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Emerging Challenges in the Agriculture Sector of Developing Countries

Agriculture as a Force for Economic Development in Jordan

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Abstract | This research investigates how agricultural activities influence Jordan's economic development from 1990 to 2021. Using Autoregressive Distributed Lag (ARDL) Bounds testing for cointegration analysis, the findings reveal that agriculture positively impacts Jordan's economic growth in the short term, though this relationship does not persist in the long term. Based on these results, the study proposes targeted agricultural development strategies aligned with Jordan's economic structure. Recommendations include government policies to enhance agriculture's contribution to economic growth, investment in value-added technologies for agricultural products, creating favorable conditions for agricultural export investors, and providing support to agricultural producers including small farms and SMEs to stimulate broader economic activity.

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Introduction

The relationship between agriculture and economic development has long captivated scholars, especially when it comes to lower-income countries. Agriculture's potential to drive growth and act as a catalyst for broader development has been the subject of extensive debate and evolving perspectives (Al-Adwan, 2024; Mohammad *et al*., 2025a). Over time, this discussion has reflected shifts in economic theory and empirical evidence across diverse countries and periods, illustrating just how complex and dynamic the role of agriculture really is. In developing countries, agriculture remains a cornerstone of livelihoods. According to the 1982 Agriculture and Economic Development Report, nearly two-thirds of people in these nations rely primarily on farming for income. Jordan exemplifies this pattern: Although

agriculture's share of GDP has diminished over the years, its importance for employment, food security, and rural development persists. This duality reflects a broader theoretical tension in economic development discourse, which often centers on two-sector models contrasting the traditional agricultural sector with the modern industrial sector. Growth is frequently attributed to industrial expansion, while agriculture is viewed as a stepping stone or labor reservoir (Hujran *et al.*, 2023; Mohammad, 2025). Similarly, dependency theories emphasize that trade restrictions and the focus on building manufacturing for regional markets tend to be prioritized for rapid growth.

Yet, an alternative viewpoint underscores the direct influence of agricultural surplus on the growth of non-agricultural sectors, advocating for balanced macroeconomic and sectoral policies that support both agriculture and industry. This ongoing theoretical debate naturally leads to a crucial empirical question: does economic advancement in a developing country like Jordan depend causally on the agricultural sector? Addressing this question, this study examines the contribution of agricultural development to Jordan's broader economic growth from 1990 to 2021, a period marked by significant economic reforms and policy shifts. By providing a quantitative analysis, the study aims to clarify agriculture's role as a potential driver of economic growth and support evidence-based policymaking that fosters sustainable development. Its significance lies not only in offering objective econometric insights but also in enriching the scholarly conversation on growth drivers in developing economies akin to Jordan.

The evolution of economic thought further frames this inquiry. Historically, development theories for underdeveloped economies often called classical theories have contrasted with neoclassical growth theories tailored for advanced economies. In the 1950s and 60s, agriculture was largely seen as a limiting factor in development, with the modern industrial sector as the main growth engine. This view was bolstered by the Prebisch-Singer thesis, which highlighted deteriorating terms of trade for primary goods relative to industrial products. Over time, four key theoretical frameworks have shaped the debate on agriculture's developmental role. The "Fifth Wheel" school regards agriculture as secondary to growth but warns against neglecting it. The Chicago School, inspired by Schultz (1964), focuses on human capital and rationality in boosting agricultural productivity. The trade-based perspective emphasizes agriculture's role in export earnings and foreign exchange. Finally, the agriculture-led growth view positions agriculture as a primary engine of growth, especially through mechanisms like agricultural demand-led industrialization, as formulated by Adelman (1984).

By the mid-1960s, the perspective shifted to recognize agriculture as a multifaceted contributor to growth through its effects on labor supply, food provision, savings, foreign exchange, and markets, following the insights of Johnston and Mellor (1961). However, in the 1980s and 90s, industry regained primacy in growth narratives, with many studies suggesting agricultural growth often follows, rather than leads, overall economic growth. More recently, since around 2005, agriculture's potential to stimulate growth has regained attention, notably in the 2008 World Development Report on Agriculture (World Bank, 1982). This report championed the "Agriculture for Development" approach, which recognizes the productivity of smallholder farmers in low-income countries as a critical driver of surplus generation that fuels broader economic progress. Alongside productivity gains, the development of a strong rural non-farm sector and shifts toward higher-yield crops are seen as essential.

