DIGITAL ASSETS
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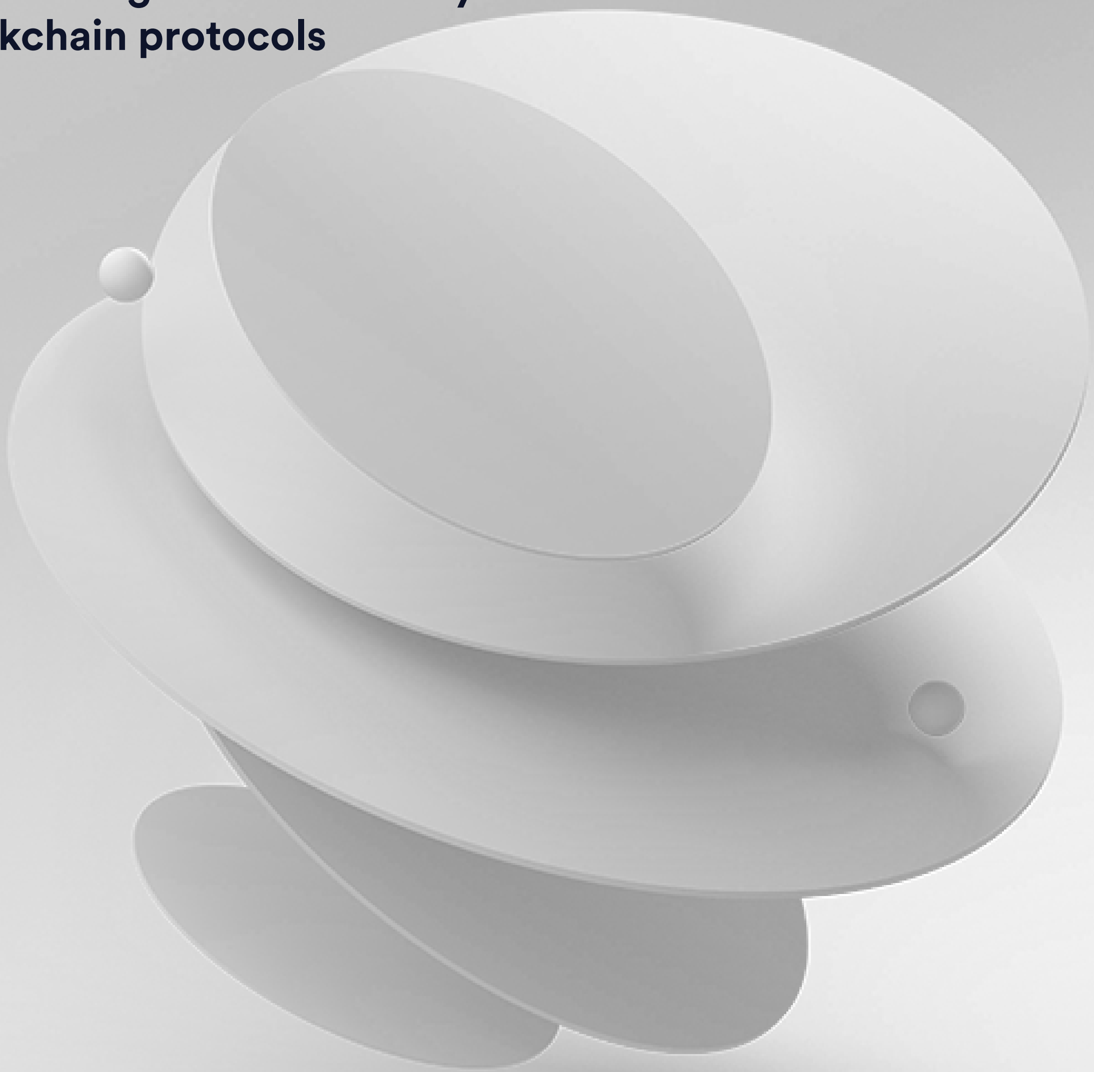
Smart Contract Landscape

Understanding the different layers of blockchain protocols



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Introduction

MarketVector Indexes™ ('MarketVector') has developed a classification scheme for digital assets and provides category indexes that allow users to measure, benchmark, and capture the performance and characteristics of targeted categories within digital assets, making the ecosystem more digestible to traditional finance investors while giving crypto native funds additional benchmarking capabilities. This article focuses on smart contract platforms.

