

# Redeemable Platform Currencies

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- This paper explores mechanisms, strategies and pricing for tech firms that issue tokens and redeemable for platform goods and services
- What we have in mind is more akin to a hypothetical Amazon or Alibaba credits/tokens than to cryptocurrencies and the relevant alternative are conventional retail bank accounts.
- These are mainly for use on platform and not general purpose tokens (including cryptocurrencies, stable coins, etc.).

# Generations of Redeemable Platform Tokens

Generation	Technology	Circulation Mechanism	Leading Examples	Redeemability	Tradability	Size
First Generation: TRADING STAMPS	Physical stamps (anonymous)	Sold wholesale to retailers then pro-rata to consumers	S&H Green stamps (US), Green Shield stamps(UK)	Convertible to awards at trading stamp stores, or by mail, after filling savers' books	Often legally prohibited, but black market	Peaked in the mid-60s when S&H was printed 32 million catalogs and 140 million savers books
Second Generation: LOYALTY POINTS	Centralized Accounting	Bundled with sales, bonus mechanisms for frequent buyers	Airline and hotel loyalty points, also supermarket and drug stores	Convertible for services of issuing company or partners	Typically constrained with limited black markets	American Airline awards 7-8% of yearly revenue miles for points (8.5 billion outstanding in 2018). Stock equals 20% <del>one year's gross revenue</del>
Third Generation: PLATFORM CASH	Centralized Accounting	Often sold at discount. Very convenient for in-platform use	Uber & Lyft cash, Starbucks stored-value cards, Amazon gift cards, Q-Coin, Gash+	Generally redeemable only on platform but still evolving	Generally none or highly constrained	Uber cash sells at 5% discount (rapidly growing), 3.3 billion Amazon gift cards unredeemed in 2019
Fourth Generation: TOKENS <sup>[a]</sup>	Cryptography, Blockchain, Cybersecurity Technologies	Initial and recurrent coin offerings (evolving), aims to out-platform uses even to the places with little financial arms	Ethereum, Telegram, Libra, Alipay, Wechat Pay	Can be redeemable for platform services, but usually aspires to universal usage	Tradable or tradable with minor restrictions	Ether can be used for smart contract services, Ether valued at over \$60 billion

# Real-world tokens have many purposes...

- Enhanced loyalty
- Tax avoidance
- Competitive advantage
- **Borrowing at low rates**
- We concentrate ONLY on the last feature, which is relatively little studied

# Potential financial imprint of Generation III tokens

- In related work (Rogoff and You, 2020) for US airlines and hotels (these are the most straightforward class of digital assets to value thanks to 10-K reporting form)
- Our preliminary ground-up estimate suggests that (prior to covid-19!!), the total accounting market value of outstanding US hotel and airline loyalty obligations was on the order of \$50-\$100 billion. It is quite significant and on the same order as profits for most airlines in recent years.
- **But they have becoming increasingly important, and generation III could assume a far larger size.**

# Delta Example

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Markets

# United Leads U.S. Peers With \$5 Billion Loan Against Awards Plan

By [Esha Dey](#)

June 15, 2020, 8:44 AM EDT *Updated on June 15, 2020, 2:44 PM EDT*

- ▶ Carrier expects \$17 billion in liquidity by end of September
- ▶ MileagePlus deal follows abandoned junk-bond offering in May

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- Literature
- Core model and simplest version of result on why making tokens nontradeable (or to be precise highly illiquid) is optimal for the platform unless it can generate large profits outside of platform thanks to convenience yield.
- BREAK (5-min Q&A)
- Allowing for more general pricing and issuance strategies, VERY quick overview of results
- Extension of main result to heterogeneous agent case
- CONCLUSIONS

# Literature Review

- We are NOT about the ability of cryptocurrencies to compete with fiat currency:
  - Biais et al (2018)
  - Budish (2018)
  - Athey, Parashkevov, Sarukkai, and Xia (2016)
  - Sockin and Xiong (2018)
  - Schilling and Uhlig (2019)
- Ours is not a model of the foundations of fiat money
  - However, our assumption that the value and liquidity of a token depends on an underlying matching probability is reminiscent of Kiyotaki and Wrights classic (1989) general equilibrium search theoretic model of fiat money, and our analysis of embedding memory in tokens is similarly reminiscent of Kocherlakota (1998) discussion of money as a crude form of memory.
- We do not emphasize possible convenience yield in the core model:
  - Prat, Danos, and Marcassa (2019) assume that “utility tokens” more convenient for within-platform purchases. We discuss introducing a convenience yield in an extension.



