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ROAD FREIGHT TRAFFIC AND INDUSTRIAL ACTIVITY: EVIDENCE FROM THE GREEK CRISIS

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Structure of the presentation:

- Motivation and objectives of the paper
- Data description
- Description of the proposed toll index
- Econometric modelling
- Results
- Conclusions
- Ideas for future research

Study motivation:

✓ There are well established and varying linkages among transport, economic development and the environment, which may change by the level of development, economic growth rate and type of transport.

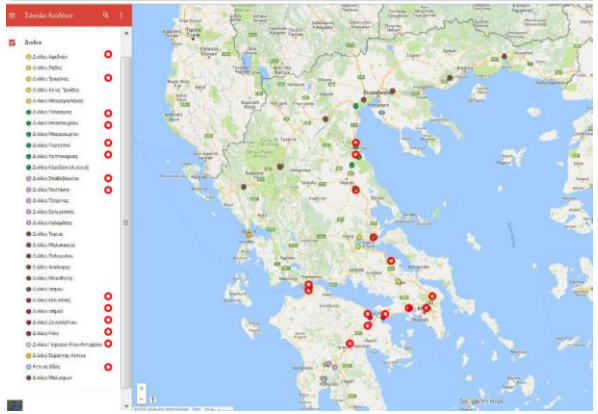
✓ There is an increasing concern about the effectiveness of 'decoupling' strategies (introduced in the White Paper for Transport 2001, to increase transport at a lower rate than the economy at large) aimed at 'greening' and improving transport efficiency without curbing economic growth.

Study objectives:

➢ Construct a *toll index* for Greece describing the traffic intensity of truck vehicles along most of the suburban and interurban highway toll stations of the country.

➢ Use the toll index to determine the **short- and long-term impact** of freight traffic on manufacturing or industrial activity in Greece, during a long and deep economic recession.

Data description



Sample period

- From April 2008 to April 2016: 97 monthly observations about the number of trucks passing along suburban (Attica's peripheral) and interurban highway toll stations.

