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CLASSIFICATION OF ON-CHAIN METRICS FOR STRUCTURAL ANALYSIS OF DIGITAL ASSET MARKETS

Abstract. This study develops a structured classification of on-chain metrics for the analysis of digital asset market structure and introduces a five-dimensional analytical framework that integrates blockchain-derived indicators into a coherent system of market interpretation. I examine the analytical roles of transaction activity metrics, supply distribution indicators, liquidity measures, network participation variables, and investor behaviour signals as complementary dimensions describing capital circulation processes within distributed ledger environments. I construct a methodological taxonomy that organizes heterogeneous blockchain indicators according to their structural contribution to market analysis rather than their technical measurement properties. I demonstrate that transaction metrics capture the intensity and direction of capital flows, supply distribution indicators reflect ownership concentration and accumulation regimes, liquidity measures describe the availability of assets for exchange participation, network activity metrics signal changes in user engagement, and behavioural indicators reveal shifts in investor positioning across market cycles. I further propose a five-dimensional structural model that explains how these analytical layers interact and jointly determine the internal configuration of digital asset ecosystems.

I introduce the concept of structural on-chain analytics as an integrated methodological approach that interprets blockchain-based indicators as components of a unified analytical environment rather than isolated measurements of network activity. I show that this framework improves the consistency of market diagnostics and supports the identification of structural transitions between accumulation, distribution, expansion, and consolidation regimes observable in distributed financial systems. The results extend the methodological foundations of digital asset market research and provide a systematic basis for integrating blockchain-derived indicators into investment analysis, risk evaluation, and structural monitoring of cryptocurrency markets. The proposed classification framework supports the development of multidimensional analytical models capable of improving the interpretation of capital allocation dynamics within blockchain-based financial infrastructures.

Keywords: *On-Chain Metrics, Digital Asset Markets, Blockchain Analytics, Market Structure Analysis, Structural On-Chain Analytics, Liquidity Indicators, Supply Distribution Metrics, Network Activity Metrics, Investor Behaviour Metrics.*

JEL Classification: G10; G12; G17; C38.

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Introduction. The rapid expansion of blockchain-based financial infrastructures has fundamentally transformed the informational environment of digital asset markets and created new opportunities for analysing market dynamics through indicators derived directly from distributed ledger data. Unlike traditional financial market analysis, which relies primarily on price movements, trading volumes and balance-sheet information, blockchain networks provide transparent and continuously updated records of transactions, ownership redistribution and participant behaviour. This technological characteristic has led to the emergence of on-chain metrics as an independent analytical layer capable of reflecting the internal structural processes of digital asset ecosystems.

The growing importance of cryptocurrencies in global financial architecture increases the need for methodological approaches capable of interpreting blockchain-derived indicators not only as descriptive measurements of network activity but as structural signals of market transformation. In academic research and applied analytics, however, on-chain metrics are still predominantly used as isolated indicators integrated into platform-specific dashboards rather than as elements of a unified analytical framework. As a result, their explanatory potential for identifying capital flow dynamics, ownership configuration changes, liquidity conditions and behavioural shifts of market participants remains only partially realised.

The problem of constructing a coherent classification system for on-chain indicators is directly connected with broader scientific and practical tasks related to the structural interpretation of digital asset markets. The ability to systematise blockchain-derived metrics into analytically meaningful groups creates the methodological basis for diagnosing market-cycle phases, identifying accumulation and distribution regimes, and evaluating the sustainability of digital asset ecosystems. From a practical perspective, such systematisation supports investment decision-making, improves risk assessment procedures and enhances the reliability of analytical models applied in cryptocurrency market research.

The purpose of this study is to develop a structured classification of on-chain metrics for the analysis of digital asset markets and to propose a five-dimensional structural model that integrates blockchain-derived indicators into a coherent analytical framework for interpreting transaction dynamics, ownership configuration, liquidity conditions, network utilisation intensity and investor behaviour.

To achieve this objective, the study addresses the following research tasks: to analyse the analytical nature and functional role of on-chain metrics in digital asset market research; to systematise blockchain-derived indicators according to their contribution to the structural interpretation of market dynamics; to develop a classification of on-chain metrics reflecting their structural role in digital asset market analysis; to construct a five-dimensional structural model of digital asset markets based on integrated interactions among groups of on-chain indicators; to introduce the concept of structural on-chain analytics as a methodological approach to interpreting blockchain-derived market information.

The object of the research is the system of blockchain-based indicators describing the internal structure of digital asset markets. The subject of the research is the classification and structural interpretation of on-chain metrics as analytical instruments for identifying transaction dynamics, ownership redistribution processes, liquidity conditions, network participation intensity and behavioural transformations of market participants within cryptocurrency ecosystems.

The development of a structured analytical framework for interpreting on-chain indicators contributes to expanding the methodological foundations of digital asset market research and supports the transition from descriptive blockchain monitoring toward multidimensional structural analysis of distributed financial systems.

Literature Review. The growing importance of digital asset markets has stimulated a rapidly expanding body of academic research devoted to understanding the determinants of cryptocurrency price formation, market structure, transaction dynamics, and behavioural patterns of network participants. Early studies primarily examined cryptocurrencies as speculative financial assets and focused on return distributions, volatility characteristics, and diversification potential within investment portfolios. In particular, Liu and Tsyvinski (2020) demonstrated that cryptocurrency returns are largely driven by factors specific to blockchain adoption and investor demand rather than traditional macroeconomic variables, highlighting the distinct analytical nature of digital asset markets. Similarly, Ang, Morris, and Savi (2023) showed that cryptocurrencies exhibit asymmetric payoff structures attractive for portfolio allocation under preferences for positive skewness, confirming their role as nontraditional investment instruments within alternative asset classes.

