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Investigating the Impact of Credit on Total Factor Productivity and the Growth of Value Added in Iran's Economic Sectors: A Panel ARDL Approach[1]

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Abstract:

A developed financial system, which ensures the provision, allocation, and direction of resources toward productive economic sectors, is one of the key drivers of economic growth and development. On the other hand, given the low efficiency of various economic, productive, and social sectors, attention to total factor productivity (TFP) is fundamental for global competitiveness. Given resource constraints in the economy, improving this factor can enhance investment, optimize resource allocation, prioritize productive sectors, reduce costs, improve product quality, and increase value added in economic sectors. Accordingly, the present study aims to investigate the impact of credit on total factor productivity and the growth of value added in Iran's economic sectors using the Panel ARDL approach and quarterly time series data from 2012Q1 to 2024Q4 (Persian calendar).

The results indicate that real credit, real exchange rates, and real capital formation in machinery have a positive and direct impact on the growth of value added and total factor productivity in economic sectors. Specifically, credit in the industrial sector and exchange rates in the service sector exert the greatest influence on TFP and the growth of value added. Additionally, capital formation in machinery in the agricultural sector has the most significant impact on total factor productivity.

[1] This Article is Extracted from a PhD Dissertation.

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Introduction

Achieving economic growth and development is one of the most important concerns and primary goals of any economic system. In recent decades, economists have emphasized the necessity of an efficient financial sector to ensure optimal resource allocation for achieving stable and sustainable economic growth (Mehrara et al., 2019). A well-developed financial sector can facilitate economic growth by efficiently allocating savings and financial resources, identifying and financing cost-effective investment and employment opportunities in the real economy, managing and distributing risk, facilitating trade in goods and services, and implementing corporate governance mechanisms (Taherpour et al., 2018). In other words, economic growth depends on the deepening or expansion of the financial sector. According to the supply-leading hypothesis, when financial development drives economic growth, increased financial activity enhances financial services, ultimately leading to financial deepening and economic growth. Conversely, the demand-following hypothesis suggests that economic growth increases the demand for financial services, thereby necessitating financial development (Juma Ahmed, 2021).

The relationship between economic growth and financial development reflects two contrasting views. Some economists argue that financial system development does not influence economic growth, as suggested by Modigliani and Miller, Lucas and Levine, Meyer and Sears (1984), and Stern (1989). In contrast, Keynesian and neoclassical economists (Mehrara et al., 2019), Schumpeter (1912), Goldsmith (1969), McKinnon (1973), Shaw (1973), Fry (1978), Moore (1986), King and Levine (1993), Beck et al. (2000), and Levine et al. (2000) emphasize the role of financial development in expanding demand in the real economy and promoting economic growth (Taherpour et al., 2018). Other scholars, including Patrick (1966), Robinson (1952), Young (1986), and Ireland (1994), consider economic growth and financial development as contingent on technological progress and labor productivity improvements. Meanwhile, a bidirectional relationship between economic growth and financial development is highlighted by Greenwood and Smith (1997), Greenwood and Jovanovic (1990), and Leontief and Khan (1999) (Mehrara et al., 2019). Financial development consists of capital market expansion and banking sector growth. The banking sector's development is measured through indicators such as the ratio of deposits to GDP, M1 and M2 money supply relative to GDP, the ratio of liquid liabilities to GDP, and private sector credit relative to GDP. Banking consists of credit provisions and the credit channel mechanism (Nouri & Ibrahim, 2019). Bank credit is a crucial link in the transmission of money, financing production, consumption, and capital formation, thereby enhancing economic activity. It also strengthens the transmission mechanism of monetary policy and aids in achieving monetary policy objectives, particularly when the banking system is well-functioning and regulated. Consequently, empirical literature underscores the role

of bank credit to the private sector as the best measure of financial development for improving economic growth, given that banks and financial institutions play the most significant role in facilitating financial services (Juma Ahmed, 2021).
In any economic system, banks serve as financial intermediaries (Moradi et al., 2018). On the one hand, they collect savings and direct them toward productive economic sectors, providing financial resources for investment, supporting businesses, and supplying various production inputs such as labor, capital, technology, and raw materials. Additionally, banks finance agricultural needs, corporate equipment, and government expenditures, contributing to improved productivity across economic sectors and ultimately fostering economic growth. On the other hand, banks facilitate trade and commerce by organizing transactions and expanding markets (Fathi-Aqababa et al., 2019). Therefore, bank credit is critical in developing economies as the primary financial instrument for mobilizing savings, financing investment, and directing resources toward productive activities, thereby reducing investment risks (Awad & Karaki, 2019). The monetary and financial system plays a significant role in economic performance. In developing countries, where capital markets are underdeveloped, the banking sector is the primary source of financing for productive economic activities. Due to the limited role of capital markets in Iran, the economic system is "bank-centric." According to reports from the Central Bank of Iran, the Tehran Stock Exchange, UNCTAD, and the country's annual budget laws, the banking sector accounted for 80-83.7% of financing from 2016 to 2021, while the capital market's share ranged between 8.1% and 19%. Given the limited role of capital markets, Iran's banking system significantly influences the entire economy through credit provision (Fathi-Aqababa et al., 2019). In recent years, financial constraints on productive economic sectors have intensified. According to the Iranian Chamber of Commerce's Business Environment Monitoring Report (2022-2023), bank financing challenges have become the second most significant obstacle for businesses, suggesting inefficiencies in directing resources to productive sectors, reducing banks' lending capacity, and limiting inflation control through quantitative balance sheet management policies. This reluctance of banks to provide and direct credit toward productive economic activities is evident in reports from the Central Bank of Iran. From 2011 to 2023, 39% of bank loans were allocated to the industrial, mining, and agricultural sectors, while 51% were directed toward services, trade, and miscellaneous sectors. The growth rate of loans to economic sectors in 2021 compared to 2020 was 54%, with 44% allocated to services, 35.9% to industry, and only 12.7% to agriculture. Moreover, in 2023, only 18% of loans were allocated to productive activities, with a mere 5% designated for their development and improvement. Given the fundamental role of the industrial sector in economic cycles, alongside the contributions of the agricultural and service sectors to growth (Taghavi et al.,

