Money and Barter in the Field: Evidence from the Life and Death of a Digital Currency

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Motivation

- A large New Monetarist literature on the microfoundation of money and barter has developed in theory and in lab experiments (e.g. Lagos, Rocheteau and Wright 2017; Rocheteau and Nosal 2017; Duffy 2016; Hommes 2020)
  - Characterize behavior given assumptions about info and trade sequence
  - Much learned about simulated environments
- Unclear whether assumptions are consistent with actual trade
  - Barter is typically informal and unrecorded
  - Quantitative evidence on barter very rare
- Advent of online platforms and digital currencies present new avenues for studying money and barter in the field

This paper

- New high-frequency barter and token transaction data in the field
  - Covers rise and fall of redeemable money in a Toronto-based barter platform
- Event studies of unexpected monetary experiments
  1. Fivefold monetary expansion (Event study #1)
  2. Sudden reductions in token redemption (Event study #2, #3)
- Question: Which models are most consistent with monetized and barter exchange in the field?

Preview of Results

Main Empirical Findings

1. No detectable change in posted token price throughout
2. Monetary expansion $\Longrightarrow$ transactions $\uparrow$
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$\Longrightarrow$ Additional margins of responses not currently in most New Monetarist models (e.g. entry, redemption, search effort, reputation)

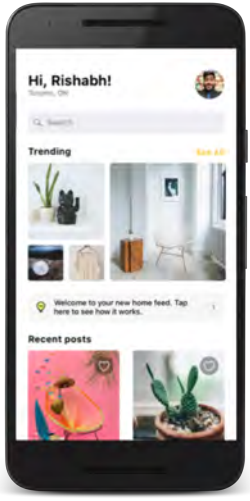
Setting and Data

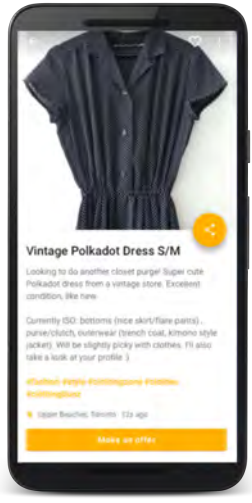
The Bunz community (initially "Bumz")

- Started in 2013 as a Facebook group in Toronto for cash-constrained millennials to exchange personal possessions
- Since 2016, trades conducted through a mobile app
- $\sim 10,000$ daily active users (circa early 2019), mostly young adults Demographics

Features of the Bunz economy

- Items are highly heterogeneous (e.g., used clothing, accessories, plants, food)
- Participants are strangers
- No repeated interactions
- No credit or banks
- No cash (anti-capitalist ideology, enforced by removal of item posts)
- Searching for items takes time





Barter mechanics:

- Sellers post items (e.g. used clothing, plants)
- Sellers post an "ISO" list ("in search of")
- Buyers search or browse
- Buyers make an offer
- Buyer and seller message to meet

Message example ISO example

Introducing BTZ

In April 2018, Bunz introduced BTZ

- **Issued by platform.** Users endowed with 1000 BTZ. Users earn more by inviting friends, posting items, or answering surveys, but cannot buy.
- **Redeemable via Shop Local at fixed price.** Users can redeem 100 BTZ for \$1's worth of goods at Shop Local stores, who are reimbursed by platform.
- Transferable among users via QR code or username
- No utility yield or storage cost
- No centralized exchange

New UI | Shop Local Map | Shop Local Trend

Data

Bunz provided comprehensive, time-stamped user-level data including:

- Token transactions (sender, receiver, amount)
- User ratings (proxy for transaction completion)
- Item posts and descriptions (includes posted BTZ price)
- Messages (sender, receiver, text, offer messages linked to item post)
- User characteristics (including survey responses and geotag)

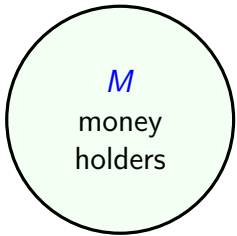
Limitations: Items not standardized; prices often not available

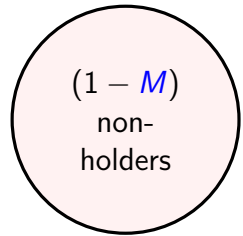
Regular users account for most platform activity

- Regular user definition:
  - at least 10 transactions total
  - less than 70% of transactions in single month
  - active for at least 6 months
- Accounts for:
  - 8% of active users
  - 83% of transactions (measured by ratings)
- Among regular users, usage of the platform is highly persistent
  - Over 80% sent a message in the week one year after entry
- Will measure effects on all / regular / frequent users

Conceptual Framework

Kiyotaki Wright (1993) with redemption





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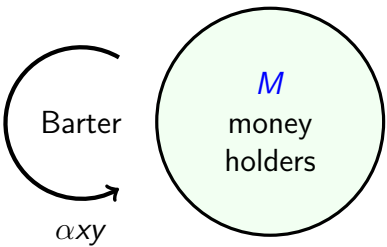

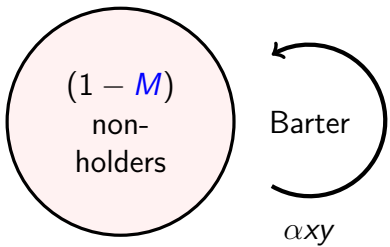

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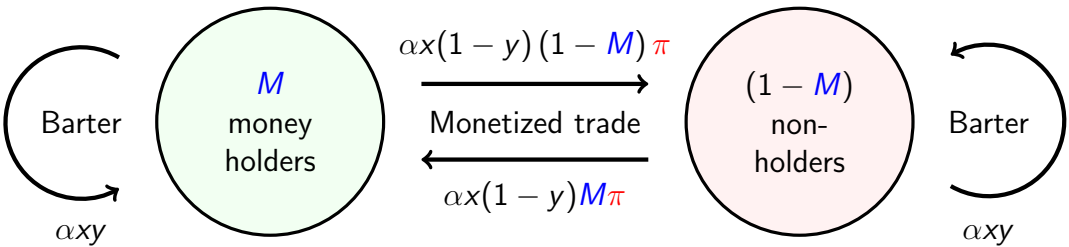

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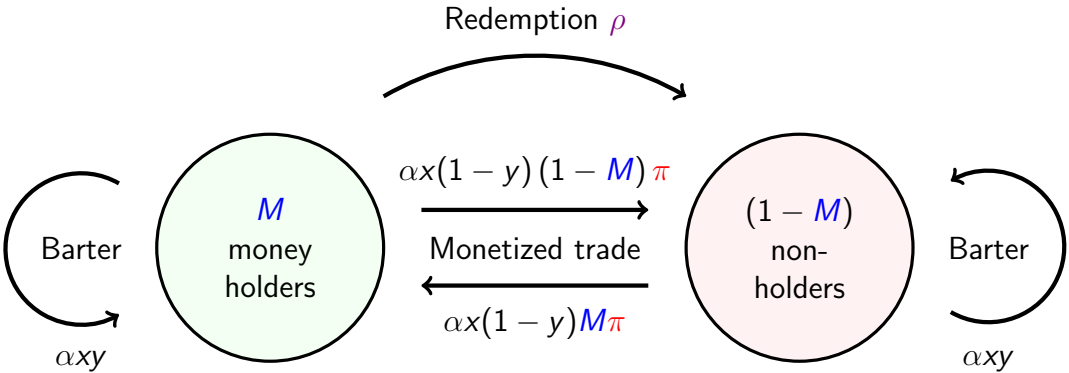