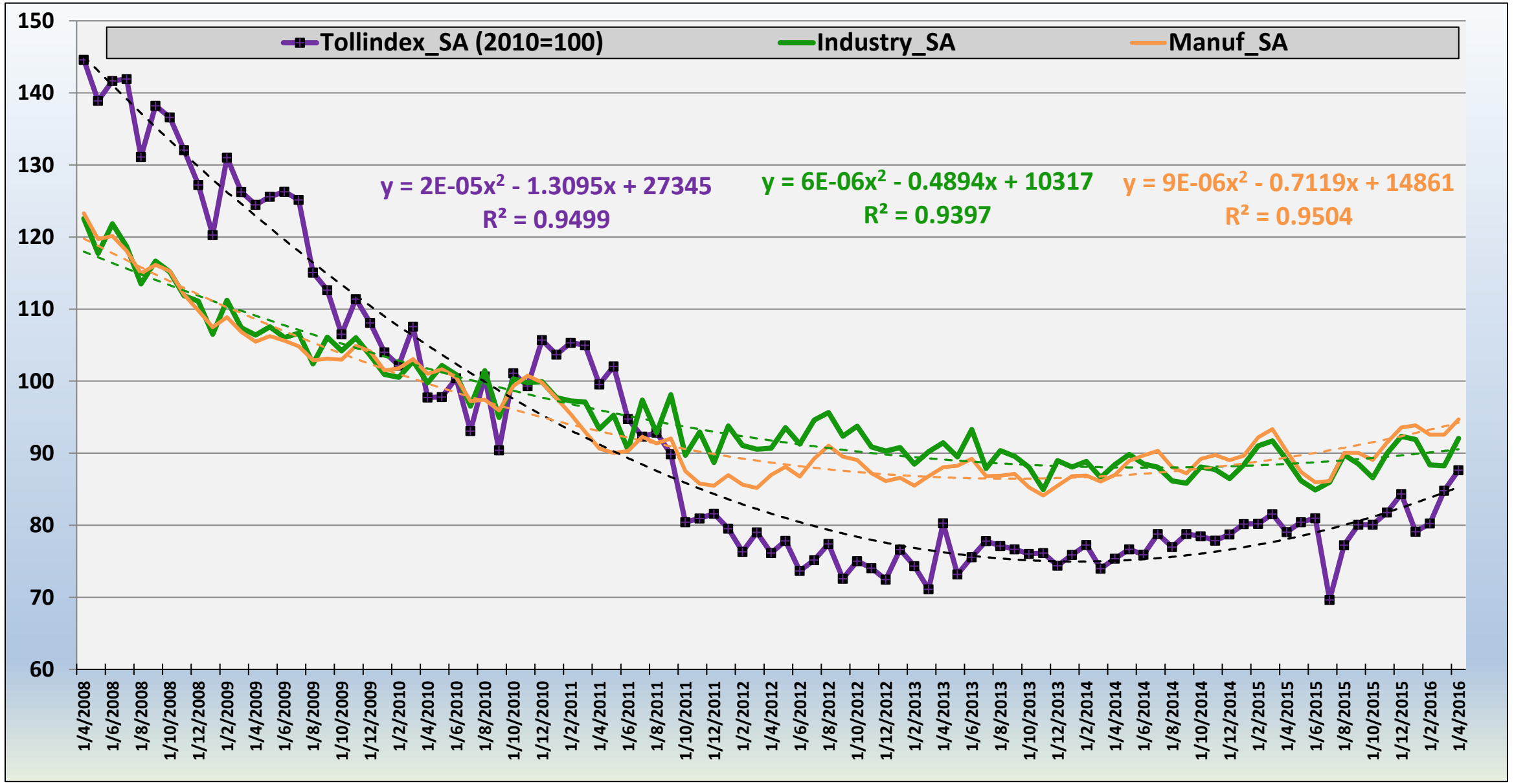
Toll highway traffic sample

- It encompasses key highway links (from four highway concession companies) spanning the main development axis of mainland Greece:
  - Along the Patras-Athens-Thessaloniki corridor, and passing through six NUTS-2 regions:
    - The highway links refer to the Rio-Antirrio Bridge (Western Greece), highway segments among Attiki and Central Greece, as well as between Central Greece, Thessaly and Central Macedonia, and highway segments between Attiki and prefectures of Peloponnese Region.
- Truck traffic refers to ***Category 3*** for 2-axle and 3-axle goods vehicles and ***Category 4*** for 4-(and more) axle goods vehicles. Based on their maximum payload, the total number of goods vehicles is summed using weights equal to 40% for Category 3 and 60% for Category 4.

Description of indices

- **Toll index**: composite index composed of 14 weighted toll indices in Greece
  - Standardization of the toll highway traffic volume (2010 = 100).
  - *Source*: Own processing based on data originating from concession companies and the Ministry of Infrastructure and Transport
- **Manufacturing index** for Greece
  - Gross value added of industrial manufacturing (2010 = 100).
  - *Source*: Own processing based on ELSTAT
- **Industry index** for Greece
  - Gross value added of the whole industry sector (2010 = 100).
  - *Source*: Own processing based on ELSTAT
- Each index is seasonally adjusted data (controlling for working days and calendar effects) and the monthly average value in 2010 equals 100.

Time evolution of the *toll*, *industry*, and *manufacturing* indices



Some empirical observations

- The correlation coefficient of the toll index with the manufacturing (industry) index is 95.67% (95.21%).
- One can notice that there is evidence of ***quadratic trend*** in all three time-series.
- It seems that the series co-move and there might be evidence of co-integration.
- All these are crucial for the econometric model specification.

Econometric modelling I

- We employ the famous Autoregressive Distributed Lag (ARDL) model of Pesaran and Shin (1999).

$$Y_t = \boldsymbol{c} + \sum_{j=1}^{p} \lambda_j \cdot Y_{t-j} + \sum_{i=0}^{q} b_i \cdot X_{t-i} + u_t$$

  where *c* contains deterministic factors (constant term, trends) and *u* is the serially uncorrelated error term.

- ARDL allows for estimation of short-run (SR) and long-run (LR) effects of *X* on *Y* in 1-step efficiently, and for SR causality of *Y* on *X*.
- Employed variables can be either *I*(1) or *I*(0), but they must not be *I*(2).
- Co-integration is tested with the bounds testing procedure of Pesaran, Shin and Smith (2001), as extended by Bertsatos, Sakellaris and Tsionas (2022, 2023).

