FAIRMARKET ~ THE PROVABLY FAIREST AND MOST INCLUSIVE MARKET MODEL

1M1

Abstract. This paper describes a novel, multi-dimensional, infinitely inclusive market model. The described model yields infinite types of new market dynamics and traditional markets as special cases, based on very few parameters. As the market allows any supply of arbitrarily small or large value to be traded in any currency, incl. subjective value currencies, any resulting liquid market must then find the fairest value of the supply.

I Definitions

I.1 Market.

Assume we have a *seller* with a finite *supply* $\mathbb{S}$ and there exists a *demand* $\mathbb{D}$ consisting of *bid*s.

A *market* $\mathbb{M}$ is a function that determines the **next** *bid* to be serviced. Formally,

$$\mathbb{M}(\mathbb{S}, \mathbb{D}) = B$$

where $B \in \mathbb{D}$ is a *bid*.

More generally, we add a parameter to the *market* $\mathbb{M}$ to output the *bid* **next after** some given *bid* B.

$$\mathbb{M}(\mathbb{S}, \mathbb{D}, B) = B_{\text{next}}$$

$$B, B_{\text{next}} \in \mathbb{D} \cup \emptyset$$

$\emptyset$ represents an end, as follows. Simplifying $\mathbb{M}(\mathbb{S}, \mathbb{D}, B)$ to $\mathbb{M}(B)$,

$$\mathbb{M}(\emptyset) = B_{\text{first}}$$

$$\mathbb{M}(B_{\text{last}}) = \emptyset$$

This then allows for an ordering of the *bid*s

$$\mathbb{D} = [B_1, ..., B_N] = \left[\mathbb{M}^1(\emptyset), \mathbb{M}^2(\emptyset), ..., \mathbb{M}^N(\emptyset)\right] = [\mathbb{M}^{\text{rank}}(\emptyset)]_{\text{rank}=1}^{N}$$

In this paper, we will define a partial ordering and a total ordering that is ***fairest***, most ***inclusive*** and accomodates **all** types of *market*s, as well as innovating new types of *market*s with a generic framework.

I.2 Parameters.

The *seller* sets the following *parameters* $\mathbb{P}$:

$$\mathbb{P} = (\underline{M}, \mathbb{I})$$

$$\underline{M} \geq 0 \ \text{ minimum value of the supply}$$

$$\mathbb{I} = \text{importance}$$

The *importance* $\mathbb{I}$ will be explained later. It is a setting of the *seller* defining the importance of the different categories of *bid*s.

I.3 **Bid.**

Each *bid* B looks as follows:

$$B = (T, A, \mathbb{P})$$

$$T = \text{time of creation}$$

$$A = (q, \text{ccy}, \text{FX}) \text{ is the amount of the bid}$$

$$\mathbb{P} = \ \text{the sellers parameters at time} \, T$$

The *amount* A contains a quantity q, a *currency* ccy and an exchange rate to a *base currency* FX, all fixed at time T.

I.4 **Currency and FX.**

Let $\mathbb{C}$ be the universe of all existing currencies. Then

$$\mathbb{C} = \mathbb{C}_{\text{obj}} \,\dot{\cup}\, \mathbb{C}_{\text{subj}}$$

that is, any *currency* either has objective value xor subjective value.

We choose some

$$\text{ccy}_{\text{base}} \in \mathbb{C}_{\text{obj}}$$

as the *base currency* and we define

$$\text{FX}(\text{ccy}) = \text{FX}(\text{ccy}, T) = \text{FX}(\text{ccy}, \text{ccy}_{\text{base}}, T)$$

as the *fair* exchange rate between ccy and ccy_{base}, i.e.

$$1[\text{ccy}] = \text{FX}(\text{ccy})[\text{ccy}_{\text{base}}]$$

and

$$\text{FX}(\text{ccy}) = \emptyset \ \text{ if} \, \text{ccy} \in \mathbb{C}_{\text{subj}}$$

Before we categorize the *bid*s, let's simplify them. First, we call a *bid* B *objective*

$$B \text{ is objective} \Leftrightarrow \text{ccy} \in \mathbb{C}_{\text{obj}}$$

if it is of an objective value currency.

