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The Digital Asset Lending Landscape

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Researched by The Block and The Block Research

The Block is an information services company founded in 2018. Its research arm, The Block Research, analyzes an array of industries including digital assets, fintech, and financial services.

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Table of Contents

Section 1: Introduction

> "*Let us lend cheerfully, for the time is pretty sure to come when we will wish to borrow*."
> James Ellis, Actor and Writer

The default of several major crypto firms such as Celsius, FTX and Three Arrows Capital (3AC) in 2022 and the ensuing turmoil in the crypto industry has shed light on an area that has been central to financing the sector's tremendous growth over the past few years: digital asset lending. In the broadest sense, digital asset lending allows for the allocation of funds from lenders to borrowers in the crypto space. This report takes stock of market structure and landscape of digital asset lending at the end of 2022. It also provides insights into the state and outlook for its regulation. Note that the focus of this report is on *explicit* lending and not *implicit* lending as provided, for example, by derivatives such as perpetual futures.

Since inception, the crypto space has always been moving rapidly. With the ongoing turmoil in 2022, the speed of change has only accelerated: contagion from recent defaults is still spreading, particularly in the lending space. For example, at the time of writing, it is not clear whether Genesis, the largest institutionally focused lending firm, will remain viable as a business. In addition, many retail-focused centralized crypto lending companies have halted customer withdrawals or entered bankruptcy. Many of these firms have been operating in a regulatory void with shadow-bank like service offerings. At the time of writing, there is very high uncertainty as to whether many centralized lending firms still operating in the crypto industry will be solvent in a year.

The report's different sections are impacted by the evolving situation to different degrees. High-level analyses of the lending market structure are less affected by the current wave of bankruptcies. However, the state of individual players in crypto lending is evolving rapidly and therefore could change meaningfully following the publication of this report. Finally, policymakers' regulatory stance, impacted by the prospect of further losses for retail customers this year, is still shaping up. While this uncertainty is taken into account when drawing conclusions and gauging possible future developments, it should be borne in mind when reading the report.

Growth in Crypto Space and VC Flows Were on a Tear

The total market cap of cryptocurrencies increased from $19bn at the beginning of 2017 to $0.9tn at the time of writing. During the first half of 2022, $18bn of venture capital was invested into crypto and blockchain projects. This number, which captures about 13% of overall VC funding, is significant because it partly includes the turmoil that took place during the captured period. As recently as 2020, crypto startups saw 'only' $6.5bn of venture capital inflows. Nevertheless, the challenging situation in crypto markets in 2022 has likely led to a slowdown in funding.

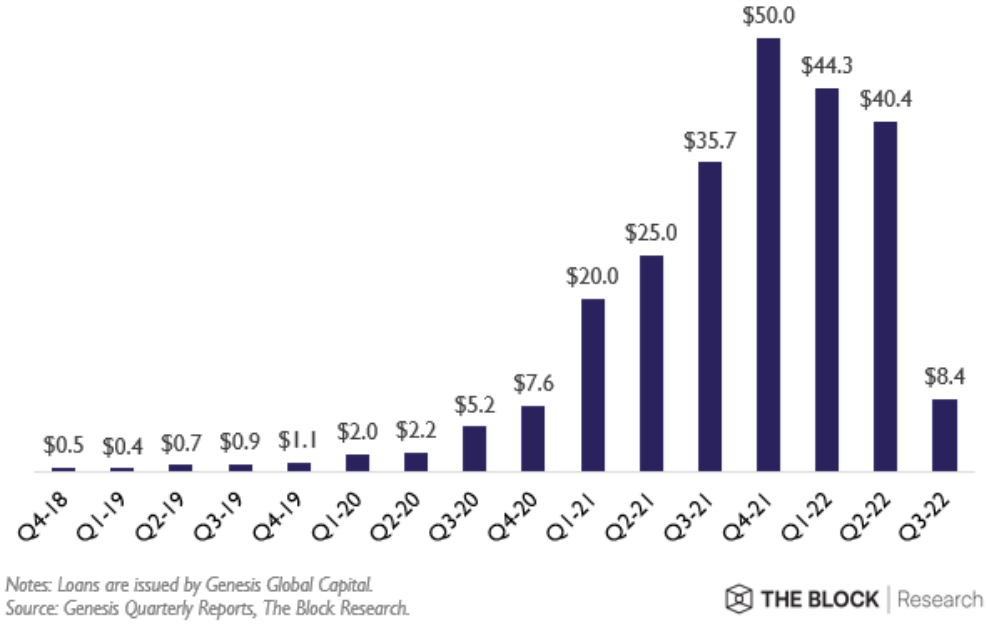
Lenders Grease the Wheels of Crypto

Similar to the traditional financial system ('Tradfi'), borrowing and lending rails are the plumbing for capital allocation in the crypto space. At the highest level, this report distinguishes between (i) centralized lenders and (ii) decentralized (on-chain) lenders. While

centralized lenders operate like a company in the traditional sense, with centralized decision making, decentralized lenders aim to operate as Decentralized Autonomous Organizations (DAOs) and provide platforms that are largely operated by code.

Because the bulk of centralized lending firms are privately owned and do not disclose their financial position, metrics that capture the size and composition of their lending book are difficult to obtain. However, some numbers that are reflective of the digital asset lending growth story are available. For example, one centralized entity that regularly provides data on its lending business is Genesis. Figure 1.1 displays the loan originations of Genesis over time. Genesis' quarterly loan origination, which it carries out via its subsidiary Genesis Global Capital, rose from $500mm in Q4 2018 to $8.4bn in Q3 2022, a 17-fold increase. As of Q3 2022, Genesis' total outstanding loans amounted to $2.8bn (as compared to Q4 2018: $123mm). Regarding on-chain protocols, one of the largest lenders is Aave. Its total amount borrowed increased from $12.41mm in May 2020 to $1.96bn at the time of writing.

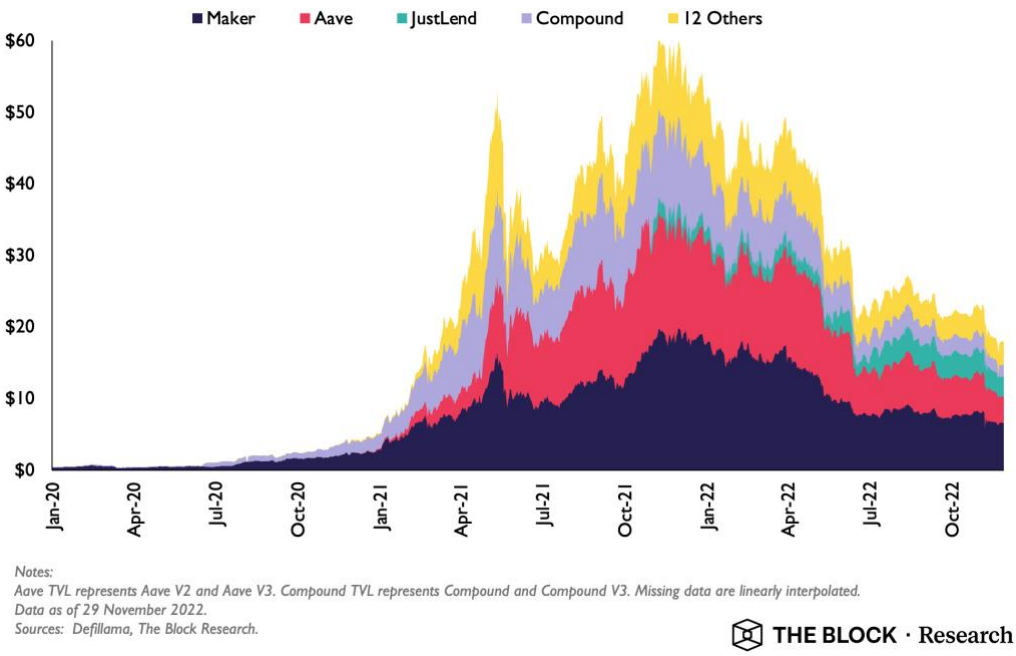
Figure 1.1: Loan Originations of Genesis (bn)



Notes: Loans are issued by Genesis Global Capital.
Source: Genesis Quarterly Reports, The Block Research.

To get an idea about growth in the aggregate decentralized lending space, Figure 1.2 displays the total value locked (TVL) in the largest on-chain lending and collateralized debt position (CDP) protocols. The '12 Others' contain Algofi Lend, B.Protocol, Benqi Lending, Euler, Geist Finance, JustStable, Kava Lend, Liquity, Morpho, Tectonic, Venus, and Vires Finance. The figure provides two insights. First, the decentralized lending space grew from almost 0 before 2020 to a $18bn ecosystem in 2022. Second, the severity of the market downturn in 2022 stands out - it resulted in a drop of TVL of 65%.

Figure 1.2: Total Value Locked in On-Chain Lending Protocols (bn)



Notes:
Aave TVL represents Aave V2 and Aave V3. Compound TVL represents Compound and Compound V3. Missing data are linearly interpolated.
Data as of 29 November 2022.
Sources: Defillama, The Block Research.

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Estimates for the size of the total digital lending market, which is defined as the aggregate revenue of all companies offering products and services in the digital lending market, are projected to grow from $10.7bn in 2021 to $20.5bn in 2026. This is an increase of about 92%, highlighting its growth potential going forward. In comparison, the global lending market is expected to grow from $7tn in 2021 to $11.3tn in 2026, an increase of 'only' 61%. It should be kept in mind that these longer-term projections were calculated before the current turmoil in crypto lending though.

Digital Asset Lending Features a Distinctive Market Structure

The digital asset lending market structure is not completely reflective of that found in Tradfi. Companies such as Genesis and on-chain protocols as Aave exist because crypto has no traditional banks that provide on-chain credit. Similar to banks, crypto lenders allocate the funds of thousands of counterparties between savers and investors. However, unlike banks, they cannot access short term funding from the FED in case they are illiquid. In that respect, they are more capital constrained. Digital asset lending companies also play an important role in facilitating investment strategies, which exist because of liquidity fragmentation in the crypto space. For example, there are several crypto exchanges with sufficient volume and liquidity to carry out sizable trades. However, given that there are no harmonized margin requirements or settlement arrangements across those exchanges, traders need to hold capital on each unless prime brokerage services provide a more capital-efficient solution.

Yield Considerations Play a Large Role for Demand and Supply of Digital Assets

Until recently, centralized platforms such as BlockFi took deposits, oftentimes from retail customers, and then lent them, usually to institutional customers, taking a spread on interest payments received in the process. However, after the implosion of several 'retail aggregators' this year, funding has become much scarcer. Due to capital inefficiencies in the crypto space, sophisticated market participants have been able to generate double digit yields with market neutral strategies. To lever up, they borrow and are willing to pay a high interest rate, which in return attracts the funds supplied.

While the market has cooled down markedly since 2021, at the time of writing, customers at Nexo (one of the largest centralized lending firms funded by retail deposits) still obtain 10% for depositing USDC. This is considerably above the yield for U.S. corporate junk bonds, which amounted to ~8.5% on November 25. By contrast, on that date the supply yield for USDC equaled 1.1% on Aave, which may indicate, that the former i) subsidizes its yield product, e.g. because retail lenders demand a higher risk premium to put their funds on centralized lending platforms, ii) rations supply, or iii) serves a different market segment. In some industries, subsidizing yields can be sustainable in a growth environment, with a strategy that aims at maximizing customer acquisition to also sell other products and services. Such a strategy has been followed, for example, by companies operating ride sharing apps. However, to be able to continue paying out high yields in a competitive market, which allows users to re-allocate their funds with a 'simple' signature of their wallet, some companies such as Celsius, undertook highly risky investment strategies with user funds themselves. Other companies, such as Voyager lent out those funds in uncollateralized fashion to third parties such as 3AC, which subsequently defaulted.

Lending Exposure Took Centre Stage During the Recent Crypto Turmoil

> "*In the past people cared about absolute yield, now they care about risk-adjusted returns.*"
> Sidney Powell, CEO and Co-founder Maple

Topical Box 1.1 provides an overview of the sequence of events that led to the default of Celsius, a crypto lender, FTX, a crypto exchange and 3AC, an investment firm that had borrowed heavily from several lenders. These companies' defaults, which took place against a difficult macroeconomic backdrop and after the meltdown of a major algorithmic stablecoin, UST, led to a turmoil across crypto markets, in which retail depositors and institutional lenders realized major losses.

Topical Box 1.1: The (Ongoing) Crypto Turmoil of 2022

The first half of 2022 proved to be difficult for every major asset class. There was a deteriorating macroeconomic outlook from a general 'Covid hangover', which was further worsened by Russia's invasion of Ukraine, and followed by Western sanctions. This was compounded by China's restrictive Covid policy, which led to supply-chain issues and increasing prices. Against this backdrop, the Federal Reserve tightened its monetary policy to rein in inflationary pressures. Since digital assets are among the most volatile 'risk-on' assets, this led to a considerable downward spiral in prices.

