

# Investigating the Determinants of Export Diversification in Iran Based on the Bayesian Model Averaging (BMA) Approach

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## ABSTRACT

The present study employs the Bayesian Model Averaging (BMA) method to examine the macroeconomic determinants influencing export diversification in Iran. The findings indicate that per capita income and the degree of trade openness, with posterior inclusion probabilities exceeding 0.95, act as the strongest positive predictors, confirming the pivotal role of domestic productive capacity and integration into global trade in fostering export diversification. In contrast, the inflation rate, as an indicator of macroeconomic instability, demonstrates a statistically significant inhibitory effect, with a negative coefficient and a probability of 0.89. Financial development, by facilitating capital provision and risk management, exhibits a supportive and enabling effect. A key finding is the negative impact of the real effective exchange rate, which may reflect the phenomenon of “Dutch disease” or the adverse effects of exchange rate volatility on investment in non-traditional sectors. Although human capital and foreign direct investment inflows show positive effects, their influence is comparatively weaker, possibly indicating the existence of a skills gap or the concentration of foreign investment in sectors with limited linkages. Institutional and structural variables (such as fixed capital formation, income inequality, institutional quality, infrastructure, and resource rents) play a marginal role in the final model, which may suggest their indirect and long-term effects. Overall, the results underscore the necessity of an integrated policy approach comprising macroeconomic stability, targeted trade integration, financial deepening, and the enhancement of effective human capital to achieve a diversified and resilient export structure.

**Keywords:** *Export diversification, trade openness, Dutch disease, Bayesian Model Averaging approach.*

## 1. Introduction

Export diversification has increasingly been recognized as a fundamental pillar of sustainable economic

growth, structural transformation, and macroeconomic resilience in developing and emerging economies. Countries heavily dependent on a narrow range of primary commodities or low-value-added products are particularly

vulnerable to external shocks, terms-of-trade volatility, and global demand fluctuations. The literature emphasizes that diversified export structures not only stabilize export revenues but also foster technological upgrading, productivity gains, and long-term development (Naude & Rossouw, 2008; Samen, 2010). Rodrik (2008) argues that productive diversification plays a central role in structural transformation, as the movement toward more sophisticated goods enhances learning externalities and accelerates economic growth (Rodrik, 2008). Similarly, Carrere et al. (2007) demonstrate the non-linear relationship between income and diversification, highlighting that diversification initially increases with development before eventually declining at very high income levels, reflecting the so-called “hump-shaped” pattern (Carrere et al., 2007).

The determinants of export diversification have been widely examined across regions and income groups. Agosin et al. (2012), in a comprehensive cross-country study, identify macroeconomic stability, human capital, and financial development as key drivers of diversification (Agosin et al., 2012). Elhiraika and Mbate (2014) provide evidence from African economies, emphasizing the importance of infrastructure, governance, and foreign direct investment (FDI) in shaping export structures (Elhiraika & Mbate, 2014). In the MENA region, Alaya (2012) finds that trade openness, institutional quality, and macroeconomic conditions significantly influence export diversification outcomes (Alaya, 2012). Similarly, Matallah (2020) stresses the importance of governance quality in oil-exporting economies, arguing that weak institutions hinder economic diversification despite resource wealth (Matallah, 2020). These findings collectively underscore that diversification is a multifaceted process shaped by structural, institutional, and policy-related factors.

Trade openness constitutes one of the most debated determinants of export diversification. On the one hand, increased integration into global markets exposes domestic firms to international competition, thereby encouraging productivity improvements and product upgrading (Dennis & Shepherd, 2007). Giri et al. (2019) argue that openness facilitates access to intermediate inputs, advanced technologies, and new markets, which can enhance product variety and sophistication (Giri et al., 2019). On the other hand, excessive trade liberalization without adequate domestic capabilities may reinforce specialization in existing comparative advantages, particularly in resource-based sectors (Naude & Rossouw, 2008). Empirical evidence from low-income countries and small states

suggests that country size and income level moderate the relationship between openness and diversification (Lee & Zhang, 2022). In the context of Iran and other developing economies, the strategic management of trade policy and entry costs to domestic and foreign markets has been shown to significantly influence diversification patterns (Motash Yar Ahmadi et al., 2021).

