INTEGRATION OF THE COMPAS FRAMEWORK AND GAME THEORY FOR OPTIMIZING INTERNATIONAL COMPETITIVENESS STRATEGIES

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Abstract. *The article explores the possibility of integrating the COMPAS approach and game theory to optimize international competitiveness strategies. The topicality of the topic is due to the growth of competition on international markets and the limited resources of small open economies, in particular the Republic of Moldova. The purpose of the study is to justify an integrated management model that combines the analytical capabilities of COMPAS and game theory tools for making strategic decisions in an international environment. The study is based on the analysis of statistical data on the foreign economic activity of the Republic of Moldova, indicators of international competitiveness and analytical reports of international organizations for the period 2020–2025. The methodological basis is comparative analysis, institutional analysis and strategic management methods with elements of game modeling. Within the framework of the study, international competition is considered as a strategic interaction of economic agents under conditions of limited information. The results show that the combination of COMPAS and game theory makes it possible to more accurately assess the country's position in international markets and predict the behavior of competitors. The use of an integrated approach makes it possible to increase the validity of the choice of strategies, reduce risks and adapt management decisions to changes in the external environment. The model has special value for the Republic of Moldova, where strategic coordination and rational choice of actions are key conditions for increasing international competitiveness.*

Keywords*: international competitiveness; strategic management; COMPASS; game theory.*

JEL: C72, F12, L10.

Introduction

International competitiveness is a key condition for sustainable development in the face of growing global uncertainty. For small open economies, strategic mistakes are more costly than for large markets. Therefore, we need tools that help make rational choices in a competitive environment. For this purpose, it is advisable to combine framework approaches of strategic analysis and formal models of competitor interaction. Game theory in this context provides a language to describe the conflict of interests, the reactions of rivals and the equilibrium of strategies (Jain, 2023).

Modern literature shows that game theory is actively used to form and explain business competition strategies. It allows you to simulate situations when the result depends not only on your own actions, but also on the behavior of other market participants. This is especially important for international markets where competition is multi-level and contains elements of incomplete information. Practical works confirm that game models can support management decisions in the conditions of competition for markets, resources and sales channels (Lu, 2024). A separate area of research is devoted to optimization game models in the competitive struggle of companies from different countries. Such approaches make it possible to evaluate the consequences of pricing strategies, quality, service and market segment selection. Hierarchical models that describe the "leader-follower" interaction and provide reasons for choosing a strategy in conditions of asymmetry of opportunities and influence are especially useful (Parvasi et al., 2023). At the same time, research shows that game-based approaches are effective not only for price competition, but also for cost management and quality improvement. This is important for international competitiveness, because it is quality and reliability that often

shape access to markets and retention of positions. Game models can be used to optimize quality spending decisions, which strengthens the strategic sustainability of companies (Roman & Dragu, 2023). Much of the current work also considers the integration of game theory with other analytical methods to increase the practical value of models. For example, the combination of game logic with strategic analysis tools makes it possible to evaluate not only the "win" in the short term, but also the long-term competitive position. In this sense, the trend towards the integration of game theory with optimization approaches is important, as can be seen from the review works in the field of financial markets (Ganti & Singhania, 2025).

In the management of supply chains and industrial strategies, there is a growing demand for models that simultaneously take into account digital transformation, risks and strategic interaction of participants. It is here that game approaches make it possible to formalize conflicts of interest between chain participants, as well as the choice between cooperation and competition. Examples of such integrated approaches are shown in research on Industry 4.0 strategies, where game theory is used together with other evaluation methods (Motallebi et al., 2025).At the same time, the theory of games demonstrates wide applicability in areas where the behavior of agents under uncertainty is important, in particular in decision-making on the "demand side" and in complex systems with many participants. This is useful for international competitiveness, because access to markets often depends on the reactions of many parties, and information is incomplete. Systematic reviews emphasize that game models help describe behavioral mechanisms and strategy choices in complex environments (Ji et al., 2024). Research also proves that game models work for constrained optimization problems where competitiveness is determined by regulatory policy frameworks or resource limits. This is important for international strategies, as companies and countries increasingly operate under environmental or carbon constraints. Examples show that game analysis helps evaluate strategic investments and agent behavior in such settings (Suski & Chattopadhyay, 2023). An added value is that game-based approaches are applicable to resilience and risk assessment when balancing criteria weights and making decisions under threats. Although such challenges may be sectoral, their logic carries over to competitive strategies where the risks are systemic. This is confirmed by examples of the use of game methods for assessing system stability and risk management (Lv et al., 2025; Liu et al., 2025). At the same time, for practical strategic management, an important role is played by complex framework approaches that allow assessing the internal capabilities, limitations and positioning of entities on international markets. In this context, the COMPAS model acts as a tool for the systematic assessment of strategic opportunities and weaknesses, which is especially valuable for economies with a high level of external dependence. However, in scientific literature, the issue of COMPAS integration with formalized game theory methods remains insufficiently developed, despite the active use of game models in various fields of management and economics (Roman & Dragu, 2023; Motallebi et al., 2025).