Empirical studies in Jordan provide additional context. For instance, Abu-Saleem *et al.* (2021) explored the impact of digital trade on Jordan's economic growth, finding long-term positive relationships between digital trade, GDP growth, and trade openness (Alhabarneh *et al.*, 2024; Al-Sawaie, 2024; Basha *et al.*, 2023; Jubran *et al.*, 2024; Salameh *et al.*, 2025; Mohammad *et al.*, 2025c, d). Similarly, Abu-Saleem *et al.* (2024) investigated service exports' short- and long-term relationships with growth, uncovering patterns that echo findings about agriculture's more nuanced role in the economy (Jubran *et al.*, 2025; Mohammad *et al.*, 2025e). Together, these theoretical insights and empirical findings form the foundation for this study's focused examination of agriculture's role in Jordan's economic development, seeking to clarify whether it truly acts as a cornerstone of growth or remains a supporting actor in the nation's evolving economy.

Materials and Methods

Data sources and period selection

This study uses annual time series data spanning

1990 to 2021, carefully chosen to capture Jordan's economic transformation over three decades. All data were sourced exclusively from World Bank datasets to ensure consistency and reliability. The starting point of 1990 holds particular importance, as it marks Jordan's transition to export-oriented industrialization policies implemented after structural adjustment programs that followed the 1988 economic crisis. These reforms prioritized export promotion, making this 32-year period ideal for analyzing how agriculture's role in economic development evolved during a time of significant trade policy shifts.

Model specifications

To investigate the short-term and long-term relationships between exports and economic growth in Jordan, this research applies Kaberuka *et al.* (2014) enhanced growth model. This model extends the traditional framework by including exports as key variables influencing economic growth. Additionally, the study considers other factors that could significantly affect the export-growth relationship in Jordan: domestic investments, foreign direct investment, and export growth itself. The theoretical basis for developing this model is the enhanced neoclassical Cobb-Douglas production function, which, in line with endogenous growth theories, recognizes technology as a vital driver of growth. The relationship between export growth and economic output is framed through the Cobb-Douglas production function shown below:

$$Y = AL^{\alpha}K^{\beta} \quad (1)$$

In Equation 1, Y represents output, A denotes production efficiency, L is labor input (measured by workforce size), and K is capital input. The coefficients α and β represent input elasticities. Productivity, labor, and capital inputs together determine output levels. In this model, GDP per capita growth rates stand for total output (Y), workforce size represents labor input (L), and gross fixed capital formation reflects the capital stock (K). To meet the study's objectives, the model also incorporates exports and other variables likely to influence economic growth. Assuming a linear form of the production function, the general structure of the estimated model appears in Equation 2:

$$Growthrateof\ GDP = \alpha + \beta X_t + \varepsilon_t \quad (2)$$

Here, X represents the independent variables affecting real GDP ($RGDP$), t indicates the years 1990–2021, and ε represents random error terms.

Drawing on Kaberuka *et al.* (2014) findings regarding agricultural growth relationships, a general empirical model for agriculture's impact on Jordanian economic growth can be formulated as:

$$GDPGrowth = \alpha_0 + \alpha_1 lnL + \alpha_2 lnK + \alpha_3 lnAGR + \varepsilon \quad (3)$$

Where: Agr: Agriculture RGDP: Economic growth
K: Capital (measured as gross fixed capital formation)
L: Labor

In line with economic theory, the coefficients for exports, gross fixed capital formation, and labor are expected to show a positive relationship with economic growth. The choice of these variables was guided by their theoretical relevance and frequent use in prior empirical studies on economic growth. The stability characteristics of the time series data were checked using Augmented Dickey-Fuller (ADF) unit root tests before estimating the growth equations. To ensure the model's adequacy, the specifications were tested for diagnostic validity and stability. The ARDL bounds testing approach for cointegration was used to estimate the growth equation, as it can explain both short-term and long-term dynamics between variables.

