ERF 26th Annual Conference

# The Dynamic Interaction of Exchange Rates and International Trade Flows in the MENA Region: GARCH Analysis

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# Agenda

1. Introduction
2. Review of Literature
3. Recent Developments about MENA
4. Methodology
5. Sampling and Data Collection
6. Results
7. Interpretation of Findings
8. Conclusion

# 1. Introduction

- The role of exchange rates and their impacts on macroeconomic performance are subjects of debate in the economics literature and core areas of interest to economists, finance experts, and policy makers.

- Most economists agree that exchange rate stability enhances foreign investment, international trade, and economic growth.

- Research work on exchange rate volatility and international trade in MENA region is scanty. Despite the existence of an abundance of literature on international trade inflows, exchange rate, and growth, there is still a paucity of empirical studies on the dynamic interaction between these aforementioned variables.

# 2. Selected Literature Review on Exchange Rate and International Trade

- Exports are more sensitive to changes in REER levels than their volatility, and the effect is more pronounced in the agriculture sector exports. Huchet-Bourdon and Korinek (2011)
- High external debt could offset the effect on trade of exchange rate movements. Kearns and Patel (2016)
- Developing countries should be cautious about relaxation in the exchange rate and embrace of the floating exchange rate, which can be dangerous for international trading performance without a highly developed financial system. Héricourt and Poncet (2015)
- Shocks causing changes in the exchange rate can lead to changes in other macroeconomic variables, which could offset the impact of exchange rate on trade. Bacchetta and van Wincoop (2000)

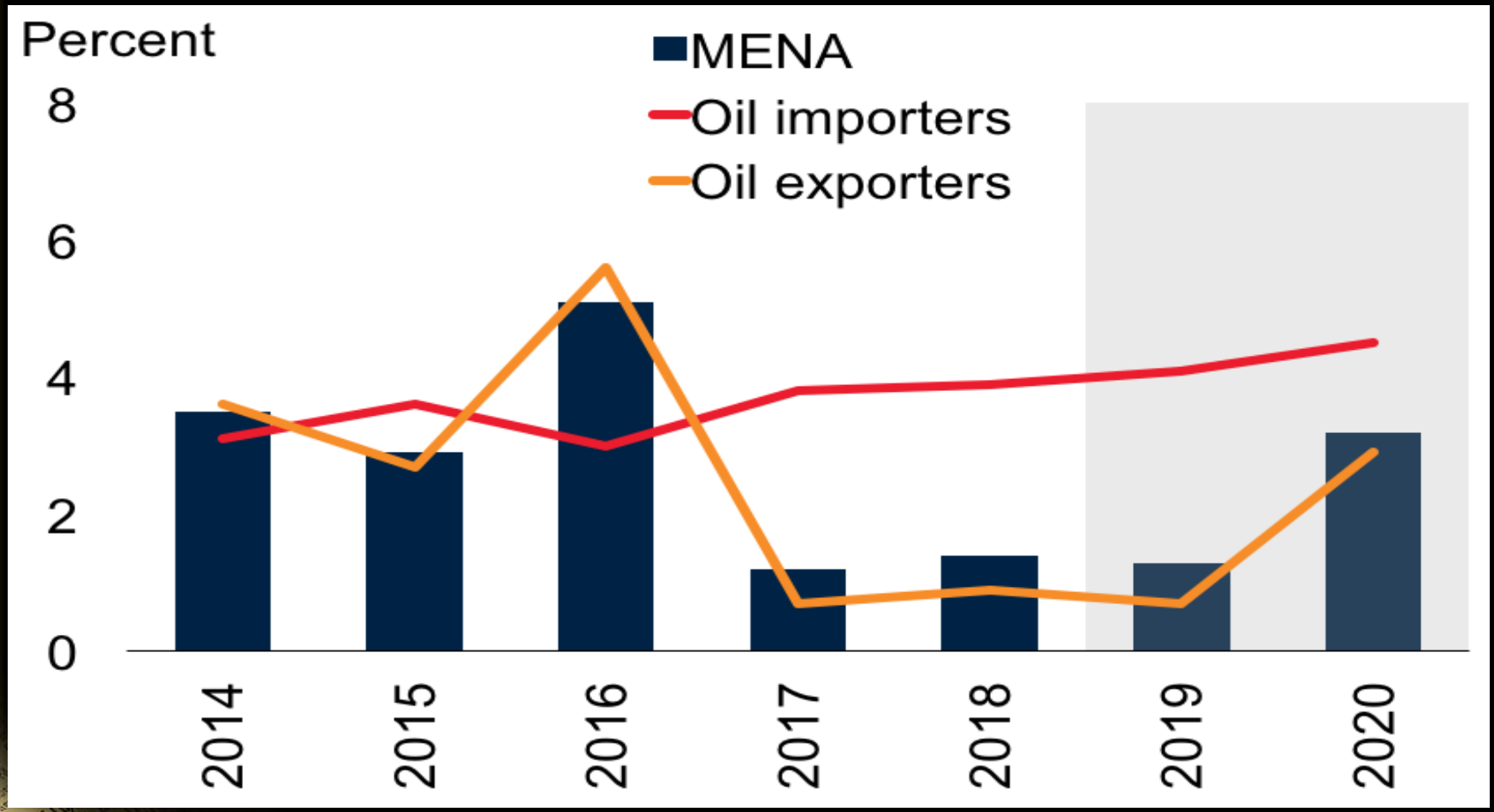
- Baek studied exports and imports of 71 products between the US and the Republic of Korea and concluded that exchange rate levels affect exports and imports between the Republic of Korea and the US. Baek (2012)

- The depreciation of the US dollar had led to exchange rate appreciation in developed Asia, and that this in turn might disrupt the complementary trade relationship between developed Asia and developing economies in the region. Thorbecke (2006)

- Currency depreciation led to lower export prices paid by foreigners and higher import prices, and these price changes in turn led to a rise in exports and a fall in imports. An increase in exports is higher when the exporting economy has a weaker financial system, especially in cases of banking crises. IMF (2015)