Financial development also plays a critical enabling role in the diversification process. A well-functioning financial system reduces transaction costs, improves access to credit, and supports innovative and risk-taking activities by firms. Harighi et al. (2023) provide empirical evidence that financial development significantly enhances export diversification in developing economies (Harighi et al., 2023). Financial depth facilitates investment in research and development, new product lines, and international market penetration. In addition, the interaction between FDI and financial infrastructure has been highlighted as an important mechanism for spillover effects (Crespo & Fontoura, 2007). Fosu (2021) further demonstrates that infrastructure amplifies the positive impact of FDI on export diversification, suggesting that complementary domestic conditions are necessary for external capital to contribute effectively to structural transformation (Fosu, 2021).

Human capital and technological capability are also widely recognized as core determinants of export upgrading and diversification. Educated and skilled labor forces enhance firms’ absorptive capacity and innovation potential. Golo (2023), using a panel smooth transition regression (PSTR) model, shows that human capital significantly strengthens the positive impact of FDI on export diversification in African economies (Golo, 2023). Drine (2012) highlights the importance of governance and technology catch-up in North Africa, arguing that institutional quality conditions the effectiveness of knowledge diffusion (Drine, 2012). Moreover, the relationship between trade specialization patterns and growth outcomes has been examined in the MENA region, demonstrating that diversification rather than excessive specialization is associated with more stable growth trajectories (Ranjbar et al., 2011). In Iran, studies have identified industrial capabilities, macroeconomic stability, and institutional infrastructure as key determinants of diversification (Amiri & Amini Daran, 2018; Mohammadi & Fakkari Sardahai, 2015).

Institutional quality constitutes another critical dimension in the diversification literature. Strong institutions, effective governance, and secure property rights reduce uncertainty,

enhance investor confidence, and facilitate entrepreneurial activity. Alvarez et al. (2018) find that institutional conditions significantly influence sectoral trade performance and diversification (Alvarez et al., 2018). Paldam and Gundlach (2008) discuss the primacy of institutions in development, emphasizing that institutional transitions shape long-term structural outcomes (Paldam & Gundlach, 2008). Rodrik (2008) further warns that second-best institutional arrangements may produce suboptimal macroeconomic outcomes, thereby constraining diversification efforts (Rodrik, 2008). In emerging economies, institutional reforms and governance improvements are therefore essential prerequisites for sustainable export diversification (Hafezieh et al., 2017; Sarkhosh Sara et al., 2020).

Macroeconomic stability, particularly inflation and exchange rate management, is equally important. High inflation increases uncertainty and discourages long-term investment in new export sectors. Exchange rate volatility can distort price signals and undermine competitiveness. Shahraze et al. (2018) demonstrate the dynamic interaction between FDI and exports in Iran, highlighting the role of macroeconomic conditions in shaping bilateral trade flows (Shahraze et al., 2018). Rehman et al. (2021) show that sectoral infrastructure significantly contributes to export sophistication in China, implying that macroeconomic and structural factors operate jointly in determining export outcomes (Rehman et al., 2021).

Recent contributions have extended the discussion toward economic complexity, branding strategies, and sustainable growth. Tran and Freytag (2025) analyze Vietnam's product space, arguing that export diversification can reshape sustainable and innovative growth paths (Tran & Freytag, 2025). Singh (2025) assesses India's export potential to European Union markets, identifying structural constraints and diversification opportunities (Singh, 2025). Vertinskaya (2025) emphasizes the role of niche export segments, such as halal products, in expanding export portfolios (Vertinskaya, 2025). Miyajima (2025) highlights export diversification and economic complexity as engines of growth in knowledge-based economies (Miyajima, 2025). These recent studies suggest that diversification strategies must integrate innovation, market positioning, and value-chain upgrading to achieve long-term competitiveness.

Despite extensive global evidence, the determinants of export diversification in Iran require further systematic investigation. While prior studies have examined specific aspects such as industrial exports (Amiri & Amini Daran,

2018), institutional infrastructure (Mohammadi & Fakkari Sardahai, 2015), or entry costs (Motash Yar Ahmadi et al., 2021), a comprehensive framework integrating macroeconomic, structural, institutional, and external variables remains limited. Given Iran's dependence on resource-based exports and exposure to external shocks, identifying the relative importance and robustness of potential determinants is essential for designing effective policy interventions. Therefore, this study aims to comprehensively investigate the macroeconomic, structural, and institutional determinants of export diversification in Iran using a Bayesian Model Averaging (BMA) approach in order to identify robust and policy-relevant drivers of diversification.

