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The Interplay of Entrepreneurship, Investment, Credit, and Market Capitalization in Shaping Sustainable Economic Growth: An ARDL Approach for the United States

Ihsen Abid*

Abstract: This study explores the interplay between entrepreneurship, foreign direct investment (FDI), domestic credit, and market capitalization in driving sustainable economic growth in the United States from 2001 to 2023. It aims to provide valuable insights for policymakers to understand how these factors collectively influence economic performance. The study employs an Autoregressive Distributed Lag (ARDL) model to analyze the long- and short-term relationships between the variables. An error correction model (ECM) is also used to investigate the speed of adjustment towards long-run equilibrium. Data for the analysis covering key economic indicators such as GDP, early-stage entrepreneurial activity, FDI, credit, and market capitalization. The results indicate that entrepreneurship (TEA) has a consistently positive impact on economic growth across all lags. FDI shows a positive effect in the current period, though its lagged effects are weaker. Domestic credit to the private sector, while significant, has a negative short-term effect on GDP growth, suggesting that credit allocation inefficiencies may hinder growth. Market capitalization exhibits a strong positive effect, underlining the importance of well-developed financial markets for economic expansion. The error correction model suggests that adjustments towards long-term equilibrium are slow, highlighting areas for policy intervention. This paper contributes to the understanding of how key economic factors interact to influence sustainable growth, particularly by emphasizing the role of entrepreneurship and market capitalization. The findings are relevant for policymakers seeking to foster long-term economic growth in the U.S., as well as for future research on economic development dynamics.

Keywords: entrepreneurship; foreign direct investment; domestic credit; market capitalization; economic growth; U.S. economy; ARDL model; error correction model.

JEL classification: O16; O11; G20; F21; E44.

* Department of Finance, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia; e-mail: *isbaklouti@imamu.edu.sa*.

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1. INTRODUCTION

Sustainable economic growth is a primary objective for policymakers worldwide, particularly in developed economies like the United States, where economic stability is foundational for long-term prosperity. The search for the determinants of economic growth has led researchers to focus on a variety of factors, including entrepreneurship, foreign direct investment, domestic credit, and market capitalization. While these factors have been extensively studied in isolation, their combined and dynamic interactions on economic growth, especially over both short and long horizons, have received limited empirical attention, particularly within the U.S. context. This study addresses this research gap by integrating these four dimensions into a unified econometric framework, providing a more comprehensive perspective on their roles in shaping sustainable economic growth.

Entrepreneurship is widely recognized as a vital driver of economic dynamism. Schumpeter's (2021) theory of "creative destruction" underlines the transformative role of entrepreneurship in fostering innovation, technological advancements, and competition, which in turn stimulate economic growth. In recent years, the focus has expanded to encompass the importance of early-stage entrepreneurial activity (TEA) as an indicator of an economy's ability to innovate and adapt (Bosma *et al.*, 2023). Research has shown that entrepreneurship is not only a catalyst for new product markets but also contributes to job creation, wealth accumulation, and the development of a resilient economy (Audretsch and Thurik, 2003). However, the precise relationship between entrepreneurial activity and growth is nuanced, as it depends on factors such as access to finance, market conditions, and regulatory environments (Urbano *et al.*, 2019). Understanding how TEA influences sustainable growth, especially in the context of the U.S. economy, is crucial for fostering a vibrant entrepreneurial ecosystem.

Foreign Direct Investment is another significant contributor to economic growth. FDI facilitates the flow of capital, technology, and expertise across borders, and has been found to positively influence productivity and economic growth (Borensztein *et al.*, 1998; Alfaro *et al.*, 2004). The relationship between FDI and growth, however, is conditional on the host country's absorptive capacity, which includes factors such as human capital, institutional quality, and financial market development (UNCTAD, 2023). In the United States, FDI plays a crucial role in enhancing global competitiveness by integrating the U.S. economy into international supply chains and driving technological advancements. Nevertheless, the impact of FDI on long-term economic growth remains an area of debate, as some studies suggest diminishing returns over time or highlight the importance of strategic policy frameworks to ensure that FDI translates into sustainable growth (OECD, 2023). Comparative studies have shown that the effectiveness of FDI in stimulating economic growth depends on complementary macroeconomic policies and structural factors (Abid, 2025a).

Domestic credit to the private sector and market capitalization are essential pillars of a robust financial system, which plays a key role in economic development. Credit availability supports investment in productive sectors, fosters innovation, and enhances consumption capacity, all of which contribute to economic growth (Beck *et al.*, 2000). However, an excessive accumulation of credit can lead to financial instability and misallocation of resources, as observed during financial crises (Cecchetti and Kharroubi, 2012). Therefore, understanding the balance between credit expansion and economic stability is crucial for fostering sustainable growth. In this regard, recent empirical work underscores the dual nature of credit's impact,

showing short-run negative effects due to inefficiencies and long-run benefits through enhanced capital formation (Abid, 2025b). Similarly, market capitalization, as a measure of financial market development, provides an important signal of economic health and resilience. Well-functioning financial markets facilitate the efficient allocation of capital, support entrepreneurial ventures, and enhance investor confidence (Pagano, 1993; Levine and Zervos, 1998). The deepening of U.S. capital markets has been linked to higher levels of economic growth and a more diversified financial ecosystem, making it a vital factor in the broader economic landscape. Studies in similar economic contexts have highlighted the importance of capital market deepening for sustainable growth outcomes (Chaabouni and Abid, 2025).