2019), this study seeks to evaluate the necessity of sector-specific policies and efficient financial resource allocation to enhance productivity and achieve economic development. Specifically, the research aims to answer the following questions:

1. How do economic sector credits impact sectoral productivity?
2. How do economic sector credits impact sectoral growth of value added?

Literature Review

In developing countries, due to the underdevelopment of capital markets and the bond market, the banking system serves as the primary financial intermediary. By utilizing credit channels and credit mechanisms (Nouri & Ibrahim, 2019), banks absorb liquidity, provide essential financial resources for promising but capital-deficient investments, and reduce investment risks (Awad & Karaki, 2019). Additionally, by directing financial resources toward productive activities in various economic sectors, the banking system enhances efficiency and ultimately fosters economic growth and prosperity (Fathi-Aqababa et al., 2020). In other words, banking and financial systems contribute to increased production, employment, and economic welfare only when the institutional framework of a country prioritizes production over brokerage, speculation, and rent-seeking activities (Taherpour et al., 2018). Institutional economists also argue that corporate financing primarily relies on the banking system's credit (Moradi et al., 2018). Credit is a non-neoclassical channel for transmitting monetary policy, implemented through expansionary or contractionary monetary policies. The adverse effects of imbalances between bank interest rates and loan interest rates, as well as the low returns on bond and security sales, can disrupt the credit channel. Bernanke and Gertler (1995) asserted that, besides real interest rates, external finance premiums (the difference between internal corporate resources and external financing costs) also influence monetary policy. Hence, they emphasized the necessity of managing short-term interest rates and external finance premiums to ensure the proper functioning of the real economy through the credit channel (Nouri & Ibrahim, 2019). Furthermore, McKinnon and Shaw, drawing from Schumpeter's research, criticized financial market regulations in their "financial liberalization" theory. They highlighted the role of banking intermediation in supplying credit to productive enterprises and facilitating economic growth by removing constraints such as interest rate ceilings and high reserve requirements (Fathi-Aqababa et al., 2020). Additionally, studies by De Gregorio & Guidotti (1995), Huang & Lin (2009), Beck et al. (2012), and Arcand et al. (2015) suggest an inverse or non-linear relationship between credit and economic growth. In contrast, Rajan & Zingales (1998) and Levine et al. (2000) argue for a positive relationship between these two variables (Hong & Fong, 2020). Therefore, investigating the factors influencing the proper functioning of

the bank credit channel and its relationship with economic growth and productivity (as representatives of the real economy) is of significant importance. Financial booms and recessions are often the result of credit expansion. However, the critical question is whether the interaction between credit, economic sectors, and business cycles always leads to higher economic growth and productivity. This question can be examined through two hypotheses regarding credit expansion, which highlight the relationship between credit sensitivity and sectoral heterogeneity:

1. **Easy Credit Hypothesis**: This hypothesis suggests that an increase in credit supply (due to factors such as unregulated monetary policies, rapid capital inflows, financial deregulation, or excessive optimism following a period of strong fundamentals) benefits borrowers in financially constrained non-tradable sectors over time (credit-time). The excessive credit supply may increase economic vulnerability through high debt levels and difficult financing conditions (as exogenous shocks in financial accelerator models) or unmet expectations (as endogenous shocks in behavioral credit market expectation models), making the economy more susceptible to the adverse effects of subsequent credit supply contractions (Muller & Werner, 2022).
2. **Productivity-Enhancing Credit Hypothesis**: According to this hypothesis, credit allocation to the tradable sector results in lower financial fragility and higher productivity compared to the non-tradable sector. In standard permanent income models for households and firms, credit demand for financing consumption and investment is driven by expected future income or productivity gains. In other words, both productivity-enhancing credit and accelerated economic growth can materialize through increased credit availability. This form of credit expansion can occur across all economic sectors; however, in the tradable sector (especially industry), due to its backward and forward linkages with other economic sectors and higher productivity, financial resources tend to be directed toward industry as the "engine of economic growth." Ultimately, this contributes to overall economic growth. Therefore, distinguishing between the tradable sector (e.g., industry) and non-tradable sectors (e.g., construction, services, etc.) is essential. During economic booms, factors such as lower net worth, lack of transparency, bank dependency, financial constraints, and reliance on collateral-backed borrowing in non-tradable sectors often lead to the misallocation of financial resources, shifting credit from the tradable to the non-tradable sector. The key question during credit booms is whether credit expansion and allocation lead to economic growth or recession. The reversal of growth effects due to credit misallocation toward non-tradable sectors can be attributed to several factors:

- **Financial Fragility and Banking Crises**: Credit allocation to non-tradable sectors is more vulnerable to banking crises compared to tradable sectors. During

banking crises, the probability of loan defaults in non-tradable sectors rises significantly. Conversely, tradable sectors exhibit lower susceptibility to banking crises and experience relatively lower reductions in credit allocations. Moreover, the misallocation of financial resources to non-tradable sectors before a banking crisis leads to substantial loan losses during banking sector bankruptcies, underscoring the heightened sensitivity of non-tradable sectors to contractionary banking policies on credit.

- **Productivity Decline and Exchange Rate Effects**: Benigno & Fornaro (2014) argue that misallocation of credit to non-tradable sectors can lead to reduced productivity, increased real exchange rates, and consequently, the erosion of competitiveness and efficiency in tradable sectors. Since knowledge accumulation in tradable sectors benefits from increasing returns to scale through externalities, misallocating credit weakens these sectors, thereby reducing economic growth and financial stability (Muller & Werner, 2022). Exchange rates serve as another transmission channel for monetary policy within the neoclassical framework, implicitly influencing interest rates. Expansionary monetary policies increase liquidity and lower interest rates, making investment more attractive and boosting aggregate demand, total production, and employment. Simultaneously, increased liquidity devalues the domestic currency relative to foreign exchange rates. A higher exchange rate and weaker domestic currency make domestic goods cheaper than foreign goods, enhancing net exports. Additionally, costlier imports encourage import-substituting industries, ultimately contributing to higher real domestic production (Krylova, 2002).

Numerous studies have explored the present research topic, which can be categorized into domestic and international studies. However, this research specifically examines the impact of credit on productivity and value-added growth in economic sectors by differentiating between credit, value-added, and productivity across sectors using a comparative analysis of Panel ARDL and Panel NARDL methods[1]. This study places special emphasis on economic sector productivity as a representative of the real economy and the transmission mechanisms of monetary policy through both the non-neoclassical credit channel and the neoclassical exchange rate channel, based on the studies of Boivin et al. (2010).

[1] The credit statistics for each economic sector in this study have been prepared for the first time by the Central Bank of Iran and made available to the researcher. It should be noted that if the credit of the economic sub-sectors had been made available to the researcher, the comprehensiveness of the present study would have been increased.

Table 1: Summary of Domestic Studies on the Research Topic

Authors	Title	Method	Findings
Fathi Aghababa et al. (2020)	The Effect of Bank Facilities on the Growth of Value-Added in Industry, Services, Agriculture, Construction, and Housing (1991-2017)	GMM	A significant positive impact of directed lending facilities on the value-added of economic sectors. The highest impact of bank facilities on value-added belongs to the services sector, followed by industry, housing, and agriculture.
Mehrara et al. (2019)	The Effect of Bank Lending and Real Interest Rates on Economic Growth in Iran and Malaysia (1985-2016)	ARDL	A positive impact of bank lending, foreign direct investment, and fixed capital formation on economic growth. A negative impact of real interest rates on economic growth in Iran and Malaysia, rejecting McKinnon and Shaw's hypothesis.
Taherpour et al. (2018)	The Role of Bank Loan Distribution in Iran's Economic Growth (1984-2015)	ARDL	A significant positive impact of short- and long-term financial development index logarithms (ratio of total loan balance to GDP) and the logarithm of productive to non-productive loan balance ratios on economic growth. Granger causality results indicate a one-way causality from financial development quality to financial development and from financial development to economic growth, consistent with Schumpeter's (1911) view.
Rezaei & Ghadamiari (2017)	The Impact of Bank Credit on Economic Growth in Iran Using Quarterly Data (1988-2014	VAR	Long-term results show that banking facilities have a greater impact on the value-added of the industry and mining sectors than on agriculture. However, in the short and medium term, the impact of bank facilities is higher in agriculture than in industry and mining.

Table 2: Summary of International Studies on the Research Topic

Authors	Title	Method	Findings
Müller & Werner (2022)	Examining Credit Allocation and Macroeconomic Volatility Using Data from 117 Countries (1948-2019)	PANEL	Investigates heterogeneity in credit allocation between tradable and non-tradable sectors and the critical link between the financial and real economy. Findings indicate that credit expansion leads to disproportionate credit growth towards the non-tradable sector (which is more finance-sensitive and constrained). Credit expansion in the non-tradable sector systematically reduces subsequent growth and triggers financial crises, whereas lending to the tradable sector is associated with strong production and productivity growth without a higher risk of financial crises.