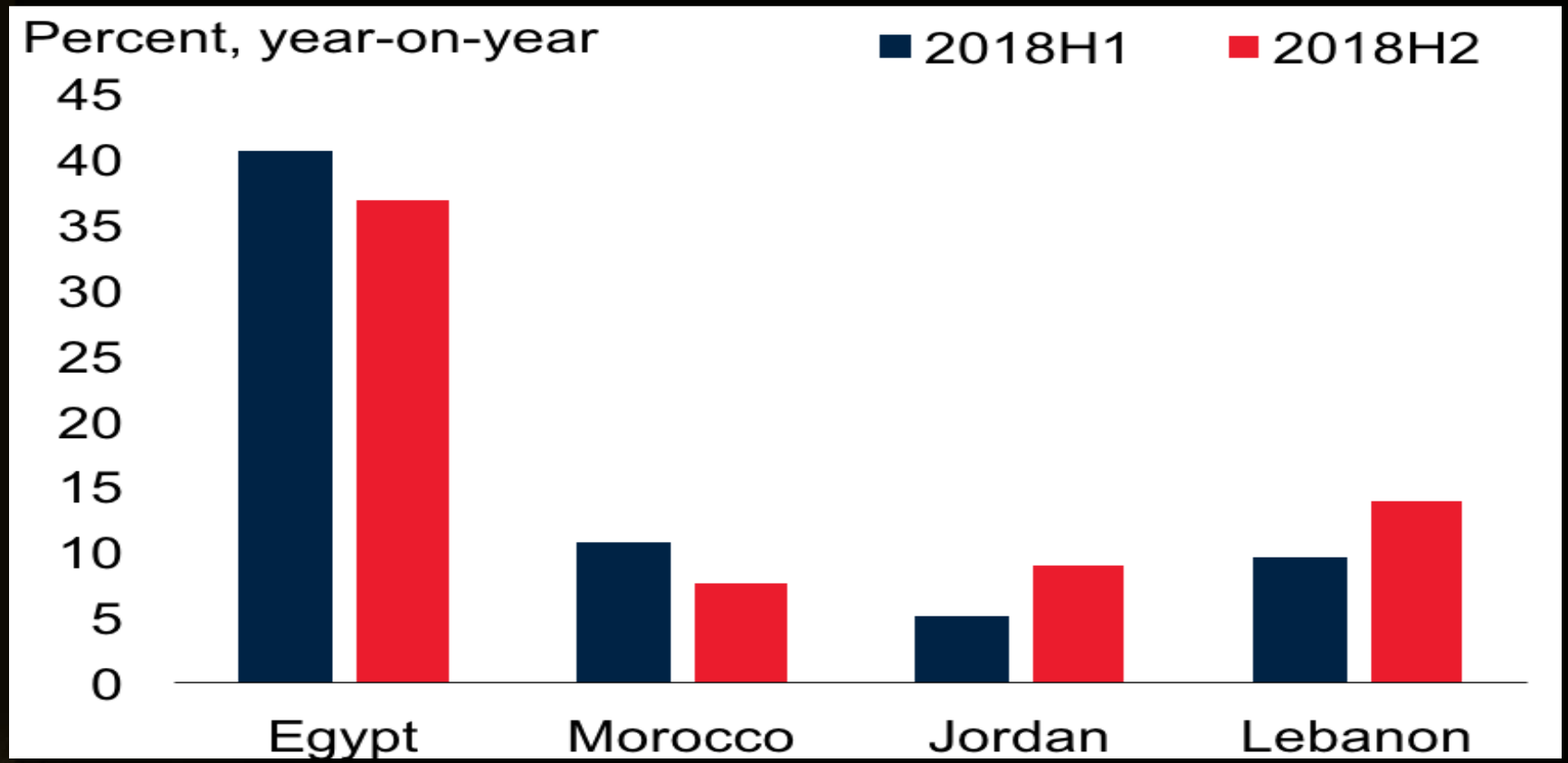
# 3. Recent Developments in the MENA Region

