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Emprendimiento y crecimiento económico: Nueva evidencia de Irán

Entrepreneurship and Economic Growth: Fresh Evidence of Iran

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RESUMEN

El emprendimiento es un recurso vital e inagotable en todos los países, desempeñando un papel crucial en su desarrollo. Es un recurso valioso y rentable que gira en torno a la creatividad humana y la capacidad de innovar. Las sociedades que se basan en el capital humano y la capacidad intelectual en lugar de depender únicamente de los recursos naturales tienden a lograr un mayor éxito a largo plazo. Este estudio examina el impacto del emprendimiento en el crecimiento económico en Irán dentro del marco de un modelo de crecimiento. Se emplea el método de Rezagos Distribuidos Autorregresivos (ARDL) para analizar datos que abarcan desde 1980 hasta 2022. Los hallazgos revelan que varios índices de emprendimiento tienen un efecto positivo y significativo en el crecimiento económico de Irán durante el período de tiempo especificado. Los resultados del estudio indican la necesidad de implementar estrategias más avanzadas para acelerar la tasa de crecimiento y avanzar más rápidamente hacia el marco schumpeteriano. Los responsables de las políticas deben poner mayor énfasis en fomentar iniciativas emprendedoras innovadoras para lograr un crecimiento y desarrollo económico mejorados.

PALABRAS CLAVE
Emprendimiento; Crecimiento económico; Rezagos Distribuidos Autorregresivos (ARDL).

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ABSTRACT

Entrepreneurship is an essential and inexhaustible resource that significantly contributes to the development of countries. It embodies a valuable and cost-effective asset rooted in human creativity and innovation. Societies that prioritize human capital and intellectual capacity over reliance on natural resources tend to achieve greater long-term success. This study investigates the impact of entrepreneurship on economic growth in Iran through the lens of a growth model. Utilizing the Autoregressive Distributed Lags (ARDL) method, the analysis encompasses data from 1980 to 2022. The results indicate that various indices of entrepreneurship exert a positive and significant influence on Iran's economic growth during the specified period. The findings underscore the need for implementing advanced strategies to accelerate growth and align more closely with the Schumpeterian framework. Policymakers are encouraged to emphasize the promotion of innovative entrepreneurial activities to enhance economic growth and development.

KEYWORDS
Entrepreneurship; Economic growth; Autoregressive Distributed Lags (ARDL).

Clasificación JEL: M13; O40.

MSC2010: 91B64,; 91B84.

1. INTRODUCTION

The economic structure of most countries has undergone significant changes in recent times. Traditional indicators and tangible assets that once determined the position of an economic enterprise have now been replaced by the importance of innovation and the creation of new products and software assets. In the past, wealth was predominantly measured by financial resources, whereas today, the wealthiest individuals are those who possess knowledge and entrepreneurial skills. Therefore, economic development in today's world is based on innovation, creativity, and the effective utilization of knowledge, which characterizes a knowledge-based economy.

Furthermore, this new era can be seen as an age of competition not only over resources and capital but also over human resources and talent, which play a crucial role in driving countries towards prosperity. Wealthy nations, particularly large industrial countries, have placed a strong emphasis on human capital and talent. They leverage educated and specialized individuals in their growth and development processes, leading to valuable innovations and creations. Entrepreneurship, in particular, has played a vital role in invigorating the economies of developed countries. Shan et al. (2003), emphasizes the importance of entrepreneurship in facilitating societal shifts towards innovative and technological changes, resulting in economic growth and the transformation of new knowledge into tangible products and services. Salazar (2004) also highlights that entrepreneurship not only contributes to job creation but also enhances the quality of life, promotes equitable income distribution, reduces social tensions, and optimizes the productivity of national resources.

Entrepreneurship is a relatively recent phenomenon in the realm of technical and economic spheres, but it has made a significant impact on the global economy and industry over the past two decades. It is regarded as a symbol of effort and business success, with entrepreneurs being recognized as pioneers in achieving success within society. They play a crucial role in the

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economic growth of countries through their leadership, management, innovation, efficiency, job creation, competition, productivity, and establishment of new companies.