Juma Ahmad (2021)	Examining Sectoral Banking Credit Facilities and Non-Oil Economic Growth in Saudi Arabia (1970-2019)	ARDL	Studies banking credit facilities across nine economic sectors, including agriculture, manufacturing and mining, electricity and water, healthcare services, construction, wholesale and retail trade, transportation and communications, services, and finance. The overall effect of credit on Saudi Arabia's non-oil economic growth is positive and significant but unequal in the short and long run. In the long run, all sectors (except agriculture and mining) have a positive and significant impact, except services, which is not significant. In the short run, all sectors (except construction, finance, services, transportation, and communications) have a positive and significant effect. Credit to wholesale and retail trade has the most significant impact on non-oil economic growth.
Nisha & Zhihua (2021)	Optimal Resource Allocation and Total Factor Productivity Improvement: A Case Study from Shanxi (2005-2016)	PANEL	Optimal resource allocation positively affects total factor productivity (TFP). The better the allocation, the higher the TFP. Conversely, irrational allocation lowers TFP. Regional regression results show that resource allocation rationalization significantly enhances overall economic conditions in Guanzhong and northern Shanxi.

Authors	**Title**	**Method**	**Findings**
Naznin & Sandeep (2020)	Monetary Policy Shocks and Industrial Production: U.S. Industry-Level Evidence Using Monthly Data (1972-2019)	FAVAR	Highlights the impact of monetary policy on economic sectors through the credit channel. Industries react differently (in terms of timing and magnitude) to unanticipated monetary policy shocks. Manufacturing industries are more sensitive than mining and extraction. Energy and durable goods industries are more sensitive than non-durable and other manufacturing industries. Industry sensitivity to interest rates affects investment decisions, with more capital-intensive industries showing greater susceptibility to monetary policy shocks. These findings suggest that policymakers should consider sector-specific responses when designing monetary policies.
Hong & Fung (2020)	Empirical Study on the Impact of Credit on Vietnam's Economic Growth	ARDL & Granger Causality	Finds a bidirectional causality between credit and GDP and a long-term negative impact of credit growth on Vietnam's economic growth. The study also shows that rising inflation leads to an

			uncontrollable increase in debt, which prevents efficient capital absorption. Credit growth plays a key role in sustaining economic development through banking system credit injection, even when efficiency is not guaranteed.
Nouri & Ibrahim (2019)	A Micro Study on Bank Credit and Economic Growth in Turkey Using Monthly Data (2010-2017)	ARDL & Toda-Yamamoto Causality	The industrial production index (IPI), including seven sub-sectors (food & beverages, textiles & clothing, wood & furniture, paper, chemicals, machinery, and mining), is the dependent variable, while total loans from commercial banks to industrial sub-sectors and interest rates are independent variables. The findings show that, in the long run, banking credit is more effective on the IPI than interest rates. Increased credit leads to higher industrial production. In the long run, credit has a positive correlation with IPI (except in the mining sector). In the short term, IPI is influenced by banking credit in mining, food, and beverages. The study also highlights the relationship between the financial sector and economic growth, where financial sector development drives economic growth. The causality between IPI, banking credit, and interest rates suggests a strong link between production and bank credit, indicating that improved credit conditions can boost production. The findings suggest that industrial sub-sector managers in Turkey should be cautious about firms with higher capital intensity and debt levels, as these firms are more vulnerable to credit supply shocks, which can affect investment decisions and productivity.

Research Methodology

This study utilizes the following variables: the logarithm of real value-added growth of economic sectors (LAV), including the logarithm of value-added growth in the industrial sector (LAV(I)), the agricultural sector (LAV(A)), and the services sector (LAV(S)), all measured at constant 2011 prices. Additionally, it incorporates the logarithm of real credit to economic sectors (LSC), including credit to the industrial (LSC(I)), agricultural (LSC(A)), and services (LSC(S)) sectors. The study also considers the logarithm of real productivity in economic sectors (LT), covering productivity in industry (LT(I)), agriculture (LT(A)), and services (LT(S)), measured at constant 2011 prices. Furthermore, the study includes the logarithm of the real exchange rate (LREER) and the logarithm of

real capital formation in machinery (LINV) at constant 2011 prices. The data for these variables have been sourced from the statistical reports of the Central Bank of Iran and the Iranian Statistical Center for the period 2012:Q1 to 2024:Q4 .

The Autoregressive Distributed Lag (ARDL) model is employed in this study due to its several advantages over other econometric techniques. These advantages include strong explanatory power in small samples, the ability to examine the stationarity properties of variables, and the capability to assess both short-term and long-term relationships between independent and dependent variables. The ARDL approach estimates these relationships using three different methods: Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed Effects (DFE) (Osmani et al., 2023).

In panel data estimation, as in time-series models, it is essential to check for the stationarity of variables. If the variables are non-stationary in a panel data model, it may result in spurious regression, where a high R^2 might indicate a false correlation between variables due to time trends. Thus, unit root tests, such as the Im, Pesaran, and Shin (IPS) test (2003), are conducted to validate the reliability of the estimated model. Unlike conventional panel data estimation methods such as fixed effects, random effects, and mixed ordinary least squares (OLS), or dynamic panel estimations like the Generalized Method of Moments (GMM) (for models with long time periods), the panel ARDL approach offers the following advantages:

- Applicability in cases where variables exhibit different levels of stationarity (I(0) and I(1)).
- High flexibility in estimating models with limited data availability.
- Suitability for estimating panel data models with long time-series dimensions.