The *amount* A of each *objective bid* can be transformed into the chosen *base currency*, as follows:

$$B(T, A = (q, \text{ccy}, \text{FX}), \mathbb{P}) \to B_{\text{base}}(T, A = (\text{FX} \cdot q, \text{ccy}_{\text{base}}, \text{FX} \equiv 1), \mathbb{P})$$

This means, without loss of generality, we can <u>assume</u> all *objective bids* to be denominated in the *base currency.*

I.5 *Bid* Categories.

<u>Assuming</u> that the *min* value $\underline{M}$ is also in the *base currency*, we <u>define</u> the following 4 *bid* categories:

$$\text{chrony } (\textbf{CHR}) \Leftrightarrow B \text{ is objective and } q = \underline{M}$$

$$\text{highroller } (\textbf{HR}) \Leftrightarrow B \text{ is objective and } q > \underline{M}$$

$$\text{lurker } (\textbf{LURK}) \Leftrightarrow B \text{ is objective and } q < \underline{M}$$

$$\text{subjective } (\textbf{SUBJ}) \Leftrightarrow B \text{ is subjective}$$

We can denote a *bid* B's *category* as $\text{BC}(B)$.

I.6 *Importance.*

The *seller* defines the *importance* per *bid category*

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}}, \mathbb{I}_{\text{HR}}, \mathbb{I}_{\text{LURK}}, \mathbb{I}_{\text{SUBJ}})$$

where each *importace* is a natural number

$$\mathbb{I}_x \in \mathbb{N}_{\geq 0}, x \in \{\text{CHR}, \text{HR}, \text{LURK}, \text{SUBJ}\}$$

the market is activated

$$0 < \sum_x \mathbb{I}_x =: \sum \mathbb{I}$$

and the ***lurkers*** never get serviced

$$\mathbb{I}_{\text{LURK}} = 0$$

Amongst every subsequence of the ordered *bid*s $[B_n, ..., B_m]$ of length $\sum \mathbb{I}$, on average, we get $\mathbb{I}_x$ many of *bid category* x.

E.g. if

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 2, \mathbb{I}_{\text{HR}} = 3, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 1)$$

then, on average, any subsequence of 6 *bid*s *serviced* should contain 2 *chrony*, 3 *highroller bid*s and 1 *subjective bid*.

II The market $\mathbb{M}$

II.1 Characteristics.

We want to create a *market* function such that:

- *importance* is respected
- order of *objective bid*s is objectively deterministic
- internal category order is maintained
- worst case *rank* for *chrony bids* is finite
- the *seller* can use it's own subjective value function to value *subjective bid*s

II.2 Internal category order.

*Chrony bid*s are *time* ordered, *highroller bids* are *value* ordered, *subjective bid*s are ordered by each *seller* **subjectively** and *lurker bid*s live in the projective infinity, never serviced.

II.3 Traditional *market*s as special cases.

- Fixed price

$$\underline{M} = \text{fixed price}$$

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 1, \mathbb{I}_{\text{HR}} = 0, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 0)$$

- Auction

$$\underline{M} = \text{min price}$$

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 0, \mathbb{I}_{\text{HR}} = 1, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 0)$$

- Barter

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 0, \mathbb{I}_{\text{HR}} = 0, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 1)$$

All other cases are mixed, innovative *market*s and can yield differing dynamics.

II.4 The algorithm.

1. Sort the *bid*s

We can almost surely assume

$$T_i \neq T_j \text{ if } i \neq j$$

that the *bid*s can be sorted chronologically.

Given this chronological ordering, let's group the *bid*s by creating subsequences of constant *parameters*:

$$\underbrace{B_1 + ... + B_{i_1}}_{\mathbb{P}_1}, \underbrace{B_{i_1+1} + ... + B_{i_2}}_{\mathbb{P}_2}, ..., \underbrace{B_{i_{G_N}+1} + ... + B_N}_{\mathbb{P}_{G_N}}$$

that is, changing the *parameters* $\mathbb{P}$ fixes the current order.

We are left with the task of ordering the *bid*s given constant *parameters* $\mathbb{P}$.