ARDL model and cointegration testing

Reformulating Equation 3 as an ARDL model gives:

$$\begin{aligned}\Delta GDPGrowth = {} & \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta GDPGrowth_{t-i} \\ & + \sum_{i=1}^{n} \alpha_{2i} \Delta ln L_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta lnK_{t-i} + \sum_{i=1}^{n} \alpha_{4i} \Delta ln Agr_{t-i} \\ & + \theta_1 GDPGrowth_{t-1} + \theta_2 ln L_{t-1} + \theta_3 lnK_{t-1} + \theta_4 ln Agr_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

Here Δ indicates difference coefficients, α_0 represents drift, ε represents error terms, and α_1, α_2, α_3, and α_4 represent short-term dynamics coefficients, while θ_1, θ_2, θ_3, and θ_4 reflect short-term dynamics, while the other coefficients capture long-term relationships. Trend characteristics were removed through differencing, and n indicates the lag length for each variable. This forms the basic equation for estimating both short-term and long-term relationships between the variables, shown in Equation 4. Bounds testing was used to verify relationships among GDP growth, labor, capital, and exports, with the existence of a long-term relationship tested empirically through

F-tests using ordinary least squares. This test examines the null hypothesis of no cointegration against the alternative hypothesis that cointegration exists.

Equation 4 coefficients are tested under these hypotheses:

$H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ (indicating cointegration absence)
$H_1: \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ (indicating cointegration existence)

The approximate critical bounds for F-statistics suggested by Pesaran *et al.* (2001) help verify whether cointegration is present. If the calculated F-statistic is below the lower bound, cointegration is rejected; if it exceeds the upper bound, the alternative hypothesis of cointegration is accepted. When the F-statistic falls between the bounds, the test results remain inconclusive. If no cointegration is found, the procedure ends at this stage. If cointegration is confirmed, however, the short-term and long-term coefficients can be estimated, clarifying how each variable affects economic growth over time.

Error correction and causality testing

Estimating short-term elasticity marks the final step. Error correction models linked to the long-term estimates are then calculated to determine short-term dynamics. Causality is assessed through these error correction models, as shown in Equation 5:

$$GDPGrowth = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} GDPGrowth_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \ln L_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \ln K_{t-i} + \sum_{i=1}^{n} \alpha_{4i} \ln Agr_{t-i} + \varepsilon_t \quad (5)$$

Here, α_1, α_2, α_3, and α_4 represent short-term dynamics coefficients, while γ shows the speed of adjustment back to long-term equilibrium following shocks; *ecmt–1* denotes the error correction term. The coefficient γ is expected to be negative and statistically significant, confirming long-run relationships between variables. Establishing causality relies on the joint significance of the lagged difference coefficients and the lagged error correction term for the dependent variables, using F-tests (Manwa, 2015; Mohammad *et al.*, 2025f).

Results

Augmented dickey-fuller unit root test results

Table 1 presents ADF test results for variables in the economic growth-exports model. Based on results, variables were I(0) (GDP growth) and I(1) (capital, labor, agriculture), justifying ARDL methodology application.

Table 1: *Unit root testing results.*

Variable	Augmented dickey-fuller (ADF)		
	Level	First difference	I(d)
GDP growth	-3.821*	-	I (0)
L	-0.323	-3.660*	I (1)
K	-1.161	-3.952*	I (1)
Agr	0.294	-3.058*	I (1)

**Statistically significant at 1% significance levels.*

The unit root test results indicate that the GDP growth variable is stationary at level, while labor (L), capital (K), and agriculture (Agr) become stationary after first differencing. This mix of I(0) and I(1) variables makes the ARDL bounds testing approach particularly appropriate for this analysis.

ARDL model diagnostic test results

Table 2 shows diagnostic test results for the model. Equation 4 passed all relevant diagnostic tests including Ramsey RESET, Jarque-Bera normality, heteroskedasticity (ARCH), and Breusch-Godfrey Serial Correlation LM tests.

