FINANCIAL MARKET STRUCTURE — 21ST CENTURY STYLE

DEFI — READY 4 PRIME TIME? AN INSTITUTIONAL PERSPECTIVE

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DEFI — IS SOFTWARE EATING FINANCE?

DECENTRALIZED FINANCE [DEFI] is with us and we postulate it is here to stay - in fact, we believe growth in DEFI will be significant over the coming years [extrapolating from the growth trajectory over the last 18 months]: the total number of users increased by 14x and total global TOTAL VALUE LOCKED [TVL] in DEFI embedded SMART CONTRACTS reached over USD170bn in September 2021 up from USD6bn last year.

At present, DEFI-verse is home to about USD170bn in TVL with staking expected to generate in excess of USD40bn by 2025 alone. For context, DECENTRALIZED EXCHANGES [DEXs] have marshalled over USD815bn in trade volume over the last 12 month with the vast majority of DEXs operating as Automated Market Makers [AMMs] and thus often acting as a gateway into DEFI.

DEXs [included but not limited to Uniswap, Sushiswap, 0x, Curve, Serum, Balancer, …] combined monthly volume surpassed USD61bn in January 2021; compared to a combined monthly DEX volume of just USD4.9bn in July 2020 - an astounding increase of over 1,100%. Although the combined volume of CENTRALIZED EXCHANGES [CEXs] in January 2021 was considerably higher at USD906bn, DEX volume is catching up with a current volume ratio of 7%, up from 4.6% in July 2020.

Yet DEFI is still undergoing the pains of rapid expansion and growth; in part stemming from the fact that it is built on digital crypto currencies that exhibit gargantuan volatility. In fact, we believe that decentralization without accountability is a major impediment for wide
scale institutional adoption of DEFI and Decentralized Autonomous Organizations [DAOs].

**TOO BIG TO IGNORE RULES SUPREME AND ...**

In light of these developments and the overall growth of crypto what should be the reaction of incumbents - knowing full well that the products that most crypto-forward people i.e., the early adopter millennials are using will be used by mainstream clients in a year and institutional investors in a few years after that. Traditional Finance [TRADFI] needs to foster relationships with these millennials - the generation that is about to inherit trillions of dollars whilst having a big distrust in [centralized] TRADFIs.

Accordingly, ‘Time is Night 4 the Old Guard’ to consider the future implications and opportunities from CRYPTO and DEFI and start creating optionality i.e. via assembling a portfolio of real options. It thus appears that the time is ripe to modernize the global financial systems using crypto technology.

**... MONEY/ LIQUIDITY ARE MERCENARY**

TRADFI current market yields tend to fall within a range of -2% -5% in a period where the global long term macroeconomic outlook is far from certain, compared to very ‘attractive or unbelievable’ Annual Percentage Yields [APYs] offered by many, in particular, ‘exotic’ DEFI protocols.

Money and or liquidity are mobile and move fast to where the perceived trade off between yield and security/ safety is maximized [i.e., in the current low/ negative interest environment, an expected 10% annual yield is compelling if the perceived risk is relatively low. Yield Farmers hunt down the most compelling rates on offer and a part of crypto investments tends to follow the trail of available yield with rapidly moving money able to cause significant fluctuations in token prices.

**... AND A REMINDER ABOUT INFORMATION**

As Grossman-Stiglitz highlighted as far back as 1980, there is also a fundamental conflict between the efficiency with which markets spread information and the incentives to acquire information. This means prices will never reflect the information which is available since if it did, those who spent resources to obtain it would receive no compensation. Which de facto means if you remove the incentive aka cost to hunt for information, you will get bad prices and thus incur risk.

In this paper, we intend to give a flavor of things to come in DEFI and showcase a limited number of DEFI AMM based business models and contrast this with TRADFI concepts. In a DEFI environment, tried and tested conventional market structure models have been adapted to account for the idiosyncratic capabilities namely: AMMs and PMMs [PROactive Market Makers i.e., DODO].