2. Decimal Importance

The *importance* $\mathbb{I}$ can be converted into decimals as follows:

$$\mathbb{I} \to \nu_x = \frac{\mathbb{I}_x}{\sum I} \in [0; 1]$$

$$x \in \{\text{CHR}, \text{HR}, \text{LURK}, \text{SUBJ}\}$$

We also know that

$$\nu_{\text{LURK}} = 0$$

$$\sum_x \nu_x = 1$$

$$\Rightarrow \nu_{\text{SUBJ}} = 1 - \nu_{\text{CHR}} - \nu_{\text{HR}}$$

which means that $\mathbb{I}$ can be represented as a 2-dim vector:

$$\mathbb{I} = \begin{pmatrix} \nu_{\text{CHR}} \\ \nu_{\text{HR}} \end{pmatrix}$$

3. Define $\mathbb{M}$

Given the previous max $\sum \mathbb{I} - 1$ number of *bid*s $[B_n, ..., B_m]$, we want to choose the **next** *bid* B_{next}.

First, we choose the next *bid category* as the *category* that brings our realized *importance* <u>closest</u> (δ) to the target *importance* as set by the seller.

To that end, calculate the realized *importance* $\hat{\mathbb{I}}$ including an **assumed** next *bid category* $\mathrm{BC}(B_{\mathrm{next}})$

$$\hat{\mathbb{I}} = \begin{pmatrix} \hat{\nu}_{\mathrm{CHR}} \\ \hat{\nu}_{\mathrm{HR}} \end{pmatrix}$$

$$\hat{\nu}_x = \frac{\#\{\mathrm{BC}(B_i) == x\}_{\mathrm{i=n\cdots m+1}}}{m - n + 1}$$

and choose $\mathrm{BC}(B_{\mathrm{next}})$ as $\underset{\mathrm{BC}(B_{\mathrm{next}})}{\operatorname{argmin}} \delta\left(\mathbb{I}, \hat{\mathbb{I}}\right)$.

If the next *category* should be CHR, then B_{next} is the chronogically next CHR *bid* available.

If the next *category* should be HR, then B_{next} is the value ordered next HR *bid* available.

If the next *category* should be SUBJ, then B_{next} can be chosen in the two following ways:

a. B_{next} is the chronogically next SUBJ *bid* available. However, the *seller* can choose to decline the *bid*, using it's subjective value function.

b. Let the *seller* choose one xor none from all the existing SUBJ *bid*s.

Either case results in a <u>total</u>, deterministic and objective ordering of all the *objective bids* and a total subjective ordering of all the *subjective bid*s, both interwoven according to the chosen *importance* $\mathbb{I}$.

A discussion of the choices is found <u>here</u>.

Note the next *category* can never be LURK, as $\nu_{\mathrm{LURK}} = 0$. The *seller* can convert LURK *bid*s into CHR or HR *bid*s or vice-versa by changing the *minimum* $\underline{M}$.

II.5 Worst case *rank*.

Any *bid* can always choose to cancel, thereby **improving** the *rank* of all *bid*s behind it. Hence we only need to talk about the worst case.

Worst case rank is deterministic if we allow it to be ∞, which it is for *HR*, *SUBJ*, *LURK*.

CHR The above algorithm keeps the worst case *rank* for *CHR bid*s [deterministic and finite]().

This is mainly because each $\mathbb{I}$ is finite, the number of *bid*s is finite, internal *CHR* order is total and deterministic and change of *parameters* locks all existing objective bids in a total order.

III Infinite inclusivity

III.1 The case.

We can assume that any possible *supply* $\mathbb{S}$ has positive value, even if miniscule. The old world did not allow the transfer of smaller values than some threshold.

Using a chain of *CFS*, defined below, we can transact arbitrarily small (or large) values.

Hence, every kind and quantity of any *supply* is supported. This market model is *infinitely inclusive.*

III.2 Smart contracts.

Smart contracts are autonomous, decentralized apps. The described market model is implemented as a smart contract for the following reasons: *infinite inclusivity*, zero credit risk, perfect <u>transparency</u>, ability to use any kind of *currency.*

III.3 ***Fungability.***

A *currency* is called *fungible* if it is available in varying units.