# GDP Growth



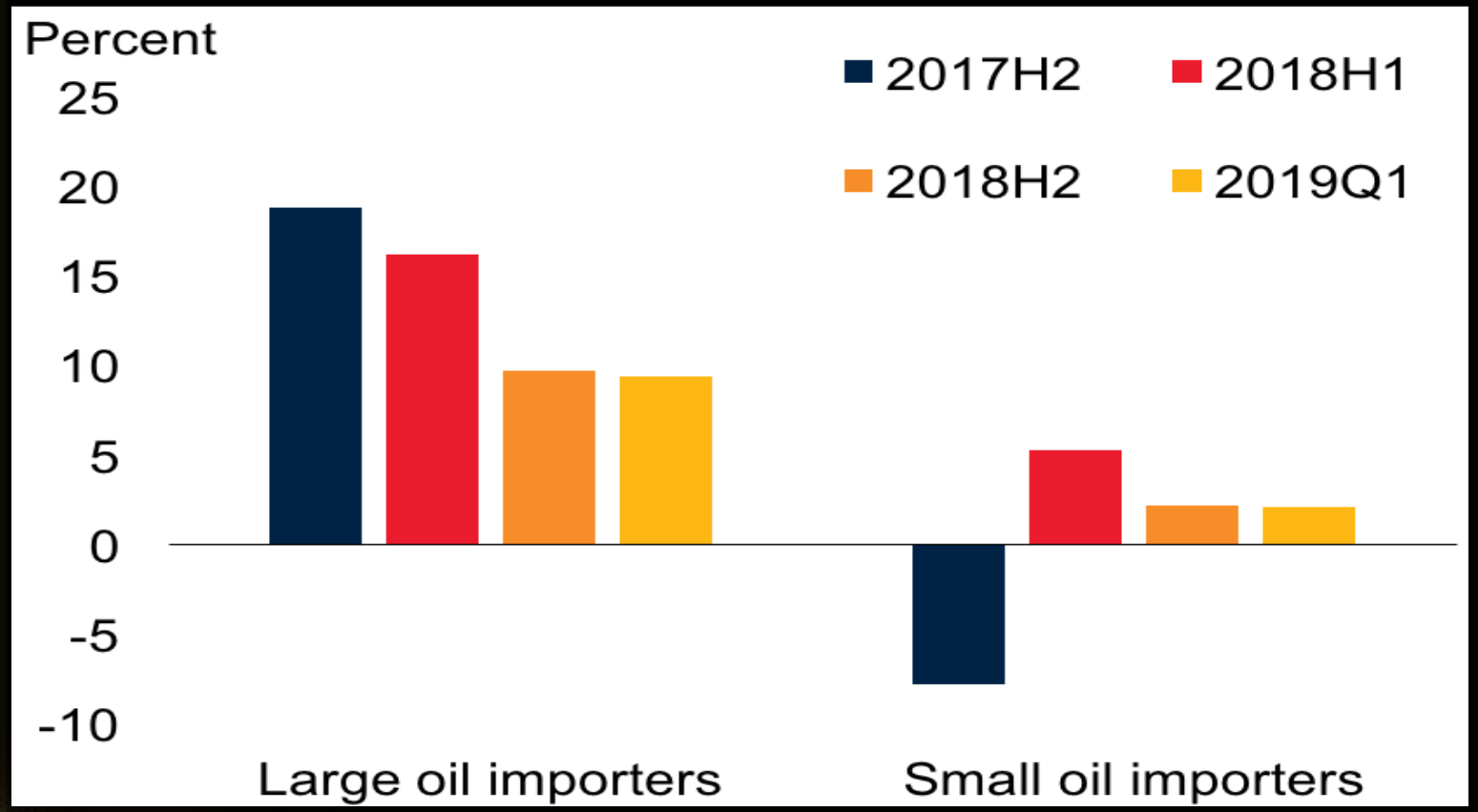

Sources: Haver Analytics, IMF, World Bank

# Tourism Growth



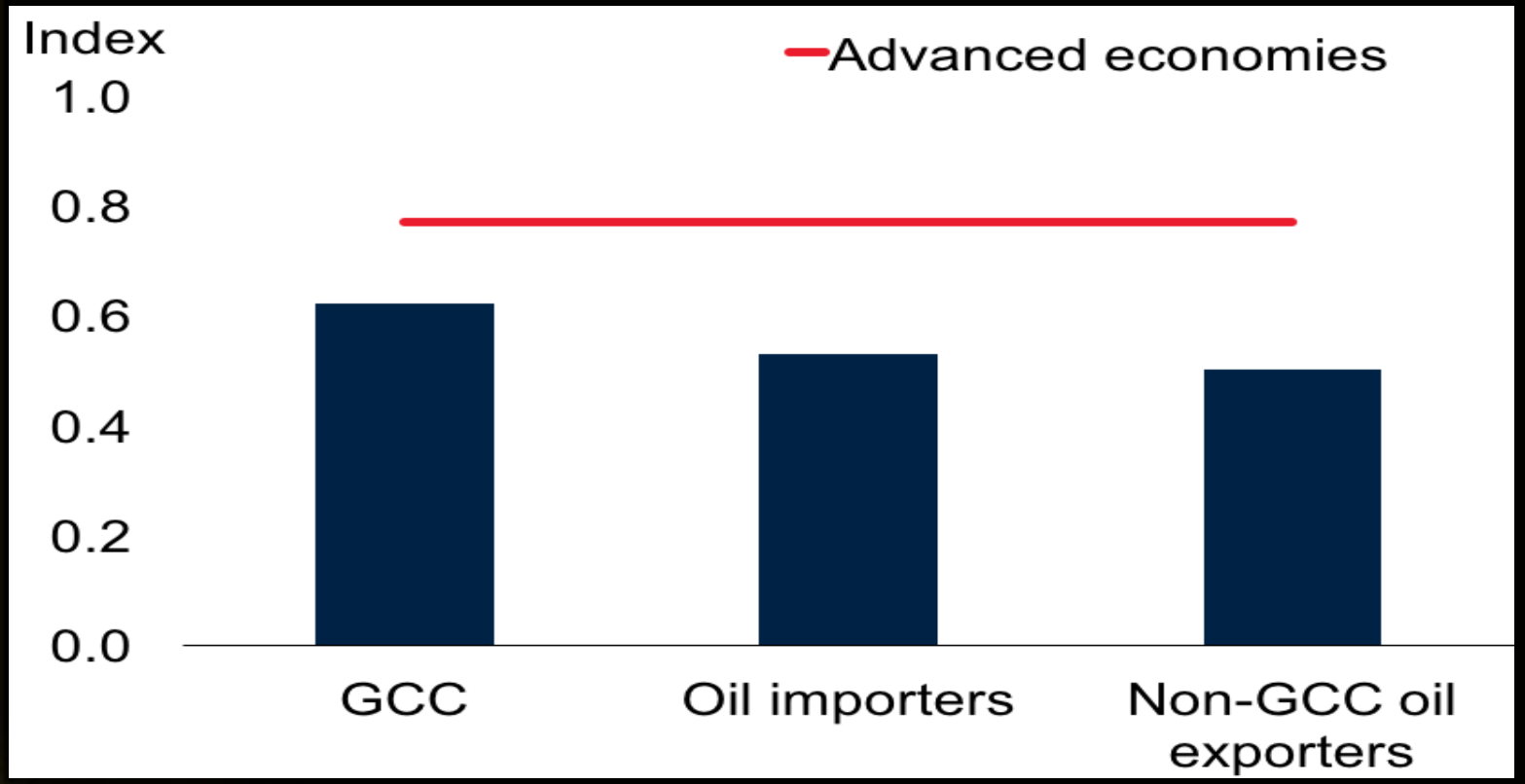

Sources: Haver Analytics, IMF, World Bank

# Good Exports Growth: Oil Importers



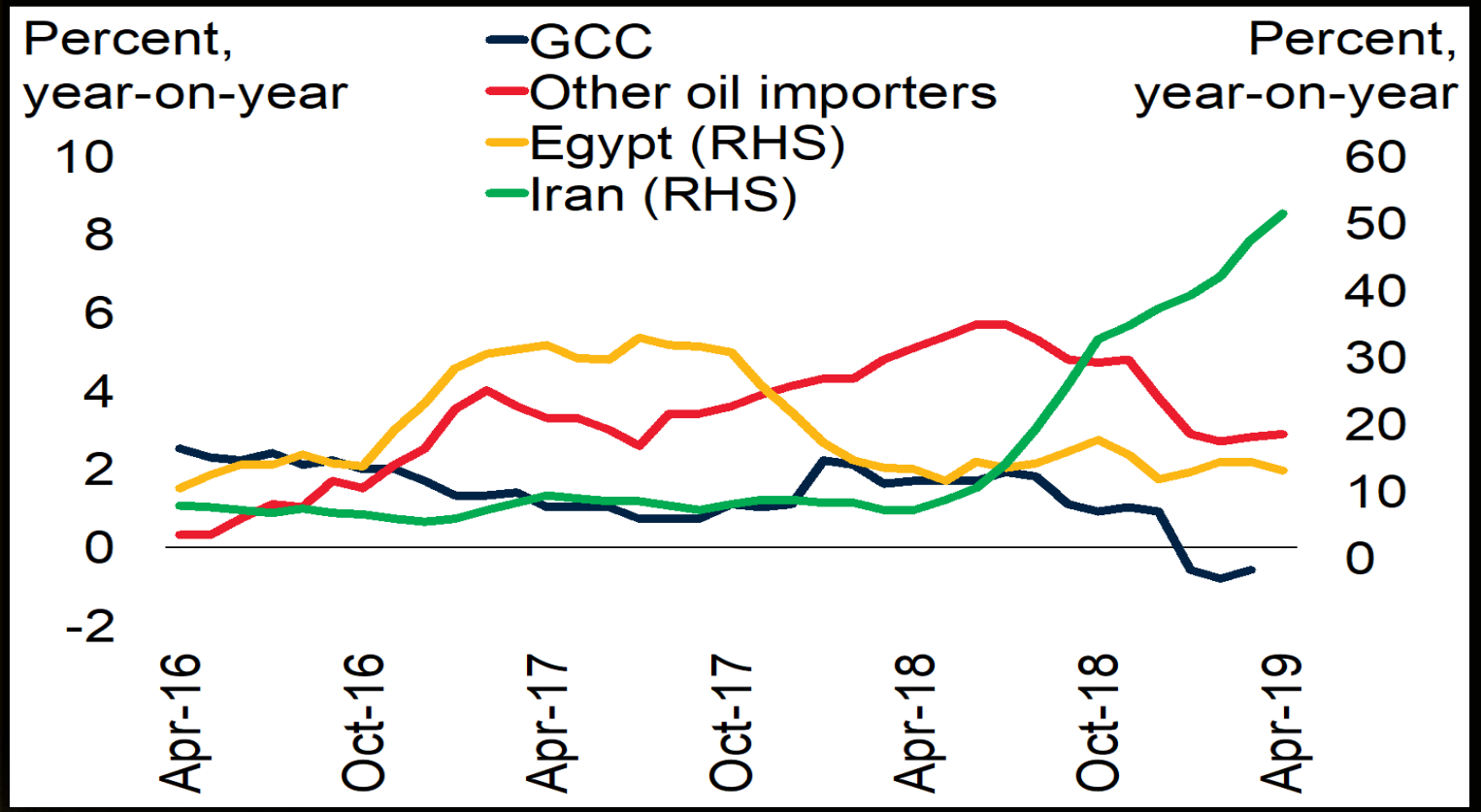

Sources: Haver Analytics, IMF, World Bank

# World Bank Human Capital Index



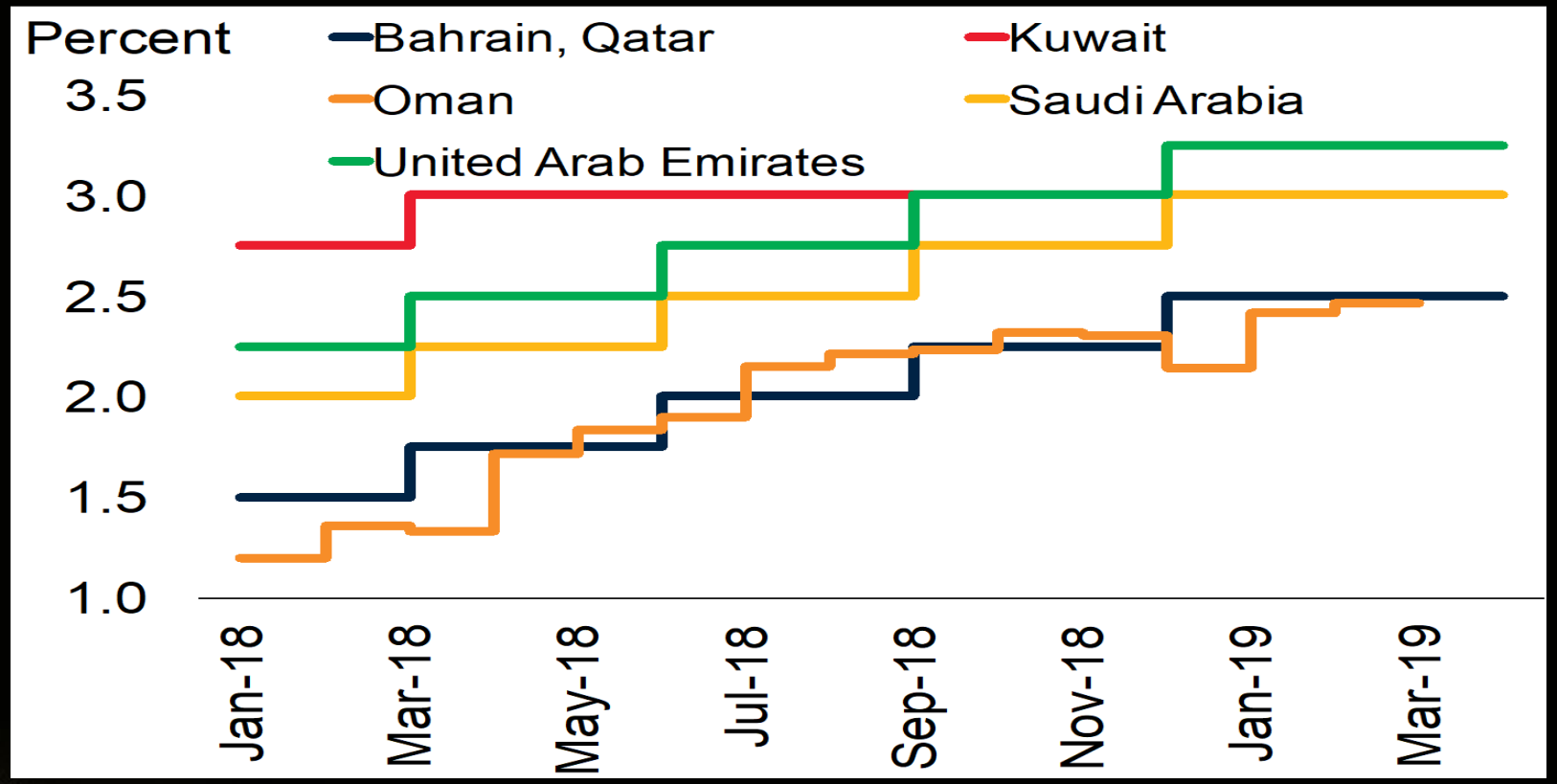

Sources: Haver Analytics, IMF, World Bank

# Inflation



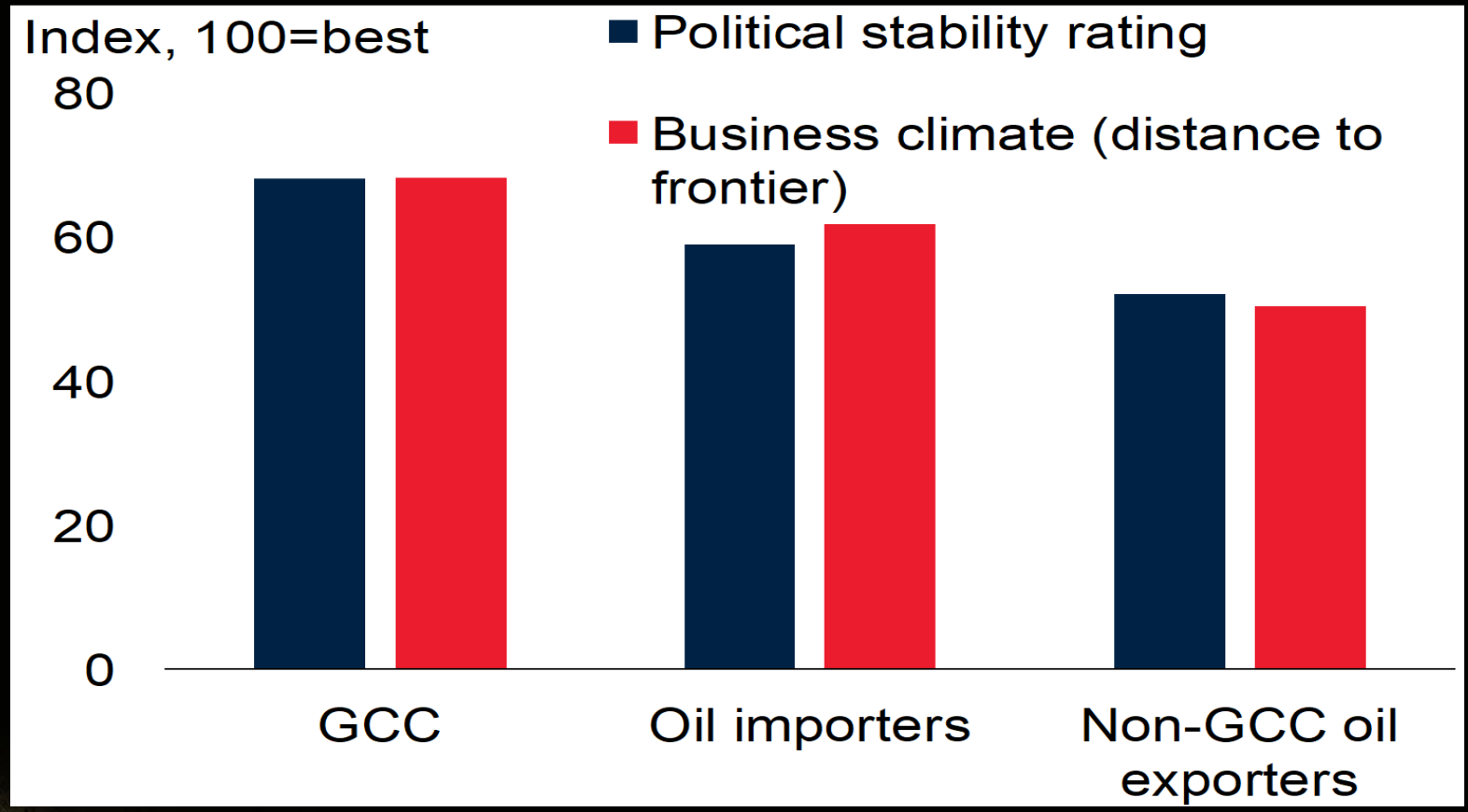

Sources: Haver Analytics, IMF, World Bank

# GCC Interest Rate



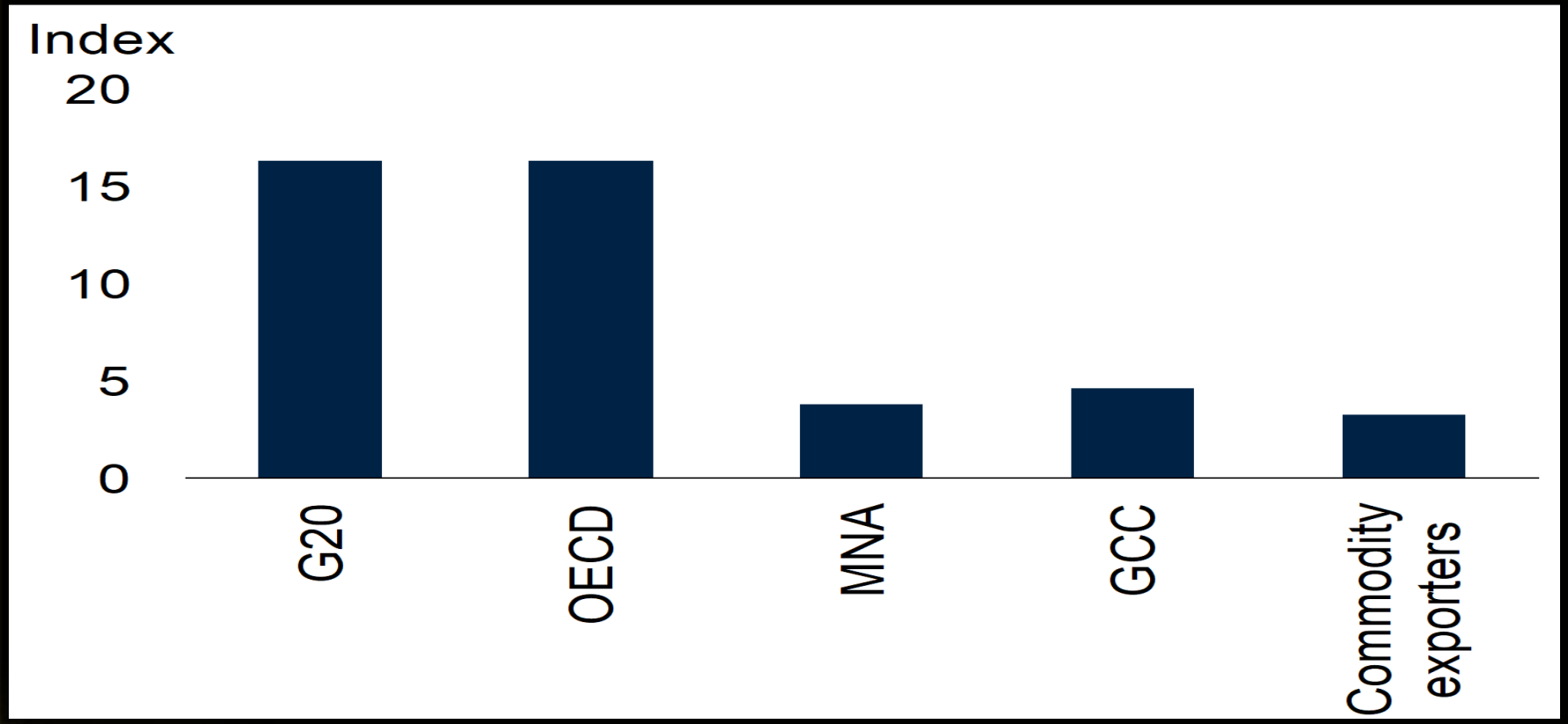

Sources: Haver Analytics, International Country Risk Guide, IMF, World Bank.

# Political Stability and Business Climate



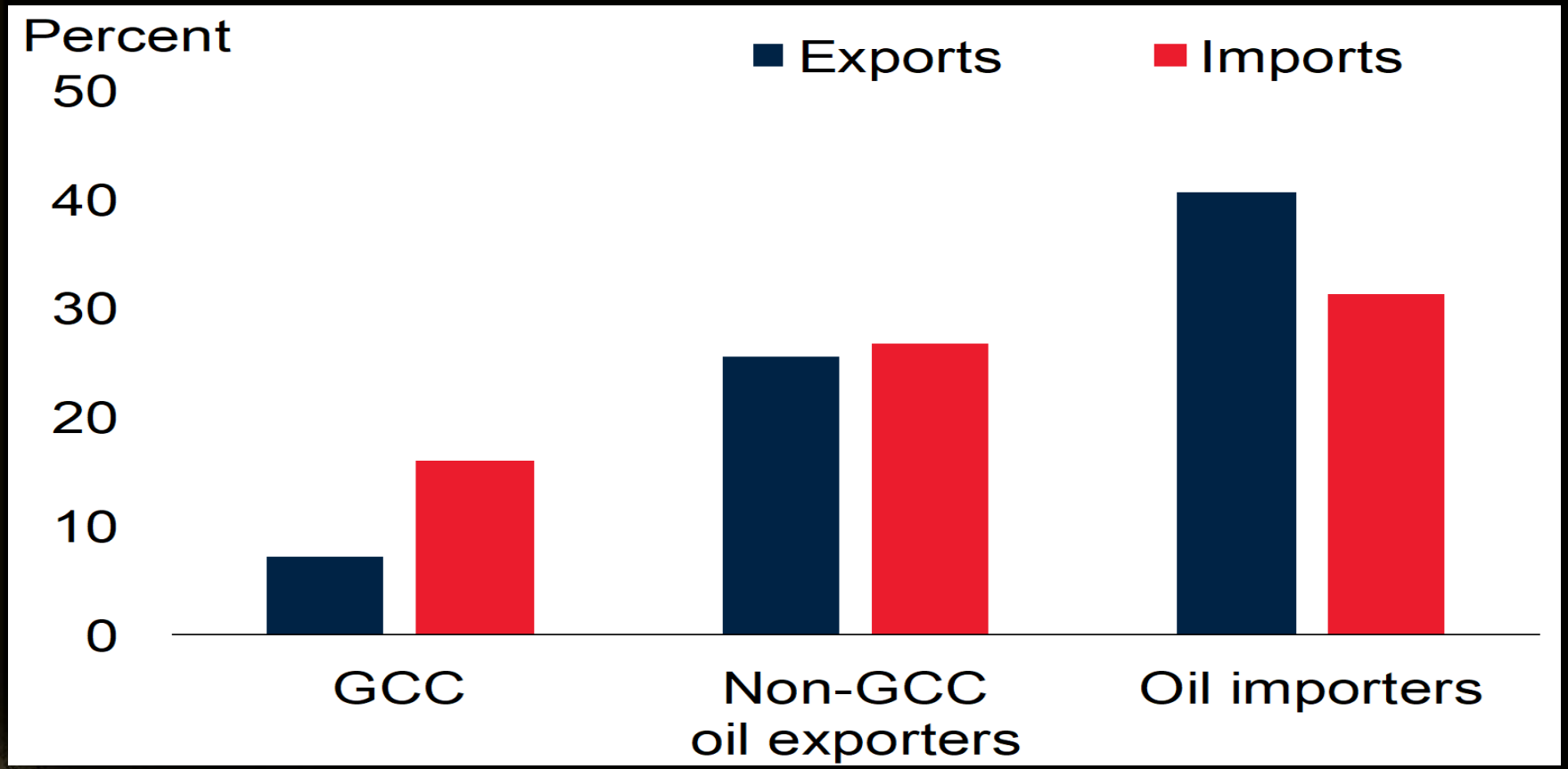

Sources: Haver Analytics, International Country Risk Guide, IMF, World Bank.

