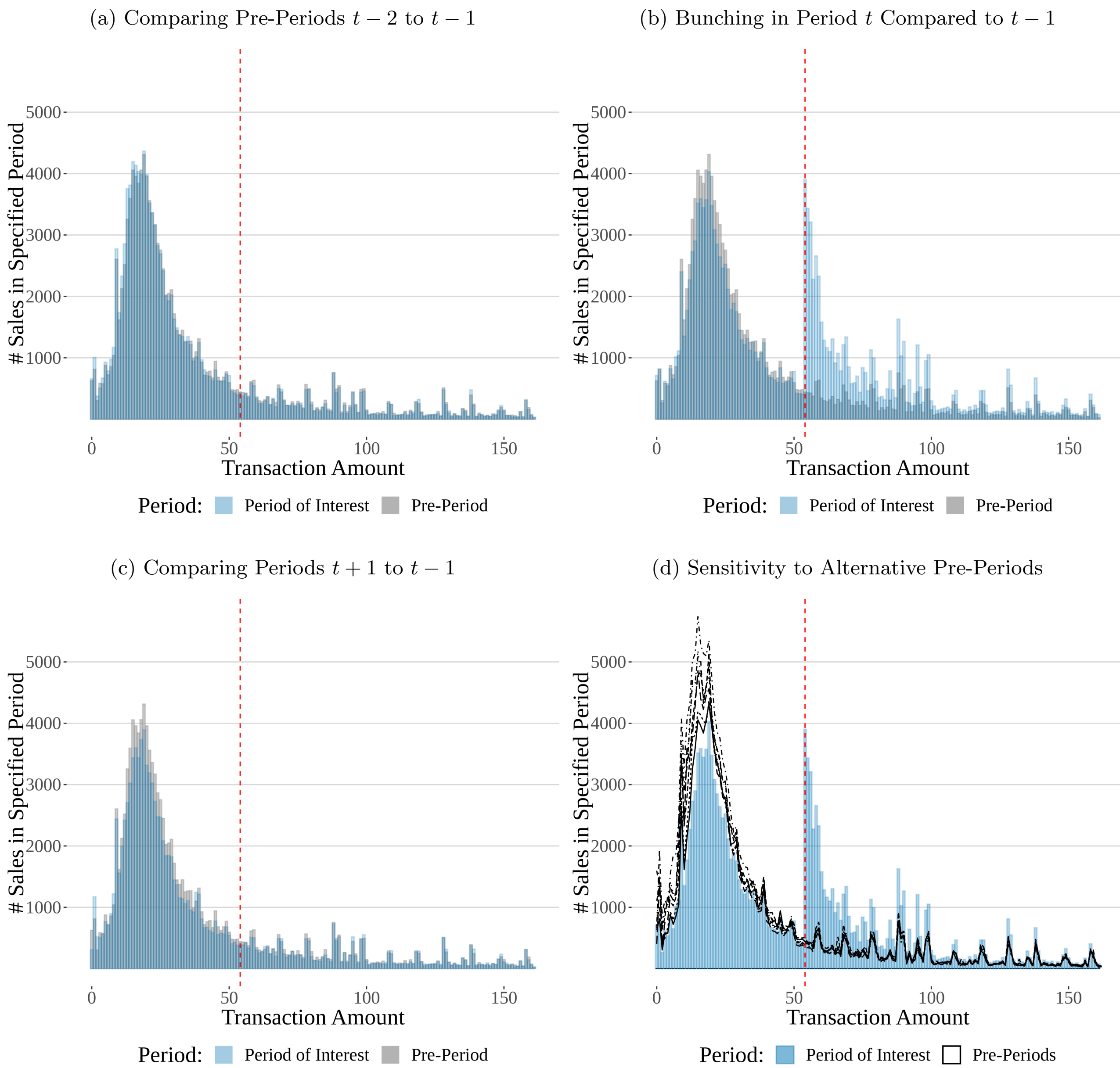
Figure OA.14

Illustration of Bunching Estimator for 200-100 Multi-Category Coupon in City C, Wave 2



