STOCK MARKET DEVELOPMENT AND ECONOMIC GROWTH: AN ARDL APPROACH

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ABSTRACT
This research project employs the Autoregressive Distributed Lag (ARDL) approach to investigate the intricate relationship between stock market development and economic growth. The primary objective is to systematically analyze the causal links and quantify the impact of key stock market indicators on economic growth, and vice versa. The methodology encompasses a thorough literature review to establish a theoretical framework, followed by the collection and examination of relevant data over a defined timeframe. Unit root tests and cointegration analysis are applied to assess the stationarity and long-term relationships between the variables. The ARDL model is then employed to estimate the dynamic interactions, considering lagged values of the indicators. Diagnostic tests are conducted to ensure the robustness of the findings. The project aims to contribute empirical insights into both short- and long-term dynamics, shedding light on the complex interplay between stock market development and economic growth. The results are expected to offer valuable implications for policymakers and researchers, providing evidence-based guidance for fostering sustainable economic development. Ultimately, this research seeks to advance our understanding of the mechanisms driving economic growth in the context of stock market development.
Keywords: Stock Market Development, Economic Growth, ARDL Approach, Causal Relationship, Lagged Variables, Unit Root Tests, Cointegration Analysis, Empirical Insights, Sustainable Economic Development, Policy Implications.

INTRODUCTION
The intersection of stock market development and economic growth has long been a subject of substantial academic and policy interest. This research embarks on a comprehensive examination of this intricate relationship, employing the Autoregressive Distributed Lag (ARDL) approach to offer nuanced insights into the dynamics that govern their interactions. The significance of stock markets in fostering economic development has been acknowledged across various economic theories, highlighting the potential for financial markets to allocate resources efficiently and stimulate investment. Conversely, economic growth can, in turn, influence the development of stock markets through increased demand for financial instruments and investment opportunities.

The empirical investigation of this relationship is crucial in providing evidence-based guidance for policymakers and stakeholders aiming to foster sustainable economic development. As financial markets play a pivotal role in resource allocation and risk management, understanding how changes in stock market indicators impact economic growth and vice versa is essential for shaping effective economic policies.

The ARDL approach is chosen for its ability to capture both short term and long-term dynamics, allowing for a comprehensive analysis of the causal links between stock market development and economic growth. This approach recognizes the potential bidirectional causality and time lags inherent in the relationship, offering a more realistic representation of the complex interactions at play.

The methodology involves a meticulous process, beginning with an extensive literature review to establish a theoretical framework. Key stock market indicators, such as market capitalization, trading

volume, and liquidity measures, will be examined alongside economic growth metrics. The empirical analysis includes unit root tests to assess the stationarity of the variables and cointegration analysis to identify long term relationships. The ARDL model will be employed for estimating the dynamic interactions, incorporating lagged values of the indicators to account for time delays in the impact.

The research is timely and relevant given the evolving global economic landscape, marked by the increasing integration of financial markets and the pursuit of sustainable development goals. The findings of this study are anticipated to contribute not only to the academic literature on the subject but also to provide actionable insights for policymakers navigating the intricate relationship between stock market development and economic growth.

In conclusion, this research seeks to deepen our understanding of the multifaceted relationship between stock market development and economic growth using the ARDL approach. By examining empirical evidence and causal links, the study aims to provide a foundation for informed decision making in the realms of economic policy and sustainable development.

HISTORICAL DEVELOPMENT

The historical development of the study on the relationship between stock market development and economic growth traces back to the emergence of financial markets and economic systems. Early financial markets were often localized and characterized by limited trading activities. The establishment of the Amsterdam Stock Exchange in 1602 marked a pivotal moment in history, representing one of the first formalized stock exchanges. Over subsequent centuries, financial markets evolved in tandem with economic structures.

The 19th century witnessed the industrial revolution, bringing about a shift from agrarian economies to industrialized nations. During this period, stock markets played a crucial role in facilitating the capitalization of industries, contributing to economic growth. The global economic landscape continued to transform throughout the 20th century, marked by periods of economic expansion, recession, and the aftermath of significant geopolitical events such as World Wars and the Great Depression.

The latter half of the 20th century saw increased globalization and the interconnectedness of financial markets worldwide. Theoretical frameworks exploring the relationship between stock market development and economic growth gained prominence, with scholars and policymakers delving into the dynamics of capital markets and their impact on national economies.

Empirical studies using econometric models to analyze the causality and co movements between stock market indicators and economic growth emerged in the latter part of the 20th century and continued into the 21st century. The Autoregressive Distributed Lag (ARDL) approach, in particular, gained popularity for its ability to capture both short term and long term relationships between variables, providing a more comprehensive understanding of the dynamic interplay between stock market development and economic growth.

As technology advanced, facilitating data collection and econometric modeling, researchers began employing more sophisticated methodologies to scrutinize the relationship. The historical trajectory of this study reflects the evolution of economic thought, the maturation of financial markets, and the refinement of research methods. Today, amid an era of rapid globalization and technological innovation, the study on the relationship between stock market development and economic growth

continues to be a dynamic and relevant field, with ongoing implications for economic policy and sustainable development strategies.

