Abdex: Decentralized Stablecoins and Order Book Trading Application-specific Blockchain *†

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Abstract. Abdex is a decentralized financial application-specific blockchain utilizing Tendermint consensus and Proof of Stake mechanism. Its core functions encompass decentralized stablecoins, on-chain spot and derivative order book trading, on-chain market-making algorithm, and market-making order. Stablecoins can be minted via over-collateralized loan or primary market subscription, and maintain their values innovatively through risk hedging, exposure, and arbitrage. This addresses the limitations of DAI introducing centralized stablecoins and LUSD liquidating borrowers who should not be liquidated. Abdex supports stablecoins pegged to fiat currencies and a global currency index, enabling loss-free conversion between anchors due to over-collateralized property. Abdex facilitates mobile retail payments with stablecoins, integrating long-term holding of cryptocurrencies with daily consumption. To provide trading depth for stablecoin system and expand stablecoin applications, Abdex implements fully on-chain spot and derivative order book trading, leveraging AppChain's specialization, high TPS, and finality. Ample liquidity is ensured by on-chain market-making algorithm, and market-making order that balances market-making costs, system efficiency, and interests of validators. Abdex offers a variety of tradings, including perpetual contracts, stock indices, and commodity futures trading. Loss-free conversion of Abdex stablecoins enables direct global asset trading, bypassing liquidity challenge of trading Quanto. Market manipulation and aberrant pricing are deterred through measures. Developed with Cosmos SDK, Abdex offers high performance, scalability, cross-chain interoperability, and supports community governance. Overall, Abdex provides a secure, efficient, and convenient global asset trading and payment platform through innovative stablecoin design, on-chain order book, and market-making mechanisms.

*The whitepaper aims to furnish a conceptual elucidation. The details are available on `http://www.abdex.fi` and `https://github.com/Abdex-Finance`.

†This paper is translated from the Chinese version. Its contents may not coincide precisely with those in Chinese version.

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1 Introduction and competitive landscape

1.1 Shortcomings of centralized finance and traditional decentralized finance

1.1.1 Shortcomings of centralized finance

Centralized finance (CeFi) is also known as traditional finance. In CeFi, currencies circulate under the supervision of entities such as governments and central banks. Users predominantly rely on CeFi institutions to access a range of financial services. This architecture has given rise to numerous challenges, including asymmetrical competitive advantages, elevated barriers to entry, high costs, and the sale of user trading data to market makers[1], thereby impeding equitable market participation for smaller investors. Additionally, CeFi services frequently pose hindrances to cross-border asset investments, transfers and payments, and foreign exchange transactions.

In the realm of cryptocurrency, CeFi exchanges are often accused of lacking transparency and face issues such as price manipulation, network disruption, server failure, misappropriation of user funds, and asset freezing. The bankruptcy of the FTX exchange[2] underscores the severity of these problems, leading to substantial losses for numerous institutions engaged in hedging transactions.

In the context of cryptocurrency, CeFi contradicts the core principles of blockchain technology, which embodies decentralization, transparency, and security. These attributes offer superior solutions for financial services.

Consequently, decentralized finance (DeFi) emerged, grounded in smart contracts. The DeFi Summer epitomizes the growing demand for this innovative financial service. Leveraging blockchain technology, DeFi services can deliver more autonomous, transparent, secure, and open financial services, addressing the requirements of market participants and circumventing the challenges associated with CeFi services. The primary driving forces behind the DeFi Summer are freedom and transparency, as blockchain and its underlying algorithms furnish the foundation.

1.1.2 Shortcomings of traditional decentralized finance

DeFi projects were initially developed on the Ethereum-based EVM ecosystem. Ethereum is a decentralized "computer" that can run decentralized applications (dApps) on the blockchain in a decentralized manner. These applications are powered by smart contracts, which are computer programs executed on the Ethereum network. Nevertheless, DeFi still faces several obstacles in challenging the dominance of CeFi, including high entry barrier, immature user experience, and elevated transaction fee, commonly referred to as gas fee.

The most significant obstacles that DeFi encounters are computational efficiency and gas fee. Due to the limited computing resources on the public chain, all smart contracts must compete, resulting in high gas fee. Consequently, executing complex financial logic, including the central limit order book (CLOB), which is a standard feature in CeFi, poses significant challenges for DeFi projects.

1.2 Advantages of decentralized financial AppChains

Since the inception of application-specific blockchain (AppChain) by Cosmos and Polkadot in 2016, the Cosmos ecosystem has advanced to encompass a comprehensive suite of infrastructure. The fundamental idea of AppChain is that each dApp is deployed on its own specific blockchain, rather than on a public chain.

This approach prevents competition for computational resources among dApps, thereby substantially improving the performance of dApps, decreasing computational expenses and gas fees. To tackle the issue of information silos between AppChains, Cosmos has introduced the Inter Blockchain Communication (IBC) protocol, which facilitates secure and dependable inter-chain information exchange.

Abdex is a DeFi AppChain developed based on the Cosmos SDK, aims to achieve efficient and cost-effective DeFi services.

The main benefits of DeFi AppChains are as follows

1) Improved transaction efficiency: DeFi AppChain is designed specifically for a certain financial application. In comparison to public chains such as Ethereum, AppChains offer faster transaction confirmation times, higher transaction throughput, and lower transaction fees.

2) Better user experience: DeFi AppChains can provide a superior user experience by simplifying the financial transaction process through a faster, more intuitive, and user-friendly interface.

3) Enhanced security: DeFi AppChains can improve security through specific designs, adopting stricter admission mechanisms, increasing the cost of malicious behavior for verification nodes, and ensuring system security.

4) Improved scalability: DeFi AppChains exhibit exceptional scalability, enabling the distribution of diverse financial functions across multiple chains via some specific designs, thereby optimizing system throughput.

Abdex capitalizes on the exceptional performance and minimal gas fees proffered by Appchains to implement a series of complex financial functions, including spot and derivative CLOB tradings. As a result, users can enjoy an experience that resembles traditional finance, exceeding what is currently provided by other blockchain projects.

1.3 Shortcomings of existing stablecoins

Stablecoin is one of the primary applications of cryptocurrency and blockchain. As of February 2023, the total market capitalization of stablecoins has exceeded 137 billion USD [3]. By pegging the values to fiat currencies, stablecoins provide users with a way to combat the high volatility of the cryptocurrency market, while leveraging blockchain technology for efficient global transfers and transactions.

At present, centralized stablecoins like USDT and USDC are the mainstream offerings in the market. They collect off-chain assets as collateral and issue corresponding amounts of stablecoins on-chain. These stablecoins rely on centralized institutions for issuance and maintenance, and their security and stability are vulnerable to manipulation and control by the issuer, which has raised concerns about centralization in multiple incidents. The largest centralized stablecoin by market capitalization, USDT, has experienced multiple instances of price decoupling due to lack of transparency and regulation [4]. Even USDC, considered a regulated and secure stablecoin, experienced price depegging from the dollar value during the Silicon Valley Bank's collapse [5]. Additionally, centralized stablecoins are susceptible to centralized regulatory guidance, and they can freeze stablecoin assets of on-chain users, which is currently a topic of controversy.

Over-collateralized stablecoins are considered a feasible solution for decentralized stablecoins. MakerDao's DAI [6] is a pioneer and the largest decentralized stablecoin by market capitalization. MakerDao as a lending protocol is targeted at long-term cryptocurrency holders who require short-term cash flow. Users can borrow DAI minted by the protocol through collateralizing more than 150% of their cryptocurrencies. The protocol requires DAI to be pegged 1:1 to the US dollar. Users can reclaim their collateralized cryptocurrencies by repaying the borrowed DAI and paying interest. The over-collateralization mechanism does not rely on centralized institutions and is implemented through smart contracts, offering the advantages of decentralization and transparency. If a user's collateral ratio falls below 150%, the protocol will sell the user's collateral to liquidate the loan.

The Liquity Protocol [7] is another leader in decentralized stablecoins. It only accepts ETH as collateral with an collateral ratio of 110% (a lower collateral ratio increases the protocol's liquidation risk).