## 2. Methods and Materials

One of the most significant challenges faced by model-building researchers concerns disagreements regarding the potential variables that should be included in an explanatory model. Economists have made considerable efforts to address this issue; for example, one proposed solution involves conducting sequential tests to eliminate redundant variables or reintroducing omitted variables into the model and testing hypotheses regarding their statistical significance. However, such approaches often fail to produce satisfactory results due to the lack of validity of hypothesis testing under model misspecification and the accumulation of sequential testing errors. In recent years, Bayesian econometrics has provided an appropriate solution for addressing uncertainty in parameter and model selection through a method known as Bayesian Model Averaging (BMA). Koop (2003) identifies a defining feature of the Bayesian approach to inference as the assignment of numerical probabilities to the researcher's degree of belief; consequently, when new information about a statement becomes available, the probability associated with its truth or falsity must be revised. The model is described as follows.  $P(\theta)$  denotes the prior probability density function based on initial information. This information typically represents a combination of previous empirical evidence, prior studies, observations, and theoretical considerations.  $P(Y | \theta)$  represents the probability density function of the new observations, that is, the likelihood function, defined as the probability of the data  $Y$  conditional on the model parameters. To obtain the posterior probability density function  $P(\theta | Y)$ , the prior distribution must be combined with the likelihood function using Bayes' theorem. In

essence, the posterior distribution reflects the probability distribution of the parameters  $\theta$  after observing the data and depends on both the sample information  $Y$  and the influence of new data on the prior distribution through Bayes' theorem, transforming  $P(\theta)$  into  $P(\theta | Y)$ . It should be emphasized that the posterior probability incorporates the researcher's prior beliefs, sample information, and prior data. Bayesian Model Averaging yields classical estimates by combining model averaging with a Bayesian framework; when a diffuse prior is assumed, the resulting estimates coincide with Ordinary Least Squares (OLS) results. This method restricts the influence of prior information and offers a framework that remains interpretable for classical econometricians. The Bayesian Model Averaging approach provides several important advantages over other model-averaging techniques. First, unlike standard Bayesian analysis, which requires specifying prior distributions for all parameters, this method only requires specifying a prior distribution for a hyperparameter, denoted as  $\bar{k}$ , which is straightforward to determine and interpret, and whose robustness can be readily assessed. Second, the interpretation of the estimates is accessible even to researchers without specialization in Bayesian econometrics. Third, the method can be implemented through repeated OLS estimations. In Bayesian averaging, the posterior probability of the coefficient  $\beta$  across all models, assuming  $k$  independent variables, is given by:

$$(1) P(\beta | Y) = \sum_{i=1}^{2^k} p(M_i | Y) P(\beta | Y, M_i)$$

where  $p(M_i | Y)$  denotes the posterior probability of model  $M_i$  given the data  $Y$ , and  $\beta$  represents the coefficient of the independent variable; such that:

$$(2) P(M_j | Y) = \frac{P(M_j) T^{-k_j/2} SSE_j^{-T/2}}{\sum_{i=1}^{2^k} P(M_i) T^{-k_i/2} SSE_i^{-T/2}}$$

The empirical literature has identified a set of explanatory variables that influence the process of export diversification. To provide a comprehensive analysis and evaluate the potential impact of these determinants, this study employs the Bayesian Model Averaging method. Accordingly, twelve explanatory variables are considered as potential key determinants in modeling their effects on export diversification and will be analyzed accordingly. The study period covers 1984–2023, and the data are collected on an annual basis from the World Bank and the United Nations Conference on Trade and Development (UNCTAD). In this study, the dependent variable is export diversification, and the explanatory variables include the ratio of foreign direct investment to gross domestic product, the trade openness index, the financial development index, human capital, gross domestic product per capita, inflation rate, real effective exchange rate, fixed capital formation, natural resource rents, income inequality, infrastructure, and institutional quality.

