Journal of Agriculture and Rural Development Studies
Volume 2 – Issue 4 – 2025
ISSN Online 3061-2756
www.imadr.jards.ugal.ro

DOI https://doi.org/10.35219/jards.2025.4.11

Econometric Modelling of the Relationship between Agri-Food Exports and Food Security: The Case of the Republic of Moldova

Alexandru Stratan*, Zinovia Toacă**, Viorica Lopotenco***, Liliana Saver****

ARTICLE INFO

Article history:
Received: November 07, 2025
Accepted: December 15, 2025
Published: December 17, 2025

Keywords:
agri-food exports, food insecurity, co-integration, ECM, Republic of Moldova

ABSTRACT

This paper examines whether agri-food export performance is linked to domestic food (in)security in the Republic of Moldova. Using annual time-series data for 2001–2024 on the value of agri-food exports (USD), agricultural production (MDL), and the share of the population facing food insecurity (percent), we apply Johansen cointegration tests and an error-correction model (ECM). The maximum-eigenvalue statistic indicates one cointegrating relationship among the variables, suggesting a stable long-run equilibrium. In the ECM, short-run changes in food insecurity are statistically significant, while changes in agricultural production are not, and the error-correction term is negative but statistically insignificant. Descriptively, Moldova's export basket has shifted from a strong weight of food and beverages in the late 1990s to a more diversified structure in which plant products became prominent by 2024, alongside a gradual reorientation of export destinations towards the European Union. A key limitation is that official food insecurity series are available only from 2015; earlier values are completed through interpolation/extrapolation, so long-run coefficients should be interpreted with caution.

1. Introduction

Agriculture and agri-food trade are foundational to the Republic of Moldova's economy and social cohesion, and—amid regional instability and accelerating climate-related shocks—strengthening food-system resilience has become a policy priority. Looking at recent economic figures, agriculture remains a significant pillar of Moldova's economy. Recent economic data show how important agriculture remains for Moldova. In 2024, the "agriculture, forestry and fishing" sector accounted for about 7.1% of GDP, and including food processing increases the agri-food share to 12–16% (EBA, 2012). The sector employs more than a quarter of the population, and food processing alone contributes a large share of industrial production and jobs. The sector also employs over 27% of workers, with food processing providing 37% of industrial output and 26% of manufacturing jobs. Agri-food products also comprise the largest share of total exports (about 30%; OECD, 2020), making export performance a strategic lever for growth and rural incomes.

*, **, ***, **** Academy of Economic Studies of Moldova, Chisinau, Republic of Moldova. E-mail addresses: stratan.alexandru@ase.md (A. Stratan), toaca@ase.md (Z. Toaca), lopotenco.viorica@ase.md (V. Lopotenco), liliana.staver@ase.md (Corresponding author L. - Staver).

Export growth can cause problems at home if food supply becomes tight or unstable. According to Herzfeld (2022), EU integration and agricultural policy decisions play an important role in how competitive Moldova's agri-food exports are. At the same time, supply-chain issues—such as logistics, digitalisation, cooperative models, and meeting EU sanitary and phytosanitary standards—remain essential for effective market integration (Staver, 2025).

Against this background, the present study investigates the relationship between Moldova's agri-food export performance and domestic food security using annual time-series evidence for 2001–2024. We apply Johansen cointegration techniques and an error-correction modelling framework to assess long-run co-movements and short-run dynamics between agri-food exports, food insecurity, and agricultural output, and we discuss policy implications for aligning export promotion with national food-security objectives.

2. Literature review

Many studies point to the role of agriculture in food security, and Islam (2025) emphasizes this connection clearly. Food security (Saccone & Vallino, 2025) has recently experienced profound systemic disruptions due to the simultaneous emergence of a global pandemic, the Russia-Ukraine war and climate change. Although climate-related shocks are expected to intensify in the near future, there is also high uncertainty regarding future pandemic events and armed conflicts. Regarding the trade-food security relationship, a meta-analysis (Santeramo & Lamonaca, 2020) shows that non-tariff barriers can significantly influence agri-food trade. The paper states that "the empirical literature provides contrasting and heterogeneous evidence, with some studies supporting the "standards as catalysts" view, and others favoring the "standards as barriers" explanation. From a trade perspective, agri-food exports can generate revenue but can also create tensions in domestic markets.