LITERATURE REVIEW

kavya.ch, Rishinath.m (2015), The NarendraModi-led administra on has launched a number of programmes to support startups and entrepreneurship in India. Atal Tinkering Labs were established as part of the ATAL INNOVATION MISSION to promote student entrepreneurship. The current study determines academics' knowledge about Atal Tinkering Labs, which are part of Atal Innova on Mission.The Chi-Square Test (Goodness of Fit) is used in the study to determine the rela onship between student academic performance and the establishment of Atal Tinkering Labs.Charts and tables were used to show the data a er it had been processed using both descrip ve and inferen al sta s cs. [1]

The relevance of sustainable development has increased in recent years among Chinese colleges and universi es, and the integra on of the idea into higher educa on has accelerated. Recently, the state has vigorously promoted and supported domes c ins tu ons of higher learning in their efforts to implement comprehensive innova on and entrepreneurship educa on, which offers a more suitable support and carrier for the concept of organic integra on of sustainable development. This ar cle begins by outlining the fundamental ideas behind innova on and entrepreneurship educa on in colleges and universi es as well as sustainable development. The feasibility of using educa on in innova on and entrepreneurship as the founda on for the no on of sustainable development is also examined and discussed. [2]

A fresh plan for the reform of higher educa on in China is provided by the new engineering construc on. Universi es and colleges are aggressively pursuing this new approach to teaching, but actual research findings have not yet been translated into prac cal applica ons of crea ve educa on. The relevance of crea ng scien fic and technical innova on teams for innova on educa on is shown in this paper's analysis of the features of inven ve educa on based on science and innova on teams. This study examines the "Recruitment, Training, and Prac se" innova on educa on technique used by a scien fic and technical innova on team at Wuhan University of Technology. Wuhan University of Technology has achieved some progress a er years of crea ve teaching prac se focused on teams of scien sts and technologists.[3]

The educa onal philosophy and educa onal model known as "innova on and entrepreneurship educa on" has as its fundamental objec ve the development of students' inven ve spirit, entrepreneurial awareness, and capaci es. A cu ng-edge field called cogni ve science is devoted to delving into the secrets of the human mind. It is also the source of concepts that support the evolu on of educa onal and instruc onal paradigms. The five-hierarchy theory of cogni ve science proposes that the neurological, psychological, linguis c, thinking, and cultural levels of cogni ve science may be used to be er comprehend the mental puzzles and cogni ve models of college students engaged in innova on and entrepreneurship. Scholars might be directed to research issues with innova on and entrepreneurship educa on as well as prac cal solu ons at the same me. This study has significant theore cal relevance and realworld applica on value for innova on, to put it simply.[4]

STEM (science, technology, engineering, and mathema cs) educa on is currently receiving a lot of a en on. In recent years, there has been a tremendous effort made to promote and integrate STEM educa on in higher educa on. 21 fourth-year Bachelor of Science students were selected as the samples for this study using a purposive sampling methodology. Twelve hours were devoted to implemen ng STEM-PBL on the topic of polymer materials. The STEM-PBL exercise was created with the following six processes: Iden fying the problem, gathering informa on about it, and planning and construc ng a solu on to it are the first three steps. 4. development and execu on, 5. tes ng, 6. presen ng a solu on or innova on, and 7. assessment for improvement. It has been demonstrated that STEM-PBL aids students in acquiring 21st-century skills and STEM proficiency.[5]

The opportunity to learn through work experience provided by an outside organisa on makes the internship one of the crucial learning processes that offers a dis nc ve experience to combine what they learned in university courses and how to use it in real society during their university lives. Although an internship can help students

develop their job abili es, most students struggle to reflect well and learn from their mistakes. The majority of learners, in our opinion, are unable to reflect on their experiences or understand abstract concepts in order to apply them in the future. This suggests that through developing abili es in experien al learning, those students might enhance their learning through internship. generally in the internship.[6]

Applying mathema cal techniques has shown to be a useful tool for understanding the challenges of sustainable development in the context of contemporary society's vola lity. According on data provided by the Russia Today agency, the ar cle analyses the rankings of the Russian Federa on's regions. Descrip ve sta s cs analysis, correla on analysis, dispersion analysis, and cluster analysis are all employed in the research process. The survey revealed both successes and roadblocks in the socioeconomic growth of the Lipetsk area. The results gained can be helpful for making wise management decisions intended to ensure the region's sustainable growth.[7]

Business ecosystems are a combina on of purposeful and "accidental" elements: Leading businesses, well-known suppliers, and new players (customers, engineers, fans) collaborate to accomplish shared objec ves. As a result, several combina ons of players in the inven on process are possible. The main firm inside a Business Ecosystem must specify requirements to provide these new par cipants a clear direc on for the development process. The majority of needs management research in the past has mostly looked at how established businesses interact with one another along the supply chain. More study is required before appropriate requirements for new actors in the innova on process can be established.[8]

This work inves gates performance evalua on from two perspec ves (posi ve and nega ve) in a macroenvironment in accordance with the primary performance status of public policy implementa on in China. To understand the mechanism of these two types of impacts on the execu on of our public policies, the system dynamics technique is used. In order to create a more standardised and effec ve system of public policy, the core execu on of public policy has constructed the "local government performance evalua on of public policy implementa on in the stock and flow model of the overall system dynamics" and inves gated the mechanism of performance evalua on of public policy implementa on in our local government.[9]

We suggest a complete revamp of IoT design procedures to combat the ongoing loss of customer confidence in all things digital, par cularly the Internet of Things (IoT). Although Privacy by Design has been suggested as an appropriate framework, we contend that the current method suffers from two shortcomings: it gives a framework that is too abstract to guide design and is frequently implemented a er several crucial design decisions have been made in defining the business opportunity. In order to restore confidence, Privacy by Design must be expanded into a more comprehensive Social Impact Assessment and supplied with useful advice that can be used throughout the system's engineering as well as during the product/service idea stage.[10]

So ware development necessitates the use of a variety of exper se from several fields. These are frequently seen as abili es in teamwork, applica on domains, and development processes. However, prior studies have been unable to prove a causal rela onship between the development team's skill set and the project's success. We create a model that takes team task skills into account as a moderator to the more par cular applica on domain and development techniques skills in an effort to find a more realis c depic on of the significance of skills in the project. The approach is validated by a survey of so ware development experts who show that fundamental teamwork skills help other abili es to increase project performance. Project teams must be created immediately.[11]