A substantial group of studies investigates the mechanisms of price discovery and market efficiency in cryptocurrency trading environments. Research by Entrop, Frijns, and Seruset (2020) identified the determinants of price discovery across Bitcoin markets and demonstrated that liquidity fragmentation across exchanges significantly affects informational efficiency. Complementary evidence provided by Dimpfl and Peter (2021) suggested that price discovery in cryptocurrency markets is distributed across multiple trading venues rather than concentrated within a single exchange, reflecting the decentralised structure of digital asset ecosystems. Further contributions by Gemayel, Franus, and Bowden (2023) confirmed the interaction between spot markets and exchange-traded cryptocurrency products in the price discovery process, while Chen and Yang (2024) showed that the relative importance of derivatives markets in price formation varies over time depending on market conditions.

The role of derivatives and exchange-traded instruments in shaping cryptocurrency price dynamics has also received considerable attention. Augustin, Rubtsov, and Shin (2023) demonstrated that the introduction of Bitcoin futures contracts significantly influenced spot market volatility and information transmission channels. Similar conclusions were reached by Mohamad (2025), who showed that the launch of Bitcoin exchange-traded funds contributed to shifts in price discovery mechanisms by increasing institutional participation. Mazur and Polyzos (2025) further emphasised the importance of ETF fund flows as a structural factor affecting Bitcoin price formation, suggesting that institutional investment vehicles increasingly shape market liquidity conditions and capital allocation processes.

Another important research direction concerns the relationship between supply dynamics and cryptocurrency price behaviour. Rudd and Porter (2025) demonstrated that Bitcoin price movements reflect the interaction between supply constraints embedded in protocol design and fluctuations in investor demand. Ciaian, Kancs, and Rajcaniova (2026) extended this perspective by distinguishing between on-chain and off-chain demand drivers and showed that blockchain-recorded transaction activity contributes significantly to explaining price variations beyond traditional trading indicators. Similarly, Podhorsky (2024) questioned whether Bitcoin prices reflect fundamental value and argued that deviations between market valuation and structural supply conditions may indicate speculative bubbles rather than equilibrium pricing mechanisms.

A separate strand of literature focuses on the structural properties of blockchain networks themselves and their role in shaping market behaviour. Kubal and Kristoufek (2022) demonstrated the endogenous relationship between Bitcoin price and network hash rate, confirming the interaction between technological infrastructure and market valuation. Sun et al. (2022) analysed the spatial distribution of mining activity and showed that geographical concentration of computational resources influences network stability and security conditions. In addition, Kim, Ryu, and Webb (2023) examined transaction fee formation mechanisms and demonstrated that competition among network participants plays a decisive role in determining equilibrium transaction costs within blockchain systems.

The emergence of decentralised finance (DeFi) has further expanded the analytical scope of digital asset research by introducing new financial infrastructures operating entirely on blockchain networks. Schär (2022) provided one of the most comprehensive conceptual analyses of DeFi markets, demonstrating that smart-contract-based financial systems replicate traditional financial services while eliminating the need for intermediaries. Similar conclusions were reached by Jensen, von Wachter, and Ross (2021), who emphasised the structural transformation of financial intermediation in decentralised environments. Grassi et al. (2022) further argued that DeFi ecosystems challenge the conventional role of financial intermediaries by redistributing risk-management and settlement functions across network participants.

Within blockchain analytics research, increasing attention has been devoted to the interpretation of transaction-level data and ownership structures recorded in distributed ledger environments. Xia et al. (2025) proposed a two-layer transaction-network methodology for identifying address ownership patterns, demonstrating the analytical value of transaction graph structures for behavioural analysis of cryptocurrency users. Similarly, Celig, Ockenga, and Schoder (2025) examined the distributional equality of Ether supply and showed that ownership concentration remains a persistent structural characteristic of blockchain-based asset systems despite increasing adoption. These findings confirm that supply distribution metrics represent a critical analytical dimension for understanding capital concentration processes within digital asset markets.

At the same time, recent research has increasingly recognised the importance of integrating blockchain-based indicators into broader analytical frameworks describing

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network utilisation intensity and behavioural transformations of market participants. Kristoufek (2020) demonstrated that mining activity evolves along equilibrium adjustment paths consistent with endogenous network development processes, while Tsang and Yang (2021) analysed the market for Bitcoin transactions and showed that transaction demand reflects structural interaction between users and network infrastructure. Complementary evidence provided by Mišić, Mišić, and Chang (2022) highlighted the role of transaction message optimisation in improving network efficiency and reducing operational costs within blockchain environments.

Despite the significant progress achieved in analysing individual dimensions of cryptocurrency markets, existing studies remain largely fragmented in their interpretation of blockchain-derived indicators. Most empirical contributions examine either price discovery mechanisms, derivatives market effects, mining activity, supply dynamics, or DeFi infrastructures separately, without integrating transaction activity metrics, ownership distribution indicators, liquidity measures, network utilisation variables, and behavioural signals into a unified structural analytical system. As a result, the methodological potential of on-chain data for comprehensive market-structure research remains insufficiently developed.

Research Methodology. The methodological framework of this study is based on the structural interpretation of blockchain-derived indicators as multidimensional components of digital asset market analysis. The research applies the concept of structural on-chain analytics, according to which blockchain-based metrics are examined not as isolated numerical indicators but as elements of an integrated analytical system reflecting transaction dynamics, ownership configuration, liquidity conditions, network utilisation intensity, and behavioural transformations of market participants within distributed ledger environments.