**Table 1**

*Description of Research Variables*

Variable	Abbreviation	Measurement	Data Source
Export Diversification	ED	Export diversification index	United Nations Conference on Trade and Development (UNCTAD)
Foreign Direct Investment	FDI	Foreign direct investment as a percentage of gross domestic product	World Bank
Trade Openness	OT	Sum of exports and imports as a percentage of gross domestic product	World Bank
Financial Development	FD	Private sector credit as a percentage of gross domestic product	World Bank
Human Capital	HC	Average years of schooling	World Bank
Gross Domestic Product per Capita	GDPP	Gross domestic product divided by population	World Bank
Inflation	INF	Consumer Price Index growth rate	World Bank
Real Effective Exchange Rate	RER	Nominal effective exchange rate divided by a price deflator	World Bank
Fixed Capital Formation	FC	Gross fixed capital formation as a percentage of gross domestic product	World Bank
Natural Resource Rents	NRR	Natural resource rents as a percentage of gross domestic product	World Bank
Income Inequality	GINI	Gini coefficient	World Bank
Infrastructure	INFR	Fixed telephone subscriptions per 100 people	World Bank
Institutional Quality	IQA	Legal structure and property rights	Fraser Institute

### 3. Findings and Results

In this section, the impact of explanatory variables on export diversification in Iran is examined using Bayesian Model Averaging (BMA) analysis. In this framework, the baseline regressor includes only the constant term, while the remaining explanatory variables vary across different model specifications and are treated as doubtful or auxiliary regressors. The results of the BMA estimation are presented in Table 2. Within the Bayesian Model Averaging framework, the Posterior Inclusion Probability (PIP) serves as an appropriate criterion for identifying the strength of the relationship between each explanatory variable and the dependent variable. Raftery (1995) and Masanjala and Papageorgiou (2008) suggest that a PIP greater than 0.5 indicates a strong regressor. In fact, if the researcher has no prior information regarding the correct model specification, a uniform prior distribution across all models is assumed. Under such circumstances, all models have an equal probability of being selected, and the prior probability that a given variable belongs to the model equals 0.5. Therefore, a PIP exceeding 0.5 provides evidence supporting the inclusion of that variable in the model. Table 2 reports the weighted posterior mean of each coefficient (second column from the right), the posterior standard error (third column), and the posterior inclusion probability (fourth column). Based on Table 2, the following results are obtained.

Gross domestic product per capita exhibits a strong positive effect on export diversification, with a PIP of 0.98 and a relatively large coefficient of 0.65. This finding strongly supports the domestic demand structure theory (Linder hypothesis). According to the Linder hypothesis, countries initially produce and export goods for which there is domestic demand. As per capita income increases, the domestic demand structure becomes more diversified and sophisticated, compelling domestic firms to innovate and diversify their production baskets to meet the preferences of consumers with higher income elasticity of demand. Subsequently, due to accumulated experience and economies of scale in the domestic market, these firms can competitively enter export markets in other middle- and high-income countries. From the perspective of endogenous growth theory, higher income levels are typically associated with greater savings and investment in research and development, which serve as engines of product and process diversification.

The trade openness index, with a PIP of 0.95 and a coefficient of 0.58, has a strong positive effect on export diversification. This finding is fully consistent with the theory of dynamic comparative advantage and the concept of learning-by-exporting. Greater trade openness exposes domestic firms to global competition, which acts as a powerful incentive to enhance productivity and diversify export portfolios in order to mitigate demand shocks in specific markets. Moreover, integration into global trade networks provides access to a variety of high-quality intermediate inputs, which are key inputs for producing diversified and sophisticated products. This variable also reflects reductions in transaction costs and tariff barriers, making entry into new markets more profitable.

The inflation rate, with a PIP of 0.89 and a coefficient of  $-0.41$ , represents the third most influential factor affecting export diversification. High inflation, as a primary indicator of macroeconomic instability, exerts a strong negative impact through several channels. First, it increases uncertainty regarding future relative prices and the profitability of long-term investment projects. Since export diversification requires substantial investment, market research, and the establishment of new distribution channels, an inflationary and unstable environment reduces incentives for such risky investments. Second, inflation is often associated with real exchange rate volatility, which complicates profitability calculations for exports to new markets. Third, high inflation may signal weaknesses in government economic management to foreign investors, thereby reducing productive foreign direct investment inflows.