# Export Market Penetration Index




Sources: Haver Analytics, International Country Risk Guide, IMF, World Bank.

# Euro Area Trade Exposure




Sources: Haver Analytics, International Country Risk Guide, IMF, World Bank.

# 4. Methodology

# Measures for Exchange Rate Volatility

*In this study,* exchange rate volatility is measured by applying the symmetric GARCH model and asymmetric threshold-GARCH (TGARCH) model, The simplest forms of the GARCH model and TGARCH model are GARCH (1,1) and TGARCH (1,1), which can be shown as follows:

$$R_t = \beta_0 + \beta_1 R_{t-1} \quad (1)$$

$$\sigma_t^2 = \omega + \alpha\mu_{n-1}^2 + \beta\sigma_{n-1}^2 \quad (2)$$

$$\sigma_t^2 = \omega + \alpha\mu_{n-1}^2 + \beta\sigma_{n-1}^2\, d_{n-1} + \gamma\sigma_{n-1}^2 \quad (3)$$

where $\omega$ is constant. $\boldsymbol{\alpha}$, $\beta$ and $\gamma$ are coefficients. $\mu_{n-1}^2$ is the mean square of the previous time period. $\sigma_{n-1}^2$ is the variance of the previous time period. *dn* takes the value of 1 for $\mu_t < 0$, and 0 otherwise.

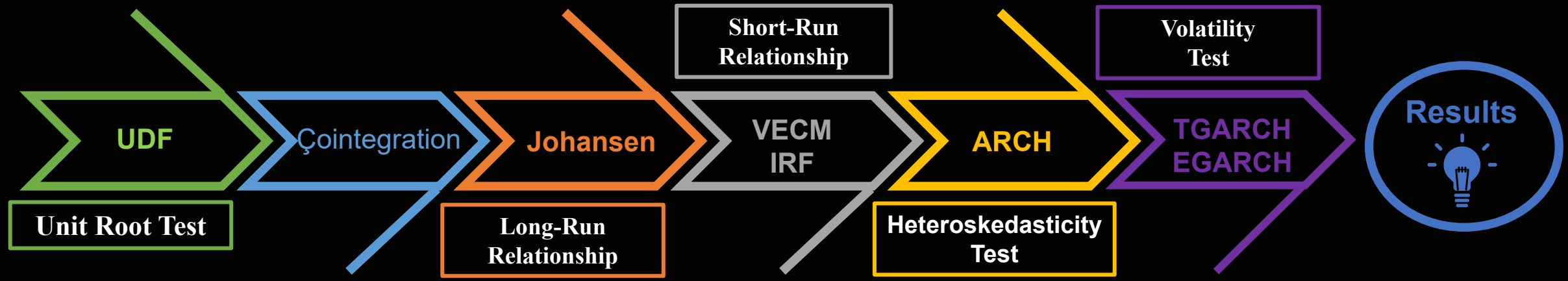
# Model Specification

To investigate the effect of exchange rate volatility on international trade, equation (4) below is estimated, incorporating pre-generated exchange rate volatility proxies.

$$Trade_{it} = \beta_0 + \beta_1 EXVOL_{it} + \beta_2 ECOFR_{it} + \beta_3 INFL_{it} + \beta_4 INTR_{it} + \beta_5 IND_{it} + \beta_6 RES_{it} + \epsilon_{it} \quad (4)$$

In Equations (4), for country i and time period t, $TRADE_{it}$ represents international, $EXVOL_{it}$ is exchange rate volatility, $ECOFR_{it}$ is economic freedom, $INFL_{it}$ is inflation rate, $INTR_{it}$ is interest rate, $IND_{it}$ is industrial growth, $RES_{it}$ is reserve and $\epsilon_{it}$ denotes to error term.