The empirical component of the study was conducted by the author on the basis of publicly available blockchain analytics datasets covering the Bitcoin network as the largest and most representative digital asset ecosystem in terms of market capitalisation, transaction volume and analytical transparency. The analysed time horizon includes the period from 2011 to 2026, which makes it possible to examine structural transformations of digital asset markets across several complete market cycles, including expansion, correction, consolidation and accumulation phases.

The empirical data used in the study were obtained from recognised blockchain analytics platforms, including Glassnode Studio[1], CryptoQuant[2], and Coinglass[3], which provide aggregated on-chain indicators derived directly from distributed ledger transaction records. These datasets include transfer volume dynamics, long-term and short-term holder supply indicators, liquid and illiquid supply measures, exchange reserve statistics, active address indicators, and realised profit–loss metrics reflecting investor positioning across market cycles. The selected indicators form a representative analytical sample covering all five structural dimensions of digital asset market activity considered in the proposed classification framework.

The structure of the dataset reflects monthly and aggregated time-series observations describing transaction activity intensity, supply redistribution processes, liquidity availability conditions, network participation levels, and behavioural responses of market participants. The use of longitudinal blockchain data allows the identification of persistent structural regularities rather than short-term fluctuations associated with individual trading episodes.

The analytical methodology combines classification analysis, comparative structural interpretation, time-series observation, and visual analytical modelling. Classification analysis was applied to systematise on-chain indicators according to their functional analytical roles within transaction activity measurement, ownership distribution evaluation, liquidity condition assessment, network utilisation monitoring and investor behaviour interpretation. Comparative structural analysis made it possible to identify interdependencies between different groups of blockchain-derived indicators and to interpret their joint contribution to the formation of market-cycle phases. Time-series analysis supported the identification of long-term regularities in capital circulation dynamics and behavioural positioning across different stages of digital asset market development.

1 Glassnode Studio. URL: https://studio.glassnode.com/ (date of access: 25.03.2026).

2 CryptoQuant. URL: https://cryptoquant.com/ (date of access: 25.03.2026).

3 Coinglass. URL: https://www.coinglass.com/ (date of access: 25.03.2026).

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In addition, graphical analytical modelling was used to construct the proposed five-dimensional structural model of digital asset markets describing interactions between the principal groups of on-chain metrics.

An important methodological feature of the research consists in the integration of heterogeneous blockchain indicators into a unified analytical taxonomy reflecting their structural role in market interpretation. This approach makes it possible to distinguish between indicators describing transfer intensity, ownership concentration,

Main Results. The rapid expansion of blockchain-based financial infrastructures has led to the emergence of a new category of analytical indicators derived directly from distributed ledger data. Unlike traditional market indicators that rely primarily on price dynamics, trading volumes or financial reporting information, on-chain metrics reflect the internal transactional structure of digital asset networks and therefore provide direct insight into the economic activity recorded within blockchain systems. These indicators form an independent informational layer that allows researchers to observe capital movements, ownership distribution patterns and behavioural transformations of market participants with a level of transparency that is not available in conventional financial markets.

In analytical practice, however, on-chain metrics are most often applied as isolated indicators interpreted within platform-specific dashboards rather than as elements of a coherent methodological framework. As a result, their analytical potential remains only partially realised, since the absence of a structured classification limits the possibility of integrating blockchain-derived indicators into the general system of financial market analysis. The transformation of on-chain data into a consistent analytical toolkit therefore requires a systematic interpretation of their functional roles within the structure of digital asset market research.

From a methodological perspective, on-chain metrics should be understood not merely as technical measurements of blockchain activity but as structural indicators describing different dimensions of network-based economic processes. Each metric reflects a specific aspect of interaction between market participants, transaction flows and asset distribution mechanisms recorded in the ledger environment. Their analytical significance arises from the fact that blockchain networks simultaneously perform the functions of settlement infrastructure, ownership registry and transaction archive, which allows on-chain data to capture both behavioural and structural characteristics of market dynamics. The classification of on-chain metrics represents a necessary step toward constructing a unified analytical framework capable of supporting structural interpretation of digital asset markets. Such classification makes it possible to distinguish between indicators describing transaction intensity, ownership configuration, liquidity conditions, network utilisation and behavioural transformations of participants. The differentiation of these analytical dimensions provides the basis for interpreting blockchain data not as a collection of heterogeneous numerical signals but as an integrated system of market structure indicators.

The analytical potential of on-chain data becomes methodologically meaningful only when individual indicators are organised into a coherent classification system reflecting their functional role in the structural interpretation of digital asset markets. Although existing analytical platforms provide extensive sets of blockchain-based indicators, these metrics are typically presented as isolated measurement tools rather than as elements of an integrated analytical framework. This limits their systematic application in academic financial research. In order to address this limitation, a structured classification of on-chain metrics is proposed based on their analytical contribution to the interpretation of capital flows, ownership configuration, liquidity conditions, network utilisation intensity and behavioural dynamics of market participants. The proposed taxonomy forms a conceptual basis for interpreting blockchain-derived indicators as components of a unified system of structural market analysis. Table 1 presents the classification of on-chain metrics.

The proposed classification demonstrates that on-chain metrics differ not only in their measurement techniques but also in their analytical functions within the interpretation of market structure. Grouping indicators according to their role in describing transaction activity, ownership distribution, liquidity movements, network utilisation and behavioural transformations allows blockchain data to be integrated into a coherent methodological framework for financial market analysis.

