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Blockchain as a Catalyst for Economic Development: Evaluating the Impact of Blockchain Technology

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Abstract

Blockchain technology has emerged as a significant innovation in the 21st century, fundamentally changing various industries by introducing decentralisation, transparency, and improved security for digital transactions. Initially developed as the foundation for Bitcoin, blockchain has evolved into a crucial tool employed across financial services, supply chain management, healthcare, governance, and various other sectors. By removing intermediaries, lowering transaction costs, and ensuring data immutability, blockchain is revolutionising global economic systems. This case study examines the economic effects of blockchain technology, particularly in relation to digital assets. This analysis explores how blockchain enhances financial efficiency through peer-to-peer transactions that operate outside traditional banking systems, demonstrating significant benefits in regions with limited financial infrastructure. The analysis delves into the influence of blockchain on supply chain transparency, enabling real-time tracking of goods, reducing fraud, and improving product authenticity ("Bitcoin: A Peer-to-Peer Electronic Cash System"). This technology's implementation in governance is assessed, highlighting its ability to improve voting systems, land registration, and public service delivery by reducing bureaucratic inefficiencies and combating corruption. An examination of blockchain integration in the healthcare sector reveals its potential to enhance patient data security, improve the interoperability of medical records, and optimise pharmaceutical supply chains. This investigation centres on the comparative examination of significant digital tokens over the past two decades. This study presents a comprehensive examination of the historical performance, stability, and return on investment of leading cryptocurrencies, such as Bitcoin, Ethereum, and Binance Coin, highlighting the most reliable and high-growth digital assets. This examination details the evolution of blockchain technology, starting with its foundational concepts in the 1990s and culminating with its widespread application across multiple industries today. The findings of this case study demonstrate that blockchain goes beyond being just a technological innovation; it acts as a vital driver for economic transformation. In light of the existing regulatory and scalability challenges, blockchain technology holds considerable promise for advancing economic development, enhancing financial security, and creating more efficient market ecosystems on a global scale (David 2017).

Keywords: Blockchain, Bitcoins, Peer-to-peer, digital currency, Crypto

Introduction

Blockchain distributed ledger technology is made up of two main parts: chains and blocks. Chains securely link blocks using cryptographic hashes, which ensures an unchangeable and verifiable record, and blocks hold transactional data for a certain amount of time. Acting as a constantly growing ledger, it keeps tamper-proof, permanent, safe notes of all the transactions. Every transaction is kept consecutively to guarantee that once recorded, data is unchangeable and cannot be altered.

This distributed method does away with the requirement for middlemen like banks or outside verifying companies.

Blockchain thus improves efficiency, openness, and security in commercial activities as well as in security. When a block reaches its maximum storage capacity, cryptographic techniques automatically produce a new block and connect it to the previous one. This procedure guarantees data integrity, lowers fraud risks, and eliminates modification possibilities (Nakamoto).

Efficiency of Blockchain

Blockchain technology simplifies difficult procedures, therefore improving operational effectiveness. The decrease in paperwork is one of its most important benefits since digital storage of transaction data replaces the requirement for actual records. This digitisation speeds the verification and settlement processes, in addition to lowering administrative expenses. Eliminating several ledgers is another important efficiency factor. Separate records maintained by companies in conventional financial systems cause discrepancies and inefficiencies. Blockchain guarantees a single source of truth whereby all the concerned parties have access to the same updated information, and so the requirement for cross-verification is eliminated. Another important quality that improves blockchain efficiency is public openness. Provided they are a part of a public blockchain network, transactions entered on a blockchain ledger are freely available. This openness lowers corruption, fosters confidence among involved parties, and enhances regulatory compliance. Moreover, the irreversibility of transactions guarantees that once they are confirmed and included in the blockchain, they cannot be changed or undone. This guarantees dependability and helps to prevent fraud, illegal alterations, and chargeback problems, thereby safeguarding money transactions (Tapscott and Tapscott)

Applications in Public and Private Sectors

Widely applicable in both public and private sectors, blockchain technology supports operational efficiency, security enhancement, and economic growth. Reduction of costs is one of its main advantages. Conventional financial systems have middlemen who raise transaction expenses: banks, brokers, and clearinghouses. Blockchain reduces costs and allows direct transactions between parties, therefore eliminating intermediaries and enabling them (Zohar 2015). Blockchain also offers more efficiency. Many businesses depend on antiquated technologies and hand-operated procedures that impede operations. By means of smart contracts, blockchain automates procedures guaranteeing flawless execution free from delays. Improved security is also critical since, recently, hacking attempts, data breaches, and cyber threats have become rather common. Blockchain is a very safe solution for both financial and non-financial uses since it uses cryptographic encryption to guard transactions and prevent illegal access of sensitive data (Pilkington).