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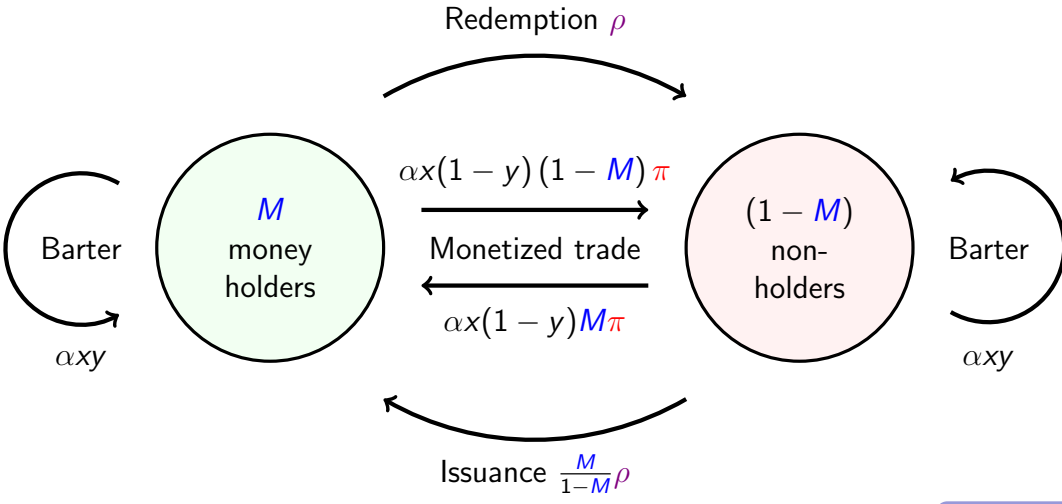


Equilibrium

Suppose $M < \overline{M}$.

1. If $\rho > \rho_1$, there is a unique monetary equilibrium;
2. If $\rho \in [\rho_0, \rho_1]$, there is a monetary equilibrium and a non-monetary equilibrium;
3. If $\rho < \rho_0$, there is a unique non-monetary equilibrium.

Proof

Prediction 1 (Effect of Monetary Expansion)

Suppose $\rho > \rho_1$ and $M < \min\{\overline{M}, \frac{1}{2}\}$. If M increases, then:

1. Peer-to-peer monetized transaction volume increases; and
2. Barter transaction volume is unchanged.

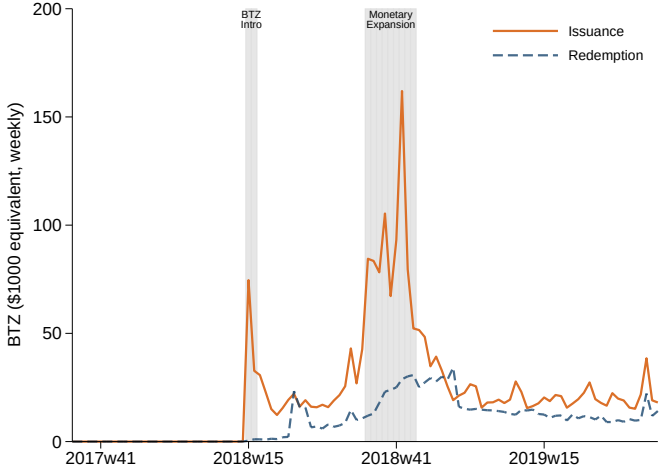
Prediction 2 (Effect of Reduced Redemption)

Suppose $M \in (0, \overline{M})$. If ρ declines from above ρ_1 to below ρ_0, then:

1. Token acceptance decreases;
2. Peer-to-peer monetized transaction volume decreases; and
3. Barter transaction volume is unchanged.

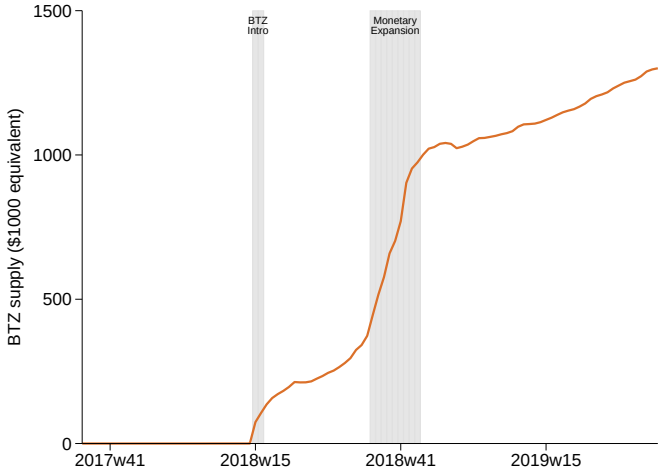
Effect of Monetary Expansion

Large wave of token issuance in Oct 2018



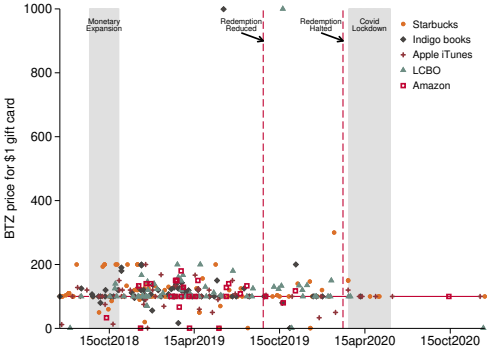
Driven by increased "Daily BTZ Drop"

Token supply increased fivefold as a result

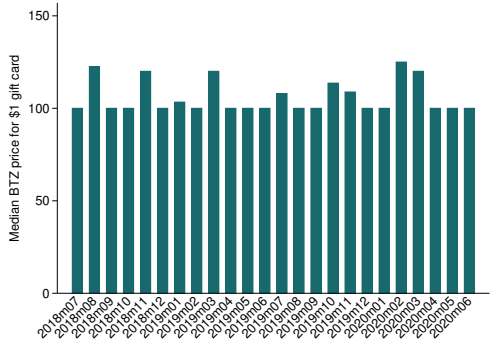


Token supply = cumulative issuance - cumulative redemption

Despite monetary expansion, token prices did not move



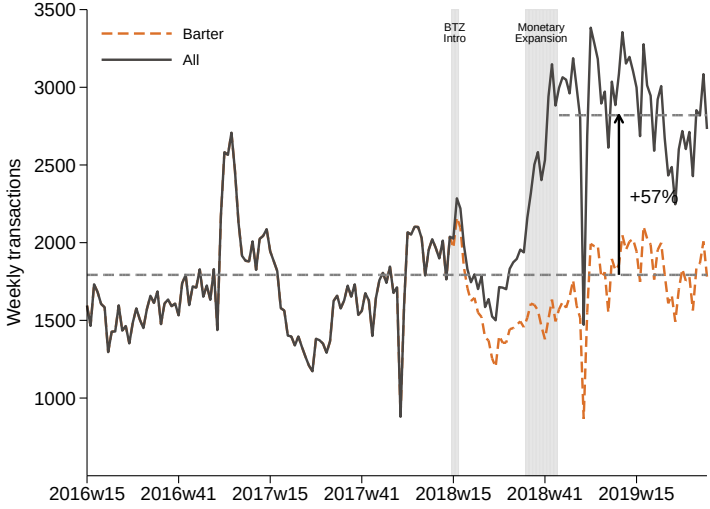
All posted token prices



Median posted token price

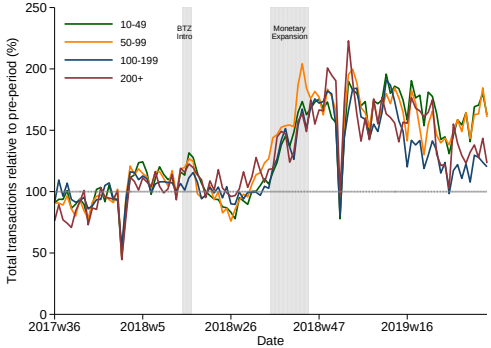
Measured using posted BTZ price of **store gift cards** / face value in dollars

