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Dynamic Responses of Inflation, Agricultural Production, and Terms of Trade to Oil Price Fluctuations in Kazakhstan: An Structural VAR Approach

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ABSTRACT

The influence of oil price fluctuations on Kazakhstan's inflation, agricultural production, and terms of trade over 2000-2024 is examined using annual observations for 2001-2024. A Structural VAR with recursive long-run (F-triangular) identification is estimated, and a VAR(4) specification is selected by LR, FPE, AIC, and HQ criteria. Results indicate moderate inflation persistence and pronounced agricultural inertia, while net trade dynamics are primarily autoregressive. Structural estimates and impulse responses show that positive oil price shocks raise inflation in the short run and temporarily depress agricultural production, with effects fading over the medium term; trade shocks briefly lift inflation, whereas inflation shocks modestly weaken net trade. Variance decompositions confirm that inflation is predominantly self-driven (≈85.5% at a ten-period horizon) but increasingly influenced by oil and supply-side conditions; agricultural output displays rising sensitivity to inflation and trade signals; oil prices remain largely exogenous with limited domestic feedback. Policy implications include stronger fiscal-monetary coordination to contain oil-induced inflation, productivity and energy-efficiency gains in agriculture to cushion cost shocks, and export diversification to mitigate terms-of-trade volatility and enhance macroeconomic resilience.

Keywords: Oil Price Shocks, Inflation, Agricultural Production, Terms of Trade, Kazakhstan, Structural VAR
JEL Classifications: C32, E31, F41, Q43

1. INTRODUCTION

Kazakhstan's macroeconomic performance is closely tied to movements in global energy markets because hydrocarbons anchor both fiscal capacity and the external sector. Since the early 2000s, swings in international oil prices have shaped government revenues, exchange rate dynamics, production costs, and inflation, while indirectly influencing agricultural output and overall trade performance. This reliance on a single commodity exposes the economy to external shocks, making it essential to understand how oil price volatility propagates through domestic prices, the real sector, and the terms of trade in order to assess resilience and long-term stability.

In resource-dependent economies, oil price shocks typically operate through intertwined supply - and demand-side channels. Energy disturbances can amplify inflation and output variability, especially where diversification is limited (Blanchard and Galí, 2007; Brini and Jemmali, 2016). For Kazakhstan, these mechanisms are particularly salient: oil market volatility affects both fiscal outcomes and competitiveness via input costs and relative prices, reinforcing the link between external shocks and domestic macroeconomic adjustments.

Agriculture remains strategically important for food security, rural employment, and regional development, yet it is acutely exposed to energy-related cost pressures. Evidence for Kazakhstan documents

asymmetric responses of agricultural and industrial output to oil price movements, pointing to sectoral rigidities and the role of energy inputs (Baisholanova et al., 2025; Abdibekov et al., 2024). Similar patterns are observed in other emerging economies, where oil shocks produce mixed inflationary and output effects through concurrent cost-push and demand mechanisms (Souza and Mattos, 2022).

Trade is a further conduit through which oil price dynamics affect the domestic economy. Among Turkic economies, energy production and foreign trade jointly influence growth, illustrating how export concentration heightens exposure to global demand and price cycles (Ibyzhanova et al., 2024). In addition, responses to oil shocks in emerging markets are often regime-dependent, shifting with exchange-rate flexibility, policy credibility, and structural diversification (Togonidze and Kočenda, 2022). For Kazakhstan, higher oil prices can temporarily strengthen the trade balance via export revenues, but persistent volatility can erode competitiveness and intensify inflationary spillovers.

Against this backdrop, a focused examination of how inflation, agricultural production, and trade performance respond to oil price fluctuations is crucial for gauging Kazakhstan's macroeconomic stability. While prior studies frequently analyze isolated pairs of relationships - such as energy-growth or oil-inflation - there remains limited evidence on their joint, time-varying interactions within a unified macroeconomic setting. This study addresses that gap by investigating the interconnected responses of inflation, agriculture, and terms of trade to oil price shocks in Kazakhstan's resource-dependent economy, offering policy-relevant insights into the channels through which global energy volatility shapes domestic stability and long-run performance.

2. LITERATURE REVIEW

A substantial body of research examines how oil price fluctuations pass through open-economy channels-prices, costs, and external balances - to shape macroeconomic outcomes in resource-dependent settings. In this review, we emphasize the most policy-relevant empirical contributions for Kazakhstan, focusing on how inflation, agricultural production, and terms of trade respond dynamically to oil shocks and positioning these insights to inform our SVAR-based analysis.