# Methodology Map



# 5. Sampling and Data Collection

# Sample

This study uses a sample of **15 MENA countries**: Algeria, Bahrain, Djibouti, Egypt, Iraq, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and the United Arab Emirates.

*Libya, Syria, West Bank, and Gaza and Yemen are excluded from the study due to data unavailability.*

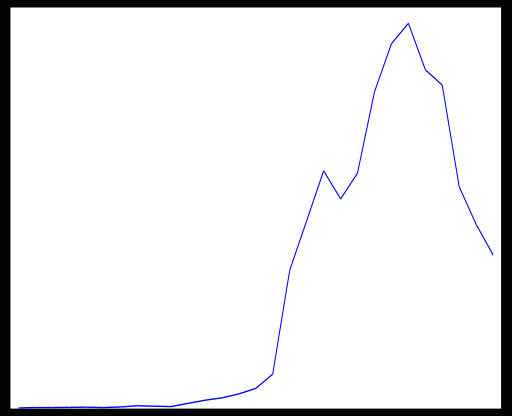
Annual time series data **(1990-2018)** were sourced from the Statistical Bulletin of Central Banks, World Development Indicators (WDI) from the World Bank data set and International Financial Statistics (IFS) developed by the IMF.

# Description of Variables and Sources of Data

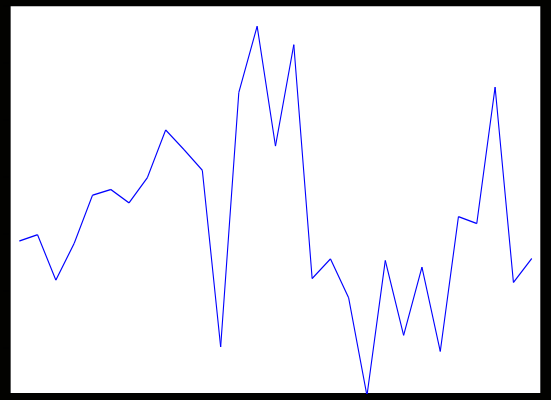
| Variables | Description | Data Source |
|---|---|---|
| **TRADE** | International trade measured by total trade (% of GDP) | World Bank Development Indicators |
| **EXVOL** | The volatility of real effective exchange rate (%), measured by GARCH (1,1) & TGARCH (1,1) | Bruegel Datasets: Real effective exchange rates for 178 countries: A new database |
| **ECOFR** | Economic freedom index | U.S. Heritage Foundation, |
| **INFL** | Inflation rate measured by consumer price index | IMF IFS Statistics, |
| **INTR** | Interest rate measured by the real interest rate | World Bank Development Indicators |
| **IND** | Industrial growth measured by value-added growth | World Bank Development Indicators |
| **RES** | Official reserve | World Bank Development Indicators |