In recent research, alongside the consideration of quantitative variables such as human capital (Capelleras et al., 2019) and government expenditures (Dewi et al., 2018), and qualitative variables like income distribution (Neves et al., 2016), corruption and institutions (Galindo-Martin et al., 2020; Urbano et al., 2019), special attention has been given to entrepreneurship as one of the influential variables on economic growth (Cao & Shi, 2021; Prasetyo & Kistanti, 2020; Bosma et al., 2018; Urbano & Aparicio, 2016). Nevertheless, some empirical studies indicate that the role of entrepreneurship in economic growth varies based on business environment characteristics (such as unemployment and employment status) (Urbano et al., 2020; Aparicio et al., 2016). Moreover, the relationship between growth and entrepreneurship is somewhat unclear (Szerb et al., 2019) as a comprehensive and well-defined model has not yet been introduced (Urbano et al., 2019). More importantly, the existing entrepreneurship literature is mostly focused on advanced and developed economies like North America and Europe. Since the establishment of new businesses and entrepreneurship has gradually become a vital source for economic growth and employment development at the regional level in recent years (Stam & Van de Ven, 2021), therefore, the significance and role of entrepreneurial activities in economic performance may contribute to reducing the gap between advanced and emerging economies. In fact, entrepreneurship is now the most important global economic phenomenon in developing countries, which has received relatively less attention. Therefore, understanding the relationship between entrepreneurial activities and macroeconomic performance in developing economies is essential for researchers and entrepreneurship policymakers (Cao & Shi, 2020).

In the current context, where Iran's economy is grappling with multiple challenges and mismanagement, such as abnormal rates of unemployment, low domestic production, weakened government investment power, and a decline in non-oil exports, it becomes imperative to examine the potential of entrepreneurship growth and fostering an entrepreneurial culture that aligns with Iranian culture, capabilities, preferences, and available resources. By doing so, entrepreneurship can be leveraged as a means to address the current economic challenges and prevent further deterioration of conditions in the future. Given the significance and role of entrepreneurship in generating new ideas and enhancing human capital, as well as the undeniable effect of human capital accumulation on economic growth and production, this study aims to analyze the impact of entrepreneurship capital on the economic growth of Iran. To this end, this paper sets out to analyze the interplay between entrepreneurship and economic growth in Iran, offering a comprehensive understanding of how entrepreneurial endeavors can contribute to overcoming existing economic challenges and steering the country towards sustained development. This study underscores the critical role entrepreneurship can play in aligning with Iran's unique socio-economic landscape to spur innovation, create employment opportunities, enhance productivity, and foster prosperity. By bridging the gap between theory and empirical analysis, this research aspires to provide fresh insights into the dynamics of entrepreneurship and its potential implications for Iran's economic trajectory. This study contributes to the literature contextually by focusing on the Iran's economy where the relationship between entrepreneurship and economic growth is under-researched despite its importance. It is expected that the study will be helpful for both policymakers and researchers in Iran.

The remaining sections of the paper are organized as follows. Section Two is dedicated to a comprehensive literature review and previous studies. In Section Three, we delve into the specifics of the data, methodology, and models employed for estimation, presenting our empirical results and interpretation. Finally, in Section Four, we draw our conclusions and highlight the implications of our findings.

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2. LITERATURE REVIEW

The analysis of factors influencing economic growth has been a subject of extensive study from various perspectives throughout history. Adam Smith (1776) proposed a wealth creation approach, emphasizing market expansion through division of labor and efficient allocation of manpower. Smith argued that innovation and entrepreneurship, in conjunction with market expansion, lead to increased allocation and division of labor, resulting in enhanced productivity, production, and wealth accumulation. Building upon Smith's theory, Kirzner (1973) introduced the concept of the entrepreneur as an individual whose intelligence enables the discovery of profitable opportunities, considering them as the driving force behind economic growth.

Hayek (1945) presented his theory within the framework of a free economy, acknowledging that individuals, with their acuity and intelligence, create opportunities for society. He posited that an atmosphere of innovation fosters an increased number of entrepreneurs, thereby establishing the foundation for economic growth. Solow's (1956) neoclassical growth model emphasized the role of inputs such as manpower and physical capital as key determinants of growth. However, the shortcomings of the neoclassical approach in explaining economic growth solely through exogenously determined inputs led to the development of endogenous growth theories in the 1980s and 1990s.

Lucas (1988) viewed human capital as the primary variable driving growth, highlighting the positive effects of human capital on the productivity of other individuals within the surrounding environment. Romer's (1990) endogenous growth theory also emphasized the role of knowledge as a key factor in growth. As a result, human capital emerged as a fundamental variable incorporated into growth models. The rise of endogenous growth models recognized entrepreneurship as a crucial factor in economic growth. Schmitz (1989) introduced a model based on endogenous growth theories, highlighting the creation of new enterprises as an endogenous growth factor that positively influences economic growth. The decision to become an entrepreneur or work for a company was rationalized within this model. The increased number of entrepreneurs was seen as an additional input in the economy, with entrepreneurs disseminating and applying knowledge and technology, contributing to increased economic growth.

Holcombe (1998) regarded entrepreneurship as the engine driving economic growth. Audretsch & Thurik (2004) proposed a transition from a managed economy to an entrepreneurial economy, emphasizing the importance of knowledge and entrepreneurship capital as key factors in entrepreneurial activities. Schumpeter (1911) underscored the role of entrepreneurs in economic growth through innovation. He argued that entrepreneurs seek to introduce new products and methods, disrupting market equilibrium and leading to creative destruction, whereby existing enterprises struggle to compete and may exit the market.