Four (interrelated) key developments stand out as drivers for the severity of the slump in crypto markets. First, the implosion of UST, an algorithmic stablecoin pegged to the U.S. Dollar on the Terra blockchain not only fueled the downward spiral of the market, but also led to uncertainty about which players had exposures to the Terra ecosystem. The UST fallout also included a temporary de-peg in USDT, the biggest (largely) 'fiat-backed' stablecoin, which also affected the unity exchange rate between ETH and STETH (liquid staked ETH from Lido). The devaluation of STETH caught several major players off-guard, leading to losses from supposedly market neutral highly leveraged investment strategies.

Second, multiple centralized lending and borrowing platforms were caught up in the mayhem with now defunct investment strategies and were forced to halt withdrawals of customer funds. Celsius, a notable operator in the space with $12bn in AUM as of May 2022, ultimately entered insolvency protection and is now facing federal investigations in the United States. The liquidation of hundreds of millions of dollars' worth of digital assets further depressed prices, fueled fire sale spirals and generally damaged trust, particularly of retail investors, who had been a major source of financing for the company.

Third, the default of 3AC, which had borrowed billions of dollars opaquely from multiple third-party crypto entities, created significant stress in the market regarding risk exposures across the crypto sector. This was reflective of the situation in the traditional financial system when Lehman defaulted. Not knowing which entities were still solvent, lenders started recalling funds, aggravating the liquidity situation. With no lender of last resort backstopping the downward spiral, crypto took a further leg down.

Fourth, after revelations that crypto exchange FTX and related trading firm Alameda Research may be insolvent, a run on the exchange took place forcing FTX to suspend customer withdrawals. On 11 November 2022, FTX, Alameda Research, and ~130 related entities filed for Chapter 11 bankruptcy. Since then, the vast majority of creditors have not been able to withdraw their funds, with the top 50 creditors being exposed to the tune of more than $3bn. While the overall extent of contagion from two of the largest crypto players remains unclear, some companies with considerable exposure have emerged since then. The first one is BlockFi, which previously received an up to $400mm cash injection from FTX, has halted customer withdrawals, and filed for Chapter 11 bankruptcy. The second one is Genesis, which had lent $2.36bn to 3AC and also had exposure to FTX. As a result, it stopped customer redemptions and loan originations. This had an immediate knock-on effect on Gemini (a leading U.S.-based crypto exchange), which halted customer redemptions for its 'earn product' due to its exposure to Genesis. It remains to be seen whether the contagion spreads even further.

The macro backdrop remains challenging with the Fed tightening monetary policy, ongoing bankruptcy proceedings for key crypto players and fears of further liquidation events. Short/medium-term sentiment for crypto and the lending sector in particular remain subdued. Section 4 of this report looks at how regulators addressed the fallout of Lehman Brothers and ensuing meltdown of the financial system in 2008/2009 to gauge what types of regulations may be implemented in the digital asset lending ecosystem which saw a similar turmoil in 2022.

Financial Stability and Protection of Retail Funds are Top of Mind for Regulators

Regulators around the world have been taking notice of the turmoil emanating from the crypto lending space. Crucially, similarities in the business models of crypto lenders and traditional banks mean that the former are exposed to the same risks as traditional financial institutions. This includes credit risk, liquidity risk, and interest rate risk. However, while their Tradfi counterparts are regulated and supervised for all these risks, most crypto lending firms have operated outside of the purview of regulatory agencies. This situation will likely be addressed by regulators going forward.

The remainder report is built up as follows. Section 2 provides insights into the motives for demand and supply of digital assets to lenders and sheds light on popular investment strategies in the space. Section 3 gives an overview of the current digital asset lending landscape, distinguishing between centralized and decentralized entities. Section 4 outlines the current state of crypto regulation in the U.S. and discusses potential regulatory levers for lending in the digital asset space going forward. Section 5 concludes and provides an outlook.

Section 2: Lending Market Structure

> "*That's always the way in this world. The chappies you'd like to lend money to won't let you, whereas the chappies you don't want to lend it to will do everything except actually stand you on your head and lift the specie out of your pockets.*" Sir Pelham Grenville Wodehouse, Writer

This section takes a bird's eye view of the crypto lending market structure and provides analyses along two dimensions. Firstly, it looks at the drivers of demand and supply of credit based on economic incentives and regulations. Second, it distinguishes centralized lending companies from decentralized lending protocols, shedding light on the main differences and the implications for lending and borrowing market participants.

Crypto's Markets are (Still) Capital Inefficient

The crypto space is affected by market fragmentation. This impacts demand and supply dynamics by constraining investor access and causing capital allocation inefficiencies. Despite the tremendous growth and innovative potential of the digital asset industry, regulators have not yet provided a comprehensive regulatory framework, and thereby access, for all investors. For example, in most jurisdictions, banks steer clear of the crypto space even as investment on behalf of their customers for lack of a regulatory framework. However, international regulatory bodies like the Bank for International Settlements (BIS) have started to carry out consultations about the regulatory treatment of crypto assets.

As a second best to directly investing in digital assets for lack of regulatory clarity, affected market participants may use derivatives, such as, bitcoin futures traded on the CME. Furthermore, retail investors, who may want to invest for their retirement via traditional brokerage accounts or IRAs, have only very limited access. As will become clear below, this market fragmentation causes pricing inefficiencies that can be used for leveraged arbitrage strategies.

Despite crypto's unique characteristics of near-instant global transferability/settlement, 24/7 trading and marking to market that render it (in principle) superior for collateralization, the crypto ecosystem is not as capital efficient as the traditional financial system. This is largely driven by a lack of central clearing and standardized cross-margining between large exchange venues. Centralized crypto exchanges such as Binance for spot/futures trading, or Deribit for options, are the preferred venues for sophisticated investors because of their deep liquidity. But each trading venue usually requires pre-funding. For example, a hedge fund may only need to place $10mm with its prime broker in Tradfi, allowing for simultaneous buys and sells of the same security across ten (non-crypto) exchanges (e.g. to benefit via arbitraging price differentials). However, a crypto hedge fund may have to fund all ten accounts across crypto exchanges. In the example, the crypto ecosystem is ten times less capital efficient. In addition, overcollateralization for loans is the norm due to a lack of digital identity in the wider (DeFi) crypto ecosystem.

Companies like FalconX provide prime brokerage services to help professional investors address capital scarcity, navigate market inefficiencies, and execute complex investment

strategies. Topical Box 2.1 provides additional insights into the role of prime brokers in Tradfi and provides an overview of the troubled financial position of Genesis, a major provider of prime brokerage services in the crypto space.

Topical Box 2.1: Prime Brokerage in Tradfi and Genesis on a Rocky Road

In Tradfi, prime brokers offer a variety of services to institutional investors who need deep liquidity to carry out sophisticated trades. To be able to coordinate complex, large-scale trading operations on behalf of their clients, they are usually large financial institutions themselves, like, for example, Goldman Sachs. These firms can make use of established infrastructure (DTCC, ISDA frameworks etc.), to carry out clearing, securities lending, OTC trades, and cash management.

Prime brokers can be exposed to market and credit risks when carrying out large transactions with/on behalf of their clients. However, they normally aim to mitigate such directional exposures and generate income from i) fees, ii) interest rate spreads between their lending and borrowing rates, as well as iii) re-hypothecating client funds. For example, a prime broker may hedge market exposure from an OTC trade via building up offsetting positions in the inter-dealer broker market, or credit exposure via credit default swap positions.

With regard to the crypto space, there are a number of important differences when it comes to providing prime brokerage services. Most importantly, the sophisticated Tradfi infrastructure is not available. There is no established inter-dealer broker market, and central clearing, or deposit financing are not available. Crucially, bank funding is not accessible. This leads to capital scarcity and higher funding risks for companies providing prime brokerage services. It also impacts how they can manage maturity mismatches. For example, if a lender has a longer maturity on the asset side of its balance sheet than on the liability (funding) side, it faces the risk of a run, which may turn a situation of illiquidity into insolvency. Finally, some (credit) risks stemming from client positions cannot be easily offloaded or hedged but may need to be mitigated by, for example, collateralising loan exposures.

Genesis, which is a subsidiary of Digital Currency Group (DCG) and provides prime brokerage services in the crypto space, offers five core services to its customers: i) trading, ii) institutional borrowing, iii) custody, iv) yield services, v) derivatives. Starting in 2013 as the first OTC Bitcoin trading desk, Genesis became the largest crypto lender in the space. During the height of the crypto market in Q4 2021, the firm originated $50bn of loans, an increase of 40% vs Q3 2021. Furthermore, in Q1 2022, Genesis had a record $14.6bn of active outstanding loans.

Genesis plays a central role for crypto custody, capital allocation (via intermediating between investors and savers), and yield generation. Since it was considered a very safe option for depositing funds, most sophisticated crypto players used its service offerings. Genesis' clients range from family offices and hedge funds to CeFi platforms, but also cover Circle Yield, which aggregates funds from corporations and institutional investors, or Gemini earn, which aggregates retail savings. For example, a corporate holding funds in Circle Yield receives yield on its balances which are generated by Genesis' lending business on the backend.

During this year's turmoil in the crypto space, Genesis was exposed to a number of shocks. First, it had lent $2.36bn to 3AC, which filed for Chapter 15 bankruptcy in New York. Genesis' parent, DCG, assumed part of those liabilities, when not all exposure could be recovered from the collateral. Second, it was also exposed to Babel Finance, which halted customer withdrawals after losing $280mm in proprietary trading. Third, after the implosion of FTX, Genesis needed another $140mm equity infusion, because its trading arm had $175mm locked up on FTX's exchange.

On 16 November 2022 Genesis halted redemptions of customer funds of its lending unit. This had knock-on effects to connected yield platforms such as Gemini Earn, which subsequently also halted customer withdrawals. Since then, Genesis' lending unit has struggled to raise new capital to the tune of $500mm-$1bn, and has warned that it could file for bankruptcy if it is unable to do so. Given the downswing in the crypto space, chances may be slim that Genesis' lending unit can generate income to cover its expenses and facilitate customer redemptions in the foreseeable future.

Genesis has been extremely important for pioneering prime brokerage services in the crypto space. Its distressed financial position may result in several possible outcomes for the broader institutional crypto landscape.

- First, Genesis may obtain another capital injection from its parent DCG. However, given that i) Genesis has already obtained several capital infusions in 2022, risking the health of its parent company, and ii) a likely reduced profitability during the crypto downswing, which makes justifying such an investment even harder, chances for this option seem rather dim.
- Second, the acquisition of Genesis by a major Tradfi prime broker, which may want to establish itself in the space, could be a solution. Chances for this outcome may also be rather low, since crypto's image as an investment class has been significantly tarnished with this year's ongoing turmoil and allegations of fraud. Genesis may be in such a dire financial position that it represents too large of a risk – even for the most risk-loving investors in the market.
- Third, DCG may negotiate with Genesis' creditors to accept a haircut (including its own exposures) to keep the company viable. This may be a viable outcome for the space and prevent a bankruptcy that could result in extensive litigations until creditors obtain back (part of) their funds.
- Fourth, and bleakest for the outlook of the space, would be a default of Genesis, which could lead to knock-on effects to DCG. Both companies are reportedly linked through a web of intercompany loans as revealed in a letter to shareholders by DCG. In the event of a bankruptcy of Genesis, the space would likely see new price bottoms. In addition, it would constitute a major market setback in terms of institutional infrastructure and likely increase inefficiencies and fragmentation.

For further discussions on prime brokerage services in crypto and potential ways forward for Genesis also see @ramahluwalia and the discussion in the Unchained Podcast of 6 December 2022.

Having outlined the main drivers for capital inefficiency in the crypto space, consider next the demand and supply side for digital asset lending.

2.1 Drivers for Demand and Supply of Crypto Credit

Demand for crypto lending is mainly driven by four types of borrowers: i) crypto companies, ii) retail clients, iii) blockchains with proof-of-stake as consensus mechanism that offer staking rewards, and iv) financial institutions and professional traders.

Demand for Lending From Crypto Companies

Crypto companies such as miners, whose businesses may be perceived as risky by traditional financial institutions, use crypto credit to finance their activity. For example, a company may pledge some of the bitcoin it obtains from its mining operations as collateral to obtain credit for buying additional mining equipment. Other commercial entities that demand such loans are crypto corporations or foundations. The former use credit lines to obtain working capital (e.g. an exchange), while the latter use credit for expenses such as developer compensation.

Demand for Lending From Retail Clients

Retail clients use crypto credit to make purchases, enter leveraged trading positions, or, in the decentralized space, carry out yield-farming strategies, which consist of multiple legs of lending and borrowing cryptocurrencies across potentially several protocols. For example, a person living in a jurisdiction with weak institutional quality (e.g. poor rule of law and contract enforcement) such as Argentina or Turkey may decide to hold its wealth in crypto instead of fiat to preserve the purchasing power of their funds in the face of high inflation. If that person wishes to carry out purchases, she can obtain crypto credit, with her crypto as collateral. In addition, retail clients may prefer to make purchases using crypto credit instead of selling their crypto to maintain exposure to a market with large upside potential, while not realizing taxable gains. Table 2.1 provides an overview of rates, and collateral requirements for selected CeFi and DeFi (decentralized, on-chain protocols) retail lenders at the time of writing.