# Data Trends

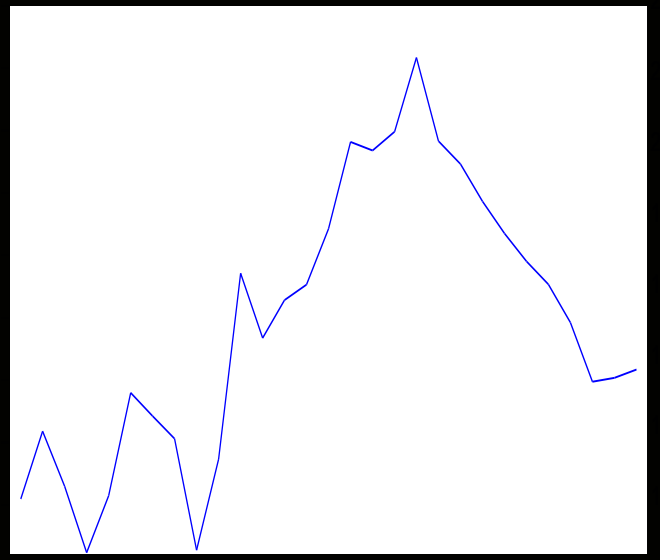
ECOFR



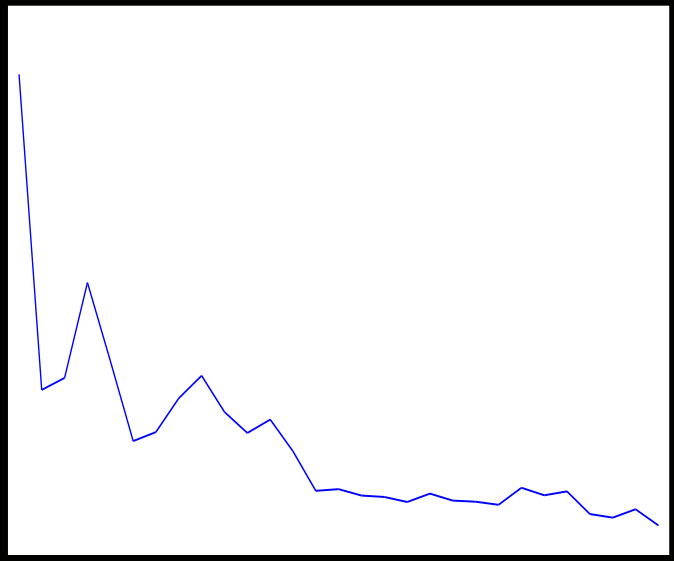
IND



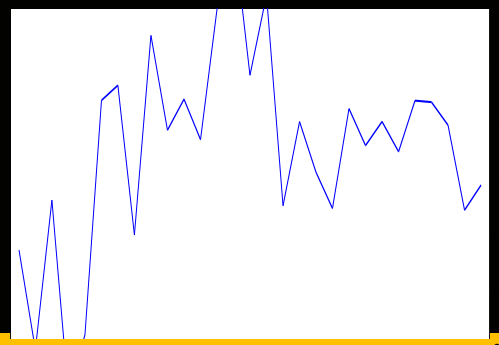
Trade



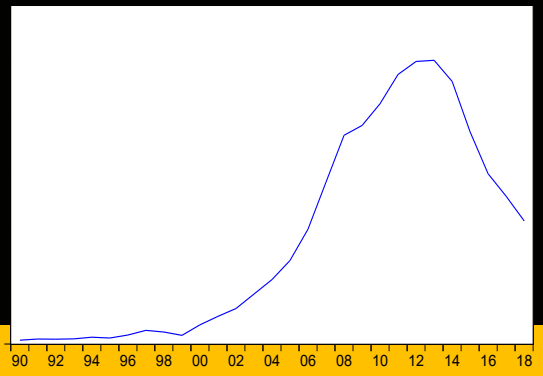
ER



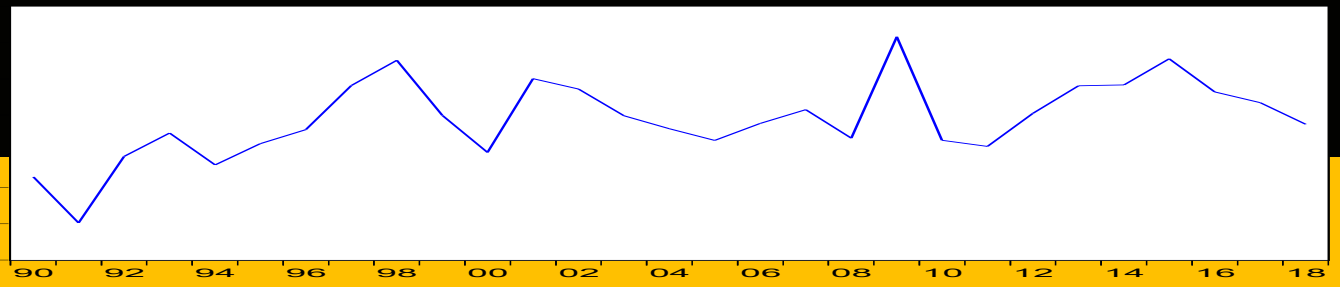
INFL



RES




INTR




**Source:** Authors' preparation

## 6. Results

## 7. Interpretation of the findings

# Unit Root Test

| Variable | Level | | | | First Difference | | | |
|---|---|---|---|---|---|---|---|---|
| | *Intercept* | | *Intercept and Trend* | | *Intercept* | | *Intercept and Trend* | |
| | *Prob.** | *T-Statistics* | *Prob.** | *T-Statistics* | *Prob.** | *T-Statistics* | *Prob.** | *T-Statistics* |
| TRADE | 0.4713 | -2.971853 | 0.9122 | -3.580623 | 0.0005* | -2.976263 | 0.0024* | -3.587527 |
| EXVOL | 0.6329 | -1.261421 | 0.1022 | -3.242082 | 0.0009* | -3.745469 | 0.0448* | -3.641270 |
| INFL | 0.5207 | -2.971853 | 0.6650 | -3.580623 | 0.0002* | -5.392448 | 0.0009* | -5.403225 |
| INTR | 0.0137* | -2.971853 | 0.0228* | -3.953571 | 0.0000* | -7.190693 | 0.0000* | -7.274761 |
| IND | 0.0107 | -3.659743 | 0.0352* | -3.750388 | 0.0000* | -8.384662 | 0.0000* | -8.239793 |
| RES | 0.2322 | -2.138279 | 0.0352* | -3.801457 | 0.04392* | -2.245913 | 0.04296* | -2.425841 |
| ECOFR | 0.5562 | -1.422841 | 0.6878 | -1.7776691 | 0.0420* | -2.871084 | 0.0184* | -2.879148 |

*Result is significant at 5% level

**Source:** Authors' estimation (statistical work is performed using E-views software version 9).

# Johansen Cointegration Test

Sample (adjusted): 1992 2018
Included observations: 27 after adjustments
Trend assumption: Linear deterministic trend
Series: TRADE ERVOL ECOFR INFL IND INTR RES
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.935904 | 206.9023 | 125.6154 | 0.0000 |
| At most 1 * | 0.832029 | 132.7234 | 95.75366 | 0.0000 |
| At most 2 * | 0.707396 | 84.55634 | 69.81889 | 0.0021 |
| At most 3 * | 0.594869 | 51.37510 | 47.85613 | 0.0225 |
| At most 4 | 0.416446 | 26.97938 | 29.79707 | 0.1021 |
| At most 5 | 0.246283 | 12.43668 | 15.49471 | 0.1372 |
| At most 6 * | 0.162956 | 4.802731 | 3.841466 | 0.0284 |

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

**Source:** Author's estimation (statistical work is performed using E-views software version 9)

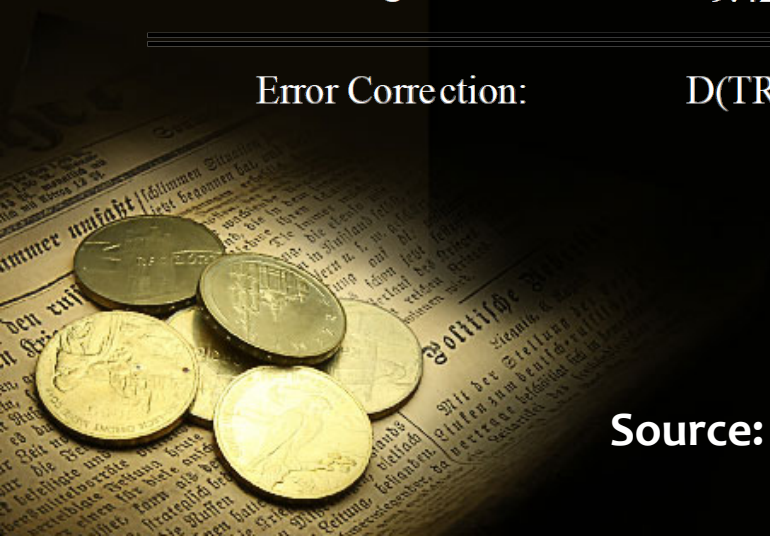
# Vector Error Correction Model (VECM)

Vector Error Correction Estimates
Sample (adjusted): 1993 2018
Included observations: 26 after adjustments
Standard errors in ( ) & t-statistics in [ ]

| Cointegrating Eq: | CointEq1 |
|---|---|
| TRADE(-1) | 1.000000 |
| ERVOL(-1) | -0.620375<br>(0.77388)<br>[-0.80164] |
| C | 9.422432 |

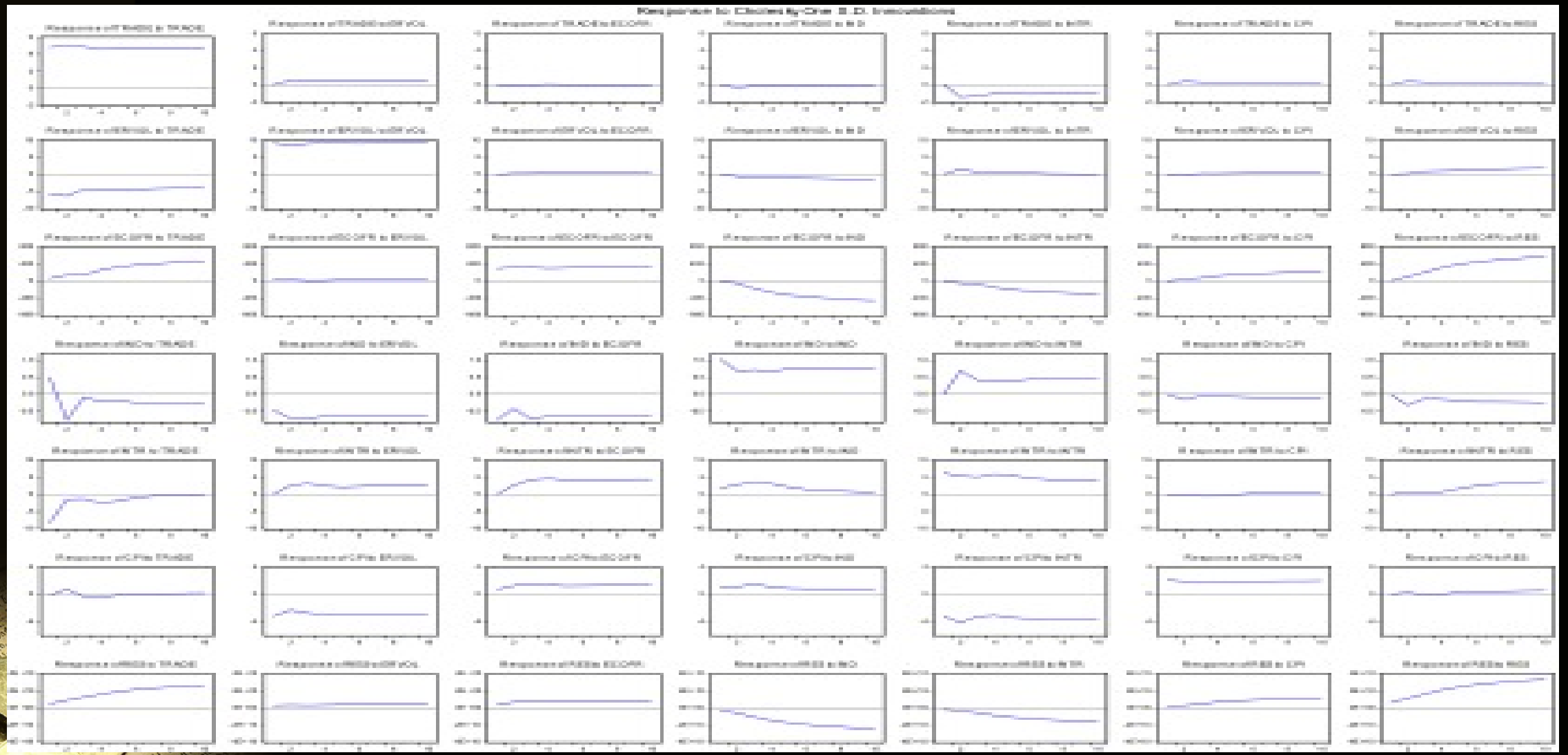
| Error Correction: | D(TRADE) | D(ERVOL) |
|---|---|---|
| R-squared | 0.693092 | 0.816579 |
| Adj. R-squared | 0.488487 | 0.694299 |
| Sum sq. resids | 142.4833 | 415.5152 |
| S.E. equation | 3.082027 | 5.263175 |
| F-statistic | 3.387464 | 6.677922 |
| Log likelihood | -59.00707 | -72.92090 |
| Akaike AIC | 5.385159 | 6.455453 |
| Schwarz SC | 5.917431 | 6.987725 |
| Mean dependent | 0.287954 | -1.601298 |
| S.D. dependent | 4.309314 | 9.519174 |