Kirzner (1973) approached the relationship between entrepreneurship and economic growth from the perspective of an entrepreneur's ability to discover profitable opportunities. He emphasized that entrepreneurship thrives on the identification and exploitation of unequal opportunities, driving improvements in market efficiencies and the emergence of more entrepreneurs. Kirzner believed that markets, characterized by imperfect information, are inherently imbalanced, and entrepreneurs, through their intelligence and information acquisition, identify profitable opportunities that lead markets towards equilibrium through increased productivity and production.

Moreover, scholars such as Bamol (1993), Wennekers et al. (1997), and Gould (1972) have emphasized the significance of institutions in fostering entrepreneurship, which, in turn, promotes economic growth and innovation. They argue that economic growth is facilitated when institutions are efficient and incentivize desirable activities.

Table 1 provides an overview of various empirical studies conducted in the field of entrepreneurship and economic growth.

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Table 1 – Summary of previous studies.

Main results	Entrepreneurship indicator	Economic growth indicator	Sample Time Period	Author/Authors
Entrepreneurship has a positive relationship with economic growth. Entrepreneurship increases innovations and increased innovations in turn increases economic growth rate.	The number of employers	GDP	13 developed countries 2002 to 2007	Galindo & Mendez (2014)
The increase in entrepreneurship rates in developing countries has a positive impact on economic growth. However, this effect is not observed in developed countries.	Global Entrepreneurship Monitor (GEM) Index	Per Capita GDP	Two group of developed and developing countries 2003-2011	Prieger et al. (2016)
The positive and significant effect of employers on economic growth, Creative and entrepreneurial ideas are the key to economic growth in examined countries.	The number of employers	GDP	Latin American Countries and all countries 2004-2012	Aparicio et al. (2016)
In the long run, entrepreneurship has a positive impact on economic growth, but in the short run, this relationship is not always consistent.	Three indicators: Total early-stage entrepreneurial activity (TEA), Perceived capabilities (PEC) and perceived opportunities (PEO)	Per Capita GDP	Eurozone countries 2001-2016	Pradhan et al. (2020)
Entrepreneurship has a positive effect on economic growth	self-employment	Per Capita GDP	European countries 2010-2019	Gonzalez-Sanchez et al. (2020)
There is a significant positive relationship between entrepreneurial activities and economic growth	Global Entrepreneurship Monitor (GEM) index	Per Capita GDP	G-20 economies 2001-2016	Gautam & Lal (2021)
Sustainable entrepreneurship promotes regional economic growth. there is a positive mediation effect of sustainable entrepreneurship influencing regional economic growth through technical R&D	new time-varying index of entrepreneurship based on innovative spirit, entrepreneurial spirit and decision-making	Per Capita GDP	China 2000-2018	Gu & Wang (2022)

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	spirit			
EI is a significant determinant for economic growth. The study added to the prior literature by confirming that EI drives economic growth which can be useful for the policymakers	entrepreneurial intention (EI), total early-stage entrepreneurial activity (TEA), established business ownership (EBO) rate and high job creation expectation (HJCE) rate	GDP	BRICS countries 2014 - 2018	Gaba & Gaba (2022)
entrepreneurship has a positive and significant influence on economic growth in the BRICS economies. the causality testing revealed a one-way relationship running from entrepreneurship towards economic growth.	Percentage of 18–64 population who are either a nascent entrepreneur or owner-manager of a new business	per capita GDP	BRICS countries 2002-2021	Tahir & Burki (2023)

Source: Authors' finding

3. EMPIRICAL ESTIMATION

3.1. Model and data

The research implemented the endogenous growth framework pioneered by Romer (1990) and Lucas (1988), building upon the neoclassical growth theory advanced by Ramsey (1928). Solow (1956) is credited with popularizing the neoclassical model, which posits technological change as exogenous and maintains constant returns to scale. According to this model, capital and labor are interchangeable, with diminishing marginal products. Considering the development of growth models and the identification of various factors affecting economic growth, the role of entrepreneurship capital in economic growth has gained significant attention in recent years. In this section, we utilize a modified version of the neoclassical growth model with fixed returns to scale to examine the impact of entrepreneurship on economic growth in Iran. The basic form of the model is as follows:

$$Y_t = A_t F(K_t, L_t, Z_t) \qquad (1)$$

Where, Y represents total real products in an economy; A represents technology of the total production; L represents total labor force, K represents total physical capital; and Z represents all other factors which are effective on economic growth based on existing economic literature.