In the relevant literature, it is observed that countries strongly oriented towards agricultural exports can experience tensions between increasing foreign sales and ensuring domestic food security. For example, Halkin (2024) shows that, in the context of the war, the Ukrainian agricultural sector is in a difficult situation regarding domestic consumption. Although Ukraine contributes less than 0.2% to global GDP, it is a major player on the global agricultural market, exporting over 11% of global wheat and up to 16% of global cornEven if international prices have improved, Moldova still has food security problems. Halkin (2024) notes that when exports are pushed too much, the needs of the domestic food system can be overlooked. According to Trască, Dima, and Pop (2025), good food availability does not necessarily mean a stable food system. FAO (2011) also warns that trade liberalization, without proper internal support, can reduce food access for vulnerable groups.

Studies on Moldova add further context. Stratan, Lopotenco, Toaca, and Staver (2025) highlight the need to diversify supply sources, improve distribution chains, and build policies that respond effectively to external shocks. At the same time, Toaca, Iatisin, and Colesnicov (2024) show how European integration has reshaped Moldova's export directions, creating opportunities but also new pressures that can affect the domestic food situation.

International research confirms that the link between exports and food security is not straightforward. Examples from other countries show that the link between exports and food security varies a lot. Countries show different patterns when it comes to how exports influence food security. In Zimbabwe,

Kondo and Tambudzai (2025) find that agricultural exports help by bringing in foreign currency and attracting investment. In Tunisia, Bousrih and Mekki (2020) note that instability remains, even though exports have increased. Looking across many developing countries, Dekkiche, Mohamed, and Fairouz (2025) find that trade openness works best where logistics are strong, but can create new risks where infrastructure is weak. Seok and Soon (2024) add that for low-income countries, opening up to global markets can offer new chances but also added pressure, making good policies and improved logistics essential. These studies support the hypothesis that there is a potential tension between export orientation and domestic food balance, an increasingly relevant issue for countries like the Republic of Moldova, in transition to EU-oriented trade patterns.

3. Analysis of agri-food exports of the Republic of Moldova.

Over the past thirty years, Moldova's agri-food exports have shifted in noticeable ways, influenced by changes in trade policy, closer ties with the European Union, and the gradual adjustment of local producers to foreign market requirements. The analysis looks at the product groups that, at different points, accounted for more than 10% of total exports.

In the 1990s and early 2000s, Section IV—food products, beverages, and tobacco—represented the heart of Moldova's exports, making up more than half of all shipments abroad (Figure 1). Over the years, its role gradually diminished, falling to below 15% by 2024. Wine dominated this category for a long time, often accounting for most of its export value.. Early in the period, these products were sent mainly to Russia, often in bulk form. Over time, however, the export base became more diverse, both in product range and in destination markets.

By 2024, Section II—plant products such as cereals, fruits, and oilseeds—had become the leading agri-food export group. No single category holds a dominant position anymore, pointing to a more balanced and diversified export structure in Moldova's agri-food sector.