According to the data provider Coingecko, there are over 140 different platforms[1]. While each of these chains appear to be successful today, it's impossible to know which of them will eventually support the largest and most robust ecosystems or which will survive the competitive landscape. No single protocol is necessarily perfect for every application. Therefore, the future of smart contract chains will encompass many protocols that are popular today and some that have yet to be created. The **MarketVector™ Diversified Smart Contract Indexes** enable investors to measure and access the broader smart contract platform market without worrying about picking any specific chain.

What are Smart Contracts?

Smart contracts are a defining feature of smart contract platforms. These are essentially code modules that can be controlled externally or run autonomously. The term "smart contract" was first used by the well-known cryptographer, Nick Szabo, in the early 1990s (Szabo 1994). Smart contracts run on networks like Ethereum or Solana and can be programmed using a corresponding programming language[2]. They can be simple or complex and can process inputs, generate outputs, or run automatically according to a pre-defined schedule.

One of the key benefits of smart contracts is that they can be made unstoppable, as they are protected from external interference. They strictly adhere to a pre-defined rule set, which makes them ideal for applications like digital asset management, where a guaranteed payment stream is required. Another advantage is that smart contracts have the ability to control digital assets and send or receive them.

There are various programming languages for smart contracts, including Solidity[3] for the Ethereum blockchain and Vyper[4]. To give a simple example of a smart contract program, the following code uses Solidity to store an integer that can be modified and retrieved via methods:

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[1] See coingecko.com

[2] A programming language must possess what is referred to as Turing completeness. If this property is present, any theoretically solvable programming task can be accomplished using the language.

[3] See https://ethereum.org/en/developers/docs/

[4] See https://docs.vyperlang.org/en/stable/

```
contract SimpleStorage {
  uint storedData;
  function set(uint x) public {
  storedData = x;
  }
  function get() public view returns (uint) {
  return storedData;
  }
}
```

Smart contract programs can be combined to create more complex applications. For example, the following code provides a minimal version of a smart contract for generating a cryptocurrency:

```
contract Coin {
  address public minter;
  mapping (address => uint) public balances;
  event Sent(address from, address to, uint amount);
  constructor() {
  minter = msg.sender;
  }
  function mint(address receiver, uint amount) public {
  require(msg.sender == minter);
  require(amount < 1e60);
  balances[receiver] += amount;
  }
  function send(address receiver, uint amount) public {
```

```
  require(amount <= balances[msg.sender], "Insufficient balance.");

  balances[msg.sender] -= amount;

  balances[receiver] += amount;

  emit Sent(msg.sender, receiver, amount);

  }

}
```

This code can be used to create a smart contract that includes functions for sending and receiving tokens. The central control instance is eliminated, making the smart contract autonomous. The mapping of a guaranteed payment stream can also be implemented using a smart contract. For example, a smart contract could be created to hold a certain amount of digital assets and protect them from external access. The program would then send specified amounts to an external address at pre-defined times, without the need for further interaction. This process is unstoppable and can only be stopped if the entire network is destroyed.

By appropriately parameterizing the contract, using external data, and implementing deposit and withdrawal options, a smart contract can quickly be transformed into a smart account. This provides a digital version of a guaranteed payment stream, and the required amount of assets must be available at the start of the program and cannot be changed later, eliminating the risk of credit default.

The main benefits of smart contracts are:

- Speed & accuracy: no need to rely on mediator or other third party; instructions automatically executed with code.
- Trust: blockchain transparency & transaction irreversibility ensure there is only one definitive contract shared with all involved parties, which decreases the risk of fraud and manipulation.
- Cost reduction: automation & removal of intermediaries is the compelling economic argument.