Transaction metrics represent the primary analytical layer of on-chain data because they reflect the intensity and direction of value transfers recorded within blockchain networks

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Table 1. Classification of on-chain metrics for structural analysis of digital assets

Metric category	Analytical content	Typical indicators	Analytical role in market structure research
Transaction metrics	Reflect the intensity and direction of value transfers recorded within blockchain networks	Transaction volume, number of transactions, average transaction size, transfer velocity	Identification of capital flow dynamics and transactional activity within digital asset markets
Supply distribution metrics	Describe the structure of asset ownership and concentration of holdings across network participants	Holder concentration ratios, whale balances, long-term vs short-term holder supply, realised capitalisation structure	Assessment of ownership configuration and redistribution processes affecting market stability
Liquidity metrics	Characterise the movement of assets between storage environments and trading infrastructure	Exchange inflows and outflows, exchange reserve balances, stablecoin supply dynamics, transfer-to-exchange ratios	Evaluation of liquidity conditions and potential supply pressure within trading environments
Network activity metrics	Measure the level of economic utilisation of blockchain infrastructure	Active addresses, new addresses, transaction fees, hash rate indicators	Assessment of network utilisation intensity and underlying economic activity of digital asset ecosystems
Investor behaviour metrics	Reflect behavioural patterns of market participants derived from holding duration and transaction inactivity	Dormancy indicators, holding period structure, accumulation signals, distribution signals	Identification of behavioural transformations and shifts in investment strategies across market cycles

and provide direct evidence of capital circulation beyond exchange-based trading activity. Among the most informative indicators in this category is transaction volume (Fig. 1), which measures the total value transferred across the network and reflects the scale of capital participation in network activity. Sustained growth in transfer volume typically indicates expansion of economic engagement, whereas declining values may signal contraction of transactional demand.

The dynamics of total transfer volume presented in Fig. 1 reflect several structural regularities of transaction activity within digital asset markets. In particular, pronounced increases in transfer volume coincide with key phases of market-cycle transformation and indicate intensified capital redistribution within the network. Periods of sustained price growth are generally accompanied by an expansion of transaction activity, which reflects the strengthening economic utilisation of the network infrastructure. At the same time, subsequent declines in transfer volume after phases of market overheating signal a temporary contraction of capital

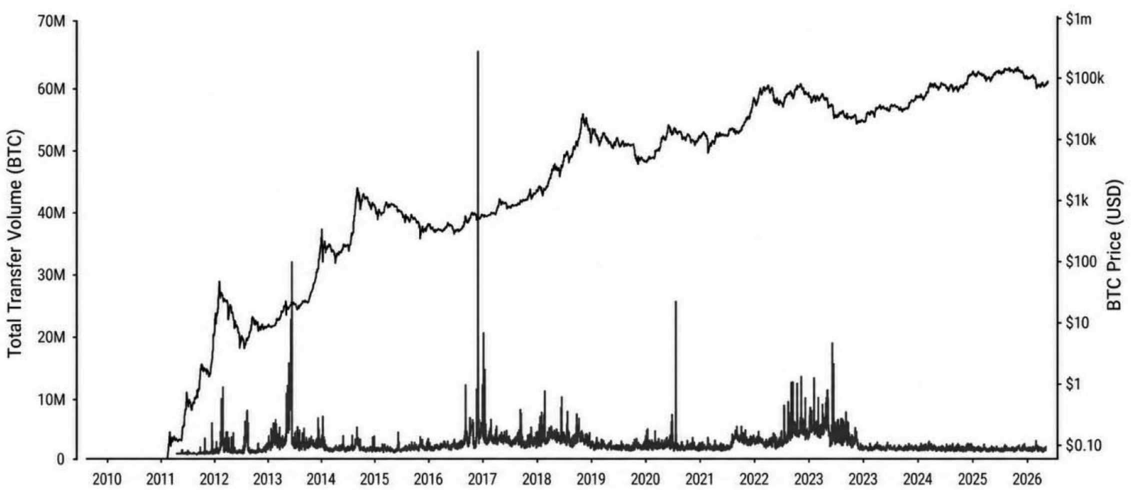

Fig. 1. Total transfer volume in the Bitcoin network as an indicator of transaction activity intensity

Source: Glassnode Studio[1]

1 Glassnode Studio (2026) BTC: Total Transfer Volume. URL: https://studio.glassnode.com/charts/transactions.TransfersVolumeSum?a=BTC (date of access: 25.03.2026).

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circulation. The divergence observed between price dynamics and transfer activity further confirms that transaction metrics function as independent indicators of structural changes in network-level economic behaviour.

The number of transactions captures the frequency of interactions between network participants and therefore reflects the degree of decentralised economic activity. When transaction counts increase without significant changes in transfer size, this usually indicates broader participation rather than concentration of capital. An additional structural perspective is provided by average transaction size, which helps distinguish between institutional-scale transfers and retail-level activity and supports the identification of shifts in the composition of market participants. Complementary insight is offered by transaction velocity, which reflects the intensity of asset circulation within the network and indicates redistribution processes across ownership structure. Taken together, transaction metrics support the identification of capital flow intensity, participation structure and redistribution dynamics within digital asset markets, allowing differentiation between accumulation, circulation and consolidation phases of network-based economic activity.

Supply distribution metrics constitute a key analytical category of on-chain indicators that describe the allocation of digital assets across different groups of network participants and therefore reveal the structural configuration of ownership within the market. Unlike transaction metrics reflecting capital movement intensity, these indicators capture concentration patterns, accumulation behaviour and redistribution processes shaping the internal architecture of asset supply.

Among the most informative measures are holder concentration (Fig. 2.), which reflects the share of supply controlled by large participants and indicates structural asymmetries in ownership distribution, and long-term holder supply, which characterises the extent of strategic accumulation and the stability of investor positioning. Complementary insight is provided by short-term holder supply, reflecting the proportion of actively circulating assets associated with increased trading responsiveness to market fluctuations. Additional analytical significance is associated with the realised capitalisation structure, which evaluates supply distribution according to acquisition price levels and enables the identification of accumulation zones and shifts in investor cost basis across market cycles.