This paper aims to investigate the interplay between entrepreneurship, FDI, domestic credit, and market capitalization in shaping sustainable economic growth in the United States between 2001 and 2023. This study is unique in its integrated approach, assessing both individual and joint effects of these variables through a unified model. By employing an autoregressive distributed lag (ARDL) model and an error correction model (ECM), this study examines the short- and long-term effects of these variables on GDP. The ARDL model is particularly suitable for this analysis because it accommodates variables with mixed levels of integration (I(0) and I(1)), allows for a small sample size, and provides robust estimates of both long-run equilibrium and short-run dynamics (Pesaran *et al.*, 2001). The analysis provides a comprehensive view of these factors over the past two decades. In doing so, it contributes to the existing literature by addressing the multidimensional nature of economic growth drivers and demonstrating the relevance of a combined macro-financial and entrepreneurial framework in understanding growth trajectories in the U.S.

The remainder of this paper is structured as follows: Section 2 reviews existing literature on entrepreneurship, foreign direct investment, domestic credit, and market capitalization, emphasizing their individual and combined roles in sustainable economic growth. Section 3 outlines the methodology, describing the data, model specifications. Section 4 presents the results of the empirical analysis. Section 5 discusses the findings in the context of U.S. economic growth. Finally, Section 6 concludes the paper, summarizing key findings and offering policy recommendations for fostering sustainable growth.

2. LITERATURE REVIEW

The interplay of entrepreneurship, foreign direct investment (FDI), domestic credit, and market capitalization in driving sustainable economic growth has been extensively examined in the economic literature. This section synthesizes relevant studies to provide a robust theoretical foundation.

2.1 Entrepreneurship and Economic Growth

Entrepreneurship is widely recognized as a critical driver of economic growth through its role in fostering innovation, employment creation, and economic diversification. Schumpeter's (2021) theory of "creative destruction" remains a cornerstone, emphasizing that entrepreneurial ventures disrupt inefficient systems, driving productivity improvements and technological advancements.

Following Schumpeter, numerous scholars in the mid-to-late 20th century expanded the theoretical foundations of entrepreneurship and its macroeconomic relevance. Kirzner (1973)

introduced the concept of the "alert entrepreneur," emphasizing the role of opportunity recognition and arbitrage in market processes. Baumol (1990) later distinguished between productive and unproductive entrepreneurship, arguing that the institutional environment determines whether entrepreneurial activity contributes to or detracts from economic growth. These theoretical advancements underscored the importance of regulatory and institutional quality in channeling entrepreneurship toward productive outcomes.

In the 1990s and early 2000s, empirical studies began to validate these theories using cross-country data. Wennekers and Thurik (1999) highlighted the dual role of entrepreneurship in promoting innovation and employment while noting its dependence on broader economic structures. Carree and Thurik (2003) provided econometric evidence that shifts in entrepreneurial activity correlate strongly with GDP growth in both developed and developing economies, especially during periods of structural change.

Recent empirical studies have built upon this framework. For instance, Acs *et al.* (2013) demonstrate that entrepreneurial ecosystems significantly contribute to GDP growth by fostering innovation and addressing market failures. Similarly, Bosma *et al.* (2023) highlight the crucial role of Total Early-stage Entrepreneurial Activity (TEA) in enhancing long-term economic performance, particularly in high-income economies like the United States. Audretsch and Thurik (2003) expand on these findings, showing that entrepreneurship is a key determinant of knowledge-based growth, where small and medium-sized enterprises (SMEs) play a pivotal role in accelerating technological innovation. Furthermore, Urbano *et al.* (2019) argue that entrepreneurship positively impacts social and economic resilience, enabling economies to adapt to structural changes. Recent regional studies employing the ARDL framework confirm the significance of entrepreneurial activity in promoting sustained economic expansion (Abid, 2025c).

2.2 Foreign Direct Investment

FDI is a major channel for technology transfer, capital inflows, and market integration. Its impact on growth, however, is contingent on the host country's absorptive capacity. Borensztein *et al.* (1998) argue that FDI significantly boosts growth only when accompanied by adequate human capital and robust institutions. Alfaro *et al.* (2004) expand on this, highlighting that the presence of well-functioning financial markets is critical for translating FDI into productivity gains.

In addition, UNCTAD (2023) emphasizes the importance of targeted policies to maximize FDI spillovers, such as workforce development programs and infrastructure investments. OECD (2023) notes that countries with effective FDI strategies experience greater integration into global value chains, enhancing competitiveness. In the United States, the immediate positive effects of FDI on GDP growth align with these findings, though diminishing long-term impacts suggest potential inefficiencies in leveraging FDI for sustained economic benefits.