Wei et al. (2024) investigated whether exogenous oil supply shocks spill over into global agricultural commodity prices, highlighting biofuels as a central conduit. Using a carefully identified structural setup, they showed that adverse supply shocks systematically raise food prices, with stronger effects for crops tied to biofuel demand. The paper documents heterogeneous pass-through across commodities and horizons, underscoring how oil-agriculture linkages heighten food-price inflation risks and complicate stabilization policies in open economies exposed to energy-driven cost shocks.

Gazzani et al. (2024) introduced a real-time identification of oil price shocks at daily frequency within an SVAR framework. By aligning shock dating with high-frequency information, they demonstrated that real-time decompositions may diverge materially from ex-post monthly assessments, especially near regime shifts. The approach enhances timeliness in evaluating inflationary pressure and output risks, offering policymakers earlier signals about the nature of ongoing oil shocks and their likely macro footprints relative to traditional, lower-frequency methods.

Kilian et al. (2024) modeled geopolitical oil price risk within a macro framework that separates downside risk from central tendencies. They showed that time-varying geopolitical risk raises macro uncertainty, amplifies inflation responses to oil shocks, and dampens real activity via precautionary behavior. The analysis stresses the importance of risk-sensitive communication and policy credibility, as risk-driven shocks propagate more forcefully than standard supply-demand disturbances, with pronounced implications for inflation expectations and financial conditions.

Baumeister and Hamilton (2019) revisited the structural interpretation of oil price movements under incomplete identification in VARs. They argued that earlier work understated the role of supply disruptions in price spikes and macro effects. Re-estimating with refined identification, they found larger medium-run real-activity impacts from supply shocks than commonly assumed. Their results warn against attribution bias in decomposing oil shocks and motivate rigorous identification when mapping oil dynamics into inflation and output responses.

Jo (2014) examined oil price uncertainty shocks-distinct from level shocks-using a VAR with stochastic volatility-in-mean. The study found that heightened uncertainty depresses global industrial production and trade through precautionary demand and financial channels. Crucially, uncertainty shocks display dynamics not captured by standard price innovations, revealing an expectations-driven mechanism that can aggravate inflation-output trade-offs and underscoring the need to monitor volatility alongside price levels.

Valenti et al. (2023) estimated a weekly structural VAR of the U.S. crude oil market using Bayesian set identification to allow high-frequency inference on shock types. The authors reported time-varying contributions of supply, demand, and risk shocks, improving short-horizon assessments of inflation pressure and real activity. The weekly framework refines nowcasts relative to monthly models, particularly during rapid repricing episodes, thereby strengthening real-time policy analysis and communication.

Taghizadeh-Hesary et al. (2019) analyzed trade linkages as transmission channels of oil price fluctuations across open economies. Drawing on cross-country evidence, they showed that oil shocks affect terms of trade via monetary and exchange-rate mechanisms, with stronger and more persistent effects in less diversified exporters. The findings emphasize how export concentration magnifies external price pass-through into domestic inflation and competitiveness, and how structural diversification can mitigate oil-driven volatility.

Beltrán et al. (2025) studied how global demand "news" shocks propagate to oil futures and emerging markets using a

proxy-SVAR identified around major labor announcements in the U.S. and euro area. Positive demand-news shocks lift oil prices and tighten external financing conditions in EMEs, amplifying domestic macro responses through oil-financial channels. The paper highlights the informational role of high-frequency news in shaping expectations, terms-of-trade movements, and inflation risks in resource-dependent economies.

Bhandari and Kim (2025) examined how OPEC-related supply disruptions and high-frequency oil "news" shocks affect U.S. CPI inflation using an IV-SVAR and disaggregated CPI data. They showed that both realized and news shocks raise headline and energy inflation, with heterogeneous pass-through across tradables and non-tradables. News shocks diffuse faster into core goods than services, revealing an expectations channel and underscoring the policy value of distinguishing shock types when managing near-term inflation pressures.

Akhmedov (2019) assessed Kazakhstan's macroeconomic responses to world oil price shocks within a VAR framework. The study documented strong sensitivity of growth, prices, and external indicators to oil movements, with faster post-2008 adjustment relative to earlier episodes-evidence of evolving transmission mechanisms and policy settings. Results point to simultaneous income and cost-push channels, highlighting exchange-rate and fiscal spillovers and motivating country-specific analysis where export concentration and terms-of-trade volatility shape inflation and real activity.

3. METHODS

To explore the dynamic interconnections among inflation, agricultural production, net trade, and oil prices in Kazakhstan, this study applies a Structural Vector Autoregression (SVAR) framework. Unlike the conventional VAR model, the SVAR approach incorporates theoretically grounded restrictions that enable the identification of structural shocks with clear economic interpretation (Sims, 1980; Lütkepohl, 2005). This method is particularly appropriate for resource-dependent economies like Kazakhstan, as it captures both the immediate and long-run mechanisms through which external shocks - such as fluctuations in oil prices - influence domestic economic variables.