The motivation for choosing the topic is the need to create an integrated approach to the formation of international competitiveness strategies, which combines analytical assessment of capabilities and formalized modeling of strategic interaction. Special attention is paid to the Republic of Moldova as a small open economy, where strategic choice errors have disproportionately high consequences, and the coordination of actions of economic agents is critically important.

The purpose of the study is to justify an integrated management model that combines the COMPAS approach and game theory tools to optimize international competitiveness strategies. The task of the work is to analyze the possibilities of using game models in combination with COMPAS to increase the validity of strategic decisions, reduce risks and adapt to changes in the external environment.

The research uses methods of analysis, comparison and generalization, as well as elements of strategic management and game modeling. The results of modern scientific publications and analytical studies devoted to the application of game theory in business strategies, competitive behavior management and decision optimization are used. The analysis of previous works shows that most studies focus on

certain aspects of game analysis or industry examples, while the integration of framework management models and game theory in the context of international competitiveness remains insufficiently systematized. This determines the scientific novelty and practical significance of this research.

Results

The obtained results reflect the key limitations and opportunities of the international competitiveness of the Republic of Moldova in the context of integration into the EU market. Analysis of modern reports of international organizations shows that the country's competitive position is determined not by one factor, but by a combination of "solid" economic parameters and the quality of management decisions at the level of politics and business. Productivity is the basic structural constraint, as it sets the boundaries for the transition from price competition to differentiation, innovation, and entry into more profitable segments of international markets (World Bank, 2023). In parallel, institutional capacity and predictability of rules shape the economy's ability to scale competitive advantages through stable investment conditions, access to financing, coherence of state support programs, and efficiency of coordination between the state and the private sector (European Commission, 2024). For Moldova, this block is critical, as European integration simultaneously expands market access and increases requirements for compliance, management discipline, and strategic planning, and therefore strengthens the role of management as an "adaptation mechanism" to the external environment (European Commission, 2024).

Separately, the results emphasize the importance of integration into European economic chains as a practical channel for realizing competitiveness. Here, not only the total volume of trade becomes important, but also the structure of exports, the level of concentration in one market, the ability to hold long-term contracts and positioning in value-added chains, where bargaining power, standard requirements and logistical reliability are decisive (Hagemejer & Dąbrowski, 2025). For managerial analysis, this means that competitiveness should be evaluated through indicators that directly affect the choice of strategies: the degree of dependence on the EU market, performance indicators, signs of the "institutional quality" of the SME support policy, as well as the availability of financial and infrastructural resources to strengthen competitive positions (OECD, 2024; European Bank for Reconstruction and Development, 2023). That is why the study summarizes the basic quantitative and structural indicators that can be used as input parameters for the COMPAS framework analysis and subsequent formalized modeling of strategic interaction using game theory. Table 1 presents an extended set of indicators that better "explain" Moldova's international competitiveness from a management standpoint: dependence on the EU market, commodity structure of exports to the EU, scale of bilateral trade, productivity gap, SME readiness for digitalization, and institutional and investment environment.

Table 1. Key indicators of international competitiveness of the Republic of Moldova

Block	Indicator	Value	Period	Management content for strategy
Sales markets and concentration	EU share in Moldova's exports	67% of exports	2024	High "stake on one market": the strategy must be EU-first and compliance-oriented.
Sales markets and concentration	EU-Moldova bilateral trade	EUR 7.6 billion	2024	The size of the "playing field" is already large; it is not "entry" that wins but positioning in value chains.
The structure of exports to the EU	The share of "vegetable products" in Moldova's exports to the EU	28%	2024	Risk of price volatility; strategies for diversification and increasing added value are needed.
The structure of exports to the EU	Other leading groups in exports to the EU	Machines and electrical equipment;	2024	There is a "window" for industrial and processing niches; important contracts, standards, quality engineering.

