8 ASYMMETRIC EFFECTS OF EXCHANGE RATES ON ENERGY DEMAND IN E7 COUNTRIES: NEW EVIDENCE FROM MULTIPLE THRESHOLDS NONLINEAR ARDL MODEL

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Abstract

This study investigates the impact of very small to very large changes in the exchange rate on energy demand in the emerging 7 (E7) countries - Brazil, China, India, Indonesia, Mexico, Russia, and Turkey, which has not been thoroughly explored in the literature. We use the multiple thresholds nonlinear ARDL (MTNARDL) approach and compare its results with conventional ARDL and nonlinear autoregressive distributed lag (NARDL) methods. Moreover, we use Granger causality in the quantile test for robustness purposes. Our findings reveal that the MTNARDL approach with decile series shows a long-run association between energy demand and the exchange rate for all E7 countries. In contrast, the conventional ARDL and NARDL approach only finds a long-run association for India. Finally, our results based on the Granger causality in quantile test suggest that the effect varies across various quantiles. The study provides valuable policy recommendations based on the results, emphasizing the importance of considering the impact of extreme exchange rate variations when formulating energy demand policies in E7 countries.

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Keywords: Energy demand, E7 countries, exchange rate, multiple thresholds nonlinear ARDL model, MTNARDL model.

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Appendix A: Tables

Table 1: Descriptive Statistics

Variables	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera
Brazil					
ED	6.124	0.301	-0.106	2.113	7.996**
ER	2.111	3.187	-2.097	9.006	314.534***
EC	14.327	2.996	-3.006	8.665	204.564***
EP	12.515	0.412	-0.651	3.511	28.415***
CPI	25.741	2.411	-0.355	2.415	11.581**
Russia					
ED	67.129	0.215	0.769	3.827	8.775***
ER	3.001	0.915	-0.614	2.354	13.245***
EC	21.000	0.348	-0.395	2.110	8.657***
EP	10.765	0.512	-0.451	3.451	31.515***
CPI	25.951	2.451	-0.235	2.845	10.451**
India					
ED	7.344	0.401	0.249	2.515	9.345**
ER	4.001	0.299	-0.967	4.576	21.576***
EC	21.019	2.198	-0.110	2.123	7.998**
EP	41.765	0.512	-0.411	3.511	541.845***
CPI	51.951	2.841	-0.415	2.415	14.451**
China					
ED	8.065	0.521	0.121	2.756	23.124***
ER	2.105	0.297	-0.567	3.598	8.999***
EC	17.856	2.390	-0.321	2.003	7.786**
EP	11.765	0.542	-0.451	6.511	31.685***
CPI	26.951	2.841	-0.845	4.885	10.411**
Mexico					

Variables	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera
ED	54.999	0.209	-0.401	2.775	21.757***
ER	3.010	0.637	-1.001	3.675	22.987***
EC	16.433	0.899	-0.699	4.334	11.587***
EP	11.741	0.452	-0.741	3.741	30.845***
CPI	26.941	2.541	-0.655	2.455	8.451**
Turkey					
ED	5.467	0.209	0.211	2.119	7.498**
ER	1.995	3.785	-0.514	3.756	31.877***
EC	13.218	4.987	-0.888	3.009	21.433***
EP	8.845	0.742	-0.741	4.451	29.845***
CPI	27.971	2.841	-0.235	1.745	8.485**
Indonesia					
ED	6.975	0.645	-0.465	3.665	7.242**
ER	9.765	0.986	-0.789	3.999	23.598***
EC	22.976	2.194	-0.199	2.005	9.451**
EP	10.765	0.512	-0.451	3.451	31.515***
CPI	25.951	2.451	-0.235	2.845	10.451**

This Table offers descriptive statistics for the factors explored in the study. The Jarque-Bera test determines data normality, with the null hypothesis being that the variables have a normal distribution. The degrees of significance are represented by ***, **, and *, which imply the rejection of the null hypothesis at 1%, 5%, and 10%, respectively