Transactions increased by 57%; barter volume unchanged

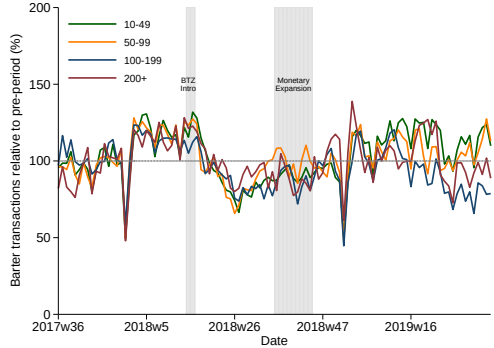


Measured using user ratings upon trade completion

Result is similar for different subsets of regular users



All transactions



Barter transactions

Margins of adjustment

	All users (1)	Regular users (2)
(a) Total transactions	57%	57%
(b) Barter transactions	3%	2%
(c) Entry	59%	-1%
(d) Offer messages sent	41%	37%
(e) Transactions per offer	11%	14%
(f) Items posted	38%	38%
Number of users	215271	10790
Pre-event weekly transactions	1793	1489

Robustness

- No pre-trends in entry, exit, offer messages sents, transactions per offer
- Not driven by changes in beliefs about token value
  - No discontinuity in token acceptance Details
  - No change in redemption as share of expenditure Details
- Not driven by exogenous changes in redeemability
  - No discontinuity in availability of token-redeeming stores Details
- Not driven by exogenous increase in goods supply
  - Increase was gradual, suggesting learning over time Details

Effect of Reduced Redemption

Bunz announced reduction in redemption on September 9, 2019

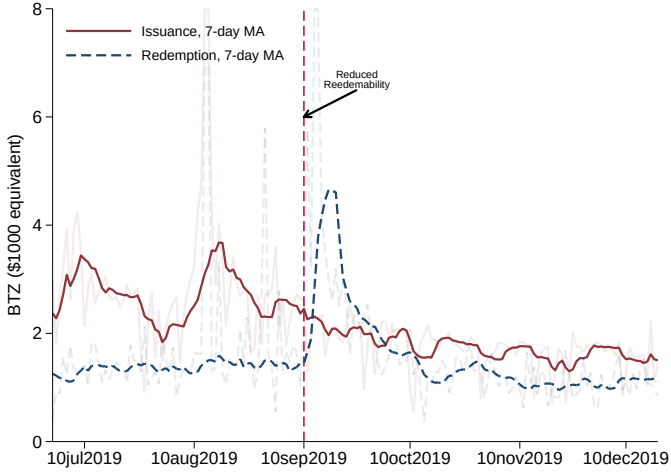
After a deep dive into our company priorities, Bunz will only be running the Shop Local Program revolving around food and coffee, as this is where our focus will be moving forward.

Effective immediately, you will no longer be able to accept BTZ and convert them into CAD currency.

We will be locking your wallets, and everyone will be paid up to September 10th inclusive, so please don't worry about any revenue that you brought in through the program as we will be settling your account with you and removing you from the application.

User uproar widely reported on local news

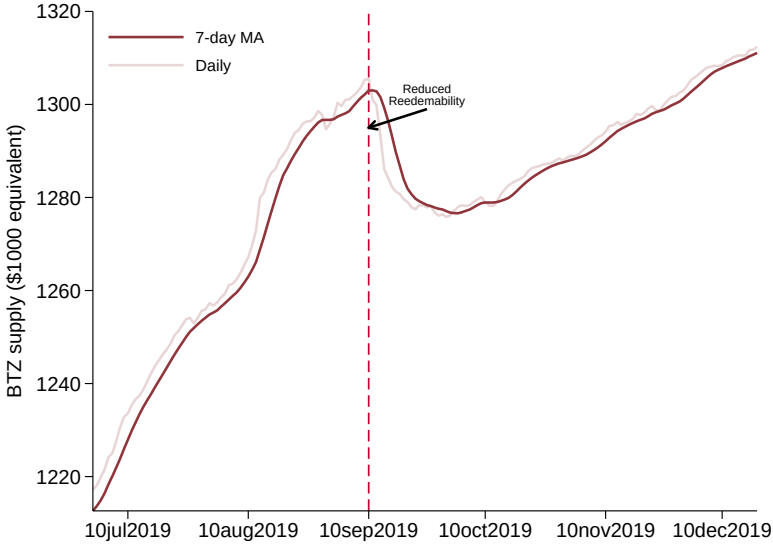
Token redemption immediately spiked



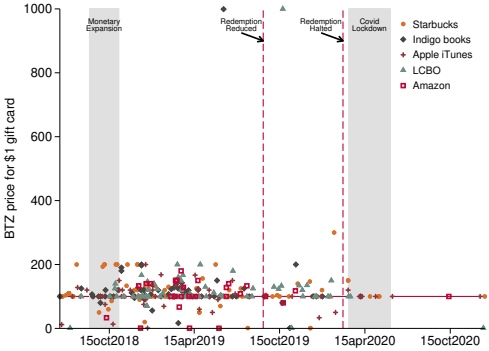
"Eating like a king"

Velocity

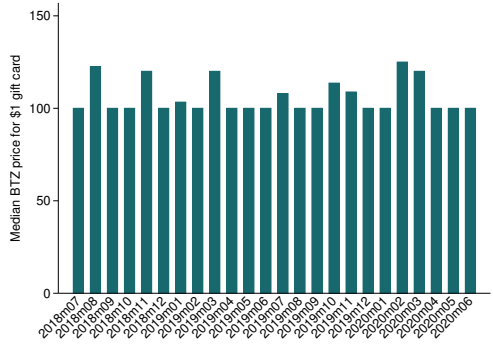
Despite run, total supply largely unchanged