The table shows the lending and borrowing rates for USDC, when providing BTC as collateral. It offers two key insights. First, CeFi rates are currently more advantageous for lenders, while borrowers get better conditions in DeFi. The rate difference is rather pronounced, possibly indicating that i) CeFi lenders serve other segments of the market than DeFi lenders, ii) customers require a much higher risk premium to hold funds on a CeFi platform, and/or, iii) CeFi lenders aim to reduce their lending exposure in the current market situation by only providing loans at rather high rates (which possibly also allow for a higher spread). Second, collateral requirements for retail appear to be lower in DeFi, which may result from smoother/automatic (smart-contract-based) liquidation mechanisms – throughout the turmoil in crypto, DeFi protocols and liquidations have been operating smoothly. Note that this second point does not generally apply to lending to institutions: before the current wave of bankruptcies, centralized lenders were willing in many cases to provide uncollateralized loans to institutional clients.

Table 2.1: Set of Retail Lending and Borrowing Rates for USDC

Lender Type	Lending Platform	Lending Rate	Borrowing Rate	LTV at Origination, WBTC as Collateral
DeFi	Aave	1.04%	2.24%	Max 72%
DeFi	Compound	1.81%	3.45%	Max 70%
CeFi	Ledn	8.00%	9.90%	50%
CeFi	Nexo	10.00%	13.90%	50%

Notes:
Rates provided by Nexo may vary with loyalty level (#Nexo tokens staked).
Source: Company/protocol websites as of 30 November 2022.

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Demand for Lending From Proof-of-Stake Blockchains

Blockchains with proof-of-stake consensus mechanisms provide rewards (in the form of new coin issuance) in return for "locking up" funds on-chain to secure their networks. Among other services, lending companies have launched crypto staking to allow their depositors to reap these rewards. For example, BlockFi engaged in crypto staking. With the merge on Ethereum successfully accomplished, an increasing share of crypto activity may be taking place on proof-of-stake blockchains, probably resulting in a growing importance of this driver for crypto credit demand going forward.

Demand for Lending From Financial Institutions and Professional Traders

Among crypto borrowers, financial institutions and professional traders, in particular hedge funds, family offices, and proprietary trading companies, make up the largest fraction of demand for crypto lending. For example, at a high level, digital asset manager CoinShares' investment strategies consist of three main fields of activity at varying proportions: i) market making, ii) statistical arbitrage, and iii) fixed income, with digital asset lending and borrowing falling into the latter bucket. Depending on market conditions and the firm's investment strategy, a large proportion of its book may be allocated to borrowing and lending with digital asset lending companies.

Most professional investment approaches can be broadly divided into i) market making, ii) directional investment strategies and iii) market neutral strategies.

- **Market makers** simultaneously quote bids and asks for a crypto asset, thereby increasing liquidity on exchanges. The spread between bids and asks offered makes sure that the market maker remains profitable under different market situations. Ideally, a market maker can immediately sell an asset that has been bought, to not build up too large of an inventory. To do so, he needs to hold an optimal inventory of the traded pair, which may change, depending on the market situation. Crypto credit provides market makers with flexible on-demand funds to react to market developments.

- **Directional investment strategies** are speculative bets and consist of going net long or short crypto assets, usually using leverage to magnify the risk-return profile. For example, one of the underlying reasons for 3AC's default on its liabilities, seems to be that the fund took large directional bets, which turned against it.

- **Market neutral strategies** aim at profiting from market inefficiencies, while neither being net long or short. Three market neutral strategies have been extremely popular in crypto and span: i) the basis trade (or 'cash-and-carry'), ii) cross-exchange arbitrage, and iii) the Grayscale trade. These three market-neutral strategies are discussed below.

First, the *basis trade* consists of simultaneously entering a spot position and a futures position with the same underlying and exposure amount, with one leg of the trade being long and the other leg being short. The aim of the strategy is to profit from the disappearance of a perceived mispricing between the two positions while the futures positions mature. For example, differences in prices between both legs can be driven by limited investment access for certain participants, such as institutional investors, to spot BTC markets. This in turn may be due to a preference (or regulatory requirement) to operate on more regulated BTC futures markets. That setup can lead to a divergence of the future's current price relative to the spot price, which however fully disappears until maturity. Hence, if both legs are held to maturity, the locked-in premium is obtained as arbitrage profit. The mispricing can be very persistent and extremely profitable during strongly trending markets.

Second, *cross-exchange arbitrage* aims at profiting from pricing differences for the same asset across exchanges. For example, a trader may buy bitcoin on an exchange, where it is listed with a price that is lower than on another exchange, where she simultaneously sells the asset, increasing the overall portfolio's net asset value. Pricing differences for a homogenous asset can emerge due to market fragmentation that is tied to an asset's liquidity – lower liquidity across different exchange venues usually results in more market fragmentation. Case Study 2.1 provides a stark example for potential reasons underlying cross-exchange pricing differences and how traders have profited from them over time.

Case Study 2.1: The Kimchi Premium

The name 'Kimchi Premium' refers to a traditional Korean cabbage dish and was coined after observing that the price of bitcoin can deviate over extended periods of time between South Korean exchanges and the vast majority of other exchanges.

Normally, one would expect a premium across different exchanges for a fungible asset to disappear, because it offers an arbitrage opportunity: buying bitcoin on Western exchanges and selling it at a Korean exchange for a relatively higher price. However, capital controls and the fact that Korean exchanges' most liquid pairs involve the Korean Won (unlike other exchanges, that usually trade against some USD-pegged stablecoin) make it difficult to efficiently implement arbitrage strategies. In addition, Korean investors can only wire up to $50,000 per year abroad, and implementing an arbitrage strategy features an additional leg due to the difference in the traded pair (one leg in USD, the other in KRW).

These strategies are complicated by the fact that bitcoin transactions, such as wiring bitcoin from one exchange to another, take time – while the average confirmation time for a

transaction on the bitcoin network is 10 minutes, exchanges usually require a number of additional block confirmations to minimize the risk that the transaction may not be final.

These inefficiencies led to a fragmentation of the bitcoin market and hence the price, in particular during times when Korean market participants were very bullish on cryptocurrencies. The Kimchi Premium appeared around 2016 and reached almost 55% in January 2018. Between 2016 and 2020, bitcoin prices in Korea exceeded those in the U.S. by 2.27% on average. At the time of writing, the price of a bitcoin in Korea is 3.9% above that abroad.*

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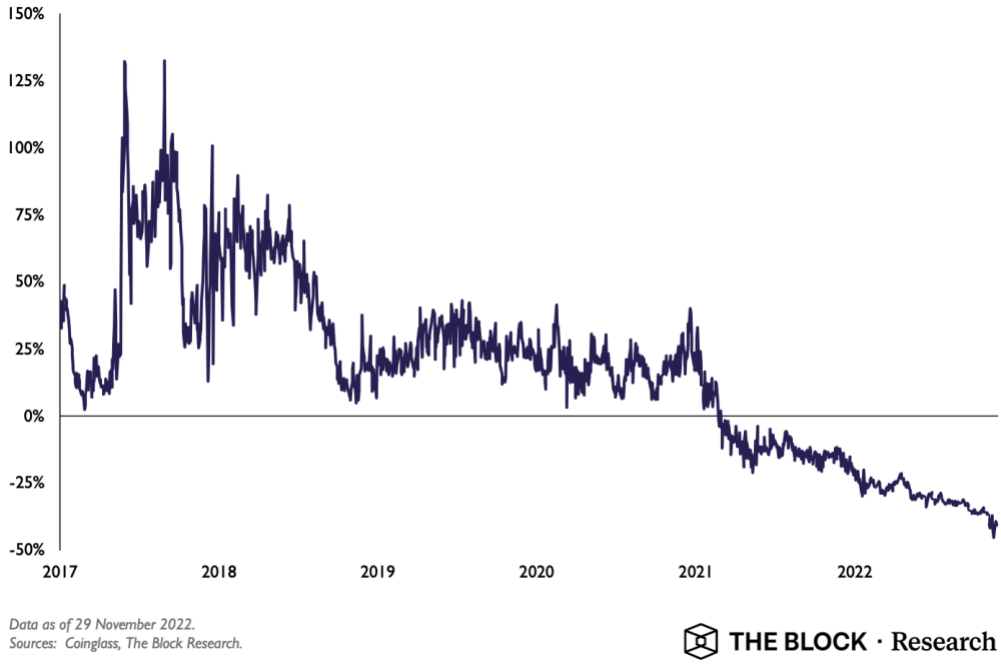
* Price difference for BTC closing price in USD between Upbit Exchange and Binance.

Third, the *Grayscale trade* consists of trying to arbitrage a market inefficiency, which has emerged over time in the pricing of the Grayscale Bitcoin Trust (GBTC). Grayscale Investments, a subsidiary of DCG, is the largest digital currency asset manager, and GBTC is its most popular product with $10.27bn AUM on 29 November 2022. Investing in the fund is popular for investors, who want to invest in bitcoin without using a crypto exchange or their own digital wallet. Furthermore, institutional investors, who may not be allowed to directly invest into bitcoin may use GBTC instead. It can be bought on traditional brokerage platforms and is therefore easily accessible.

The Grayscale trade, which is described in the following, also exists for other Grayscale Trust products, for example Ethereum. However, GBTC has been the largest and most popular fund for the trade. The inefficiency stems from the fact that accredited investors can obtain in-kind units of GBTC at the net asset value in exchange for bitcoins. After a waiting period of 6 months these GBTC units can then be sold in the open market at secondary market prices. Notably, the fund does not offer redemptions which has resulted in significant divergences between shares' net asset value and secondary market prices. Therefore, the fund has traded for a long time of its history at a premium to the underlying NAV. Figure 2.1 displays the GBTC's premium (discount) to NAV.

To profit from this premium, hedge funds can borrow bitcoin and deposit them with the Grayscale Trust to obtain in-kind units of GBTC at the NAV. After 6 months, the hedge fund can sell the units in the open market to capture the premium. The trade is not a risk-free arbitrage, since the premium may disappear before the holding period of 6 months is over. That is indeed what happened after the trade became popular, resulting in a large number of subscriptions, and hence new shares which were being sold on the secondary market. Accordingly, the premium turned to a discount in February 2021 which at the time of writing stands at ~40%. Due to the distressed financial position of Genesis (i.e., halting withdrawals), and its relation to DCG, many investors have (rightfully or wrongfully) sought to reduce their exposure to GBTC, thereby increasing the discount. To stem these fears, Grayscale published a blog post outlining why the underlying asset of its trust products (e.g., the BTC held in GBTC), is safe, secure, and will remain segregated from the other assets of DCG.

Figure 2.1: Daily GBTC Premium/Discount to NAV



Supply of Crypto Assets to Lending Entities

The outlined drivers for crypto credit demand have proven to be strong pull factors, resulting at times in double-digit interest rates offered by crypto lending companies to scoop up funds. Incentivized by high demand-driven yields, supply is mainly coming from investors and companies with (temporary) idle funds, or professional investors, such as hedge funds. A key impediment, which holds supply constrained, in particular during exuberant markets, is a missing regulatory framework, keeping large institutional investors at bay.

While difficult to quantify, the 2022 turmoil in the crypto space has very likely reduced supply of funds. First, major retail-focused players halted customer redemptions or entered bankruptcy, rendering aggregation of retail funds less efficient. Second, the bankruptcies have inflicted losses on retail. Customer confidence and trust in centralized lending companies has been (rightfully) eroded - for the time being, they are hesitant to entrust their funds to these companies and many have opted for self-custody instead. Whether this will prove to be permanent, remains to be seen.

The next sub-section sheds light on the key differences between lending companies in the digital asset lending space by distinguishing between centralized and decentralized lending.

2.2 Differences Between Centralized and Decentralized Lending

Lending companies can be subdivided into those, which operate in the DeFi space, and those which operate in centralized fashion (CeFi). The mode of operation (CeFi vs DeFi) has important implications as to how these companies/protocols are run. They can be compared across the eight dimensions: i) interest rate and maturity, ii) custody, iii) transparency, iv) user experience, v) regulation, vi) customer base, vii) collateralization, and viii) privacy.