The reduced-form VAR(p) model is specified as:

$$y_t = c + \sum_{i=1}^{p} A_i y_{t-i} + u_t, u_t \sim (0, \Sigma_u) \quad (1)$$

Where y_t is the $k \times 1$ vector of endogenous variables, A_i are coefficient matrices, and u_t represents the reduced-form residuals. To recover the underlying structural relations, the model can be rewritten in its structural form as:

$$A_0 y_t = c + \sum_{i=1}^{p} A_i^* y_{t-i} + B\varepsilon_t, \ \varepsilon_t \sim (0, I) \quad (2)$$

where A_0 denotes contemporaneous relationships among variables, B is a diagonal matrix linking structural shocks to reduced-form residuals, and ε_t represents orthogonal structural innovations.

Identification of structural shocks requires placing k(k-1)/2 restrictions on A_0 or on the long-run multipliers of the system. This study employs a recursive long-run identification (F-triangular restriction). Accordingly, the long-run multiplier matrix $F = \Psi(1)$ is constrained to a lower-triangular structure:

$$\Psi(1) = \begin{bmatrix} f_{11} & 0 & 0 & 0 \\ f_{21} & f_{22} & 0 & 0 \\ f_{31} & f_{32} & f_{33} & 0 \\ f_{41} & f_{42} & f_{43} & f_{44} \end{bmatrix} \quad (3)$$

This structure assumes the recursive ordering oil prices→net trade→agricultural production→inflation, consistent with Kazakhstan's economic characteristics. Oil prices are considered the most exogenous variable, influencing trade, production, and inflation in the long run, while inflation is the most endogenous, reflecting accumulated responses to shocks from the real and external sectors. Trade and agricultural production act as transmission channels, mediating the impact of oil price variations on domestic price dynamics.

The estimation process is conducted in two main steps. First, the optimal lag length for the reduced-form VAR is determined using multiple information criteria, including LR, FPE, AIC, HQ, and SC, ensuring both model parsimony and predictive adequacy. Second, structural parameters are estimated through maximum-likelihood procedures under the imposed recursive restrictions. Following estimation, Impulse Response Functions (IRFs) and Forecast Error Variance Decompositions (FEVDs) are derived. The IRFs illustrate how each variable responds over time to a one-standard-deviation structural shock, while the FEVDs quantify the relative contribution of each structural shock to the forecast variance of each variable, providing insight into both short- and long-term interactions (Sims and Zha, 1999).

All series were examined for stationarity using the Augmented Dickey-Fuller (ADF) test, confirming that inflation is integrated of order zero, I(0), while agricultural production, net trade, and oil prices are integrated of order one, I(1). The combination of I(0) and I(1) variables supports the SVAR framework, which maintains long-run dynamics without the need for differencing. Diagnostic checks for stability, autocorrelation, and heteroskedasticity validate the robustness of the model. Consequently, this methodology provides a rigorous and theoretically consistent approach to analyzing how external oil price shocks transmit through Kazakhstan's trade and agricultural sectors to shape domestic inflationary trends.

4. FINDINGS

This study examines how inflation, agricultural production, trade performance, and oil prices interact and influence each other in Kazakhstan. Inflation, measured by the GDP deflator, serves as a key indicator of overall price stability and economic health. The agricultural production index reflects the development and resilience of the agricultural sector, which remains essential

for Kazakhstan's food security and rural economy. Net trade in goods and services, expressed in current USD, captures the country's external trade position and the effects of changing terms of trade. Finally, the Europe Brent Spot Price in USD per barrel represents global oil market trends that significantly shape Kazakhstan's export revenues and macroeconomic conditions. An overview of the key variables and their data sources is provided in Table 1. The analysis draws on annual data covering the years 2000-2024. The research data were collected from the following online sources https://data.worldbank.org, https://w3.unece.org/, and https://www.eia.gov (Access date: September 20, 2025).

Descriptive and distribution statistics of the study variables are presented in Table 2. Throughout the period under review, inflation (INFR) averaged 12.04%, agricultural production (AGPI) reached 4.48, net trade in goods and services (NTGS) recorded 22.84, and the mean oil price (OPRC) was 4.10. The Jarque-Bera test results show that all variables, except NTGS, exhibit normal distribution patterns. The minor deviation observed in NTGS is not considered problematic, as such fluctuations are common in open, resource-dependent economies like Kazakhstan and remain within acceptable limits for the SVAR analysis.

The results of the ADF unit root test, shown in Table 3, highlight the stationarity properties of the variables used in this study.