Aside from the Ramsey RESET test, which suggests some misspecification possibly due to omitted variables or nonlinearities the other tests indicate the model is well specified. There is no evidence of serial correlation, residuals are normally distributed, and heteroskedasticity is absent. The Jarque-Bera test confirms normality, with a p-value of 0.577, well above the 5% threshold. The Breusch-Godfrey LM test for serial correlation shows a p-value of 0.064,

Table 2: *ARDL model diagnostic results.*

Test	Test statistic	P-value	Null hypothesis	Conclusion
Breusch-godfrey serial correlation LM test	3.796	0.064	H_o: No serial correlation	Cannot reject H_o
Ramsey reset test	6.504	0.018	H_o: Correctly specified	reject H_o
Jarque-Bera normality test	1.099	0.577	H_o: Normal distribution	Cannot reject H_o
Heteroskedasticity test: ARCH	8.442	0.295	H_o: Homoskedasticity	Cannot reject H_o

slightly above 0.05, supporting the null hypothesis of no autocorrelation. Similarly, ARCH testing for heteroskedasticity returns a p-value of 0.295, indicating no ARCH effects. Overall, despite some indication of misspecification via the RESET test, the model meets the key diagnostic criteria, suggesting it is generally appropriate for the analysis. That said, some refinement may improve it in future work.

Cointegration bounds test

The bounds test results in Table 3 investigate the existence of a long-run cointegration relationship between economic growth and its explanatory variables. The F-statistic value of 17.338 exceeds the upper bound critical value of 3.67 at the 95% confidence level, strongly rejecting the null hypothesis of no cointegration.

Table 3: *Cointegration existence bounds testing.*

Test statistic	Value	k	Level of significance	"Bound critical values" "lower bound"	upper bound"
"*F*-statistic"	17.338	3		I(0)	I(1)
			1%	3.65	4.66
			5%	2.79	3.67
			10%	2.37	3.20

This result confirms the presence of a long-term relationship among the variables, justifying the estimation of both long-run and short-run coefficients using the ARDL model framework.

Long-term relationship results

Table 4 displays the estimated long-term coefficients. The results show that the relationships between GDP growth and the explanatory variables agriculture, capital, and labor are negative and statistically insignificant in the long run.

Table 4: *Estimated long-term coefficient results.*

Dependent variable: GDP growth				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LOG (K)	-0.003083	0.011243	-0.274253	0.7864
LOG (L)	-0.038900	0.022726	-1.711661	0.1010
LOG (AGR)	-0.000788	0.008224	-0.095824	0.9245
C	0.074319	0.066827	1.112118	0.2781

The insignificant long-term relationship between agricultural growth and economic growth in Jordan contrasts with the significant short-term effect discussed later (sections 4-5). This suggests that although agriculture may provide a short-term economic boost, structural factors hinder these gains from translating into sustainable long-term growth. Several explanations might account for this. Jordan faces severe water scarcity and limited arable land, restricting agricultural growth potential. The agricultural sector might also be poorly integrated with other economic sectors, limiting intersectoral linkages necessary for sustained growth. Moreover, the volatility of agricultural output due to climate and market factors could undermine its role as a stable long-term growth driver. Unexpectedly, capital also shows an insignificant negative correlation with GDP growth in the long run. This counterintuitive finding could stem from structural problems in Jordan's investment climate, such as inefficient capital allocation, regulatory hurdles, or other barriers reducing returns on investment. Similarly, labor exhibits a negative, though marginally insignificant (p=0.1010), relationship with economic growth. This contradicts standard growth theories and may reflect issues like low labor productivity, skills mismatches, or other structural labor market challenges. Overall, these results suggest that Jordan's long-term economic growth may depend on factors beyond those captured by this model possibly institutional quality, technological progress, or international economic ties.

Short-term dynamic model

Table 5 presents the results from the short-term error correction model. Here, the first differences of agriculture, labor, and capital have positive and statistically significant effects on real GDP growth.