While enterprises and governments can build closed blockchains to exploit smart contract functionality, it's often more practical to use existing open permissionless blockchain platforms that support smart contracts.

What are Smart Contracts Platforms?

Smart Contracts Platforms are a type of blockchain software protocols that allow for global value transfer without the need for permission. They operate like operating systems like iOS or Android, but for smart contracts instead of apps. The leading platform in this space is Ethereum.

Smart contract platforms are open-source and serve as the foundation for decentralized applications (DApps) that run on a distributed network rather than a central server. They enable the execution of arbitrary code in the form of smart contracts, which can power other decentralized apps and even have their own tokens.

Each smart contract platform has its own unique features and trade-offs, such as speed, security, cost, degree of centralization, and hardware requirements to run a node. They also have their own execution environment, programming language, fee structure, and governance. The fees for using the platform depend on the computational power required to execute and deploy the smart contract.

Categorizing Smart Contract Platforms

The protocol layer in web3 is facing a challenge in terms of choosing between interoperability and modularity. Interoperability refers to the ability of different chains to communicate and work together, while modularity refers to the delegation of different tasks to different chains.

In the monolithic-and-interoperable web3 model, a single blockchain protocol handles all four core blockchain functions, which include execution, settlement, consensus, and data availability. Chains communicate with each other through communication hubs, and scalability is achieved through advanced communication protocols or sharding[5]. On the other hand, in the modular-and-stacked blockchain system, different protocols handle different components and blockchain operations. For example, one blockchain may handle settlement and consensus while another handles data availability and execution. This debate between monolithic-and-interoperable and modular-and-stacked blockchains is important for infrastructure providers as it affects the demand for access and usage of different blockchains.

There's another way to look at how smart contract protocols can be categorized. As an investor, to better understand these projects, it helps to put them into layers, like how internet protocols are put into layers. Most of these projects can be classified as Layer 0, Layer 1, or Layer 2 blockchains.

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5 Sharding is a technique in blockchain technology that allows for the horizontal division of the database across multiple nodes, each responsible for a portion of the data. This enables the processing of large amounts of transactions in parallel, improving the scalability of the blockchain. In traditional, non-sharded blockchains, all nodes must process every transaction, which can lead to slowdowns as the number of transactions grows. By dividing the database into smaller pieces and processing them simultaneously, sharding can significantly increase the speed and efficiency of the network.

Layer 0 (Cosmos, Polkadot): Layer 0 blockchains are a relatively new concept in the blockchain world, and aim to solve the problem of fragmentation in the ecosystem. Layer 0 blockchains are not built on top of other chains, but rather are the underlying infrastructure for multiple blockchains to work together. The idea behind Layer 0 is to create a decentralized infrastructure that all blockchains can use, eliminating the need for each blockchain to have its own infrastructure. This can help to reduce waste, as blockchains can share resources and infrastructure, resulting in a more efficient and cost-effective ecosystem.

Layer 1 (Ethereum, Solana, Cardano, Avalanche): Layer 1 blockchains are often referred to as public chains and are the most well-known among blockchain enthusiasts. The characteristics of Layer 1 blockchains are: they are independent and can work without relying on other chains, they have their own structure and mechanisms, such as consensus mechanisms, ledgers, nodes, encryption algorithms, and tokens. Layer 1 blockchains can also support higher-level blockchains, protocols, and applications, and build their own ecosystems.

Layer 2 (Polygon, Optimism, Metis): Layer 2 blockchains are built on top of Layer 1 chains, and are designed to solve the scaling problem of Layer 1. Most of these projects are focused on solving the scaling issues of Ethereum. Layer 2 blockchains perform most tasks off-chain and only push the results back to Layer 1 for simple processing and recording. This mechanism reduces the burden on Layer 1, resulting in faster transaction verification speeds and lower transaction fees. Some of the technologies used to help Ethereum scale include Optimistic rollups, Zero-knowledge rollups, State channels, Side chains, Plasma, and Validium. Rollups and State channels are the most commonly used solutions in Layer 2 projects.