2.3 Domestic Credit and Financial Development

The role of domestic credit in economic growth is complex. While financial intermediation enables investment and innovation, excessive credit growth can lead to inefficiencies and financial instability. Beck *et al.* (2000) find that while credit supports

medium-term growth, its short-term effects are often negative due to over-leveraging or misallocation of resources. Cecchetti and Kharroubi (2019) similarly caution that financial sector overexpansion can hinder growth by diverting resources from productive sectors.

Rajan and Zingales (2001) underscore the importance of effective financial regulation to ensure that credit is allocated economically productive activities. In developed economies like the United States, the dual impact of domestic credit, supporting economic expansion while fostering financial vulnerabilities, reflects the need for balanced financial policies to mitigate risks.

2.4 Market Capitalization and Financial Markets

Market capitalization, a key indicator of financial market development, plays a pivotal role in economic growth by enabling efficient capital allocation, risk management, and investor confidence. Levine and Zervos (1998) provide evidence that well-functioning stock markets significantly enhance GDP growth by improving liquidity and facilitating long-term investments. Pagano (1993) similarly highlights that deep and liquid financial markets channel resources into high-growth industries, fostering innovation.

In the U.S. context, market capitalization's strong positive relationship with GDP growth aligns with the findings of Demirgüç-Kunt and Levine (2001), who emphasize that developed financial markets enhance resilience and innovation capacity. Further, Bencivenga and Smith (1991) argue that market development mitigates financing constraints for entrepreneurial ventures, supporting sustainable economic performance.

While individual contributions of entrepreneurship, FDI, credit, and financial markets to economic growth are well-documented, their combined effects remain underexplored, particularly in developed economies like the United States. Furthermore, the role of structural factors, such as regulatory frameworks and innovation systems, in mediating these relationships requires further investigation. The present study addresses these gaps by integrating these variables into a unified empirical framework, offering new insights into their dynamic relationships.

2.5 Hypotheses Development

Based on the preceding review of literature and theoretical underpinnings, we propose the following hypotheses to guide the empirical analysis:

H1*: Entrepreneurship, as measured by Total Early-stage Entrepreneurial Activity (TEA), has a positive and significant impact on sustainable economic growth in the United States.*

H2*: Foreign Direct Investment (FDI) positively influences sustainable economic growth, although its effect may vary depending on the absorptive capacity of the U.S. economy.*

H3*: Domestic credit to the private sector has a non-linear effect on economic growth, positively contributing to the long term but potentially showing negative short-term effects due to resource misallocation or financial instability.*

H4*: Market capitalization, as an indicator of financial market development, has a positive and significant relationship with sustainable economic growth.*

3. METHODOLOGY

The use of autoregressive distributed lag (ARDL) and error correction models (ECM) in economic analysis provides insights into short- and long-term relationships between variables. Pesaran *et al.* (2001) advocate for ARDL models due to their ability to handle variables with different integration orders, making them particularly useful for macroeconomic studies. Bahmani-Oskooee and Brooks (1999) emphasize the importance of ECM terms in understanding the speed of adjustment toward long-term equilibrium, a key metric for assessing policy effectiveness. Studies applying these methods, such as Asteriou and Hall (2016), highlight their utility in exploring complex relationships among financial and economic variables.

The current study contributes to these growing empirical studies by applying these models to understand the interplay between entrepreneurship, foreign direct investment, domestic credit, market capitalization, and sustainable economic growth in the United States over the period 2001–2023.

The analysis uses two main econometric approaches: the Autoregressive Distributed Lag (ARDL) model and the Error Correction Model (ECM). These methods are chosen for their suitability in capturing both short- and long-term dynamics between variables, particularly in the presence of potential non-stationary time series data.

The methodology follows a structured approach, combining descriptive data exploration, econometric modelling, and robustness checks.

3.1 Data Sources and Variables

This study explores the interconnections between entrepreneurship, foreign direct investment, domestic credit, and market capitalization in driving sustainable economic growth in the United States from 2001 to 2023. The data for the analysis are sourced from the Global Entrepreneurship Monitor (GEM) Adult Population Survey and the World Bank Database. Key variables include:

- DP (constant 2015 US$): Used to measure economic growth (denoted as GDPC).
- Total Early-stage Entrepreneurial Activity (TEA): A measure of entrepreneurial activity within the economy.
- Foreign Direct Investment (FDI): Measured as the net inflows of FDI as a percentage of GDP.
- Domestic Credit to Private Sector (CRE): Measured as domestic credit extended to the private sector as a percentage of GDP.
- Market Capitalization (CAP): Measured as the market capitalization of listed domestic companies as a percentage of GDP.

Table no. 1 below presents the key variables; their descriptions and sources of data covered in the analysis.