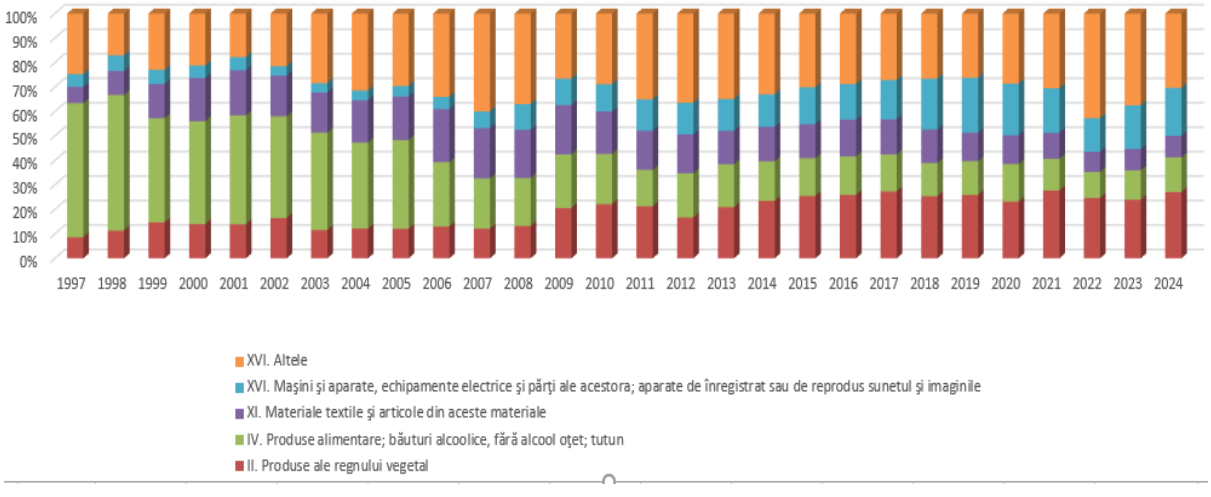

Figure 1 Structure of exports of the Republic of Moldova by CNG sections, 1997–2024

Source: Author's elaboration based on data from (NBS, 2024)

Figure 2 shows how Moldova's export map has shifted dramatically over the past three decades. In the late 1990s, most exports still went to the post-Soviet region, especially Russia and other CIS countries. Starting in the 2000s, this share began to decline gradually amid trade instability and the emergence of non-tariff barriers in economic relations with eastern partners.

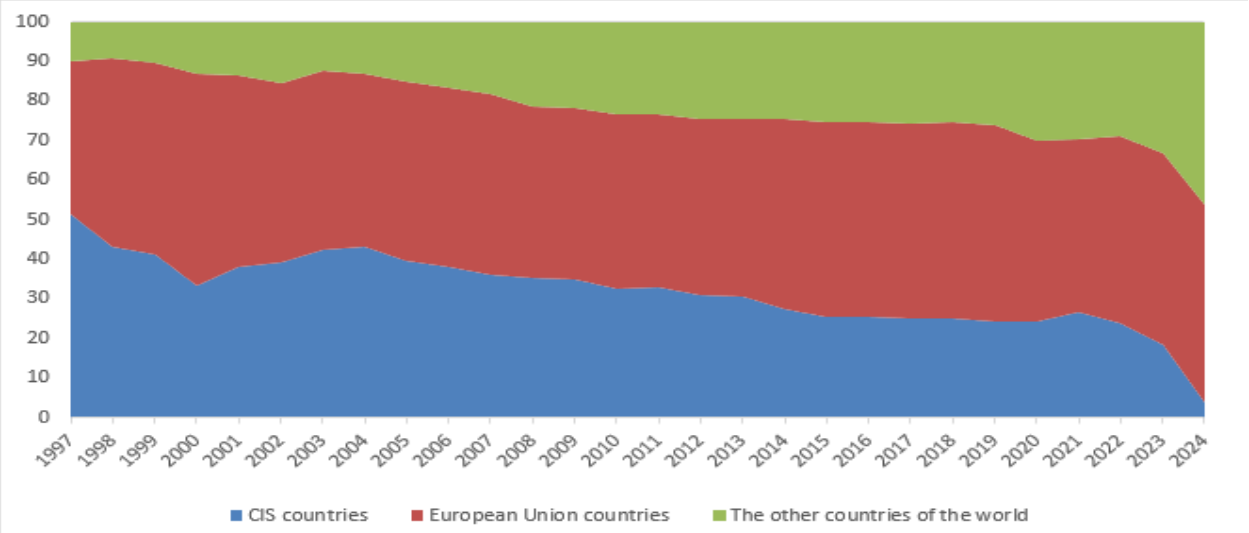

Figure 2 Evolution of the geographical structure of exports of the Republic of Moldova,

Source: Author's elaboration based on data from (NBS, 2024)

Over time, Moldova's export routes have gradually shifted toward European markets, a movement strengthened after the 2014 Association Agreement and the DCFTA opened easier access to the EU. As exports to Europe grew, so did interest in new destinations, including the Middle East, Asia, and North America, helping the country reduce reliance on its traditional post-Soviet partners. Figure 2 clearly captures this shift, showing how Moldova's agri-food trade has moved from dependence on a single region to a more balanced global pattern.