The Smart Contract Landscape:

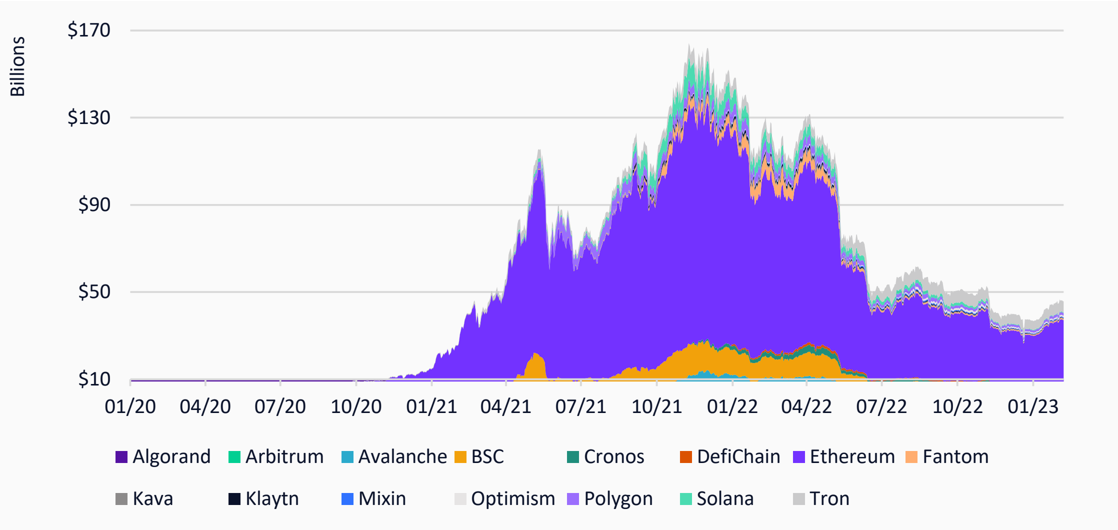
Ethereum is by far the largest smart contract platform. But other competitors are catching up. Layer-1 blockchains saw a dramatic increase in quantifiable user activity, largely driven by the emergence of DeFi ecosystems across the various platforms. Average transaction fees on Ethereum rose to record-high levels, at times leaving users paralyzed with exorbitant gas fees[6] and long confirmation times during times of extreme network demand.

In this environment of significant network demand and rapidly increasing costs, non-Ethereum Layer-1s with comparatively lower fees began to take center stage as users sought alternatives for activities they typically performed on Ethereum (Watkins 2021).

[6] Gas Fees: Gas refers to the fee, or pricing value, required to successfully conduct a transaction or execute a contract on the Ethereum blockchain platform (see https://www.investopedia.com/terms/g/gas-ethereum.asp).

A popular ratio for quantifying the success of a smart contract platform is the Total Value Locked (TVL). TVL is the overall value of crypto assets deposited in a smart contract. This number is predominantly used in DeFi protocols. It is a key metric for gauging interest in that particular sector of the crypto industry. **Exhibit 1** shows the development of the TVL over time. Although Ethereum continues to maintain the largest share, newer protocols are gaining traction.

Exhibit 1: DeFi TVL on smart contract platforms



Source: MarketVector, DeFi Llama.

All Layer-1 chains aim to solve the so called blockchain trilemma. This expression was coined first by Ethereum founder Vitalik Buterin and describes the problem of finding the right balance between security, decentralization and scalability.

> *"We will either solve the scalability and consensus problems or die trying."*
>
> *Vitalik Buterin, co-founder of Ethereum*

Scalability and decentralization are often held back by security, but security tends to be compromised by any shifts on a network that offer scalability. Projects either choose to focus on two out of three or work on finding a solution to tackle the trilemma once and for all.