The dynamics of long-term holder supply presented in Fig. 2 reflect structural changes in ownership distribution associated with accumulation behaviour across market cycles. A persistent increase in the share of assets held by long-term participants indicates the strengthening of strategic positioning and reduced short-term circulation within the network, whereas temporary declines typically correspond to redistribution phases and rising transactional activity. The comparison with price dynamics demonstrates that growth in long-term holder balances often

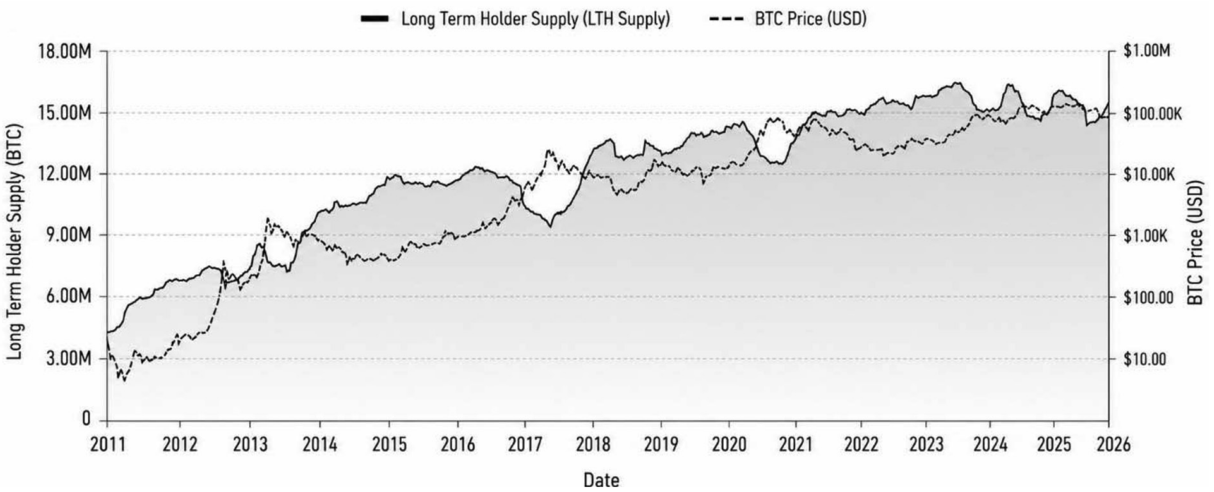

Fig. 2. Long-term holder supply as an indicator of strategic accumulation dynamics in digital asset markets

Source: Coinglass[1]

1 Coinglass (2026) Bitcoin Long Term Holder Supply. URL: https://www.coinglass.com/pro/i/long-term-holder-supply (date of access: 25.03.2026).

precedes or accompanies periods of market stabilisation, confirming the analytical significance of this indicator for identifying accumulation regimes and shifts in investor time horizons within the ownership structure of digital asset markets.

Liquidity metrics represent an analytical category of on-chain indicators that characterise the availability of assets for exchange, transfer and market participation within blockchain networks. Unlike transaction metrics reflecting movement intensity and supply distribution metrics describing ownership structure, liquidity indicators capture the degree to which assets remain economically active and capable of responding to changes in market conditions.

Among the most informative measures are liquid supply (Fig. 3.) and illiquid supply, which distinguish between assets

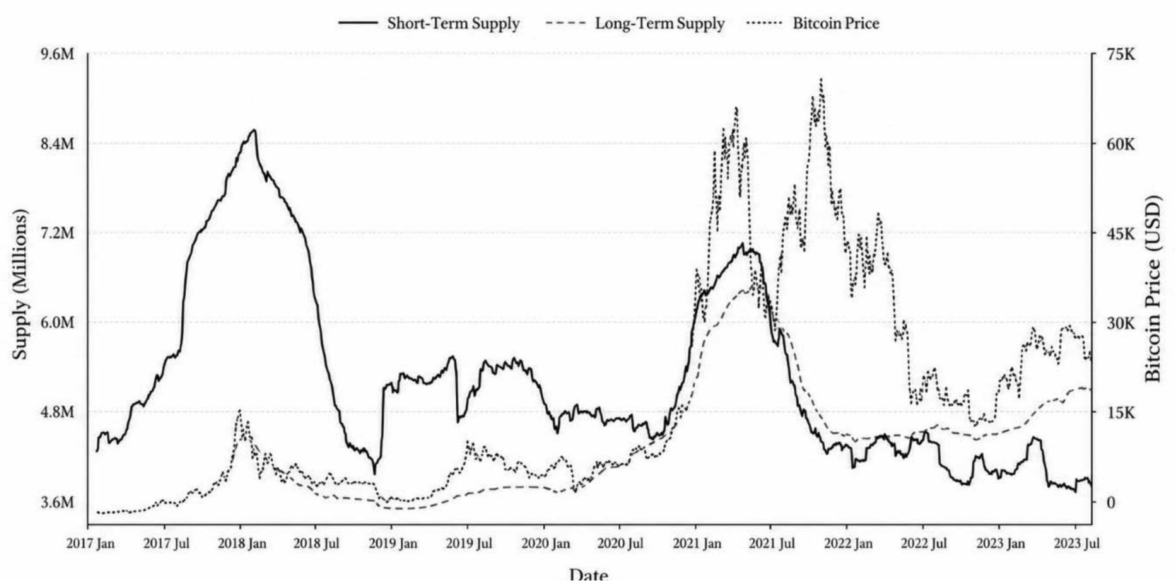

Fig. 3. Dynamics of short-term holder supply as an indicator of circulating liquidity in the Bitcoin market