Considering the pivotal role of entrepreneurship capital in economic growth, we incorporate this variable as a determinant of economic growth in our research model. This reflects our acknowledgment of entrepreneurship's significant contribution to driving economic expansion. The empirical analysis in our study adopts an extended version of the Cobb-Douglas production function. Known as the Cub-Douglas extended production function, this form is extensively employed in growth accounting to scrutinize the relationship between inputs and economic output.

$$Y_t = A_t F(K_t, L_t, E_t) \qquad (2)$$

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Where, *t* represents time; *Y* represents GDP, *E* represents certain entrepreneurship indicators, *K* and *L* represents physical capital and labor force, respectively. Estimation of the effect of entrepreneurship capital on economic growth in this study is performed based on production function method and first, it is assumed that the form of production function would be similar to extended Cub-Douglas form and as following.

$$Y = A\,E^{\alpha_e} K^{\alpha_k} L^{\alpha_l} \qquad (3)$$

by taking the natural logarithms of both sides of above equation, production function is turned into a linear function as following.

$$lnY = lnA + \alpha_e lnE + \alpha_k lnK + \alpha_l lnL \qquad (4)$$

Assuming the availability of variable information, the parameters of the production function can be estimated. This function can be estimated for analyzing time series data within a country or across multiple countries.

If we consider the assumption of fixed return to production scale and also if, payment to production factors would be equal to final production size, the coefficient of α represents the share of factors in total GDP. All the factors, except for technology changes, can be seen in the above equation and that these changes also are obtained as the residuals and mainly are known as total growth rate or multifactor productivity. Based on the mentioned empirical studies and theoretical framework of research and also considering the extended growth model of Solow, for studying the effect of entrepreneurship capital on GDP growth in Iran the following final model is presented:

$$LnGDPt = f\,(LnLt,\ LnKt,\ LnEKt,\ LnEKHt)$$

Where:

$LnGDP_t$: logarithm of GDP in constant price of 1997 in Billion Rial.

LnK_t : The logarithm of real physical capital in billions Rial.

LnL_t: The logarithm of the number of skilled and trained labor force which has been also incorporated into the model as a proxy for human capital.

EK_t and EKH_t : Entrepreneurship indicators used in this study which indicate to the number of employers and Self-employed.

t: Represents time.

The dependent variable in equation (5), denoting economic growth, is GDP measured in constant prices of 1997. The data for this variable have been sourced from the Central Bank of Iran. Another crucial explanatory variable in the model is physical capital, which is widely recognized for its substantial influence on GDP growth as per various economic growth theories. The data for this variable have similarly been acquired from statistics provided by the Central Bank of Iran. Another pivotal variable influencing economic growth is the labor force. Extensive research in the realm of economic growth underscores the substantial impact of a skilled and educated labor force, often characterized as a knowledge-based workforce. In this study, the number of labor force members possessing higher education and secondary education is

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utilized as a proxy for the effective labor force's impact on economic growth, which concurrently serves as a proxy for human capital. The data pertaining to this variable have been collected from the Statistics Center of Iran.

Moreover, entrepreneurship capital serves as another explanatory variable in this study. To scrutinize its effect on economic growth in Iran, two indicators are utilized: the number of self-employed individuals and the number of employers. Quantitatively gauging entrepreneurship poses a challenge in empirical studies due to its multifaceted and intricate nature. However, the number of self-employed individuals is commonly employed as an indicator of entrepreneurship, as these individuals have opted for autonomous economic endeavors, assuming associated risks, rather than working for other entities. This choice to pursue self-employment embodies one of the attributes of an entrepreneur. The data on the number of employers and self-employed individuals across different years are sourced from the Statistics Center of Iran, which acquires the data from censuses. By incorporating these variables into the analysis, our aim is to evaluate the influence of entrepreneurship capital and the composition of the labor force on economic growth in Iran.

3.1.1 Descriptive statistic of variables

Table 2 – Descriptive statistics.

	GDP	L	K	EKH	EK
Average	489175.1	4444468.	846369.5	11989607	234649.1
Mean	215680.2	4177447.	885956.1	10797531	211302.5
Max.	1893834.	7897504.	2227193.	22729815	596414.8
Min.	88033.58	2517490.	73915.00	6322197.	43911.00
Standard deviation	495432.3	1706161.	574813.3	4835824.	136668.1
Skewness	1.501395	0.483514	0.474972	0.708221	0.832572
Kurtosis	4.013729	1.930518	2.588858	2.361663	3.290102
Jarque-Bera value	21.76287	4.504360	2.321433	5.229866	6.189873
Probability	0.120019	0.105170	0.313262	0.073173	0.065278

Source: Research finding

Table 2 shows descriptive statistics for the variables utilized in this research. The initial row of the table exhibits the average values of the variables. Subsequent rows provide details such as the mean, maximum, and minimum observations, alongside standard deviation, skewness, and kurtosis for each variable. Jarque-Bera statistics and corresponding probability percentages are

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also included to evaluate the normality of the distribution of observations.

