Utility Tokens as a Commitment to Competition

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Overview

Abstract

Utility tokens (digital assets redeemable for products/services) offer the ability to commit firms to competitive prices. By forcing transactions to run through tokens that are tradable on a secondary market, a monopolist is unable to extract rent without undermining the value of a token.

The Core Problem

Key Friction: In the absence of tokens, the platform (e.g., Uber) acts as a **monopolist** that controls the matching technology between consumers and providers. Neither side can trade directly without the platform.

Resulting Issues:

- The firm sets prices p_t above the marginal cost c to maximize profits.
- This pricing excludes some consumers who would have been willing to pay above cost.
- Total welfare (consumer + provider + firm surplus) is reduced — a *deadweight loss*.
- Network effects amplify this monopoly power: as more users join, the firm gains further control.

Benchmark Model (No Tokenization) — Setup

Setting:

- Platform (e.g., Uber) is the **only** way riders and drivers can match.
- Each period $t = 1, \dots, T$: new riders/providers enter, trade once, then exit.
- Firm chooses:
  - Q_t: fraction of riders served (matches)
  - p_t: price riders pay
  - r_t: payment to drivers

Consumer Types:

- v_i: rider type i's value for one identical ride
- α_i: fraction of riders of type i
- $L_i = \sum_{j=1}^{i} \alpha_j$: cumulative share of market up to type i

Benchmark Model (No Tokenization) — Firm Behavior

Firm Profit:

$$\pi_t = (p_t - r_t)Q_t, \quad \text{with } r_t = c$$

(drivers are competitive, so firm pays marginal cost c).

Demand:

$$p(Q_t) = v_i \text{ if } Q_t \in (L_{i-1}, L_i]$$

Choosing Q_t pins down price — serving more riders lowers price.

Firm's Problem:

$$\max_{Q_t \in \{L_1, \ldots, L_N\}} (p(Q_t) - c)Q_t$$

Firm picks the cutoff $Q_t = L_{i_m} < 1$ that maximizes profit.

Intuition:

- Serves only high-value riders, keeps price $> c$.
- Creates *deadweight loss*: fewer rides, lower welfare.

Uber as an Example — Setup

Interpretation: Apply the benchmark model to Uber as a monopolistic platform.

Consumer (Rider) Types:

$$v_1 = 28,\ v_2 = 20,\ v_3 = 14,\ v_4 = 9$$

Each v_i is the rider's **willingness to pay** ($ per standard ride).

Market Composition:

$$\alpha_1 = 0.15,\ \alpha_2 = 0.25,\ \alpha_3 = 0.35,\ \alpha_4 = 0.25$$

$$L_1 = 0.15,\ L_2 = 0.40,\ L_3 = 0.75,\ L_4 = 1.00$$

Provider Cost (represents fuel, time, and vehicle wear per ride):

$$c = 10$$

Firm Decision: Uber chooses Q_t (fraction of riders served) and price p_t to maximize profit.

Uber as an Example — Results and Intuition

Candidate Outcomes:

Q_t	$p(Q_t)$	$(p(Q_t) - c)Q_t$	Interpretation
0.15	28	2.70	Only richest riders served
0.40	20	4.00	Top 40% served (optimal)
0.75	14	3.00	Includes medium riders
1.00	9	-1.00	Loses money on low riders

Equilibrium:

$$Q_t^* = 0.40, \quad p_t^* = 20, \quad r_t = c = 10$$
$$\pi_t^* = (20 - 10)(0.4) = 4.0$$

Intuition:

- Uber restricts access to top 40% of riders to keep prices high.
- Consumers with $v_i < 20$ (even if $v_i > c$) are excluded (**deadweight loss**).
- Total welfare $= 5.2$, less than the competitive level $= 6.6$.

Tokenization of the Benchmark Model

The introduction of tokens to the benchmark model occurs at $t = 1$, where the firm specifies a set of rules that govern how the tokens will interact with the platform.

The tokenized firm is assumed to follow four rules:

1. Durable tokens can be traded by any agent in a common token market open to all agents.
2. The firm cannot charge agents any fees for accessing or using the platform.
3. Tokens are the sole means of payment on the platform. No other payments can be made between consumers and providers upon matching.
4. The price of a unit of service is fixed in tokens—one token can be exchanged for one unit of service.

