Towards Principled Evaluation of Smart Contract Fee Markets

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1 Fee Market Criteria

A number of informal desired properties exist for a well functioning, liquid fee market. They are enumerated and described below

1.1 Simplicity in Incentives

Simplicity of the strategy space for users/transaction performers (SSU): the strategy for rational, cost-minimizing users and transaction sources should be as simple as possible, ideally a minimal honest strategy encouraged by the protocol.

Simplicity of the strategy space for miners/ordering proposers (SSP): similarly, the strategy for the actors deciding ordering in the sytem (in the case of PoW, miners) should be as simple as possible, ideally a minimal honest strategy encouraged by the protocol.

Resistance to Collusion/Exploitation (COL): Ideally, collusion amongst miners in a cartel specifically tagetting the fee market should minimally affect economic and computational optimality for users. A single miner's influence on these properties should also be clearly and tightly bounded.

1.2 Economic Optimality

Maximize guarantee of price stability (STB): For users paying for transaction inclusion, fee levels should be maximally predictable both in the near and long term, and should take into account all currently available public information.

Minimize deadweight loss (SOC): The price that users are paying should roughly reflect the social cost of a transaction on the network (for example, the

cost of doing the associated computation and storage over the time marginally incurred by this transaction). The marginal cost = (charges to user - social cost)^2 should be minimized. **todo check/refine this**

Minimize arbitrage (ARB): Reduce the incentive for arbitrage on symmetric public information for all actors within the system. One example with a first price auction that pays miners is incentive for miners to "bank gas" during lulls.

Black swan events (SWN): Reduce the impact of tail risk scenarios, ensuring that rare but catastrophic events do not permanently damage the mechanism or its users. Concretely, reduce the cost of such scenarios to all users of the system while increasing the cost of triggering such scenarios.

1.3 Computational Optimality

Node overhead (NOV): The overhead of such schemes on the computation, memory, and network required by nodes on the decentralized transaction system (and thus the reduction in transaction capacity it demands) should be minimal.

1.4 User Experience

Ability to express complex preferences (PRF): Users should ideally be able to express complex preferences on transaction inclusion, including dependencies, specific blocks for inclusion, or changes in their bids or preferences over time.

2 Analogies to traditional futures / forward markets

In traditional markets there are two different types of contracts that give the contract buyer (holder) the obligation to purchase the asset

In traditional futures: time of execution, price, amount is set. customer pays for the right to buy. Both customer and supplier have to put up collateral as margin. Initial margin (IM) is set based on absorbing a price jump. Movements in prices after contract initiation will adjust the amount of margin by the price movement. This method mitigates default risk dynamically and gives more credibility to using traditional asset pricing models that do not account for default risk.

Our forward contract will have: amount of gas to be delivered, start and end block during which the gas must be delivered. We depart from traditional futures by allowing a callable feature where the future can be exercised in a specific (short) time window

2.1 Challenges of Margin Requirements in current systems

To incorporate a fluid margin requirement into a blockchain based system there are a several inputs required to allow it to operate effectively.

These include but aren't limited to

-price feed oracles tracking the hedged item -settlement procedures for the expired contract -expiry date of said contract -required margin balances for the maker and taker -procedures in the instance of default -penalties in the instance of default -optionality for early termination

Our system utilizes in protocol features to incorporate many these inputs. This ensures less reliance of external sources such as price feed oracles.

3 Fee Market Redesign Proposals

Several proposals exist for redesigning Ethereum's fee market that can be analyzed under the above criteria. We enumerate them below.

3.1 Current First-Price Auction Based Market

[todo describe current market and inefficiencies]

Currently the Ethereum network utilizes a First-Price Based auction. Using this model, users give a price they are willing to pay to have their transaction included in each block. As such, miners are incentivized to include transactions that maximize their fee revenue. Today most blockchains use this model. One drawback being that there is no way to choose the optimal bid.

https://ethresear.ch/t/first-and-second-price-auctions-and-improved-transaction-fee-markets/2410

"Ethereum's demand is more elastic likely because there is a wider array of applications that can be developed on Ethereum, with different costs per unit gas. For example, it is known that when gasprices went to an all-time high of 70 gwei in early January, transaction counts hit an all-time high (despite no growth in gas usage), which showed that demand from more complex smart contract use cases was being substituted by demand for simpler transactions such as ETH and ERC20 token transfers."

"https://ethresear.ch/t/estimating-cryptocurrency-transaction-demand-elasticity-from-natural-experiments/2330"

3.2 kth price auctions

https://ethresear.ch/t/first-and-second-price-auctions-and-improved-transaction-fee-markets/2410

3.3 Double Auctions

Many asset markets follow some double auction format. The most popular form is the limit order book instantiation found on (centralized) exchanges NYSE, NASDAQ, and Coinbase. In these settings, we have a list of orders that can been seen by participants at any point in time. Transactions occur when a buy order (bid)

Applying the double auction (order book model) to blockchains is challenging as there is no concept of continuous time.

3.4 Min fee adjustment model

[todo describe]

3.5 Future Directions

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