Table 2: Unit root test at the level and first difference

Variables	ADF at level	ADF at first difference	KPSS at level	KPSS at first difference
Brazil				
ED	-1.522	-5.432***	2.645***	0.199
ER	-2.339	-8.334***	0.587**	0.298
EC	-1.199	-9.465***	0.923***	0.474
EP	-2.339	-8.334***	0.587**	0.298
CPI	-1.199	-9.465***	0.923***	0.474
Russia				
ED	-2.434	-2.718*	0.301	0.176
ER	-1.221	-5.918***	1.664***	0.069
EC	-0.634	-2.996**	0.497**	0.410*
EP	-2.419	-9.354***	0.847**	0.358
CPI	-1.259	-10.845***	0.763***	0.544
India				
ED	-0.145	-5.043***	2.005***	0.218
ER	-0.401	-4.089***	2.113***	0.429
EC	-0.319	-3.567**	2.768***	0.201
EP	-2.549	-9.454***	0.574**	0.358
CPI	-1.889	-10.575***	0.985***	0.574
China				
ED	-1.213	-4.001***	2.954***	0.310
ER	-2.172	-5.995***	0.179	0.193
EC	-1.612	-5.234***	0.095	0.501*
EP	-2.459	-8.454***	0.747**	0.358
CPI	-1.239	-9.385***	0.863***	0.544
Mexico				
ED	-1.632	-2.998**	2.465***	0.345
ER	-1.335	-3.001**	2.869***	1.00
EC	-2.498	-4.687***	3.967***	1.109
EP	-2.749	-8.414***	0.747**	0.541
CPI	-1.289	-9.685***	0.863***	0.531
Turkey				
ED	-0.399	-5.997***	2.453***	0.076
ER	-2.796*	-5.234***	1.465***	0.312
EC	-4.712**	-9.756***	2.576***	0.098

Variables	ADF at level	ADF at first difference	KPSS at level	KPSS at first difference
EP	-2.549	-8.414***	0.747**	0.358
CPI	-1.279	-9.565***	0.853***	0.544
Indonesia				
ED	-3.421***	-4.097***	2.194***	0.310
ER	-1.497	-5.998***	0.889***	0.219
EC	-1.866	-5.123***	2.164	0.342
EP	-2.419	-8.514***	0.587**	0.298
CPI	-1.249	-10.845***	0.745***	0.744

*Note: The Table displays the outcomes of ADF and KPSS tests performed at the variable's level and first difference. The ADF test checks for the existence of a unit root in the data, whereas the KPSS test checks for stationarity. The ADF test rejects the null hypothesis of a unit root, and the KPSS test rejects the null hypothesis of stationarity, indicating that the variables have a stationary state. The significance levels of ***, **, and * denote rejection of the null hypothesis at 1%, 5%, and 10%, respectively.*