To examine the impact of credit on productivity and the value-added growth of economic sectors (industry, services, and agriculture), the study employs the following relationships (1) and (2):

$$LAV_{it} = f(LSC_{it}, LREER_{it}, LINV_{it}) \quad (1)$$

$$LTit = f(LSCit, LREERit, LINVit) \quad (2)$$

These equations are rewritten in the panel ARDL framework as follows (Kargar & Tarazkar, 2019):

$$\Delta LAV_{it} = \phi_{i,t-1} + K_i LSC_{it} + B_i LREER_{it} + W_i LINV_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta LAV_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij} \Delta LSC_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij} \Delta LREER_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij} \Delta LINV_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

$$\Delta LT_{it} = \phi_{i,t-1} + K_i LSC_{it} + B_i LREER_{it} + W_i LINV_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta LT_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij} \Delta LSC_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij} \Delta LREER_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij} \Delta LINV_{i,t-j} + \mu_i + \varepsilon_{it} \quad (4)$$

In equations (3) and (4), i = 1,2,….,N is the number of sections (economic sectors), t = 1,2,…,T is the time period, LAV and LT are the dependent variables, LSC, LREER and LINV are the explanatory variables of the model, and μ_i is the disturbance component.

Pesaran and Smith (1995) introduced the Mean Group (MG) method, where long-run coefficients for each cross-section are estimated separately and averaged across units. This method estimates a distinct equation for each unit, with heterogeneous short-run and long-run coefficients, as well as unique intercepts, estimated coefficients, and standard errors for each cross-section. The parameters are derived using an unweighted average of the estimated coefficients without imposing any constraints (Chaitip et al., 2015). Pesaran et al. (1999) extended this approach by developing the Pooled Mean Group (PMG) method, which assumes homogeneity in long-run coefficients across all cross-sections while allowing short-run coefficients to be heterogeneous for each unit in the process of adjusting toward long-run equilibrium. Moreover, the residuals from the error correction model must be free of autocorrelation, and the error correction term should be negative. In the Dynamic Fixed Effects (DFE) method, the long-run coefficients are assumed to be homogeneous, similar to the PMG approach. However, short-run coefficients exhibit greater homogeneity, and the speed of adjustment toward equilibrium is lower for each cross-section. Additionally, this method faces the issue of simultaneous equation bias (Kargar & Tarazkar, 2019).

Research Findings

To prevent unrealistic and spurious model estimation results, the variables used in econometric regression models over time must be stationary, or their combination must be stationary. In other words, the stationarity condition of the variables used in the research is a fundamental prerequisite for the reliability and validity of the estimation results. To assess stationarity, several tests exist; some belong to the first-generation unit root tests, which assume cross-sectional independence, while others belong to the second-generation unit root tests, which assume cross-sectional dependence.

Based on the above discussion, in panel data econometrics, the first step is to determine the presence or absence of cross-sectional dependence. In this study, the Pesaran cross-sectional dependence (CD) test was utilized. The null hypothesis of this test assumes cross-sectional independence among different sections. According to the information in Table 3, which presents the results of the cross-sectional dependence test, the null hypothesis is accepted, confirming the cross-sectional independence of the data used in this study.

Table 3: Pesaran Cross-Sectional Dependence Test

Econometric Model	Statistic	P-Value	Result
LAVit= f(LSCit, LREERit, LINVit)	0.86	0.35	Cross-sectional independence
LTit=f(LSCit, LREERit, LINVit)	0.64	0.17	Cross-sectional independence

Source: Research Findings

After confirming the cross-sectional independence of the data, the Im, Pesaran, and Shin (IPS) test, a first-generation unit root test, was used to examine data stationarity.

Table 4: Unit Root Test Results (IPS)

Variable	Statistic	P-Value	Stationarity Status
Log of Real Value-Added Growth in Economic Sectors (LAV)	16.5695	0.0000	I(0)
Log of Real Credit in Economic Sectors (LSC)	4.52835	0.0000	I(0)
Log of Real Productivity in Economic Sectors (LT)	3	0.7820	I(1)
First-Difference of Log of Real Productivity in Economic Sectors (dLT)	6.04509	0.0000	
Log of Real Effective Exchange Rate (LREER)	0.93920	0.1738	I(1)
First-Difference of Log of Real Exchange Rate (dLREER)	5.25104	0.0000	
Log of Real Capital Formation in Machinery (LINV)	1.85006	0.0322	I(0)

Source: Research Findings

The results indicate that none of the variables are I(2), meaning that the model estimation can proceed without concern for spurious regression. In the next step, the appropriate model was selected among three estimators (PMG, MG, and DFE) using the Hausman test. The results of this test are presented in Table 5[1].

Table 5: Model Selection Results

Econometric Model	Hausman Test	MG vs. PMG Selection	MG/DFE vs. PMG/DFE Selection	Selected Model
LAVit= f(LSCit, LREERit, LINVit)	Chi-Square Statistic	1.96	3.74	PMG
	P-Value	0.58	0.42	
LTit=f(LSCit, LREERit, LINVit)	Chi-Square Statistic	2.65	2.74	MG
	P-Value	0.000	0.66	

Source: Research Findings

According to the results, in the econometric model **LAVit= f(LSCit, LREERit, LINVit)**, the test statistic and p-value indicate that the null hypothesis, which states that PMG is more efficient and consistent than MG and DFE, is accepted. However, in the econometric model **LTit=f(LSCit, LREERit, LINVit)**, the test results suggest that MG is the more efficient and consistent estimator. The estimation results for these models, after determining the optimal lag length, are presented in Tables 6 and 7.