Table no. 1 – Summary of Variables, Descriptions, Sources, and Coverage

Variable	Description	Source
GDPC	GDP per capita (constant 2015 US$)	World Bank
TEA	Total Early-stage Entrepreneurial Activity	GEM APS
FDI	Foreign Direct Investment (% of GDP)	World Bank
CRE	Domestic Credit to Private Sector (% of GDP)	World Bank
CAP	Market Capitalization (% of GDP)	World Bank

The descriptive statistics for the selected variables are presented in Table no. 2. This table summarizes key statistical measures such as the mean, standard deviation, minimum, maximum. These statistics offer valuable insights into the characteristics of the dataset before performing more advanced econometric analyses.

Table no. 2 – Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDPC	22	30.4705	0.1193	30.2619	30.6721
TEA	23	2.5162	0.2294	2.0268	2.9544
FDI	23	0.4424	0.3554	-0.4419	1.0280
CRE	23	5.2350	0.0715	5.0901	5.3987
CAP	22	4.8976	0.2204	4.3627	5.3267

The descriptive statistics for the variables GDPC, TEA, FDI, CRE, and CAP reveal various patterns. GDPC (GDP in constant 2015 US$) has minimal variation, and a very small standard deviation, indicating a stable GDP over the period. TEA (Total early-stage Entrepreneurial Activity) shows moderate variation, with a mean of 2.5162. FDI (Foreign Direct Investment as a percentage of GDP) exhibits significant fluctuation, with a mean of 0.4424. CRE (Domestic credit to the private sector as a percentage of GDP) is quite stable, with a low standard deviation. CAP (Market capitalization of listed domestic companies as a percentage of GDP) shows some variation. Overall, the data suggests that GDPC and CRE are relatively stable, while FDI and TEA show more variation, indicating greater economic fluctuation in those areas.

3.2 Autoregressive Distributed Lag (ARDL) Model

The ARDL model for the dependent variable (GDPC) and independent variables (TEA, FDI, CRE, and CAP is specified as:

$$\Delta GDPC_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \, \Delta GDPC_{t-i} + \sum_{j=0}^{q} \gamma_j \, \Delta TEA_{t-j} + \sum_{k=0}^{r} \delta_k \, \Delta FDI_{t-k} + \sum_{l=0}^{s} \theta_l \, \Delta CRE_{t-l} + \sum_{m=0}^{t} \varphi_m \, \Delta CAP_{t-m} + \epsilon_t \quad (1)$$

where Δ denotes the first difference of the variables, and ϵt is the error term. The number of lags (p, q, r, s, t) is determined by the Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC) (Akaike, 1974; Schwarz, 1978). This method is preferred because it can effectively handle both short- and long-run dynamics in a single framework (Pesaran *et al.*, 2001).

3.3 Error Correction Model (ECM)

To examine the speed of adjustment towards long-run equilibrium, an Error Correction Model (ECM) is estimated. The ECM is derived from the ARDL model and is used to capture short-run dynamics and the speed at which the system returns to equilibrium after a shock. The ECM equation is given by:

$$\Delta GDPC_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \, \Delta GDPC_{t-i} + \sum_{j=0}^{q} \gamma_j \, \Delta TEA_{t-j} + \sum_{k=0}^{r} \delta_k \, \Delta FDI_{t-k} + \sum_{l=0}^{s} \theta_l \, \Delta CRE_{t-l} + \sum_{m=0}^{t} \varphi_m \, \Delta CAP_{t-m} + \lambda EC_{t-1} + \epsilon_t \quad (1)$$

where EC_{t-1} is the error correction term derived from the long-run equilibrium relationship. The coefficient λ represents the speed of adjustment toward equilibrium. A negative and statistically significant λ indicates that the system corrects back to the long-run equilibrium (Engle and Granger, 1987; Johansen, 1988).

3.4 Model Diagnostics and Testing

To ensure the robustness and reliability of the analysis, several diagnostic tests are conducted. Unit root tests, such as the Augmented Dickey-Fuller (ADF) test, are employed to examine the stationarity of variables, as the ARDL approach accommodates variables integrated of order zero (I(0)) or one (I(1)), but not of order two (I(2)) (Dickey and Fuller, 1979).

The presence of a long-run relationship among the variables is assessed through the bounds testing procedure within the ARDL framework, which confirms cointegration if the calculated F-statistic exceeds critical values (Pesaran *et al.*, 2001).

The application of diagnostic tests such as the Breusch-Pagan and White tests is essential in validating regression results by detecting potential heteroskedasticity, which represents a violation of the assumption of constant error variance (Breusch and Pagan, 1979; White, 1980). Addressing heteroskedasticity ensures more reliable and efficient parameter estimates. Similarly, the Durbin-Watson test is employed to detect autocorrelation in the residuals, thus verifying the independence of error terms, a crucial assumption in linear regression (Durbin and Watson, 1950). These tests collectively enhance the robustness and reliability of the model's estimates by addressing violations of key econometric assumptions. Additionally, the Shapiro-Wilk test is applied to assess the normality of the residuals. This test determines whether the residuals deviate significantly from a normal distribution. A p-value greater than 0.05 suggests that the residuals follow a normal distribution, meeting one of the fundamental assumptions required for valid statistical inference in regression analysis (Shapiro and Wilk, 1965). Together, these diagnostic tests reinforce the robustness of the regression model and the reliability of its conclusions. Lastly, model stability is evaluated using the CUSUM and CUSUMSQ tests, which detect parameter constancy over time, ensuring the reliability of the estimated relationships (Brown *et al.*, 1975).