Source: Cryptoquant[1]

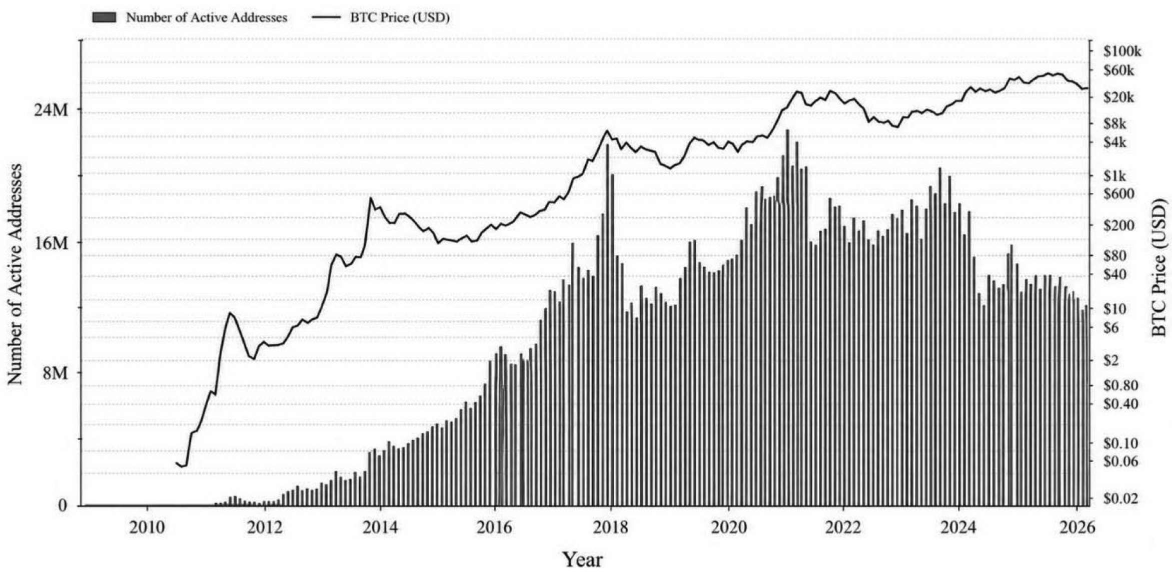

Fig. 4. Dynamics of active addresses as an indicator of network participation intensity in the Bitcoin ecosystem

Source: Glassnode Studio[2]

1 Cryptoquant (2023) Examining Bitcoin's Liquid Supply. URL: https://cryptoquant.com/insights/quicktake/64fcc4540526041375d31238-Examining-Bitcoins-Liquid-Supply (date of access: 25.03.2026).

2 Glassnode Studio (2026) BTC: Number of Active Addresses. URL: https://studio.glassnode.com/charts/addresses.ActiveCount?a=BTC&chartStyle=column&mScl=lin&resolution=1month&zoom=all (date of access: 25.03.2026).

regularly involved in circulation and assets held in long-term storage. Changes in their relative proportions reflect shifts between accumulation and distribution regimes. Complementary insight is provided by exchange reserve dynamics, which indicate the volume of assets available for potential trading activity and therefore signal variations in short-term market responsiveness. Together, liquidity metrics support the identification of circulation capacity, capital availability and structural constraints affecting price formation processes within digital asset markets.

The dynamics of short-term holder supply reflect structural changes in the share of assets available for active market circulation and therefore characterise variations in liquidity conditions across market cycles. Periods of increasing short-term supply correspond to phases of intensified trading participation and higher sensitivity of the market to price fluctuations, whereas declining values indicate transitions toward accumulation regimes associated with reduced circulating liquidity. The comparison with Bitcoin price reveals that expansions of liquid supply typically accompany upward market phases, while subsequent contractions signal the redistribution of assets into longer-term holding structures and the stabilisation of ownership configuration within the network.

Network activity metrics reflect the intensity of interactions between participants within blockchain networks and therefore characterise the level of functional utilisation of digital assets beyond price dynamics. Indicators such as the number of active addresses (Fig. 3.), transaction count, new address formation, and network growth rate make it possible to assess the expansion of the user base, the degree of participation in transfer activity, and the continuity of network engagement across market cycles. In structural market analysis, sustained growth of network activity typically indicates strengthening adoption processes and broadening participation, whereas declining activity signals contraction of transactional interaction and weakening demand for network usage, often preceding phases of reduced market momentum.

The number of active addresses reflects changes in the scale of user participation in blockchain transactions and serves as an indicator of functional network utilisation across market cycles. Growth in active addresses corresponds to periods of expanding adoption and increasing interaction among participants, whereas declines indicate contraction of transactional engagement and weakening network activity. The comparison with Bitcoin price dynamics demonstrates that increases in network participation typically accompany expansion phases of the market, while subsequent reductions reflect transitions toward consolidation stages in the structure of digital asset demand. Changes in realised profit and loss (Fig. 5.) provide insight into the timing and intensity of distribution and accumulation behaviour among market participants during different phases of the Bitcoin market cycle.