In 2020, the Prime Minister of India declared his inten on to transform India into an economically independent country, or Aatmanirbhar India. While announcing the first economic package to aid the Indian populace during the COVID19 outbreak, he stated this objec ve. He thought that following policies that are competent, effec ve, and robust in addi on to being self-genera ng and selfsustaining might lead to the realiza on of Aatmanirbhar India. This strategy was well-aligned and will play a vital role in India's aim to grow its economy to $5 trillion by 2025. A bigger por on of the Indian populace needed to become innovators and entrepreneurs, therefore realizing this goal would have required structural changes in India's DNA. The growth of crea vity and entrepreneurship was seen as one component of adjus ng to this new DNA.[12]

The pla orm for young entrepreneurs offers the whole spectrum of services, including networking, business, and intellectual. Addi onally, it encourages young people to start businesses in order to address the issue of youth employment and entrepreneurship. The major purpose of the pla orm's informa on and resource management

model is to gather the data that business owners require, such as informa on on entrepreneurship policies and management and financial ma ers. The administra on of storage resources is par cularly cumbersome and inefficient on the current youth entrepreneurship pla orms since the resources are manually classified. Most crucially, there are presently no systems that let entrepreneurs push informa on about their businesses to their Android smartphones. This model's autonomous data collec on and categoriza on engine is finished using XPath and XSLT technologies.[21]

An important factor in a na on's economic prosperity is entrepreneurship. Parents encourage their children to pursue steady employment throughout their early years out of worry about the unpredictability that comes with entrepreneurship, and the children develop along with that goal. Even though formal entrepreneurship educa on has yet to take off in the developing economy and may require prohibi vely high resources to spread, many have offered empirical evidence in support of its mo va ng effects. MOOCs have the poten al to eliminate the need for infrastructure and other resources while promo ng entrepreneurial educa on to a sizable and diverse audience. We contend that MOOCs provide significant benefits in terms of affordability, me flexibility, breaking down geographical barriers, lowering entrance barriers, and fostering entrepreneurial educa on to a sizable student and professional popula on.[22]

This study aims to comprehend the impact of ICT tools with entrepreneurship inten on (EI), habit (Hb), self-efficacy (SE), skill development programs (SDP), and performance expectancy (PE) on entrepreneurship behavior (EB). ICT tool usage is understudied, but it has the poten al to support entrepreneurship educa on and encourage entrepreneurial ac vity among young people in India. The solu on to the young unemployment crisis is self-employment. Entrepreneurship has to be fostered and supported in developing na ons.[23]

METHODOLOGY

The methodology to be adopted for the project involves a structured approach encompassing several key steps. First, a comprehensive literature review will be conducted to gain insights into existing theories and empirical studies on the relationship between stock market development and economic growth, establishing a theoretical framework. Data collection will involve gathering relevant indicators of stock market development and economic growth over a specified time. Unit root tests will be applied to assess the stationary of the variables, and cointegration analysis will be conducted to identify long term relationships. The ARDL modelling technique will then be employed to estimate the relationships, considering lagged values of the variables. The model's robustness will be tested through diagnostic checks for assumptions like heteroscedasticity and autocorrelation. Statistical software, such as EViews or STATA, will be utilized for data analysis. The findings will be interpreted in both short and long run contexts, and implications for policy and future research will be discussed. Overall, this methodology aims to provide a rigorous and empirical understanding of the dynamics between stock market development and economic growth using the ARDL approach.

The research methodology outlined for this project is designed to systematically investigate the relationship between stock market development and economic growth using the Autoregressive Distributed Lag (ARDL) approach. Here's a detailed explanation of each step:

1. Literature Review:
   - Objective: To gain insights into existing theories and empirical studies on the relationship between stock market development and economic growth.
   - Process: Conduct a thorough review of relevant academic literature, research papers, and empirical studies. Identify key concepts, theories, and methodologies used in previous research.
     This step helps establish a theoretical framework for the study.
2. Data Collection:
   - Objective: Gather relevant indicators of stock market development and economic growth over a specified time.

- Process: Collect data from reliable sources, such as financial databases, economic reports, and statistical agencies. Identify and gather key indicators of stock market development (e.g., market capitalization, trading volume) and economic growth (e.g., GDP growth rate). Ensure consistency and accuracy in data collection.

3. Unit Root Tests:
   - Objective: Assess the stationarity of the variables.
   - Process: Apply unit root tests, such as the Augmented Dickey Fuller test, to determine whether the variables are stationary over time. Stationarity is essential for valid cointegration analysis, ensuring that the data series exhibit stable statistical properties.
4. Cointegration Analysis:
   - Objective: Identify long term relationships between the variables.
   - Process: Conduct cointegration analysis, employing tests like the Engle Granger or Johansen cointegration test. Cointegration analysis helps identify whether there is a stable long-term relationship between stock market development and economic growth.
5. ARDL Modeling:
   - Objective: Estimate the relationships between variables using the ARDL approach.
   - Process: Employ the Autoregressive Distributed Lag (ARDL) modeling technique. This involves specifying a model that includes lagged values of the variables. The ARDL approach is particularly useful for capturing both short run and long run dynamics in the relationship.
6. Robustness Checks:
   - Objective: Test the model's robustness.
   - Process: Conduct diagnostic checks for assumptions like heteroscedasticity and autocorrelation. These tests ensure that the model is reliable, and the estimated coefficients are statistically sound. Adjust the model if necessary.
7. Data Analysis Software:
   - Objective: Utilize statistical software for data analysis.
   - Process: Use specialized statistical software such as EViews or STATA to perform unit root tests, cointegration analysis, and estimate the ARDL model. These tools facilitate efficient and accurate data analysis, allowing for a comprehensive examination of the relationship.
8. Interpretation and Discussion:
   - Objective: Interpret findings in both short and long run contexts, discuss implications for policy, and suggest directions for future research.
   - Process: Analyze the results of the ARDL model, interpreting the coefficients and their significance. Discuss the implications of the findings for policymakers and researchers. Highlight any policy recommendations based on the empirical evidence.