The ARDL and ECM models are estimated with optimal lag lengths chosen based on the AIC and BIC criteria.

This methodology allows for a comprehensive examination of the impact of entrepreneurship, FDI, credit, and market capitalization on economic growth, both in the short

and long run. By using ARDL and ECM models, the study addresses the complexities of dynamic interactions and provides insights into policy interventions aimed at fostering sustainable economic growth.

4. RESULTS

To examine the relationships between the variables in this study, we present the correlation matrix for GDP (GDPC), Total Early-stage Entrepreneurial Activity (TEA), Foreign Direct Investment (FDI), Domestic Credit to the Private Sector (CRE), and Market Capitalization (CAP) in Table no. 3.

Table no. 3 – Correlation matrix

Variable	GDPC	TEA	FDI	CRE	CAP
GDPC	1.0000				
TEA	0.7201	1.0000			
FDI	0.1022	-0.1702	1.0000		
CRE	0.5993	0.3132	0.0522	1.0000	
CAP	0.6350	0.6283	-0.0897	0.6891	1.0000

The correlation analysis for the variables GDPC, TEA, FDI, CRE, and CAP reveals several relationships. GDPC exhibits a strong positive correlation with TEA and moderate positive correlations with CRE and CAP. This suggests that as GDP per capita increases, early-stage entrepreneurial activity, domestic credit to the private sector, and market capitalization of listed companies tend to rise as well. TEA is moderately positively correlated with CAP and shows a weaker relationship with CRE. FDI shows very weak correlations with all the other variables, indicating limited or no significant relationship with GDPC, TEA, CRE, and CAP. Finally, CRE is moderately correlated with CAP, suggesting that credit to the private sector is somewhat related to the market capitalization of domestic companies. Overall, GDPC, TEA, CRE, and CAP are positively correlated, while FDI shows weak associations with the other variables.

The results of the Dickey-Fuller unit root tests for the variables GDPC, TEA, FDI, CRE, and CAP are summarized in Table no. 4. This test allows to assess the stationarity of the data.

Table no. 4 – Dickey-Fuller test results

Variable	Test Statistic	Variable	Test Statistic
GDPC	-0.5190	DGDPC	-4.8720***
TEA	-1.6870	DTEA	-5.0120***
FDI	-4.1410***	DFDI	-7.6770***
CRE	-2.3480	DCRE	-4.7590***
CAP	-2.0670	DCAP	-5.4700***

Note: *** implies the significance at 1% level

The Dickey-Fuller tests reveal that FDI is stationary, while GDPC, TEA, CRE, and CAP are non-stationary with p-values greater than 0.05. Non-stationary series will require differencing or transformation to ensure stationarity for further analysis. The Dickey-Fuller test results for the first-differenced variables indicate that all series are now stationary.

When selecting the appropriate lag length for an Autoregressive Distributed Lag (ARDL) model, both AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion) are commonly used to evaluate model fit (Table no. 5).

Table no. 5 – Model selection

Model	Lag	AIC	BIC
Model 1	1	-120.7317	-110.7744
Model 2	2	-167.3856	-153.2190

Model 2 is the more appropriate choice due to its better fit, as indicated by the lower AIC and BIC values compared to Model 1. The inclusion of multiple lags in Model 2 allows for capturing more temporal dynamics, making it more suitable for analyzing the relationships between the variables.

The estimation results of the ARDL model are presented in Table no. 6. This table displays the coefficients and statistical significance of the various variables included in the model, as well as the lag structure of the variables.

Table no. 6 – ARDL regression model

Variable	Coefficient	Std. Err.	t-Statistic	p-value	95% Confidence Interval
DGDPC					
L1	-0.1045	0.1639	-0.6400	0.5590	[-0.5596, 0.3507]
L2	0.6735***	0.1286	5.2400	0.0060	[0.3166, 1.0304]
DTEA					
No Lag	0.0662***	0.0073	9.1000	0.0010	[0.0460, 0.0863]
L1	0.0478***	0.0076	6.3200	0.0030	[0.0268, 0.0688]
L2	0.0411***	0.0065	6.2900	0.0030	[0.0230, 0.0592]
FDI					
No Lag	0.0130***	0.0027	4.7500	0.0090	[0.0054, 0.0206]
L1	-0.0005	0.0040	-0.1100	0.9160	[-0.0115, 0.0106]
L2	0.0081*	0.0032	2.5600	0.0630	[-0.0007, 0.0169]
DCRE					
No Lag	-0.1882***	0.0257	-7.3100	0.0020	[-0.2596, -0.1167]
L1	-0.3767***	0.0702	-5.3700	0.0060	[-0.5715, -0.1819]
L2	-0.1294**	0.0413	-3.1400	0.0350	[-0.2439, -0.0148]
DCAP					
No Lag	0.0979***	0.0095	10.2500	0.0010	[0.0714, 0.1244]
L1	0.1421***	0.0280	5.0700	0.0070	[0.0643, 0.2198]
L2	0.0305	0.0144	2.1100	0.1030	[-0.0096, 0.0706]
Constant	11.8387***	1.1862	9.9800	0.0010	[8.5452, 15.1321]
R-squared		0.8998	Adjusted R-squared		0.8991
F-statistic		1458.3400	p-value		0.0000
Root MSE		0.0029			