Token prices also did not move



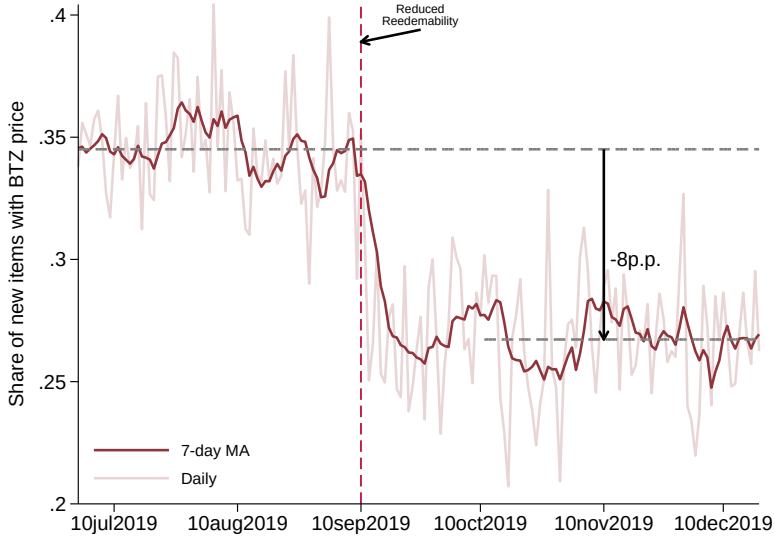
All posted token prices



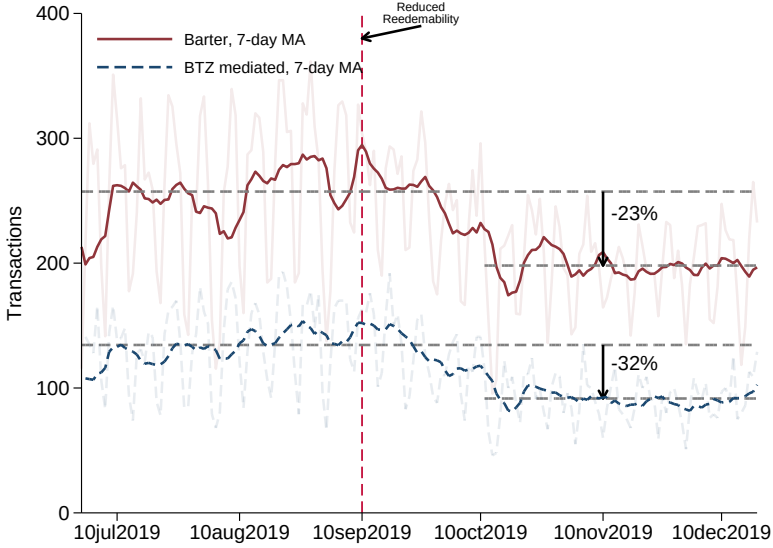
Median posted token price

Measured using posted BTZ price of **store gift cards** / face value in dollars

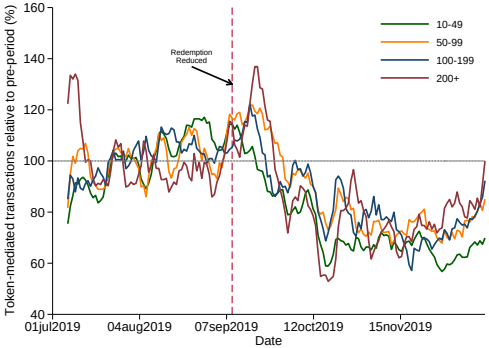
Token acceptance immediately fell



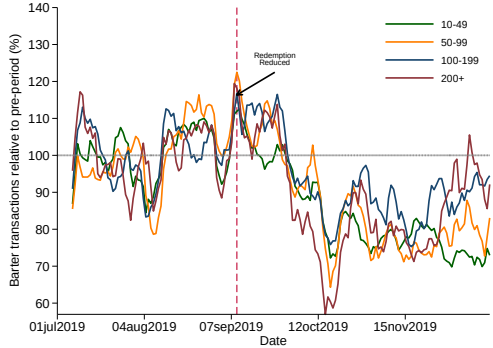
Token-mediated and barter transactions both fell



Result is similar for different subsets of regular users



Token-mediated transactions



Barter transactions

Margins of adjustment

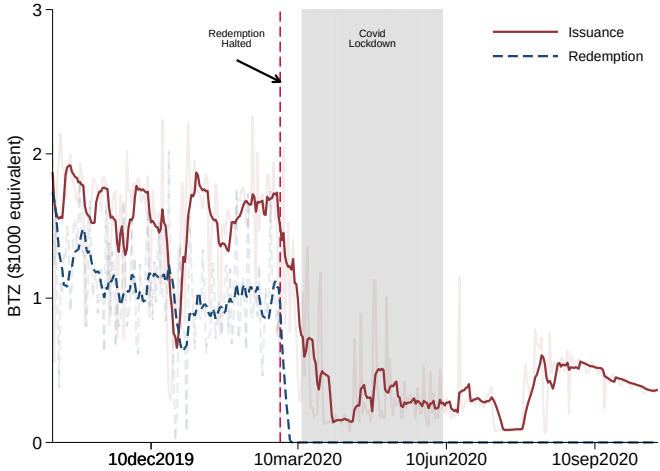
	All users (1)	Regular users (2)
(a) Token acceptance	-23%	-22%
(b) Token redemption	-31%	-1%
(c) Token-mediated transactions	-32%	-28%
(d) Barter transactions	-23%	-21%
(e) Entry	-61%	-56%
(f) Offer messages sent	-15%	-11%
(g) Transactions per offer	-12%	-13%
(h) Items posted	-29%	-23%
Number of users	215271	10790
Pre-event weekly transactions	2742	2218

Effect of Redemption Halt

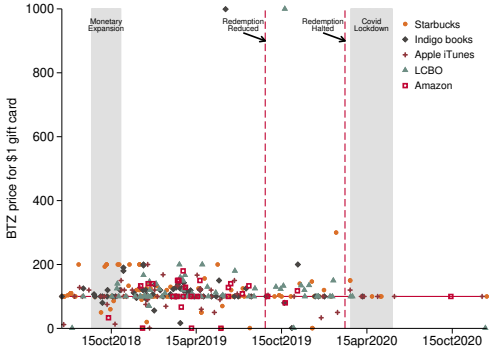
BTZ Shop Local Redemption - Gaming Update

Please note that as of today, we will be temporarily pausing the Shop Local Program. An internal audit and review has been conducted of the BTZ rewards program and the Shop Local program, and despite many people using the program properly, several critical issues were flagged around the gaming of BTZ rewards. Our engineering team will be implementing additional checks and controls, which we will communicate out once those controls are in place. Any shops that participate in our Shop Local program will be paid up in full for any amounts owed up to the pause, and we will communicate with both the Shops and with the community once the protective changes are in place and the pause is lifted. We apologize for the short notice, and we appreciate your patience while we work. -Bunz

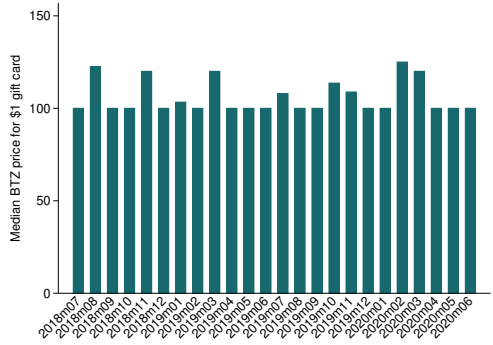
Token issuance and redemption immediately collapsed