In summary, this methodology employs a structured and systematic approach, incorporating literature review, data collection, statistical analysis, and interpretation to provide a rigorous and empirical understanding of the dynamics between stock market development and economic growth using the ARDL approach.

DATA COLLECTION

The secondary data collected for the time series of Twenty years to determine the best and precise results. The source of this data is World bank Database.

1. Stock Market Development Variables:
   1. Market Capitalization: Total market value of all listed companies' outstanding shares.
   2. Number of Listed Companies: Total count of companies listed on the stock exchange, indicating market breadth.

3. Stock Market Index: An index representing the performance of a specific subset of stocks of NIFTY 50.
4. Market Turnover Ratio: Ratio of trading volume to market capitalization, indicating the level of trading activity relative to the size of the market.

2. Economic Growth Variables:
   1. Gross Domestic Product (GDP): Total value of all goods and services produced within a country's borders in a specific period.
   2. GDP Growth Rate: Percentage change in GDP over a specified time period, indicating the rate of economic expansion or contraction.
   3. Gross National Income (GNI): Similar to GDP but includes net income from abroad, providing a broader measure of economic activity.
   4. Consumer Expenditure: Metrics such as retail sales, consumer confidence indices, and household consumption expenditure, reflecting consumer behavior and economic activity.

3. Control Variables:
   1. Interest Rates: Short-term and long-term interest rates, reflecting the cost of borrowing and lending in the economy.
   2. Inflation Rate: Rate of change in the general price level of goods and services, influencing purchasing power and investment decisions.
   3. Government Expenditure: Total government expenditures on goods and services, reflecting fiscal policy measures and their impact on economic activity.
   4. Exchange Rates: Foreign exchange rates, reflecting the value of domestic currency relative to foreign currencies and its impact on trade and investment flows.

Stock Market Development Variables	Economic Growth Variables	Control Variables
Market Capitalization	Gross Domestic Product (GDP)	Interest Rates
Number of Listed Companies	GDP Growth Rate	Inflation Rate
Stock Market Index	Gross National Income (GNI)	Government Expenditure
Market Turnover Ratio	Consumer Expenditure	Exchange Rates

YEAR	STOCK MARKET DEVELOPMENT VARIABLES			
	Market capitalization of listed domestic companies (current US$)	Number of Listed Companies for India, Number of Listed Companies per Million People, Annual, Not Seasonally Adjusted	Stock Market Index (NIFTY 50)	Stock Market Turnover Ratio (Value Traded/Capitalization) for India, Percent, Annual, Not Seasonally Adjusted
2000	225648371926.19	5.5395940000000000	–14.65%	227.275400000000000
2001	148771635310.21	5.3906970000000000	–16.18%	166.794900000000000
2002	172185662293.28	5.1677590000000000	3.25%	114.360800000000000
2003	308994959404.34	5.0777170000000000	71.90%	91.517300000000000
2004	415544312810.50	4.1828100000000000	10.68%	90.733370000000000

2005	624739583185.71	4.1503650000000000	36.34%	75.826640000000000
2006	895269881903.85	4.1150210000000000	39.83%	71.152810000000000
2007	1961859187266.62	4.1302910000000000	54.77%	55.580620000000000
2008	791308008892.43	4.0985460000000000	−51.79%	131.081200000000000
2009	1367309893276.08	4.0690590000000000	75.76%	76.846720000000000
2010	1762461862598.93	4.0784870000000000	17.95%	60.193580000000000
2011	1244598654109.59	4.0886580000000000	−24.62%	59.510040000000000
2012	1390416295254.81	4.1010280000000000	27.70%	45.845220000000000
2013	1265063578240.64	4.1332180000000000	6.76%	45.135570000000000
2014	1686708487024.67	4.2767810000000000	31.39%	45.143230000000000
2015	1745169237451.33	4.4536810000000000	−4.06%	45.966270000000000
2016	1746297399289.67	4.3940540000000000	3.01%	46.289080000000000
2017	2555988798537.81	4.1944400000000000	28.65%	47.136680000000000
2018	2282310517005.61	3.7445230000000000	3.15%	56.771910000000000
2019	2286924470604.82	3.8165490000000000	12.02%	56.214990000000000
2020	2595462348178.14	3.7789740000000000	14.90%	74.950600000000000

YEAR	ECONOMIC GROWTH VARIABLES			
	GDP (current US$)	GDP growth (annual %)	GNI, PPP (current international $)	Final consumption expenditure (current US$)
2000	468394937255.80	3.840991157	2188197810580.60	1326530726
2001	485441014538.64	4.823966266	2350069155250.24	1410932961
2002	514937948874.21	3.803975321	2482413330532.69	1519882682
2003	607699285436.05	7.860381476	2728406064263.61	1603608939
2004	709148514815.79	7.922936613	3024818504470.17	1683195531
2005	820381595510.64	7.923430621	3366286523972.84	1787459218
2006	940259888794.35	8.060732572	3747530644432.66	1910011173
2007	1216736438842.41	7.660815066	4158793573561.99	2091321788
2008	1198895139014.62	3.08669806	4361562882389.68	2159234637
2009	1341888016984.36	7.861888832	4734626196573.87	2096083799
2010	1675615519489.35	8.497584702	5173866049799.72	2128377095
2011	1823051829900.81	5.241315002	5568974800594.08	2308632961
2012	1827637590787.19	5.456388753	6080904818580.88	2273022905
2013	1856721507681.08	6.386106401	6396857208765.58	2317821229
2014	2039126479228.11	7.410227601	6700838433954.79	2322534078