Note: ***, **, and * imply the significance at 1%, 5%, and 10% level, respectively

The ARDL regression for the period 2001-2023 shows strong results, indicating that the model explains a significant portion of the variation in GDP. The F-statistic of 1458.34 with a p-value of 0.0000 suggests that the overall model is highly significant. The R-squared value of 0.8998 indicates that the model explains 99.98% of the variance in the dependent variable,

with an adjusted R-squared of 0.8991 indicating a good fit even after accounting for the number of predictors.

In terms of individual variables, the second lag of DGDPC (L2) is statistically significant, while the first lag (L1) is not. Total Early-stage Entrepreneurial Activity is highly significant, with all lags (no lag, L1, and L2) contributing positively to DGDPC. Foreign Direct Investment shows a positive effect for the current period, but the first lag is insignificant, and the second lag is marginally significant. Domestic Credit to the Private Sector is significant across all lags, suggesting that changes in credit have a strong influence on economic growth. Similarly, Market Capitalization shows significant effects for the current period and the first lag, though the second lag is marginally significant.

The constant term is highly significant, confirming a strong baseline effect. The model's low Root MSE of 0.0029 and the significant t-statistics across many variables suggest that the ARDL model provides a robust explanation of DGDPC.

The tests for autocorrelation and heteroskedasticity suggest that the model meets the necessary assumptions for reliable inference. The autocorrelation test, with a p-value of 0.1357, indicates that there is no significant evidence of autocorrelation in the residuals, meaning that the residuals are independent of each other. This satisfies the assumption of no serial correlation in the errors. Additionally, both tests for heteroskedasticity, White's test and the Breusch-Pagan test (Breusch, 1978), yield p-values of 0.3253 and 0.3199, respectively, which are greater than the common significance threshold of 0.05. This means that we fail to reject the null hypothesis of homoskedasticity, indicating that the variance of the residuals is constant across observations. Lastly, the Shapiro-Wilk test for normality of the residuals yields a p-value of 0.36327, which is also above the 0.05 threshold. This result suggests that there is no significant evidence to reject the null hypothesis that the residuals are normally distributed. Since normality is crucial for performing hypothesis tests and constructing confidence intervals, this result further supports the model's reliability.

In conclusion, the findings from these diagnostic tests suggest that the model satisfies the assumptions of no autocorrelation, no heteroskedasticity, and normality in the residuals. These results indicate that the model is well-specified and that the statistical inferences drawn from it are likely to be valid.

The ECM regression output provides insights into the short-run dynamics and the adjustment toward long-run equilibrium (Table no. 7).

Table no. 7 – Error Correction Model (ECM) Results

Variable	Coefficient	Std. Error	t-value	p-value	95% Confidence Interval
DTEA	0.0439	0.0978	0.4500	0.6600	[-0.1658, 0.2536]
FDI	0.0057	0.0436	0.1300	0.8990	[-0.0879, 0.0992]
DCRE	-0.9587***	0.2843	-3.3700	0.0050	[-1.5684, -0.3490]
DCAP	0.4145***	0.0734	5.6500	0.0000	[0.2572, 0.5719]
ecm	0.8315	1.7155	0.4800	0.6350	[-2.8479, 4.5110]
Constant	28.4572***	0.3611	78.8200	0.0000	[27.6828, 29.2316]
R-squared		0.7276	Adjusted R-squared		0.6304
F-statistic		7.4800	p-value		0.0013
Root MSE		0.0640			

Note: *** implies the significance at 1% level

The results of the error correction model (ECM) provide valuable insights into the short-run dynamics and the adjustment process toward long-run equilibrium for GDP. The model explains 72.76% of the variation in DGDPC in the short run (R-squared = 0.7276), with an adjusted R-squared of 63.04%, indicating a good fit. The overall model is statistically significant, as demonstrated by the F-statistic (7.48, p = 0.0013).

In terms of short-run impacts, the coefficients for domestic credit and market capitalization are statistically significant, with contrasting effects. Domestic credit negatively influences GDP, suggesting that higher credit availability may not immediately translate into economic growth. Conversely, market capitalization has a strong positive effect, indicating its pivotal role in boosting GDP. However, the short-run impacts of Total Early-stage Entrepreneurial Activity and Foreign Direct Investment are statistically insignificant, suggesting limited immediate effects on GDP.

