State-space based analysis and forecasting of macroscopic road safety trends in Greece

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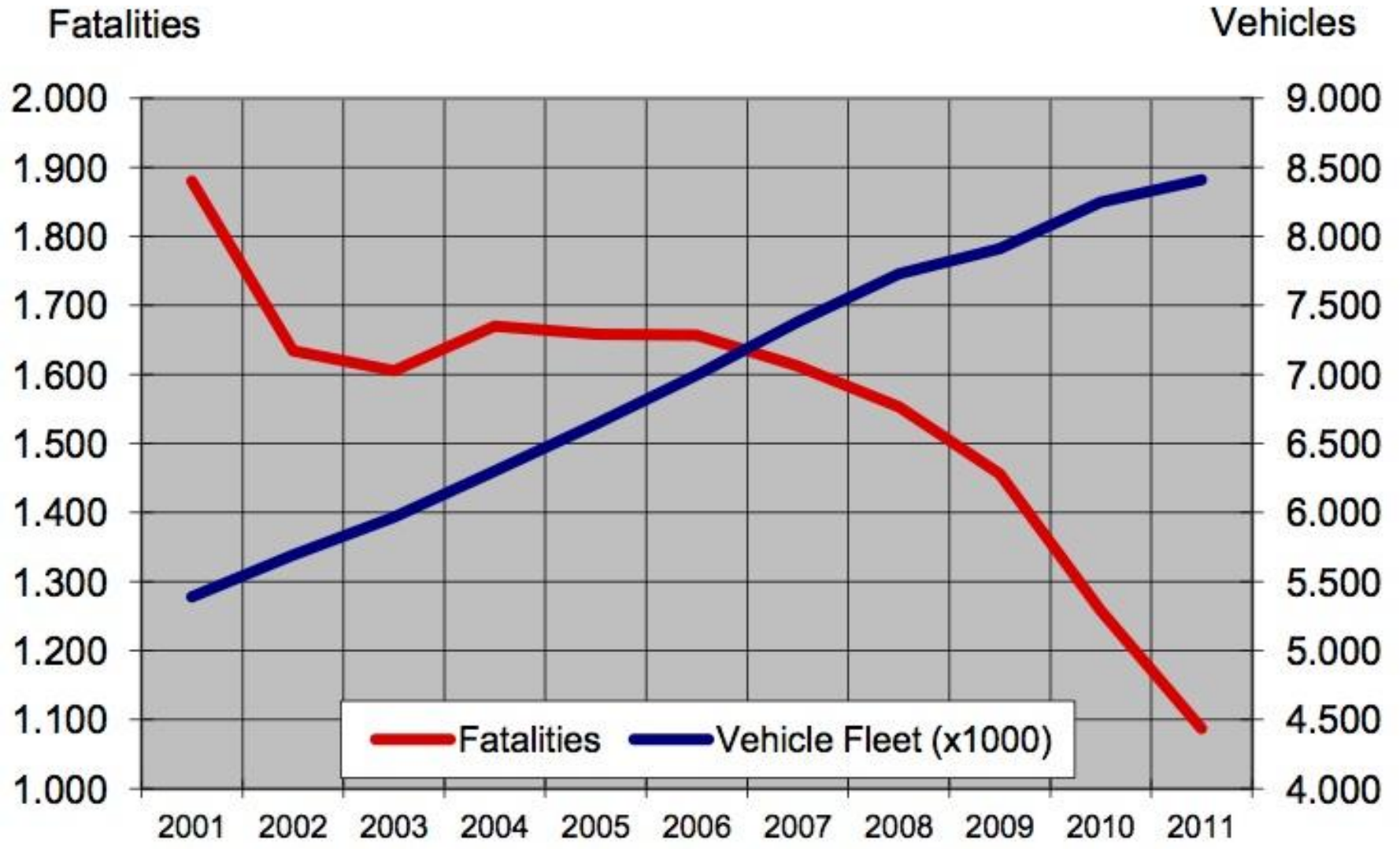
Basic road safety figures, Greece 2001-2011 (1/2)



Basic road safety figures, Greece 2001-2011 (2/2)

- During the last decade, road fatalities in Greece have decreased by 42%, whereas serious injuries decreased by 50%
- The rate of fatalities per number of vehicles has decreased the same period by 63%
- This high fatalities rate is also explained by the high increase of the vehicle fleet in Greece during the same period
- Increase in Police enforcement was found correlated to the road fatalities decrease

Background

- The analysis of macroscopic road safety trends has received a lot of attention in the literature
- Using dedicated time series analysis techniques such as ARMA-type and state space modeling is recommended
  - These two types of models are not exclusive of one another as each type of model may also be written under different forms, and
  - equivalences between well-defined specifications have been empirically demonstrated.
- Reliable estimates of exposure (vehicle-kilometers) are not available for Greece
  - Suitable proxies, such as vehicles in circulation, GDP, or fuel consumption are considered