[1] Before estimating the Panel ARDL model, the Panel NARDL model was estimated, which was not approved due to the rejection of the Wald test hypotheses.

Table 6: Model Estimation Results (LAVit= f(LSCit, LREERit, LINVit) / PMG)

	Variable		Variable symbol	Coefficient	Significance level
Long-run coefficients	Log of real credit in economic sectors		LSC	0.87	0.006
	Log of real exchange rate		LREER	0.24	0.025
	Log of real investment in machinery		LINV	0.26	0.001
Short-run Coefficients of Economic Sectors	**Agriculture**	**Log of real credit in agriculture**	LSC(A)	0.12	0.011
		Log of real exchange rate	LREER	0.25	0.005
		Log of real investment in machinery	LINV	0.41	0.009
		Error correction term (ECT)	$ECT_A(-1)$	-0.24	0.031
	Industry	**Log of real credit in Industry**	LSC(I)	0.52	0.002
		Log of real exchange rate	LREER	0.32	0.003
		Log of real investment in machinery	LINV	0.45	0.008
		Error correction term (ECT)	$ECT_I(-1)$	-0.37	0.018
	Services	**Log of real credit in Services**	LSC(S)	0.24	0.044
		Log of real exchange rate	LREER	0.86	0.019
		Log of real investment in machinery	LINV	0.32	0.028
		Error correction term (ECT)	$ECT_S(-1)$	-0.52	0.000
	Total Economy	**Log** of real credit	LSC	0.50	0.025
		Log of real exchange rate	LREER	0.13	0.007
		Log of real investment in machinery	LINV	0.15	0.016
		Error correction term (ECT)	ECT (-1)	-0.64	0.011

Source: Research Findings

The results in Table 6 suggest that increases (or decreases) in real credit, real exchange rates, and real capital formation in machinery lead to corresponding increases (or decreases) in real value-added growth across economic sectors in both the short and long run. The impact of real credit and real capital formation in machinery on value-added growth is most significant in the industrial sector. This can be attributed to the strong backward and forward linkages of the industrial sector with other parts of the economy and its foundational role in shaping economic boom and bust cycles. By effectively directing financial resources toward production and productive sectors, economic growth can be enhanced while improving employment, reducing market instability, lowering asset prices (such as housing and foreign exchange), and ultimately increasing overall economic production. However, in recent years, due to severe economic sanctions, currency fluctuations, and financial transfer restrictions under FATF regulations, investment in equipment and machinery, as well as industrial sector capacity expansion, has been severely hampered. Additionally, the banking system's restrictive practices, such as excessive collateral requirements and the blocking of local currency funds for opening letters of credit, have exacerbated these challenges. The low impact of agricultural credit on economic value-added growth is mainly due to delays in government financial support, rising costs of raw materials and agricultural production, increased loan defaults due to farmers'

financial difficulties, and reduced profitability despite the presence of intermediaries and speculative market activities.

The real exchange rate has had the most substantial short-term impact on value-added growth in the service sector. This is attributed to exchange rate uncertainty affecting employment in agriculture and industry, leading to labor displacement toward the service sector. Exchange rate fluctuations increase industrial costs (e.g., raw materials, intermediate goods, technology, and machinery), reducing industrial value-added. Additionally, uncertainty caused by exchange rate volatility has shifted investments toward speculative, non-productive activities, negatively impacting industrial growth. Furthermore, the government's lack of fiscal discipline, excessive borrowing from the central bank, and expansionary credit policies to cover budget deficits have fueled inflation, causing deviations in the real exchange rate from its equilibrium path. Currency fluctuations have also reduced non-oil export competitiveness and increased the cost of importing essential agricultural inputs (e.g., chemical fertilizers), which has significantly affected Iran's economy.

Table 7: Model Estimation Results (LTit=f(LSCit, LREERit, LINVit) / MG)

Economic sectors		Variable	Variable symbol	Coefficient	Significance level
Agriculture	Long-run coefficients	Log of real credit in agriculture	LSC(A)	0.19	0.007
		Log of real exchange rate	LREER	0.32	0.050
		Log of real investment in machinery	LINV	0.43	0.001
	Short-run Coefficients	Log of real credit in agriculture	LSC(A)	0.16	0.064
		Log of real exchange rate	LREER	0.11	0.059
		Log of real investment in machinery	LINV	0.35	0.032
	Error correction term (ECT)		$ECT_A(-1)$	-0.005	0.001
Industry	Long-run coefficients	Log of real credit in Industry	LSC(I)	0.56	0.310
		Log of real exchange rate	LREER	0.24	0.008
		Log of real investment in machinery	LINV	0.40	0.022
	Short-run Coefficients	Log of real credit in Industry	LSC(I)	0.70	0.046
		Log of real exchange rate	LREER	0.15	0.000
		Log of real investment in machinery	LINV	0.27	0.013
	Error correction term (ECT)		$ECT_I(-1)$	-0.003	۰,۰۰۱
Services	Long-run coefficients	Log of real credit in Services	LSC(S)	0.19	0.0009
		Log of real exchange rate	LREER	0.55	0.016
		Log of real investment in machinery	LINV	015	0.004