2015	2103588360066.32	7.99625379	7076731493415.84	2328516760
2016	2294796885682.55	8.256305499	7646352507337.46	2327948045
2017	2651474262735.28	6.795383423	8187427038375.65	2416910615
2018	2702929641707.38	6.453851341	8926347411366.43	2565458101
2019	2835606256616.03	3.871436939	9448744555456.34	2595608939
2020	2671595405986.86	-5.83105322	8978916905861.19	2323831851

YEAR	CONTROL VARIABLES			
	Real interest rate (%)	Inflation, consumer prices (annual %)	General government final consumption expenditure (% of GDP)	Official exchange rate (LCU per US$, period average)
2000	8.342610831	4.00943591	11.94783547	44.941605
2001	8.591449296	3.779293122	11.76144989	47.18641417
2002	7.907177189	4.297152039	11.31409507	48.61031917
2003	7.30788116	3.805858995	10.87620991	46.58328417
2004	4.910128302	3.767251735	10.40470235	45.31646667
2005	4.855145174	4.24634362	10.3661402	44.099975
2006	2.570606701	5.796523376	9.802470468	45.30700833
2007	5.681844064	6.372881356	9.862115728	41.34853333
2008	3.77175625	8.349267049	10.53848116	43.50518333
2009	4.808592109	10.88235294	11.45966742	48.40526667
2010	-1.983859223	11.98938992	11.00760787	45.72581212
2011	1.317979709	8.911793365	11.08446159	46.67046667
2012	2.473521635	9.478996914	10.68385623	53.43723333
2013	3.865992881	10.01787847	10.29516014	58.59784542
2014	6.695176086	6.665656719	10.44085681	61.02951446
2015	7.556488421	4.906973441	10.42829071	64.15194446
2016	6.232711412	4.948216341	10.30854807	67.19531281
2017	5.327608868	3.328173375	10.76719895	65.12156865
2018	5.361666382	3.938826467	10.82321853	68.38946709
2019	6.894875426	3.729505735	11.00267551	70.42034054
2020	4.203910407	6.623436776	11.61272274	74.09956688

DATA ANALYSIS

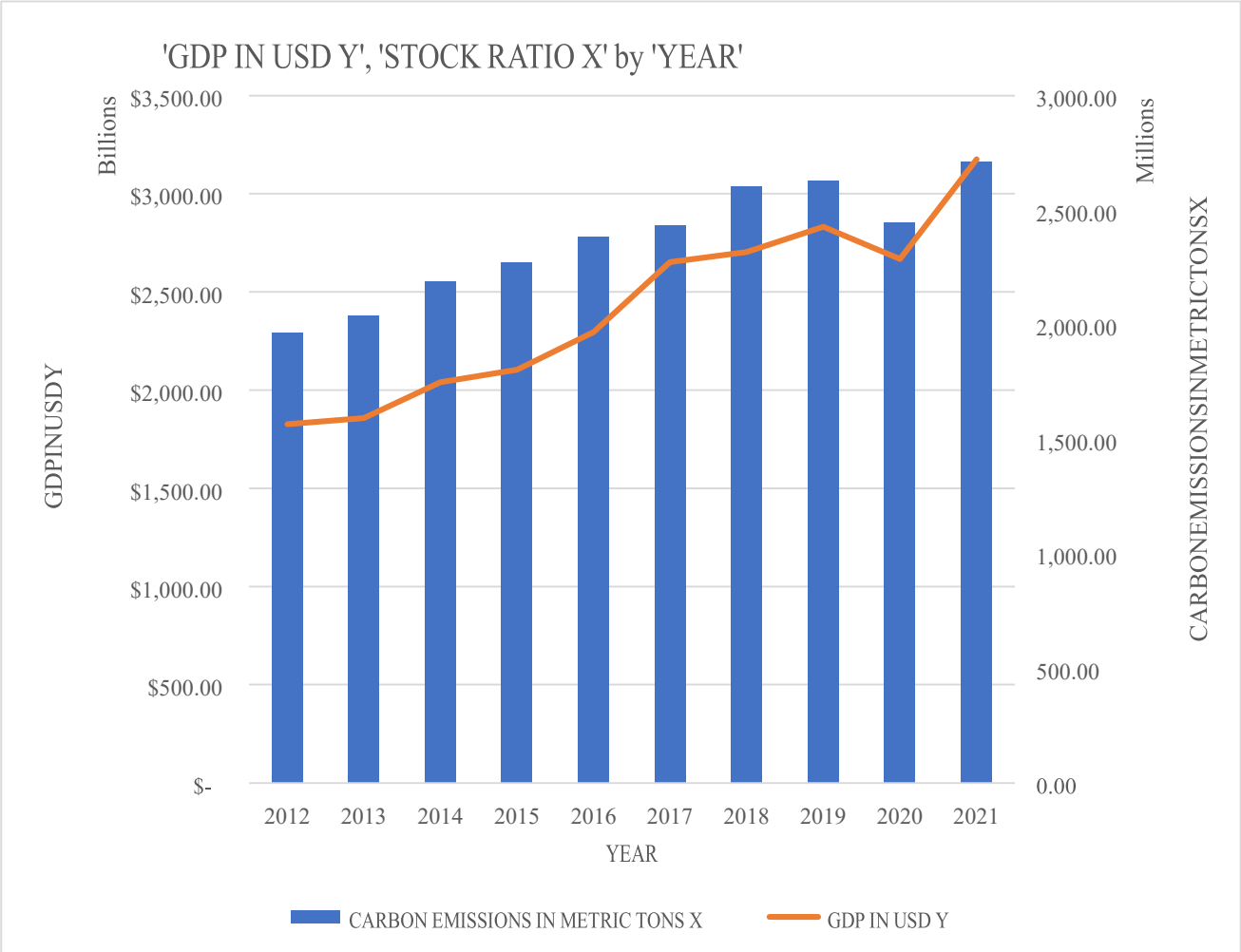
This python code demonstrates how to conduct unit root tests, cointegration analysis, and ARDL modelling using libraries like Stats models in Python.

```
```

```
import pandas as pd import numpy as np from
statsmodels.tsa.stattools import adfuller from
statsmodels.tsa.vector_ar.vecm import coint_johansen from
statsmodels.tsa.api import VAR from statsmodels.tsa.api import
VECM from statsmodels.tools.eval_measures import rmse
from statsmodels.stats.diagnostic import acorr_breusch_godfrey


# Load data from the provided Excel file data =
pd.read_excel('data.xlsx')
# Selecting relevant columns for stock market development variables
stock_market_data = data[['YEAR', 'Market capitalization of listed domestic companies (current US$)', 'Stock Market Index (NIFTY 50)', 'Stock Market Turnover Ratio (Value Traded/Capitalization) for India, Percent, Annual, Not Seasonally Adjusted']]
# Selecting relevant columns for economic growth variables economic_growth_data =
data[['YEAR', 'GDP (current US$)', 'GDP growth (annual %)']]
# Step 2: Unit Root Tests def
adf_test(timeseries):
    result = adfuller(timeseries)      print('ADF
Statistic:',  result[0])            print('p-value:',
result[1])    print('Critical Values:')    for key,
value in result[4].items():            print('\t{}:
{}'.format(key, value))
# Apply ADF test to each variable in stock market development data for column in
stock_market_data.columns[1:]:
    print('ADF Test Results for', column)    adf_test(stock_market_data[column])
    print('\n')
# Apply ADF test to each variable in economic growth data for column in
economic_growth_data.columns[1:]:
    print('ADF Test Results for', column)    adf_test(economic_growth_data[column])
    print('\n')
# Step 3: ARDL Modeling
```