Despite halt, token prices did not move



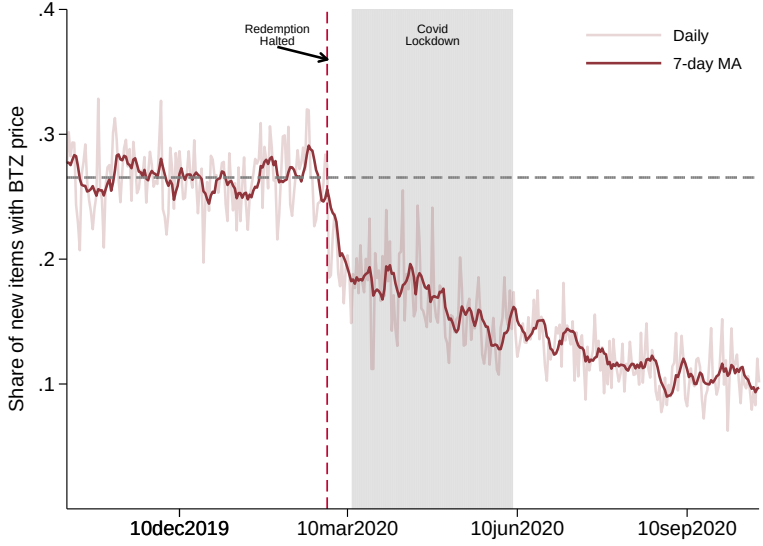
All posted token prices



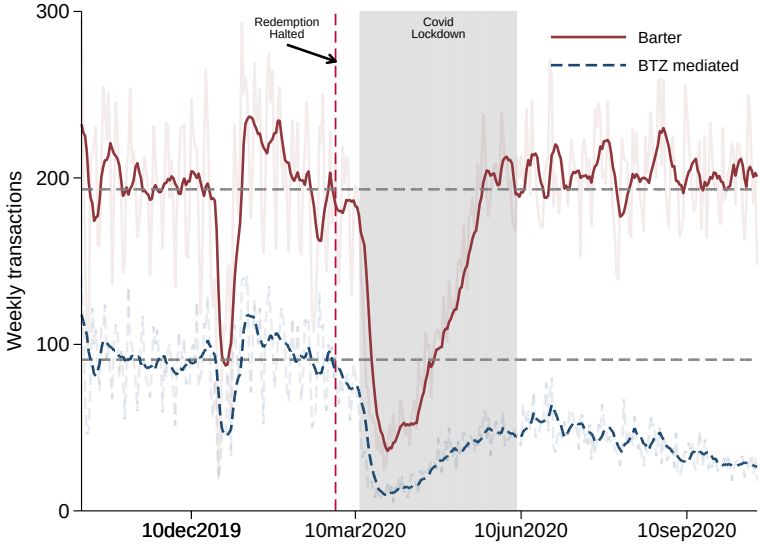
Median posted token price

Measured using posted BTZ price of **store gift cards** / face value in dollars

Token acceptance immediately fell



Token-mediated transactions fell, but not barter



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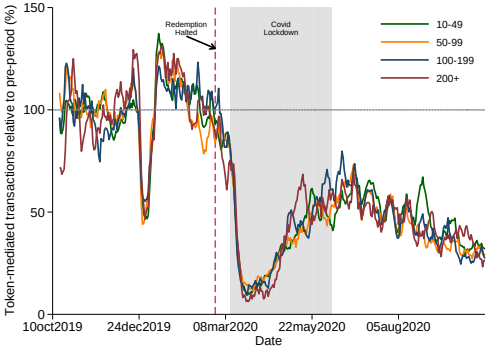
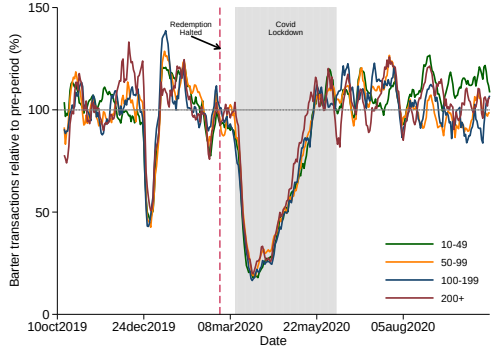


Token-mediated transactions



Barter transactions

Margins of adjustment

	All users (1)	Regular users (2)
(a) Token acceptance	-57%	-57%
(b) Token-mediated transactions	-58%	-57%
(c) Barter transactions	5%	5%
(d) Entry	-47%	-6%
(e) Offer messages sent	-14%	-13%
(f) Transactions per offer	-1%	-3%
(g) Items posted	-2%	-2%
Number of users	215271	10790
Pre-event weekly transactions	1988	1670

Discussion

Summary of Findings

- Main findings are consistent with conceptual framework:
  1. No change in token price throughout
  2. Monetary expansion increased transactions
  3. Reduced redeemability reduced token acceptance and transactions

- Additional margins of adjustment are revealed
  - Partial acceptability
  - Endogenous entry and search effort
  - Endogenous redemption volume $\implies$ run dynamics
  - Trust and reputation $\implies$ reduction in barter trade

Comparing Theory and Evidence

- Findings reject many canonical models:
  1. Rejects models where money is inessential (e.g., Arrow-Debreu)
  2. Rejects models w/o acceptance margin (e.g. MIU, CIA, Woodford 2004)
  3. Rejects models w/o price adjustment frictions (e.g., Lagos Wright 2005)

- Evidence explained by New Monetarist models with price coordination frictions (e.g., Green Zhou 1998, 2002; Kamiya Shimizu 2006, 2007a,b, 2011; Jean Rabinovich Wright 2010)
  - E.g. indivisible goods, price posting, random search
  - Money is essential; changes in redeemability can shift equilibrium

Conclusions

- Detailed data + monetary experiments in a real-world barter economy
- Takeaway: Severe price rigidity related to lack of centralized market
  1. No change in token price throughout
  2. Monetary expansion increased transactions
  3. Reduced redeemability reduced token acceptance and transactions
- Explained only by New Monetarist models with price coordination frictions (e.g. Green Zhou 98, 02; Kamiya Shimizu 06, 07, 11; Jean Rabinovich Wright 10)
- Reveals margins of responses absent from most models (e.g. entry, redemption, search effort, reputation)

Appendix: Background

- Double coincidence of wants = impediment to trade
- Beer, transit tokens, gift cards often used to complete transactions, but did not circulate (Jing and Wong 2022) Examples

Back

Top 3 ISO items 🔥

DUB Original Beer for everything (1 can = $3)

berries, avocados, fruit for small trades

Unopened (!) Coffee beans

More ISO items

gift cards, of course

BNWT Lulu, Lole, Alo and other premium workout brands

premium unopened hair oil

Top 3 ISO items 🔥

Transit fare

GC (loblaws ideally)

lush

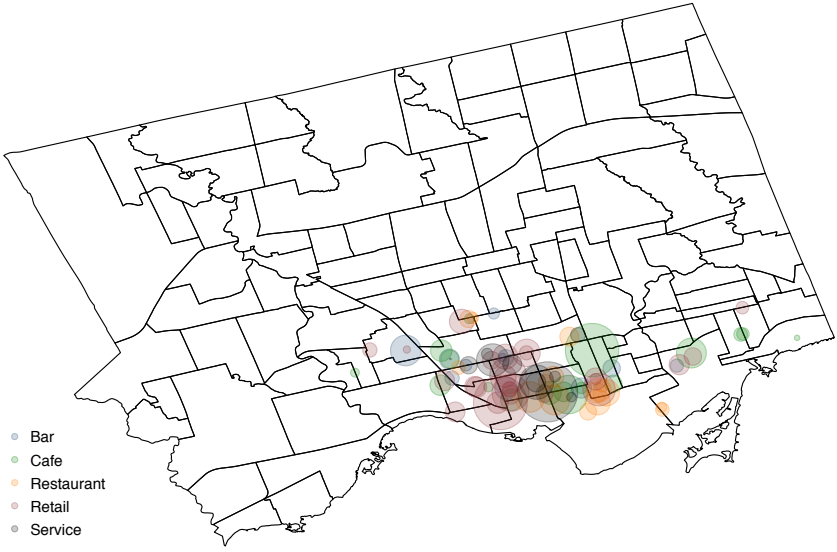
Top 3 ISO items 🔥

🍷 wine (red · white · rosé · sparkling)