	Short-run Coefficients	**Log of real credit in Services**	LSC(S)	0.08	0.000
		Log of real exchange rate	LREER	0.21	0.0487
		Log of real investment in machinery	LINV	0.01	0.0245
	Error correction term (ECT)		$ECT_S(-1)$	-0.002	0.009
Total Economy	Long-run coefficients	**Log of real credit**	LSC	0.65	0.000
		Log of real exchange rate	LREER	0.17	0.005
		Log of real investment in machinery	LINV	0.33	0.002
	Short-run Coefficients	**Log of real credit**	LSC	0.8	0.001
		Log of real exchange rate	LREER	0.02	0.000
		Log of real investment in machinery	LINV	0.11	0.004
	Error correction term (ECT)		ECT(-1)	-0.02	0.008

Source: Research Findings

The findings in Table 7 indicate that real credit, capital formation in machinery, and the real exchange rate have a positive and direct relationship with total factor productivity (TFP) in both the short and long run. Credit to the industrial sector has the highest impact on TFP, although its long-term effect is not statistically significant. Industrial sector financing enables investment in new machinery, research and development, workforce training, and increased competitiveness, all of which enhance productivity and production quality. In the agricultural sector, capital formation in machinery has the most significant effect on TFP. The use of smart technologies, farmer education, and effective resource management can enhance productivity in this sector. Strategies such as precision irrigation, mechanized farming, organic fertilizers, improved technical knowledge, and better planning can optimize agricultural output.

In the service sector, exchange rate fluctuations have the most pronounced impact on TFP in both the short and long term. Exchange rate volatility affects import/export costs, competitiveness, foreign investment, operational expenses, innovation, and labor markets. Strengthening the national currency can reduce import costs, improving service quality and affordability. However, an overvalued currency can reduce international demand for domestic services. Ensuring exchange rate stability is crucial for attracting foreign investment and boosting productivity.

Conclusion and Recommendations

Achieving economic growth and development is a key objective for any economic system. A developed financial system, which ensures the provision, allocation, and direction of resources toward productive economic sectors, is a driving force for sustainable growth and development. However, in developing countries such as Iran, due to deficiencies in the capital market, the banking

sector plays a significant role in financing investment activities in productive sectors. Furthermore, in developing countries, total factor productivity (representing the real sector of the economy) is the most crucial factor in global competition due to the inefficiency of various economic, production, and social sectors. Given the limited resources in the economy, improving productivity can lead to increased investment, better allocation and prioritization of resources toward productive and high-potential sectors, cost reduction, improved product quality, increased value-added in economic sectors, and more.

This study employs the Panel Autoregressive Distributed Lag (Panel ARDL) approach and utilizes seasonal time-series data from 2012 to 2024 to examine the effect of credit on productivity and value-added growth in Iran's economic sectors. The results of the Pesaran cross-sectional dependency test indicate the independence of cross-sections in both models. The Im, Pesaran, and Shin (IPS) unit root test confirms the stationarity of all variables except for productivity and real exchange rate variables. Subsequently, using panel comparison methods, the appropriate model was selected for each regression. The Panel PMG model was validated for estimating the effect of credit on value-added, while the Panel MG model was confirmed for estimating the effect of credit on productivity.

The estimation results of the Panel PMG model for the LAVit = f(LSCit, LREERit, LINVit) equation indicate that real credit, real exchange rate, and real capital formation in machinery have a positive and direct relationship with value-added growth in the studied economic sectors in both the long and short term. The impact of credit and capital formation in machinery on value-added growth is most significant in the industrial sector, while the real exchange rate exerts a greater influence on value-added growth in the services sector in the short term. Similarly, the estimation results of the Panel MG model for the LTit = f(LSCit, LREERit, LINVit) equation demonstrate that credit, capital formation in machinery, and the real exchange rate positively and directly affect total factor productivity in both the short and long term. The industrial sector exhibits the highest sensitivity of productivity to credit in the short term. The agricultural sector, however, experiences the most substantial impact of capital formation in machinery on total factor productivity in both the short and long term. In the services sector, the exchange rate has the greatest impact on total factor productivity over both time horizons.

Thus, the key findings of the two examined regressions are as follows:

- The industrial sector exhibits the most significant impact of credit on productivity and value-added growth among all economic sectors. In other words, the transmission mechanism of monetary policy through the non-neoclassical credit channel is stronger in this sector compared to others. According to the Central Bank's national accounts report at constant prices (2016 base year) for the period 2011–2022, the industrial sector accounted for 24.4% of GDP, agriculture 10.4%, and services 56.8%. Consequently, misallocation of

financial resources and credit away from productive sectors could lead to inefficiencies, reduced economic justification for investment projects, lower production and employment, increased uncertainty and instability, and working capital issues for manufacturing enterprises. Moreover, this misallocation could redirect financial flows toward unproductive sectors, increasing the prices of real assets such as housing, foreign currency, and gold.