**TRADING PARADIGMS**

**DEX/ CLOBs AND AUTOMATED MARKET MAKERS**

DEXs have emerged and evolved over the past few years to provide an alternative/ viable solution to CEXs. DEX exchanges allow direct peer-to-peer transactions to take place without intermediaries. By utilizing decentralized smart contracts encoded on public blockchains, users always retain their private keys which

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1 Most DEFI platforms/ projects are set up as DAOs where no one or everyone [with liability being a collective concern] to varying degrees is in charge depending on the governance model that underpins the respective DEFI/ DAO models [i.e., every token holder has the right to vote on decisions governing the DEFI protocol - in practice, the concept of proxy voting is prevalent in the world of DEFI with institutions or major token holders casting the majority of votes]. In addition, no final legal verdict has been issued whether tokens are to be treated as securities which could drastically affect how CRYPTO and consequently DEFI operates. In addition, broader adoption is subject to, among others, clarifications around tax policy, securities law, federal insurance and transaction fees.

2 The level of DEFI yields is in part due to TradFi’s risk aversion i.e., lack of credit for Crypto transactions, the complexity of DEFI interacting with DEFI - early adopters only - and regulatory apprehension. Consequently there is a temporary imbalance between supply and demand which is further exacerbated given that many investors are keen to make leveraged bets on Crypto. Accordingly, keen Crypto investors are willing to pay a premium to take out loans from DEFI protocols [i.e., Aave, Compound, and Uniswap] and specialized lenders [i.e., BlockFi and Celsius] that turn to DEFI platforms for liquidity. The tradeoff: 10% + interest versus selling Crypto holdings which in term trigger short term capital gains taxes. For as long this supply/ demand imbalance persists, high interest loans offer the means for short term attractive [above long term normal] expected returns for DEFI depositors. In the medium to long term, such high yields are unlikely to persist as TRADFI & CO get more comfortable with Crypto.
removes counterparty risk inherent to CEXs. Thus, DEXs eliminate intermediaries and allow users to trade directly from their [non-custodial] wallets.

DEXs excel in providing access to the long tail of DEFI products and crypto assets that may have too little liquidity or too much regulatory uncertainty for CEXs to consider adding them. DEXs also allow for greater composability and interoperability between different DEFI ‘Money Legos’ or protocols, unlocking entirely new use cases. DEXs thus enable rapid product iteration and experimentation which has led to the development of novel DEFI primitives such as flash loans, AMMs, algorithmic stablecoins, synthetic assets, liquidity mining, decentralized price oracles, etc...

Furthermore, DEXs have also demonstrated an opportunity to rethink the traditional trade execution model; the most prominent exchange models are based on a more conventional order book model and the more novel AMM model.

The key difference between trading on an AMM and a CENTRAL LIMIT ORDER BOOK [CLOB] based exchange is the mechanism of fair price formation for subsequent trade execution. CLOBS exchanges rely on an aggregated list of buy and sell orders submitted by traders on a given pair with CLOB allowing traders to either bid or ask [sell] for an asset at a specified price. The difference between the highest bid and the lowest ask is called the spread. Markets with high liquidity have much smaller spreads, since the depth of demand and supply at each price level is high.

Conversely, AMM design features aim to provide an efficient liquidity mechanism to allow for the efficient exchange of tokens in that an AMM acts as a bot for quoting prices at any time users wish to trade two assets [the theory behind AMMs is based on game theory and behavioural economics]. Unlike a CLOB model that specifies prices at which buyers and sellers wish to trade, an AMM aggregates liquidity for both sides of a trading pair [demand/ supply] into a single pool and determines a single market price according to a deterministic algorithm with the price formula being based on the pool’s current liquidity or the availability of an asset in the common liquidity pool. Hence, AMMs do not require market makers, but rather heavily rely on liquidity providers to join the pool and expand its size to ensure that tokens reflect a fair price.