However, existing over-collateralized stablecoins, represented by the MakerDao and Liquity protocol, still have significant shortcomings in price anchoring, collateral liquidation, and application scenarios.

1.3.1 Stablecoin price anchoring

One of the challenges faced by stablecoins is the deviation from their face value in secondary market trading, despite being backed by underlying assets of equal or greater value. This deviation undermines the stability that they are meant to provide.

Initially, DAI was designed to have a soft peg to the US dollar. The Dai Savings Rate (DSR) smart contract adjusts the interest rate to influence supply and demand relationships, with the goal of achieving a 1:1 peg between DAI and the US dollar. However, due to over-collateralization, DAI lacks a closed arbitrage cycle, which often leads to significant deviations from its face value.

In contrast, centralized stablecoins have a closed arbitrage cycle. Taking USDT as an example, in the secondary market, if the price of USDT is $1.05, arbitrageurs can immediately make a risk-free profit of $0.05 by sending $1 to Tether, the issuer of USDT, to get 1 USDT and sell it at the price of $1.05. This arbitrage behavior increases the selling volume of USDT in the secondary market, thereby decreasing the price of USDT until the arbitrage opportunity disappears. Conversely, if the price of USDT is $0.95, arbitrageurs can immediately buy USDT at $0.95 and exchange it for real $1 with Tether to make a profit of $0.05. This process is known as "arbitrage between the primary and secondary markets" in traditional finance.

However, for DAI, such arbitrage is not feasible due to over-collateralization. Suppose the price of DAI is $1.05, arbitrageurs can collateralize $1 worth of ETH within the protocol. However, due to over-collateralization, they can only obtain 0.67 DAI. Even if they sell these 0.67 DAI at $1.05, their ETH remains collateralized. To end the arbitrage trade, arbitrageurs must wait for the DAI price to decrease, then repurchase 0.67 DAI at a lower price to redeem their collateralized ETH. During this process, arbitrageurs face the risk of the DAI price not dropping, their collateralized ETH being liquidated, and the cost of borrowing interest, all of which significantly limit the arbitrage behavior. Only when the DAI price exceeds $1.5, the above process is immediately executable and risk-free. However, at that point, the stablecoin is no longer stable. When the DAI price falls below $1, arbitrage becomes even more difficult because only users who have previously borrowed can purchase DAI in the secondary market and redeem collateral in the primary market. This arbitrage is even more limited in effectiveness.

In 2020, MakerDao protocol had to introduce the PSM (Peg Stability Module) to stabilize the price of DAI. Users can deposit one centralized stablecoin (such as USDT) into the protocol in exchange for 1 DAI. At the same time, users can also swap their DAI for USDT held within the protocol. The MakerDao protocol achieves a closed arbitrage cycle through this non-overcollateralized method, but there are still limitations. The amount of USDT that users can be swapped must not exceed the USDT balance in the protocol's treasury, which is inherently lower than the total face value of issued DAI. This is attributed to the fact that a portion of DAI is created using an over-collateralized approach. Presently, centralized stablecoins constitute more than 50% of protocol's treasury, resulting in DAI becoming a "centralized decentralized stablecoin." This situation makes DAI's security dependent on centralized stablecoins, exposing it into centralized regulatory risk. In the USDC unanchoring event [5], the price of DAI also deviated significantly from its intended pegged value.

Another leader in decentralized stablecoins is the Liquity Protocol [7], which only accepts ETH as collateral and requires an collateral ratio of 110%. Lower collateral ratios increase the protocol's liquidation risk. Based on the aforementioned arbitrage cycle, the price ceiling for Liquity stablecoin LUSD is set at $1.1.

In the case where the price of LUSD falls below $1, the Liquity Protocol permits users who have not previously borrowed to buy LUSD in the secondary market and exchange it for $1 worth of ETH within the protocol. This arbitrage mechanism helps maintain a price floor for LUSD, however, the protocol must forcibly liquidate borrowers whose collateral ratio exceeds 110%. This is because arbitrageurs do not need to engage in borrowing within the protocol beforehand. To tackle this issue, Liquity implemented a "queue for liquidation" mechanism that liquate the borrower's collateral with the lowest collateral ratio which exceeds 110%, and get ETH to give arbitrageur. The process will continue to liquidate other positions until the arbitrageurs stop to exchange for ETH.

Consequently, the collateral provided by borrowers is not secure, and the liquidation of collateral remains uncertain. The only thing borrowers can do is to deposit more collateral than other borrowers to mitigate the risk of liquidation. This situation has given rise to competition for collateral ratios. Currently, the overall collateral ratio of the Liquity Protocol has exceeded 240%, limiting borrowers who genuinely need to borrow.

In contrast to the aforementioned protocols, Abdex stabilizes the stablecoin price by hedging and exposing risks in the derivatives market, thereby circumventing the need for centralized stablecoins and the "queue for liquidation" mechanism.

1.3.2 Collateral liquidation of stablecoin system

The value of stablecoins relies on the underlying assets that back them. Stablecoin is considered backed only when the value of the treasury supporting it is equal to or greater than its issued face value.

Collateral liquidation is necessary when market price fluctuations threaten the balance of treasury. For existing stablecoins, the liquidation process involves buying back the stablecoins with collateral and subsequently burning them. Taking DAI as an example, liquidation will be triggered when the collateral ratio falls below 150%, generally ensuring that the return of liquidation surpasses the face value of the corresponding stablecoin. Additionally, an extra penalty is usually imposed on the borrower due to be liquidated, which is then added to the treasury of the protocol to safeguard against potential shortfalls during exceptional periods.

Under extreme market conditions, a steep decline in collateral price may lead to increasing liquidation, and the selling caused by liquidation may further decrease the collateral price, resulting in a downward spiral of liquidation and price. The liquidity of the stablecoin market significantly influences the safety of liquidation. In extreme scenarios, insufficient liquidity in the stablecoin trading market may hinder the completion of liquidation, causing a sharp increase in stablecoin price, exacerbating the downward spiral, and heightening the risk of an inadequate value in the treasury of stablecoin protocol.

MakerDAO employs a two-stage Dutch auction for liquidation. However, historical data indicates that the protocol's liquidation price is often lower than the market price, as the auction needs a lower price to attract liquidators to engage in this complex game and endure a lengthy waiting process. The high auction entry barriers and the complexity of procedure also constrains the depth of liquidation. In the "MakerDAO 312 incident" [8], a sharp drop in ETH price triggered a multitude of on-chain liquidation transactions, leading to blockchain congestion, high gas fees, difficulties in price feeding for oracles, and instances of liquidators acquiring ETH from liquidation at no cost.

Moreover, when the assets backing a stablecoin in the treasury are worth less than the issued stablecoin's face value, the MakerDAO protocol will auction MKR tokens to buy DAI and cover the deficit in the treasury. MKR serves as the governance token of the MakerDAO protocol, granting voting and dividend rights on MakerDAO protocol.

Compared to MakerDAO, Liquity's liquidation process is more secure. The majority of LUSD is staked by borrowers in the protocol's stability pool, earning profits from other borrowers' liquidation. Consequently, there is no need to worry about liquidity and price issues during liquidation. Instead, liquidation can be executed directly based on the oracle-provided price. The limitation of application scenarios for LUSD have inadvertently become a guarantee of its security.

1.3.3 Application scenarios of stablecoins

As a pioneer in decentralized stablecoins, DAI has gained widespread adoption in payments, decentralized tradings, and various other use cases, showcasing its significant practical value. However, the diversity of these application scenarios results in liquidity fragmentation, heightening the risk associated with buying stablecoins for liquidation and diminishing liquidation efficiency. Furthermore, the integration of centralized stablecoins into the MakerDAO protocol has raised centralization concerns, impacting DAI's decentralized applications.

In the Liquity protocol, the primary reason for user participation in borrowing is to stake LUSD to the Liquity stability pool, rather than borrowing itself. The LUSD stability pool generates profits by liquidating other users' collateral. This situation presents a paradox: borrowers' profits originate from the liquidation of other borrowers. The limited application scenarios for LUSD have contributed to the security of its liquidation process, as most LUSD is put in the stability pool, awaiting liquidation. However, this strategy may ultimately intensify competition for collateral ratios and result in reduced returns from the stability pool.