Moreover, a correlation matrix of the model's variables is furnished to explore the general relationship among these variables.

Table 3 – Correlation matrix of variables.

	EK	EKH	K	L	GDP
EK	1.00				
EKH	0.51	1.00			
K	0.41	0.46	1.00		
L	0.45	0.39	0.48	1.00	
GDP	0.94	0.92	0.97	0.96	1.00

Source: Research finding

The correlation matrix reveals significant relationships between the variables under study. Strong positive correlations are observed between GDP and each of the variables, including the number of employers, the number of self-employed individuals, physical capital, and the labor force, indicating that an increase in these factors corresponds with higher economic output. Notably, the number of employers demonstrates the strongest correlation with GDP, followed closely by physical capital and the labor force. The correlation coefficients suggest that the presence of employers and self-employed individuals, along with investment in physical capital and a larger labor force, are key drivers of economic growth. These findings underscore the importance of entrepreneurship and investment in human and physical capital in fostering economic growth and development in Iran.

3.2. Estimation method

To examine the dynamic relationships among our research variables over both short and long-run horizons, the Autoregressive Distributed Lags (ARDL) model was chosen. This selection was supported by diagnostic evaluations and the inherent characteristics of our dataset. The ARDL model possesses distinct features that distinguish it from other time series models. One notable attribute of the ARDL model is its ability to address potential endogeneity issues in the model variables by incorporating lagged values of the dependent variable into the explanatory variables. Furthermore, the ARDL model offers the flexibility of not requiring all variables to be integrated to the same order, as it can accommodate a combination of first difference integration, level integration, or both. An important advantage of the ARDL model is its suitability for cases with limited sample sizes, particularly relevant in developing countries where data scarcity is prevalent. This versatile model is widely employed in economic research due to its capability to simultaneously estimate both long-run and long-run dynamic relationships between variables (Aghaei et al., 2024).

Various econometric methods are available to estimate the long-run cointegration relationship between variables. In existing literature, methods such as the Engle-Granger test (1987), Johansen test (1991), and Pesaran's test (2001) are utilized for this purpose. The Engle and Granger cointegration test (1987) identifies cointegration between two variables of the same integration order, making it suitable for examining the relationship between two variables but less effective in multivariate scenarios. To address this limitation, the Johansen (1988, 1991) cointegration test was introduced, enabling the examination of cointegration among several variables. The Johansen test, based on vector error correction modeling (VECM), was designed to overcome the shortcomings of the Engle and Granger tests. However, it requires all variables

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to have the same integration order, which is typically not the case in most economic time series. Therefore, to investigate cointegration among multiple variables with different integration orders of I (0) and I (1), Pesaran et al.'s cointegration test (2001) can be employed.

In this study, given the differing integration orders of the variables and the objective of assessing both long-run and short-run dynamic relationships among these variables, the model proposed by Pesaran et al. (2001) is utilized. The linear ARDL model is employed to examine the relationship between entrepreneurship and economic growth in Iran. The model is structured as follows:

$$\Delta(LnGDP)_t = \alpha_0 + \alpha_1(LnGDP)_{t-1} + \alpha_2(LnL)_{t-1} + \alpha_3(LnK)_{t-1} + \alpha_4(LnEK)_{t-1} + \alpha_5(LnEKH)_{t-1} + \sum_{i=1}^{t} \beta_i \Delta(LnGDP)_{t-i} + \sum_{i=1}^{t} \rho_i \Delta(LnL)_{t-i} + \sum_{i=1}^{t} \varphi_i \Delta(LnK)_{t-i} + \sum_{i=1}^{t} \omega_i \Delta(LnEK)_{t-i} + \sum_{i=1}^{t} \gamma_i \Delta(LnEKH)_{t-i} + \psi_t$$

In this equation, Δ represents the first-order difference operator. α_0 and ψ denote the constant coefficient and the disturbance term of the model at time t, respectively. Coefficients β_i, ρ_i, φ_i, ω_i, φ_i, and γ_i represent the short-run coefficients of the model, while α_1 to α_5 denote the long-run coefficients. The ARDL method typically relies on the F-statistic, and the asymptotic distribution of this statistic is non-standard under the null hypothesis of no cointegration vector. In estimating the ARDL model, the initial step involves estimating the equation using the Ordinary Least Squares (OLS) method. The evaluation of each equation's estimation, aimed at determining the presence or absence of a cointegration relationship between the variables, depends on the significance of the F-statistic for the coefficients of lagged variables in the model. For instance, the hypothesis test concerning the existence or absence of a long-run relationship (cointegration) is conducted based on the Wald test.