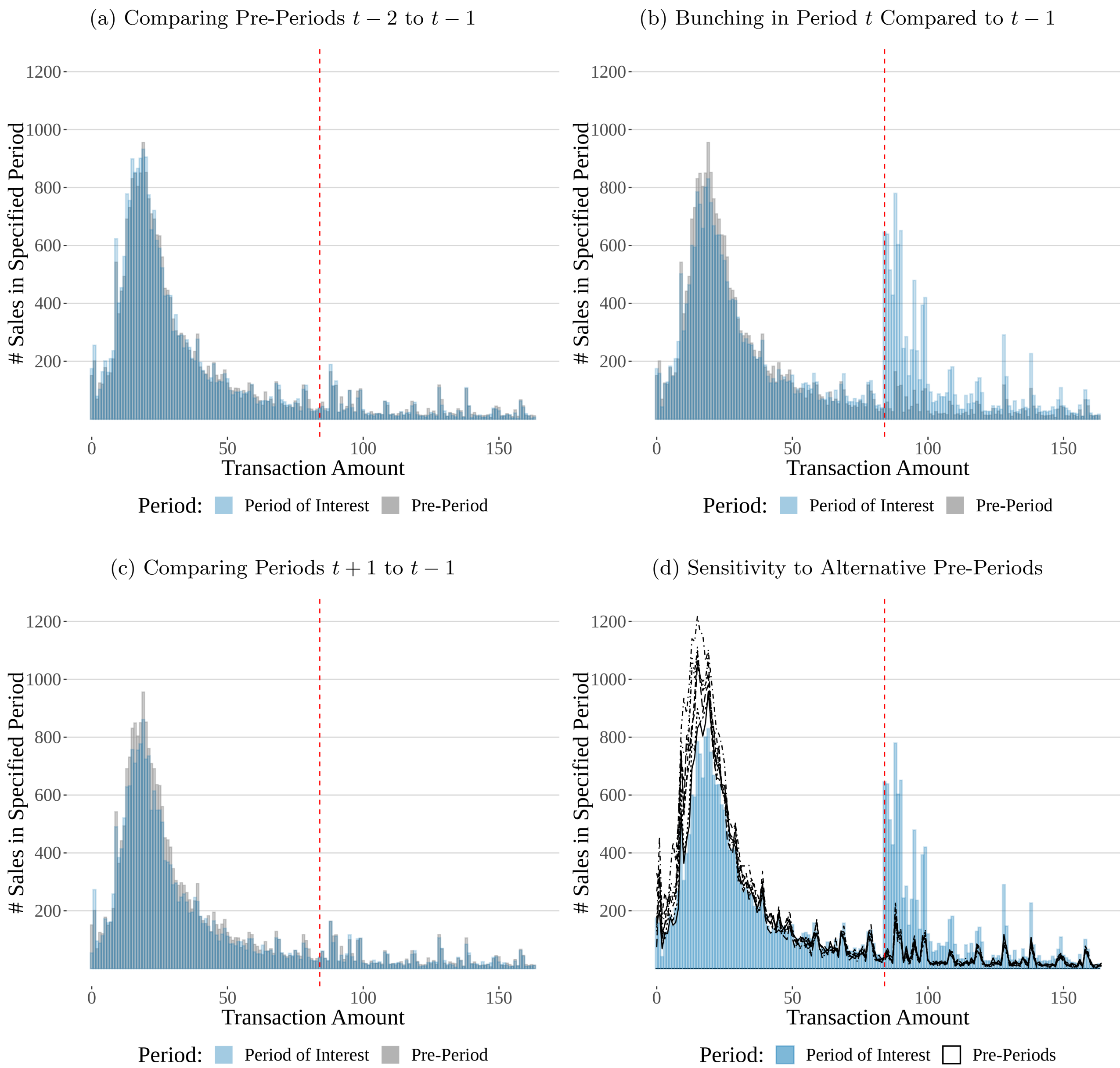
Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.15
Illustration of Bunching Estimator for 54-18 Multi-Category Coupon in City A, Wave 2