AMM DEXs use different formulas to quote prices for their liquidity pools. The XYK formula pioneered by Uniswap illustrates price formation in a typical AMM: the price is calculated based on the ratio of the two assets in the pool as follows: \( x \cdot y = k \) [constant]. The constant \( k \) represents the total token balances in a liquidity pool that determine the token prices, \( x \), and \( y \) at a given time.

**LIFTING THE CURTAIN: WHAT IS A DECENTRALIZED EXCHANGE?**

A DEX is an autonomous application that enables peer-to-peer trading without a central governing body to facilitate smooth and efficient trading. To get a better understanding of a DEX, let us first look at the fundamental design of an exchange.

At core, an exchange is a platform that facilitates trading of assets between users. Exchanges do this by bringing asset buyers and sellers under one roof and facilitating a market for a given asset pair. Liquidity is important for any market, and therefore sufficient supply of both assets in a pair must be well established.

For the longest time, exchanges in the crypto world have been centralized meaning they have been created, managed, and controlled by a single entity. Running a CEX is often a highly sophisticated and expensive endeavor. The central entity needs to establish a reliable custodial solution that will keep the clients funds safe as they trade on the exchange. The central entity also needs to create an order matching engine that will match orders between buyers and sellers quickly and accurately.

Last but not least, the central entity has to provide liquidity on the platform to make sure all trades take place swiftly and efficiently at a minimum spread.

Therefore, the central working pieces that make up any exchange are custody, liquidity and order matching. In Traditional Finance, these functions can be separated such that there is a different entity controlling the
custody of funds, another entity supplying liquidity, and
the exchange working to match orders from buyers and
sellers. In the crypto world, however, the lack of support
from legacy systems has forced most exchanges to take
on the responsibility of providing all three functions.

CEX often rely on order-book-based matching engines.
The order books on CEXs are used to list all the buy
and sell orders of a particular cryptocurrencies while
maintaining a record of the exchange's trading volume
as well as price points. When you are depositing funds
to a CEX, you are ultimately trusting that the managers
of the exchange will return your funds when you
request them and that they are not misappropriating
your deposited funds. This high level of centralized
control creates a single point of weakness that could be
exploited.

DEXs emerged as a solution to the high degree of
control of centralized markets. DEXs operate without a
middleman facilitating the trades between buyers and
sellers without the need for trust on an intermediary or
each other. Simply put, a DEX aims at giving freedom
and control to users by allowing them to use the
exchange without third-party custodial solutions.

A user might, for instance, decide to connect their wallet
directly to the exchange platform without necessarily
handing over the funds to the exchange. However, with
decentralization as a key focus, the first generations
of crypto DEXs were built with on-chain order books
that were simply difficult to scale due to the limitations
of blockchain technology plus they lacked sufficient
liquidity.

Then came off-chain DEXs that attempted to solve the
issue of scalability with the first generation of on-chain
order book-based exchanges. Off-chain DEXs enable
order matching of buyers and sellers of the blockchain
and only use the distributed digital ledger as a venue for
settling trades that have happened off-chain. While this
presented solutions, it also brought about some issues
such as front-running. The main problem remaining was
a lack of sufficient liquidity.

The latest generations of DEXs are AMMs, which seek
to overcome the liquidity issue of previous exchange
structures. While conventional DEXs only decentralize
custody through using smart contracts to match
orders, AMMs have gone a step further to decentralize
liquidity as well. These exchange platforms have
managed to increase the scalability of DEXs built on
the blockchain by removing the need to rely on order
books or centralized Liquidity Providers [LPs], but most
importantly, they have brought about unprecedented
levels of healthy liquidity to DEXs.

**AMMs — 101**

An AMM is a DEX that relies on liquidity crowdsourcing
mechanisms from platform users. While a CEX and
an order book-based DEX rely on centralized venues
of liquidity, an AMM-based DEX creates its source of
liquidity through a smart contract that crowdsources
funds into liquidity pools.

A typical AMM solves the issue of low liquidity and
trading volume on DEXs by incentivizing the platform's
users to provide liquidity in a decentralized manner.
AMM platforms use smart contracts to give users the
option of locking their funds in a smart contract for
a reward.