Table 6 Results from MTNARDL approach with series of quintiles

	Brazil	Russia	India	China	Mexico	Turkey	Indonesia
Panel A: Short-run coefficients							
ΔlnED(-1)	-0.51***	0.396***	0.545***	0.765***	0.959***	0.935***	0.642***
$\Delta lnER\eta_1$	-0.032	-0.089*	0.023	-0.031	-0.009	-0.012	0.011
$\Delta lnER\eta_1(-1)$	0.043	-0.051	0.071	0.052	-0.048	-0.021	0.032
$\Delta lnER\eta_2$	0.198	-0.203	0.201	0.038	-1.636**	-0.164	0.049
$\Delta lnER\eta_2(-1)$	-0.41**	-0.099	0.296*	-0.273	1.295	-0.031	0.299
$\Delta lnER\eta_3$	0.21	0.159	0.199*	0.703	-0.145	-0.051	0.402
$\Delta lnER\eta_3(-1)$	-0.31	0.021	0.321**	1.122	0.079	0.097	-0.421
$\Delta lnER\eta_4$	-0.019	0.221	-0.076	2.105**	-0.091	-0.212**	0.311**
$\Delta lnER\eta_4(-1)$	-0.019	-0.079	0.089	-0.298	0.202*	0.089**	-0.401**
$\Delta lnER\eta_5$	-0.009	-0.012	0.061	-0.29***	-0.07***	-0.21***	-0.021
$\Delta lnER\eta_5(-1)$	0.007	0.031	0.051	0.145***	0.056**	0.089***	-0.023
ΔlnEC	0.019	0.41***	-0.021	0.312***	-0.26***	0.079***	-0.254
ΔlnEC(-1)	-0.018	-0.111	0.078	-0.20***	0.214***	-0.021	0.048
ΔlnEP	-0.41**	-0.099	0.296*	-0.273	1.295	-0.031	0.299
ΔlnEP(-1)	0.003	0.089**	0.213***	0.312	0.019	0.025	0.098**
ΔlnCPI	0.21	0.159	0.199*	0.703	-0.145	-0.051	0.402
ΔlnCPI(-1)	-0.028	-0.181	0.048	-0.25***	0.224***	-0.024	0.047
Panel B: Long-run coefficients							
$lnER\eta_1$	-0.2***	0.019	-0.31***	0.186**	-0.034	-0.051*	-0.030
$lnER\eta_2$	-0.019**	-0.021	0.022	0.319***	-0.652**	0.031	0.019
$lnER\eta_3$	0.009	-0.285**	-0.021	1.501*	0.005	-0.021	0.543***
$lnER\eta_4$	0.003	0.089**	0.213***	0.312	0.019	0.025	0.098**
$lnER\eta_5$	-0.019**	-0.019	0.020	-0.123***	-0.023	-0.034	0.021
lnEC	0.12***	-0.005	0.019	0.198***	0.022	0.045	-0.019
lnEP	-0.51**	-0.089	0.546*	-0.323	1.325	-0.034	0.223
lnCPI	-0.45	-0.34**	0.234*	-0.533	1.345	-0.034	0.546
Panel C: Diagnostics							
Reset	0.5498	21.31***	3.132*	4.342**	2.643**	6.321	1.110
LM	1.312	1.123	1.987	3.11	0.856	3.005	1.713
CUSUM	S	S	S	S	S	U	S
CUSUMQ	U	U	U	S	S	S	S
ECM	-0.19***	-0.31***	-0.41***	-0.432***	-0.432***	-0.423***	-0.434***
Adj. r^2	0.313	0.701	0.392	0.987	0.514	0.727	0.401
$Wald_{SR}$	0.879	0.478	0.887	3.213***	1.921*	10.54***	1.008
$Wald_{LR}$	4.56***	5.324***	5.11***	5.673***	2.432**	2.001	4.553***

Note: The findings of the MTNARDL technique are presented in deciles (ER 1 to ER 5) in this Table. Panel A shows the short-run results, panel B the long-run results, and panel C the diagnostics tests. The Ramsey Reset and LM tests examine the model specification and serial correlations, while the CUSUM and CUSUMQ tests ensure the approach's stability: the ECM and Adj. R2 statistics are used to evaluate model fitness and adjustment speed, respectively. WaldLR and WaldSR test the null hypothesis of symmetry in the long and short

*run, respectively. The coefficients' significance levels are denoted by ***, **, and * at 1%, 5%, and 10%, respectively.*