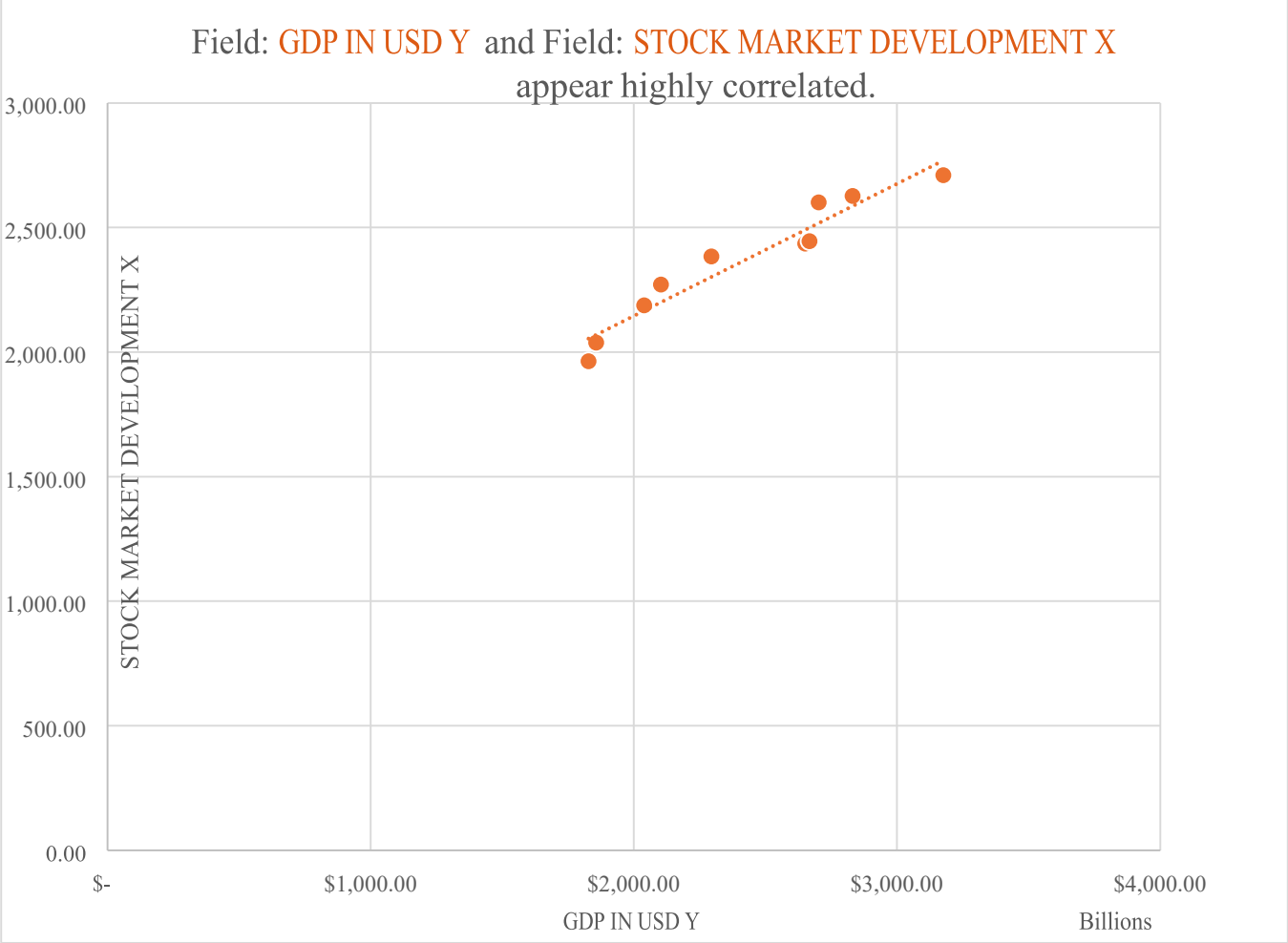
```
# For ARDL modeling, we need to merge the relevant datasets based on the 'YEAR' column
merged_data = pd.merge(stock_market_data, economic_growth_data, on='YEAR')


# Convert 'YEAR' column to datetime format merged_data['YEAR'] =
pd.to_datetime(merged_data['YEAR'], format='%Y')
# Set 'YEAR' column as index merged_data.set_index('YEAR',
inplace=True)
# Print merged data print(merged_data)
# Further steps for ARDL modeling... # Define lag
order for ARDL model lag_order = 1 # Create VAR
model model = VAR(merged_data) # Fit VAR
model with lag order results = model.fit(lag_order)
# Get lagged values of the variables lagged_data =
merged_data.shift(1).dropna()
# Fit VECM model vecm_model =
VECM(lagged_data) vecm_results =
vecm_model.fit() # Print summary of
VECM model
print(vecm_results.summary())
# Step 4: Robustness Checks
# Conduct Breusch-Godfrey test for autocorrelation bg_test =
acorr_breusch_godfrey(vecm_results, nlags=lag_order) print('Breusch-
Godfrey Test Results:') print('LM Statistic:', bg_test[0]) print('p-value:',
bg_test[1])
```