For example, the entire AMM exchange is run by
an algorithm that sets the price of the assets paired
together in any given market such that the prices are
adjusted automatically based on supply and demand
signals. To enable a smooth trading experience, the
algorithm will try and maintain a constant supply of
liquidity in the pool by adjusting the price of one asset
against another in a market pair.

The liquidity pool on AMM DEXs is built on smart
contracts that act as the custodians of funds provided
by LPs on the exchange. The smart contract locks the
token pairs provided by LPs in the pool in exchange for
a liquidity pool token representing the LP's share of the
liquidity in the pool. For instance, if you provide 200 X

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1 For instance, for a market pair with assets X and Y, the total value of both assets in the liquidity pool should maintain a constant value. In this case, when you multiply the amount of X to the amount of Y in the liquidity pool, the result should be a constant. That way, all the token pairs added by multiple LPs will always add up to a constant liquidity value thereby stabilizing the market. For example, if you have 10 X tokens and 5 Y tokens in a pool, where the value of token X is USD10,000, and that of Y is USD2,000 a constant ratio of 1.5 should be maintained to produce constant liquidity in the pool at all times. Therefore, if the demand for one of the tokens in the token pair X/ Y increases, the price of the other will change to balance out the equation.
tokens and 400 Y tokens of liquidity to an AMM DEX, you will receive LP tokens proportional to the total value of your liquidity in contrast to the entire liquidity pool.

Liquidity has been a persistent problem among DEXs. While a DEX can decentralize custody of funds, most struggle to facilitate a reliable amount of liquidity supply. The AMM approach of incentivizing platform users to provide liquidity is referred to as liquidity mining.

**INSTITUTIONAL READINESS**

While DEFI is creating notable economic opportunities for borrowers and lenders in the financial ecosystem, there are still significant bottlenecks along the way, including regulatory uncertainty, compliance, transparency, the steep learning curve and the risks involved with smart contracts.

At present, many DEFI protocols exist in a regulatory grey area as they facilitate the exchange of potentially unregistered securities and movement of funds. Market participants will need to perform their own due diligence and risk analysis to determine which protocols do not violate securities or money transmission laws. Furthermore, DEFI protocols possess an additional risk in that underlying smart contracts could be insecure or don’t perform as intended during times of stress i.e., collateral volatility, and concentration risk i.e., core developers with administration rights making unauthorized or harmful changes to the underlying smart contract.

Securities Regulation is about to make its imprint on CRYPTO and DEFI/ AMMs. As such, one should make the assumption – and build infrastructure and propositions accordingly – that regulation will reign supreme and that regulatory [jurisdictional] arbitrage will diminish over time. Building towards a fully regulatory environment means among others: Know Your Client [KYC], Anti Money Laundering [AML] and Know Your Token [KYT] and Transaction Monitoring across the entire customer journey including on/ off ramp into CRYPTOland. In addition, we assume - based on the DUCK TEST ‘if it looks like a duck, swims like a duck, and quacks like a duck, then it probably is a duck’ - that over time most coins and tokens will be considered and regulated as securities and/ or a NEW FORM of regulated asset.

Furthermore, some AMM design features inherently limit institutional adoption. For example, some AMMs are subject to impermanent loss that can put liquidity providers’ capital at risk. AMMs building across different blockchains cause a lack of interoperability, which introduces silos that prevent the establishment of a single global order book normalized in a single currency.

Various protocols are set to improve on previous challenges by introducing flexible fee structures, but a lack of scalability and interoperability, especially on the Ethereum blockchain, still limit these protocols. Further, overcollateralized loans and a lack of price discovery on smart-contract-controlled liquidity pools present huge risks for institutions looking to leverage DEFI technologies.

Regardless of these challenges institutional investors will be looking to invest in platforms that feature an optimum level of capital efficiency.