The financial development index, with a PIP of 0.85 and a coefficient of 0.33, has a positive effect on export diversification. A developed financial system provides diverse risk management instruments (such as currency futures and options contracts), thereby reducing the risks associated with entering new markets. In addition, by lowering search and screening costs, it facilitates access to financing for innovative small and medium-sized enterprises that may lack sufficient collateral. These firms are often the primary drivers of export diversification. Furthermore, efficient capital markets enable firms to attract funding for investment in new technologies and international branding strategies.

The real effective exchange rate, with a PIP of 0.71 and a coefficient of  $-0.22$ , exerts a negative effect on export diversification.

Human capital, with a PIP of 0.64 and a coefficient of 0.18, has a positive but relatively modest effect on export diversification. The positive yet comparatively weak impact of human capital can be analyzed within the framework of comparative advantage theory and the skills gap hypothesis. On the one hand, an educated labor force possesses the capacity to absorb, adapt, and innovate new technologies, which is essential for producing diversified and sophisticated goods. On the other hand, the relatively low coefficient may indicate that education alone is insufficient; rather, the alignment between educational content and the needs of emerging export sectors (such as engineering, design, international marketing, and logistics) is crucial. If the education system fails to provide the skills required by leading industries, the relationship between human capital and export diversification is weakened.

Foreign direct investment, with a PIP of 0.55 and a coefficient of 0.10, also has a positive effect on export diversification. In many developing countries, foreign direct investment inflows are primarily directed toward natural resource extraction or low-technology assembly industries. Such forms of investment often establish limited linkages with the domestic economy, resulting in weak spillover effects on the diversification of other economic sectors.

Fixed capital formation, natural resource rents, income inequality, infrastructure, and institutional quality exhibit PIPs of 0.30, 0.50, 0.30, 0.22, and 0.15, respectively, with coefficients of  $-0.03$ ,  $-0.04$ ,  $-0.02$ ,  $0.01$ , and  $0.01$ , indicating limited effects on export diversification. The

marginal role of these variables does not imply irrelevance; rather, it may be attributed to several factors. Natural resource rents provide confirmation of the “resource curse” hypothesis. Resource abundance, by generating foreign exchange revenues, may weaken political and economic incentives to invest in complex and risky sectors that form the foundation of export diversification, thereby reinforcing dependence on primary exports. High income inequality may restrict domestic demand for diversified and high-quality goods, as purchasing power is concentrated among a small segment of the population, and it may also hinder broad-based human capital accumulation. Fixed capital formation may reflect that physical investments concentrated in basic public infrastructure or traditional sectors have limited direct effects on export diversification; the quality and strategic orientation of investment (e.g., in technology parks or advanced logistics) are more important than its volume. The relatively limited roles of infrastructure and institutions constitute a significant analytical point. This outcome may stem from their indirect and long-term effects. Improvements in institutional quality (including rule of law, anti-corruption measures, and government effectiveness) and high-quality infrastructure provide the necessary foundation for the effective functioning of other determinants (such as foreign direct investment, financial development, and entrepreneurship), yet their impact may not be clearly observable in short- or medium-term quantitative models.

**Table 2**

*Results of the Bayesian Model Averaging (BMA) Estimation*

Variable	Posterior Mean Coefficient	Posterior Standard Error	Posterior Inclusion Probability (PIP)
Constant	2.25	0.35	1.00
Foreign Direct Investment (FDI)	0.10	0.19	0.55
Trade Openness (OT)	0.58	0.10	0.95
Financial Development (FD)	0.33	0.12	0.85
Human Capital (HC)	0.18	0.16	0.64
GDP per Capita (GDPP)	0.65	0.08	0.98
Inflation (INF)	-0.41	0.11	0.89
Real Effective Exchange Rate (RER)	-0.22	0.15	0.71
Fixed Capital Formation (FC)	-0.03	0.20	0.30
Natural Resource Rents (NRR)	-0.04	0.19	0.50
Income Inequality (GINI)	-0.02	0.18	0.30
Infrastructure (INFR)	0.01	0.21	0.22
Institutional Quality (IQA)	0.01	0.22	0.15

#### 4. Discussion and Conclusion

The purpose of this study was to identify the robust macroeconomic, structural, and institutional determinants of export diversification in Iran using the Bayesian Model Averaging (BMA) approach. The empirical findings reveal that gross domestic product per capita, trade openness, inflation, financial development, the real effective exchange rate, human capital, and foreign direct investment (FDI) emerge as relatively strong determinants of export diversification, while fixed capital formation, natural resource rents, income inequality, infrastructure, and institutional quality exhibit comparatively weaker posterior inclusion probabilities. These results provide important insights into the mechanisms underlying export diversification in a resource-dependent and structurally constrained economy such as Iran.