Block	Indicator	Value	Period	Management content for strategy
		processed food; textiles; metals		
Export dependence (longer series)	Share of exports to the EU-27 in total exports (official series)	58.4%	2022	Shows that the concentration on the EU is a sustainable trend and not a one-time shock.
Productivity and the "power base" of competitiveness	Moldova's labor productivity relative to benchmarks	75% from Mon. Macedonia; 40% from Romania; 20% from Slovenia	assessment in CEM	This is a "structural constraint" in the game: without increasing productivity, the strategy boils down to price and margin.
SMEs and digitalization (possibility of rapid adaptation)	Composite score of SME digitization policies	3.40 (close to the regional average)	SME Policy Index 2024 assessment	Shows "institutional readiness" for digital strategies but does not guarantee their mass in business.
SMEs and digitalization (structure)	The share of SMEs in the ICT sector	5% of SMEs	2021 (last verified point)	There is a core of competencies for service export/IT cooperation; it is important to connect with exporters of goods.
Institutional capabilities	EBRD portfolio in the country	€1.111 million; 57 active projects; 41.8% private share	as of February 2023	There is a resource for "strengthening moves" in the game: funding, infrastructure, management standards.
Policy and coordination with the EU	Coordination of access/integration rules with the EU	Assessment of progress and requirements in the annual report	2024	Fixes the "rules of the game" and their change; it sets the limits and penalties/gains in the model.

Source: summarized by the author based on World Bank (2023), EBRD (2023), OECD (2024), European Commission (2024), Hagemejer & Dąbrowski (2025).

Table 1 shows that the international competitiveness of the Republic of Moldova is formed in conditions of high concentration in the EU market and at the same time a limited "power base" for the transition to differentiation strategies. Most tellingly, the EU's share of total exports is about two-thirds, which means dependence on one dominant market and its rules, standards and demand cycles (Hagemejer & Dąbrowski, 2025). In management logic, this reduces the scope for "opportunistic" strategies and increases the price of error, because any change in the regulatory regime or market access requirements quickly translates into lost volumes and margins. That is why the strategy of compliance, stability of contracts and controlled risks becomes critical for companies, and not just the strategy of short-term sales growth. Increasing Moldova's international competitiveness requires a strategy that simultaneously reduces the risk of excessive dependence on one market, increases productivity as the basis of competitive strength, activates the digital and organizational capabilities of SMEs, and uses available investment levers to move to higher added value. It is this set of parameters that is suitable for the further integration of COMPAS and game theory, because it allows us to formalize the constraints, gains and risks of strategic choices in the competitive environment of the EU.

As can be seen from Figure 1, the productivity gap between the Republic of Moldova and the benchmark countries is significant and has a direct managerial interpretation for international competitiveness strategies. On a Moldova = 1 basis, North Macedonia's index is 1.33, Romania's is 2.50, and Slovenia's is 5.00, meaning that even the nearest benchmark has about a third higher productivity, while the gap with the EU's higher-level country is multiple. This means that in a competitive environment, Moldovan companies operate with a lower "efficiency resource" per unit of labor and therefore have less margin for investment in quality, marketing, certification, R&D and

after-sales service. In practical terms, this shifts the structure of competitive strategies towards price competition and shorter contracts, because the cost of differentiation becomes relatively more expensive and less profitable under conditions of limited productivity.