Econometric modelling II

- First, we examine the responses of the *ln* of manufacturing index on the *ln* of toll index. We use the natural logarithm (*ln*) to estimate elasticities.

$$MAN_t = c + m \cdot t + n \cdot t^2 + \sum_{j=1}^{p} \lambda_j \cdot MAN_{t-j} + \sum_{i=0}^{q} b_i \cdot TOLL_{t-i} + u_t$$

- Second, we estimate the effects of the *ln* of toll index on the *ln* of industry index.

$$IND_t = c + m \cdot t + n \cdot t^2 + \sum_{j=1}^{p} \lambda_j \cdot IND_{t-j} + \sum_{i=0}^{q} b_i \cdot TOLL_{t-i} + u_t$$

- We allow for maximum of 12 lags, and we use the Schwarz (SIC) and Akaike (AIC) criteria for the lag selection.

- The efficient sample is from 2009:M05 to 2016:M04, i.e., $T = 84$.

Results I

Unit-root tests

- Before we run the ARDL models, we make sure that none of the employed variables are I(2) or have a higher order of integration.
- Augmented Dickey-Fuller (ADF) (1979) tests with intercept, linear and quadratic trend (c, t, t^2) are employed.
- There is no evidence of I(2) variables, either with SIC or AIC.
- For robustness, we also use ADF tests with intercept (c), and intercept and linear trend (c, t). Similar results are obtained.
- Now, we can proceed with ARDL estimation and test:

Hypothesis 1: **LR effect of TOLL on MAN**

Hypothesis 2: **SR effect of TOLL on MAN**

Results II
ARDL estimates "MAN TOLL". SIC (2,1)

ARDL in levels

The dependent variable is *LOGMAN*

Selected model: ARDL(2,1)

Variable	Coefficient	Std. Error	t-Statistic
LOGMAN(-1)	0.970977	0.095130	10.20681
LOGMAN(-2)	-0.342636	0.095250	-3.597247
LOGTOLL	0.155814	0.036743	4.240626
LOGTOLL(-1)	-0.163259	0.036585	-4.462426
TREND	-0.001846	0.000407	-4.538727
TREND^2	1.42E-05	3.08E-06	4.609885
C	0.794202	0.146805	5.409896

- Testing for serial correction, we find no such evidence.
- There is evidence of normally-distributed errors according to Jarque-Bera test.

ARDL in error-correction form

The dependent variable is Δ(LOGMAN)

Variable	Coefficient	Std. Error	t-Statistic
D(LOGMAN(-1))	0.342636	0.095250	3.597247
D(LOGTOLL)	0.155814	0.036743	4.240626
LOGMAN(-1)	-0.371659	0.074206	-5.008449
LOGTOLL(-1)	-0.007445	0.033847	-0.219951
TREND	-0.001846	0.000407	-4.538727
TREND^2	1.42E-05	3.08E-06	4.609885
C	0.794202	0.146805	5.409896