🍏 sealed consumables

🌿 oil of oregano

Back



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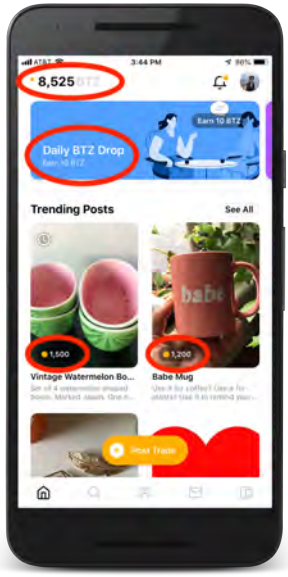
AT&T
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86%
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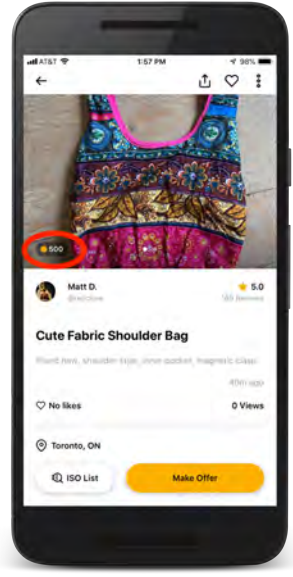
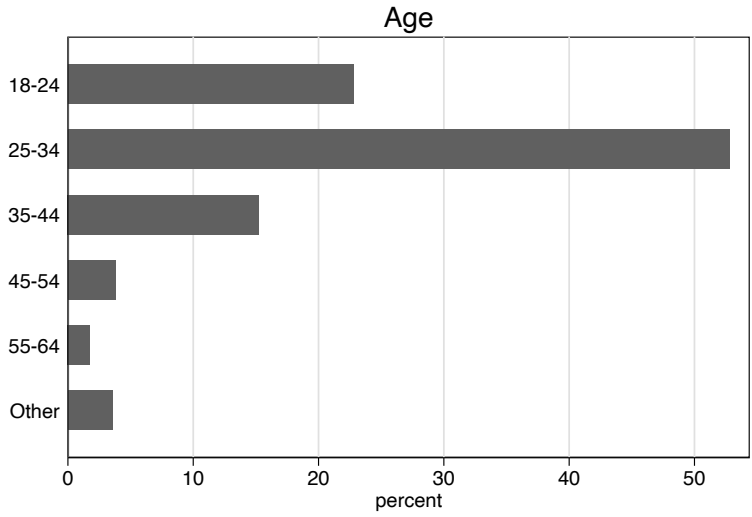
Daily BTZ Drop
Earn 10 BTZ
Trending Posts
See All
1,500
Vintage Watermelon Bo...
1,200
Babe Mug
babe
Start Trade


AT&T
1:57 PM
98%
500
Matt D.
5.0
Cute Fabric Shoulder Bag
No likes
0 Views
Toronto, ON
ISO List
Make Offer

Back

User demographics



Survey conducted: 2018-11-12

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Descriptive Statistics

- Typical user: Millennial in Toronto
  - 75% are 18-34 years old Details
  - 53% have a bachelors degree Details
  - 27% earn $< \$20K/yr$, but 40% earn $> \$50K/yr$ Details
- 4,243 users completed 17,284 transactions in March 2018
  - Top 569 users account for 50%
  - Top 118 users account for 20%

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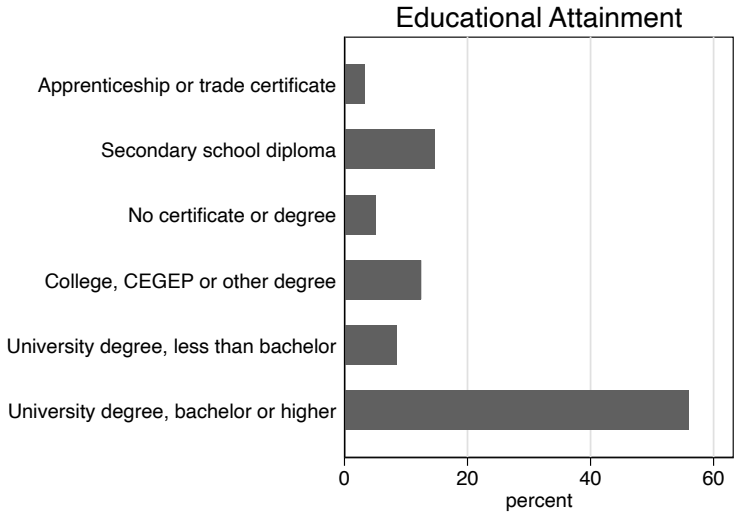
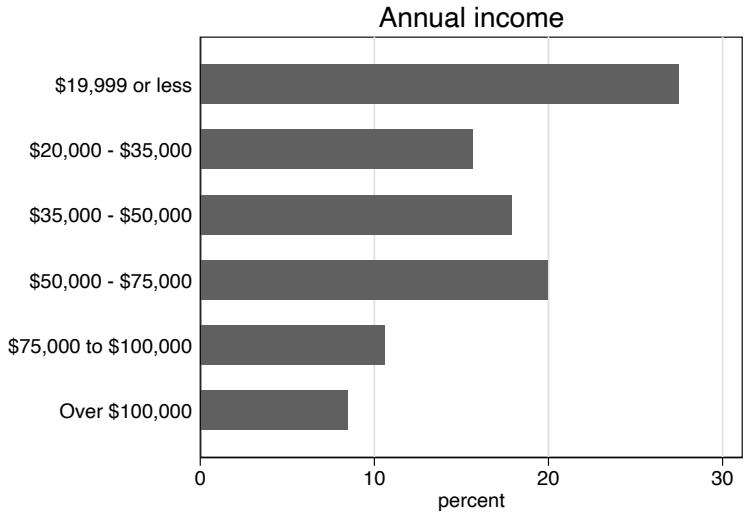
User demographics



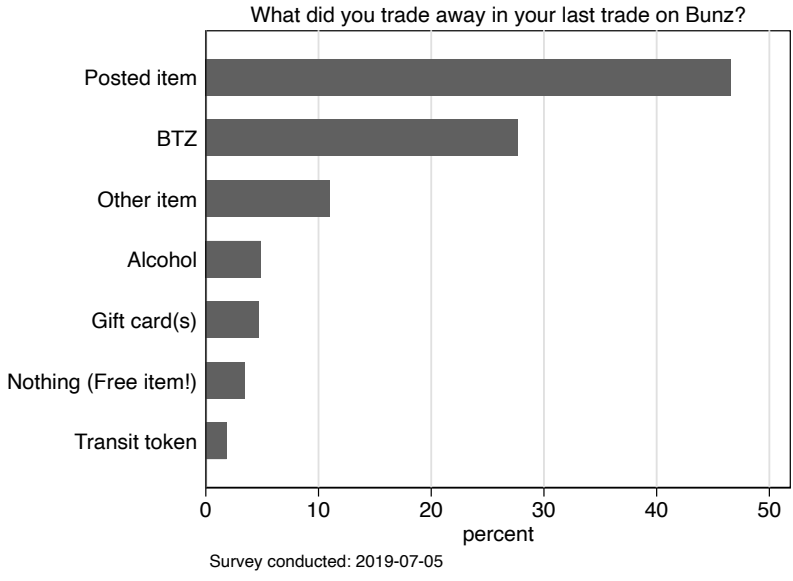
Back

User demographics



Survey conducted: 2018-10-15

Back


What did you trade away in your last trade on Bunz?
Posted item
BTZ
Other item
Alcohol
Gift card(s)
Nothing (Free item!)
Transit token
0
10
20
30
40
50
percent
Survey conducted: 2019-07-05