Importance of Blockchain in the Modern Era

Blockchain technology's capacity to solve modern issues in data security, financial access, and digital transactions fuels its quick acceptance. Its main contributions are guarantees of data immutability and security. Blockchain guarantees unaltered and tamper-proof data by using cryptographic methods. Since a distributed network verifies transactions, dishonest behaviour is significantly reduced (David, 2017). Another vital component of blockchain relevance is decentralised transactions. Blockchain lets peer-to-peer transactions be free of the requirement for a centralised financial institution, unlike conventional banking systems. This improves financial inclusion, especially in areas lacking strong banking infrastructure. Blockchain also gives people authority over their own digital assets, therefore lowering dependency on outside third parties and supporting financial independence (Iansiti and Lakhani).

History of Blockchain

Blockchain technology is developing over several decades. Blockchain originated with a cryptographic technique developed by Stuart Haber and W. Scott Stornetta in 1991 to timestamp digital documents. Merkle Trees were introduced in 1992 and let several records be kept in a safe chain of blocks, thereby improving data security. Reusable Proof of Work, devised by cryptography activist Hal Finney in 2004, tackled double-spending in digital transactions. When Satoshi Nakamoto saw blockchain as a distributed, peer-to-peer electronic cash system in 2008, that was the true innovation. Launched a year later, Bitcoin—the first cryptocurrency using blockchain technology—started a new chapter in digital finance (Narayanan et al. 2025).

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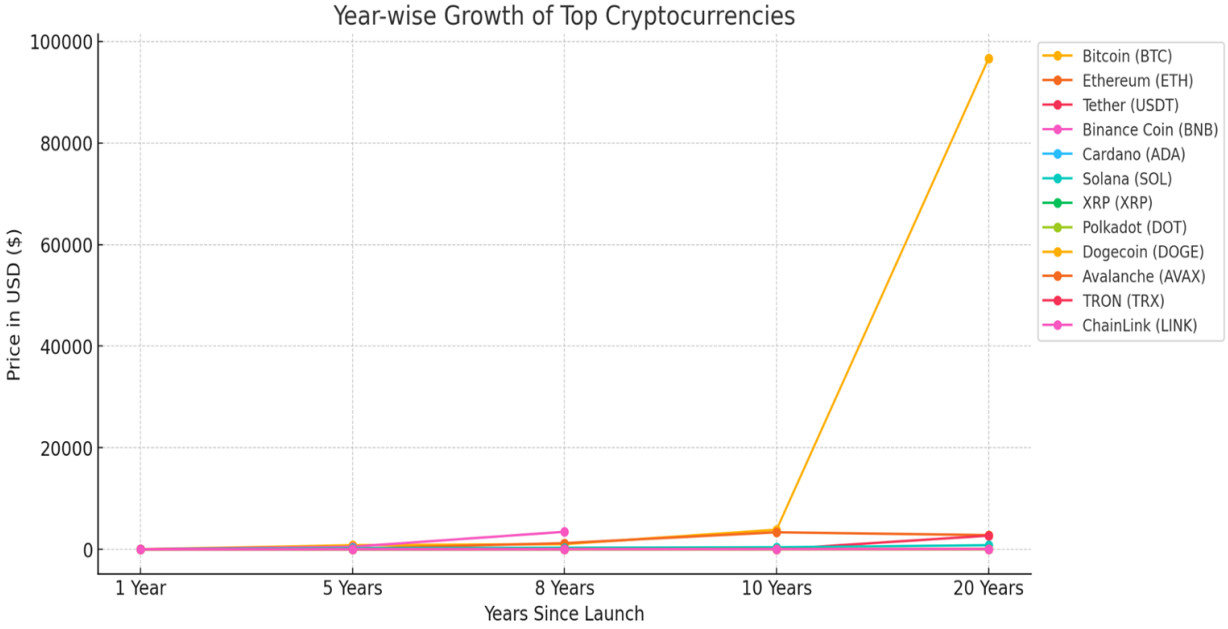
The Role of Blockchain in Economic Development

By removing intermediaries like banks and allowing direct peer-to--peer transactions that lower costs and increase efficiency, blockchain has fundamentally changed the financial sector. Blockchain-recorded transactions are non-reversible and unchangeable, therefore shielding sellers from fraud and guaranteeing more financial safety. Smart contracts' automation of payment procedures, reduction of manual intervention, and improvement of transaction correctness and dependability help to further simplify financial operations. Beyond conventional financial uses, blockchain becomes the basis for digital currencies since it provides a transparent, distributed, safe way of doing financial transactions. Blockchain guarantees tamper-proof transactions by using cryptographic encryption, therefore removing fraud and unauthorised alteration risk. Blockchain-based digital currencies' natural anonymity improves user anonymity, therefore enhancing digital payment security. Furthermore, blockchain technology minimises conversion fees by enabling smooth cross-border transactions, therefore avoiding conventional banking infrastructure and hence lowering costs and accelerating transaction speed in the worldwide economy. (Swan 2019).