Table 1: Variable descriptions and sources

Variable	Short Description	Source
INFR	Inflation, GDP deflator (annual %)	https://data.worldbank.org
AGPI	Agricultural production index	https://w3.unece.org
NTGS	Net trade in goods and services, (BoP), current USD	https://data.worldbank.org
OPRC	Europe Brent Spot Price FOB Dollars per Barrel	https://www.eia.gov

Table 2: Descriptive statistics results

Statistics	INFR	AGPI	NTGS	OPRC
Mean	12.03890	4.476629	22.83847	4.103550
Median	11.21111	4.535820	23.40662	4.176846
Maximum	21.55171	4.862522	24.46279	4.715190
Minimum	1.823550	3.925926	18.84735	3.197039
Standard Deviation	6.010501	0.268393	1.407928	0.472811
Skewness	0.101370	−0.264404	−1.249497	−0.545036
Kurtosis	1.764227	1.784387	3.936246	2.233082
Jarque-Bera	1.633581	1.830577	7.418257	1.850438
Probability	0.441847	0.400401	0.024499	0.396445

Table 3: ADF unit root test findings of variables

Variable	Level		1st Difference	
	t-statistics	Probability	t-statistics	Probability
INFR	−3.963394	0.0060	−5.627490	0.0002
AGPI	−1.153613	0.6760	−14.09324	0.0000
NTGS	−2.042583	0.2680	−5.160510	0.0004
OPRC	−1.925520	0.3157	−4.256918	0.0034
Test critical values:				
1% level	−3.737853		−3.769597	
5% level	−2.991878		−3.004861	
10% level	−2.635542		−2.642242	

Inflation (INFR) is found to be stationary at level, as indicated by its significant t-statistic (−3.963394) and P-value (0.0060), confirming it as I(0). In contrast, agricultural production (AGPI), net trade in goods and services (NTGS), and oil price (OPRC) are non-stationary at their levels but become stationary after first differencing, with all P-values falling below 0.05, indicating that they are integrated of order one, I(1). The mixture of I(0) and I(1) variables confirms that the data meet the necessary conditions for SVAR analysis. This pattern is consistent with the characteristics of emerging economies such as Kazakhstan, where both domestic dynamics and external market factors shape long-term macroeconomic behavior.

The results of the VAR lag length selection criteria, demonstrated in Table 4, provide the basis for defining the optimal dynamic specification of the model. Several widely accepted statistical measures were employed - namely, the Likelihood Ratio (LR) test, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan–Quinn Criterion (HQ) - to ensure a balanced evaluation of model accuracy and complexity. The findings indicate that four out of five criteria, including LR, FPE, AIC, and HQ, consistently favor lag 4 as the most appropriate specification. At this lag, the LR statistic attains its highest significant value, while FPE and AIC reach their minimums, suggesting improved predictive strength and an overall better model fit. Although the SC criterion prefers a shorter structure at lag 2, its conservative nature explains this difference.

The estimation results of the Vector Autoregression (VAR) model, indicated in Table 5, illustrate the dynamic relationships among inflation (INFR), agricultural production (AGPI), net trade in goods and services (NTGS), and oil prices (OPRC) in Kazakhstan. The findings reveal that inflation demonstrates a degree of persistence, with its first and second lags (0.187 and 0.452, respectively) exerting positive effects on current inflation. This suggests that past price movements continue to shape present inflationary dynamics. Moreover, lagged values of agricultural production and trade also display positive, though moderate, influences on inflation, indicating a connection between real-sector performance, external trade, and domestic price stability.

For agricultural production (AGPI), both lagged terms are significant and positive, with coefficients of 0.788 and 0.468, confirming a high level of inertia and continuity in Kazakhstan's agricultural output. The first lag of oil prices shows a mild negative effect (−0.104), implying that short-term increases in oil prices may temporarily raise production costs and slightly constrain agricultural output.

In the NTGS equation, trade performance is primarily driven by its own past values, as reflected in the significant positive coefficients for the first (0.553) and second (0.531) lags. This highlights the persistence of Kazakhstan's external trade balance and the structural stability of its export sector. Oil price dynamics further reinforce this relationship; as higher oil prices tend to enhance net trade through improved export revenues.

The OPRC equation also shows positive autoregressive effects, confirming the persistence of oil price movements over time. While

Table 4: Optimal lag length findings for the VAR model

Lag	LogL	LR: sequential modified LR test statistic (each test at 5% level)	FPE: Final Prediction Error	AIC: Akaike Information Criterion	SC: Schwarz Information Criterion	HQ: Hannan-Quinn Information Criterion
0	−75.60914	NA	0.023066	7.581823	7.780779	7.625001
1	−47.23705	43.23365	0.007367	6.403529	7.398312	6.619422
2	−19.61673	31.56609	0.002973	5.296831	7.087441	5.685439
3	−8.013793	8.840331	0.008225	5.715599	8.302036	6.276922
4	90.77448	37.63363*	1.68e-05*	−2.168998*	1.213265*	−1.434960*