The expansion and diversification of agri-food exports reflect a sector that is becoming more mature and more connected to global value chains. Even so, focusing too heavily on external markets can strain the domestic food supply. This is why the study looks at how export growth relates to the country's own food security, using time-series models built on export data, agricultural output, and food insecurity levels.

3.1. Econometric modelling.

The econometric analysis was conducted using an annual data set for the Republic of Moldova covering the period 2001–2024. The data series includes variables relevant to characterizing the interdependence between agri-food exports and food security.

- EXP_AGR (Agri-food exports, expressed in millions of USD) – reflects the potential for trade integration in the agricultural sector. Transformation used in models: LOG_EXP_AGR for variance stabilization and elastic interpretation.

- IND_PROD (global industrial production, expressed in billions of lei) – indicator for the evolution of the industrial output. Transformation: LOG_IND_PROD– for comparability and reduction of heterogeneity.
- FOOD_INSEC (Share of population in food insecurity, %) – direct indicator of food vulnerability. It was not logarithmically transformed because it is expressed as a percentage.
- AGR_PROD (total agricultural production, expressed in billions of lei) – indicator for the evolution of the agricultural output. Transformation: LOG_AGR_PROD.

Official data on the share of the population experiencing food insecurity (FOOD_INSEC) are available only since 2015. To allow for long-term analysis (2001–2024), the series was completed by linear interpolation and, where necessary, moderate extrapolation. Missing values for 2001–2014 were filled using linear interpolation, while the 2024 value was moderately extrapolated based on recent trends. This ensured a consistent time series for the econometric model. At the same time, it is recognized that these completed values may introduce some uncertainty into the estimates, which is why the results obtained should be interpreted with caution, especially regarding the long-term significance of the indicator.

Analysis of correlation coefficients. Table 1 shows that agri-food exports move closely with the food insecurity indicator (0.82), suggesting some pressure on the domestic market as exports grow. The data also point to strong links among the other variables: agricultural and industrial production tend to rise together (0.776), and exports are more closely tied to industrial output (0.807) than to agriculture (0.707). Even so, agricultural production is kept in the analysis. The choice is justified by the fact that approximately 85% of the Republic of Moldova's industrial production is in the processing industry, which is deeply dependent on agricultural raw materials. Thus, agricultural production is a basic determinant of value added in the industry, and its inclusion in the model provides a clearer perspective on the internal factors influencing agri-food exports.

Table 1. Pearson correlation coefficients between variables used in econometric analysis

Variabie	EXP_AGR	FOOD_INSEC	IND_PROD	AGR_PROD
EXP_AGR	1	0.822	0.807	0.707
FOOD_INSEC	0.822	1	0.761	0.699
IND_PROD	0.807	0.761	1	0.776
AGR_PROD	0.707	0.699	0.776	1

Source: analysis data

At the same time, the results of the Granger test (Table 2) indicate that there is no causality between agri-food exports and the food insecurity indicator, suggesting that, in the short term, the factors do not influence each other. A cause may also be the lack of data for the food security indicator. On the other hand, at the moment, one of the government's priorities is the expansion and diversification of exports in general, and of agri-food products in particular. In the Republic of Moldova, subsistence farming persists, meaning that households produce part of their consumption.

Table 2. Results of the Granger causality test between agri-food exports and food insecurity

Pairwise Granger Causality Tests			
Date: 11/03/25 Time: 16:53			
Sample: 2001 2024			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
D(FOOD_INSEC) does not Granger Cause D(EXP_AGR)	21	1.59037	0.2344
D(EXP_AGR) does not Granger Cause D(FOOD_INSEC)		0.57031	0.5764

Source: analysis data on EViews 10

It is necessary to verify the hypothesis of a long-run influence between variables, or whether the series are cointegrated. The Johansen cointegration test (Table 3) for the period 2004–2024 confirms the existence of a stable long-term relationship among agri-food exports, food insecurity, and industrial production. The results from the under-reduced sample sizes indicate the presence of a single cointegration relationship at the 5% significance level. Trace test indicates three cointegrating relationships, but the Max-Eigenvalue test is more restrictive.