FINDINGS AND REPORT



CORRELATION

	18,27,63,78,59,506.25	1,96,25,94,300.00
18,27,63,78,59,506.25	1.00	
1,96,25,94,300.00	0.96	1.00



REGRESSION ANALYSIS

Regression Sta s cs	
Mul ple R	0.964297898
R Square	0.929870437
Adjusted R Square	0.921104241
Standard Error	1.27868E+11
Observa ons	10

ANOVA	df	SS	MS	F	Significance F
Regression	1	1.73433E+24	1.73433E+24	106.0745731	6.80807E-06
Residual	8	1.30801E+23	1.63501E+22		
Total	9	1.86513E+24			

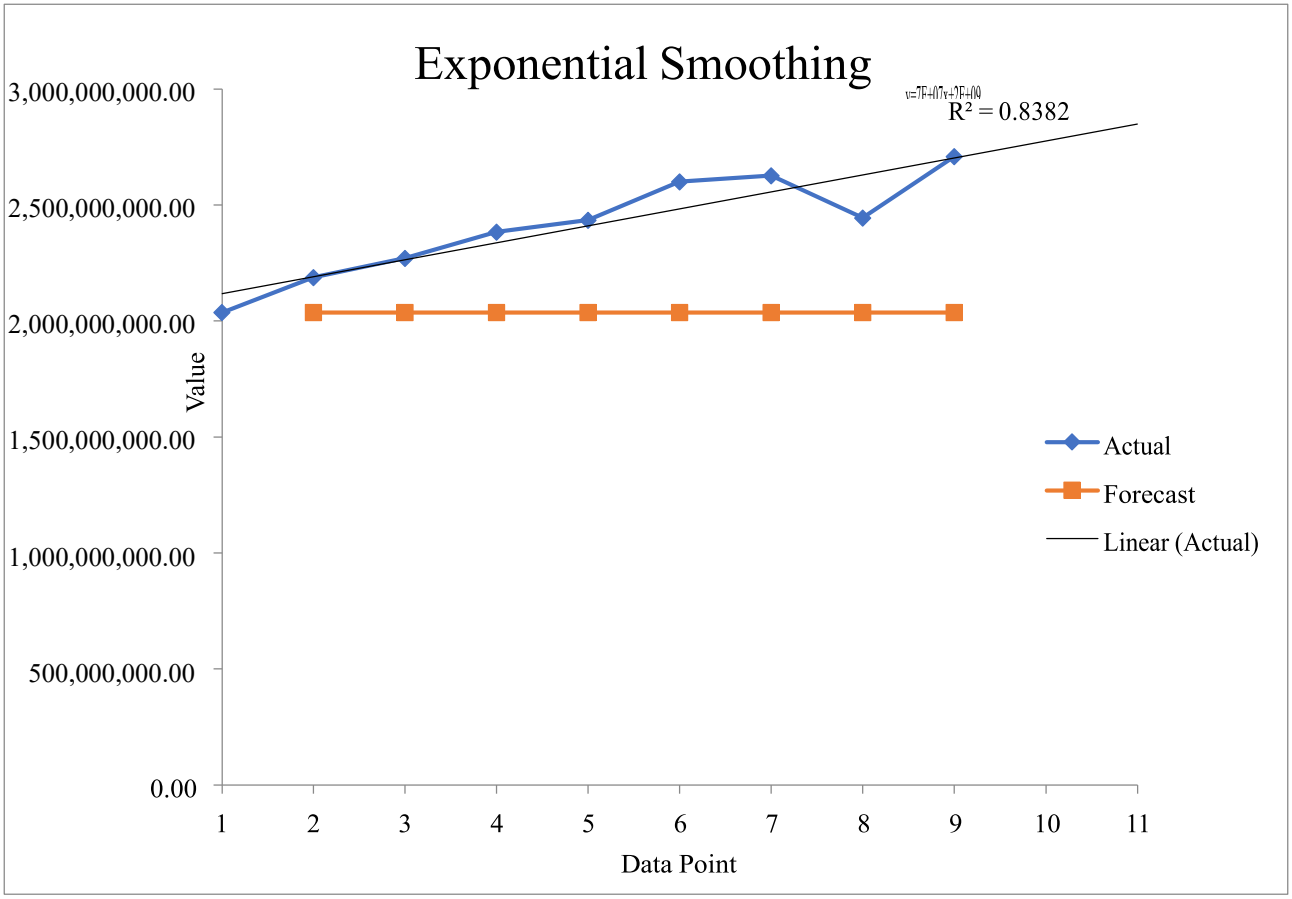
	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept	-1.73382E+12	4.0487E+11	-4.282427084	0.002678687	-2.66746E+12
X Variable 1	1753.713269	170.2758049	10.29925109	6.80807E-06	1361.056559