The dynamics of net realised profit and loss reflect shifts in investor positioning

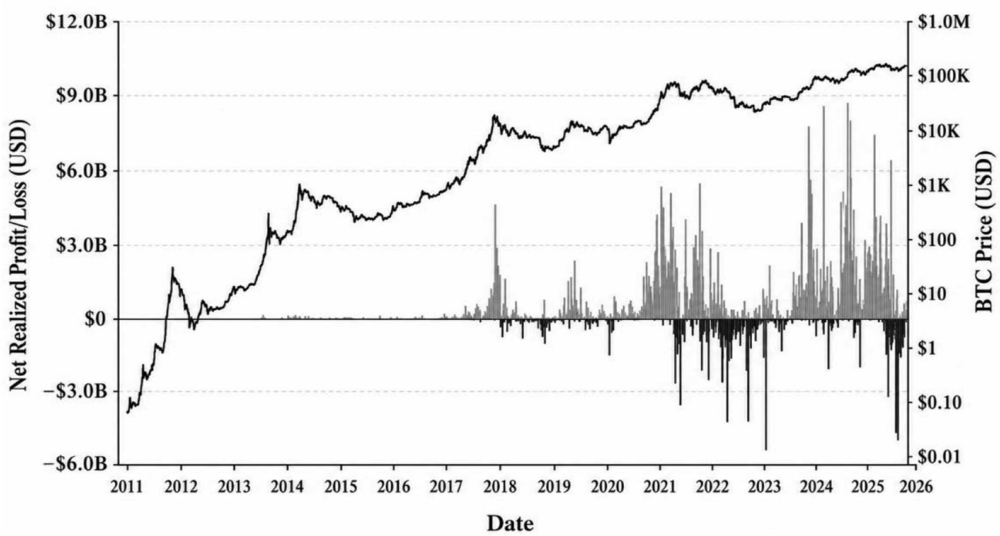

Fig. 5. Net realised profit and loss as an indicator of investor positioning across Bitcoin market cycles

Source: Coinglass[1]

1 Coinglass (2026) Bitcoin NRPL (Net Realized Profit Loss). URL: https://www.coinglass.com/pro/i/net-realized-profit-and-loss (date of access: 25.03.2026).

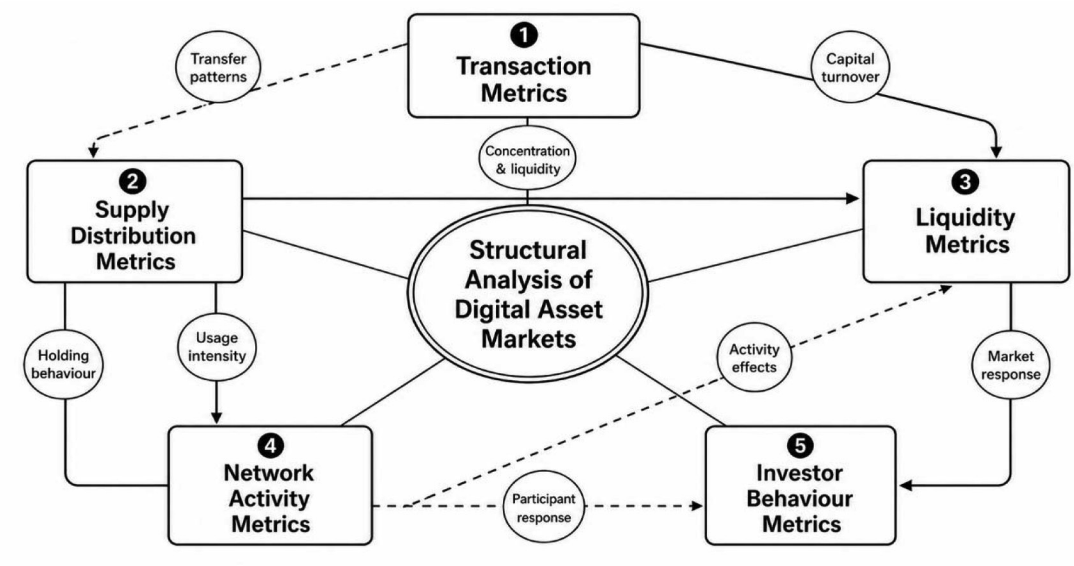

Fig. 6. Five-dimensional structural model of digital asset markets based on integrated on-chain metric interactions

between profit-taking and loss-realisation regimes, thereby revealing transitions between expansion, correction and consolidation phases of the market. Periods of large realised profits typically correspond to distribution stages associated with elevated selling pressure, whereas sustained realised losses indicate capitulation episodes and the subsequent formation of accumulation zones that support the restructuring of ownership across market cycles.

The proposed classification extends the analytical role of on-chain indicators beyond descriptive blockchain monitoring and introduces a five-dimensional structural framework for interpreting digital asset markets. Within this framework, transaction activity, ownership configuration, liquidity conditions, network utilisation and investor positioning are treated as interconnected components of market structure observable directly through distributed ledger data. In order to systematize on-chain indicators and develop a coherent analytical framework for digital asset market analysis, a five-dimensional structural model (Fig. 6.) is proposed that reflects the interactions among transaction, supply distribution, liquidity, network activity, and investor behaviour metrics.

The proposed model establishes a multidimensional framework for the structural analysis of digital asset markets by integrating five functional groups of on-chain metrics into a unified analytical system. Unlike conventional approaches, in which individual indicators are typically examined in isolation, the model reveals their structural and causal interdependencies through channels such as transfer activity, capital concentration, network usage intensity, and market participant response. This configuration enables the cryptocurrency market to be interpreted not merely as a price-driven system, but as a complex behavioural and network-based structure in which liquidity conditions, supply distribution patterns, and investor decision-making processes emerge from the interaction between transactional dynamics and network activity. As a result, the model provides a methodological basis for identifying market cycle phases and enhances the explanatory power of on-chain analysis in the context of structural digital asset market research.