Ethereum is moving towards a new system that incorporates sharding and Layer-2 solutions. Meanwhile, Polkadot, a Layer-0 protocol, aims to collaborate with other blockchains. Solana is investing in a costly infrastructure in order to enhance scalability. Avalanche, a Proof of Stake blockchain, utilizes a complex consensus method that offers both security and high transaction throughput. Similar to Binance Smart Chain, Avalanche is compatible with the Ethereum Virtual Machine (EVM), making it easy for Ethereum developers to transfer their applications. Cosmos calls itself the "Internet of Blockchains" and enables the creation of individual Layer 1 blockchains that can easily transact and transfer value between one another. The following table illustrates the different attributes of smart contract blockchains:

Exhibit 2: Characteristics of different Smart Contract Protocols

	Algorand	Avalanche	BSC
Architecture	Single-Chain	Multi-chain (subnets)	Single-chain (synchronous)
Consensus	Proof-of-Stake	Avalanche Proof-of-Stake	Proof-of-Stake
TPS	1100	4500	220
Finality Time (sec)	4-5	2	35
CPU Cores	2	2	8
RAM (GB)	4	4	16

	Cosmos	Ethereum	Polkadot	Solana
Architecture	Multi-Chain (IBC-compatible)	Single-chain (synchronous)	Multi-Chain (Parachains)	Single-Chain (synchronous)
Consensus	Tendermint Proof-of-Stake	Proof-of-Stake	Nominated Proof-of-Stake	Proof-of-History
TPS	4000	20	100000	50000
Finality Time (sec)	7	78	12-60	2
CPU Cores	4	4	8	12
RAM (GB)	16	8	32	128

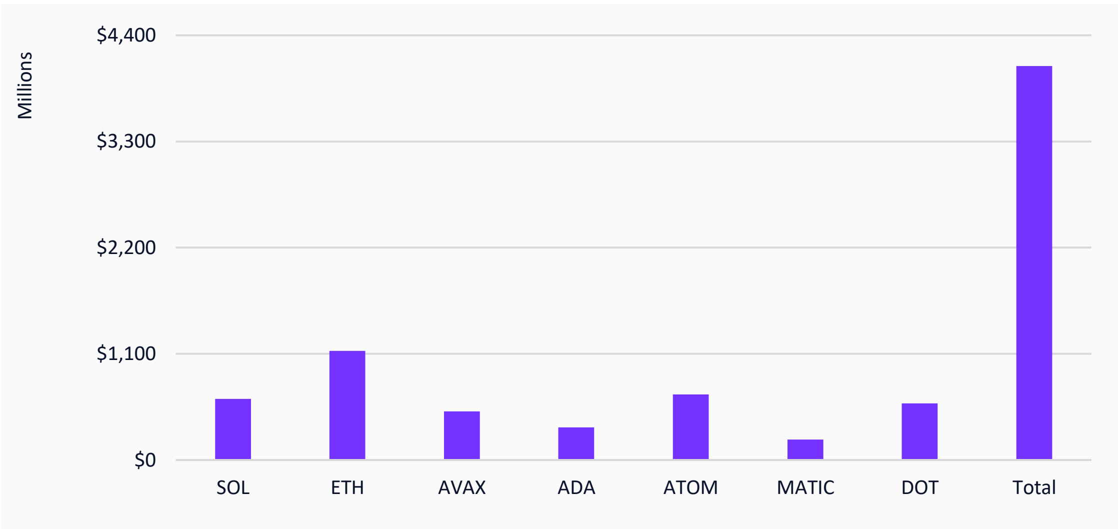
Source: Coin98 Analytics, the Block Research. TPS is the number of transactions a blockchain network can process each second or the number of transactions executed per second. Finality Time is an accurate gauge of speed for blockchain networks and indicates how long it takes, till a transaction is confirmed and final in. The hardware date CPU & RAM indicate how large the requirements are to run a node in the network.