*Indicates lag order selected by the criterion (each test at 5% level)

Table 5: Vector autoregression estimates

Variable	INFR	L_AGPI	L_NTGS	L_OPRC
INFR(−1)	0.187159	0.012534	0.039038	0.003699
	(0.41398)	(0.00512)	(0.06652)	(0.01841)
	[0.45209]	[2.44969]	[0.58688]	[0.20091]
INFR(−2)	0.019294	−0.013038	−0.006534	0.002610
	(0.27577)	(0.00341)	(0.04431)	(0.01226)
	[0.06996]	[−3.82537]	[−0.14745]	[0.21284]
L_AGPI(−1)	−11.03047	0.087524	−0.083713	−0.061051
	(8.98308)	(0.11102)	(1.44337)	(0.39950)
	[−1.22792]	[0.788330]	[−0.05800]	[−0.15282]
L_AGPI(−2)	3.265916	0.678003	1.085103	−0.023405
	(9.46886)	(0.11703)	(1.52143)	(0.42111)
	[0.34491]	[5.79349]	[0.71321]	[−0.05558]
L_NTGS(−1)	3.368118	−0.017251	0.553062	0.190525
	(3.24457)	(0.04010)	(0.52133)	(0.14430)
	[1.03808]	[−0.43019]	[1.06087]	[1.320038]
L_NTGS(−2)	−0.000280	0.104288	−0.149915	0.025853
	(3.30809)	(0.04089)	(0.53153)	(0.14712)
	[−8.5e-05]	[2.55072]	[−0.28207]	[0.17573]
L_OPRC(−1)	−14.08702	−0.104294	−0.285923	0.188661
	(11.9350)	(0.14751)	(1.91767)	(0.53078)
	[−1.18031]	[−0.70704]	[−0.14910]	[0.35544]
L_OPRC(−2)	1.981936	−0.082918	0.673964	−0.101120
	(10.4334)	(0.12895)	(1.67641)	(0.46401)
	[0.18996]	[−0.64303]	[0.40203]	[−0.21793]
C	17.27856	−0.098206	7.384991	−0.838652
	(44.5436)	(0.55053)	(7.15711)	(1.98099)
	[0.38790]	[−0.17839]	[1.03184]	[−0.42335]
R^2	0.264513	0.928802	0.554641	0.686121
Adjusted R^2	−0.155765	0.888118	0.300150	0.506761
Sum squared resid	613.3402	0.093689	15.83459	1.213092
S.E. equation	6.618914	0.081805	1.063505	0.294363
F-statistic	0.629375	22.82939	2.179415	3.825395
Log likelihood	−70.39498	30.65202	−28.34267	1.201113
Akaike AIC	6.903911	−1.882784	3.247189	0.678164
Schwarz SC	7.348235	−1.438461	3.691512	1.122488
Mean dependent	11.88650	4.512833	23.03979	4.175488
S.D. dependent	6.156755	0.244568	1.271268	0.419135
Determinant resis covariance (dof adj.)			0.001760	
Determinant resis covariance			0.000242	
Log likelihood			−34.76678	
Akaike information criterion			6.153633	
Schwarz criterion			7.930929	

the influence of inflation and trade on oil prices remains limited, the positive coefficients suggest moderate interconnectedness between domestic economic activity and external market conditions.

Overall, the diagnostic statistics validate the reliability of the model. The R^2 values range from 0.26 for inflation to 0.93 for agricultural production, indicating that the model captures the essential variation in each dependent variable. The F-statistics confirm overall model significance, and the relatively low values of the Akaike (AIC) and Schwarz (SC) criteria confirm the efficiency of the selected lag structure.

Table 6: Structural VAR estimates

Model	Coefficient	Standard error	z-statistic	Prob.
C (1)	6.223870	0.917660	6.782326	0.0000
C (2)	−0.176362	0.100717	−1.751074	0.0799
C (3)	0.913017	0.577252	1.581662	0.1137
C (4)	0.356215	0.194301	1.833310	0.0668
C (5)	0.466644	0.068803	6.782320	0.0000
C (6)	1.839419	0.491472	3.742669	0.0002
C (7)	0.519062	0.170697	3.040837	0.0024
C (8)	1.965653	0.289820	6.782317	0.0000
C (9)	0.719755	0.109629	6.565382	0.0000
C (10)	0.131911	0.019449	6.782331	0.0000

In summary, the VAR(4) model effectively captures Kazakhstan's key macroeconomic linkages. The results show that inflationary pressures are moderately persistent, agricultural output remains stable but sensitive to oil price shocks, and trade performance is strongly influenced by external energy market conditions. These interdependencies reflect the broader structural features of Kazakhstan's resource-based economy, where oil price fluctuations continue to play a central role in shaping both domestic and external economic dynamics.