**MERcenARY MONEY: THE CHASE 4 YIELD**

Investors are always on the hunt for yield or search for the ‘edge’ that provides an insight that is the source for alpha generation.

Centralized Crypto Exchanges still have the lion’s share of transactional volume in the crypto world. According to statistics, the top crypto exchanges process over USD50bn worth of transactions every 24 hours. However, these crypto giants are often criticized for their tendency to experience technical issues, especially when traffic on their sites spikes.

AMM DEXs solve several issues with CEXs while adding a lucrative incentive layer of liquidity mining thus making DEXs more attractive than CEXs. Compared to CEXs, AMMs have been showcasing impressive growth.
The fast ascension of AMMs into the crypto economy’s primetime has made them a premier venue for traders, LPs, and most token issuers. While the convenience and safety of self-custody is a useful functionality, it goes without saying that liquidity mining, also known as yield farming, is by far one of the biggest contributors to the growing popularity of AMMs.

Simply put, AMMs offer rewards to platform users who lock their funds in smart contracts that supply liquidity to the entire platform. These rewards are distributed proportionally to LPs according to their risk exposure in the liquidity pool.

This action decentralizes the source of liquidity and therefore the control of the entire exchange platform. In essence, the liquidity and overall health of DEXs are defined by the size of their liquidity pool and not the exchange’s trading activity as is the case with CEXs. The concept is similar to lending money to a bank and receiving interest at the end of the loan contract.

Overall, decentralized AMM platforms are considered more attractive by users as they give the user more control over their funds and the opportunity to earn yield.

**QUO VADIS:**
**AN ATTEMPT TO PEAK AROUND THE CORNER**

**A. AN INVESTMENT PERSPECTIVE**

Cryptocurrency hedge funds gained nearly 24% in August 2021 as large swings in digital asset prices helped them outperform investors in sleepy equities and currencies markets. The strong pace of gains means funds focused on bitcoin and other digital assets have returned 145% this year, according to data from Eurekahedge⁴. What’s NOT to like about that?

**B. HUNT 4 YIELD**

Return ought to be commensurate with Risk. Cryptocurrency investment opportunities are plentiful and cover a wide spectrum of risk/return configuration and thus satisfy the hunger for yield across a wide risk appetite spectrum.

Risk in this context needs to be understood as broader than just investment/volatility risk to include governance, structural and regulatory risk. Yield and return from AMMs’, exotic currencies and more lending and borrowing liquidity pools will vary and are subject to change over time. Accordingly, due diligence is paramount and should be considered an ongoing process rather than an upfront consideration – we believe that for the foreseeable future active management in crypto is key to yield and risk management.

**C. DIVERSIFICATION EFFECT**

Moreover, ‘The Economist’ magazine recently reminded investors about WHY it may be wise to hold Bitcoin in an investment portfolio⁵. This assertion dates back to 1952 when Harry Markowitz wrote his seminal paper⁶ about diversification based on insight that it is not necessarily an asset’s own riskiness that is important to an investor but rather its contribution to volatility of the overall portfolio which in turn is primarily a question of the correlation between all the assets within an investor’s portfolio.

Bitcoin, in particular, has demonstrated that it tends to move independently of other assets. Although, past performance does not always indicate future returns, a recent ‘The Economist’ study showed that the correlation between Bitcoin and a global stock portfolio since 2018 has been between 0.2 – 0.3, over longer periods even weaker. Therefore, a portfolio with a 1% allocation to BTC displayed better risk-reward characteristics than one without it; more generally, an optimal portfolio contained a BTC allocation of 1 - 5%⁷. Exposure to cryptocurrencies can be obtained directly via SPOT investments and indirectly through DERIVATIVES and STRUCTURED PRODUCTS such as ETNs and TRUST based structures.