Tokenization of the Benchmark Model cont.

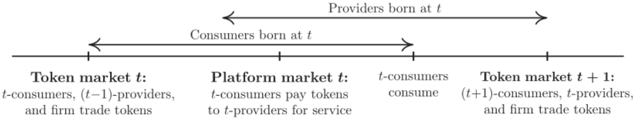

Figure 1. Sequence of events and lifespans of agents. This figure shows the sequence of events during period t and the lifespans of short-lived consumers and service providers born at t.

Alongside these rules,

Assumption 1

Service providers born in period T can redeem their tokens with the firms at the end of this period for c

In a finite-horizon, this prevents convergence to $\pi_T = 0$; an infinite-horizon extension would not include this assumption.

Consumers and Providers on Tokenized Platform

- **Agents & Timing**
  - Consumers: born in period t, demand for service in period t
  - Providers: those born in period $t-1$, supply services in period t.
- **Providers' Incentives**
  - Providers supply if: $\delta \cdot \pi_{t+1} \geq c$
  - If they are in final period T, then $\pi_T = c$
- **Consumers' Demand**
  - Consumers buy if (eq. 8): $v_i \geq \pi_t$ where i indexes individual consumers.
  - Total consumer demand for tokens is given by (eq. 7)

$$d_t(p_t) = \begin{cases} L_i & \text{if } v_{i+1} < p_t \leq v_i \text{ for some } i \in \{1, \ldots, N\}, \\ 0 & \text{if } v_1 < p_t \end{cases}$$

A Closer Look at Consumers' Demand

Consumers' Demand: Each consumer i has a discrete valuation v_i for one unit of service. Consumers buy if:

$$v_i \geq p_t$$

Hence, aggregate demand for tokens is:

$$d_t(p_t) = \#\{i : v_i \geq p_t\}$$

Left-continuity: When $p_t = v_i$, take the larger demand level *just before* the price jumps.

- At the cutoff price v_i, consumer i is still counted as demanding.

Implication: The secondary market price p_t adjusts so that total demand $d_t(p_t)$ exactly matches total supply Q_t. Small changes in q_t (token issuance) can cause discrete jumps in p_t.

Example of The Aggregate Demand Function

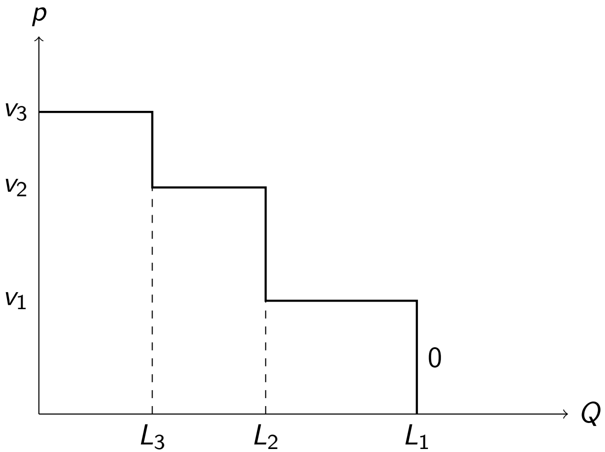

Figure: Stepwise price function $p(Q)$: horizontal segments are v_i, jumps at L_i.

Firm on Tokenized Platform

The firms only source of profit comes from trading its own utility tokens on the token market.

For each period t:

- The firms sells $q_t > 0$ tokens or buys back $q_t < 0$.
- The cumulative outstanding tokens held by (non-firm) agents,

$$Q_{t-1} \equiv \sum_{s=1}^{t-1} q_s, \quad Q_0 = 0$$

(sum of all q_s up through period $t-1$ (start of period t))

Firm on Tokenized Platform cont.

Consumers demand tokens $d_t(p_t)$, and token supply in period t equals previously issued tokens + current issuance:

$$Q_t = Q_{t-1} + q_t$$

Then, the **market-clearing** (supply = demand) condition is (eq. 9),

$$d_t(p_t) = Q_t$$

The price p_t is set by the matching of buyers and sellers in the secondary market; the firm can only influence it via q_t.