Structural on-chain analytics may be defined as an integrated analytical approach to the study of digital asset markets that examines blockchain-based indicators as an interconnected system of structural relationships rather than as isolated signals of market activity. Such an approach extends the traditional scope of on-chain analysis beyond descriptive monitoring of individual metrics and enables the identification of structural shifts in market regimes, capital concentration processes, and behavioural transformations of market participants, thereby providing a more comprehensive methodological basis for diagnosing market cycle phases and assessing the sustainability of digital asset ecosystems.

Conclusion. Digital asset markets increasingly function as structurally observable financial systems in which transaction flows, ownership redistribution,

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liquidity conditions, network utilisation intensity and investor positioning become directly measurable through distributed ledger data. The proposed classification of on-chain metrics establishes a coherent analytical framework that integrates these dimensions into a unified system of structural indicators describing the internal configuration of blockchain-based market activity. Such systematisation transforms heterogeneous blockchain-derived signals into a consistent methodological toolkit suitable for interpreting capital circulation processes and behavioural transformations across cryptocurrency market cycles.

The five-dimensional structural model of digital asset markets clarifies the functional interdependencies between transaction activity, supply distribution, liquidity conditions, network participation and investor behaviour and demonstrates that these analytical layers jointly determine the structural dynamics of digital asset ecosystems. Stable and partial interactions between metric groups reveal how transfer intensity influences ownership concentration, how liquidity availability reflects redistribution regimes, and how network participation signals shifts in market engagement across different stages of market evolution. This multidimensional interpretation expands the analytical scope of blockchain data beyond descriptive monitoring and strengthens the explanatory capacity of on-chain indicators in identifying accumulation phases, distribution regimes and structural transitions in investor positioning.

The introduction of the concept of structural on-chain analytics provides a methodological foundation for interpreting blockchain-based indicators as components of an integrated analytical environment rather than isolated measurements of network activity. Such approach improves the consistency of digital asset market diagnostics and supports the identification of structural regularities in capital allocation processes observable directly within distributed ledger systems. The integration of transaction metrics, supply distribution indicators, liquidity measures, network activity variables and behavioural signals into a unified analytical taxonomy enhances the interpretative reliability of blockchain-derived information and contributes to the development of multidimensional models of cryptocurrency market structure.

The results obtained create opportunities for improving analytical procedures applied in digital asset investment research, market-cycle identification and risk assessment frameworks. Structural interpretation of blockchain indicators strengthens the ability to detect early signals of liquidity contraction, accumulation regimes and behavioural shifts among market participants, thereby supporting more informed evaluation of market sustainability conditions in cryptocurrency ecosystems.

Future research directions may include the extension of the proposed classification framework to multi-asset blockchain environments, the incorporation of decentralised finance indicators into structural market models, and the development of quantitative composite indices describing multidimensional structural states of digital asset markets. Such developments may contribute to the formation of next-generation analytical architectures capable of supporting systematic monitoring of structural transformations in distributed financial ecosystems.

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КЛАСИФІКАЦІЯ ОНЧЕЙН-МЕТРИК СТРУКТУРНОГО АНАЛІЗУ РИНКУ ЦИФРОВИХ АКТИВІВ

У статті розроблено структуровану класифікацію ончейн-метрик для аналізу ринку цифрових активів та запропоновано п’ятивимірну аналітичну модель, що інтегрує показники, отримані з даних розподілених реєстрів, у цілісну систему інтерпретації ринкової структури. Узагальнено аналітичні функції метрик транзакційної активності, показників розподілу пропозиції, індикаторів ліквідності, метрик мережевої активності та поведінкових характеристик інвесторів як взаємопов’язаних складових дослідження процесів руху капіталу в середовищі цифрових активів. Сформовано методологічну таксономію, у межах якої ончейн-індикатори систематизовано відповідно до їх структурної ролі в аналізі ринку, а не лише за технічними параметрами вимірювання. Показано, що транзакційні метрики відображають інтенсивність і напрям переміщення капіталу, показники розподілу пропозиції характеризують концентрацію активів і процеси накопичення, індикатори ліквідності визначають ступінь доступності активів для ринкової взаємодії, метрики мережевої активності відображають рівень участі користувачів у функціонуванні мережі, а поведінкові індикатори дозволяють ідентифікувати зміни позиціонування учасників ринку в межах різних фаз ринкового циклу. Запропоновано п’ятимірну структурну модель ринку цифрових активів, яка відображає взаємозв’язки між зазначеними аналітичними блоками та пояснює формування внутрішньої конфігурації цифрових фінансових екосистем.

Введено поняття структурного ончейн-аналізу як інтегрованого методологічного підходу до інтерпретації блокчейн-індикаторів у межах єдиної аналітичної системи дослідження ринку. Обґрунтовано, що використання такого підходу підвищує узгодженість діагностики ринкових трансформацій та розширює можливості виявлення структурних змін у процесах накопичення, розподілу та перерозподілу цифрових активів. Отримані результати розширюють методологічні засади дослідження ринку цифрових активів та формують основу для інтеграції ончейн-метрик у задачі інвестиційного аналізу, оцінювання ризиків і структурного моніторингу розвитку цифрових фінансових екосистем.

Ключові слова: ончейн-*метрики, ринок цифрових активів,* блокчейн-*аналітика, структурний аналіз ринку, структурний* ончейн-*аналіз, показники ліквідності, метрики розподілу пропозиції, метрики мережевої активності, поведінкові метрики інвесторів*.

JEL Classification: G10; G12; G17; C38.

Конфлікт інтересів: автор повідомляє про відсутність конфлікту інтересів.
Автор підтверджує, що в роботі використано ресурс штучного інтелекту Grammarly для перевірки та стилістичного редагування тексту англійською мовою.

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The author confirms that the artificial intelligence tool Grammarly was used in this work to check and stylistically edit the text in English.

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