Case Study: Top-Performing Digital Tokens Over the Past Two Decades

Several cryptocurrencies have shown amazing increase over the last two decades; Bitcoin (BTC) is the most



valued and often used digital asset among them. Originally costing $0.0564 in 2009, Bitcoin showed its supremacy as a store of value by rising to $96,615.44 in 20 years. Thanks to its smart contract features, Ethereum (ETH) followed with notable increase and reached $3,353.50 in a decade. While Solana (SOL), Polkadot (DOT), and Binance Coin (BNB) acquired traction in decentralised finance (DeFi) and blockchain ecosystems, Tether (USDT) stayed steady as a stablecoin. With varied degrees of volatility, XRP, Dogecoin (DOGE), and Cardano (ADA) likewise demonstrated consistent development. While younger coins like Solana and Avalanche have shown great growth potential in shorter time frames, the research emphasises Bitcoin and Ethereum as the most reliable long-term bets.

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UOM: DOLLAR

S. No	Cryptocurrency	Year Launched	1 Year	5 Years	8 years	10 Years	20 Years
1	Bitcoin (BTC)	2009	0.0564	802.39	1,021.75	3,854.79	96,615.44
2	Ethereum (ETH)	2015	0.7533	127.41	1,214.66	3,353.50	4891
3	Tether (USDT)	2014	1.0000	1.0107	1.0005	1.0007	1.001
4	Binance (BNB)	2017	9.5359	507.51	3,451.39	3500	5000
5	Cardano (ADA)	2017	0.7826	1.3776	0.9613	2	3
6	Solana (SOL)	2020	1.7993	207.77	300	400	800
7	XRP (XRP)	2012	0.005613	0.006311	0.188	0.8329	2.4034
8	Polkadot (DOT)	2020	0.2217	2.4034	5	8	10
9	Doge(DOGE)	2013	0.0003531	0.009145	0.01061	0.07145	0.0912
10	Avalanche	2020	4.1185	39.23	45	55	65
11	TRON	2017	0.07868	0.07778	0.2651	0.8	2
12	Chain Link	2019	1.7411	24.11	30	35	55

UOM: INR

S. No	Cryptocurrency	Year Launched	1 Year	5 Years	8 years	10 Years	20 Years
1	Bitcoin (BTC)	2009	14.15597	201393.79	256451	967523	24249741.3
2	Ethereum (ETH)	2015	189.0726	31978.942	304870	841703	1227603.83
3	Tether (USDT)	2014	250.9924	253.67802	251.118	251.168	251.243393
4	Binance (BNB)	2017	2393.438	127381.15	866273	878473	1254962.01
5	Cardano (ADA)	2017	196.4267	345.76713	241.279	501.985	752.977203
6	Solana (SOL)	2020	451.6106	52148.691	75297.7	100397	200793.921
7	XRP (XRP)	2012	1.40882	1.584013	47.1866	209.052	603.235137
8	Polkadot (DOT)	2020	55.64502	603.23514	1254.96	2007.94	2509.92401
9	Doge(DOGE)	2013	0.088625	2.2953255	2.66303	17.9334	22.890507
10	Avalanche	2020	1033.712	9846.4319	11294.7	13804.6	16314.5061
11	TRON	2017	19.74808	19.522189	66.5381	200.794	501.984802
12	Chain Link	2019	437.0029	6051.4268	7529.77	8784.73	13804.5821