# Model Setup - Consumer

- One unit of the (perishable) platform commodity costs one dollar, and provides one unit of consumption.
- A consumer demands one unit of the platform commodity with probability  $p$  and zero units with probability  $(1 - p)$ .
- Risk-neutral infinitely-lived agents with time discount factor  $\beta$
- Amount of consumers as unit one. No aggregate uncertainty ( $p$  products sold every period)
- $\theta = 1$  with probability  $p$  and  $\theta = 0$  with probability  $(1 - p)$

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} \theta_s C_s$$

# Model Setup- Marginal Claim

- Probability of  $M^{th}$  token being used at future date  $N \geq M$

$$X_{N,M} = \binom{N-1}{M-1} p^M (1-p)^{N-M}$$

- Token value as a combination of discounted marginal claims

# Model Setup - Platform (Issuer)

- Platform can issue a “currency” in the form of tokens that can be redeemed to one unit of the platform commodity in any given period.
- Risk-neutral platform discounts the future at  $\beta^*$
- As a large platform, it has better outside opportunities than the small consumers.
- Incentive for currency issuance: discount wedge  $\beta^* < \beta$
- Other benefits may apply but beyond the scope of this paper: convenience yield, transaction costs (Visa: 1.51% + 0.1 per swipe), tools to expand market or compete with other platforms.

The issuer announces the issuance plan in all periods.

- Consumers buy or trade tokens at the end of period  $t - 1$
- In period  $t$ ,
  1. Consumption uncertainty reveals
  2. If shock hits, a consumer buys one unit commodity with token or fiat money.
  3. Consumers buy or trade tokens at the end of period  $t$

# Core Model Setup - Simplifying Assumptions (for now)

- Currency issuance does not affect consumer demand for platform consumption.
- Zero production cost
- No platform failure or bankruptcy
- The platform can make credible commitments
- “stable coin” whose platform-use value is fixed in terms of fiat money, and we assume no inflation
- The platform currency is tradable among consumers only if the platform allows it

- PDV of platform absent token issuance:  $\frac{\beta^*}{1-\beta^*}p$
- In this case, PDV of platform:  $\frac{\beta}{1-\beta}p$
- The present value after token issuance bounded by  $[\frac{\beta^*}{1-\beta^*}p, \frac{\beta}{1-\beta}p]$

# Non-Tradable ICO

- Platform announces a fixed quantity of coins that it would it going to sell,  $M$ .
  - All the tokens must be priced at the value of marginal token

$$\begin{aligned}P_{I,N} &= \sum_{N \geq M} \beta^N X_{N,M} \\&= \sum_{N \geq M} \beta^N \binom{N-1}{M-1} p^M (1-p)^{N-M} \\&= \left[ \frac{\beta p}{1 - \beta(1-p)} \right]^M\end{aligned}$$

- It is equivalent to announce the price  $P_{I,N}$  and let consumers determine the quantity  $M$

# Intuition of Derivation (Math Induction)

- Prob(used in first period)= $p$ . Value  $\beta p$
- Prob(used in second period) =  $p(1 - p)$ . Value  $\beta^2 p(1 - p)$
- First Token Value:  $V(1) = \beta p(1 + \beta(1 - p) + [\beta(1 - p)]^2 + \dots)$

$$Value(1) = \frac{\beta p}{1 - \beta(1 - p)}$$

- An iterative process from  $M$  to  $M + 1$ : For any period,  $M^{th}$  token is being spent, the expected value of  $(M + 1)^{th}$  token is always  $\frac{\beta p}{1 - \beta(1 - p)}$  the value of  $M^{th}$  token is always 1. Thus,

$$V(X + 1) = \frac{\beta p}{1 - \beta(1 - p)} V(X)$$

$$V(M) = \left( \frac{\beta p}{1 - \beta(1 - p)} \right)^M$$



- Tradability a crucial property: use outside the platform, in-platform convenience
- Consumers want to hold excess tokens as long as they provide risk-free return
- When  $M = 1$ , tradable token price is the same with a non-tradable token

$$\frac{\beta p}{1 - \beta(1 - p)}$$

- It takes  $\frac{M-1}{p}$  periods to the state  $M = 1$ , thus price follows:

$$P_{I,T} = \beta^{\frac{M-1}{p}} \left( \frac{\beta p}{1 - \beta(1 - p)} \right)$$