$H_0: \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0$ Existence of cointegration (long-run relationship)

H_1 $: \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq 0$ Absence of cointegration (long-run relationship)

To evaluate the hypothesis test, critical values established by Pesaran et al. (2001) are employed. These critical values consist of both the upper critical boundary (UCB) and the lower critical boundary (LCB), which are pivotal in discerning the presence or absence of cointegration. If all variables in the model are integrated at level (I_0), the lower critical boundary is utilized to assess the significance of cointegration. Conversely, when the variables in the model are integrated to the first difference or a combination of the first difference and level, the upper critical boundary is used to evaluate the significance of the cointegration relationship. If the calculated F-statistic is lower than the upper critical boundary, it indicates a significant cointegration relationship between the variables. Conversely, if the F-statistic does not exceed the lower critical values, it suggests the absence of a cointegration relationship. If the F-statistic falls between the upper and lower critical boundaries, the error correction method (ECM) is the preferred approach to infer the presence of cointegration among the variables.

However, it is noteworthy that the critical values provided by Pesaran et al. (2001) are more suitable for larger samples (T=500 to T=40000). Given the relatively small sample size in this study, the utilization of critical values from Narayan (2005) is deemed more appropriate. The critical values proposed by Narayan et al. have demonstrated better performance for sample sizes ranging between 30 and 80 (Narayan, 2005). Subsequently, short-run and long-run coefficients are estimated, and to ensure the model's accuracy, diagnostic tests are conducted. Equation (7) is provided to estimate the model's short-run coefficients, with γ_i representing the speed of adjustment for the long-run equilibrium of the model due to short-run shocks or error

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correction.

$$\Delta(LnGDP)_t = \gamma_0 + \sum_{i=1}^{t} \beta_i \Delta(LnGDP)_{t-i} + \sum_{i=1}^{t} \rho_i \Delta(LnL)_{t-i} + \sum_{i=1}^{t} \varphi_i \Delta(LnK)_{t-i} + \sum_{i=1}^{t} \omega_i \Delta(LnEK)_{t-i} + \sum_{i=1}^{t} \gamma_i \Delta(LnEKH)_{t-i} + \gamma_i \mathrm{ECM}_{t-1} + \vartheta_t$$

3.2.1 Stationary of Variables

In this section, stationary of variables is done by using Augmented Dickey-Fuller unit root test.

Table 4 –stationary of variables

Result	Critical value at 10%	Critical value at 5%	Critical value at 1%	Dickey -Fuller statistics	Variable
I(1)	-2.599925	-2.923780	-3.574446	-5.3192242	Employers (EK)
I(0)	-2.598551	-2.921175	-3.568308	-6.011977	Self-Employed (EKH)
I(1)	-2.598551	-2.921175	-3.5668308	-4.377661	GDP
I(1)	-2.598551	-2.921175	-3.568308	-5.940671	Physical capital(K)
I(1)	-2.598551	-2.921175	-3.568308	-6.753683	Labor force(L)

Source: Research finding

As demonstrated in the provided table, all research variables, with the exception of EKH, exhibit unit roots at their respective levels, but become stationary with one difference. Differencing variables can potentially result in the loss of significant information. Therefore, the most suitable estimation method in this scenario would be the Autoregressive Distributed Lags (ARDL) method. The ARDL approach facilitates the incorporation of both stationary and non-stationary variables in the model, rendering it suitable for analyzing the relationship between variables with differing orders of integration. Through the utilization of the ARDL method, we can effectively capture the dynamics and long-run relationship between the variables in the model.

3.2.2 Optimal Lag Selection, Cointegration Teste results, and other Diagnostic Statisics

According to Sims' methodology, the selection of pertinent variables and the determination of an optimal lag structure are crucial in autoregressive system models. With these models often entailing numerous parameters, adopting a principle of parsimony becomes imperative to discern the optimal lag length. Information criteria, such as Schwartz's Bayesian Information Criterion (SBIC), serve as indispensable tools for this purpose, particularly in system models. Given the study's constrained timeframe and SBIC's superior performance in small sample sizes, it was employed to ascertain the optimal lag order. Following stationary tests on the variables to ensure integration does not exceed the second difference, the investigation proceeds to evaluate the long-term relationships among the variables and conduct diagnostic tests to validate model stability. The first column of Table 5 illustrates the estimated relationships

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between model variables. The second column presents optimal lag lengths determined by SBIC. Pesaran's F-test values, examining long-run relationships, are depicted in the third column, indicating confirmed long-run relationships at a 95% confidence level in model. Moreover, consistent negative and significant error correction coefficient (ECM) values, as per Kremers et al. (1992), validate the presence of long-run relationships in estimation model. Diagnostic statistics in the subsequent columns corroborate classical assumptions and the estimated models' validity, reinforcing the reliability of interpretations and conclusions drawn from ARDL model.

Table 5- Results of long-run relationship test and other diagnostic tests.