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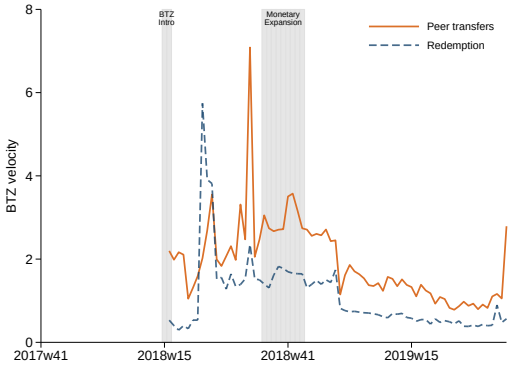
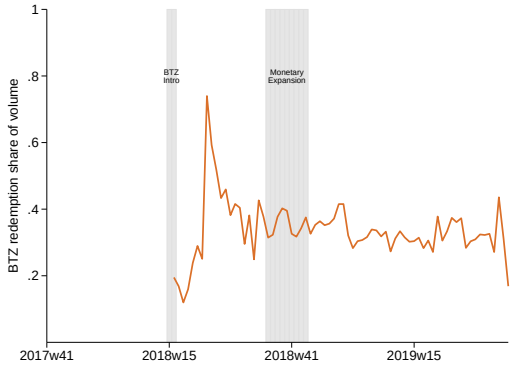
Appendix: Effects of Monetary Expansion

Token velocity



BTZ velocity



Redemption share of BTZ spend

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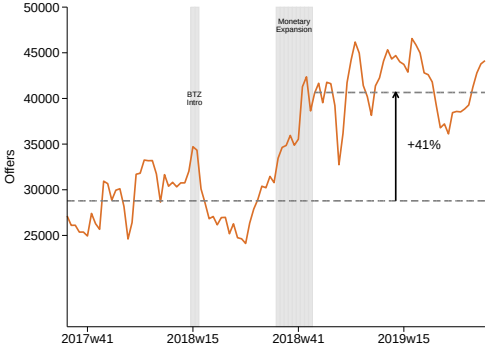
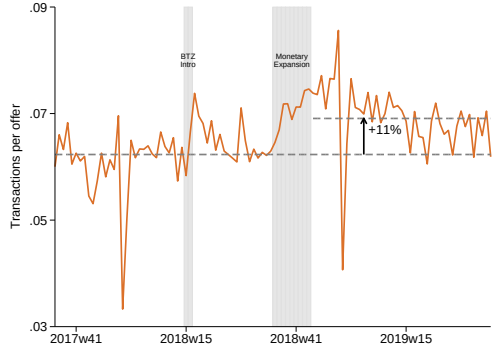
Offers vs transactions per offer



Offers



Transactions per offer

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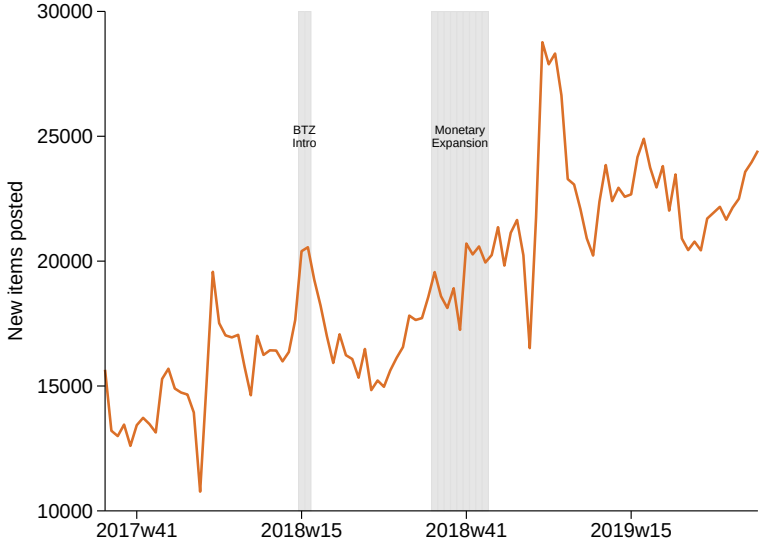
Increase is not driven by rise in items posted



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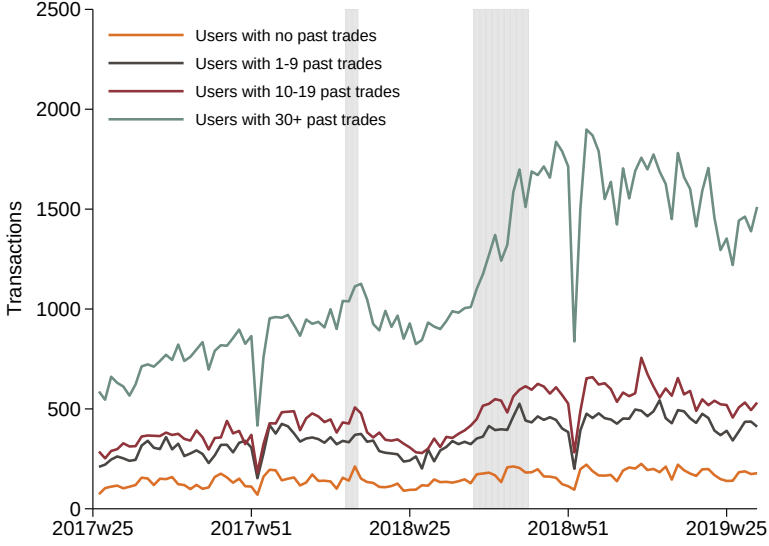
No increase in new users who transact



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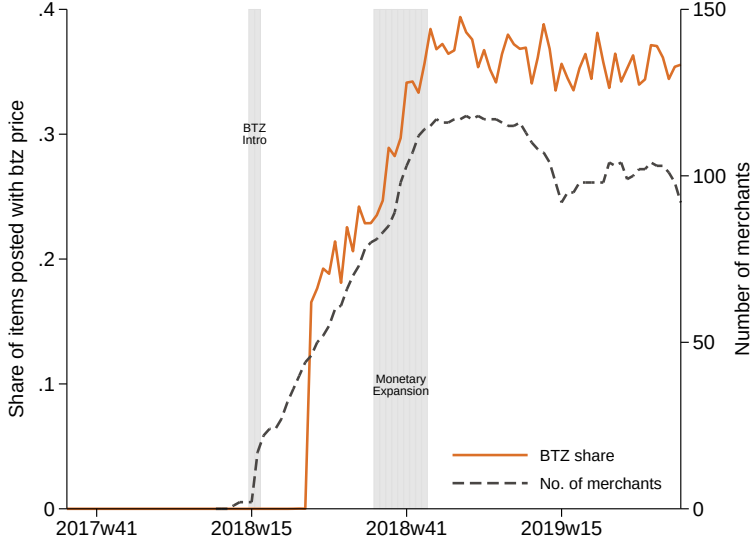
Share of item posts with BTZ price