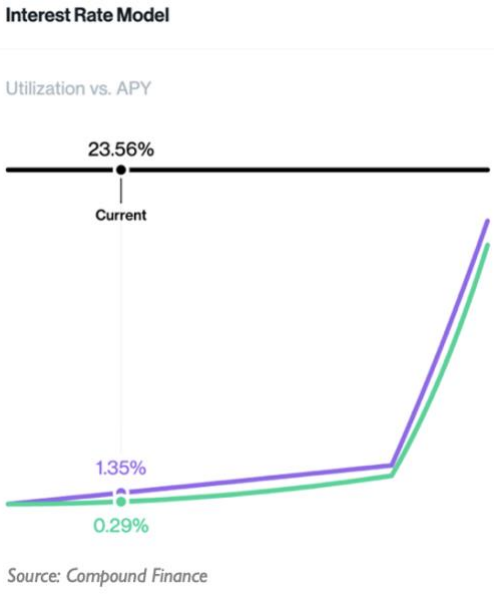
Interest Rate and Maturity

A lender's interest rate may be fixed or floating and feature immediate or longer maturity. Furthermore, these features may differ between the lender's borrowing and lending rates. Lenders, which allow for maturities to differ between the asset and liability side are exposed to a maturity mismatch, which can result in illiquidity and balance sheet losses under adverse market conditions. The importance of proper balance sheet risk management came to the fore when Celsius halted withdrawals because of illiquidity. In the traditional financial system, regulation has been effective in mitigating the bulk of this risk. For example, the Basel Committee on Banking Supervision requires monitoring interest rate risk in the banking book. This risk, if deemed excessive for a bank, may lead to supervisory action in the form of capital surcharges. Since large parts of the crypto lending space are so far not under regulatory purview, customers providing funds need to carefully study the fine print of a company's risk management, in particular the lenders' policy on maturity mismatch and liquidity. Section 4 of this report provides more details on the state of regulation for digital asset lending.

Lending rates offered are managed differently on CeFi and DeFi platforms. While CeFi platforms such as BlockFi usually offer stable rates, which are manually adjusted from time to time, most DeFi lending protocols (in terms of TVL), feature floating rates for lenders and borrowers. These are algorithmically tied to each other and allow for immediate payback of a loan or funds provided. Topical Box 2.2 provides further details about algorithmic interest rate setting in DeFi lending protocols.

Topical Box 2.2: Algorithmic Interest Rate Setting in DeFi Lending Protocols

Lending protocols allow permissionless lending and borrowing of self-custodied digital assets 24/7 on-chain. Since liquidity on-chain can be limited, and transactions can be expensive (e.g. to adjust amounts lent and borrowed), lending protocols use a liquidity pool from which customers can borrow: there is no direct interaction between a lender and a borrower, but each transaction takes place between a market participant and a liquidity pool. This allows lending protocols to operate without a central intermediary and use smart contracts on a distributed ledger instead. For this reason, the blockchain (or layer) the lender operates on is an important consideration and impacts the user experience regarding transaction cost and security.



Most permissionless lending protocols follow a pooling approach, where lending counterparties can deposit funds into designated pools (for example USDC), which can be tapped by borrowers. The (floating) interest rate depends on the pool's utilization rate, which is the fraction of 'funds lent' to 'funds deposited'. The higher the utilization rate, the higher the interest rate charged.

Consider, for example, Compound (V2) Finance's interest rate schedule for its USDC pool, as depicted above. At a utilization of 23.56%, the lending rate is 0.29% and the borrowing rate is 1.35%. At 100% utilization rate, these increase to 31.27% and 34.2%, respectively. Note that the spread is introduced to cover loss-risk and provide protocol income. Some protocols, such as Aave, may also charge an origination fee. All borrowers must overcollateralize their loans. For example, the maximum loan to value ratio for WBTC as collateral is 70% on Compound. In the event that a loan becomes undercollateralized (as indicated by oracle price feeds), the collateral is liquidated.

Some protocols allow for fixed-rate borrowing, but the TVL for fixed-rate loans is still rather negligible in DeFi. For example, Aave allows borrowing at a fixed rate, which may be changed at the protocol's discretion. However, the interest rate is usually prohibitively high when compared to the floating rate: While the variable interest rate for USDT on Aave is 3.21%, the fixed rate is 12.28% (both on 30 November 2022). Other notable exceptions are Centrifuge, Element Finance and Maple which all offer fixed rate options for their users. Finally, for the Maker protocol, the borrowing fee for the Dai ('stability fee') depends on the collateralization provided and can be adjusted by the protocol.

Even though the bulk of DeFi lending is carried out with immediate maturity, it does not result in eliminating illiquidity risk for protocol users. In a scenario, where the utilization rate of a pool is 100% (all funds are borrowed), lending participants cannot withdraw their funds until the utilization rate decreases. Note that such a situation should not exist for long however since the interest rate becomes prohibitively high in such a scenario. For example, at a utilization rate of 100%, the algorithmically determined borrowing rate for USDT e.g. on Aave is 64%.

Centralized lenders adjust rates at their own discretion, but usually keep them unchanged unless the market situation changes. Borrowing rates may depend on collateralization and term, while the lending rates are influenced by the term and amount provided. Most lenders (those remaining after the ongoing wave of bankruptcies) offer relatively generous yields for small amounts of funds provided. Also, increasing the term for which funds are provided usually results in more favorable interest rates.

Some CeFi lenders carry out a maturity transformation: usually the maturity on their liability side is below the maturity on their asset side. This exposes them to interest rate and illiquidity risk. For example, recently defaulted BlockFi held 10% of borrowed amounts in inventory, and aimed to hold at least 50% in inventory or in loans that can be called within 7 days, and at least 90% in inventory or in loans that can be called back within a year.

Custody

One key dividing line between CeFi and DeFi is custodianship. While CeFi platforms normally take custody of user funds, or hold them in custody of another service provider, DeFi protocols allow for self-custody, which means that users remain in control of their funds. For example, centralized lenders can and have frozen withdrawals of customer deposits in 2022. On the other hand, decentralized lending protocols such as Compound generally allow customers to withdraw funds under most market situations. Exceptional market situations,

such as 100% utilization rate of a pool, should be extremely rare and only of temporary nature. On-chain self-custody offers several advantages, including i) 24/7 world-wide accessibility to credit with near-instant settlement, ii) verification that the set of (smart contract) rules is followed, iii) financial infrastructure, which is interoperable 'out-of-the-box' and can be re-combined/composed with other DeFi protocols, and iv) transparency.

Transparency

The importance of transparency came to the fore with the contagious events after the implosion of the Terra network. The default of 3AC, Celsius and FTX triggered firesales and pushed other lenders into bankruptcy. As it remained unclear for some time who else may be exposed, companies became more reluctant to lend. For example, because of the turmoil in crypto, Wintermute's balance sheet shrank by 50% due to a reduction in liquidity provision from lenders. The crisis was mostly driven by CeFi entities, with DeFi protocols remaining largely unscathed apart from a strong drop in TVL. Most DeFi protocols are very transparent about lending and borrowing due to their public blockchain nature. A protocol's solvency can be checked in real time, which is a clear advantage over CeFi lenders, even if the latter is a regularly audited entity.

User Experience

One of the main reasons why centralized entities in crypto have a much higher number of users is their superior user experience when compared to DeFi. Centralized entities usually provide market participants with easy access to their product, feature deep liquidity, and have excellent customer service. In contrast, interacting with DeFi protocols requires significant technical expertise when it comes to deploying funds with wallet software and analyzing protocol risk. For example, users are still required to manually adjust their wallets' chain IDs to deploy their funds on different blockchains.

Regulation

Another area, where most CeFi lenders are ahead of DeFi protocols is regulation, or (pro-active) implementation of KYC and AML rules. While crypto regulation is generally an area under development, most CeFi lenders operate with at least some licenses. By contrast, most DeFi lending protocols are not yet in scope of regulation and KYC/AML implementation due to their decentralized nature. Notable exceptions are Compound Treasury and Centrifuge, which implement KYC and AML measures. Both companies issue lending products under the SEC's Reg D exemption, making them more attractive for institutional customers required to operate within existing regulatory frameworks. Overall, the difference in regulatory coverage allows centralized lenders to tap the potentially much larger capital demand/supply from institutional investors as a customer basis and thereby operate on a much larger scale.

Collateralization

While CeFi lenders can provide loans without collateral (or in under-collateralized fashion), making their service more capital efficient, the largely pseudo-anonymous nature of on-chain users requires DeFi lenders to mostly provide over-collateralized loans. Notable exceptions exist, such as, for example, Maple, which provides loans to KYC'd institutional customers. The flipside of less capital-efficiency from over-collateralization is less risk under adverse market conditions. This turned out to be crucial to keep DeFi protocols largely solvent and liquid during this year's turmoil in crypto.

Privacy

Privacy considerations are the flipside of transparency and may differ between CeFi and DeFi. While both lender types are using public blockchain rails, the latter with self-custody, publicly visible individual transactions on a protocol may reveal more information. For example, once customer funds enter a CeFi lender's wallet, transactions become difficult to trace because funds are mixed with a large number of clients. The lender has an internal ledger to keep track of individual funds and related transactions. In contrast, a customer's specific wallet address on-chain usually allows for tracing all interactions that are carried out with a protocol. An exception to this are privacy solutions as provided by, for example, zk.money.

Summing up, the crypto lending space is hampered by inefficiencies driven by a lack of standards, central clearing, KYC, and a proper regulatory framework, leading to market and liquidity fragmentation. This provides the setup for several arbitrage strategies that can drive high yields and high capital demand for digital asset lending. The digital asset lending space can be subdivided into centralized lenders and decentralized lending protocols. While the former had a head start in terms of loan origination, not least because they help channel liquidity from/to institutional investors, the latter are catching up.

The next chapter provides more details on the digital asset lending landscape.

Section 3: The Digital Asset Lending Landscape

> "*To lend money without interest, is certainly an action laudable and extremely good; but it is obvious, that it is only a counsel of religion, and not a civil law.*" Charles Louis de Secondat, Baron de La Brède et de Montesquieu, Political Philosopher

This section sheds light on key players in the digital asset lending space by distinguishing between decentralized and centralized entities. Some of the centralized entities, for example, FalconX, have an exclusive focus on institutional clients, while others, for example, Nexo, directly provide services for both, retail and institutional investors. Centralized lenders are therefore further broken down into those that i) mainly focus on institutional clients, and ii) those that source (part of) their funds from retail clients.

The recent crypto crash driven by the default of 3AC and Chapter 11 bankruptcy filings of major players such as Celsius, FTX and Voyager, as well as the regulatory and market reactions towards these developments impacts the landscape and how players position themselves therein. However, it is not yet clear what the final outcomes will be when the dust has settled. Therefore, the landscape overview provided in this section takes a snapshot of the current state, including players that have entered Chapter 11 proceedings (and may yet return) and those that recently defaulted and will likely be liquidated. Figure 3.1 provides an overview of key entities selected for this section.

> "*CeFi has advantages regarding client service, a better UI, and more regulation. With CeFi you can offer more tailored products, including mortgages. However, highly liquid and fungible products, such as overcollateralized loans may be better served by DeFi, in situations where clients understand security considerations and do not require a level of support.*" Adam Reeds, Co-Founder and CEO of Ledn

Figure 3.1: The Digital Asset Lending Landscape

3.1 Centralized Digital Asset Lenders

This subsection provides information on centralized digital asset lenders. It gives key company information and more detailed descriptions with a focus on lending and other business activities. Broad license information is included since it provides a signal to market participants about the extent to which the company is regulated, including for non-lending

related activities. In addition, information as to whether the company was directly affected by this year's market rout is included.

Centralized Lending Entities Directly Sourcing from Retail Customers

Table 3.1 provides key information on centralized digital asset lenders, which source (part of) their funds directly from retail clients. These funds are then used, depending on the lender's business model, to directly invest, or lend out to retail or institutional clients. Most of the companies are U.S.-based (30%), followed by Singapore (28%) and the UK (17%). Among those, in terms of funding and employee count, the larger players tend to be based in the U.S., except for Amber Group and Crypto.com, which are Singapore-based.

Table 3.1: Centralized Lending Entities Directly Sourcing Funds from Retail Customers

Lender	Established	Location	Number of Employees	Total Funding ($mm)	Status
Amber Group	2017	Singapore	251-500	628	
Bitcoin Suisse	2013	Switzerland	101-250	48	
BlockFi	2017	U.S.	501 - 1000	1400	Bankruptcy
Celsius	2017	U.S.	251-500	904	Bankruptcy
Crypto.com	2016	Singapore	1001-5000	-	
Gemini	2014	U.S.	501 - 1000	424	Halted Withdrawals (Gemini Earn)
Helio	2017	Australia	11-50	-	
Hodlnaut	2019	Singapore	11-50	0.1	Bankruptcy
Ledn	2018	Canada	101-250	104	
Lendingblock	2017	UK	11 - 50	10	
Matrixport	2019	Singapore	101 - 250	100	
MyConstant	2018	U.S.	51-100	-	Halted Withdrawals
Nebeus	2014	UK	1-10	6	
Nexo	2017	UK	251-500	53	
Tesseract	2017	Finland	11 - 50	25	
Unchained Capital	2017	U.S.	11-50	42	
Vauld	2018	Singapore	51-100	27	Halted Withdrawals
Voyager	2017	U.S.	101 - 250	360	Bankruptcy

Notes:
Figures as of 15 December 2022.
Sources: Crunchbase, company websites, The Block Research.