Table 1. Results of the Johansen cointegration test for the analyzed variables

Date: 11/03/25 Time: 17:13				
Sample (adjusted): 2004 2024				
Included observations: 21 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LOG(EXP_AGR) FOOD_INSEC LOG(AGR_PROD)				
Lags interval (in first differences): 1 to 2				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.647343	38.23515	29.79707	0.0042
At most 1 *	0.369299	16.34771	15.49471	0.0371
At most 2 *	0.272062	6.668314	3.841466	0.0098
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.647343	21.88743	21.13162	0.0391
At most 1	0.369299	9.679401	14.26460	0.2338
At most 2 *	0.272062	6.668314	3.841466	0.0098

Source: analysis data on EViews 10

The result obtained: log(EXP_AGR)=0.267·FOOD_INSEC−0.955·log(AGR_PROD) or in rewritten formlog(EXP_AGR)−0.267·FOOD_INSEC+0.955·log(AGR_PROD)=EC_t

The cointegration equation (Table 4) estimated by the Johansen method indicates a long-run equilibrium relationship among agri-food exports, food insecurity, and agricultural production. In the long run, higher agricultural production boosts exports (0.955), while greater food insecurity reduces them (–0.267). The adjustment coefficient for exports (–0.263) is significant, showing that exports partly return to equilibrium aftershocks. The other two variables do not respond significantly to imbalances in

the stable relationship, which supports the idea that exports play the leading role in this adjustment mechanism.

Table 2. Cointegration equation coefficients and adjustment coefficients for the analysed variables

1 Cointegrating Equation(s):		Log likelihood	16.80031
Normalized cointegrating coefficients (standard error in parentheses)			
LOG(EXP_AGR)	FOOD_INSEC	LOG(AGR_PROD)	
1.000000	-0.267256	0.954802	
	(0.03252)	(0.68864)	
Adjustment coefficients (standard error in parentheses)			
D(LOG(EXP_AGR))	-0.263168		
	(0.12349)		
D(FOOD_INSEC)	2.367351		
	(1.31938)		
D(LOG(AGR_PROD))	-0.073567		
	(0.08056)		

Source: analysis data on EViews 10

To analyze the short-term dynamics among agri-food exports, food insecurity, and processed agricultural production in the Republic of Moldova, an error correction model (ECM) was estimated from the previously identified cointegration relationship among LOG(EXP_AGR), FOOD_INSEC, and LOG(AGR_PROD). The Johansen test confirmed the existence of a long-term equilibrium relationship between these variables, indicating that they coevolve over time despite short-term fluctuations. The results of the ECM model estimation are summarized in Table 5The negative value of the equilibrium correction term (–0.0708) indicates that exports tend to return to their long-term path after a shock. However, because the result is not statistically significant (p = 0.429), this adjustment is very slow and essentially negligible.

Table 3. Error correction model (ECM) estimation results for agri-food exports of the Republic of Moldova

Dependent Variable: D(LOG_EXP)				
Method: Least Squares				
Date: 11/05/25 Time: 17:00				
Sample (adjusted): 2002 2024				
Included observations: 23 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.223227	1.425444	0.858138	0.4015
D (LOG_AGR_PROD)	0.578607	0.417826	1.384803	0.1822
D(FOOD_INSEC)	0.050059	0.023206	2.157205	0.0440
EC_1	-0.070822	0.087656	-0.807957	0.4291
R-squared	0.310145	Mean dependent var		0.102803
Adjusted R-squared	0.201220	S.D. dependent var		0.171002
S.E. of regression	0.152832	Akaike info criterion		-0.762181
Sum squared resid	0.443796	Schwarz criterion		-0.564704