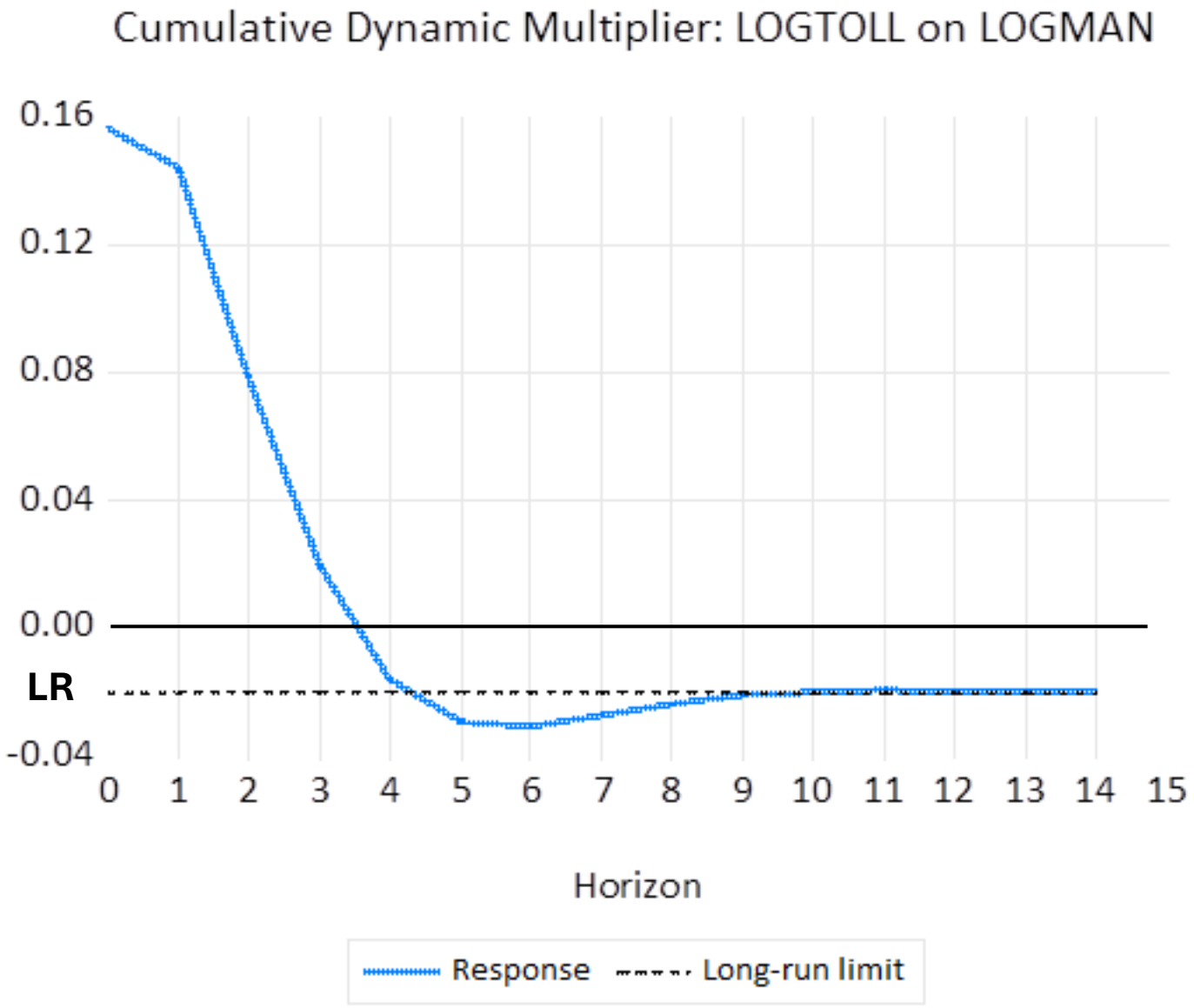
- The error-correction term is -0.372 and statistically significant, implying a speed of adjustment equal to 37.2% to any disequilibrium in the toll index within the first month.
- The results imply a *weak negative decoupling* between industrial activity and freight traffic given that the toll index elasticity equals to 0.16 (i.e., $\Delta GDP<0$, $\Delta VOL<0$, %ΔVOL / %ΔGDP = 0-0.8).

Results III
ARDL estimates "MAN TOLL". SIC (2,1)

- We employ the bounds testing procedure, based on the ARDL in error-correction form, for the existence of a co-integrating relationship running from *TOLL* to *MAN*.
- It turns out that *MAN*(-1) and *TOLL*(-1) are jointly statistically significant, with or without the deterministic trends.
  - F_{yx} test is passed. Step 1
- The error-correction term (ECT) is statistically significant.
  - t_y test is passed. Step 2
- However, *TOLL*(-1) is statistically insignificant.
  - t_x test is not passed. Step 3
- We find evidence of **degenerate co-integration.**
  - The LR multiplier of TOLL on MAN $\frac{-TOLL_{t-1}}{MAN_{t-1}} = -0.02$ is not statically significant as well.