UOM: POUND

S. No	Cryptocurrency	Year Launched	1 Year	5 Years	8 years	10 Years	20 Years
1	Bitcoin (BTC)	2009	0.044556	633.8881	807.183	3045.28	76326.1976
2	Ethereum (ETH)	2015	0.595107	100.6539	959.581	2649.27	3863.89
3	Tether (USDT)	2014	0.79	0.798453	0.7904	0.79055	0.79079
4	Binance (BNB)	2017	7.533361	400.9329	2726.6	2765	3950
5	Cardano (ADA)	2017	0.618254	1.088304	0.75943	1.58	2.37
6	Solana (SOL)	2020	1.421447	164.1383	237	316	632
7	XRP (XRP)	2012	0.004434	0.0049857	0.14852	0.65799	1.898686
8	Polkadot (DOT)	2020	0.175143	1.898686	3.95	6.32	7.9
9	Doge(DOGE)	2013	0.000279	0.0072246	0.00838	0.05645	0.072048
10	Avalanche	2020	3.253615	30.9917	35.55	43.45	51.35
11	TRON	2017	0.062157	0.0614462	0.20943	0.632	1.58
12	Chain Link	2019	1.375469	19.0469	23.7	27.65	43.45

UOM: DIHRAM

S. No	Cryptocurrency	Year Launched	1 Year	5 Years	8 years	10 Years	20 Years
1	Bitcoin (BTC)	2009	0.163521	2326.3693	2962.36	11176.2	280117.145
2	Ethereum (ETH)	2015	2.184043	369.39981	3521.66	9722.8	14180.4763
3	Tether (USDT)	2014	2.8993	2.9303225	2.90075	2.90133	2.9021993
4	Binance (BNB)	2017	27.64743	1471.4237	10006.6	10147.6	14496.5
5	Cardano (ADA)	2017	2.268992	3.9940757	2.7871	5.7986	8.6979
6	Solana (SOL)	2020	5.21671	602.38756	869.79	1159.72	2319.44
7	XRP (XRP)	2012	0.016274	0.0182975	0.54507	2.41483	6.96817762
8	Polkadot (DOT)	2020	0.642775	6.9681776	14.4965	23.1944	28.993
9	Doge(DOGE)	2013	0.001024	0.0265141	0.03076	0.20715	0.26441616
10	Avalanche	2020	11.94077	113.73954	130.469	159.462	188.4545
11	TRON	2017	0.228117	0.2255076	0.7686	2.31944	5.7986
12	Chain Link	2019	5.047971	69.902123	86.979	101.476	159.4615

Return on Investment (ROI) analysis

The top-performing cryptocurrencies' return on investment (ROI) study over several time spans exposes notable variations in market stability and growth. With an impressive 20-year ROI of 1,985,928.89%, Bitcoin (BTC) remains the most dominant asset due to its exceptional store of value. Following with a remarkable 10-year ROI

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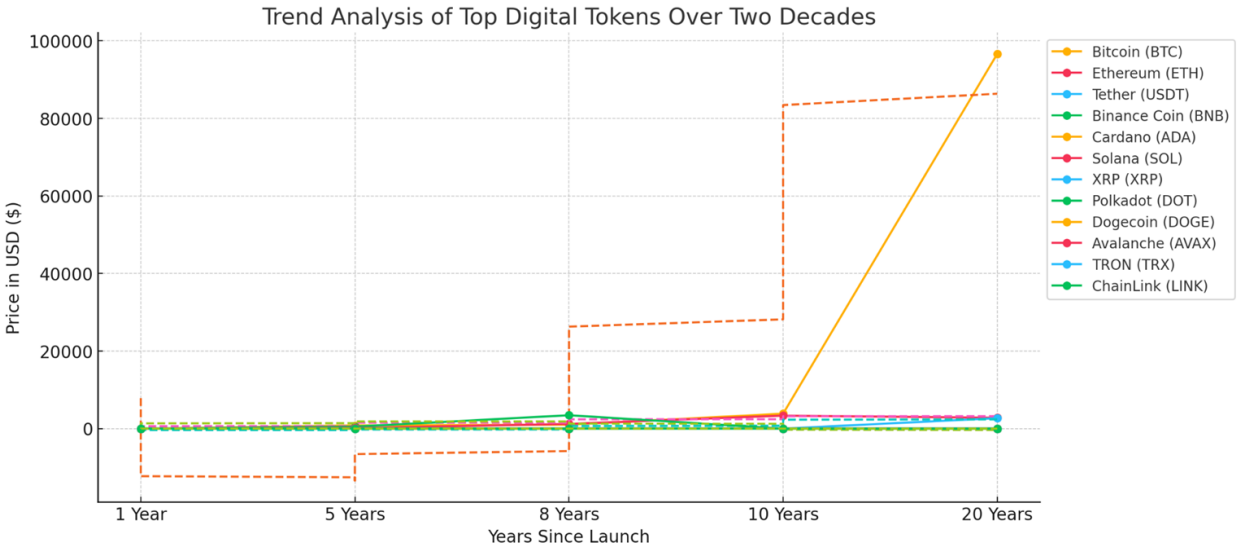
of 10,817.74%, Ethereum (ETH) is credited to its general acceptance in smart contracts and distributed apps (dApps). Maintaining a near 1:1 ROI, stablecoins such as Tether (USDT) guarantee price stability for traders. Thanks mostly to its integration into Binance's ecosystem, Binance Coin (BNB) has exhibited amazing success among utility tokens, with a 5-year ROI of 3,383% and a 10-year ROI of more than 23,333%. With Solana (SOL), Avalanche (AVAX), and Polkadot (DOT) showing significant short-term gains—Solana boasts a 5-year ROI of 944.41%. Reflecting community-driven demand rather than utility-based acceptance, meme coins including Dogecoin (DOGE) and speculative assets including TRON (TRX) and XRP have shown modest but erratic growth. While more recent blockchain initiatives present high-risk, high-reward prospects for investors, our data shows that Bitcoin and Ethereum remain the most consistent long-term investments.