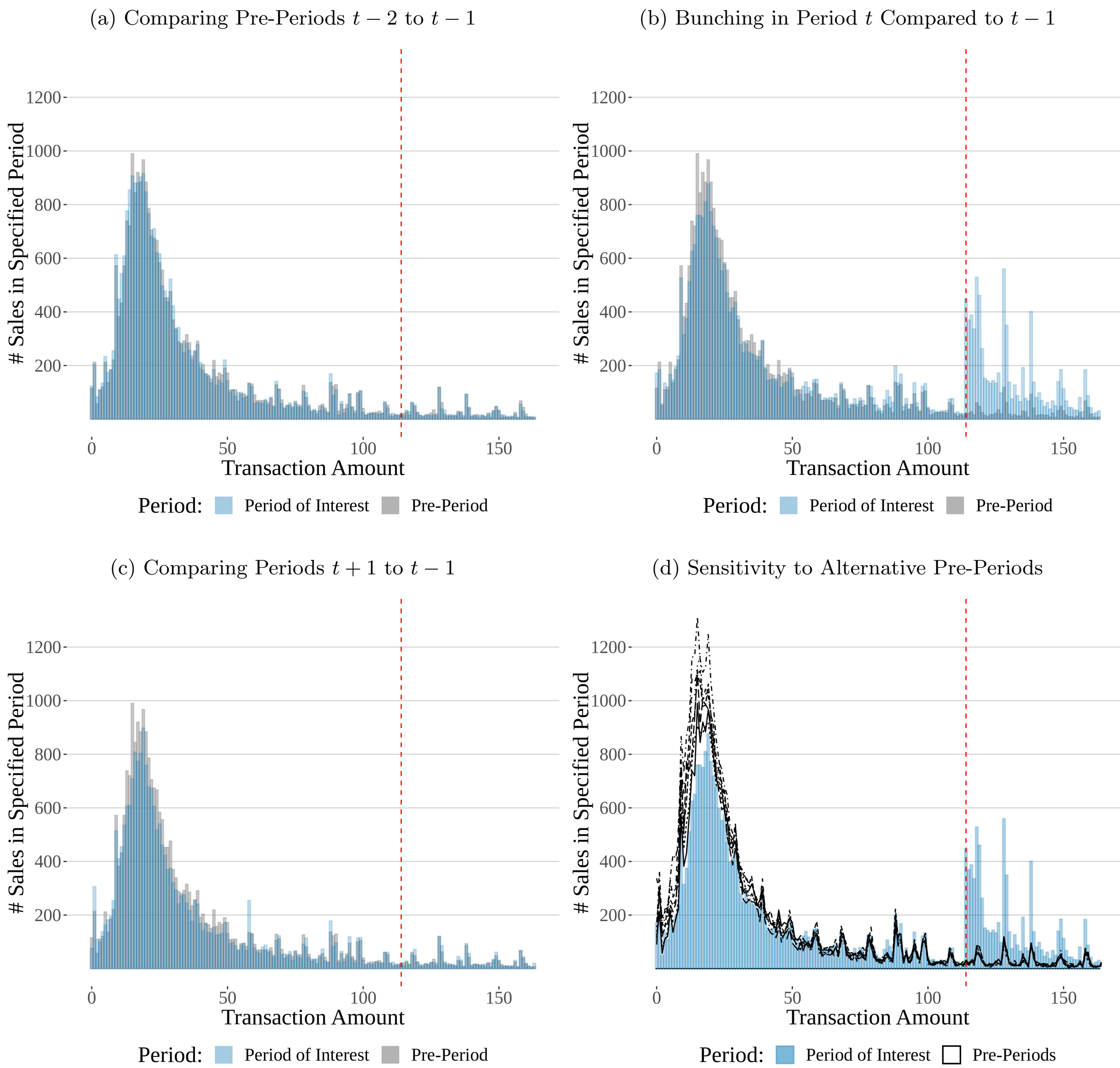
Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. This figure includes all spending targeted by the multi-category coupon, whereas Figure 1 displays only spending in food delivery, which is the largest category of spending targeted by the multi-category coupon. There is less measurement error regarding both the timing and spending amount in the food delivery spending category compared to the other categories. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.16
Illustration of Bunching Estimator for 84-28 Multi-Category Coupon in City A, Wave 2



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Relative to Figure OA.4, this figure includes all spending targeted by the multi-category coupon, not just food delivery. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