The error correction term is negative and highly significant, indicating a rapid adjustment of short-term deviations back toward the long-run equilibrium. Although agriculture does not show a significant long-term effect, it clearly boosts economic growth in the short term. Specifically, short-term GDP growth responds positively to changes in agricultural growth, a 1% increase in agriculture leads to about a 0.08% rise in economic growth. This supports the idea that agriculture can act as a short-term economic stimulus in Jordan, even if these gains don't translate into long-term growth. Similarly, both labor and capital have positive short-term impacts: A 1% increase in gross fixed capital formation is associated with roughly a 0.09% increase in GDP growth, while a 1% increase in the labor force leads to about a 0.13% increase. The error correction coefficient, at -1.144718, is strongly

Table 5: *Short-term estimated error correction model results.*

Dependent variable: GDP growth				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
DLOG (K)	0.088046	0.019415	4.535064	0.0002
DLOG (L)	0.134120	0.065677	2.042119	0.0533
DLOG (AGR)	0.080146	0.022894	3.500785	0.0020
Coint Eq (-1)*	-1.144718	0.113093	-10.12194	0.0000
R-squared	0.823029	Mean dependent var		0.000665
Adjusted R-squared	0.802609	S.D. dependent var		0.032464
S.E. of regression	0.014423	Akaike info criterion		-5.516375
Sum squared resid	0.005409	Schwarz criterion		-5.329548
Log likelihood	86.74562	Hannan-quinn criter.		-5.456607
Durbin-watson stat	2.179519			

* p-value incompatible with t-Bounds distribution.

negative and significant, suggesting the system corrects approximately 114% of past disequilibrium within one year. This "overshooting" implies that the adjustment might temporarily exceed equilibrium before settling down. The relatively fast adjustment speed, combined with its statistical significance, supports the presence of long-term Granger causality from the explanatory variables to GDP growth, despite the insignificant long-term coefficients themselves. The contrast between the significant short-term effects and the insignificant long-term effects suggests that while agriculture, labor, and capital can temporarily stimulate Jordan's economy, structural issues may prevent these benefits from being sustained over time. This distinction carries important policy implications: Short-term agricultural interventions could provide immediate economic stimulus, but longer-term structural reforms are essential to achieving sustainable growth.

Discussion

Our findings reveal an interesting paradox in how agriculture affects economic growth in Jordan. On the one hand, agricultural activity shows a clear, statistically significant boost to GDP in the short term about 0.08% growth for every 1% increase in farming output. On the other hand, this positive effect fades over time, suggesting that while agriculture can help stabilize the economy in the near term, it does not drive lasting prosperity on its own. This tension makes sense when we consider Jordan's circumstances: an arid climate with only about 10% arable land, and an economy increasingly shaped by the service sector rather than farming.

Water scarcity sits at the heart of this challenge. As one of the world's most water-stressed countries, Jordan faces severe physical limits on how much farming can expand or modernize. These water constraints interact with other barriers urbanization steadily eats away at available farmland, climate shocks remain an ever-present threat, and more dynamic sectors compete for scarce resources. Together, these factors create a ceiling for how much agriculture can contribute to long-term growth, no matter how well policies or investments are designed. Placed in context, these results sit between two long-running views in development thinking. The short-term gains echo classic theories like Johnston and Mellor's linkage model, which highlight how farming can spark broader economic activity. Yet the fact that these gains do not accumulate over time supports later research that emphasizes the need for structural transition toward other sectors. Interestingly, this pattern is similar to what Abu-Saleem *et al*. (2024) found for Jordan's service exports: sectors generate temporary bursts of growth but struggle to transform the overall economic trajectory on their own. All this points to the need for balanced, realistic policies. For short-term economic resilience, targeted agricultural support still matters especially programs that protect rural jobs and safeguard food security during economic downturns. But longer-term strategy must go further. Jordan can make the most of its farming sector through precision irrigation, climate-resilient crops, and value-added processing that stretches every drop of water. At the same time, a serious effort to diversify the economy is essential, investing in other areas like services, tourism, light manufacturing, and technology to create more durable engines of growth.

This combined approach acknowledges farming's real value without leaning on it too heavily.