THE BLOCK · Research

Amber Group was founded in 2017 and is based in Singapore. It is a crypto-financial services firm, which offers products to access liquidity, earn yields, and carry out risk

management. Clients can deposit tokens for fixed and floating rates at different maturities. Furthermore, Amber provides crypto-collateralized loans. The company holds multiple licenses across jurisdictions, including a money lenders license in Hong Kong. It is also registered as a Money Services Business in Canada with FINTRAC as well as with FinCEN in the U.S. During the 2022 crypto market turmoil, Amber Group claimed to have no exposure to Alameda Research and, having less than 10% of its trading funds stuck on FTX, denied insolvency allegations.

Bitcoin Suisse was set up in 2013 in Switzerland as a crypto financial services provider. Besides crypto loans, the company offers customers products for buying, trading and staking cryptocurrencies. Customers can borrow from CHF100,000 to CHF50mm or equivalent if sufficient crypto collateral is provided. Interest rates depend on an assessment of the collateral, size of the loan and term. Bitcoin Suisse also lets users obtain credit from Liquity (see DeFi lenders below) at 0% interest. It is a member of the Swiss self-regulatory organization "Financial Services Standards Association". Bitcoin Suisse had applied for a Swiss banking license, however, withdrew its application because it failed to meet some requirements of the Swiss financial regulator.

BlockFi was founded in 2017 in the U.S. and is a crypto financial services company, which offers crypto loan and institutional services, a crypto credit card, interest accounts, trading, and a wallet. Regarding its lending business, customers can borrow against collateral provided, or deposit funds in an interest account. Since February 2022 these interest accounts are no longer available to new U.S. clients. However, as of November 2022 accredited U.S. investors can access them again. The company also lends out deposited funds via its BlockFi prime product, which provides lending and trading for institutional clients. Finally, BlockFi gives equipment-backed loans for miners and provides companies with working capital. The company holds numerous state-issued licenses for its lending business across the U.S., including Loan, Money Transmitter and Money Broker Licenses. BlockFi paused many of its platform activities, including customer redemptions, because of its significant exposure to FTX and Alameda Research. On 28 November 2022, BlockFi filed for bankruptcy protection. Please refer to Section 4 of this report for more information regarding regulatory activity related to BlockFi.

Celsius, which was founded in 2017 and is based in the U.S., was one of the major "yield as a service" providers for retail depositors through lending and DeFi yield strategies. However, it has filed for Chapter 11 bankruptcy protection due to its deficient risk management practices and is currently facing allegations of fraud. Celsius holds a finance lender license in California. It also holds various state Money Services Businesses or Money Transmitter licenses, which however seem not to cover its earn product. Vermont's Department of Financial Regulation has claimed that Celsius lacks appropriate licenses "and until recently was operating largely without regulatory oversight". Please refer to Section 4 of this report for more information regarding regulatory activity related to Celsius.

Crypto.com was founded in 2016 and is based in Singapore. The company provides its users instant loans with 30+ crypto assets accepted as collateral. In addition to this lending business, the company has several other lines of business. It covers payments via offering a visa card, offers exchange services, and operates an NFT platform. It also provides infrastructure

services via the Cronos and Crypto.org blockchains, which are both based on Cosmos SDK. Crypto.com has several licenses and registrations in its key markets, including an Australian Credit License, a Malta Virtual Financial Assets License (required to provide digital asset exchange and custodial services while fulfilling KYC and AML requirements), and a European Electronic Money Institution License. It is an Exempted Digital Payments Token Entity in Singapore, where it is headquartered. It also holds Money Transmitter Licenses in the U.S. and a Money Services Business registration with FINTRAC in Canada.

Gemini was founded in 2014 in the U.S. and is a crypto exchange and custodian. The company's three main product lines are 'Gemini exchange' which lets users buy, sell and store bitcoin, 'ActiveTrader', which provides customers with more advanced trading tools, and 'Gemini Earn'. The latter allows users to earn interest on their cryptocurrency deposits. Gemini has been partnering with Genesis' institutional lending service to help connect accredited cryptocurrency borrowers with its depositors. Gemini Trust Company, LLC is a New York trust company and maintains a Money Transmitter License or equivalent in jurisdictions where it offers its products. 'Gemini Earn' stopped customer redemptions after Genesis paused withdrawals due to the market turmoil in the crypto space. As of 4 December 2022, Genesis owed Gemini $900mm related to its lending activities.

Helio Lending was founded in 2017 in Australia and provides clients, who deposit cryptocurrency as collateral, with a platform to borrow fiat. Its parent company is Cyios Corp, which offers financial and loan origination services. There are no margin calls on loans offered by Helio. However the company secures its loans via writing put and call options on the collateral provided. Depending on price fluctuations in the collateral, at the end of the loan the borrower may not receive back the collateral in full. On 8 April 2022 the lender was charged by the Australian Securities and Investments Commission for false Australian credit license claims.

Hodlnaut was founded in 2019 in Singapore as a crypto lender, which lets users deposit their crypto holdings and earn interest on them. Its fixed term deposit product allows users to choose a deposit term between 28 to 360 days on stablecoins and crypto tokens. After halting withdrawals, it has filed for bankruptcy protection in Singapore in August 2022. The company held $13mm on FTX before withdrawals from the exchange were frozen in November 2022. Previously, the Monetary Authority of Singapore had granted the company an "in principle" approval for a license under Singapore's Payment Services Act.

Ledn was founded in 2018 in Canada and has a large presence as a crypto lender in Latin America. It has three main lending products. First, customers can deposit USDC or BTC to save and receive yield. These funds are then lent out to institutions or retail borrowers. Second, customers can deposit BTC to borrow USDC for up to 12 months. The product also offers the possibility to deposit BTC to leverage up 2 times. Third, customers can deposit BTC to get a mortgage, which is also included in the collateral, thereby exposing the loan to less volatility from the cryptocurrency and reducing the risk of a margin call. The company is incorporated in Canada, but not regulated as a bank or other depositary institution.

Lendingblock was set up in 2017 in the UK and is a lending platform for cryptocurrencies and digital assets. The company's services enable retail users to borrow against crypto

collateral, or to deposit crypto on a savings account to earn interest. Similarly, it offers lending and borrowing services to institutional customers. Lendingblock operates under a Gibraltar DLT license.

Matrixport was founded in 2019 and is headquartered in Singapore. It is a cryptocurrency financial services company that operates six different business verticals: Prime Services, Defi, Custody, VC, Asset Management and Trading. Regarding its lending activity, customers can deposit crypto into the company's 'earn' product to receive an interest rate. The company also makes available collateralized loans via its 'loan' product. Matrixport's platform is operated via Matrixport Technologies Ltd., a British Virgin Island company. Its custodial services are carried out by Cactus Custody, which is a Hong Kong Trust Company and part of the Matrixport group. Matrixport's fixed income offering was affected by FTX' collapse, however, it has remained solvent despite the crypto fallout.

MyConstant is a p2p lending platform set up in 2018 in the U.S. Among other products offered, which include crypto swaps and staking, it facilitates lending and borrowing backed by cryptocurrency. Similar to Celsius, customers can deposit fiat or cryptocurrency, which is subsequently lent/invested by the platform. The company is not regulated as a financial institution. MyConstant halted withdrawals in November 2022 due to 'deteriorating market conditions'.

Nebeus was founded in 2014 and is based in the UK. It offers loans for up to 36 months with the interest rate depending on collateralization. In addition, Nebeus offers a wallet, crypto trading and staking. Users can also 'rent out' their crypto to the platform. Nebeus is licensed as a virtual financial asset provider in Spain and as an Electronic Money Institution in Ireland.

Nexo was founded in 2017 and is based in the UK. It provides its retail customers with loans that are collateralized with crypto. The interest rate on the (open-ended) loans depends on the share of the company's token in the overall portfolio in the customer's wallet. Like many of its competitors, it also offers interest bearing crypto accounts. While its main business has been geared towards retail, Nexo also started to serve institutional clients via prime brokerage type services that allow institutional customers to trade, borrow, lend, and store digital assets. Among others, the company holds numerous Money Transmitter and Lending licenses in U.S. states, as well as licenses from Canada, Hong Kong, and the Seychelles. On 26 September 2022 eight U.S. state regulators announced an array of legal actions against Nexo and issued cease and desist orders over its crypto interest-bearing accounts. In December 2022, the company announced it would be phasing out services in the U.S. due to a "regulatory dead end".

Tesseract was set up in 2017 in Finland and operates as a digital asset financial services and investment management company. While its focus is on institutional brokerage and asset management, the company serves investors, retail trading platforms, custodians, and capital borrowers globally. The company operates with a Virtual Asset Service Provider license in the European Union and is supervised by the Finnish Financial Supervisory authority.

Unchained Capital is a Bitcoin financial services company founded in the U.S. in 2017. The company's Bitcoin-collateralized loans are provided for terms ranging from 6 to 36 months. In addition to providing Bitcoin backed loans, Unchained Capital also provides custody services and allows acquiring Bitcoin via a trading desk. The company holds Money Services and Money Transmitter licenses in several U.S. states.

Vauld is a crypto lender, which was founded 2018 in Singapore. Customers can deposit crypto tokens at fixed or flexible rates to earn a yield. They can also take out loans that are collateralized with cryptocurrency. After halting withdrawals, the company applied to the Singapore High Court for a moratorium on 8 July 2022. Prior to halting withdrawals, it had applied for a license at the Monetary Authority of Singapore under the Payment Services Act. It has signed a term sheet with lending company Nexo for a potential acquisition.

Voyager, founded in 2017 in the U.S., is a crypto asset broker, which provides institutional and retail clients with three main lines of business. 'Trading services' match customers with counterparties across 12+ exchanges and liquidity providers. 'Custody services' include an interest account, which provides customers with interest on deposited tokens, staking, and a debit card. 'Lending services' allow Voyager to provide loans from digital assets that are deposited on the platform to third parties. After suffering from liquidity constraints and continued cascading liquidations triggered during the Luna/UST collapse in May 2022, Voyager filed for Chapter 11 bankruptcy protection in July 2022 and subsequently delisted from the Toronto Stock Exchange. Voyager holds Money Transmitter licenses in numerous U.S. states. FTX had initially been on track to acquire Voyager's assets, however, after FTX's bankruptcy, Voyager reopened the bidding process.

For the sake of completeness, leading cryptocurrency exchanges also offer lending products even though this is not a key area of their business. A more detailed analysis of centralized entities' related yield, staking and lending services is provided in "The Block Research: "Exploring DeFi Yields Services by Centralized Entities". For example, **Binance** allows staking with its "Binance Earn" products, as well as lending, and depositing tokens into several DeFi services. The product lines generate income for Binance by taking a cut of users' returns. Savings can be at fixed or flexible terms. The interest rate is generated by using deposits for leveraged borrowing and 'other business' by Binance (or its users, which may be institutional entities). Similarly, **Coinbase** offers its customers the ability to borrow against Bitcoin as collateral, and **Kucoin** provides both collateralized borrowing and lending services. Note that smaller exchanges, such as for example Singapore-based **Zipmex,** also offer their customers the ability to deposit their cryptocurrency to generate yield. After halting client withdrawals, Zipmex filed for protection against creditors in Singapore in July 2022.

Centralized Entities with Lending Business Focused on Institutions

Table 3.2 provides key information on centralized digital asset lenders, which have a focus on institutions for their lending business. The bulk of institutional-focused lending companies are based in the three jurisdictions Hong Kong, UK, and U.S., with the latter leading by total funding.

Table 3.2: Institutional-Focused Centralized Entities

Lender	Established	Location	Number of Employees	Total Funding ($mm)	Status
Anchorage Digital	2017	U.S.	251-500	487	
B2C2	2015	UK	11-50	37	
Babel Finance	2018	Hong Kong	101 - 250	120	Halted Withdrawals, Restructuring
BitGo	2013	U.S.	101 - 250	70	
Blockchain.com	2011	UK	501 - 1000	490	
Enigma	2017	UK	1-10		
FalconX	2018	U.S.	101-250	477	
Galaxy Digital	2018	U.S.	251 - 500	523	
Genesis	2013	U.S.	251-500	not disclosed	Halted Withdrawals (Genesis Global Capital)
NYDIG	2017	U.S.	251 - 500	1400	
OSL	2018	Hong Kong	1-10	not disclosed	
Sygnum	2017	Switzerland	101-250	90	

Notes:
Figures as of 15 December 2022.
Sources: Crunchbase, protocol websites, The Block Research.

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Anchorage Digital is a digital asset services company which was founded in 2017 in the U.S. In addition to its lending and yield services, the company also provides custody, staking, governance, and trading. Their loan product offers tailored structuring and is integrated with Anchorage's platform for custody trading and staking. Anchorage Lending is licensed by the California Department of Financial Protection and Innovation. Custody and settlement services are offered through Anchorage Digital Bank National Association, which is a national trust bank chartered by the Office of the Comptroller of the Currency.

B2C2 is a digital asset liquidity service provider, which was set up in 2015 in the UK. In addition to lending and borrowing services, including structured loans, their platform facilitates spot and derivative trading. The company undertakes regulated and unregulated activities, whereby parts of the company are registered with FINCEN, FINTRAC, supervised by the FCA, and/or hold a VASP license on the Cayman Islands.