1.4 Advantages of Abdex stablecoins

The Abdex stablecoins address the limitations of existing stablecoins by introducing innovative price anchoring and liquidation methods. This stablecoin system guarantees price stability through arbitrage between primary and secondary markets, risk hedging and exposing in the derivatives market, thus eliminating the need for introducing centralized stablecoins and "queue for liquidation" mechanism. To avoid the traditional liquidation process, which necessitates the buying and burning of stablecoins as well as the associated unpredictable derivative reactions, the Abdex stablecoin system adopts a derivative hedging approach using ETH or BTC as collateral for liquidation. The security of the liquidation process is guaranteed by the depth sustained through the on-chain market-making algorithm 3.2.1 in Abdex's derivative markets. This strategy effectively mitigates the impact on liquidation resulting from insufficient liquidity of Abdex stablecoins.

Overall, Abdex has enhanced the security of its stablecoins by implementing targeted liquidity control in the derivative markets, on-chain trigger mechanisms (to mitigate the effects of blockchain congestion on liquidation), and other measures.

In terms of application scenarios, Abdex stablecoins are utilized on the Abdex on-chain spot and derivatives order book exchanges. This provides traders holding Abdex stablecoins with a variety of trading opportunities, such as investing, hedging, and arbitrage in cryptocurrencies, global stock indices, and commodities. That not only expands the decentralized stablecoin application, but also greatly improves the user experience.

Moreover, Abdex stablecoins facilitate mobile retail payments, allowing long-term holders of BTC and ETH to mitigate the volatile fluctuations of cryptocurrencies and integrate crypto payments into their daily lives.

The Abdex stablecoin system is fully decentralized, offering collateral protection for borrowers while achieving more effective value anchoring, safer collateral liquidation, and a broader range of application scenarios for stablecoins.

In addition to the above innovations, the Abdex stablecoin system also supports multi-asset collateralization and stablecoins pegged to multiple fiat currencies, as well as the global stablecoin GLBa, which tracks a global currency index.

By leveraging the over-collateral feature of Abdex stablecoins, Abdex has pioneered lossless conversion between stablecoins. This effectively addresses the high costs of foreign exchange trading and eliminates barriers to investing in global markets.

1.5 Shortcomings of existing decentralized exchanges

1.5.1 Shortcomings of existing decentralized spot exchanges

Due to the scarcity of computational resource and high gas fee on Ethereum, the traditional central limit order book (CLOB) model faces challenges when deploying on the blockchain. As a result, the automated market maker (AMM) model [9] has become widely adopted, as it significantly reduces the computational demands of decentralized exchanges and addresses the liquidity issues caused by the challenges faced by traditional market makers when using on-chain order book. The AMM formula is defined as follow

$$x \times y = k$$

where x and y represent the quantities of base and quote tokens in the base/quote trading pair, respectively, and k is a constant that only changes when there is a change in the pool. Users who want to participate in market-making, known as liquidity providers (LP), only need to deposit base and quote tokens in the proportion of x and y in the pool (i.e., the current price of the trading pair in the pool). At this point, the system will adjust the size of k proportionally. For external transactions, AMM changes the quantities of x and y while keeping k constant and traders need to pay trading fees to the pool.

However, for non-stablecoin trading pairs, LPs often face high impermanent losses, which often surpass the gains from market-making and trading fees. To ensure users' willingness to participate in liquidity provision, decentralized exchanges usually airdrop additional rewards to LPs to encourage them. These rewards often comprise exchange's governance tokens. This behavior will lead to the inflation of this token, causing a drastic decline in token price. To address this issue, decentralized exchanges commonly offer high-yield governance token staking services to decrease token circulation and stabilize the price. However, this process may be unsustainable.

The key to ensuring the sustainability of the AMM model is providing LPs with long-term, positive returns. Several innovations aim to reduce AMM impermanent loss, with one approach focusing on decreasing arbitrageur profit, which affect the prices in liquidity pool. For example, consider the Proactive Market Maker (PMM) algorithm of the DODO protocol [10].

AMMs exhibit purely passive market-making behavior, as their trading prices are determined by the token ratio within the pool. This means that when trading prices in other markets change significantly, AMMs cannot actively adjust their market-making prices. During these times, arbitrageurs can exploit the price spread between external markets and AMM markets for risk-free arbitrage, buying low and selling high. The profits earned by arbitrageurs directly correspond to the LPs' losses. To address this issue, the DODO protocol integrates oracle price of external markets, ensuring that the market-making price closely aligns with these oracle prices.

$$P = \begin{cases} i(1-k+k(\frac{B_0}{B})^2), & \text{if} \quad B < B_0 < 0 \\ i(\frac{1}{1-k+k(\frac{Q_0}{Q})^2}), & \text{if} \quad Q < Q_0 < 0 \\ i, & otherwise. \end{cases}$$

where P is the market-making price, i is the oracle price, and k is the slippage coefficient used to control the trading slippage. B_0 is the target inventory of the base asset set by LP, and B represents the current inventory. Similarly, Q_0 is the target inventory of the quote asset, and Q represents the current inventory.

According to the above formula, the market-making price is not based on the token ratio in the pool, but on the oracle price i. At the same time, the market-making price needs to be adjusted based on the inventories B and Q to control the inventory risk and ensure that the market liquidity does not dry up. External trading can cause the inventories B and Q to deviate from the target inventories B_0 and Q_0. The more the deviation, the more slippage external traders need to pay to compensate LP for the inventory risk.

When $k = 1$, the above formula degenerates into the traditional AMM model. When $k \to 0$, the above approaches the stablecoin exchange Curve.

Intuitively, PMM is quite close to a simple market-making algorithm in order book. It can be imagined that if i is the current price of an order book exchange, PMM algorithm can be discretized and used to make market by placing limit orders on the order book. AMM, and its derivative versions like PMM, can be considered continuous versions of order book market-making algorithms, while order book market-making is a discrete version of AMM. The mathematical equivalence between AMM and CLOB has already been proven [11].

However, compared to commonly used order book market-making algorithms, PMM may be simpler and less effective. For instance, in contrast to AS market-making strategy mentioned later [12], PMM does not account for price volatility.

In addition to impermanent loss, AMM and its derivatives possess the inherent drawback of not supporting limit orders. Limit order can only be executed by continuously monitoring the pool price and placing a market order when the targeted price is touched. This not only leads to higher fees for limit order traders but also reduces overall market liquidity. In AMM, liquidity is solely derived from the liquidity pool, implying that placing limit order not only fails to provide market liquidity but also consumes it. This is inherently detrimental to market depth. Furthermore, the trading mode of AMM does not conform to the trading intuition of most traders, which may also limit the development of AMM.

1.5.2 Shortcomings of decentralized derivative exchanges

In the cryptocurrency market, perpetual contracts are the most prevalent type of derivative product, characterized by having "no delivery deadline".

Participants in the traditional futures market primarily consist of hedgers, speculators, and arbitrageurs. The initial purpose of the futures market was to provide hedgers with tools to hedge future price risks. Speculators utilize the leverage function of margin trading to speculate while simultaneously providing liquidity as the counterparty to hedgers. Arbitrageurs generate profits through arbitrage trading, ensuring that futures prices remain within a reasonable range.

However, speculators in the futures market face several unresolved issues:

1) Liquidity in the futures market is dispersed since the liquidity of a certain commodity is distributed across various delivery dates. Consequently, futures trading often encounters significant slippage.

2) Speculators need to roll over their positions before the futures contracts expire, meaning they must close their current futures positions and reopen new ones in the subsequent contract. This process generally entails liquidity risk and spread loss. For physical delivery contracts, if speculators fail to close their positions in time, they may confront the predicament of taking over a substantial amount of physical goods.

3) The price hard anchoring between futures and spot prices only occurs on the futures delivery date. Before that, there may be a considerable spread between futures and spot prices. Speculators typically aim to engage in leveraged trading of spot prices, which does not align with their expectations.