- The financing and investment in machinery and equipment primarily occur through imports. However, due to severe economic sanctions in recent years, exchange rate fluctuations, and money transfer restrictions under FATF constraints, the capacity expansion of the industrial sector has been disrupted, leading to increasing depreciation of machinery and outdated technology.
- Capital formation in agricultural machinery has the most substantial impact on total factor productivity because the agricultural sector in Iran is less affected by oil price fluctuations and political or social issues. Additionally, management and technical efficiency in the agricultural sector have been found to be more influential than in other economic sectors. However, productivity in the industrial sector faces challenges such as weak competitiveness, inadequate skill levels among workers, lack of up-to-date technology and training, a traditional and non-competitive economic structure, and limited support for attracting skilled professionals, inventors, and researchers.
- The real exchange rate, as a neoclassical monetary policy transmission channel, has the most significant impact on total factor productivity and value-added growth in the services sector. The industrial sector is highly vulnerable to exchange rate fluctuations due to its extensive interaction with the global economy, reliance on imported raw materials, technology, equipment, and intermediate goods, and the rising costs of production associated with exchange rate increases. While the agricultural sector is less exposed to exchange rate fluctuations due to its lower dependence on imported inputs, such fluctuations still affect real variables such as production and employment, potentially impairing the ability of agricultural enterprises to repay loans and increasing the volume of non-performing loans in the banking sector. Conversely, the services sector has a high degree of flexibility in coping with economic fluctuations and can absorb labor displaced from the industrial and agricultural sectors due to exchange rate shocks.

Policy Recommendations

Based on the study's findings and the importance of credit in enhancing productivity and value-added growth in Iran's economic sectors, the following policy recommendations are proposed:

- Establish specialized banks and mandate the banking system to allocate a portion of its resources to finance productive economic sectors, avoiding excessive engagement in non-productive activities.

- Promote bank participation in productive economic activities through financial instruments such as productive credit certificates (GAM), domestic letters of credit (LC), and contract-based financing (factoring).
- Improve working capital financing for economic sectors by assessing their creditworthiness and providing preferential credit lines aligned with their production and sales, while discouraging speculative investments in parallel markets (e.g., real estate, foreign currency, gold, and international financial markets).
- Avoid excessively tight monetary-credit policies to prevent cost pressures on productive economic sectors.
- Ensure economic stability and control exchange rate fluctuations to reduce reliance on imported raw materials and intermediate goods, lower customs tariffs, and provide foreign exchange facilities for industrial expansion and modernization.
- Provide credit with strict oversight to ensure high-impact utilization, such as supporting value-added agricultural processing industries, knowledge-based agriculture, and technology modernization in the industrial sector.
- Enhance the competitiveness of industrial products through the development of priority value chains, fostering creativity and innovation, and upgrading investment and technology adoption.
- Prevent raw material exports and instead focus on completing and enhancing value chains for economic growth.
- Implement and monitor sectoral policies under Article 47 of the Seventh Development Plan to improve resource allocation and enhance productivity.
- Reform outdated and restrictive regulations that hinder the full utilization of productive and service capacities, in support of domestic production and knowledge-based industrial growth.
- Strengthen institutional coordination and mission-oriented governance to effectively implement industrial development policies.

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بررسی تأثیر اعتبارات بر بهره‌وری کل عوامل تولید و رشد ارزش افزوده در بخش‌های اقتصادی ایران: رویکرد پانل ARDL

چکیده:

نظام مالی توسعه یافته جهت تامین، تخصیص و هدایت منابع به سمت بخش‌های مولد اقتصادی یکی از پیشران‌های رشد و توسعه اقتصادی است. از سویی دیگر توجه به بهره‌وری کل عوامل تولید، به دلیل کارایی پایین بخش‌های مختلف اقتصادی، تولیدی و اجتماعی اساسی‌ترین عامل رقابت در عرصه جهانی به‌شمار می‌آید؛ زیرا با توجه به محدودیت منابع در اقتصاد توجه به این عامل و بهبود آن می‌تواند سبب افزایش سرمایه‌گذاری، تخصیص و اولویت‌بندی در هدایت منابع به سمت بخش‌های مولد و مستعد، کاهش هزینه‌ها، بهبود کیفیت محصول، افزایش ارزش‌افزوده بخش‌های اقتصادی و... شود. براین اساس هدف پژوهش حاضر بررسی تاثیر اعتبارات بر بهره‌وری کل عوامل تولید و رشد ارزش‌افزوده بخش‌های اقتصادی ایران با استفاده از رهیافت Panel ARDL و داده‌های سری زمانی فصلی طی بازه زمانی $۱۳۹۱q_1$-$۱۴۰۲q_4$ است. براساس نتایج تحقیق اعتبارات حقیقی، نرخ ارز حقیقی و تشکیل سرمایه حقیقی ماشین‌آلات اثری مثبت و مستقیم بر رشد ارزش‌افزوده بخش‌های اقتصادی و بهره‌وری کل عوامل تولید دارند؛ به گونه‌ای که اعتبارات بخش صنعت و نرخ ارز بخش خدمات بیش‌ترین تاثیر را بر بهره‌وری کل عوامل تولید و رشد ارزش‌افزوده بخش‌های اقتصادی داشته‌اند. تشکیل سرمایه ماشین‌آلات بخش کشاورزی نیز بیش‌ترین تاثیرگذاری را بر بهره‌وری کل عوامل تولید داشته است.

کلمات کلیدی: سیاست پولی، اعتبار، بهره‌وری، رشد اقتصادی، مدل خودرگرسیون پانلی با وقفه‌های توزیع‌شده.