Cryptocurrency	All-Time High (ATH) Price	ATH Date	All-Time Low (ATL) Price	ATL Date	ICO Price
Bitcoin (BTC)	$109,389.84	Jan 2025	$0.0008	Jul 2010	N/A (No ICO)
Ethereum (ETH)	$4,878.26	Nov 2021	$0.4209	Oct 2015	$0.31
Tether (USDT)	$1.32	Jul 2018	$0.5683	Mar 2015	N/A (No ICO)
Binance (BNB)	$686.31	May 2021	$0.09611	Aug 2017	$0.15
Cardano (ADA)	$3.10	Sep 2021	$0.01735	Oct 2017	$0.0024
Solana (SOL)	$260.06	Nov 2021	$0.5052	May 2020	$0.22
XRP (XRP)	$3.39	Jan 2025	$0.002802	Jul 2014	$0.0058
Polkadot (DOT)	$55.08	Nov 2021	$2.69	Aug 2020	$0.29
Dogecoin (DOGE)	$0.73	May 2021	$0.00008547	May 2015	N/A (No ICO)
Avalanche (AVAX)	$146.22	Nov 2021	$2.79	Dec 2020	$0.50
TRON (TRX)	$0.30	Jan 2018	$0.001091	Sep 2017	$0.0019
ChainLink (LINK)	$52.88	May 2021	$0.1263	Sep 2017	$0.11



Limitations

This study has various restrictions even if it offers insightful analysis of the part blockchain technology plays in economic development. The study depends on past data; hence, variations in data standards and market volatility could influence it. Regulatory uncertainty also presents a problem since blockchain rules differ between countries and might change suddenly, therefore influencing acceptance and performance. The research focuses on the current state of blockchain development, even though future advancements in scalability, security, and processing power could alter its economic implications. Furthermore, the market for cryptocurrencies is still rather speculative; hence, long-term trend projections are erratic. Though it does not thoroughly address other sectors, including energy, real estate, and education, the paper mostly concentrates on blockchain applications in finance, supply chains, governance, and healthcare. Since blockchain is still a relatively new technology, and its full economic impact is yet to be realised, a major restriction is the dearth of long-term empirical research. Furthermore, even if blockchain improves security, issues including cyberattacks, smart contract flaws, and illicit activity including money laundering remain worries. Furthermore, lacking in thorough analysis is the environmental impact of blockchain technology. Furthermore, with regard to the great energy consumption of Proof-of-work systems Even with these problems, the study gives us a good foundation for understanding how blockchain can change things. However, to draw the conclusions even stronger, future studies should include real-time data analysis, more general business applications, and regulatory evaluations.

Author Contributions

Mr Arumugam and Mr Pandiyarajan, Dr Shanmugavelan Poovandesigned the study; Dr Hemachandran Ravikumar provided ideas on the final design and selection of assessment tools. All the authors were involved in data collection, summarising, statistical analysis, and finalising the report. Dr Vasanthan G has made the rough draft of the research paper; Dr Hemachandran Ravikumar provided the initial draft of the manuscript, and the final version is made available by considerations of all.

Declarations of conflicts of interest

The authors declare that they have no potential conflicts of interest regarding the study design, research analysis, or publication of this article.

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Ethical Approval

The study was approved by the Review Committee of the UNS Research Council.

Conclusion

Blockchain technology is transforming industries by enhancing security, reducing costs, and improving operational efficiency. Its decentralised nature makes it an ideal solution for various economic activities, including financial transactions, supply chain management, and public governance. As blockchain adoption continues to rise, its potential to shape the future of the global economy becomes increasingly evident. By ensuring transparency, security, and efficiency, blockchain is poised to revolutionise the way businesses and governments operate.

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