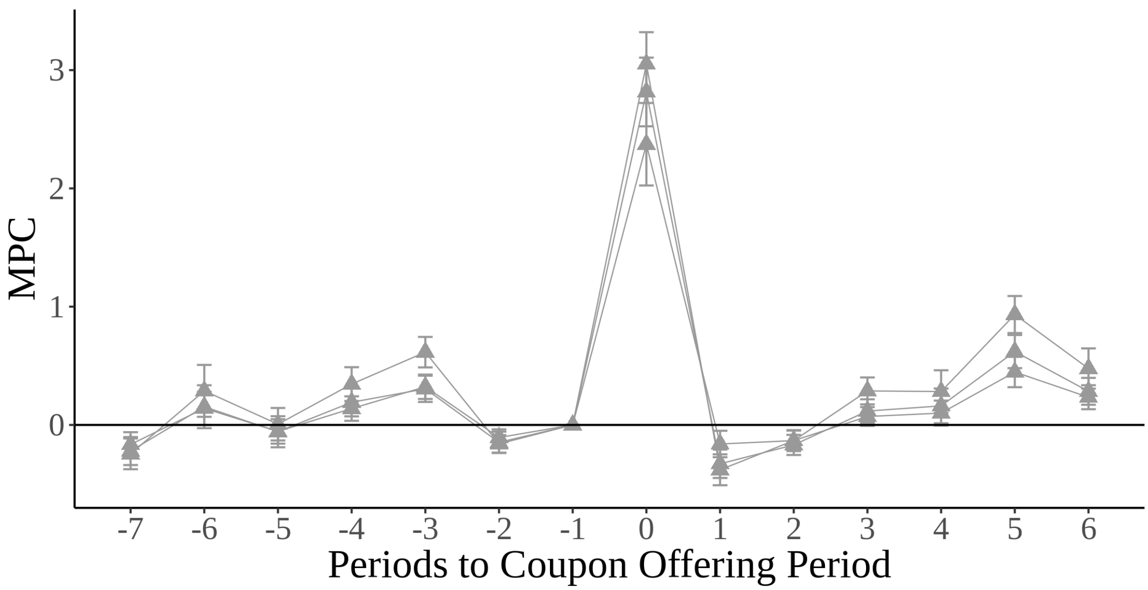
Figure OA.17
Illustration of Bunching Estimator for 114-38 Multi-Category Coupon in City A, Wave 2



Notes: This figure illustrates the bunching estimator by comparing the distribution of spending between periods around the time the coupons were distributed. Relative to Figure OA.5, this figure includes all spending targeted by the multi-category coupon, not just food delivery. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon wave period to seven pre-periods ($t-1$ through $t-7$).

Figure OA.18

Evolution of MPC^{coupon} estimates Over Time

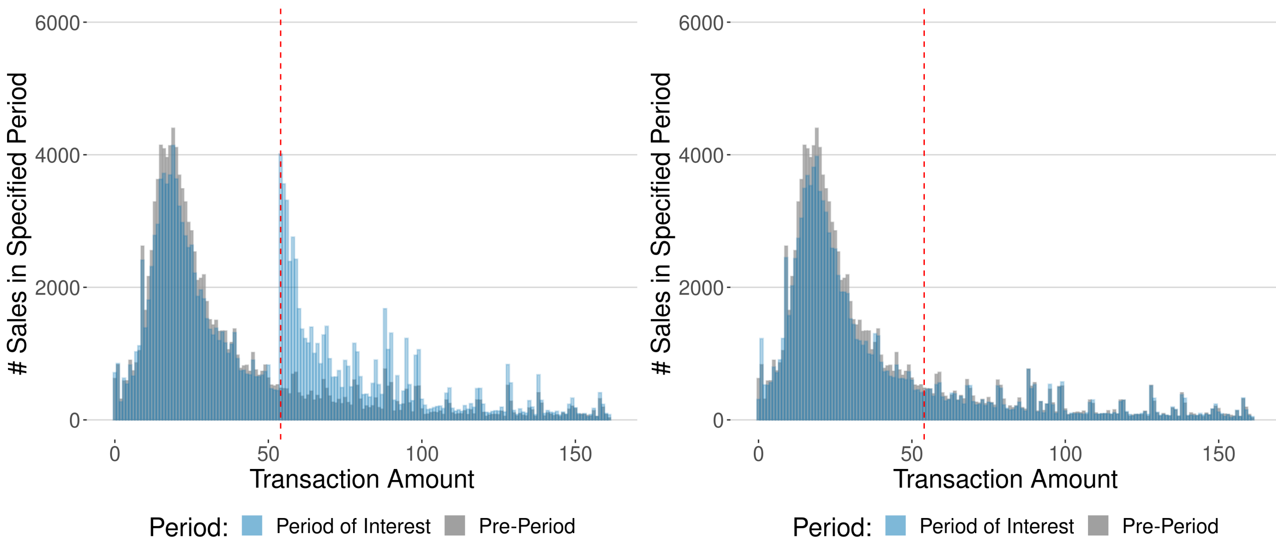


Notes: This figure reports MPC^{coupon} estimates over time for the three "Multi-Category" coupons distributed in wave 2 in City A. The small negative estimate after coupon wave is consistent with a very small amount of intertemporal substitution. The confidence intervals are built with bootstrapped standard errors based on 1000 replications of a cluster-based bootstrap procedure that resamples the ¥1 bins of transactions with replacement.