Babel Finance, founded in 2018, is a Hong Kong-based financial service provider for high-net-worth individuals and institutional investors in the crypto space. In addition to crypto lending and borrowing, the company provides crypto asset management, brokerage services, and mining services. Babel Finance's proprietary trading desk lost 8,000 bitcoins and 56,000 Ether during the June 2022 crypto plunge, and subsequently halted customers withdrawals. It has submitted a rescue plan and seeks to raise hundreds of millions of dollars in debt and equity investments. If successful, the plan would turn Babel's largest creditors into its shareholders. Before the crypto turmoil, the company was in the process of applying for crypto-related licenses in Hong Kong and Singapore.

BitGo was founded in 2013 in the U.S. and is a digital asset financial services firm. Besides prime lending services, custody, trading and settlement it offers portfolio management for its

clients. The company claims to process over 20% of all global Bitcoin transactions by leveraging its network of industry clients. Note that Galaxy Digital's deal to acquire BitGo for $1.2bn announced in May 2021, was terminated in August 2022. BitGo holds Trust licenses in New York and South Dakota.

Blockchain.com was set up in 2011 in the UK and offers a non-custodial wallet, exchange services and institutional services. Its institutional service, which includes crypto lending, was launched in 2019 and currently accounts for about 50% of Blockchain.com's revenue. It holds Money Transmitter licenses in several U.S. states, and a crypto license in Lithuania, which allows for exchanging and storing virtual assets.

Enigma Securities is a digital asset service provider founded in 2017 in the UK. Besides its borrowing services, it provides liquidity as well as crypto advisory. Its institutional borrowing product is available for a range of business purposes such as mining business loans against BTC collateral. Enigma Securities Limited is an appointed representative of Makor Securities London Ltd which is authorized and regulated by the Financial Conduct Authority.

FalconX was founded in 2018 in the U.S. and is a digital asset platform that allows institutions to access and manage all their crypto strategies through a single interface to execute trading, credit and clearing. The company also provides inventory management, and market making services. Their treasury management product allows for flexible staking and crypto-collateralized loans. FalconX is a Class 3 Malta Virtual Asset Service Provider and is provisionally registered with the U.S. CFTC as a swap dealer and a member of the National Futures Association.

Galaxy Digital (OTCMKTS: BRPHF, TSX: GLXY) was founded in 2018 in the U.S. and is a financial services and investment management company, which offers institutions and professional investors several service lines including asset management, investment banking and mining, principal investments, and trading. Crypto lending is offered among its trading services to provide customers with portfolio leverage. As of June, it reported $940mm worth of gross counterparty loan originations for 2022. Galaxy Digital Holdings LP has licenses for its lending business in California, Delaware, Maryland, Montana, North Dakota and Rhode Island. The company announced in November to have $77mm exposure to imploded crypto exchange FTX.

Genesis, founded in 2013 in the U.S., is a digital asset prime brokerage for professional and institutional investors and operates as a wholly owned subsidiary of DCG. It provides its clients with the ability to trade, borrow, lend, and custody digital assets. Genesis is one of the largest lenders for (explicit) portfolio leverage in the crypto space. Its two other lines with major client activity are the spot and derivatives trading desks. Genesis holds a Money Services Business license. It is also regulated as a Securities Broker Dealer with the SEC and holds a digital currency license with the NYSDFS. After being exposed to losses from the FTX collapse, Genesis halted customer withdrawals in November 2022. It has warned investors that its lending unit may default if it cannot secure new funding.

NYDIG was set up in 2017 in the U.S. and is a bitcoin financial services firm. It offers institutions, funds, and corporates a suite of services including back-end platform services,

trade execution and borrowing and lending. The latter includes asset-backed lending, equipment financing, loan servicing, and structured financing. The company operates via two regulated subsidiaries, which hold a Virtual Currency and Money Transmitter license in New York and a Limited Purpose Trust Charter from the NYDFS.

OSL was founded in 2018 in Hong Kong and provides brokerage services to institutions interested in investing in the digital assets sector. In addition, it also provides exchange, custody, and SaaS products. Professional investors can access its lending product via OSL's prime brokerage services. OSL is a subsidiary of the publicly traded company, BC Technologies (HKG: 0863) and is regulated as a Virtual Asset Service Provider to operate a brokerage by the Securities and Futures Commission in Hong Kong.

Sygnum was set up in 2017 in Switzerland and is a digital asset bank. In addition to its crypto lending business, it provides custody, brokerage, tokenization, asset management, and B2B digital asset banking services. Its crypto-collateralized loans have no fixed repayment terms and interest is charged based on actual drawings. The company holds a Swiss banking license and a Singapore Capital Markets Services (CMS) license.

Summing up, a large share of centralized lending activity, based on number of lenders, employee count and total funding, takes place in the U.S. Bankruptcies of U.S.-based firms involving loss of retail funds have increased regulatory pressure to reign in this freewheeling part of digital asset lending. The wave of bankruptcies and freezing of customer funds by centralized lenders dealing with retail has eroded confidence in the reliability of many crypto intermediaries. At the time of writing, it is unclear which of the centralized lenders, many of which have been operating in a regulatory void and offering services that resemble shadow banking, will remain solvent when all contagion has been absorbed by the crypto ecosystem.

On the institutional-focused side, some U.S.-based lenders had to write down losses/exposures. It remains unclear whether Genesis, the crypto space's largest lending firm will remain solvent. Going forward, heightened regulatory scrutiny for lending firms, especially those sourcing funds directly from retail customers, appears highly likely. Regulators are scrambling to bring this part of digital asset lending into their fold. This is further discussed in Section 4.

3.2 Decentralized Digital Asset Lenders

> "*DeFi allows traditionally intermediated economic activities to be carried about by code, therefore raising efficiencies. Though there may be certain tradeoffs between collateral requirements and capital efficiency, the technological requirements of DeFi makes the entire system more robust and resilient.*" Stephen Kenny, Institutional Business Manager at Aave

While the activity on decentralized lending protocols still appears to be lagging centralized lenders, particularly regarding institutional clients, the former has benefited from technological advancements of blockchain infrastructure and may be further supported by an additional growth catalyst: the opacity of some of the centralized players. For example, customers of Celsius could not verify how the company was using their funds in its now defunct investment strategy. Another example for 'off-chain opacity' is that 3AC had

borrowed from multiple counterparties without these counterparties knowing about 3AC's assets. In contrast, on-chain activity by lending protocols is transparent and customers can rely on automatic execution of smart contracts, which can prevent fraud to some extent. Note that self-custody via smart contracts may not be bulletproof under all circumstances. See, for example, "The Block: Solana whale shuffles $25 million to reduce risk to DeFi protocol Solend", which provides insights on how a protocol came close to overriding smart contract logic to prevent a potential liquidation cascade.

The nature of permissionless protocols allows for letting everyone access these frameworks without any KYC or AML checks being carried out. Since regulatory frameworks are still forthcoming, financial institutions may only be sparsely active on permissionless protocols. Pseudonymity makes this statement hard to verify, however, most financial institutions are discouraged or barred by their regulators from directly venturing into DeFi/crypto.

Table 3.3 displays key information on DeFi protocols, which operate in three distinct areas of crypto lending, (i) 'money market' like protocols with overcollateralized lending pools ('Overcollateralized Lending'), (ii) lending protocols issuing stablecoins backed by collateralized debt positions ('CDP'), and (iii) uncollateralized lending protocols financing real-world assets ('Uncollateralized Lending'). While there may be some overlap between categories for some protocols, they have been assigned to the set which best reflects their main business model. For example, Aave has been experimenting with unsecured borrowing, but its business is mostly underpinned by overcollateralized loans.

Given the large number of DeFi lending protocols (230+), a subset of protocols (based on TVL) is analyzed in this report. Due to the threshold approach, more niche/experimental companies with a small TVL are not covered. See Defillama for an overview of all protocols in the chosen categories. The cut-off thresholds chosen are >$1bn for overcollateralized money market protocols such as Aave, >$400mm for lending protocols issuing stablecoins such as Maker, and >$30mm for uncollateralized real-world-asset protocols such as Maple. Notably, the threshold for uncollateralized real-world-asset protocols is about one order of magnitude smaller than that of overcollateralized and CDP-based protocols. This is due to the fact that their institutionally-focused nature could draw in large pools of capital and catalyze rapid growth of the broader DeFi lending ecosystem. It is therefore included despite its smaller footprint in terms of TVL.

> "*Integration of real-world assets may turn out to be crucial for scaling DeFi. At the same time, integrating with the real world carries risks, such as centralization and regulatory overreach.*" PaperImperium, working on and around Maker

> "*Real-world assets are a promising new asset class in crypto because they allow providing a relatively stable and safe yield between 3-10% on the senior tranche throughout the cycle.*" Mike Ruzic, working on and around Centrifuge

Table 3.3: Key Decentralized Lending Protocols

Lender	Established	Total Funding ($mm)	TVL ($mm)	Type	Blockchain
Aave	2017	49	5930	Overcollateralized Lending	Arbitrum, Avalanche, Ethereum, Fantom, Harmony, Optimism, Polygon
Centrifuge	2017	16	83	Uncollateralized Lending	Ethereum
Compound	2017	71	2340	Overcollateralized Lending	Ethereum
Goldfinch	2020	38	100	Uncollateralized Lending	Ethereum
JustLend	2020	-	3200	Overcollateralized Lending	Tron
JustStable	2020	-	925	CDP	Tron
Liquity	2019	8	424	CDP	Ethereum
Maker	2014	80	6510	CDP	Ethereum
Maple Finance	2020	3	204	Uncollateralized Lending	Ethereum, Solana
TrueFi	2020	13	37	Uncollateralized Lending	Ethereum
Venus	2020	-	1780	Overcollateralized Lending	BNB Chain

Notes:
CDP means Collateralized Debt Position.
Figures as of 29 November 2022.
Sources: Crunchbase, DefiLlama, protocol websites, The Block Research.

THE BLOCK · Research

The largest DeFi lending protocol by TVL is Maker ($6.5bn), followed by Aave ($5.9bn), JustLend ($3.2bn), and Compound ($2.3bn). Most lenders are based on Ethereum or EVM-compatible chains. Note that Aave, Compound Treasury and Maker have recently also opened permissioned lending pools. This is however at a much smaller scale than their permissionless activity.

Aave was founded in 2017 as a protocol to allow for permissionless lending and borrowing on Ethereum. In its latest iteration, Aave V3, the protocol follows a multi-chain strategy, operating on a wider ecosystem of EVM-compatible chains. It recently seeded Lens Protocol (a decentralized social network) and is working on introducing its own stablecoin, Gho, similar to Maker. Aave Limited (to be distinguished from the protocol Aave, which is a platform on which it operates providing integration and support) has an Electronic Money Institution license from the FCA, which allows offering services such as issuing digital cash alternatives and providing payment services.

Centrifuge was set up in 2017 and is among the leading protocols that tokenize real-world assets, such as trade receivables. While the protocol uses its native Centrifuge chain to tokenize real world assets, it also leverages a bridge to Ethereum so that investors can

interact with the protocol on a more widely used chain. The protocol also expands to blockchains, which are substrate based (Polkadot and Kusama). Centrifuge issues its products under the SEC's Reg D exemption and enforces KYC/KYB policies. Both Aave and Maker protocols have integrations with Centrifuge to also allow for real-world asset collateralization.

Compound was founded in 2017 and is an Ethereum-based protocol, which establishes money markets where, similar to Aave, the interest rate is automatically adjusted depending on pool utilization. The protocol can be used to deposit, or borrow to invest, use or short-sell tokens. In its latest iteration, Compound III, the protocol provides a single borrowable asset (USDC), thus moving away from a pooled risk model. While the Compound protocol is governed by a DAO and therefore permissionless, Compound Treasury, (which facilitates regulatory-compliant borrowing and lending) is governed by Compound Labs. Compound Treasury issues its products under the SEC's Reg D exemption.

Goldfinch was set up in 2020 as a decentralized protocol financing real-world assets. Loans are issued by corporate entities, and mostly cover global multi sector loans or consumer loans in developing countries. On a high level, incentive alignment on Goldfinch works similar to Maple, and Truefi: Loans are approved by backers, who, in the event of a default own the first loss piece. Lending pools are subdivided into senior and junior tranches, with the (lower risk) senior tranches available for investment to liquidity providers.

JustLend is a money market protocol set up in 2020 on the TRON blockchain. Similar to Aave and Compound, interest rates are determined by an algorithm, which aims to bring demand and supply into equilibrium. JustLend also plays a key role in absorbing liquidity of the TRON blockchain's algorithmic stablecoin, USDD.

JustStable is a decentralized stablecoin protocol set up in 2020 on the TRON blockchain. Similar to Maker, stablecoins (USDJ) are backed by (over-)collateralized debt positions, which are automatically liquidated in case the debt position is not adequately collateralized anymore.