When it comes to Proof-of-Stake algorithms, each blockchain focuses on a different approach, with varying hardware requirements. The Ethereum competitors excel in terms of Transaction Throughput (TPS), but the level of decentralization can be more challenging to evaluate. Oftentimes, a faster transaction speed may compromise security and result in centralization. If you're considering investing in any Layer-1 blockchain tokens, it's important to weigh the strengths and weaknesses, including scalability and composability, which determine the network's ability to process transactions and integrate components for specific products and services, such as DeFi or NFTs. Lastly, it's crucial for investors to consider the adoption rate of these smart contract chains and gauge the engagement of the user and developer community to accurately assess the value of the network.

Valuing Smart Contract Protocols

Most smart contract platforms collect transaction fees denominated in the native tokens and mint new issuance rewarded to network validators or to other users who delegate tokens to network validators. This consensus algorithm is called Proof-of-Stake, which selects validators in proportion to their quantity of holdings in the associated token. Multiplying the percentage of a given token's supply which is staked, by the interest rate (APY) on offer by delegated validators or directly from the protocol, yields the market's expectations of value creation over the next year. As of February 2023, the following sample of smart contract platforms "market-implied revenue" totals $4.0bn on a combined market cap of $254bn, putting the universe on a price-to-sales ratio of ~66x forward estimates.

Exhibit 3: Smart Contract 1 year forward revenue implied by current staking rates



Source: MarketVector, stakingrewards.com, Staking Rewards are APYs. Data as of February 8, 2023.

Token	Staking Rate
SOL	7.06%
ETH	3.86%
AVAX	9.13%
ADA	3.32%
ATOM	22.06%
MATIC	4.53%
DOT	14.43%

Smart Contract Methodology & Performance

MarketVector puts the Smart Contract token in different indexes according to size and liquidity criteria. Broad indexes will capture the performance of coins with $250mn market cap and $10mn average daily transaction volume (ADTV). Leaders capture the performance of coins with $1bn market cap and $25mn ADTV, and introduces additional screening requiring the coins to be traded on a major US exchange and supported by a reputable crypto custodian.

The categorization is split into 3 layers: **Category, Industry Group** and **Industry**. MarketVector differentiates platforms by their architecture:

Exhibit 4: MarketVector Category Scheme for Smart Contracts

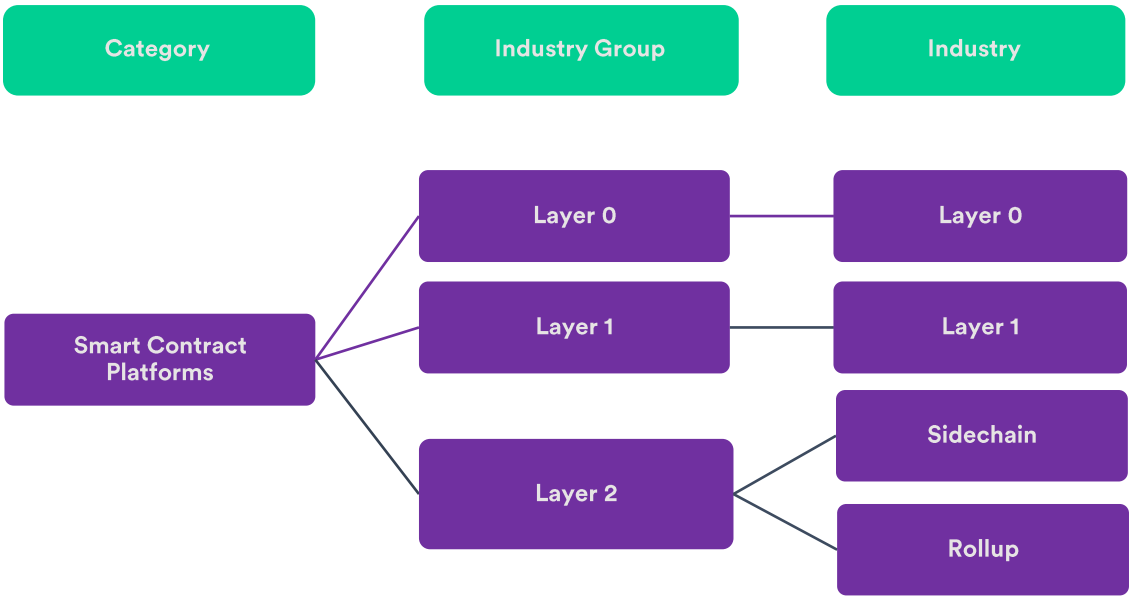
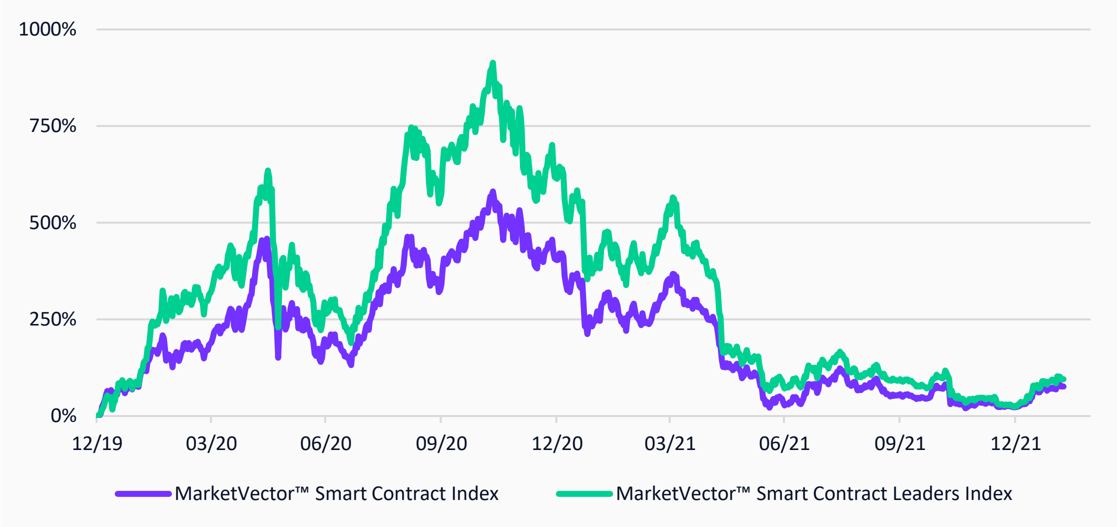


Exhibit 5: Cumulative Performance

Shows the cumulative performance of the **MarketVector™ Smart Contract Indexes** since January 2021.



	Leaders	Broad
Annualized Return	24.46%	20.44%
Annualized Volatility	80.26	77.88
Market Cap bn USD	266.53	277.56
# Constituents	13	25

Source: MarketVector, data as of February 8, 2023.

As shown in **Exhibit 5**, the leaders outperform the broad index. Nevertheless, both indexes show a strong cumulative performance over the bull run in 2021. While the competition between smart contract platforms may be fierce, the cost-advantage of these protocols vs. traditional finance and web 2.0 platforms is becoming more evident to market participants. A diversified exposure to this growing sector can be an attractive foundation of growth-oriented portfolios. **MarketVector™ Smart Contract Indexes** provide investors a simple and robust solution to create innovative products.

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Martin Leinweber is works as a Digital Asset Product Strategist at MarketVector Indexes™ providing thought leadership in an emerging asset class. His role encompasses product development, research and the communication with the client base of MarketVector Indexes™. Prior to joining MarketVector Indexes™, he worked as a portfolio manager for equities, fixed income and alternative investments for almost two decades. He was responsible for the management of active funds for institutional investors such as insurance companies, pension funds and sovereign wealth funds at the leading German quantitative asset manager Quoniam. Previously, he held various positions at one of Germany's largest asset managers, MEAG, the asset manager of Munich Re and ERGO. Among other things, he contributed his expertise and international experience to the establishment of a joint venture with the largest Chinese insurance company PICC in Shanghai and Beijing. Martin Leinweber is co-author of “Asset-Allokation mit Kryptoassets. Das Handbuch “(Wiley Finance, 2021). It’s the first handbook about integrating digital assets into traditional portfolios. He has a Master in Economics from the University of Hohenheim and is a CFA Charter holder.

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