Ramsey test	Autocorrelation test	Heterogeneity variance test statistic	Normality test	F statistic pesaran	Optimal lag	Estimated model
2.040980 (0.1346)	0.074756 (0.3585)	1.871172 (0.6160)	3.8987 (0.960)	* 7.4990	(1,1,1,1,0)	GDP= f (L, K, EK, EKH)

Source: Research findings

Based on the diagnostic statistics provided in Table 5, the model's classical assumptions, including the absence of serial autocorrelation, correct functional form, normal distribution of residuals, and homogeneity of variance, are upheld, thereby confirming the validity of the findings. These results affirm the robustness of the model and bolster confidence in the estimated relationships between the variables.

3.3. Short-run and Long-Run Estimation

After performing the necessary diagnostic tests, in this part of the research, the long-run and short-run relationship between the research variables using the ARDL method is presented in Table (6). Table 6 presents the results of estimating the model using the Autoregressive Distributed Lags (ARDL) method. The table likely includes the estimated coefficients for each variable in the model, along with their corresponding standard errors, t-statistics, and p-values. These statistics provide information about the significance and magnitude of the relationships between the variables.

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Table 6 – Entrepreneurship and GDP growth

Short-run Results			
Dependent variable: Ln GDP			
Variable	Coefficient	t statistics	Probability
Ln GDP (-1)	0.64205	11.221	[.000]
LnL	0.15672	2.4662	[.018]
LnL (-1)	0.26770	3.7281	[.001]
LnK	0.99808	2.6285	[.012]
LnK (-1)	0.85656	2.4232	[.020]
LnEK	0.41232	2.2525	[.030]
LnEK (-1)	0.54503	3.1307	[.003]
LnEKH	0.29172	2.1031	[.042]
Costant coefficient	7.1098	1.9724	[.056]
Time trend	0.0220	1.5925	[.119]
Dummy variable of war with Iraq (D)	-0.083048	-1.3233	[.193]
Error Correction Term (ECT)	-0.2879	-2.4381	[.019]
R2	0.9671		
Adjusted R2	0.9564		
F	132.7000		
DW-statistic	1.9089		
Long-run Results			
Dependent variable: LnGDP			
Variable	Coefficient	t-value	Probability
LnL	0.42834	1.7728	[.084]
LnK	0.54230	2.0413	[.048]
LnEK	0.60271	2.1077	[.031]
LnEKH	0.24246	2.5165	[.021]
Constant coefficient	8.2657	1.7158	[.094]
Time trend	0.05491	1.3791	[.176]
Dummy variable of war with Iraq(D)	-0.3226	-1.3749	[.177]

Source: Research finding

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The results of the estimations indicate that all the estimated coefficients have the expected signs, and most of the variables are statistically significant at a high confidence level. The F-value suggests that the model's coefficients are collectively significant, and the Durbin-Watson test shows no evidence of autocorrelation in the model's error terms. Other diagnostic tests, presented in Table (5), confirm the validity of the regression and the accuracy of the obtained results. The lag selection in the model has been determined using the Schwarz-Bayesian criterion. Since the model has been estimated logarithmically, the coefficients for the variables represent their elasticity with respect to economic growth.

The short-run findings reveal that the inclusion of a dummy variable representing social-political changes during the war with Iraq has been implemented. The coefficient associated with the Iran and Iraq war dummy variable suggests a negative impact on GDP; however, this observation lacks statistical significance. Coefficient for the labor force variable is 0.15 and statistically significant at a high confidence level. This suggests that a 1% increase in the number of educated labor force leads to a 0.15% increase in GDP. The lagged labor force variable also has a positive and significant effect on GDP growth, indicating that a higher number of skilled and educated labor force in the present leads to higher GDP growth in the future. The coefficients for physical capital and its lagged value show a positive and significant effect on GDP growth. This suggests that in short-run, increased investment and capital accumulation contribute to GDP growth in Iran.

Both indicators of entrepreneurship have positive and significant coefficients at a 95% confidence level in short-run. The coefficient for the number of employers indicates that a 1% increase in the number of employers leads to a 0.4% increase in GDP. The coefficient for the number of self-employed is 0.29, indicating that an increase in self-employed individuals also contributes to GDP growth. However, the effect of employers is higher compared to self-employed individuals, indicating that employer-based enterprises have a stronger impact on economic growth. The coefficient for the time trend variable is positive but not statistically significant. This suggests that the passage of time has a positive effect on increasing GDP in Iran, likely due to population growth and technological advancements.

As observed in the table 6, all the long-run coefficients of the variables are statistically significant at high levels. This indicates that the skilled and trained labor force, physical capital, and entrepreneurship indicators have a positive and significant effect on GDP growth in Iran during the studied period. On the other hand, the dummy variable representing war shows a negative effect on GDP growth in the long run, although it is not statistically significant.