Liquity, set up in 2019, is a decentralized borrowing protocol, which allows to draw loans with Ether as collateral. Borrowers are paid out their loan in LUSD, which is a stablecoin pegged to the USD. While the loan is free of interest, an origination fee must be paid.

Maker was founded in 2017 and is a DAO-operated credit facility and synthetic issuance platform for DeFi's most important decentralized stablecoin, DAI ($5.9bn market capitalization at the time of writing). To obtain credit in the form of DAI, users must lock collateral, which includes productive crypto assets such as, for example, staked ETH, into a smart contract vault.

Maple was set up in 2020 and is a real-world assets protocol that provides borrowers with liquidity pooled on Ethereum. It provides undercollateralized loans, which is possible because borrowers, which are KYCed, sign a standardized legal agreement to access loans. The underwriting is left to the lenders: Lending pools are managed by pool delegates, who determine borrowers considered creditworthy for their pool. Their interests are aligned by

holding a first loss piece of the pool. On 5 December, Orthogonal Trading defaulted on Maple loans worth $36mm. With another $18mm distressed, about 66% of Maple's loans in its four active pools are affected, likely leading to losses for Maple lenders.

Truefi was founded in 2019 and provides a framework for on-chain borrowing without collateral. Borrowers are vetted (by TrueFi), and loan applications must be approved by stakers of TRU, the native token of TrueFi. Stakers receive staking rewards in exchange for being assigned the first-loss piece in case a pool defaults. While borrowers are KYCed and must sign loan agreements, anyone can deposit funds into lending pools. Unused pool-liquidity is automatically employed to generate yield in DeFi protocols such as Aave or Curve Finance. However, due to institutional demand, utilization rates have been relatively high, in particular after the liquidity crunch following the bankruptcy of Celsius.

Venus Protocol was set up in 2020 on BNB Chain. it contains elements of Maker's stablecoin protocol as well as money market protocols such as Aave and Compound. The protocol issues VAI, a stablecoin backed by other crypto assets and pegged to the U.S. Dollar. Like other money market protocols, interest rates are algorithmically determined based on pool demand and supply.

While on-chain lending protocols have achieved considerable size in terms of TVL within a relatively short timeframe, the technology for on-chain lending is still developing. Furthermore, from a regulatory perspective decentralized digital asset lending is almost uncharted territory. Decentralized lending protocols come with a big promise of transparency and automation. It may therefore be beneficial to have a proper regulatory framework, that maintains the advantages of on-chain lending (innovative prowess, efficiency, transparency) while reigning in the most egregious risks to live up to this promise and usher in more institutional capital. It is important to note in that respect, that the 2022 crypto turmoil triggered (but not exclusively caused) by Celsius, 3AC and Terra left on-chain lending protocols largely unscathed.

This section provided an overview on the key players in the digital asset lending space. While all crypto lenders suffered from a liquidity crunch following the Celsius/3AC/FTX bankruptcies, decentralized lending protocols weathered the storm rather well in comparison to their centralized counterparts. One of the key underlying reasons for the crash and loss of funds was market opacity during the turmoil in 2022, in particular among centralized lenders. In many cases retail customers of centralized lenders could not see or verify easily how their funds were used. Similarly, on a higher level, professional investors such as 3AC did not disclose whom they had exposure to, or allegedly committed outright fraud. When 3AC couldn't pay back its loans, many counterparties were surprised about the extent of exposures that had been built up from multiple lenders to 3AC. This led to contagion between crypto lenders and borrowers: both direct shocks (credit defaults), but also indirect shocks took place. The latter emerged when lenders, being unsure about the solvency of the counterparties, started calling back most of their loans.

The same issues regarding transparency (and probably also outright fraud when dealing with 'doxxed' teams) seem not as acute among the major DeFi lenders portrayed in this section. In DeFi, protocol activity is mostly visible to everyone, including all on chain transactions.

Furthermore, outright fraud can be limited where lending and borrowing is automatically carried out by smart contract logic. While hacks, scams, and "rug pulls" are still frequent in the wider DeFi ecosystem, and regulation is largely absent, the space holds promise if the technology further matures, and investors can operate within a (yet to emerge) regulatory framework.

Going forward there are two developments which are poised to emerge in the face of heightened demand for transparency. First, regulators will increasingly scrutinize the space, and also attempt to bring DeFi in scope. Second, market participants will put a premium on transparency and possibly also regulatory coverage.

Given i) the high likelihood that regulators will put supervisory frameworks for crypto in place, effectively unlocking the space for professional and institutional investors, and ii) the natural on-chain transparency that comes with DeFi protocols and their smart contracts, chances are that the on-chain component of crypto lending will grow more important going forward. Whether this happens by centralized players harnessing on-chain transparency for their purposes, or by decentralized protocols maturing and becoming regulated remains to be seen.

The following section looks at recent regulatory trends, putting a focus on the U.S.

Section 4: Regulatory Trends

> "*While I do not condone individuals or entities blatantly violating the Commodity Exchange Act or our rules, we cannot arbitrarily decide who is accountable for those violations based on an unsupported legal theory amounting to regulation by enforcement while federal and state policy is developing.*" Summer Kristine Mersinger, Commissioner of the Commodity Futures Trading Commission

Different regulatory frameworks for crypto are emerging around the world. Some are very restrictive, such as in China, where most crypto activity is banned. Others, such as Dubai, provide a less onerous framework, attracting many crypto-focused businesses. On 30 June 2022 the EU also announced that it has reached agreement on the legislative proposal for its market on crypto assets (MiCA), which would be among the first comprehensive regulatory frameworks for crypto service providers, crypto assets, and stablecoins, of a major jurisdiction.

While the U.S. is at the global center of crypto developments, a comprehensive regulatory framework still needs to be developed for the industry to realize its full potential. It has been delayed not least by on-going discussions as to which regulatory agency is in charge, notably between the CFTC and the SEC. This section first outlines the key areas of interest/concern for regulatory bodies with an emphasis on digital asset lending. The section concludes by outlining the current state of crypto regulation in the U.S. and provides an outlook about how planned legislation may impact digital asset lending going forward.

4.1 Key Crypto Areas of Regulatory Scrutiny

> *"Regulation can be a double-edged sword for crypto companies. It is often seen by new entrants as a barrier to entry preventing them from moving fast. However, not adhering to regulation can inhibit the capacity to scale with a long-term view. Going forward there is very little doubt that proper regulation will be one of the key catalysts supporting growth in the digital asset lending space.*" Jean-Marie Mognetti, CEO of CoinShares

Distributed ledger technology and digital assets have been changing the ways people can borrow, save and invest, both in developed and developing markets. While it is a source of yield and access to funding in the former, it helps financially integrate those that do not have access to basic financial services in the latter. Therefore, although the crypto space is currently still largely segregated from the traditional finance space, crypto companies and protocols have started to move into the business of traditional banking.

As outlined in Section 2 of this report, digital asset lenders are allocating funds from savers/lenders to investors/borrowers for both stable and volatile assets. While digital asset lending can still be considered niche in terms of aggregate global lending, the area has been growing considerably over the past years. In the face of this growth and, most recently, the implosion of the Terra blockchain and subsequent bankruptcies of major lending firms, regulatory bodies have increased their focus on digital asset markets. Regulatory scrutiny will

likely be focused on the three dimensions i) digital asset lending (involving retail), ii) stablecoins, and iii) DeFi.

Digital Asset Lending

Regarding regulation for digital asset lending, this section focuses on lenders, which directly take funds from retail customers. Their 'institutional-only' counterparts (see Section 2) are not high on regulators to-do-list (yet). There are two main reasons for this: financial regulators put considerable emphasis on i) consumer protection and ii) financial stability.

First, in keeping with their mandate for consumer protection, regulators will place high priority on companies that have allegedly caused significant financial losses for retail participants while operating outside the regulatory perimeter. Second, institutional-only companies with no retail focus are not (yet) considered systemically relevant by regulators. In this context, systemically relevant means that a major default could lead to real economic effects, like for example a credit crunch causing unemployment if a large fraction of the financial system ends up in default.

However, regulators are monitoring the space, and once deemed systemically relevant, lenders with a pure focus on institutional clients may be subject to additional regulation as well. Furthermore, regulatory action on digital asset lenders that directly source from retail clients, may also affect the business of those lenders that focus exclusively on institutional clients. The reason for this is that a large fraction of crypto liquidity is ultimately sourced from retail, whether this is directly or indirectly.

Regulatory focus on digital asset retail lenders already started to take shape even before the 2022 crypto turmoil, with companies such as Celsius at its epicenter. For example, in the U.S., several state regulators issued cease and desist orders to companies offering deposit-like products to retail. Nevertheless, this increasing regulatory scrutiny does not necessarily imply that all companies in the space have been operating in a completely illicit manner. Many lenders have applied for and obtained state lender licenses or even bank charters. Note that to obtain licenses, companies do not necessarily have to apply, but can also become regulatory compliant via acquisitions. Besides crypto lending activities involving retail, some priority is also given to stablecoin regulation.

Stablecoins

Fiat-backed stablecoins, which are largely pegged to the USD, have a market capitalization of $144bn as of 29 November 2022 and have emerged as a key use-case in crypto by removing price volatility and anchoring it to fiat. This feature has also put them among the most important tokens for borrowing and lending in the crypto space. For example, the token with the highest TVL on Aave is the USDC with $711mm (29 November 2022). Furthermore, the biggest decentralized stablecoin pegged to the USD in terms of TVL (~$5.9bn at the time of writing) is DAI issued by Maker, which is one of the major decentralized players observed in Section 3. Effectively, DAI issued can be considered USD loans, which are collateralized by crypto assets. Besides their importance in DeFi, stablecoins touch upon the critical subject of monetary sovereignty of nation states. Although regulators and central banks seem to still be in the "discussion phase" of policy development, including evaluating whether or not central bank digital currencies (CBDC) should be introduced, it is clear that future regulation

for stablecoins will affect the lending space at least peripherally. Finally, DeFi writ large as a new technology framework, which provides financial services while almost completely escaping regulatory scrutiny, has come into the regulators' crosshairs.

DeFi

On 9 December 2022 DeFi had a TVL of $55.4bn of which lending protocols (including those based on CDP) make up more than 40%. Its decentralized nature makes it unsuitable for existing regulatory frameworks, and regulators are still struggling to strike a balance between consumer protection and maintaining the innovative prowess of the sector. Given that a sizable share of its growth takes place on decentralized lending protocols, any regulatory framework for DeFi in general will likely impact digital asset lending as well. However, regulatory approaches for DeFi still seem to be in the discussion phase.

The next sub-section focuses on the state of crypto regulation in the U.S. and how recent initiatives may affect digital asset lending.

4.2 Crypto Regulation in the U.S.

2021 was a record year for crypto-related monetary sanctions from the SEC and CFTC. With the ongoing crypto turmoil, enforcement actions and overall scrutiny have become even more heightened in 2022. As mentioned above, two federal regulators have claimed jurisdiction on crypto assets. Formally, the SEC is in charge to govern securities. Whether a digital asset is a security is usually determined with the Howey test, which is outlined in more detail below. The CFTC has jurisdiction over commodities and derivative transactions. It has argued that sufficiently decentralized cryptocurrencies like BTC are to be treated as commodities.

The Current State: Regulation by Enforcement?

A consistent regulatory framework for crypto is still largely absent in the U.S. Moreover, fraudulent activity and hacks are widespread in the crypto space and often involve loss of funds for retail. Given the absence of clear legislation, it appears that for the time being U.S. regulators have adopted the 'second best' practice of 'regulation by enforcement' as a stopgap measure.

Despite referring to retail customers as depositors in their advertisements and loaning out those funds to other clients, some crypto lending platforms such as Celsius have not been operating under similarly onerous regulatory regimes as traditional financial institutions. Their lending products often provide much higher yields than those available in the traditional financial system. Higher yields can be on offer for at least two possible reasons. One can be driven by strong loan demand in the crypto space. The second may be related to less onerous (due to not being similarly regulated) risk management requirements. For example, less stringent risk management may lead to higher risk taking with customer funds, building up considerable maturity mismatches or carrying out unsecured lending.

Such activities almost perfectly fit the definition of 'shadow banking', a term coined by economist Paul McCulley. "Shadow banking" refers to nonbank financial institutions, which

engage in maturity transformation. For example, commercial banks use demand deposits to fund longer term loans. Celsius, taking retail customers' funds, which can be withdrawn daily, and investing them in staked ETH, a product which is rather illiquid, looks eerily similar. Yet, the difference between a regulated lending institution and a shadow bank like Celsius is that the former has access to emergency borrowing from a lender of last resort in case of illiquidity and that its deposits are federally insured. When customers started withdrawing considerable amounts of funds, Celsius first became illiquid and stopped withdrawals, and then insolvent after being forced into liquidating many of its assets.

In addition, many digital asset lending entities also offered lending products to retail without registering them with the SEC as a security. SEC registration is a time-intensive process with ongoing reporting and disclosure requirements. While one may argue that those lending products were structured to evade SEC regulation, the SEC has previously stated that "[w]hether a particular investment transaction involves the offer or sale of a security – regardless of the terminology or technology used – will depend on the facts and circumstances, including the economic realities of the transaction." It made a similar argument for crypto lending products that are offered to retail customers.