In contrast, perpetual contracts are derivative products specifically designed for speculators, as they do not require delivery. The price anchoring mechanism between spot and perpetual contract relies on exchange of funding amount. At fixed intervals (such as every hour or three times a day), the system observes the price spread between perpetual contract and spot. When the perpetual contract price exceeds the spot price, the long side must pay the funding amount to the short side, and vice versa. The funding amount increases with the price spread. To avoid or obtain funding amount, traders will execute corresponding trades that will narrow the spread.

Implementing the derivative trading using AMM is more difficult than spot trading, as it involves multiple factors, including margin, leverage, and liquidation. AMM employ liquidity pool as counterparty, rather than traders, and face greater risks due to leverage effects. Currently, the leader in decentralized derivative protocols, GMX [13], has been controversial, with some arguing that GMX may fall into a "death spiral" in a bull market.

1.6 Advantages of Abdex decentralized order book and on-chain market-making algorithm

1.6.1 Decentralized order book and trading depth

Compared to AMM and its derivatives, CLOB aligns more closely with traders' intuitions and resembles the trading experience on centralized exchanges. As mentioned earlier, the drawbacks of AMM encompass significant slippage, lack of native support for limit orders, a single source of trading depth, and challenges in offsetting impermanent loss with liquidity pool rewards.

Nonetheless, the benefits of AMM are also clear. Besides lower computational complexity, AMM offers everyone a predefined, fair, transparent, and uniform market-making strategy. Participants only need to supply funds without crafting their own strategies, which lowers the entry barrier for market-making. Once the profitability issue of AMM is addressed, the depth of its market will grow substantially.

In contrast, the liquidity of CLOB appears more "artificial" because market makers' trading strategies are not transparent, and their limit orders can be canceled at any moment. This can cause the market depth to vanish instantly when liquidity is genuinely needed, posing a risk to other market participants and Abdex stablecoin system.

Therefore, Abdex opts to use a mature order book market-making algorithm within the on-chain CLOB, replacing the responsibilities of AMM and granting higher trading priority to it. On-chain market-making algorithm not only dose not need to pay gas fees and trading fees, but also obtain a portion of the trading fees from counterparties. This ensures the positive profitability of market-making algorithms and increases market liquidity.

Similar to AMM, Abdex's on-chain market-making algorithm is also pre-set, fair, transparent, and uniform. Participants only need to provide funds to engage in market-making activities. Correspondingly, on-chain market-making participants must adhere to the lock-up period restrictions and cannot withdraw funds during this span. Withdrawal requests must be submitted in advance, or the funds will automatically enter the next lock-up period. This design aims to provide stable and predictable liquidity for the order book market. The Abdex stablecoin system will refer to the liquidity provided by the algorithm for stablecoin minting control to ensure the liquidation security of stablecoin system.

Another innovative measure that Abdex takes to increase liquidity is to use market-making orders to encourage blockchain validators to provide liquidity through front-running trades using their own market-making algorithms or cross-market arbitrage 3.2.3. Abdex considers a limit order filled within a block as a market-making order. No trading fees are charged for executing market-making orders, and the gas fee paid is refunded once the order is confirmed as a market-making order (validators have the motive to pack their own transactions without gas fee compensation).

Traditional market-making algorithms and liquidity arbitrage require placing and canceling numerous limit orders between ask and bid sides in the order book. To prevent pointless operations and malicious traffic attacks from consuming on-chain computing resources, blockchains typically charge gas fee for each operation, which is then paid to mining validator. This significantly increases the cost of traditional market-making algorithms and liquidity arbitrage.

Abdex encourages the aforementioned behaviors through front-running trades and market-making orders to boost liquidity in the order book. In Abdex, front-running trades specifically refer to validator nodes detecting market orders, identifying profitable opportunities, and placing the optimal limit order to match the market order. With no trading fees, gas fees, and order cancellations required, the cost of such market-making and arbitrage activities is zero.

Market-making orders will not harm the interests of traders placing market orders or participants in on-chain market-making algorithms. Front-runners typically need to place limit orders at more favorable prices than those offered by on-chain market-making algorithms to execute their trades, which reduces the slippage for traders placing market orders. The on-chain market-making algorithm does not suffer any loss of benefits, as it still receives a share of the trading fees from the trades matched by market orders and market-making orders.

1.6.2 Spot and derivative Trading

Abdex provides spot trading and derivative trading services, which can be difficult to implement using the AMM model. To achieve the goal of on-chain trading for global assets, Abdex also offers global stock indices and commodity futures trading. The blockchain extends trading hours to 24/7 to accommodate the needs of various users.

It is important to note that global stock indices and commodity futures tradings on Abdex use Abdex stablecoins pegged to the local currency as collateral. When trading global assets with a single currency as collateral, quanto products are often employed as a solution. Quanto products are derivatives with underlying assets priced in one currency but settled in another. However, these products can be difficult to hedge for market makers and this greatly limits their liquidity. To address this issue, Abdex leverages the zero-cost conversion advantage of its stablecoins, offering derivative products using Abdex stablecoins pegged to the local currency as collateral. This approach enables the market to have better trading depth.

1.6.3 Measures to prevent abnormal derivative prices

In derivative trading, Abdex employs a range of strategies to mitigate abnormal trading prices and forced liquidation events.

In perpetual contract trading, Abdex not only enables regular fund exchanges but also automatically triggers them when the trading price deviates from the spot price by a predetermined percentage. This approach penalizes the traders who maliciously manipulate market prices and provides additional margin for regular traders, thereby preventing them from being liquidated.

Regarding futures contracts, if the on-chain futures contract price strays from the target futures oracle price and reaches a specific upper threshold, the system will deny trades exceeding that price until it returns to the acceptable range. This safeguard ensures that traders are shielded from abnormal on-chain price fluctuations.

These measures are designed to protect the interests of normal traders within a fully transparent blockchain trading environment and to prevent losses resulting from malicious financial attacks. Abdex is dedicated to constructing a fair, transparent, and secure trading environment while offering users efficient and dependable derivative trading services.

2 Abdex stablecoin system functions

2.1 Borrowing and acquiring stablecoins

Abdex stablecoins can be acquired through the following three channels:

1) Primary market over-collateralized borrowing: Users can borrow Abdex stablecoins, such as USDa (pegged to the US dollar), EURa (pegged to the euro), and GLBa (pegged to a global fiat currency index) by collateralizing BTC and ETH with a collateral ratio of over 150%. Users can choose their preferred borrowing period, and the stablecoin system will mint the stablecoins and transfer them to users' accounts. For example, when borrowing USDa by collateralizing ETH, the user's borrowing limit is determined by the liquidity constraint of the on-chain market-making algorithm 3.2.1 for the ETH/USD:ETH perpetual contract to ensure the safety of collateral liquidation. This contract has the index tied to the ETH/USD rate and uses ETH as collateral, ensuring the safety of collateral liquidation.

2) Primary market subscription: To guarantee the scalability of stablecoins, users can directly subscribe to them through the stablecoin system using BTC or ETH. For instance, when subscribing to USDa with ETH, the system employs the ETH as collateral and hedges it in the ETH/USD:ETH perpetual contract market 2.3.1. Concurrently, USDa is minted and transferred to the user. The subscription price is affected by the system's hedging strategies and estimated funding rates. Furthermore, the system imposes a restriction on the subscription price, ensuring that it remains no lower than the stablecoin's face value.

3) Secondary market purchase: Users can directly buy USDa from other users who are offering it for sale on the Abdex order book spot market 3.1.1, such as the ETH/USDa market, by using ETH.

2.2 Adjustment of collateral and repayment of borrowing

During the borrowing period, borrowers can increase or decrease their collateral at any time. However, it is crucial to maintain a collateral ratio above 150%. If this rate falls below the threshold, a partial liquidation will be triggered to restore the collateral ratio above 150%. This process will also accompany a liquidation penalty, which serves as profit for the Abdex stablecoin module and is transferred to its treasury. Abdex employs partial liquidation instead of full liquidation to avoid placing undue stress on the liquidity of the Abdex perpetual contract order book.