The results of the Structural VAR (SVAR) estimation, shown in Table 6, reveal the long-run structural linkages among inflation, agricultural production, trade performance, and oil prices in Kazakhstan, based on the recursive long-run identification scheme (F triangular). The estimated coefficients demonstrate how structural shocks propagate through the economy, capturing both direct and indirect channels of transmission between key macroeconomic variables.

Several coefficients are highly significant, confirming the robustness of the model. Specifically, C(1), C(5), C(7), C(8), C(9), and C(10) are statistically significant at the 1% level, with z-statistics between 3.04 and 6.78, indicating strong and stable long-run relationships. The largest coefficient, C(1) = 6.223, suggests a dominant structural impact, most likely associated with oil price or inflationary shocks, which have historically shaped Kazakhstan's macroeconomic landscape. Similarly, the positive and significant parameters C(8) and C(9) reflect strong transmission effects, showing that oil price changes tend to

influence trade performance and inflation through both supply and demand channels.

Coefficients C(2) and C(4), while only moderately significant, still point to persistent though weaker interactions, consistent with gradual macroeconomic adjustments in resource-based economies. Overall, the SVAR results confirm that Kazakhstan's economy exhibits stable and interpretable long-run structural relationships. The recursive identification ensures model consistency and supports credible impulse response analysis. These findings highlight that oil price fluctuations continue to serve as a central driver of macroeconomic dynamics, influencing production, trade, and inflation over the long run.

The results of the Impulse Response Function (IRF) analysis, presented in Graph 1, illustrate how shocks to one variable influence others over time within Kazakhstan's macroeconomic framework. Using the Cholesky decomposition with Monte Carlo simulations (±2 S.E.), the analysis traces the dynamic interactions among inflation (INFR), agricultural production (AGPI), net trade (NTGS), and oil prices (OPRC).

The results show that a positive shock to oil prices (OPRC) leads to a clear short-term increase in inflation, followed by a gradual return to equilibrium after about five periods. This confirms Kazakhstan's exposure to global oil price fluctuations, where higher energy costs quickly translate into domestic inflationary pressure. In contrast, agricultural production (AGPI) initially reacts negatively to oil price shocks, reflecting increased input and energy costs, but the impact diminishes over time as the sector adjusts to new conditions.

A shock to net trade (NTGS) causes a temporary rise in inflation, indicating that trade fluctuations affect domestic prices through import and export cost channels. Inflation shocks, on the other hand, have a mild negative effect on net trade, likely reflecting reduced export competitiveness in the short run.

Both inflation and agricultural production exhibit persistence, responding most strongly to their own past shocks but stabilizing gradually over time.

Overall, the IRF findings demonstrate a clear interdependence among Kazakhstan's key macroeconomic variables, with oil prices acting as a major transmission mechanism. Shocks originating in the oil sector have both direct and indirect effects on inflation, trade, and agricultural output, but the economy tends to stabilize in the medium term, reflecting a pattern typical of resource-dependent emerging economies.

The results of the Forecast Error Variance Decomposition (FEVD), presented in Table 7, illustrate how structural shocks contribute