To determine whether an asset is a security, the SEC has been applying the Howey test. To this end it also provides a framework for investment contract analysis of digital assets on its website. According to that document, "an 'investment contract' exists when there is the investment of money in a common enterprise with a reasonable expectation of profits to be derived from the efforts of others".

In addition, the SEC leverages the 'family resemblance test' (or Reve's test), which presumes that a note is a security unless (i) it bears resemblance to a set of enumerated categories of exceptions, or (ii) a new category should be added to the list. In the U.S., investment products that fit these tests should be registered with the SEC or be subjected to an exception. For more details see, for example, "Lexis: U.S. Regulation of Digital Asset Lending Platforms".

Regulatory scrutiny led to three key state/federal enforcement actions in the area of digital asset lending, affecting BlockFi, Celsius and Nexo. The New Jersey Bureau of Securities issued a cease and desist order on 22 July 2022 to BlockFi to prevent it from selling unregistered securities, disguised as interest-earning crypto interest accounts. In particular, the Bureau stated that

"BlockFi allows investors to purchase the BIAs ['BlockFi Interest Account'] by depositing certain eligible cryptocurrencies into accounts at BlockFi. BlockFi then pools these cryptocurrencies together to fund its lending operations and proprietary trading. In exchange for investing in the BIAs, investors are promised an attractive interest rate that is paid monthly in cryptocurrency. The BIAs are not protected by Securities Investor Protection Corporation (the "SIPC") or insured by the Federal Deposit Insurance Corporation (the "FDIC"). The BIAs are subject to additional risk, compared to assets held at SIPC member broker-dealers, or assets held at banks and savings associations, almost all of which carry FDIC insurance. Nor are they registered with the Bureau or any other securities regulatory authority, or exempt from registration. Despite the additional risk, and lack of safeguards

and regulatory oversight, as of 31 March 2021, BlockFi held the equivalent of $14.7 billion from the sale of these unregistered securities in violation of the Securities Law."

In addition, the SEC has charged BlockFi in February 2022 with not registering its retail crypto lending products, largely re-emphasizing the un-registered activities outlined by the New Jersey Bureau of Securities in its cease and desist order. BlockFi subsequently reached an agreement by paying $100mm in penalties and pursuing registration of its crypto lending product. In November 2022, BlockFi paused many of its platform activities and customer redemptions because of its significant exposure to FTX and Alameda Research, and subsequently filed for bankruptcy.

On 17 September 2021 the New Jersey Bureau of Securities issued a cease and desist order against Celsius and its borrowing/investment activities, which contained in essence the same allegations that were issued against BlockFi. In response, Celsius announced that going forward, for the U.S. it will offer its lending products to accredited investors, only. On 13 July 2022, Celsius initiated Chapter 11 bankruptcy proceedings.

On 26 September 2022, eight U.S. state regulators announced an array of legal actions against Nexo and issued similar cease and desist orders over its crypto interest-bearing accounts. In December 2022, the company announced that it will phase out services in the U.S.

Outlook: Towards a Regulatory Framework for Crypto Assets

As outlined above, a crypto regulatory framework is largely absent and so far, it has not been entirely established which agency, the SEC or the CFTC, is in charge of regulating digital asset markets and firms. In this situation, and against a backdrop of tremendous growth and subsequent slump in the cryptocurrency space, legislators saw the need to spring to action.

To create momentum and ensure "Responsible Development of Digital Assets", President Biden's executive order from 9 March 2022 was signed. The executive order calls, among others, for measures to:

- Protect U.S. Consumers, Investors, and Businesses and encourages regulators to ensure sufficient oversight and safeguard against any systemic financial risks posed by digital assets.
- Protect U.S. and global financial stability and mitigate systemic risk by addressing any regulatory gaps.
- Mitigate illicit finance and national security risks from the illicit use of digital assets (AML/KYC/Terrorist Financing).
- Promote U.S. leadership in technology and economic competitiveness to strengthen U.S. leadership in the global financial system.
- Promote financial inclusion via equitable access to safe and affordable financial services.

Subsequently, on 16 September 2022, based on nine reports from federal agencies, the White House issued a fact sheet to outline a framework for policy recommendations based on the measures above. Developing a comprehensive framework for digital asset regulation will be an iterative process which is informed by inputs from the public and federal agencies.

There are three key areas from which development will likely be spurred: First, stakeholders, lobby groups, and think tanks can make policy recommendations based on the executive order. Second, Congress can enact legislation to address issues highlighted in the executive order. For example, on 7 June 2022 Senators Gillibrand and Lummis introduced the "Lummis-Gillibrand Responsible Financial Innovation Act" to propose a comprehensive framework for digital asset regulation. Third, regulatory guidance and enforcement may be enacted by the CFTC and SEC. Given that the crypto turmoil of 2022 particularly impacted digital asset lenders, chances are that going forward, regulation will address this part of the crypto ecosystem.

Regarding crypto lending, regulation emerging from the executive order will likely touch on consumer protection and financial stability. To gauge which types of rules may be used to bring digital asset lending into the regulatory perimeter, it is instructive to highlight key lending regulations in the traditional financial system. Regulators may attempt to map some of the rules for traditional lenders to their crypto counterparts, which carry out similar activities. The main argument for this is that regulators should be technology neutral but same activities should be subject to the same rules.

Deposit-taking financial institutions have been subject to a host of regulatory requirements that ensure customer funds are safe and micro- and macroprudential risks remain under control. The 2022 crypto crash with digital asset lenders at its epicenter has many parallels to the great financial crisis and its Lehman moment. To address issues underlying that crash in TradFi, in particular opacity, illiquidity under adverse market conditions and large exposures between entities, regulators introduced the so-called Basel III framework. Topical Box 4.1 outlines some of the risks and rules, which in the future may, in some shape or form, also apply to crypto lenders that carry out similar activities.

Topical Box 4.1: Key Regulations for Financial Institutions in Tradfi

Counterparty Credit Risk: "is the risk that the counterparty to a transaction could default before the final settlement of the transaction in cases where there is a bilateral risk of loss. Banks are required to identify their transactions that expose them to counterparty credit risk and calculate a counterparty credit risk charge" based on a specified methodology. Further details are available under "BIS' Basel Framework: Calculation of Risk-Weighted Assets for Credit Risk".

Interest rate risk: "refers to the current or prospective risk to the bank's capital and earnings arising from adverse movements in interest rates that affect the bank's banking book positions. When interest rates change, the present value and timing of future cash flows change. This in turn changes the underlying value of a bank's assets, liabilities, and off-balance sheet items and hence its economic value." If a bank is considered to have excessive interest rate risk based on a regulator's methodology, it may be required to

hold additional regulatory capital. Further details are available under "BIS' Basel Framework: Interest Rate Risk in the Banking Book".

Liquidity risk: Basel III addresses liquidity risks on both the asset and liability side of banks' balance sheets. The **liquidity coverage ratio** is designed to ensure banks always have an adequate level of readily available, high-quality liquid assets, which can quickly and easily be converted into cash to meet any liquidity needs that may arise during a 30-day period of liquidity stress. Further details on the liquidity coverage ratio are available under "BIS' Basel Framework: Liquidity Coverage Ratio". The **net stable funding ratio** "requires banks to maintain a stable funding profile in relation to the composition of their assets and off-balance-sheet activities. See "BIS' Basel Framework: Net Stable Funding Ratio".

Large exposures risk: is defined as the maximum loss that a bank could face in the event of a sudden counterparty failure to a level that endangers the bank's solvency. Regulation "requires banks to measure their exposures to a single counterparty or a group of connected counterparties and limit the size of large exposures in relation to their capital". See "BIS' Basel Framework: Large Exposures" for further details.

In addition to the above **microprudential** regulations (dealing with the safety of individual institutions), the Basel framework also introduces **macroprudential** considerations (dealing with risks that may lead to systemic risks, i.e. a (partial) meltdown of the financial system), such as countercyclical capital surcharges as well as requiring banks, which are considered systemically important, to hold more regulatory capital.

Would (some of) those rules have prevented the severe turmoil in the crypto space in 2022? It was caused by a combination of high leverage, opaque interconnections, bad risk management, and allegedly outright fraud. Where those rules could have made a difference is on the risk management side. For example, they may have prevented a build-up of extreme exposures in uncollateralised fashion to a single counterparty, such as in the case of Voyager. By contrast, those rules may not have made a difference in cases of misrepresentation or outright fraud, such as, for example, committing the same collateral to multiple counterparties or using customer funds to stopgap losses. While digital asset lenders will be more careful in their risk management for some time, they may again start to relax prudent risk measures when the situation has normalized and contagion in the crypto ecosystem has been absorbed. This procyclicality is inherent in all financial markets. Therefore, a regulator enforcing a minimum amount of transparency and regulatory level playing field may not be the worst outcome in the long run. It remains however to be seen how those rules could be implemented for lenders in the DeFi sector, a question regulators generally still grapple with.

> *"From a lending perspective, trust and transparency have become critical for short- and long-term success. We have witnessed over the past few months what can happen when opaque business practices and the unwillingness to disclose certain information collide."* Cynthia Wu, Founding Partner & COO at Matrixport

As highlighted in this section, regulatory trends are clearly moving in the direction of developing an encompassing framework for crypto companies to operate in. Recent enforcement action has been directed towards crypto lenders providing investment products to retail customers. While centralized lenders focused only on institutional clients are not yet top of mind on regulators' agendas, it's only a matter of time until they may also be subject to more stringent regulations. Existing regulation for institutions in the traditional finance space may provide a glimpse into regulators' possible levers to enforce a regulatory level playing field.

The next section concludes.

Section 5: Conclusions and Outlook

This report sheds light on the digital asset lending landscape from three angles. First, it investigates the lending market structure by looking at drivers of demand and supply for crypto lending as well as key differences between centralized and decentralized lending. Second, it provides an overview of the digital asset lending landscape by portraying the key entities in the crypto lending space. Third, it points out regulatory trends, which are taking place in the U.S., with a focus on crypto lending.

Crypto lending is projected to continue to grow. However, the recent market turmoil with crypto lending at its epicenter has led to a watershed moment with many similarities to the Lehman moment in the traditional financial system in 2008. This report argues that there could be two main effects from this on future developments in the digital asset lending space.

First, stakeholders will likely put a premium on transparency. This includes (i) retail customers who deposit funds to obtain a yield, (ii) institutional lenders who will likely require assurances about exposures of their counterparties, and (iii) regulators, who need visibility into the sector's micro and macroprudential risks.

Second, the impact on retail clients from crypto lending defaults is top of mind for regulators. Where possible under existing rules, regulators will step up enforcement against crypto lending that is considered risky for retail. In parallel, regulators are prioritizing the development of regulatory frameworks for the space, including for decentralized entities. Digital asset lenders, which mainly focus on institutional clients, may not yet be top of mind for regulators. However, given the growth dynamics of the space it may only be a question of time, until they will also be subject to additional regulatory guidance.

Two additional developments stand out. One, the bankruptcy of many retail focused CeFi lenders affects supply from this market section. The situation is highly uncertain, and even transparency initiatives, for example proof-of-reserves, are no panacea. Unless major players with proper regulation and supervision enter the market, supply may remain subdued, at least until the next major market upswing. Two, the unclear situation of Genesis, including its parent DCG, could have major implications for the health of the broader institutional crypto landscape. Should Genesis default, it could in the short run lead to another severe drop in crypto markets. Due to Genesis' importance as the backbone of large parts of yield services and lending activity, negative effects would probably linger for some time, affecting intermediation and capital efficiency in the crypto ecosystem. At the time of writing the way forward for Genesis remains unclear.

Despite headwinds for centralized lending companies, it is unclear, whether on-chain digital asset lenders will be the unambiguous winners. On first thought, one may conclude so because their technology comes naturally with full transparency of on-chain transactions. However, full transparency of all transactions can be a red flag for some entities: even though pseudonymity does not assign a clear name for an on-chain transaction, competitors may be able to draw conclusions based on the size and direction of publicly visible trades.

In addition, the DeFi crypto ecosystem needs to become much more user-friendly to support mainstream borrowing and lending activity – CeFi platforms provide a more familiar 'Web2 like' experience (at the cost of custody risk). The immaturity is highlighted, for example, by the recent threat of a potential fire sales spiral in the Solana ecosystem, a blockchain that has been advertised as being most suitable for financial institutions, from the default of a large borrower on the Solend protocol, its flagship lending protocol.

Finally, institutional clients, which are likely big drivers of future growth, need a regulatory framework to operate in. The absence of a regulatory framework for large parts of on-chain lending hinders capital to flow into this part of the ecosystem.

In conclusion, and looking into the crystal ball, while the space is set to further grow despite the current severe downturn, the DeFi vs CeFi lending debate is not yet settled. The relative growth of DeFi lending will depend on continuing maturation of on-chain protocols as well as regulatory clarity.

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