The statistically significant ECM (-1) coefficient of -0.28 suggests a notable speed of adjustment in response to deviations from equilibrium within the model. In practical terms, this implies that approximately 28% of any deviations from equilibrium in GDP growth caused by external factors will be corrected in the subsequent period, moving the system closer to its long-run equilibrium. Essentially, in the face of shocks or disturbances in a particular period, around 28% of the prior period's discrepancies will be rectified within the model. This highlights the model's ability to self-adjust and return to its long-term equilibrium path over time, enhancing its reliability in predicting and understanding economic dynamics.

3.3.1 Stability Test

Evaluating the stability of estimated parameters in ARDL estimation is essential for ensuring the reliability of the results. In this study, two tests were conducted to assess parameter stability: the Cumulative Sum of Residuals (CUSUM) and the Cumulative Sum of Squared Residuals (CUSUMSQ) tests applied to the regression residuals. The results of these tests indicate no evidence of parameter instability in the estimated models. Consequently, the stability of the estimated parameters enhances confidence in the validity of the policy recommendations derived from these results.

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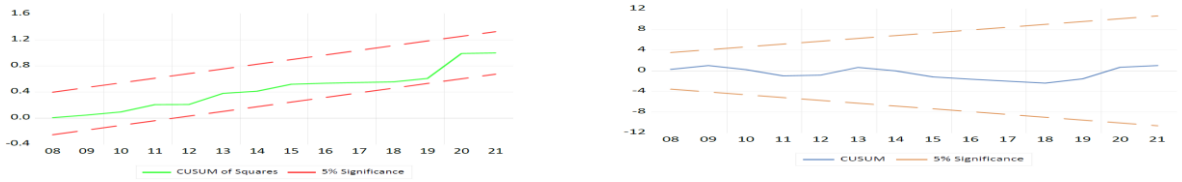
Figure 2- CUSUM and CUSUMSQ graphs.



Source: Research findings

4. CONCLUSION AND POLICY IMPLICATIONS

Undoubtedly, a nation's capacity for wealth accumulation and overall well-being hinges on its ability to cultivate, harness, and disseminate knowledge. Throughout history, monumental strides and advancements have been propelled by expansive scientific domains and technological breakthroughs. Entrepreneurship, deeply intertwined with human intellect and skills, assumes a paramount role in societal economic evolution and expansion. Entrepreneurs possess the prowess to transmute ideas into novel products and services, whether by establishing small to medium-sized enterprises, pioneering innovative market introductions, or revolutionizing existing markets. They wield the capacity to implement novel production methodologies within pre-existing firms or startups, while also proffering cutting-edge technical and engineering services to the market. Recent years have witnessed a resurgence in scholarly and policymaker interest surrounding entrepreneurship's pivotal role in industrial dynamics and economic advancement. Schmitz (1989) have propounded models underscoring how an augmented entrepreneurial presence can foster sustained growth through imitation. Echoing similar sentiments, Lucas (1988) accentuates entrepreneurs' significance in embodying distinct values and wielding a distinctive form of human capital, positing divergent growth trajectories across nations. This acknowledgment of entrepreneurship's catalytic role in economic advancement has spurred intensified efforts toward nurturing an entrepreneurial ecosystem. By championing and incentivizing entrepreneurship, nations can unleash their populace's innovative potential, propel economic advancement, and lay the groundwork for enduring development.

This study has rigorously investigated the influence of entrepreneurship indicators on GDP growth in Iran spanning from 1980 to 2022, employing time series models and the Autoregressive Distributed Lags (ARDL) method. The outcomes underscore a noteworthy and statistically significant positive relationship between indicators associated with employers and self-employed individuals, serving as proxies for entrepreneurship, and GDP growth in Iran. These findings hold profound policy implications for Iran's developmental trajectory, accentuating the pivotal role of entrepreneurship. Alongside human and physical capital, entrepreneurship capital emerges as a linchpin in the production function and growth model. Entrepreneurs wield a direct impact on production and growth through innovation, with the dissemination of knowledge further augmenting their catalytic influence on growth and development.

Hence, it is imperative for the Iranian government and policymakers to prioritize the enhancement of entrepreneurship capital from multifaceted aspects. Establishing an enabling environment for entrepreneurial endeavors should be of paramount importance, necessitating a holistic approach to evaluate and enhance economic, political, social, cultural, and legal factors shaping the business landscape. This entails fostering a competitive ambiance conducive to entrepreneurship and fostering heightened investment by entrepreneurs in Iran. By directing efforts towards bolstering entrepreneurship, Iran can harness the latent potential of its human capital and nurture innovation and creativity. Consequently, this concerted focus on entrepreneurship will catalyze economic growth, spur job creation, and foster comprehensive

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development.

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6. CONFLICTS OF INTEREST STATEMENT

The author declares no conflicts of interest related to this study.

7. DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are available from the corresponding author upon request.

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