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4 Financial Times, Hedge Funds Riding Crypto Wave Post Bumper Returns, September 14, 2021
5 The Economist, Why It Is Wise to Add Bitcoin to An Investment Portfolio, September 25, 2021
7 Whilst Portfolio Selection laid out how investors should approach asset choice selection and thus derive an optimal asset allocation, it does not address fundamental beliefs and considerations about the sources of return. In particular, common investment assumptions hold that returns from investing in equities reflect an exposure to a firm’s future income stream; from fixed income it is the risk free rate plus credit risk but it is less clear what derives the returns from BTC other than speculation.
D. BUSINESS MODEL INNOVATION

Finally, true business model innovation provides an opportunity beyond Faster Better Cheaper [FBC] – i.e., replicating the same underlying business on a new technology platform/paradigm – to use components to develop novel ways of doing business. For example, integrated trading and clearing models provide both DEX/ CEX with an opportunity to create more capital efficient derivative trading models that offer a more cost effective way to obtain CRYPTO exposure.

Furthermore, CEXs could serve as a front-end for users to interact with DEFI products and could confer greater convenience and provide a superior user experience. By integrating DEFI protocols, CEXs could retain market share by offering users cutting edge products and proactively shaping how users interact with them. CEXs have the resources to build integrated UI/UX and could, for example, provide automated and integrated cash, yield, clearing and netting solutions across different DEFI protocols.

Conversely, DEFI protocols could gain value by tapping into additional distribution channels and generate additional revenue for CEXs in the form of i.e., listing/trading fees, net interest margin for DEFI lending products, and staking revenue share agreements.
About the authors

**Dr Peter T. Golder** joined SIX Digital Exchange [SDX] in June 2020 and serves as its Chief Commercial Officer with a mandate to define and execute innovative and commercially viable business models to establish SDX as a leader in global institutional Digital Assets and Crypto markets.

Peter is a Board member of the Global Blockchain Business Council [GBBC] and the Ethereum Enterprise Alliance [EEA]. In addition, he serves on the InterWork Alliance [IWA] Leadership Council and is an advisor to the FinTech Council of the International Capital Markets Association [ICMA]. Peter regularly publishes on industry matters and is a frequent speaker at [Digital Asset and Crypto] industry events.

Peter is a passionate financial services entrepreneur, executive and investor with over 25 years of international capital markets and investment banking experience. Peter is an advocate of the power of data and technology to enable the creation of innovative/ disruptive business models to build a more trusted, sustainable and effective financial services ecosystem.

**Natalie Salemink** joined SDX in Zurich in early 2020 as Corporate Development Manager and has over 7 years of experience in blockchain-based capital markets across Australia, Singapore and Switzerland.

She is a PhD Candidate at Macquarie University, where she explores topics in decentralized finance and blockchain-based capital markets. Prior to this, Natalie worked for a Capital Markets Research Centre in Sydney, founded a crypto start-up and consulted various blockchain projects in Switzerland. She also educates and advises governments on cryptocurrencies and decentralised finance regulation.

About SIX and SIX Digital Exchange

SIX is a major Financial Market Infrastructure [FMI] provider that operates exchanges and Centralized Securities Depositories [CSD] in Switzerland and, via the acquisition of the BME in 2020, also in Spain. SIX runs the payments system in Switzerland and operates payment infrastructure on behalf of the Swiss National Bank. SIX also manages a financial information business focused on providing data products and services to financial institutions globally.

SIX is building new digital market infrastructure in its fully owned subsidiary SIX Digital Exchange [SDX].

SDX has obtained FINMA licenses for its Exchange and Central Securities Depository [CSD] and plans to offer issuance, listing, trading, settlement, servicing, and custody of digital assets. SDX is also a global leader in the development of Central Bank Digital Currency [CBDC] via its partnership with the Swiss National Bank and the Bank for International Settlements. SDX has partnered with SBI Digital Asset Holdings from Japan to set up a similar digital market infrastructure offering in Singapore.

**SDX Vision**

- a trusted global integrated institutional liquidity network and ecosystem
- for the issuance, trading & settlement, transfer, custody of digital assets
- in both public and private markets as well as regulated digital securities and crypto assets
- underpinned by a data collection and distribution layer advanced analytics capabilities
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