Graph 1: Impulse response function analysis

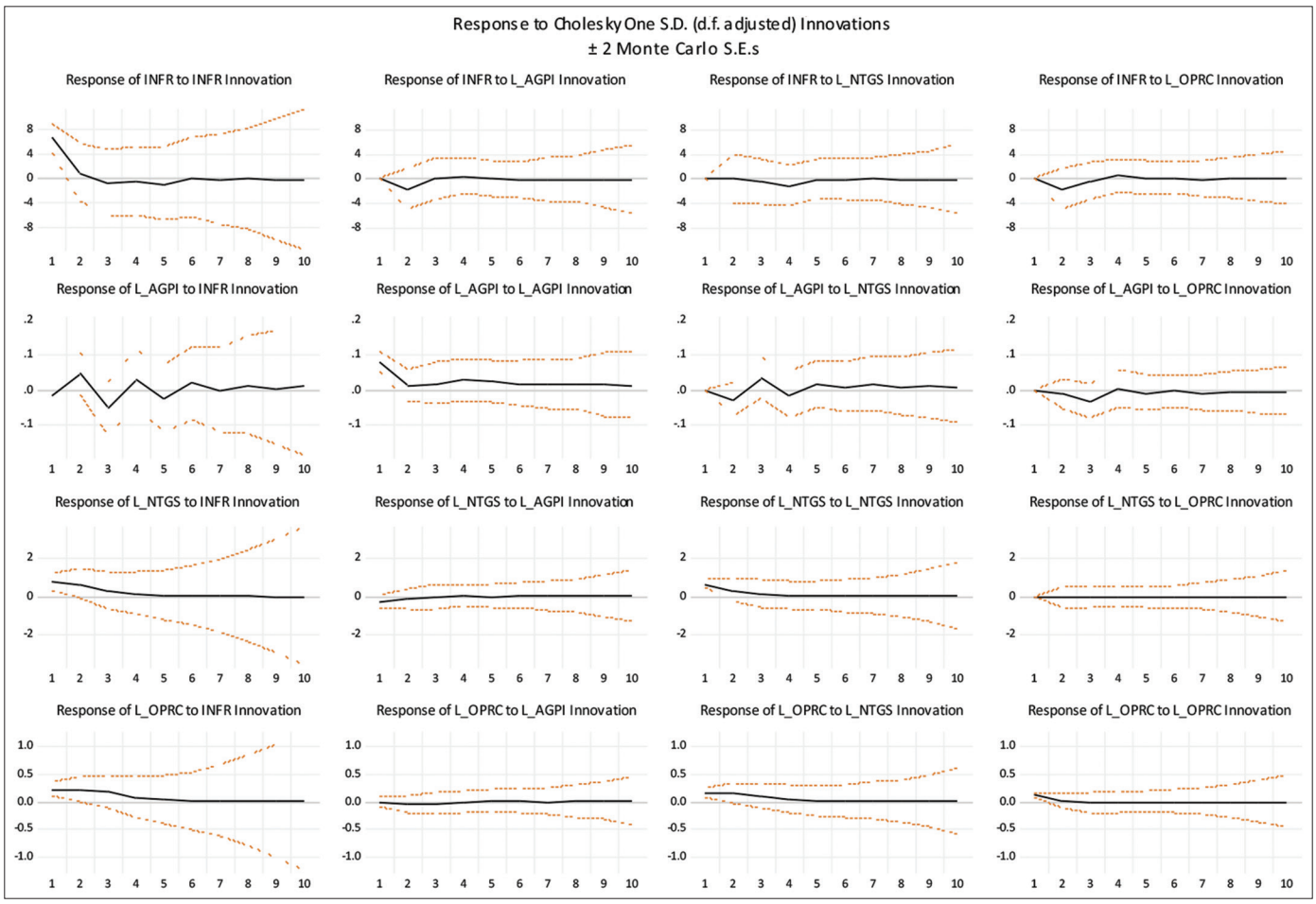

Table 7: Variance decomposition

Variance decomposition of INFR					
Period	Standard Error	INFR	L_AGPI	L_NTGS	L_OPRC
1	6.618914	100.0000	0.000000	0.000000	0.000000
2	7.101369	88.75936	5.725042	0.006489	5.509112
3	7.165476	88.22041	5.633510	0.468849	5.677231
4	7.297569	85.53925	5.813311	2.671842	5.975598
5	7.346127	85.70288	5.737606	2.642999	5.916512
6	7.351021	85.62501	5.816018	2.649399	5.909570
7	7.355437	85.59098	5.855750	2.646239	5.907031
8	7.357966	85.53241	5.858936	2.693309	5.915340
9	7.360302	85.51809	5.865291	2.701181	5.915437
10	7.361401	85.49364	5.879042	2.710146	5.917168
Variance decomposition of L_AGPI					
Period	Standard Error	INFR	L_AGPI	L_NTGS	L_OPRC
1	0.081805	4.063561	95.93644	0.000000	0.000000
2	0.098871	23.48900	67.05937	7.893846	1.557783
3	0.121863	32.95179	45.86749	12.58613	8.594588
4	0.128918	34.34138	45.46630	12.47119	7.721123
5	0.134652	35.00794	44.49566	12.93035	7.566047
6	0.137415	35.70848	44.34427	12.64253	7.304725
7	0.139398	34.69989	44.09777	13.62872	7.573619
8	0.141156	34.74525	44.09578	13.65923	7.499732
9	0.142441	34.20342	44.23769	14.01189	7.543997
10	0.143645	34.03238	44.29636	14.15347	7.517788
Variance decomposition of L_NTGS					
Period	Standard Error	INFR	L_AGPI	L_NTGS	L_OPRC
1	1.063505	54.84867	5.638605	39.51273	0.000000
2	1.288098	61.50007	5.122485	33.30846	0.068981
3	1.328507	62.61584	4.820667	32.49366	0.069838
4	1.342004	63.15527	4.748570	32.02544	0.070719
5	1.345936	63.12820	4.731624	32.05028	0.089889
6	1.348316	63.15795	4.732768	32.00591	0.103368
7	1.349178	63.11839	4.760883	32.00623	0.114498
8	1.349824	63.09045	4.796485	31.99457	0.118504
9	1.350315	63.05660	4.825218	31.99406	0.124118
10	1.350752	63.03080	4.849259	31.99102	0.128921
Variance decomposition of L_OPRC					
Period	Standard Error	INFR	L_AGPI	L_NTGS	L_OPRC
1	0.294363	55.83082	0.007226	28.00492	16.15703
2	0.402107	59.05557	1.772648	30.20508	8.966696
3	0.453454	61.86452	2.759393	28.13807	7.238018
4	0.463157	62.69604	2.758002	27.54088	7.005080
5	0.464606	62.89010	2.757438	27.38861	6.963853
6	0.464907	62.90156	2.766118	27.37738	6.954945
7	0.465133	62.90390	2.764951	27.37908	6.952070
8	0.465237	62.89826	2.766909	27.38109	6.953737
9	0.465286	62.89255	2.774608	27.37935	6.953492
10	0.465322	6288556	2.782445	27.37879	6.953201