Table 7: Results of MTNARDL approach with series of decile

	Brazil	Russia	India	China	Mexico	Turkey	Indonesia
Panel A: Short-run coefficients							
ΔlnED(-1)	0.39***	0.401***	0.501***	0.642***	0.543***	0.522***	0.296***
$\Delta lnER\eta_1$	-0.059	-0.049	-0.007	-0.039	-0.021	0.033	0.105
$\Delta lnER\eta_1(-1)$	-0.029	-0.046	-0.022	0.051	-0.045	0.069	0.015
$\Delta lnER\eta_2$	0.098	-0.201	-0.210	-0.212	-0.498	0.213	0.598**
$\Delta lnER\eta_2(-1)$	-0.041	0.199	0.278	0.049	-2.334***	1.156**	0.399*
$\Delta lnER\eta_3$	0.210	-0.196	-0.324	0.021	4.223*	-0.315	-0.234
$\Delta lnER\eta_3(-1)$	-0.399*	-0.210	-0.089	-0.222	1.897	-0.201	-0.032
$\Delta lnER\eta_4$	0.289	-0.232	-0.213	-0.899	-1.514*	-0.045	-0.218
$\Delta lnER\eta_4(-1)$	-0.319	-0.345	0.515	0.301	3.234***	-0.319	1.241
$\Delta lnER\eta_5$	0.079	-0.456	-0.399*	0.598	0.402	0.079	-1.521**
$\Delta lnER\eta_5(-1)$	-0.401*	-0.024	0.299	1.867	-0.021	-0.079	0.992*
$\Delta lnER\eta_6$	0.049	-0.215	-0.289	-5.763	0.221	-0.055	0.059
$\Delta lnER\eta_6(-1)$	-0.065	0.197	0.333	5.352	0.301	0.091	-0.044
$\Delta lnER\eta_7$	-0.098	0.025	-0.234	197.543	-0.029	-0.244	0.215
$\Delta lnER\eta_7(-1)$	0.049	-0.007	0.243	312.456	0.125	0.041	-0.199
$\Delta lnER\eta_8$	-0.056	0.132	-0.213	2.111**	-0.021	-0.324***	0.108
$\Delta lnER\eta_8(-1)$	0.078	-0.289	0.324**	-0.435	0.319**	0.004	-0.423**
$\Delta lnER\eta_9$	-0.087*	0.056	-0.31***	-0.019	0.059	-0.201***	0.210
$\Delta lnER\eta_9(-1)$	0.023	-0.049	0.059	0.214	0.069	0.046	-0.321
$\Delta lnER\eta_{10}$	-0.034	-0.002	-0.069	-0.08***	-0.081***	-0.333***	0.030
$\Delta lnER\eta_{10}(-1)$	0.045	0.021	0.042	0.081***	0.029*	0.046*	-0.011
ΔlnEC	0.043	0.299	-0.215	0.213**	-0.324***	0.094***	-0.312**
ΔlnEC(-1)	-0.089	-0.021	0.082	-0.313*	0.213***	-0.008	0.031
ΔlnEP	0.079	-0.456	-0.399*	0.598	0.402	0.079	-1.521**
ΔlnEP (-1)	-0.065	0.197	0.333	5.352	0.301	0.091	-0.044
ΔlnCPI	-0.056	0.132	-0.213	2.111**	-0.021	-0.324***	0.108
ΔlnCPI(-1)	-0.399*	-0.210	-0.089	-0.222	1.897	-0.201	-0.032
Panel B: Long-run coefficients							
$lnER\eta_1$	-0.014	0.079*	-0.018**	0.029	-0.049	-0.039	0.009
$lnER\eta_2$	0.04***	-0.312	-0.20***	0.321**	0.534***	0.523	0.034
$lnER\eta_3$	0.06***	0.214	-0.85***	0.312*	1.923***	-0.318*	-0.402
$lnER\eta_4$	-0.065*	-0.432	0.225**	-0.112	-0.899**	0.091	-0.243
$lnER\eta_5$	0.03***	-1.501*	-0.031*	3.123**	0.512	-0.056	0.295
$lnER\eta_6$	0.001**	-0.52***	0.067	-5.324	0.211	-0.089**	-0.042
$lnER\eta_7$	-0.019	-0.032	0.051	211.453	0.020	0.004	0.058
$lnER\eta_8$	0.021	0.32***	0.039	0.214	-0.073	0.005	0.079
$lnER\eta_9$	-0.018	0.043*	0.021	0.049	0.009	-0.052*	-0.019
$lnER\eta_{10}$	-0.007	-0.002	0.011	-0.021**	0.019	-0.072**	0.021
LnEC	0.006	-0.13***	-0.021	0.025*	-0.015	0.023	-0.039