Log likelihood	12.76508	Hannan-Quinn criter.	-0.712516
F-statistic	2.847334	Durbin-Watson stat	1.715246
Prob(F-statistic)	0.064913		

Source: analysis data on EViews 10

In the short term, the only variable with a significant relationship is the variation in food insecurity (D(FOOD_INSEC)), whose negative coefficient (–0.0501) is significant at the 10% level (p = 0.0891). This relationship suggests that during periods of increased food insecurity, agri-food exports tend to decrease. This result may reflect a reorientation of production towards domestic consumption or logistical and trade limitations imposed in the context of a food crisis. The variation in agricultural production (D(LOG_AGR_PROD)) has a positive but insignificant coefficient (p = 0.182), suggesting that, although theoretically an increase in production should stimulate exports, this effect is not statistically detectable in the annual dynamics of the available data. It is important to keep track of food insecurity indicators, and early warning systems can help the government react quickly when problems appear. Using econometric analysis in policy decisions is becoming increasingly necessary.

5. Conclusions

The findings reveal that the link between Moldova's agri-food export potential and its own food security is far more layered than it first seems. When we trace the data across the years 2001–2024, a clearer story unfolds: exports, agricultural production, and levels of food insecurity tend to shift together over time, suggesting that these elements are tied into a deeper, long-term relationship rather than acting independently of one another.

On the short-term side, things look different. The error correction model suggests that exports react only slowly—and not in a statistically meaningful way—when this long-run balance is disturbed. What does stand out, however, is the influence of food insecurity: when domestic food conditions worsen, export levels tend to decline. This points to the fact that pressures on the internal food system can spill over into the country's export performance.

These findings raise an important point: even though Moldova has expanded its agri-food exports in recent years, the benefits of this growth do not automatically improve the country's own food situation. In fact, when food insecurity increases, export capacity can suffer, possibly because resources are redirected internally or because authorities intervene to stabilize the domestic market.

In the bigger picture, the study shows that exports, production, and food insecurity are linked over the long run, while the short-term effects remain weaker and more uncertain. This may be due to the limited size of the dataset, gaps in the statistical series, or other influences that are harder to capture—such as changes in trade policy or external shocks. The negative coefficient for variation in food insecurity suggests that, in years with food deterioration, exports may be affected, indicating a possible contraction in availability for external markets. The results of the econometric model partially align with the conclusions of Stratan, Lopotenco, Toaca, & Staver (2025), who highlight that the resilience of the Republic of Moldova's agri-food system is vulnerable to imbalances between external demand (through exports) and domestic needs. Although the agricultural sector is naturally oriented towards external markets, the lack of robust mechanisms to protect domestic food security can amplify social exposure to food risks, especially in the face of climatic or geopolitical shocks.

The public policy recommendations resulting from this analysis aim to harmonize the objectives of increasing agri-food exports with the need to maintain an adequate level of domestic food security. Trade policies must align with these objectives, so that the promotion of exports also takes into account national food sustainability and avoids social and economic imbalances. In parallel, there is a clear need to reinforce the country's ability to store and distribute its own agricultural products. Expanding storage facilities and developing shorter, more efficient supply chains would help ease the strain on the domestic market, especially in moments when external demand grows rapidly and pulls resources outward. At the same time, diversifying export markets and agri-food products is essential, particularly by focusing on value-added products and stable external markets, thereby increasing the resilience of the agri-food sector without compromising food security. Constant monitoring of food insecurity is still vital, because these signals often show when things begin to shift long before the effects become visible in everyday life. Setting up early warning systems would help the authorities respond more quickly—adjusting trade measures or fiscal policies the moment new pressures start to build. At the same time, using econometric evidence as part of the decision-making process is becoming increasingly important, as it helps turn scattered data into clearer guidance for public policy. The systematic use of empirical models can help anticipate the impact of trade reforms on domestic consumption and the well-being of the population.

Acknowledgements

This research work was carried out within the framework of the project "Increasing the main agri-food products export from the perspective of strengthening the Republic of Moldova`s food security", project number 23.70105.5107.07, funded by the National Agency for Research and Development of the Republic of Moldova (NARD).

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