to the forecast error variance of each variable across horizons, clarifying the propagation and persistence of shocks within Kazakhstan's macroeconomic framework.

Inflation in Kazakhstan is predominantly self-driven, with its own shocks explaining 100% of the variance in the first period and still around 85.5% by the tenth. Over time, the influence of agricultural production (5.9%) and oil prices (5.9%) becomes more visible, suggesting that both domestic supply conditions and external energy markets gradually shape inflationary dynamics. The contribution of net trade (2.7%) remains relatively minor, confirming that price fluctuations are primarily determined by internal monetary and cost pressures rather than trade-related factors.

Agricultural production initially demonstrates strong independence, with its own shocks accounting for 95.9% of variance in the first period. However, this influence declines to 44% by the tenth, showing rising interdependence with broader macroeconomic variables. The contribution of inflation (34%) increases significantly, indicating that general price movements and monetary conditions play an expanding role in shaping agricultural output. Meanwhile, net trade (14%) and oil prices (7.5%) also become more influential, reflecting the sector's growing exposure to export dynamics and energy-related production costs.

Net trade exhibits moderate persistence, with its own shocks explaining 54.8% initially and 63% by the tenth period. The share of inflation rises notably from 39% to 63%, emphasizing that domestic price movements and competitiveness are key drivers of trade performance. The effects of agricultural production (4-5%) and oil prices (below 1%) are smaller but gradually increase, suggesting indirect spillovers through production and export channels. Overall, Kazakhstan's trade position remains mainly shaped by inflationary dynamics and internal structural factors rather than external shocks.

Oil prices remain largely self-determined throughout the observed period, with their own shocks explaining 55.8% of the variance at the beginning and 62.9% by the tenth period. The role of inflation (28-31%) reflects a moderate feedback from domestic prices, implying limited but present interaction between internal demand and global energy markets. The effects of agricultural production and trade are marginal - each below 8% - consistent with Kazakhstan's status as a price taker in global oil markets. Thus, oil prices continue to act as a persistent and dominant external driver for other macroeconomic indicators.

The Variance Decomposition results reaffirm the central role of inflation and oil prices in Kazakhstan's macroeconomic framework. Inflation demonstrates strong persistence but becomes more sensitive to oil price fluctuations, while oil prices maintain stability with minimal domestic feedback. Agricultural production and net trade gradually integrate into this structure, reflecting deeper exposure to both internal and external forces. Overall, these findings underscore Kazakhstan's continued dependence on global oil dynamics and domestic price behavior as the main forces shaping long-term economic variability.

5. CONCLUSION AND RECOMMENDATIONS

This study examined the dynamic relationships among inflation, agricultural production, trade performance, and oil prices in Kazakhstan over the period 2000-2024 using a Structural VAR framework. The findings reveal that the Kazakh economy is

significantly shaped by global oil market dynamics and internal price behavior. Inflation exhibits strong persistence, largely driven by its own lagged effects but increasingly influenced by oil price fluctuations and supply-side pressures. Agricultural production remains a stable yet adaptive component of the economy, becoming more responsive to inflationary conditions, energy costs, and trade performance over time. Meanwhile, trade activity is closely linked to domestic price movements, emphasizing the importance of price stability for sustaining competitiveness and export performance. Oil prices continue to act as the dominant external driver, transmitting shocks through both income and cost channels that affect overall macroeconomic equilibrium.

The results highlight the interdependence of Kazakhstan's key economic sectors and the pivotal role of oil in shaping both domestic and external conditions. Based on these insights, several policy directions are recommended. First, greater coordination between fiscal and monetary authorities is essential to mitigate inflationary spillovers from global oil shocks. Second, strengthening agricultural productivity and energy efficiency would enhance resilience to cost fluctuations. Finally, diversifying export structures beyond hydrocarbons could reduce vulnerability to global price volatility and support more sustainable, broad-based economic growth. These steps would collectively improve macroeconomic stability and reinforce Kazakhstan's long-term economic resilience.

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