The error correction term reflects the speed of adjustment toward long-run equilibrium. With a coefficient of 0.8315 and an insignificant p-value, the term fails to confirm a statistically significant adjustment toward equilibrium. This may indicate a weak adjustment dynamic in the model.

We apply the diagnostic tests for autocorrelation and heteroscedasticity to the residuals of the regression. The results in Table no. 8 provide insight into the validity of the regression model by identifying potential issues with these assumptions and confirming the robustness of the model's estimates.

Table no. 8 – Validity of the model

Test	Chi-squared	p-value
Durbin's test for autocorrelation	2.3780	0.1231
Breusch-Pagan / Cook-Weisberg test	0.5100	0.4734

The results from the Durbin's test for autocorrelation and the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity both indicate no significant issues with the model's residuals. For Durbin's test, the chi-squared statistic is 2.378 with a p-value of 0.1231, which is greater than the typical significance level of 0.05. This suggests that there is no significant autocorrelation in the residuals, and the assumption of no serial correlation holds. Similarly, the Breusch-Pagan / Cook-Weisberg test gives a chi-squared statistic of 0.51 with a p-value of 0.4734. Since this p-value is also above 0.05, we fail to reject the null hypothesis of constant variance, meaning there is no evidence of heteroskedasticity in the residuals. Both tests support the validity of the model's assumptions regarding residuals.

Figure no. 1 displays a CUSUM squared plot, which is typically used to test the stability of a regression model's coefficients over time. The plot includes a cumulative sum of squared residuals (CUSUM squared) with bounds of significance.

The CUSUM squared test results indicate that the model is stable over time, as the CUSUM squared line remains within the confidence bands (dashed lines). This suggests that the parameters of the model do not undergo significant structural changes, confirming the stability of the long-run relationship. Stability tests, like the CUSUM squared, ensure the reliability and robustness of the model's estimates by demonstrating that the model's coefficients remain consistent throughout the sample period.

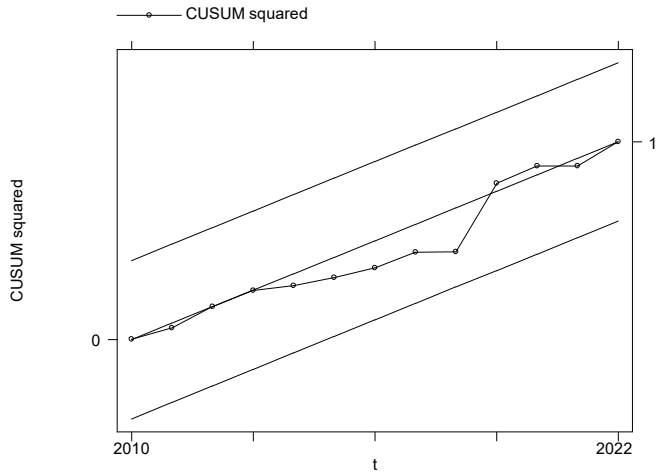

Figure no. 1 – CUSUM of Squares Test for Parameter Stability

5. DISCUSSION

This study examines the relationships among entrepreneurship, foreign direct investment (FDI), domestic credit, and market capitalization in shaping sustainable economic growth in the United States from 2001 to 2023. Using ARDL and ECM approaches, the analysis provides insights into short- and long-run dynamics, offering valuable policy implications. The empirical findings support several of the hypotheses proposed in this study.

H1: Entrepreneurship positively affects sustainable economic growth in both the short and long run. This hypothesis is supported. Entrepreneurship significantly impacts GDP growth in both the short and long run, as evidenced by the positive and significant coefficients across all lags. Total Early-stage Entrepreneurial Activity (TEA) fosters innovation, job creation, and economic diversification, which align with findings from Acs *et al.* (2013), who emphasize the systemic importance of entrepreneurial ecosystems. Similarly, Bosma *et al.* (2023) highlight the crucial role of entrepreneurship in driving sustainable economic growth by addressing gaps in traditional markets and fostering resilience. This conclusion also echoes evidence from East Asia, where technological entrepreneurship and innovation were key to sustaining economic performance across dynamic sectors (Abid, 2025d).

H2: FDI has a positive short-term effect on economic growth but a diminishing impact in the long run. This hypothesis is partially supported. Foreign Direct Investment exhibits immediate positive effects on GDP but shows diminishing significance in the long term. This aligns with Alfaro *et al.* (2004), who argue that the growth impact of FDI is contingent on the maturity of local financial markets. FDI's effectiveness also depends on policies that ensure technology spillovers and integration with local economies, as noted by UNCTAD (2023). Empirical analysis from Saudi Arabia further suggests that FDI-related growth effects are significantly enhanced when accompanied by economic diversification and environmental policy coordination (Abid and Gafsi, 2025).