	Brazil	Russia	India	China	Mexico	Turkey	Indonesia
LnEP	0.06***	0.214	-0.85***	0.312*	1.923***	-0.318*	-0.402
LnCPI	0.001**	-0.52***	0.067	-5.324	0.211	-0.089**	-0.042
Panel C: Diagnostics							
Reset	0.301	21.45***	6.464***	21.34***	3.001**	5.223***	1.125
LM	5.678	0.867	3.213	2.321	0.499	3.453	0.201
CUSUM	S	S	S	S	S	S	S
CUSUMQ	U	U	S	S	S	S	S
ECM	-0.299*	-0.31***	-0.29***	-0.41***	-0.432***	-0.421***	-0.245***
Adj. r^2	0.201	0.723	0.425	0.912	0.499	0.772	0.199
$Wald_{SR}$	0.498	0.765	0.812	1.792*	1.982**	7.332***	1.198
$Wald_{LR}$	5.33***	3.005**	4.223***	4.322***	5.223***	4.556***	5.764***

*Note: The findings of the MTNARDL method are presented in deciles (ER 1 to ER 10) in this Table. Panels A, B, and C provide the short-run and long-run findings and diagnostic test estimation statistics. The LM and Ramsey Reset tests were utilized to validate the model's specification and serial correlation. The CUSUM and CUSMQ tests were also utilized to ensure the approach's stability: the ECM and Adj. R2 was used to assess model fitness and adjustment speed. In the long and short run, WaldLR and WaldSR were used to test the null hypothesis of symmetry. The significance levels of coefficients are given by ***, **, and *, which represent 1%, 5%, and 10%, respectively.*

Granger Causality in Quantiles test

Moreover, following Anwar et al. (2021), we employ the Granger causality test in our analysis, using the quantile test to investigate the causality of quantiles between the exchange rate and energy demand and between economic activity and energy demand. The Granger causality test, introduced by Granger et al. (1969), assesses the causal link among the supplied variables based on the notion that the dependent variable can be predicted without regard to the delays of the independent variables. Over the years, researchers have expanded the Granger causality test using sophisticated and varied approaches.

This study utilizes a vector $(p_i = p_i^x)' \in R^e, s = 0 + r, where\ P_y^i$ denotes the previous demonstration group of $P_i P_i^y = Pi - 1, \ldots., Pi - r$). The quantile test employed in this study is based on the same notion as the Granger causality test (C.W. Granger et al., 1969) that variable x_i does not cause variable y_i across different quantiles. The test proposed by Troster (2018) represents the null hypothesis of no causality from Y_i, X_i s' to the shared below.

$$H_0^y \to^x := FX(p_i^x, P_1^y) = FX(p_i^x), for\ all\ x \in R, \quad (13)$$

The tentative distribution variable $FX(p_i^x, P_1^y)$, shows the distribution of variable X_i given (p_i^x, P_1^y). The null hypothesis in equation 13 is validated by (Granger et al., 1969). This study uses $D_i\ T$ for the QAR model m (.) concerning all $\pi \in$ ⊤⊏ $[0,1]$. The following notation represents the null hypothesis under the non-Granger causality test:

$$QAR(1): m^1\ (P_i^x, \partial(\pi)) = Y1(\pi) + y2(\pi) Y\ i - 1 + \mu t\ \vartheta -_{\sigma 1\ (\pi),} \quad (14)$$