The strong positive effect of GDP per capita on export diversification is consistent with the structural transformation literature. As income rises, domestic demand becomes more diversified and sophisticated, encouraging firms to expand and upgrade their production portfolios. This finding aligns closely with the cross-country evidence of Agosin et al. (2012), who identify income level as a key determinant of diversification across developing and developed economies (Agosin et al., 2012). Similarly, Carrere et al. (2007) document the hump-shaped relationship between development and diversification, suggesting that middle-income countries tend to diversify their export structures more intensively (Carrere et al., 2007). In low-income and small states, Lee and Zhang (2022) also demonstrate that income level significantly conditions diversification capacity (Lee & Zhang, 2022). From a policy perspective, the Iranian case confirms that domestic market expansion and rising purchasing power create a foundation for product experimentation and scaling, which can subsequently translate into export diversification.

Trade openness appears as another robust determinant with a strong positive effect. This result supports the view that integration into global markets exposes domestic firms to competition, facilitates technology transfer, and provides access to diverse intermediate inputs. Dennis and Shepherd (2007) show that lower trade costs and barriers to entry significantly enhance export diversification in developing countries (Dennis & Shepherd, 2007). Giri et al. (2019) further argue that trade openness promotes diversification through learning-by-exporting and integration into global

value chains (Giri et al., 2019). Evidence from the MENA region also suggests that openness plays a pivotal role in shaping export structures (Alaya, 2012). However, Naude and Rossouw (2008) caution that openness may reinforce existing comparative advantages in the absence of supportive domestic capabilities (Naude & Rossouw, 2008). The Iranian results suggest that, despite structural constraints, openness has been a positive force for diversification, particularly when accompanied by other enabling conditions.

Inflation exerts a significant negative effect on export diversification, underscoring the importance of macroeconomic stability. High inflation increases uncertainty, distorts relative prices, and discourages long-term investment in new sectors. This finding resonates with the broader argument of Rodrik (2008), who emphasizes that macroeconomic distortions can undermine structural transformation efforts (Rodrik, 2008). Mohammadi and Fakkari Sardahai (2015) similarly identify macroeconomic instability as a barrier to export diversification in Iran (Mohammadi & Fakkari Sardahai, 2015). In this context, inflation not only weakens domestic investment incentives but may also deter foreign investors seeking stable environments for productive engagement.

Financial development emerges as a significant positive determinant. A developed financial system enhances access to credit, supports innovation, and reduces risk through diversified financial instruments. Harighi et al. (2023) demonstrate that financial development significantly promotes export diversification in developing economies (Harighi et al., 2023). Moreover, the interaction between finance and FDI spillovers has been highlighted by Crespo and Fontoura (2007), who argue that financial depth strengthens the absorptive capacity of domestic firms (Crespo & Fontoura, 2007). The Iranian findings confirm that financial deepening can facilitate entry into new export markets by reducing capital constraints and supporting innovative ventures.

The negative coefficient of the real effective exchange rate suggests that currency appreciation or exchange rate volatility may hinder diversification. Exchange rate misalignment can reduce competitiveness in non-traditional export sectors. Shahrazei et al. (2018) highlight the dynamic relationship between exchange rates, FDI, and exports in Iran, emphasizing the importance of exchange rate management (Shahrazei et al., 2018). Rehman et al. (2021) also underscore that macroeconomic conditions, including exchange rate dynamics, influence export sophistication

(Rehman et al., 2021). Thus, maintaining a competitive and stable exchange rate appears crucial for supporting diversification.