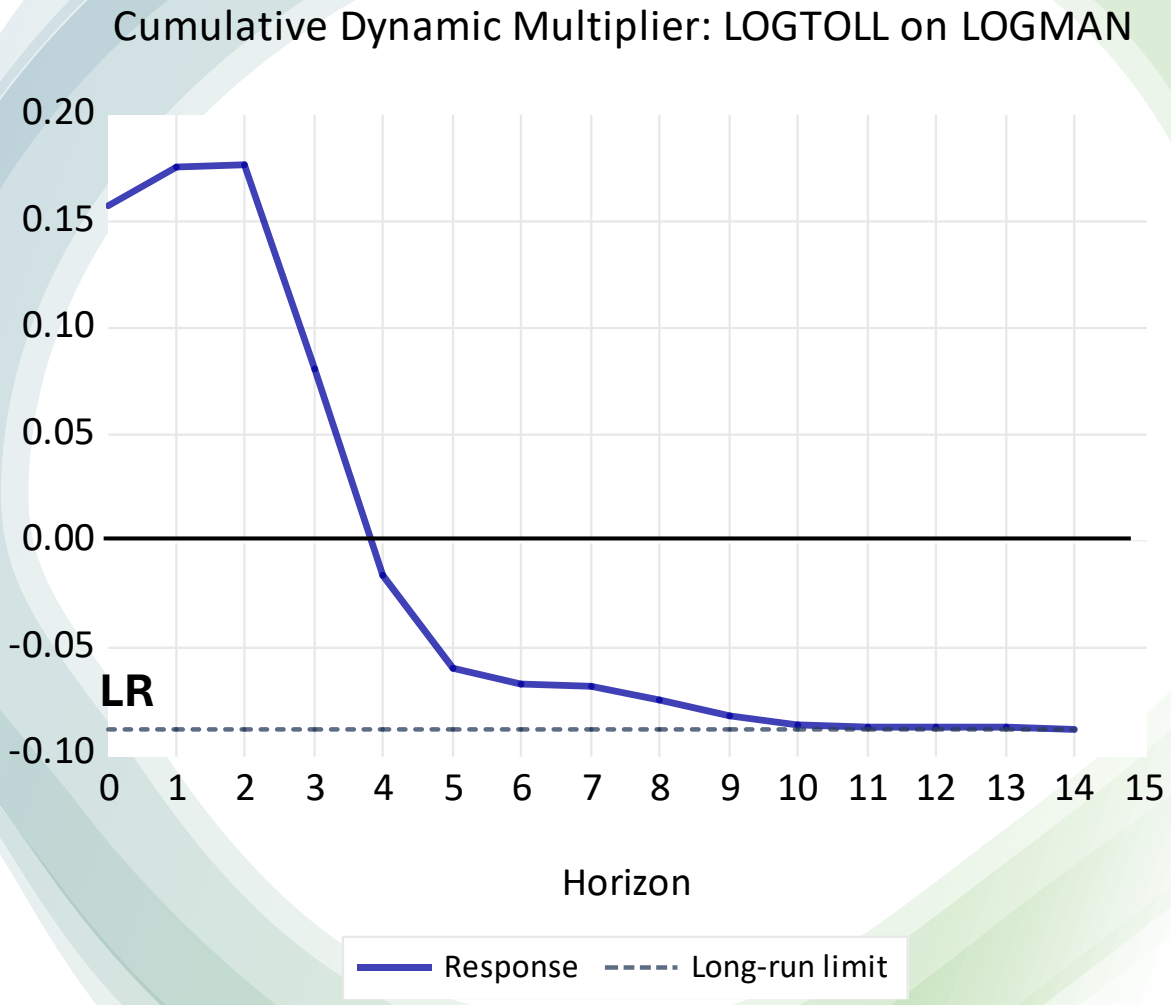
Results IV – ARDL estimates "MAN TOLL". SIC (2,1)

- Even if the LR effect of TOLL is statistically insignificant, there are statistically significant SR effects in the next two months.
- A 1% change in *TOLL* today suggests a 0.156% change in *MAN* at $t = 0$.
- A 1% change in *TOLL* suggests a 0.144% change in *MAN* at $t = 1$:
- For $t \geq 2$, the effect fades out.