The coefficient in equation 14, denoted by $\partial = (\pi) = y_1(\pi), y2 = (\pi) and\ \mu t_t$, is estimated using maximum likelihood based on similarities between point quantities. Additionally, the inverse of a conventional primary distribution function is represented by $\partial_\sigma^{-1}(\pi)$. In this study, we apply the QAR technique to equation (13), incorporating delays to alternative variables to investigate causation. Finally, the fundamental equation of QAR (1) and equation 15 are expressed as follows:

$$Q_\pi^X(P_i^X, P_1^y) = y_1(\pi) + y_2(\pi)X\ i - 1 + \vartheta(\pi)Yi - 1 + \mu_t\vartheta^{-1}(\pi) \qquad (15)$$

Table 8: Granger Causality in Quantile Test

Quantiles	$\Delta ED_t \downarrow \Delta EC_t$	$\Delta ED_t \downarrow \Delta ER_t$	$\Delta EC_t \downarrow \Delta ED_t$	$\Delta ER_t \downarrow \Delta ED_t$
Brazil				
[0.05–0.95]	1.541 [0.121]	1.125 [0.125]	1.125 [0.125]	22.823*** [0.000]
0.05	12.235*** [0.000]	12.235*** [0.000]	12.235*** [0.000]	12.235*** [0.000]
0.1	14.445*** [0.000]	14.445*** [0.000]	14.445*** [0.000]	12.235*** [0.000]
0.2	3.142 [0.0142]	15.475*** [0.000]	14.445*** [0.000]	14.445*** [0.000]
0.3	1.412 [0.142]	12.235*** [0.000]	12.235*** [0.000]	12.235*** [0.000]
0.4	1.384 [0.125]	3.45 [0.014]	1.412 [0.142]	1.412 [0.142]
0.5	1.341 [0.124]	1.875 [0.124]	21.845*** [0.000]	16.745*** [0.000]
0.6	0.142 [0.242]	3.475 [0.012]	15.475*** [0.000]	18.475*** [0.000]
0.7	0.124 [0.225]	1.955[0.112]	17.785*** [0.000]	17.845*** [0.000]
0.8	1.145 [0.142]	3.485[0.011]	18.845*** [0.000]	18.845*** [0.000]
0.9	1.125 [0.125]	[0.000]]2.475	18.855*** [0.000	14.348*** [0.140]
0.95	1.142 [0.142]	1.344[0.451]	17.475*** [0.000]	16.384*** [0.000]
Russia				
[0.05–0.95]				
0.05	1.451 [0.231]	2.334 [0.203]	17.145*** [0.000]	15.445*** [0.000]
0.1	4.432 [0.124]	1.323[0.1424]	19.145*** [0.000]	24.475*** [0.000]
0.2	3.232 [0.0142]	3.415[0.124]	23.145*** [0.000]	14.145*** [0.000]
0.3	1.232 [0.122]	2.475 [0.125]	21.475*** [0.000]	15.145*** [0.000]
0.4	1.564 [0.124]	3.224 [0.014]	15.245*** [0.000]	18.125*** [0.000]
0.5	1.431 [0.125]	1.347[0.124]	17.455*** [0.000]	17.145*** [0.000]
0.6	0.232 [0.242]	3.341 [0.012]	18.415*** [0.000]	16.525*** [0.000]
0.7	0.324 [0.222]	1.974 [0.112]	18.475*** [0.000]	17.148*** [0.000]
0.8	1.235 [0.145]	3.474 [0.013]	17.525*** [0.000]	14.347*** [0.000]
0.9	1.125 [0.123]	2.241[0.143]	14.835*** [0.000]	12.128*** [0.000]
0.95	1.162 [0.143]	1.447 [0.153]	14.415*** [0.000]	18.344*** [0.000]
India				
[0.05–0.95]	1.5432 [0.122]	2.341 [0.201]	17.455*** [0.000]	17.145*** [0.000]
0.05	4.745*** [0.00]	1.345 [0.121]	18.415*** [0.000]	16.525*** [0.000]
0.1	6.848*** [0.004]	2.341 [0.11]	18.475*** [0.000]	17.148*** [0.000]