H3: Domestic credit has a mixed impact, with short-term inefficiencies but potential long-term benefits. This hypothesis is supported. Domestic credit consistently influences

GDP growth, though its short-run negative impact suggests inefficiencies in credit allocation. Excessive credit availability may lead to non-productive investments or financial instability, as supported by Beck *et al.* (2000). Additionally, Cecchetti and Kharroubi (2019) emphasize that financial sector overexpansion can hinder sustainable growth if not aligned with productive economic activities. This is consistent with findings from energy-intensive Gulf economies, where poor credit alignment with productive sectors exacerbated inefficiencies and hindered green transition goals (Abid *et al.*, 2024).

H4: Market capitalization has a positive effect on sustainable economic growth in both the short and long term. This hypothesis is strongly supported. Market capitalization has a strong positive impact on GDP in both the short and long run, reflecting its role in fostering capital formation and investment. This finding is consistent with Levine and Zervos (1998), who highlight the role of stock markets in efficient resource allocation and innovation funding. Moreover, Pagano (2023) stresses the importance of liquidity and investor confidence for long-term economic stability. In addition, cross-country findings emphasize that financial market depth, coupled with technological integration, is essential for supporting resilient and sustainable growth models (Abid, 2025e).

The findings from this study provide several actionable insights for policymakers to foster sustainable economic growth. First, expanding support for entrepreneurship is essential, as it can amplify the long-term benefits of innovation and job creation. Policies should focus on nurturing start-ups and innovation hubs, which can drive new business ventures and stimulate economic dynamism (Audretsch and Thurik, 2003). Additionally, enhancing the spillover effects of foreign direct investment (FDI) requires targeted policies such as workforce development and supply chain integration, ensuring that local businesses and labor markets can fully absorb and benefit from FDI inflows (OECD, 2023). Optimizing credit allocation is another key area; financial oversight reforms are needed to ensure that credit flows to productive sectors, reducing the risks associated with misallocation and financial instability, thus supporting long-term growth (Rajan and Zingales, 2001). Finally, strengthening financial markets is critical to sustaining economic growth. By developing deeper and more liquid markets, the U.S. can improve the resilience of its economy, ensuring that businesses, particularly small and medium-sized enterprises (SMEs), have access to necessary capital while fostering broader economic stability (Bencivenga and Smith, 1991). Together, these recommendations offer a comprehensive framework for enhancing the economic growth trajectory of the U.S. in the years to come.

This study highlights the multidimensional interplay among entrepreneurship, FDI, credit, and market capitalization in driving sustainable economic growth. While entrepreneurship and financial markets emerge as strong drivers, inefficiencies in credit utilization and weak long-term adjustments point to areas for policy intervention. The confirmation of most hypotheses enhances the robustness of the empirical framework used.

6. CONCLUSIONS

This paper has explored the interplay between entrepreneurship, foreign direct investment (FDI), domestic credit, and market capitalization in shaping sustainable economic growth in the United States from 2001 to 2023. The empirical analysis, using an autoregressive distributed lag (ARDL) model and an error correction model (ECM), provides valuable insights into both short- and long-term dynamics.

The results demonstrate that while entrepreneurship, as measured by total early-stage entrepreneurial activity (TEA), has a consistently positive impact on economic growth, its effects are more pronounced in the long run. FDI also plays a positive role, especially in the short term, by facilitating capital inflows, technology transfer, and market expansion. Domestic credit to the private sector shows mixed effects, with its short-term influence being negative, suggesting that excessive credit expansion may not immediately translate into growth. In contrast, market capitalization has a strong positive impact on GDP in both the short and long term, highlighting the importance of robust financial markets in supporting economic growth.

Despite the overall positive influence of these variables, the study suggests that the U.S. economy faces challenges in achieving a balanced growth model that includes sustainable levels of credit and fosters deeper market capitalization. The findings underscore the need for a comprehensive policy approach that supports entrepreneurial activity, attracts FDI, ensures financial stability, and deepens capital markets.

However, several limitations must be acknowledged. First, the study focuses solely on the United States, which may limit the generalizability of the findings to other economic contexts. Second, while the ARDL and ECM methodologies capture important short- and long-run dynamics, they are inherently linear models and may not fully account for nonlinear or structural shifts in the economy. Third, data availability, particularly regarding entrepreneurial activity (TEA), imposes constraints on the temporal coverage and granularity of the analysis. Lastly, external shocks – such as the COVID-19 pandemic and global financial crises – may introduce volatility that is difficult to fully isolate within the model's framework.

In conclusion, for the U.S. to maintain and enhance its sustainable economic growth trajectory, it is essential to create an environment that encourages entrepreneurship, optimizes the benefits of FDI, manages credit expansion carefully, and further develops its financial markets. Future research should address these limitations by incorporating nonlinear modeling approaches, panel data across countries, and additional structural variables such as digital transformation, environmental sustainability, and institutional quality to provide a more holistic understanding of the drivers of sustainable growth.

ORCID

Ihsen Abid https://orcid.org/0000-0003-1358-7536

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