We can define the *fungability* $\mathbb{F}$ of a *currency* as the ratio of it's base unit to it's minimal unit.

E.g.

$$\mathbb{F}(\mathrm{USD}) = 10^2$$

$$\mathbb{F}(\mathrm{BTC}) = 10^8$$

$$\mathbb{F}(\mathrm{NFT}) = 10^0 = 1$$

III.4 Constant Factor Stablecoin (***CFS***).

A *CFS* is a simple, permissionless smart contract that exchanges the minimal unit of a *currency* ccy_1 for φ units of a new currency ccy_2 and vice-versa, as available.

ccy_2 is created by and initially fully owned by the *CFS*. For the current intents and purposes, we can refer to ccy_2 as the *CFS*

$$\mathrm{ccy}_2 \approx \mathrm{CFS}(\mathrm{ccy}_1, \varphi)$$

A *CFS* never rounds and only makes exact exchanges.

Using a *CFS*, we have increased the fungability of <u>any</u> *currency* ccy

$$\mathbb{F}(\mathrm{CFS}(\mathrm{ccy}, \varphi)) = \varphi \cdot \mathbb{F}(\mathrm{ccy})$$

III.5 Infinitely inclusive.

Assume the value of the *supply* $\mathbb{S}$ is $\varepsilon > 0$. ε can be arbitrarily small.

By chaining CFS, we can keep increasing the *fungability* until ε can be represented exactly.

$$\mathbb{F}\Big(\mathrm{CFS}^N(\mathrm{ccy}, \varphi)\Big) = \varphi^N \cdot \mathbb{F}(\mathrm{ccy})$$

A chain of CFS can achieve arbitrary *fungability.*

IV IV. Conclusion

IV.1 Provably *fairest* market.

Consider:

- We accomodate any supply of arbitrarily small or large value.
- We allow any currency, whether those of objective value xor subjective value.
- We define currency as an arbitrarily fungible bundle of arbitrary energy and information.
- We accomodate the entire region of objective value currencies possible (below, at and above the min value).
- We create the desired (according to importance) sequence of servicing the demand.
- We allow for infinite types of dynamics incl. traditional markets as special cases, set via simple parameters.

All these superlatives make this market model the most open possible.

Assuming liquidity, this market model thus provides the fairest valuation of any supply.

By changing the parameters, minimum $\underline{M}$ and importance $\mathbb{I}$, the seller can run a multi-dim optimisation to find the type of market that maximises it's value.

IV.2 Provably fairest economy.

An *economy* is a set of *trade*s. The event of a *bid* getting *serviced* is a *trade*. If this market model provides the *fairest* valuation and with it the *fairest* trade, then the resulting *economy* is *fairest economy* possible.

Micro-economics teaches us that (specilization and) **fair** trading improves the value of all parties.

IV.3 Maximum value $\Leftrightarrow$ Supply = *time*.

If this paper is correct in that the described market model results in the *fairest* valuation, then it should be used for all *market*s. Especially the most valuable market: *time*

- Everyone has *time*
- Everyone knows that *time* is most valuable.

When *supply=time*, all currencies are per ΔT. Current technology already allows $\Delta T \leq 1$ sec}.

V Notes

V.1 **most inclusive.** Considering only supplies of positive value, since we can support arbitrarily small or large values, in any type currency, we are infinitely inclusive. Being infinitely inclusive also makes it most inclusive.

V.2 **fairest.** The fairest value is achieved in the most open market possible based on the assumption that adding an intelligence to a group of intelligences increases the accuracy of the joined valuation of anything. It is valuation based on maximal information.

V.3 **fungable NFTs.** Even an NFT could in this manner be broken into smaller pieces. Having art with higher fungability increases the size of the demand, however it also seems to decrease the perceived value by some.

V.4 **full subj choice is better.** Since the seller is using it's own subjective value function, there can be no apriori internal ordering. And since there is no point in cancelling bids by the seller, as a bid can simply reappear (unless the bidder is blocked), there is no need for any internal ordering. If the next bid is SUBJ then the seller can choose any or none of the SUBJ bids.