Borrowers can repay at any time within the period by returning all or portion of the borrowed. These repayments can be completed in multiple installments. Before the expiration of the borrowing period, the blockchain will automatically send a reminder event to the network, urging the borrower to repay. If the borrower fails to repay the entire loan on time, the stablecoin system will calculate the collateral amount for continued borrowing, based on the liquidity of the derivatives market, and assist the borrower in automatically renewing the loan. The system will liquidate any excess amount.

2.3 Principles of stablecoin price stability in secondary markets

The Abdex stablecoins utilize risk hedging and exposure mechanisms to maintain the stability of stablecoin prices in secondary by employing derivatives. These derivatives consist of perpetual contracts that use BTC or ETH as collateral, rather than Abdex stablecoins themselves. This approach is primarily adopted because of the higher market value and superior liquidity of BTC and ETH, which contribute to the safety of derivative trading within the Abdex stablecoin system. Additionally, this helps mitigate liquidation risks that may arise from the dispersion and inadequate liquidity of stablecoins.

2.3.1 Risk hedging Mechanism for stablecoin system

The Abdex stablecoin system employs a hedging strategy designed to maintain the value stability of a certain portion of BTC and ETH held within its inventory, when assessed against specific fiat currencies such as USD or EUR.

Using ETH as an example asset and USD as the pricing unit, the Abdex stablecoin system hedges the risk associated with the ETH position by shorting the inverse contract ETH/USD:ETH.

Assuming the short leverage of l, the opening price of \$$p$, and the margin of m ETH, the short position is ml ETH.

If the fluctuation range of ETH is δ, the closing price is \$$p(1+\delta)$. The profit (or loss) of the derivative position in terms of USD is

$$PnL = -p\delta ml$$

Assuming that the Abdex stablecoin system receives n ETH and needs to hedge to ensure that the USD value of the received ETH, represented as np, stays constant. By setting $ml = n$ while shorting the perpetual contract, the USD value after hedging will remain unchanged, as demonstrated by the following equation

$$(1+\delta)pn - p\delta ml = pn$$

It is noted that if valued in ETH, the profit (or loss) associated with the derivative position is

$$PnL = \frac{-p\delta ml}{(1+\delta)p} = -\frac{\delta ml}{1+\delta}$$

where$\delta \in (-1, +\infty)$, $p, m \in (0, +\infty)$. The rate of return is

$$\frac{PnL}{m} = -\frac{\delta l}{1+\delta}$$

By setting the rate of return to -1, which represents a margin call situation

$$\delta = \frac{1}{l-1}$$

where$l \in (1, +\infty)$. Therefore, the derivative position employs a non-leveraged short strategy with $l = 1$, ensuring that a margin call is never triggered.

2.3.2 Risk exposure mechanism of stablecoin system

The risk exposure mechanism of the Abdex stablecoin system aims to control specific risk exposures. When the amount of ETH or BTC in the treasury is n', the system aims to achieve a risk exposure of holding $n(n \geq n')$ ETH or BTC. Taking the example of the reverse contract ETH/USD:ETH, the profit or loss of long position is denominated in USD as $PnL = p\delta ml$. To achieve risk exposure related to n, we only need to set $ml = n - n'$. In this way, combining the exposure of n' spot asset with the exposure of $n - n'$ can attain asset changes denominated in USD as δpn, i.e., $\delta pn' + \delta p(n - n') = \delta pn$.

It is important to note that, in contrast to a risk hedging with a leverage of one, the risk exposure mechanism carries the potential for a margin call. The system can offer equivalent risk exposure by utilizing a contract with one leverage rate, using Abdex stablecoin as margin, without the risk of a margin call. Nevertheless, Abdex opts against this approach for the following reasons:

1) BTC and ETH possess the highest liquidity in the cryptocurrency market. Therefore, contracts that use BTC or ETH as margin exhibit greater liquidity than those utilizing Abdex stablecoins as margin, which contributes to the safety of Abdex stablecoin system. Furthermore, employing BTC and ETH as margin, rather than multiple types of Abdex stablecoins, centralizes trading depth and prevents liquidity dispersion.

2) When the leverage of the reverse contract long position is $l = 1$, margin call will be triggered only when the δ of BTC or ETH equals -50%. In practice, Abdex employs all of its BTC and ETH as margin to maintain $l < 1$, in conjunction with Abdex discretized opening price, making liquidation less likely to occur. Abdex stablecoin system can utilize its profits to augment the margin and avert liquidation.

3) Compared with the derivative short position for liquidating stablecoins, the derivative long position aimed at prevent the stablecoin price from falling is not mandatory. Abdex can slow down this arbitrage behavior to avoid liquidation.

4) In the event of a significant drop in BTC or ETH, the derivative long position resulting from collateral liquidation in stablecoin system will reduce the short positions of the system, relieve the margin pressure of the system.

5) Under extreme circumstances, the Abdex system will charge interests on borrowers (usually not charged) to alleviate margin pressure. At the same time, charging interests can encourage borrowers to repay early, thereby increasing the stablecoin prices and reducing the short positions.

6) Historical events, such as the "DAI312 Incident" [8], demonstrate that in extreme market conditions, stablecoin prices tend to rise rather than fall, negating the need to increase risk exposure via derivatives.

2.3.3 Mechanism for stabilizing stablecoin prices above face value

The primary objective of stablecoins is to maintain price stability in the secondary market. Abdex stablecoin system is designed to maintain the stablecoin price within its order book spot markets, such as the trading pairs ETH/USDa and BTC/EURa.

When the stablecoin price in the secondary market exceeds its face value, arbitrageurs and Abdex stablecoin system will subscribe stablecoins at a lower price in the primary market. They then sell these stablecoins at a higher price in the secondary market to realize risk-free profits. By selling stablecoins in the secondary market, the price is gradually brought back to a reasonable level.

The Abdex stablecoin system has an inherent arbitrage mechanism. Through this mechanism, the Abdex system mints stablecoins, purchases ETH and BTC in the secondary market, and subsequently hedges them. In this process, the Abdex stablecoin system will earn risk-free arbitrage profits.

2.3.4 Mechanism for stabilizing stablecoin prices below face value

When the stablecoin price in the secondary market falls below face value, the Abdex system will activate its own arbitrage mechanism. The system withdraws BTC and ETH from its treasury, purchases stablecoins at a discounted price in the secondary market, and then burns them. In this process, the Abdex stablecoin system will earn risk-free arbitrage profits.

The withdrawal of BTC and ETH follows a prioritized sequence. First, the system utilizes hedged cryptocurrency assets and close hedging positions. Second, it extracts funds from the system's profit in treasury. Finally, through the risk exposure mechanism 2.3.2, it extracts cryptocurrency assets from the borrowers' collaterals and opens corresponding long positions in perpetual contracts. This ensures that the risk exposure of the system matches the borrowers' collaterals, preventing collateral value loss when the borrower repays the loan.

This process will not result in the inability to extract collateral when the borrower repays the loan, as the Abdex arbitrage process burns stablecoins. When the stablecoin price is too low and hedging position is exhausted, the amount of stablecoins in the market is less than the amount generated through borrowing. Therefore, there are not enough stablecoins in the market for borrowers to repay until the stablecoin price rises. At this point, the behaviors of arbitrageurs and the Abdex arbitrage mechanism will make the system short reverse contract and close its long positions. Therefore, this process is reasonable.

The risk exposure mechanism will not over-open long positions to increase risk. The opening of risk exposure will be linear rather than one-time. The Abdex system has the opportunity to supplement margin through arbitrage profits. When the margin is insufficient, the Abdex system will charge borrowers a small amount of interest to supplement the margin, with interest skewed towards long-term borrowers. This will encourage borrowers to repay early, thereby boosting the stable price and alleviating the position opening of the risk exposure mechanism.

2.4 Liquidation mechanism

For users use the Abdex stablecoin for collateral borrowing, the blockchain will send an event to the network when the borrower's position approaches the collateral ratio of 150%. The borrower can then either add collateral or make a partial or full repayment.

