09_NARDL

QuantFit Estimator Standard Operating Procedure

SOP: Nonlinear ARDL (NARDL)

Shin-Yu-Greenwood-Nimmo asymmetric ARDL

=> NARDL splits a regressor into positive and negative cumulative shocks to test asymmetric effects.

1. Purpose

NARDL replaces symmetric X with X? (sum of positive changes) and X^- (sum of negative changes) to test whether positive and negative shocks have different long-run and short-run effects. Wald tests for asymmetry give a formal statistical decision.

2. When to use this estimator

Theory predicts asymmetric responses (sticky prices, downside risk aversion, etc.).

Visual evidence of asymmetric reaction in residuals.

Same I(0)/I(1) data conditions as ARDL.

3. Required data structure

Same prerequisites as ARDL (no I(2)).

Identify which regressors to decompose into ?/^- asymmetries.

4. Mathematical formulation

Partial-sum decomposition of X plus standard ARDL UECM:

X_t? = Sum_{s<=t} max(DeltaX_s, 0)

X_t^- = Sum_{s<=t} min(DeltaX_s, 0)

DeltaY_t = alpha + phi Y_{t-1} + theta? X_{t-1}? + theta^- X_{t-1}^- + Sum ? DeltaY_{t-i} + Sum (?? DeltaX_{t-l}? + ?^- DeltaX_{t-l}^-) + epsilon_t

Long-run: L? = - theta? / phi;   L^- = - theta^- / phi

Wald LR: H0: L? = L^-;   Wald SR: H0: Sum?? = Sum?^-

5. Pre-estimation diagnostics

All ARDL pre-tests apply.

Decide which X to decompose; usually theoretical priors guide this.

6. Estimation procedure

Construct X? and X^- partial-sum series for each asymmetric regressor.

Estimate UECM with X? and X^- in place of X.

Compute long-run L? and L^- with delta-method SE.

Compute dynamic multipliers per horizon for both regimes.

Run Wald asymmetry tests (long-run, short-run).

Run bounds test on the extended set (k_extended = k + #asymmetric).

7. Output produced

8. Output interpretation

Wald LR p < 0.05 => asymmetric long-run response confirmed.

Wald SR p < 0.05 => asymmetric short-run response confirmed.

Dynamic multiplier chart shows the time profile of L? and L^-.

If both Wald tests fail to reject, ARDL (symmetric) is sufficient.

9. Post-estimation diagnostics

Bounds test on extended k.

Card A diagnostics.

CUSUM / CUSUMSQ stability.

Plot dynamic multipliers with CI bands.

10. Common pitfalls

Decomposing too many regressors thins degrees of freedom.

Asymmetry conclusions depend on bounds-test cointegration - confirm first.

Interpret L? / L^- only when phi? is significantly negative.

11. Reporting checklist

Which regressors are decomposed and theoretical motivation.

L? and L^- with stars.

Wald LR / SR asymmetry tests.

Dynamic multiplier chart.

Bounds test F and t.

Card A diagnostics.

12. References

Shin, Y., Yu, B., Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework.

Field | Meaning

ardlOrder | Selected lag structure

ect | phi?

lrPos / lrNeg / lrPosSE / lrNegSE | Asymmetric long-run multipliers

waldLRStat / waldLRPValue | Long-run asymmetry test waldSRStat / waldSRPValue | Short-run asymmetry test

isAsymmetric | True when waldLRPValue < 0.05

dynamicMultipliersPos / dynamicMultipliersNeg | Per-horizon multipliers

dynamicMultipliersPosCI / dynamicMultipliersNegCI | Bootstrap CIs

uecmCoefficients / SE / TStats / PValues | Full UECM table