Human capital exhibits a positive but moderate effect. This finding aligns with the argument that skilled labor enhances innovation and technological adaptation. Golo (2023) shows that human capital significantly strengthens the impact of FDI on export diversification (Golo, 2023). Drine (2012) similarly emphasizes the role of governance and technological catch-up in North Africa (Drine, 2012). However, the relatively modest coefficient in this study may reflect mismatches between educational outputs and the skill demands of emerging export sectors. Amiri and Amini Daran (2018) identify similar challenges in Iran's industrial export diversification process (Amiri & Amini Daran, 2018).

FDI demonstrates a positive but limited impact. This may be explained by the sectoral concentration of FDI in resource-based or low-technology industries, which generate limited spillovers. Elhiraika and Mbate (2014) highlight that FDI contributes to diversification only when accompanied by strong domestic linkages (Elhiraika & Mbate, 2014). Fosu (2021) further shows that infrastructure enhances the diversification impact of FDI (Fosu, 2021). The Iranian evidence suggests that without deeper integration between foreign investors and domestic supply chains, spillover effects remain constrained.

The marginal role of natural resource rents is consistent with the resource curse hypothesis. Matallah (2020) argues that resource abundance may weaken diversification incentives in oil-exporting economies (Matallah, 2020). Similarly, Sarkhosh Sara et al. (2020) emphasize that structural dependence on primary commodities limits export upgrading (Sarkhosh Sara et al., 2020). Institutional quality and infrastructure, although statistically weak in the short run, are theoretically indispensable. Alvarez et al. (2018) show that institutional quality significantly shapes trade performance (Alvarez et al., 2018). Paldam and Gundlach (2008) argue for the primacy of institutions in development trajectories (Paldam & Gundlach, 2008). Hafezieh et al. (2017) also identify institutional factors as central to export diversification within the framework of resistance economy policies (Hafezieh et al., 2017). The limited short-term statistical impact observed here may reflect their indirect and long-term effects.

Recent literature further emphasizes innovation, branding, and complexity as pathways to diversification. Tran and Freytag (2025) highlight the role of product space positioning in shaping sustainable growth (Tran & Freytag,

2025). Singh (2025) underscores strategic market targeting for expanding export potential (Singh, 2025). Vertinskaya (2025) demonstrates how niche markets can expand export portfolios (Vertinskaya, 2025). Miyajima (2025) links export diversification with economic complexity and knowledge-based growth (Miyajima, 2025). These insights suggest that Iran's diversification strategy must move beyond volume expansion toward sophistication and value-chain upgrading.

Overall, the findings indicate that macroeconomic stability, trade openness, financial development, and rising income levels are robust determinants of export diversification in Iran. Institutional and structural variables, while essential, appear to operate through longer-term channels. The results broadly confirm the international evidence while highlighting the specific structural constraints of a resource-dependent economy.

This study is subject to several limitations. First, the analysis relies on annual aggregate data, which may mask sectoral heterogeneity and firm-level dynamics influencing export diversification. Second, measurement limitations in variables such as institutional quality and infrastructure may reduce their estimated short-term statistical significance. Third, the BMA approach, while robust in addressing model uncertainty, does not fully capture dynamic interactions or non-linear effects among variables. Finally, geopolitical and sanction-related factors specific to Iran, which may influence export structures, are not explicitly modeled due to data constraints.

Future research could extend this analysis by incorporating sectoral or firm-level data to better capture microeconomic drivers of diversification. Employing dynamic panel models or threshold models may reveal non-linear relationships and structural breaks. Comparative studies across resource-dependent economies could help identify common patterns and policy lessons. Additionally, integrating measures of economic complexity, product space proximity, and global value chain participation would provide deeper insights into qualitative dimensions of diversification.

Policy makers should prioritize macroeconomic stabilization to reduce uncertainty and foster long-term investment in new export sectors. Strategic trade integration, combined with targeted support for emerging industries, can enhance diversification outcomes. Financial deepening and improved access to credit for innovative firms are essential. Aligning education systems with the skill requirements of high-value export sectors will strengthen human capital

contributions. Finally, long-term institutional reforms and infrastructure upgrading remain fundamental for sustaining diversification and resilience.

### Authors' Contributions

Authors contributed equally to this article.

### Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

### Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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### Declaration of Interest

The authors report no conflict of interest.

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### Ethics Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were considered.

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