While this study offers important insights, it also leaves questions open. The statistical tests ($p = 0.018$) hint that the model might be missing pieces perhaps certain variables we did not include shape how agriculture connects to growth, or maybe the link is more complicated than simple numbers suggest. This gap is not a flaw but an invitation to look deeper. Future research could build on this by examining factors like how technology adoption varies across regions or how trade ties shape local markets. It would be useful to test whether agriculture's impact shifts when specific thresholds are crossed or to distinguish between types of farming fruit orchards in the Jordan Valley likely contribute differently than sheep herding in the Badia. Comparing Jordan's experience with similar countries could also show whether this pattern is unique or part of a broader regional trend. Perhaps most importantly, future studies should move beyond GDP alone to look at real-world impacts: how farming shapes income gaps, affects the environment in a water-scarce nation, and influences food security as Jordan's reliance on imports grows. These lines of inquiry would bring us closer to understanding not just whether agriculture matters for development, but how, when, and for whom it matters most knowledge that could make future agricultural policies both more effective and fairer for the people who rely on them.

Conclusion and Recommendations

After analysing three decades of data, a clear pattern emerges: Agriculture gives Jordan's economy a noticeable yet temporary boost. When farming output rises by 1%, GDP typically grows by about 0.08% in the short term not transformative, but meaningful for rural communities. However, this effect fades over time, suggesting that while farming can help stabilize the economy, it cannot single-handedly drive long-term prosperity in Jordan's arid environment. These findings point toward practical, balanced policies that acknowledge agriculture's real but limited economic role. First, support for farmers should focus on resilience helping them withstand economic shocks and climate extremes through targeted assistance rather than blanket subsidies. Second, with water growing ever scarcer, investments in efficient irrigation and drought-resistant crops are not just good economics they are essential for survival. Third, Jordan should develop higher-value agricultural products that make every drop of water count, whether premium olive oils or specialty crops for export markets. But agriculture alone cannot carry Jordan's economic future. The most effective approach will combine smart farming policies with investments in other sectors tourism, light manufacturing, and technology that can deliver more sustainable growth. At the same time, we shouldn't overlook farming's deeper value in maintaining food security and preserving rural ways of life that are part of Jordan's heritage. The path forward requires nuance: neither abandoning agriculture nor relying on it too heavily, but thoughtfully integrating it into a diversified economic strategy. Future research should track how these policies play out in practice which water-saving techniques prove most effective, which value-added products succeed in the market, and how rural communities adapt to changing conditions. By combining robust data with on-the-ground realities, Jordan can develop an approach to economic development that is as practical as it is principled.

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Novelty Statement

This study contributes to the existing literature on agriculture and economic development by providing a nuanced analysis of Jordan's unique context. Unlike previous research that often treats agriculture's impact as uniformly positive or negative, this study reveals a temporal dichotomy: agriculture significantly boosts short-term economic growth but fails to sustain long-term growth. The application of the ARDL bounds testing approach to Jordan's data from 1990 to 2021 offers robust empirical evidence, addressing gaps in regional studies that have overlooked the interplay of water scarcity, limited arable land, and sectoral integration. Additionally, the study challenges conventional growth models by highlighting structural barriers that prevent agriculture from being a long-term growth driver, thereby advocating for diversified economic strategies tailored to arid economies.

Author's Contribution

Suleiman Ibrahim Mohammad: Conceptualization, methodology, formal analysis, writing original draft,

supervision.

Khaled Mohammed Al-Sawaie: Data curation, validation, writing review and editing.

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Nidal Ali Abbas: Formal analysis, writing review and editing.

Mohammad Faleh Ahmmad Hunitie: Data collection, project administration.

Anber Abraheem Mohammad: Writing review and editing, funding acquisition.

All authors contributed to the interpretation of results and approved the final manuscript.

Generative AI and AI-assisted technology statement

The authors declare that no generative AI or AI-assisted technologies were used in the preparation, analysis, writing, or editing of this manuscript. All research design, data collection, analysis, and interpretation were conducted solely by the authors.

Conflict of interest

The authors have declared no conflict of interest regarding the publication of this manuscript.

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