Once the collateral ratio reaches 150%, the system will partially liquidate the borrower's collateral, impose liquidation penalty on the borrower's collateral, and deposit fine into the stablecoin treasury. Partial liquidation should ensure that the collateral ratio is higher than 150%.

The liquidation of stablecoin system will directly hedge the liquidated position using perpetual contract, while the liquidation fine will not be hedged and will be directly deposited into the treasury as revenue.

The Abdex stablecoin system will not purchase stablecoins in the secondary spot market for liquidation, to avoid a depletion of stablecoin liquidity with a series of derivative problems.

2.5 Stablecoin conversion and global stablecoin

The Abdex stablecoin system operates based on oracle prices for collateralization, liquidation, and other processes. This allows the Abdex stablecoin to theoretically track any price provided by oracle. Due to over-collateral, the Abdex stablecoin can flexibly adjust its anchored index as long as the face value of the stablecoin remains lower than the market value of the collateral.

Consider an example where the price of ETH is $2,000 and the price of EUR is $2. A user pledges one ETH and borrows 1,000 USDa. When the user need to EUR stablecoin EURa for trading or margin, he can apply to the Abdex stablecoin system. Abdex would then burn the received 1,000 USDa, mint 500 EURa, and transfer it to the user.

This process is equivalent to the user repaying 1,000 USDa and re-pledging with one ETH to borrow 500 EURa. However, Abdex stablecoin conversion offers lower gas fee compared to the aforementioned process. The latter need to pay two gas fees, while stablecoin conversion only pay a single gas fee.

Since the Abdex stablecoin can track any price provided by the oracle, the stablecoin system can peg weighted price index of fiat currencies including US dollar, Euro, Japanese yen, and even Bitcoin. This enables the creation of a global currency stablecoin, referred to as GLBa.

2.6 Mobile payments with stablecoins

Abdex offers a mobile client that connects users' mobile phones to the Abdex blockchain using either RPC or the mobile light node. In the client, users can set maximum limits for single and daily payments to reduce security risks. The payee just need to display the QR code generated by blockchain Abdex address, and the payer scans the code, select the amount and currency for payment. Due to the finality of the Abdex chain, transactions can be confirmed within a few seconds.

The Abdex decentralized stablecoins address the issues of price volatility and long transaction confirmation time often experienced with BTC and ETH as payment methods. For users who are optimistic about BTC and ETH in the long term, they can use them for real-life payments without selling their positions. In countries and regions where the local fiat currency experiences significant price fluctuations, alternative national or global stablecoins can be utilized for pricing and payments, protecting against asset depreciation and facilitating goods pricing.

3 Abdex Order Book System Functions

3.1 Order book market

3.1.1 Spot trading

Abdex provides fully on-chain limit order book tradings. In addition to supporting trading pairs with Abdex stablecoins, such as ETH/USDa, BTC/GLBa, etc., others will also be provided.

Utilizing the IBC protocol and well-developed cross-chain bridges, Abdex facilitates information exchange and cross-chain asset transfers among the Cosmos and EVM ecosystems. This offers users an extensive range of cryptocurrency spot trading options.

To guarantee the security of the Abdex AppChain, trading pairs involved in the spot market will exclude centralized cryptocurrencies. This measure effectively mitigates potential risks associated with centralization.

3.1.2 Perpetual contract trading and measures to prevent rice abnormalities

Abdex will offer cryptocurrency perpetual contract trading, primarily focusing on cryptocurrency underlying assets, with Abdex stablecoins, BTC, and ETH as collateral. Generally, base/quote:quote contracts are referred to as forward contracts, while base/quote:base contracts are known as reverse contracts. As previously calculated, a forward contract long with one time leverage will not be liquidated, and a reverse contract short with one time leverage will not be liquidated. The funding exchange will be passively triggered every hour. There are numerous variations of the formula used to calculate the funding rate. Consider the following formula

$$f_t = clamp(\frac{\sum_{i=t-N+1}^{t} p_i - s_i}{N}, l, u)$$

where f_t is the funding rate at time t, while l and u denote the upper and lower limits of the preset funding rate, ensuring that the maximum leverage of the perpetual contract is available. p is the recognized price of the perpetual contract, which can be the mid-price, the multi-tier weighted price of the order book, or the index price. The funding rate ensures that the perpetual contract tracks the spot price, and the funding paid by the long and short parties is equal to the product of f_t and p_t.

The Abdex stablecoin system employs perpetual contracts for risk hedging and exposure, so it also needs to participate in the funding exchange. The stablecoin module, stbcn5, has an independent treasury with funds derived from commission fees, liquidation penalties, arbitrage profits, and funding rates. When the treasury receives the funding rate, it will be deposited, and when it needs to pay the funding rate, funds will be withdrawn from the treasury first. If the treasury reaches the warning line, the stablecoin module will charge interest on the collateral to cover the funding fee.

In leveraged trading, abrupt price fluctuations may lead to traders to be liquidated. Public position data on the blockchain can potentially enable malicious users to manipulate prices in order to force others' liquidations. Timed funding rates cannot guarantee that perpetual contracts will not deviate significantly from the spot price within the time interval.

While the on-chain market-making algorithm of Abdex3.2.1 provides liquidity and raises the difficulty of market manipulation by malicious users. Additional safeguards are necessary to ensure the security of users and Abdex stablecoin system. To address this, Abdex adds a mechanism in which price spread trigger funding exchange. This mechanism activates a funding exchange when the price pread reaches a certain threshold. This increases the cost for manipulation and offers targeted users more margin to reduce their risk of liquidation.

3.1.3 Futures trading and measures to prevent price abnormalities

Abdex offers future contracts denominated in the underlying currency for stock indices and commodities. The decentralized futures provided by Abdex should be aligned with their corresponding futures on centralized exchanges, maintaining consistent trading rules except for trading hours.

This approach is designed to enable market makers to perform cross-market liquidity arbitrage 3.2.3.4, transferring the trading depth of centralized exchange to Abdex. Unlike centralized futures, Abdex future market operates 24/7, which may result in diminished liquidity and increased risk of price manipulation when centralized futures stop trading.

To mitigate the risk of abnormal futures prices, Abdex implements upper and lower price limits based on a fixed percentage deviation from the centralized futures prices. When the futures price reaches the limits, the trades on that direction will be restricted.

3.2 Measures to ensure market liquidity in the order book

Leveraging the high-performance capabilities of Cosmos SDK and AppChains, Abdex can achieve fully on-chain order book functionality. However, a key distinction between blockchain-based and traditional order books is that every operation on the blockchain that need to pay gas fee, regardless of whether the transaction is eventually completed. Although gas fees on AppChains are quite lower, this may still present challenges for traditional market makers. Market makers need to execute a large number of operations, including placing and canceling limit orders. In on-chain orderbook, they need to pay unbearable gas fees.

Moreover, due to the untransparent market-making strategies in the order book, limit orders can be canceled at any moment, potentially leading to a scarcity of market liquidity. Such behavior may be intentional, posing a risk to other traders and Abdex stablecoin system.

To address these concerns, Abdex adopts following methods to ensure market depth.

3.2.1 On-chain market-making algorithm

Abdex provides a sort of on-chain service like traditional AMM model. However, Abdex's market-making algorithm is based on the CLOB and directly incorporates mature order book market-making algorithm into bloakchain. Additionally, Abdex offers fee-sharing and higher trading priority for the algorithm, which receive higher priority than market-making orders.

Abdex employs the well-known Avellaneda-Stoikov (AS) model [12] for market-making. This algorithm can supply liquidity to the CLOB while ensuring market-making profits.

$$r(s,q,t) = s - q\gamma\sigma^2(T-t)$$
$$\delta^a + \delta^b = \gamma\sigma^2(T-t) + \frac{2}{\gamma}\ln(1+\frac{\gamma}{\kappa})$$

where $r(s,q,t)$ calculates the indifferent price of the market maker quote, s represents the current market mid-price, q denotes the inventory of the underlying asset, σ is the volatility of the asset, T and t indicate the current time and the end time of the trade. $\delta^a + \delta^b$ calculates the best bid-ask spread of the market maker, where the bid price for the market maker's quote is $r - (\delta^a + \delta^b)/2$, and the ask price is $r + (\delta^a + \delta^b)/2$. γ and κ are the inventory risk aversion parameter and order book liquidity parameter, respectively.