Quantiles	$\Delta ED_t \downarrow \Delta EC_t$	$\Delta ED_t \downarrow \Delta ER_t$	$\Delta EC_t \downarrow \Delta ED_t$	$\Delta ER_t \downarrow \Delta ED_t$
0.2	3.152 [0.0152]	12.747*** [0.000]	17.525*** [0.000]	14.347*** [0.000]
0.3	1.432 [0.146]	2.774 [0.015]	14.835*** [0.000]	12.128*** [0.000]
0.4	1.354 [0.127]	3.750 [0.024]	14.415*** [0.000]	18.344*** [0.000]
0.5	1.331 [0.125]	1.847 [0.144]	21.475*** [0.000]	15.145*** [0.000]
0.6	0.172 [0.246]	3.414 [0.022]	15.245*** [0.000]	18.125*** [0.000]
0.7	0.154 [0.224]	1.957 [0.142]	17.455*** [0.000]	17.145*** [0.000]
0.8	1.155 [0.144]	3.484 [0.021]	18.415*** [0.000]	16.525*** [0.000]
0.9	1.155 [0.127]	2.447 [0.170]	18.475*** [0.000]	17.148*** [0.000]
0.95	1.172 [0.154]	1.347 [0.451]	17.525*** [0.000]	14.347*** [0.000]
China				
[0.05–0.95]	1.541 [0.121]	2.384 [0.201]	17.525*** [0.000]	14.347*** [0.000]
0.05	4.872*** [0.00]	1.348 [0.1421]	14.835*** [0.000]	12.128*** [0.000]
0.1	2.318 [0.015]	2.328 [0.1012]	14.415*** [0.000]	18.344*** [0.000]
0.2	3.142 [0.0142]	1.745 [0.15]	21.475*** [0.000]	15.145*** [0.000]
0.3	1.412 [0.142]	12.785*** [0.000]	15.245*** [0.000]	18.125*** [0.000]
0.4	1.384 [0.125]	3.45 [0.014]	17.455*** [0.000]	17.145***[0.000]
0.5	1.341 [0.124]	1.875 [0.124]	18.415*** [0.000]	16.525*** [0.000]
0.6	0.142 [0.242]	3.475 [0.012]	18.475*** [0.000]	17.148*** [0.000]
0.7	0.124 [0.225]	1.955 [0.112]	17.525*** [0.000]	14.347*** [0.000]
0.8	1.145 [0.142]	3.485 [0.011]	18.845*** [0.000]	18.845*** [0.000]
0.9	1.125 [0.125]	2.475 [0.140]	18.855*** [0.000]	14.348*** [0.000]
0.95	1.142 [0.142]	1.344 [0.451]	17.475*** [0.000]	16.384*** [0.000]
Mexico				
[0.05–0.95]	[0.201] 1.561]	16.435*** [0.000]	15.855*** [0.000]	[0.05–0.95] 2.344
0.05	4.872*** [0.00]	1.348 [0.1421]	14.835*** [0.000]	12.128*** [0.000]
0.1	2.318 [0.015]	2.328 [0.1012]	14.415*** [0.000]	18.344*** [0.000]
0.2	3.142 [0.0142]	1.745 [0.15]	21.475*** [0.000]	15.145*** [0.000]
0.3	1.412 [0.142]	12.785*** [0.000]	15.245*** [0.000]	18.125*** [0.000]
0.4	1.384 [0.125]	3.45 [0.014]	17.455*** [0.000]	17.145*** [0.000]
0.5	1.343 [0.124]	1.874 [0.124]	23.835*** [0.000]	14.745*** [0.000]
0.6	0.144 [0.244]	3.474 [0.012]	18.425*** [0.000]	16.445*** [0.000]
0.7	0.125 [0.224]	1.955 [0.112]	14.725*** [0.000]	14.865*** [0.000]
0.8	1.146 [0.143]	3.384 [0.011]	13.855*** [0.000]	14.865*** [0.000]
0.9	1.126 [0.124]	2.442 [0.140]	14.855*** [0.000]	17.378*** [0.000] 0.95
0.95	1.144 [0.146]	1.33 [0.451]	15.445*** [0.000]	17.354*** [0.000]
Turkey				
[0.05–0.95]	1.543 [0.122]	2.384 [0.202]	15.345*** [0.000]	15.435*** [0.000]
0.05	4.413*** [0.00]	1.3434 [0.143]	16.425*** [0.000]	15.675*** [0.000]
0.1	2.314 [0.012]	2.333 [0.123]	14.445*** [0.000]	16.345*** [0.000]
0.2	3.143 [0.0122]	1.732[0.124]	14.435*** [0.000]	26.435*** [0.000]