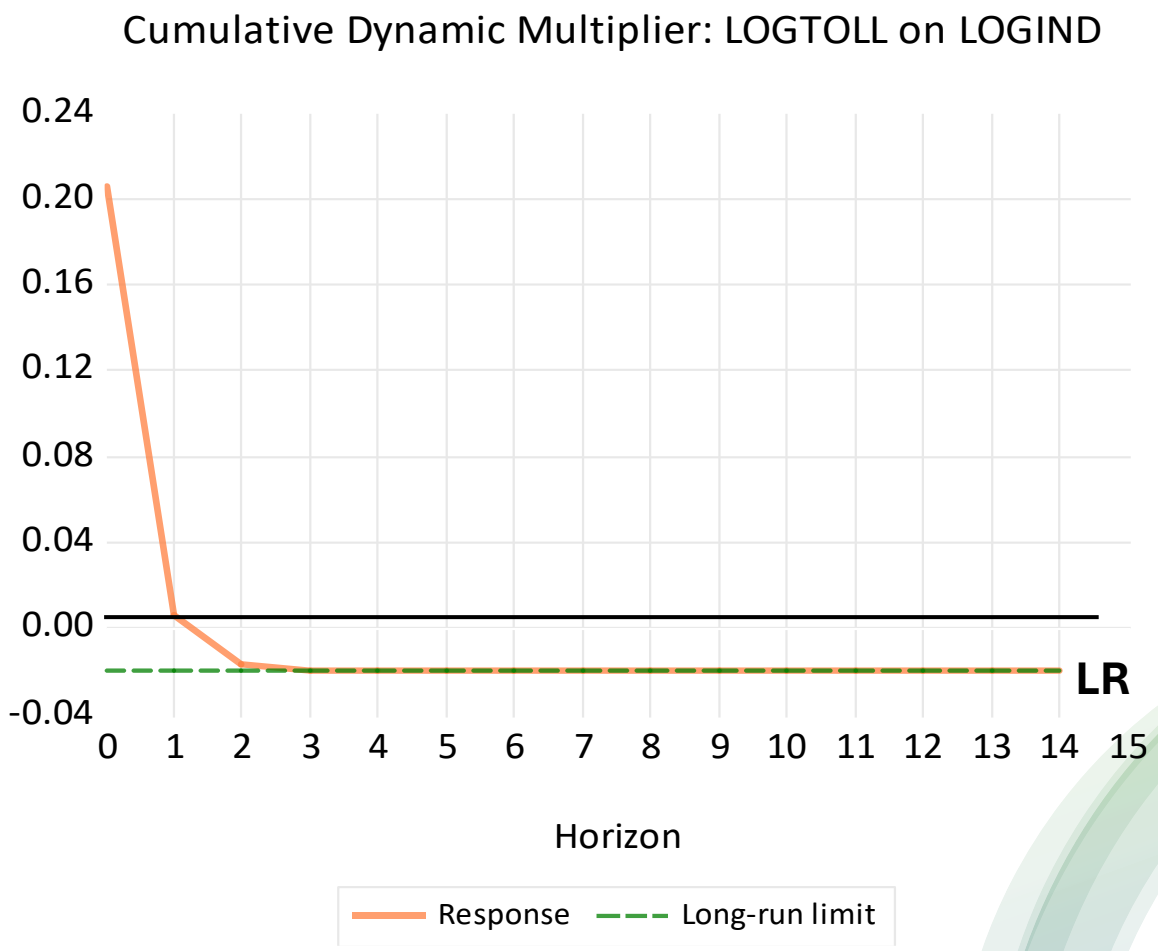
Results V – ARDL estimates “MAN TOLL” AIC (3,3)

- Similar results are obtained.
- A 1% change in *TOLL* today suggests a 0.157% change in *MAN* at $t = 0$.
- A 1% change in *TOLL* today suggests a 0.175% change in *MAN* at $t = 1$.
- A 1% change in *TOLL* today suggests a 0.176% change in *MAN* at $t = 2$ (at 10% size though).
- For $t \geq 3$, the effect fades out.



Results VI – ARDL estimates "IND TOLL". SIC (1,1)

- Almost similar results with *MAN*:
  - Degenerate case of co-integration.
  - There is no statically significant long-run response of *IND* to *TOLL*.
- A 1% change in *TOLL* today suggests an instant 0.206% change in *IND*.
- For $t \geq 1$, the effect vanishes.



Conclusions

1. A 1% increase in toll index appears to temporarily increase the manufacturing index by 0.16% with a fast time of adjustment of manufacturing activity to reach its steady-state value, and it takes approximately 10 months to close 99% of the gap.

2. Thus, a *weak negative decoupling* between road freight traffic and manufacturing (industrial) activity exists. These results are like other in EU countries (during the crisis period) and can be mostly attributed to the low productivity growth and the limited efficiency and competitiveness of road transport sector. They also depict the inability to move towards strong decoupling.

3. The toll index could potentially be used for nowcasting or near-term forecasting of changes in industrial/manufacturing activity.

4. The findings can potentially support public and private investment decisions on road capacity building according to economic cycles.

Ideas for possible extensions and future research

1. Examine whether the results are robust when we exclude Attica region or when we consider individual regions of the country.

2. Update the sample with latest observations and see whether there is robustness with existing results or not in a period of stable positive economic growth.

3. Test for possible asymmetric effects of *TOLL* on *MAN* :

   Does an increase in *TOLL* exert the same effect on *MAN* as an equal decrease in *TOLL*?
   → NARDL model (nonlinear ARDL): $TOLL^{+}\ vs\ TOLL^{-}$, Shin, Yu and Greenwood-Nimmo (2014)

4. Include other indices to test the forecasting performance, such as the business confidence and market sentiment indicators.

5. Apply the proposed methodology and compare the results regarding the Greek toll index to more countries (in the EU and beyond).

Thank you for your attention!

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