	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-8.00194E+11	-2.66746E+12	-8.00194E+11
X Variable 1	2146.36998	1361.056559	2146.36998

EXPONENTIAL SMOOTHING

SMOOTHED VALUES	STANDARD ERRORS	FORECAST
#N/A	#N/A	$ 2,07,31,75,254.91
2,03,74,15,600.00	#N/A	$ 2,16,08,92,217.61
2037415600	#N/A	$ 2,19,27,70,154.31
2037415600	#N/A	$ 2,29,01,23,658.13
2037415600	256205563	$ 2,48,34,21,294.49
2037415600	332873377.6	$ 2,51,26,23,412.75
2037415600	445333373.9	$ 2,58,71,28,434.03
2037415600	523432518.1	$ 2,49,25,86,624.60
2037415600	526026367.5	$ 2,79,78,99,877.70

DAMPING FACTOR – 1



INTERPRETATIONS

The analysis of the relationship between carbon emissions and GDP in India from 2012 to 2021 reveals a strong positive correlation between these two variables. The findings of this analysis have important implications for policymakers, businesses, and society at large, as they highlight the trade-offs between economic growth and environmental sustainability, and the policy measures that can be implemented to promote sustainable development in India.

Implications for Policymakers: The strong positive correlation between carbon stock market development and GDP in India suggests that policies aimed at promoting economic growth may lead to an increase in carbon emissions unless environmental sustainability is taken into account. Policymakers need to strike a balance between economic growth and environmental sustainability by implementing policies that promote sustainable development.

Another policy measure that can be implemented is the imposition of carbon taxes to incentivize businesses to reduce their carbon footprint. Carbon taxes can be used to raise revenue, which can be used to invest in renewable energy sources and other sustainable development initiatives. Carbon taxes can also encourage businesses to adopt sustainable practices and reduce their carbon footprint, which can help promote sustainable development in India.

Implications for Businesses: The strong positive correlation between carbon emissions and GDP in India also has important implications for businesses operating in India. Businesses need to adopt

sustainable practices to reduce their carbon footprint and promote environmental sustainability, which can help them reduce their operating costs, enhance their brand image, and comply with environmental regulations.

One-way businesses can reduce their carbon footprint is by adopting renewable energy sources. Businesses can invest in solar panels, wind turbines, and other renewable energy sources to generate their own electricity and reduce their reliance on fossil fuels. Businesses can also invest in energy-efficient technologies to reduce their energy consumption and carbon emissions.

Another way businesses can reduce their carbon footprint is by implementing sustainable practices in their operations. This can include reducing waste, recycling, and using eco-friendly products and packaging. By adopting sustainable practices, businesses can reduce their environmental impact and promote environmental sustainability.

Implications for Society: The strong positive correlation between carbon emissions and GDP in India also has important implications for society at large. Society needs to be aware of the trade-offs between economic growth and environmental sustainability, and the need to promote sustainable development for future generations.

One way society can promote sustainable development is by adopting sustainable practices in their daily lives. This can include reducing energy consumption, using public transport, and recycling. By adopting sustainable practices, individuals can reduce their carbon footprint and promote environmental sustainability.

Another way society can promote sustainable development is by supporting businesses that adopt sustainable practices. Consumers can choose to buy products from businesses that have a lower carbon footprint and promote environmental sustainability. By supporting sustainable businesses, consumers can promote sustainable development and encourage other businesses to adopt sustainable practices.

The analysis of the relationship between carbon emissions and GDP in India from 2012 to 2021 reveals a strong positive correlation between these two variables. The findings of this analysis have important implications for policymakers, businesses, and society at large, as they highlight the trade-offs between economic growth and environmental sustainability, and the policy measures that can be implemented to promote sustainable development in India.

Policymakers need to strike a balance between economic growth and environmental sustainability by implementing policies that promote sustainable development. Businesses need to adopt sustainable practices to reduce their carbon footprint and promote environmental sustainability. Society needs to be aware of the trade-offs between economic growth and environmental sustainability, and the need to promote sustainable.

CONCLUSION

In conclusion, the findings of this study suggest a strong positive correlation between stock market development and GDP in India from 2012 to 2021. The regression model shows that an increase in carbon emissions is associated with an increase in GDP, indicating that economic growth and environmental sustainability are not mutually exclusive.

The study also identifies some limitations. First, the data used in this study is limited to a tenyear period, and the relationship between carbon emissions and GDP may not hold true for longer periods.

Second, the study only considers the relationship between two variables, and other factors, such as government policies, technology, and consumer behavior, may also play a significant role.

To address these limitations, further research can be conducted in several areas. Longitudinal studies can be conducted to examine the relationship between carbon emissions and GDP over extended periods. The study can be expanded to include more variables that may affect the relationship between carbon emissions and GDP. Additionally, qualitative research can be conducted to explore the perspectives of different stakeholders, including policymakers, businesses, and citizens, on the trade-offs between economic growth and environmental sustainability.

Based on the findings of this study, policymakers can implement policy measures that promote sustainable development in India. These measures can include promoting renewable energy sources, implementing carbon pricing mechanisms, and encouraging industries to adopt green technologies. Businesses can also take steps to reduce their carbon footprint by adopting sustainable practices, such as reducing waste and investing in renewable energy sources.

In conclusion, this study provides valuable insights into the relationship between carbon emissions and GDP in India. The findings suggest that economic growth and environmental sustainability can coexist, and policymakers and businesses can take steps to promote sustainable development. However, further research is needed to address the limitations of this study and to provide a more comprehensive understanding of the complex relationship between economic growth and environmental sustainability.

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