V.5 **distance.** For δ, we can choose any 2-dim distance measure, e.g. the Euclidean metric.

V.6 **practical chrony.** For practical reasons, such as real time FX changes, it can make sense to define the categories with a precision $\varepsilon > 0$, and the relative distance $\delta = \ln\left(\frac{q}{\underline{M}}\right)$ as follows

$$\text{chrony (CHR)} \Leftrightarrow B \ \text{ is objective and } |\delta| \leq \varepsilon$$

$$\text{highroller (HR)} \Leftrightarrow B \ \text{ is objective and } \delta > \varepsilon$$

$$\text{lurker (LURK)} \Leftrightarrow B \ \text{ is objective and } \delta < -\varepsilon$$

V.7 **why lurkers.** Lurkers complete the picture of the demand. They allow the seller to realise the optimal minimum price. Traditional markets leave sellers blind to this entire bottom part of the demand.

V.8 **assuming.** These are not real 'assumptions'. These prerequisites that we are asking for are trivial and hence we are "assuming" them to be true already. Real 'assumptions' can be wrong.

V.9 **energy and info.** Energy and information as defined by the Sciences, as two fundamental elements of nature.

V.10 **min value.** Every seller has the right to define it's own minimum value for its supply.

V.11 **all markets.** I think this statement can be made formally thanks to us defining *currency* as generally as possible.

V.12 **all trade is sequential.** Serviced is used as meaning "traded".

Any finite supply requires ordering of demand. All selling of any supply is approximately sequential and most selling is sequential. Even selling digital copies of a product that seems unlimited, is in fact limited due to network bandwidth being limited and servers usually order demand on a "first-come, first-serve" basis. When supply is very large vs demand, then modeling a simultaneous trading sequentially, is not any loss at all, as the sequence can simply move very fast, giving the illution of simultaneouity.

V.13 **chrony only worst case finite.** This is a service guarantee for those bidding the minimum (chrony). A highroller is basically participating in an auction for a sooner service, which is only sooner iff $\mathbb{I}_{\mathrm{CHR}} < \mathbb{I}_{\mathrm{HR}}$. An subjective bid might never be serviced, as it depends on the seller's subjective value function. A lurker is by definition never serviced.

V.14 **deterministic and finite.** should be written up formally see fairmarket.js in FairInbox for formalism since non availability of a category is what triggers the only change possible in ordering, and this kind of event improves every bids ordering, descreasing the wait time. thus max wait time is deterministic. we have the formula. see dart code.

V.15 **auditability is better.** Even better than transparency is privacy with auditibility. This allows entities to maintain private information whilst satisfying society that everything is legal.

V.16 **multidim optimisation.** Based on my own intensive research on highly noisy and highly dimensional optimisation, I have found a multi-start Nelder-Maed to provide the best result. Solutions that have many simulations ending in them are much more likely to contain true information, rather than noise, i.e. being less outlier prone.

V.17 **objective vs subjective value.** Any currency can be said to have objective value if there exists a liquid market to exchange at least the base unit of this currency into another objective value currency. We assume that a community can agree on at least one currency that is declared objective.

Every other currency is called subjective.

V.18 **currency.** We define a currency as any bundle of energy and information that can be transmitted from one entity to another, incl. bundles containing no energy (only information) xor only energy (no information).

This provides the most generic definition possible.

V.19 **projective infinity.** Not formalized in this whitepaper.

V.20 **total ordering.** Objective bids already have deterministic ordering. If subjective bids are presented in time order, we get a total ordering using the sellers subjective value function. The total ordering is known only to the seller.

V.21 **deterministic.** means that the outputs will not change if the inputs do not change

V.22 **live in the now.** One could even replace appointments with such a market for ones time. Whenever you choose to interact with a person, instead of consulting an appointment schedule, consult the market. Importance and urgency are all expressed via the energy and information contained in every bid.

Btw, time can e.g. easily be supplied via live media streams.

V.23 **acknowledgement.** The information found in this white paper was created by [1m1](https://1m1.io) with the help of Solli Kim. Thank you Solli for sharing your mind.

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