| | |
|---|---|
| Determinant resid covariance | 213.4220 |
| Determinant resid covariance | 71.03541 |
| Log likelihood | -129.2061 |
| Akaike information criterion | 11.78509 |
| Schwarz criterion | 12.94641 |



**Source:** Authors' estimation (statistical work is performed using E-views software version 9)

# Impulse Response Function (IRF)



**Source:** Author's estimation (statistical work is performed using E-views software version 9)

# Heteroskedasticity Test: ARCH for Exchange Rate Volatility

| | | | |
|---|---|---|---|
| F-statistic | 63.33764 | Prob. F(1,26) | 0.0000 |
| Obs*R-squared | 19.85114 | Prob. Chi-Square(1) | 0.0000 |

**Source:** Authors' estimation (statistical work is performed using E-views software version 9).

# Estimation of Parameters of GARCH/TGARCH Model

Dependent Variable: TRADE
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Sample: 1990 2018
Included observations: 29
Convergence not achieved after 500 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1)

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|---|---|---|---|---|
| ERVOL | -0.291627 | 0.035393 | -8.239640 | 0.0000** |
| ECOFR | 0.020606 | 0.006904 | 2.984613 | 0.0028** |
| INFL | 0.009709 | 0.001216 | 7.985518 | 0.0000** |
| IND | 3.121113 | 1.285931 | 2.427124 | 0.0152** |
| INTR | -0.058756 | 0.098273 | -0.597884 | 0.5499 |
| RES | 5.52E-10 | 1.20E-10 | 4.618867 | 0.0000** |
| Variance Equation | | | | |
| C | 36.69950 | 31.36451 | 1.170096 | 0.2420 |
| RESID(-1)^2 | -0.172162 | 0.175904 | -0.978730 | 0.3277 |
| GARCH(-1) | 0.622406 | 0.446011 | 1.395494 | 0.1629 |

| | | | |
|---|---|---|---|
| R-squared | -0.139929 | Mean dependent var | 59.66699 |
| Adjusted R-squared | -0.329917 | S.D. dependent var | 8.801952 |
| S.E. of regression | 10.15059 | Akaike info criterion | 7.561375 |
| Sum squared resid | 2472.827 | Schwarz criterion | 7.938560 |
| Log likelihood | -101.6399 | Hannan-Quinn criter. | 7.679505 |
| Durbin-Watson stat | 1.417027 | | |

Significance Levels *** p < 0.01, ** p < 0.05, * p < 0.1.

**Source:** Authors' estimation (statistical work is performed using E-views software version 9).

# Estimation of Parameters of EGARCH Model

Dependent Variable: TRADE
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Sample: 1990 2018
Included observations: 29
Convergence not achieved after 500 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(6) + C(7)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(8)
*RESID(-1)/@SQRT(GARCH(-1)) + C(9)*LOG(GARCH(-1))

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|---|---|---|---|---|
| ERVOL | -0.292874 | 0.016020 | -18.28207 | 0.0000** |
| ECOFR | 0.019939 | 0.004513 | 4.418292 | 0.0000** |
| INFL | 4.017838 | 1.419821 | 2.829820 | 0.0047** |
| IND | 3.311586 | 0.623985 | 5.307152 | 0.0000** |
| INTR | -0.078894 | 0.030472 | -2.589043 | 0.0096** |
| RES | 5.35E-10 | 8.67E-11 | 6.170208 | 0.0000** |
| Variance Equation | | | | |
| C(6) | 4.553736 | 1.158969 | 3.929127 | 0.0001 |
| C(7) | -1.916115 | 0.803926 | -2.383446 | 0.0172 |
| C(8) | 0.411485 | 0.395884 | 1.039410 | 0.2986 |
| C(9) | 0.256958 | 0.179998 | 1.427560 | 0.1534 |

| | | | |
|---|---|---|---|
| R-squared | -0.178086 | Mean dependent var | 59.66699 |
| Adjusted R-squared | -0.374434 | S.D. dependent var | 8.801952 |
| S.E. of regression | 10.31908 | Akaike info criterion | 7.371313 |
| Sum squared resid | 2555.601 | Schwarz criterion | 7.795646 |
| Log likelihood | -97.88403 | Hannan-Quinn criter. | 7.504208 |
| Durbin-Watson stat | 1.402172 | | |

Significance Levels *** p < 0.01, ** p < 0.05, * p < 0.1.

***Source:*** Author's estimation (statistical work is performed using E-views software version 9).

# Conclusion

1. The coefficients of exchange rate volatility measured with TGARCH/EGARCH showed significant negative effects in both cases. This indicates that high exchange rate volatility can adversely affect international trade flows in sample countries.
2. Economic freedom - as a proxy of financial market development and economic openness - has a significant and positive impact on international trade .
3. Inflation has a significant positive effect on international trade as an explanatory variable, as does exchange rate volatility.
4. The statistical significance of both industrial growth and reserves boosted international trade. This indicates that effective import substitution and industrialization would significantly reduce pressure on the external sector and will increase economic activities and hence, spur economic growth.
5. The findings revealed that exchange rate volatility depressed trade flows in the long run.

# Policy Implication

This study suggests that economic policies of MENA countries should be designed to minimize exchange rate volatility. The minimum level of exchange rate volatility could be beneficial to foster international trade inflows, which might increase the overall economies of these countries. Future studies should analyze the relationship between trade with exchange rate volatility along with other macroeconomic, social, and political factors in developed and developing countries, which might further guide policy directions.

# Summery

1

**This study** examined the dynamics between real exchange rate volatility and the level of international trade

2

Panel annual time series **data** (1990-2018) **MENA**

3

**GARCH (1,1)** Model is employed to measure ER volatility

4

**CVS** are: economic freedom; inflation rate; interest rate; reserves; and industrial development

5

**Results** revealed that, in the long-run, exchange rate volatility negatively affects international trade significantly in the sample countries

6

Economic policies of MENA countries should be re-designed to minimize exchange rate volatility and therefore, foster trade

# Thank you