Dynamic Token Market Equilibrium

Equilibrium Price of Tokens: p_t is, then, given by (eq. 10),

$$p(Q_t) = \begin{cases} v_i & \text{if} \quad Q_t \in (L_{i-1}, L_i] \text{ for some } i \in \{1, \ldots, N\}, \\ 0 & \text{if} \quad Q_t > L_n \end{cases}$$

- Assuming market-clearing, profit is v_i if consumer i is within $(L_{i-1}, L_i]$

Firm's Profit: The firm chooses q_t to maximize trading profits (eq. 12),

$$\pi_t(Q_{t-1}) = \max_{q_t \geq -Q_{t-1}} \left\{ [p(Q_{t-1} + q_t) - \delta^{T-t} c] q_t + \delta \pi_{t+1}(Q_{t-1} + q_t) \right\}, \quad \pi_{T+1} = 0$$

- $[p(Q_{t-1} + q_t) - \delta^{T-t} c] q_t$ represents short-run profit.
- $\delta \pi_{t+1}(Q_{t-1} + q_t)$ represents long-run effect.
- In short, If it sells too many tokens, token prices drop $\rightarrow$ lower revenue later. If it sells too few, it misses out on revenue today.

Equilibrium Analysis

Equilibrium of the tokenized model with T periods and N consumer types is given by,

Proposition 2 (Equilibrium of Model with Tokens)

In the model with tokens, there is a unique equilibrium, in which the total quantity of tokens released, Q_t, increases over time, while the token price p_t decreases over time. With N different consumer types, the competitive outcome in the token market is achieved in exactly N periods if $\delta = 1$. If $\delta < 1$, the competitive outcome is achieved in at most N periods.

Simply put,

- $Q_t \uparrow$: Firm gradually increases token supply.
- $p_t \downarrow$: Tokens reach lower-valuation consumers.
- Gradual release maximizes profit (the firm can effectively price discriminate) and leads to competition.

Profits

Proposition 3 (Profit Comparison)

A monopolistic platform earns higher profit than a tokenized platform.

Intuition of Prop. 3

- Under monopoly, the firm sets prices directly to maximize profit in each period.
- Under a tokenized platform, the firm can only influence prices indirectly through token issuance q_t.

Welfare

Proposition 4 (Welfare Comparison)

The total welfare under a tokenized platform is higher than the total welfare under a monopolistic platform if the number of periods T is sufficiently high.

Intuition of Prop. 4

- As tokens circulate, more consumers gain access to the service over time.
- Competition in secondary markets drives prices closer to marginal cost c, reducing deadweight loss.
- A longer horizon (T large) allows tokenized trading to approach the competitive outcome.
- Hence, while firm profits fall, consumer and provider surplus rise—raising total welfare.

Utility Tokens as a Solution to the Key Friction

Key Friction: in the benchmark model, consumers and service providers are unable to match directly (they must match via the firms platform).

To fight the friction, platform rules are instituted; and any relaxation of these rules gives back monopoly power.

Primary intuition behind each rule:

- Existence of a Secondary Market - peer-to-peer exchange
- Absent of Fees - prevents rent seeking (no "wedge" in the market)
- Tokens as Sole Payment - prevents arbitrary pricing not reflective of competitive
- 1 Token, 1 Unit of Service - enforces 1:1 token-service correspondence

Incentives to Tokenize a Platform

For firms:

- Mechanical Consequence: Price-Setting
- Behavioral Consequence: Consumer Loyalty and Trust

For consumers:

- Tokens offer flexibility—buy now, use later, or hold if value is expected to rise.
- Token usability and resale expectations sustain long-run value.

Commitment through Smart Contracts

- **Definition:** A smart contract is a self-executing program stored on a blockchain that automatically enforces rules and agreements once predetermined conditions are met.

- **Purpose:** Prevents the firm from altering or bypassing platform rules after launch. It ensures commitment to token issuance rules, trading conditions, and payment flows.

- **Implementation (Simple View):**
  1. The contract is written in code (e.g., Solidity) and deployed on a public blockchain.
  2. It defines how and when tokens can be issued, transferred, or burned.
  3. Once deployed, no single party—including the firm—can modify it unilaterally.