Figure OA.19

Effects of Coupons on Total Platform Spending

(a) Bunching in Period t Compared to $t-1$ (b) Comparing Periods $t+1$ to $t-1$

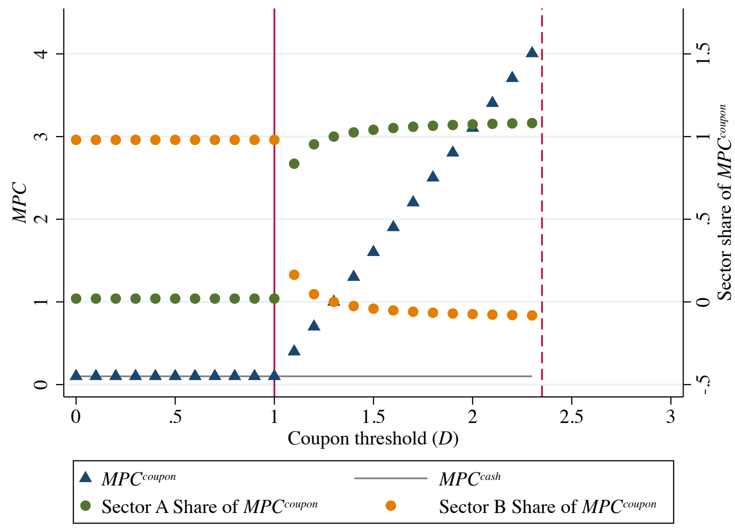


<u>Notes:</u> This figure reproduces the panels in Figure 2 using the distribution of total spending on the platform instead of the distribution of spending in a spending category targeted by the coupon. MPCs based on these comparisons of total spending are presented in Column (6) of Table 1. The similarity in figures across the analogous panels is consistent with the estimates in Table OA.2 showing limited effects of coupons on consumption in "non-targeted" spending categories.

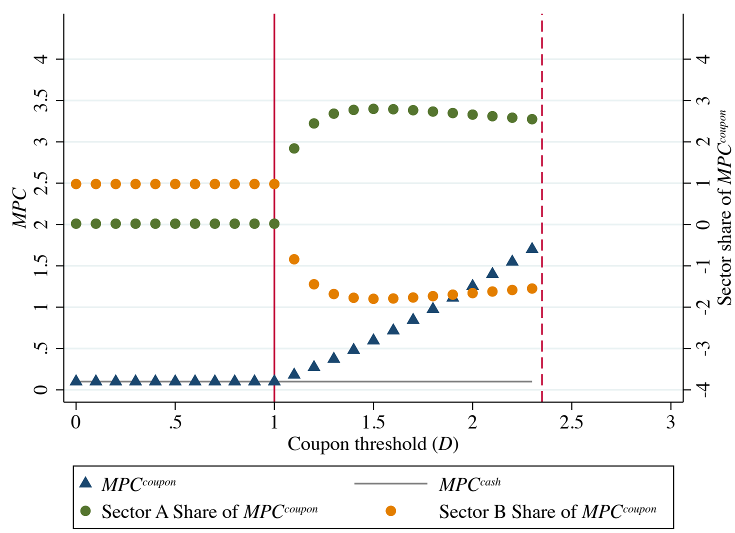
Figure OA.20

Sensitivity in Model to Different Values of the Intertemporal Elasticity of Substitution