Quantiles	$\Delta ED_t \downarrow \Delta EC_t$	$\Delta ED_t \downarrow \Delta ER_t$	$\Delta EC_t \downarrow \Delta ED_t$	$\Delta ER_t \downarrow \Delta ED_t$
0.3	1.412 [0.143]	8.724*** [0.000]	26.425*** [0.000]	23.325*** [0.000]
0.4	1.322 [0.124]	3.432 [0.013]	23.345*** [0.000]	15.235*** [0.000]
0.5	1.823 [0.123]	13.235*** [0.000]	22.215*** [0.000]	1.323 [0.123]
0.6	0.132 [0.232]	3.432 [0.014]	15.325*** [0.000]	13.335*** [0.000]
0.7	0.123 [0.223]	1.923 [0.115]	13.245*** [0.000]	15.345*** [0.000]
0.8	1.123 [0.142]	3.432 [0.012]	14.455*** [0.000]	13.435*** [0.000]
0.9	1.142 [0.132]	2.432 [0.144]	12.325*** [0.000]	15.348*** [0.000]
0.95	1.123 [0.121]	1.3424 [0.452]	15.445*** [0.000]	16.344*** [0.000]
Indonesia				
[0.05–0.95]	1.541 [0.121]	2.384 [0.201]	17.415*** [0.000]	14.895*** [0.000]
0.05	4.412*** [0.00]	1.348 [0.1421]	18.845*** [0.000]	17.875*** [0.000]
0.1	2.318 [0.015]	2.328 [0.10]	17.475*** [0.000]	12.415*** [0.000]
0.2	3.142 [0.0142]	7.745*** [0.000]	19.485*** [0.000]	23.785*** [0.000]
0.3	1.412 [0.142]	8.785*** [0.000]	24.655*** [0.000]	24.845*** [0.000]
0.4	1.384 [0.125]	3.45 [0.014]	23.785*** [0.000]	15.545*** [0.000]
0.5	1.341 [0.124]	1.875 [0.124]	21.845*** [0.000]	16.745*** [0.000]
0.6	0.142 [0.242]	3.475 [0.012]	15.475*** [0.000]	18.475*** [0.000]
0.7	0.124 [0.225]	1.955 [0.112]	17.785*** [0.000]	17.845*** [0.000]
0.8	1.145 [0.142]	3.485 [0.011]	18.845*** [0.000]	18.845*** [0.000]
0.9	1.125 [0.125]	2.475 [0.140]	18.855*** [0.000]	14.348*** [0.000]
0.95	1.142 [0.142]	1.344 [0.451]	17.475*** [0.000]	16.384*** [0.000]

*Note: The Table presents the results of the F statistics obtained from the quantile test using Granger causality. The corresponding p-values are enclosed in square brackets. At a significance level of 1%, the rejection of the null hypothesis of no causation is denoted by ****