In each Abdex block, the on-chain market-making algorithm supplies not just two orders for buying and selling but a series of limit orders. Any transaction that alters the order book causes the on-chain market-making algorithm to recalculate new buy and sell orders.

Abdex selected the AS model as its on-chain market-making algorithm primarily for two reasons. First, the AS model is a classic market-making model recognized by both academia and industry. Second, the AS model continues trading even in extreme market conditions, providing consistent and dependable liquidity to the order book.

For each order book market, the parameters of AS model should vary, reflecting the characteristics and historical data of the asset. On-chain voting determines any modifications to the parameters, with the selected parameters prioritizing the safety of the on-chain market-making algorithm over profitability.

To ensure the stability of liquidity provided by AS algorithm and the security of the stablecoin system, the participants of the algorithm can not withdraw within a predefined closed period. The sharing ratio of market-making profits will be more biased towards long-term participants to safeguard their interests from short-term ones and encourage long-term market-making.

To improve the efficiency of the algorithm, the fund pool of algorithm is shared across markets rather than operating in a single market. Abdex will divide fund pools based on the liquidity and risk. Markets with low risk and high depth will share a smaller portion of profits, while markets with high risk and low depth will receive a larger portion as compensation. The portions will also be determined by on-chain governance voting.

In this way, Abdex has created a flexible, secure, and efficient on-chain automated market-making algorithm. On-chain governance voting ensures transparency and fairness in parameter settings, contributing to market stability. At the same time, the shared fund pool mechanism will improve overall market liquidity and fund efficiency.

3.2.2 Market-making order

Although gas fees on AppChain are extremely low, market makers still pay significant fees due to the frequent placing and canceling of orders. This increases the cost of market making, widens the bid-ask spread provided by market makers, reduces market liquidity, and results in greater slippage.

However, if all order placement and cancellation operations are free, malicious users can send a large number of meaningless transactions to attack the blockchain without cost. Additionally, since validators cannot earn gas fees, they may not have the incentive to package transactions in network.

To balance these factors, Abdex proposes a new type of limit order, called a market-making order, specifically designed to facilitate liquidity provision of market makers. Abdex blockchain recognizes a limit order matched within a block as a market-making order, without trading fees, and gas fees are refunded after being recognized as a market-making order.

Therefore, validators can engage in traditional market-making and arbitrage. Validators can adjust the order of external transactions within a block, allowing their limit orders to be fully matching, i.e., "front-running". Consequently, their limit orders are considered as market-making orders. Market making orders pay no trading fees and do not need to use gas fees to incentivize validators to package their own transactions. This allows validators to enjoy a traditional market-making experience.

Validators or their clusters can offer this service to more professional market-making teams, obtaining service revenue.

The market-making order effectively balances the interests of all parties involved. It benefits validators and market makers, and does not harm the interests of on-chain market making algorithm participants. They can still receive a share of the trading fees when orders are matched with market-making orders. Although market-making orders may decrease the matching probability of on-chain market-making algorithm, they can also serve as a safety pad for on-chain market-making algorithm during extreme market conditions. The liquidity of on-chain market making algorithms is not easily reduced contributing to the security of Abdex stablecoin system. For market order traders, market-making orders help to reduce slippage and provide better execution prices.

The market-making order offers market makers a highly efficient and low-cost solution, significantly enhancing the depth of the limit order book and preventing unnecessary order placing and cancelling. It improves the overall efficiency of the blockchain. This approach achieves a balanced interest for all parties involved, and provides an better trading experience for normal traders.

3.2.3 Market making and arbitrage strategies based on market-making orders

On Abdex, market-making orders contribute to liquidity in the Abdex order book market, offering a similar market-making and arbitrage experience to traditional centralized exchanges. It is expected that market makers, who may be either verificators or professional market maker, can use the following strategies

3.2.3.1 Risk-free order book market making

When a market bid and a ask order are received in the same block, the arbitrageur can place limit orders at the best bid and ask prices to secure a profit of $s \times min(V_a, V_b)$, where s represents the bid-ask spread, and V_a and V_b denote the volume of the market bid and ask orders. Market makers can also let the on-chain market-making algorithm match some volume, thereby widening the bid-ask spread to achieve higher profits. To maximize returns, the profit of this must be precisely calculated.

3.2.3.2 Inventory risk market making

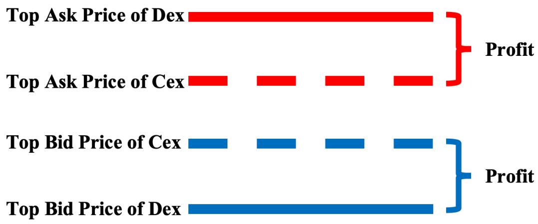
In addition to risk-free market making, market makers can take on inventory risk to pursue higher profits, as the spread increases, the likelihood of profit also rises.

3.2.3.3 Arbitrage between spot and derivative

Arbitrage opportunities may arise when a price spread exists between spot and derivative markets. Market-making orders can be used to arbitrage on these two markets. For instance, if the spot price is lower than the derivative price, one can take a long position in the spot market and a short position in the derivatives market simultaneously. Profits can be realized when the spread reverts and the positions are closed. If the spread of the perpetual contract does not revert, the perpetual contract can still provide funding fees, generating long-term funding fee profits.

3.2.3.4 Cross-market liquidity arbitrage

Market-making orders can also be used for cross-market liquidity arbitrage, which is essentially risk-free. For example, consider Market A with poor liquidity and Market B with better liquidity. In this case, the price spread in Market A is usually larger than that in Market B.



As shown in the figure above, the best bid price in Market A might be lower than that in Market B, the best ask price in Market A might be higher than that in Market B, or only one of these situations may occur.

In such circumstances, the market maker can place a limit order at the best price in Market A and wait for it to be filled. Once the limit order is matched, a market order with the opposite direction should be placed in Market B to hedge the position and obtain the spread profit.

Since the limit order is passively executed in the market with worse liquidity, and the market order is actively executed in the market with better liquidity, cross-market liquidity arbitrage effectively transfers liquidity from the market with worse liquidity to the market with better liquidity, obtaining liquidity profits.

On Abdex, front-running traders can observe the price spread between Abdex market and centralized exchanges with better liquidity, and perform liquidity arbitrage. A more advanced strategy is to use liquidity arbitrage to hedge inventory risk based on risk-free order book market making and inventory risk market making, and to get a higher return.

3.2.3.5 Cross-market linear derivative arbitrage

When the on-chain derivative price consistently deviates, either higher or lower, a pair trading can be opened by combining a position on Abdex with a opposite position on another derivative of the same type on a centralized exchange. This strategy aims to exploit the price spread between derivatives or the disparity in funding rates of perpetual contracts.

In conclusion, above strategies with market-making ordeers can provide market makers with significant low-risk or risk-free returns. They also can improve the liquidity of the Abdex order book markets, minimize slippage for market order traders, and raise the trading experience for users.

4 Economic Model

4.1 Native token ABD

ABD is the native token of the Abdex blockchain. Unlike traditional PoS chains, ABD cannot be acquired through mining to prevent the concentration of coin holdings that traditional PoS mechanism might cause. ABD tokens can be obtained through the following methods:

1) Genesis block: Like all blockchains, Abdex allocates a specific number of ABD tokens to the addresses of project investors, developers, and other early contributors in the genesis block as a reward for their initial support.

2) On-chain subscription: When Abdex's treasury requires replenishment, users can subscribe to ABD on chain to refill the treasury. The price and quantity of ABD tokens are determined by on-chain voting using ABD tokens.

3) Airdro for active users: Abdex can use ABD tokens to vote and reward active users on the chain with airdrops.

4) Community Reward: Abdex can use ABD tokens to vote and airdrop to addresses that contribute to Abdex's development, marketing, auditing, etc.