# Comparison tradable vs non-tradable ICO (1)

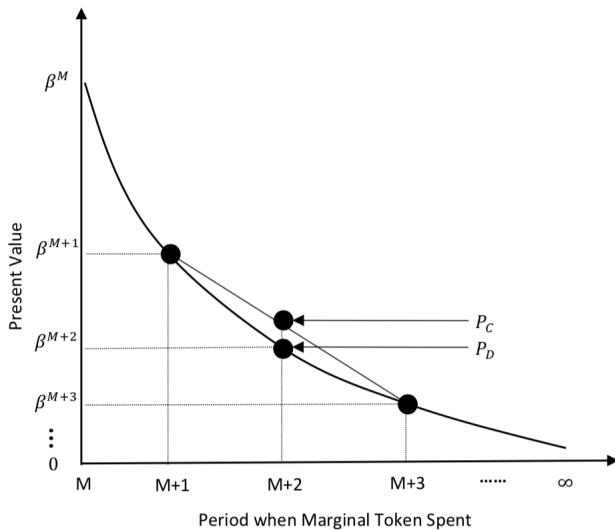
- Proposition 1 (*Effective Discount Factor Dominance*)
- The effective discount factor is higher (closer to 1) for non-tradable ICO tokens than for tradable ICO tokens

$$\beta^{\frac{1}{p}} < \frac{\beta p}{1 - \beta(1 - p)}$$

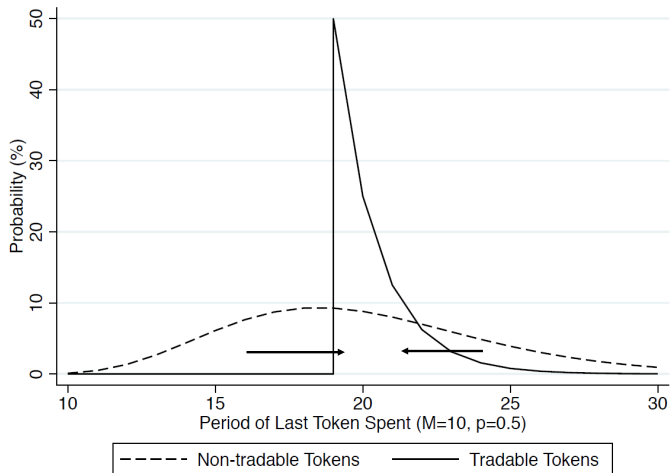
- Given the same M, non-tradable token price is higher than tradable token price

- Token Price Dominance (Proposition 1)
  - Loose analogy to the Coase Conjecture
    - A resale market introduces competition with the future and reduces the token price
  - Consumers utility function is convex in time of consumption
    - With tradability, the time to spend the last token has lower variability
    - Consumers with more tokens always want to sell tokens to consumers with fewer tokens

# Convexity in time



# Smoothed Uncertainty



## Comparison tradable vs non-tradable ICO (2)

- Proposition 2 (*Revenue Dominance*): Tradability reduces the discounted revenue of the firm.
- Proposition 1 shows lower token revenue
- Proposition 2 shows lower revenue in fiat money as well

$$\begin{aligned} R_{I,T} &= M \times P_{I,T} + \beta^* \frac{M-1}{p} \frac{\beta^* p}{1 - \beta^*(1-p)} \left( \frac{\beta^* p}{1 - \beta^*} \right) \\ &< M \times P_{I,N} + \left( \frac{\beta^* p}{1 - \beta^*(1-p)} \right)^M \left( \frac{\beta^* p}{1 - \beta^*} \right) = R_{I,N} \end{aligned}$$

- Intuition: Traded tokens delay cash revenue for the issuer.

# Relaxing assumptions of basic model

- Explicit interest payment on tokens
- Credibility and commitment
- Platform runs
- Non-zero cost of input goods
- Allowing for convenience yield on tokens

# Break for Q&A



# Model Extension (Continued)

- Allowing for recurrent sales of tokens (SCO)
  - Attempt to maintain a constant token supply (currency-like).
  - Sharply circumscribes the ability of the platform to persuade consumer to hold large numbers of tokens.
  - Token-in-advance Problem: Traded and non-traded distinction collapses.
  - Comparison of optimal non-tradeable ICO with optimal ICO + SCO. Low redemption frequency (infrequent use) favors ICO + SCO.
  - Rogoff and You (2020) document airline miles empirically subject to the token-in-advance limitation from recurrent issuance.