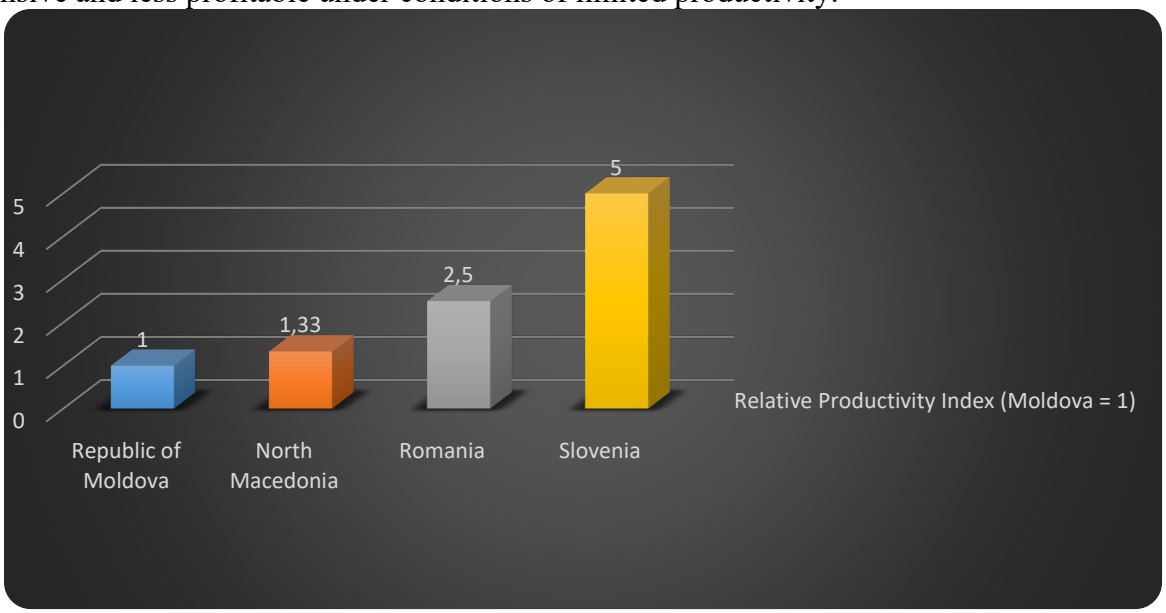

Figure 1. Productivity gap as a limitation of international competitiveness strategies (index: Moldova = 1)

Source: compiled by the author based on data from the World Bank (2023). Moldova Country Economic Memorandum: Boosting Productivity Growth.

In terms of game theory, this changes the "matrix of gains": strategies of differentiation and long-term positioning have higher initial costs and are more likely to become risky for Moldova, while a low-cost strategy may produce a faster result, but locks the country in segments with lower added value and stronger dependence on the actions of competitors. At the same time, the figure also suggests a managerial conclusion for the integration of COMPAS and game theory: to make "higher-level" strategies rational, it is necessary to change the parameters of the game through the tools of increasing productivity, access to finance and coordination, otherwise the equilibrium of the system will be maintained in low-margin scenarios where Moldova is forced to react rather than set the rules. Summarizing the results, it can be argued that the international competitiveness of the Republic of Moldova in the logic of integration into the EU market is determined by a combination of three interrelated blocks: structural efficiency (productivity), institutional manageability (predictability of rules, coordination and access to financial instruments) and the quality of positioning in European value chains (World Bank, 2023; European Commission, 2024; Hagemejer & Dąbrowski, 2025). The results show that with a high dependence on the EU market and an existing productivity gap, the country objectively has less room for differentiation and innovation strategies without external reinforcement, and therefore the scenarios of price competition and short-term contracts with increased risk remain dominant (World Bank, 2023). In the management dimension, this means that an effective strategy must be "robust" to uncertainty and competitors' reactions and rely on an integrated system of decisions: reducing concentration risks, increasing productivity as a basis of competitive strength, activating the digital and organizational capabilities of SMEs and using investment levers to move to greater added value (OECD, 2024; European Bank for Reconstruction and Development, 2023). That is why the integration of COMPAS and game theory in this article is not a theoretical construction, but a practical mechanism: COMPAS sets measurable parameters of capabilities and limitations, and game modelling allows you to turn them into a strategy selection rule in a situation of strategic interaction and incomplete information on the EU market.

Conclusions. The article systematizes the results of the analysis of the international competitiveness of the Republic of Moldova in the conditions of integration into the European Union market from the standpoint of the managerial approach. The study showed that the country's competitive position is formed under the influence of a combination of structural economic factors and the quality of management decisions at the level of state policy and business. The basic limitation remains the low level of productivity, which narrows the space for strategies of differentiation, innovation and sustainable entry into segments with high added value and determines the advantage of price competition. It has been established that the high concentration of exports in the EU market simultaneously creates opportunities for access to a large-scale solvent market and increases vulnerability to regulatory changes, logistical failures and increased competition. Under such conditions, institutional coherence, predictability of rules, access to financial instruments and the ability to coordinate actions between the state, financial institutions and enterprises, primarily small and medium-sized ones, become of key importance. The integration of the COMPAS framework and game theory allows us to interpret international competitiveness as a result of strategic interaction under conditions of limited resources and incomplete information. This approach makes it possible to formalize management constraints, assess the risks of different strategies and justify the choice of solutions aimed at increasing productivity, reducing transaction costs and improving positioning in European value-added chains. At the same time, the research has certain limitations associated with the use of aggregated statistical indicators and framework assessments of international organizations, which does not always allow to fully take into account the industry and firm specifics of strategic behavior. Further research should be directed to the construction of applied game models for individual sectors of the economy, the empirical calibration of COMPAS parameters at the level of enterprises, as well as the analysis of strategic coordination scenarios of Moldovan exporters on the EU market. This will contribute to the development of theoretical approaches and the formation of practical tools for increasing international competitiveness in the context of European integration.

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