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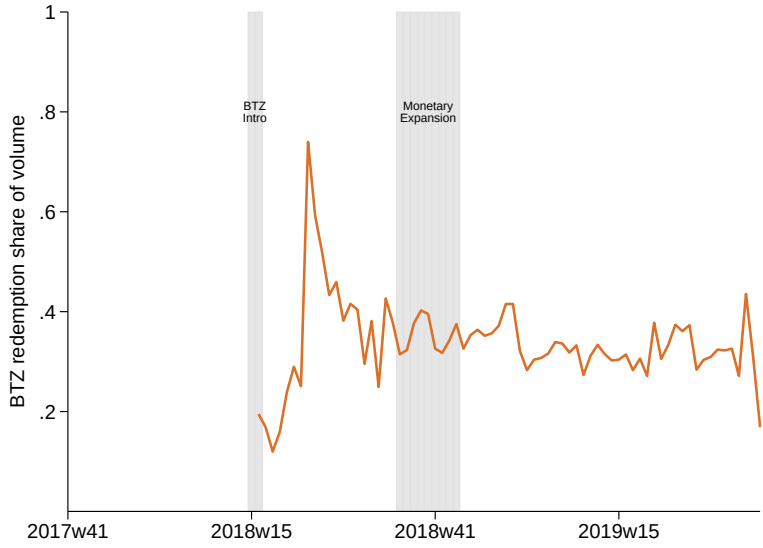
No changes in redemption as share of token expenditure



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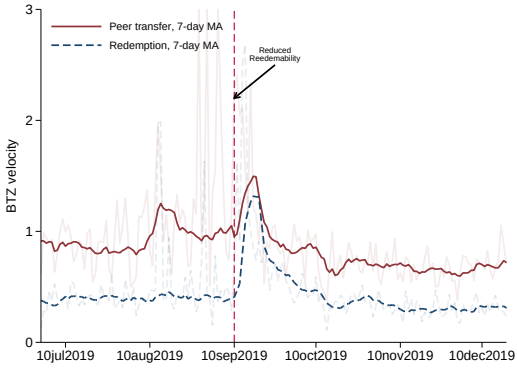
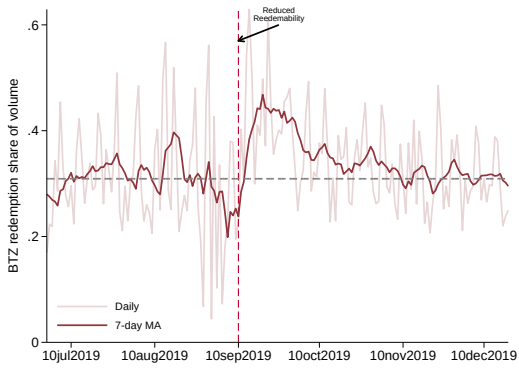
Appendix: Effects of Reduced Redeemability

Token velocity



BTZ velocity



Redemption share of BTZ spend

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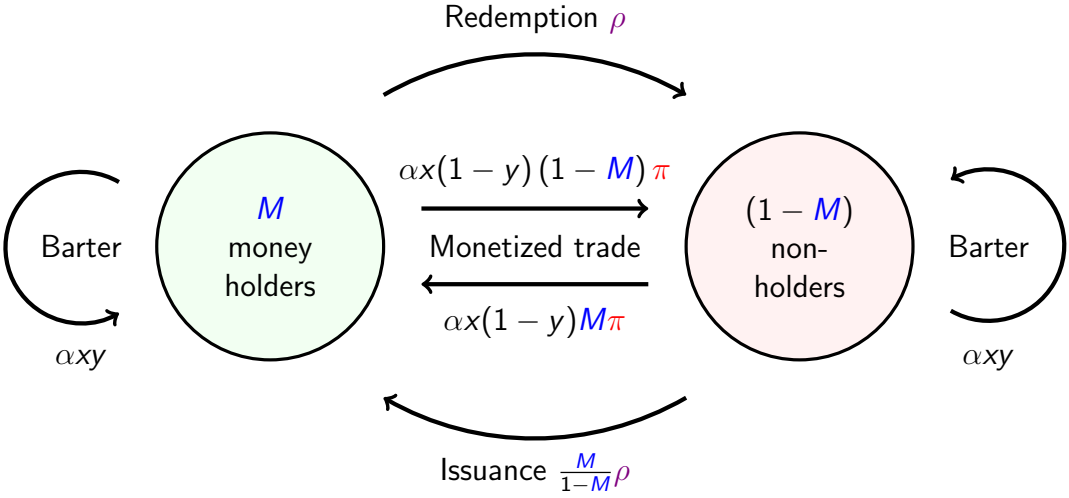
Appendix: Model

Transition Probabilities



cf. Aiyagari and Wallace (1997) and Li and Wright (1998)

Bellman Equations

$$rV_1 = \underbrace{\alpha xy(u-c)}_{\text{barter}} + \underbrace{\alpha x(1-y)(1-M)\pi(u+V_0-V_1)}_{\text{monetized trade}} + \underbrace{\rho(u+V_0-V_1)}_{\text{redemption}}$$

$$rV_0 = \underbrace{\alpha xy(u-c)}_{\text{barter}} + \underbrace{\alpha x(1-y)\pi M(V_1-V_0-c)}_{\text{monetized trade}} + \underbrace{\frac{M}{1-M}\rho(V_1-V_0)}_{\text{issuance}}$$

where $V_1, V_0 =$ value of holding / not holding money

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Equilibrium

Suppose $M < \overline{M}$.

1. If $\rho > \rho_1$, there is a unique monetary equilibrium;
2. If $\rho \in [\rho_0, \rho_1]$, there is a monetary equilibrium and a non-monetary equilibrium;
3. If $\rho < \rho_0$, there is a unique non-monetary equilibrium.

Proof

Proof

Let π_0 and π_1 be prob of accepting and paying money, respectively. Then

$$\pi_j = \begin{cases} 1 \\ \in [0,1] \\ 0 \end{cases} \iff \Delta_j \begin{cases} > 0 \\ = 0 \\ < 0, \end{cases}$$

where $\Delta_0 = V_1 - V_0 - c$, $\Delta_1 = u + V_0 - V_1$. Bellman equations imply that

$$\begin{aligned} \Delta_0 &= \frac{\alpha x(1-y)(1-M)\pi(u-c) + \rho(u-c) - (r+\sigma)c}{r+\rho+\sigma+\alpha x(1-y)\pi}, \\ \Delta_1 &= \frac{(r+\sigma+\alpha x(1-y)M\pi)(u-c) + (r+\sigma)c}{r+\rho+\sigma+\alpha x(1-y)\pi} > 0. \end{aligned}$$

$\Delta_1 > 0 \implies \pi_1 = 1$ and $\rho > \hat{\rho} \implies \Delta_0 > 0 \implies \pi_0 = 1 \implies \pi = \pi_0\pi_1 = 1$.

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Model assumptions and potential extensions

1. Indivisible money and goods
   - Divisible money; no centralized market $\Longrightarrow$ non-degenerate holdings
2. Homogeneous agents without ideological preference
   - Allow for agent heterogeneity (Shevchenko and Wright 2004)
3. Exogenous population, meeting probability, production speed
   - Endogenize entry, search / production effort
4. Agents redeem at exogenous rate
   - Endogenize with heterogeneous redemption cost
5. Platform always honors promise to redeem
   - Microfound with punishment / communal enforcement