# Model Extension (Continued)

- Incorporating memory into tokens
  - Allow token price depending on quantity of token purchased
  - Or depend on individuals entire token history
  - Or have price of new tokens depend only individuals current holdings
  - Money memory makes non-tradability even more preferred by issuers.
  - Hence, making token tradable in order to establish a PROTOTYPE CURRENCY may engender a considerable opportunity cost, particularly in the big-data era.
- Exploring how agent heterogeneity affects the results
  - This introduces many new issues in currency design
  - Core results — that the platform can in general make greater profits from a non-traded token — are generalizable

# Heterogeneity

- We relax the assumption of homogeneity  $p$  by allowing 50% frequent consumers with  $p_H$  and 50% infrequent consumers with  $p_L$
- $M_H$ : Quantity purchased by the frequent consumers
- $M_L$ : Quantity purchased by the infrequent consumers
- Fair comparison:  $\frac{M_L + M_H}{2} = M$ ,  $\frac{p_L + p_H}{2} = p$
- Three questions:
  - Do tradability dominance results still hold?
  - Is it more profitable to only cater to frequent consumers or to be more inclusive?
  - Does consumer heterogeneity encourage or discourage currency issuance?

# Non-tradable ICO (Price Only)

- The quantity for each type is governed by one price

$$\left(\frac{\beta p_i}{1 - \beta(1 - p_i)}\right)^{M_i} = \widetilde{P}_{I,N} \quad i \in \{H, L\}$$

- The quantity for each type is governed by one price

$$\frac{\log(\widetilde{P}_{I,N})}{\log\left(\frac{\beta p_L}{1 - \beta(1 - p_L)}\right)} + \frac{\log(\widetilde{P}_{I,N})}{\log\left(\frac{\beta p_H}{1 - \beta(1 - p_H)}\right)} = 2M$$

- Define  $f(p) = \frac{1}{\log\left(\frac{\beta p}{1 - \beta(1 - p)}\right)}$

- Token price can be written as  $\widetilde{P}_{I,N} = e^{\frac{2}{f(p_L) + f(p_H)} M}$

- Proposition 5 implies

$$\widetilde{P}_{I,N} < P_{I,N}$$

- First, similar to the non-tradable case, heterogeneity reduces the token price for tradable tokens. (Proposition 6)

$$\widetilde{P}_{I,T} < P_{I,T}$$

- The token price under heterogeneity is

$$\widetilde{P}_{I,T} = \beta^{\frac{M-1}{P}} [(1 - \beta^\gamma (1 - P_L)^\gamma) \frac{\beta p_L}{1 - \beta(1 - p_L)} + \beta^\gamma (1 - P_L)^\gamma \frac{\beta p_H}{1 - \beta(1 - p_H)}]$$

$$\text{where } \gamma = - \left\lfloor \frac{\log(1 + \frac{p_L}{2p_H})}{\log(1 - \frac{1}{2}p_L)} \right\rfloor$$

- $\gamma$ : Number of periods till only frequent consumers hold token

# Tradability under Agent Heterogeneity

- Second, the token price of the tradable ICO is still lower than non-tradable ICO with heterogeneity, even if prices are both lower than the case of agent homogeneity.
  - **Under heterogeneity, the effective discount rate of non-tradable ICO tokens is still higher than that of tradable ICO tokens (Proposition 7)**

$$\beta^{\frac{1}{p}} < e^{\frac{2}{\bar{r}(p_L) + \bar{r}(p_H)}}$$

- Proof:

$$e^{\frac{2}{\bar{r}(p_L) + \bar{r}(p_H)}} \geq e^{\frac{2}{\bar{r}(0) + \bar{r}(2p)}} = \left( \frac{2\beta p}{1 - \beta(1 - 2p)} \right)^2 \geq (\beta^{\frac{1}{2p}})^2 = \beta^{\frac{1}{p}}$$

- When  $M = 1$ , token price with tradability is lower than the non-tradable token price under heterogeneity (Proposition 8)
  - New for the heterogeneity case (and too complicated to show)

- This paper is a first pass at the fundamental question of how different functionality of new currencies might be of importance to regulators.
- (Some) digital assets won't be designed as tradable in the absence of regulations.
- Digital Assets are rising and rapidly evolving in redemption and issuance: Multiple billion-dollar airline miles points, Amazon gift card is widely used, Uber/Lyft/Amazon cash, STEAM platform account balance.