(a) Model Calibration with $\gamma = 0.5$

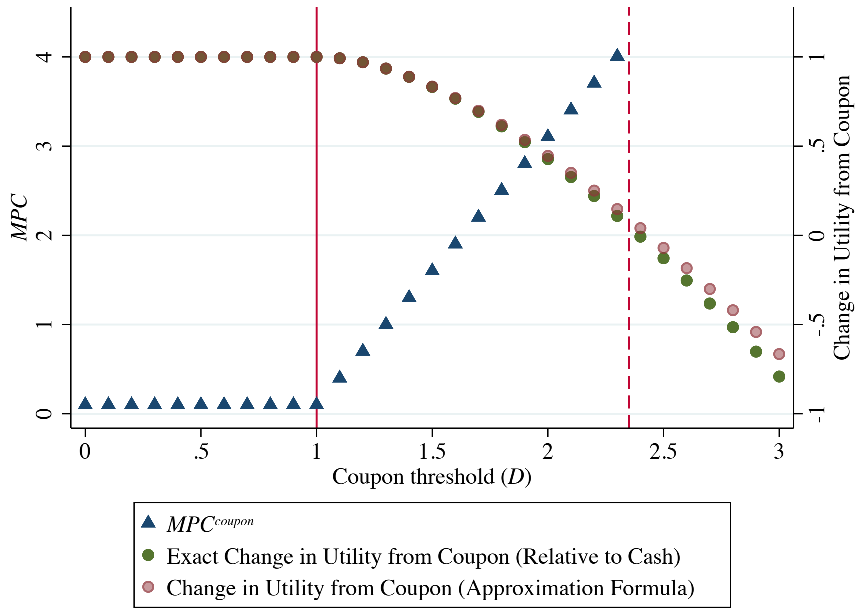


(b) Model Calibration with $\gamma = 2$



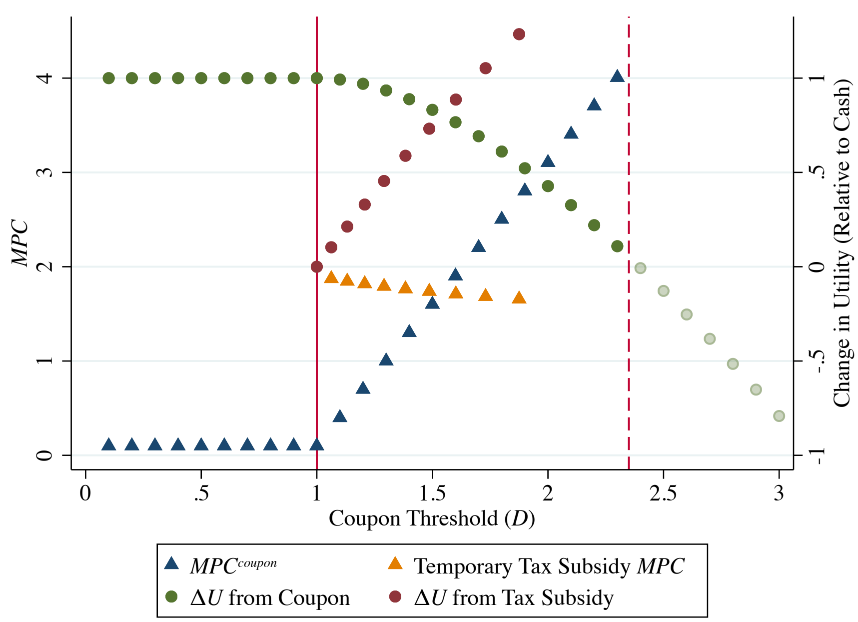
Notes: This figure shows how the model-based simulation results vary with the intertemporal elasticity of substitution ($1/\gamma$). Panel A reports results based on the baseline calibration results reported in Figure 4. In Panel A, there is very little change in Sector B consumption when the consumer is using the coupon, while most of the cash is spent in Sector B because the consumer's preferences are homothetic and only 2 percent of income is spent in Sector A each period. In Panel B, all of the model parameters described in the notes to Figure 4 are held constant except the intertemporal elasticity of substitution, which is decreased from 2 to 0.5 (as γ increases from 0.5 to 2). Now the MPC^{coupon} is smaller compared to Panel A, and this comes primarily from cross-category substitution. The increase in consumption in Sector A comes from both cross-category substitution and intertemporal substitution, while in Panel A the increase in consumption in Sector A primarily came from intertemporal substitution.

Figure OA.21
Model Calibration with Numerical Approximation



Notes: This figure shows that the numerical approximation to the change in consumer utility given in equation (5) is a very accurate approximation to the actual change in consumer utility calculated numerically in the calibrated model. This implies that the statistics in equation (5) are sufficient to accurately approximate the change in consumer utility relative to cash.

Figure OA.22
Model Simulation for Varying Coupon Threshold and Tax Subsidy



Notes: This figure reports the model-based simulation results from two policy scenarios: a coupon with a varying coupon threshold (and fixed discount), and a varying linear tax subsidy. The tax subsidy scenario considers values $\tau_A \in \{0.0, 0.03, 0.06, \ldots, 0.24, 0.27\}$. When $\tau_A = 0.15$, the tax subsidy and the coupon at threshold $D \approx 1.5$ achieve approximately the same outcome – specifically, the same effect on consumer utility and the same effect on the government budget (i.e., the same revenue cost). However, as the coupon threshold continues to increase towards D^* (at the dashed line), the revenue cost continues to increase for the tax subsidy in order to get the same increase in spending in Sector A, while the coupon's revenue cost is held constant. At the same time, consumer utility continues to decrease, while it increases as the tax subsidy becomes more generous.