5) Secondary market purchase: ABD token holders can list their tokens on the Abdex spot order book exchange for sale, and anyone can buy ABD tokens through the spot market.

ABD token holders are entitled to the following rights:

1) Staking mining: Users can stake their ABD tokens and run the Abdex full node client to become a validator node, participating in staking mining. As validator nodes, they can earn gas fees, arbitrage profits, market-making rewards, market-making service incomes, etc.

2) Delegation staking: Users can delegate their ABD tokens to validator nodes for mining and receive a portion of the income generated by staking mining.

3) Governance and voting: Holding ABD tokens grants users on-chain proposal and voting rights. All decisions, such as determining and modifying various on-chain parameters, listing financial products, reward voting, and dividends, are made through on-chain voting.

4) Dividend Rights: Upon reaching a voting agreement, ABD holders can share in the dividends of the Abdex treasury according to the proportion of ABD tokens they hold.

4.2 Staking mining

Validators can participate in Abdex staking mining by staking their own and delegated ABD tokens while running the Abdex full node client. When a validator's staked ABD exceeds the minimum required amount in the validator pool, they will enter the pool and begin mining after a predetermined number of blocks. The greater the amount of ABD staked by the validator, the faster they forward in the validator queue, making it easier to reach the front and obtain mining right.

Mining can generate significant revenue for validator nodes, but it does not award them with ABD tokens. The income from mining comprises gas fees, arbitrage returns, market-making rewards, etc. In addition, validator nodes can accept delegations from other ABD holders to earn commissions for providing staking mining service.

4.3 Gas fee

The gas mechanism of the Abdex Chain differs from Ethereum's $gas_fee = gas_amount \times gas_price$, as gas fees on the Abdex Chain are not paid in a single currency, and the pricing is more flexible.

Aside from on-chain governance-related transactions, gas fees on Abdex are not paid using the ABD token. Instead, the currency and value of gas fees vary depending on the specific business on the blockchain. Gas fee collection is typically based on the proportional or on-chain order book price of the tokens.

For instance, in the ETH/BTC spot trading pair, if you purchase ETH with BTC, the gas fee will be paid in BTC. Conversely, if you buy BTC using ETH, the gas fee will be paid in ETH. This fee amount is determined by the transaction volume ratio. In other operations, such as staking BTC to borrow USDa, Abdex will collect a fixed USD value of BTC as gas fees, calculated according to the on-chain order book price.

The gas fees are allocated to staking nodes as an incentive for packaging and processing as many transactions as possible. On the Abdex Chain, the minimum standard for executing transactions with gas is given. The initiator of an on-chain transaction has the option to offer a higher gas fee to motivate the validator to prioritize this transaction.

By default, the blockchain node client organizes transactions by gas fees from high to low and execute them.

5 Code Structure

Abdex is developed based on the Cosmos SDK and modular programming. The modules developed by Abdex itself include the stbcn stablecoin module, the pymt payment module, the ob limit order book module, the spot trading module, the perp perpetual contract trading module, the fut futures trading module, and the ibc cross-chain communication module. Each module has its own on-chain storage, accounts, messages, events, etc. This code structure facilitates the independent processing of different logics and is convenient for later optimization and upgrading.

The stbcn stablecoin module provides lending services and has the ability to mint and burn stablecoins. It serves as the primary market for stablecoins. The module can not only accept on-chain user instructions for collateralization, redemption, and other actions, but it can also interact with the spot and perp modules to participate in spot and derivative trading. These interactions allow the module for position control, liquidation, arbitrage, and other operations.

The pymt payment module provides some related permissions and quota controls for transfer payments.

The ob module is responsible for managing the order book and its matching logic. It processes orders and trade-matching instructions issued by the spot module, perp module, and fut module, and subsequently returns the results to these respective modules.

The spot module, perp module, and fut module respectively provide trading functions for spot, perpetual contracts, and futures. Users can engage with these modules to execute transactions.

The ibc module facilitates token transfer and oracle price reading through the cross-chain feature of the IBC protocol.

6 Current Progress and Future Prospects

At present, the Abdex chain has successfully completed the development of the ob module, the spot module, and a part of the perp module. The Abdex project team is focused on accelerating the development process for the entire chain and aims to launch a testnet as soon as possible.

Blockchains developed using the Cosmos SDK have high TPS and can handle huge loads. However, if the on-chain transaction volume exceeds the anticipated capacity, Abdex has a plan to divide the Abdex chain into multiple AppChains based on functions. Each chain will continue to use the ABD token for staking and implement the PoS mechanism. Inter-chain communication will be facilitated through the IBC protocol.

The Abdex blockchain is dedicated to achieving decentralized front-ends, meaning that anyone can develop front-end applications that interact with the Abdex blockchain and access them via different URLs. This approach offers greater options for users, mitigates the risk of front-ends being subject to centralized supervision. To support this objective, Abdex plans to introduce a range of incentive methods.

7 Conclusion

In summary, this paper introduces the Abdex AppChain project, which aims to create truly decentralized stablecoins and on-chain order book exchanges. With ensuring user-friendliness, it broadens the scenarios for cryptocurrencies and DeFi applications. This allows cryptocurrency holders to participate in lending, transfers, stablecoin conversions, retail payments, on-chain order book spot trading, perpetual contract trading, futures trading, and global derivative asset trading within a decentralized environment. Consequently, non-blockchain professionals can conveniently incorporate blockchain technology into their daily lives and achieve their global asset allocation goals.

To achieve these objectives, Abdex proposes a series of innovative concepts and ideas, including a stablecoin price stabilization mechanism, risk exposure mechanism, hedge liquidation mechanism, over-collateralized stablecoin conversion, on-chain order book market-making algorithm, and market-making order. Through these inventive designs, Abdex ensures the secure operation of the blockchain, provides ample liquidity in the trading market, and encourages user participation in trading.

References

[1] *2 Charts That Show Why Robinhood Cares So Much About Payment for Order Flow*. https://www.barrons.com/articles/robinhood-payment-for-order-flow-51630451893. 2021.

[2] *Bankruptcy of FTX*. https://en.wikipedia.org/wiki/Bankruptcy_of_FTX. 2023.

[3] *Defillama: DeFi Dashboard*. https://defillama.com/. 2023.

[4] *History of Tether's peg: Every time USDT traded above or below one dollar*. https://protos.com/history-of-tethers-peg-every-time-usdt-traded-above-or-below-one-dollar/. 2022.

[5] *SVB bankruptcy leads to de-pegging of USDC stablecoin*. https://cvj.ch/en/hot-topics/news/svb-bankruptcy-leads-to-de-pegging-of-usdc-stablecoin/. 2023.

[6] *The Maker Protocol: MakerDAO's Multi-Collateral Dai (MCD) System*. https://makerdao.com/en/whitepaper/. 2020.

[7] Richard Pardoe Robert Lauko. *Liquity: Decentralized Borrowing Protocol*. https://docsend.com/view/bwiczmy. 2021.

[8] *Daos Ex Machina: An In-Depth Timeline of Maker' s Recent Crisis*. https://medium.com/dragonfly-research/daos-ex-machina-an-in-depth-timeline-of-makers-recent-crisis-66d2ae39dd65. 2020.

[9] Massimo Bartoletti, James Hsin-yu Chiang, and Alberto Lluch-Lafuente. "A theory of automated market makers in defi". In: *Coordination Models and Languages: 23rd IFIP WG 6.1 International Conference, COORDINATION 2021, Held as Part of the 16th International Federated Conference on Distributed Computing Techniques, DisCoTec 2021, Valletta, Malta, June 14–18, 2021, Proceedings 23*. Springer. 2021, pp. 168–187.

[10] *DoDo Protocol Documentation*. https://docs.dodoex.io/english/. 2023.

[11] Young Jamie E. *On Equivalence of Automated Market Maker and Limit Order Book Systems*. 2020.

[12] Marco Avellaneda and Sasha Stoikov. "High-frequency trading in a limit order book". In: *Quantitative Finance* 8.3 (2008), pp. 217–224.

[13] *GMX Protocol Documentation*. https://gmxio.gitbook.io/gmx/. 2022.