Methodology (1/2)

- **Seemingly unrelated time-series equations (SUTSE)**
  - Simpler model
  - Also used as a diagnostic to determine whether more elaborate models would be useful
- **Latent risk time-series model (LRT)**
  - Without interventions
  - With interventions

- Model comparison
  - Non-nested models → Summary likelihood-based diagnostics unsuitable
  - Model quality tests (autocorrelation, heteroscedasticity, normality, transition correlations, …)

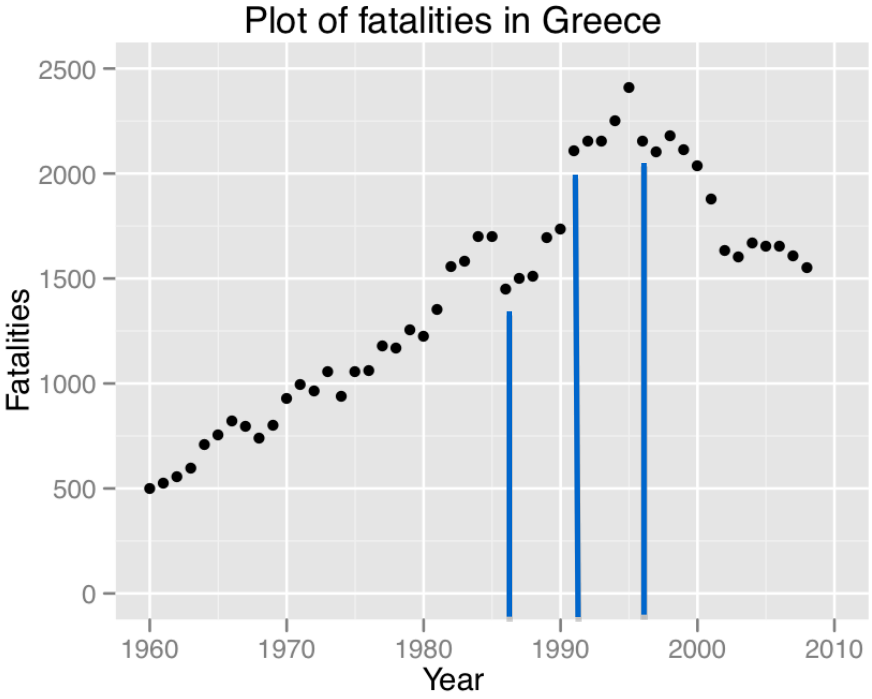
Methodology (2/2)

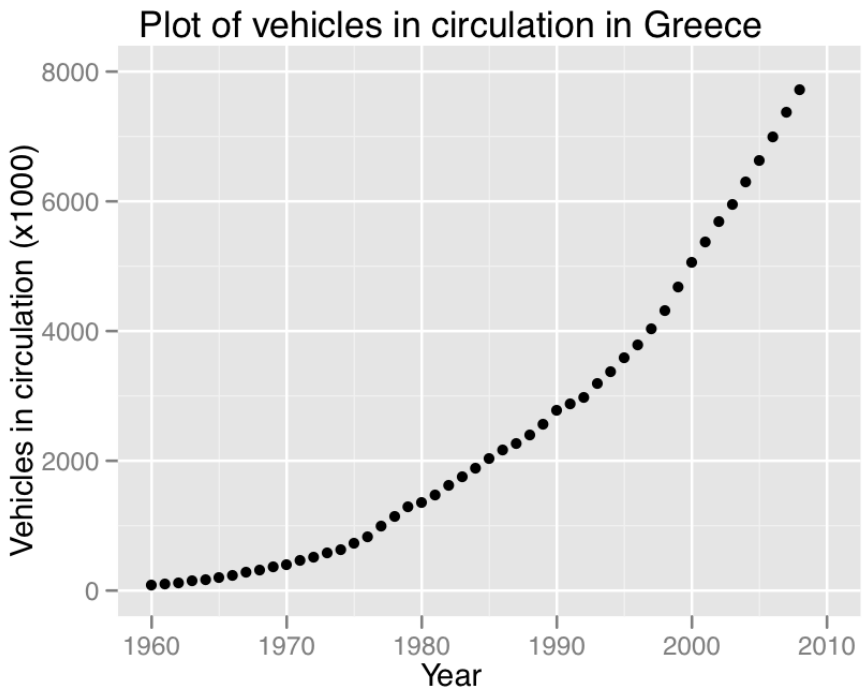
- Data used in this research were extracted from:
  - the CARE database of the European Commission with disaggregate data on road fatalities,
  - the Eurostat database with aggregate statistics on all sectors

- Processing and analysis of these data took place within the Dacota EU co-funded research project (2010-2012)

- These results will be soon available at the European Road Safety Observatory of the European Commission (www.erso.eu).

Data Considered

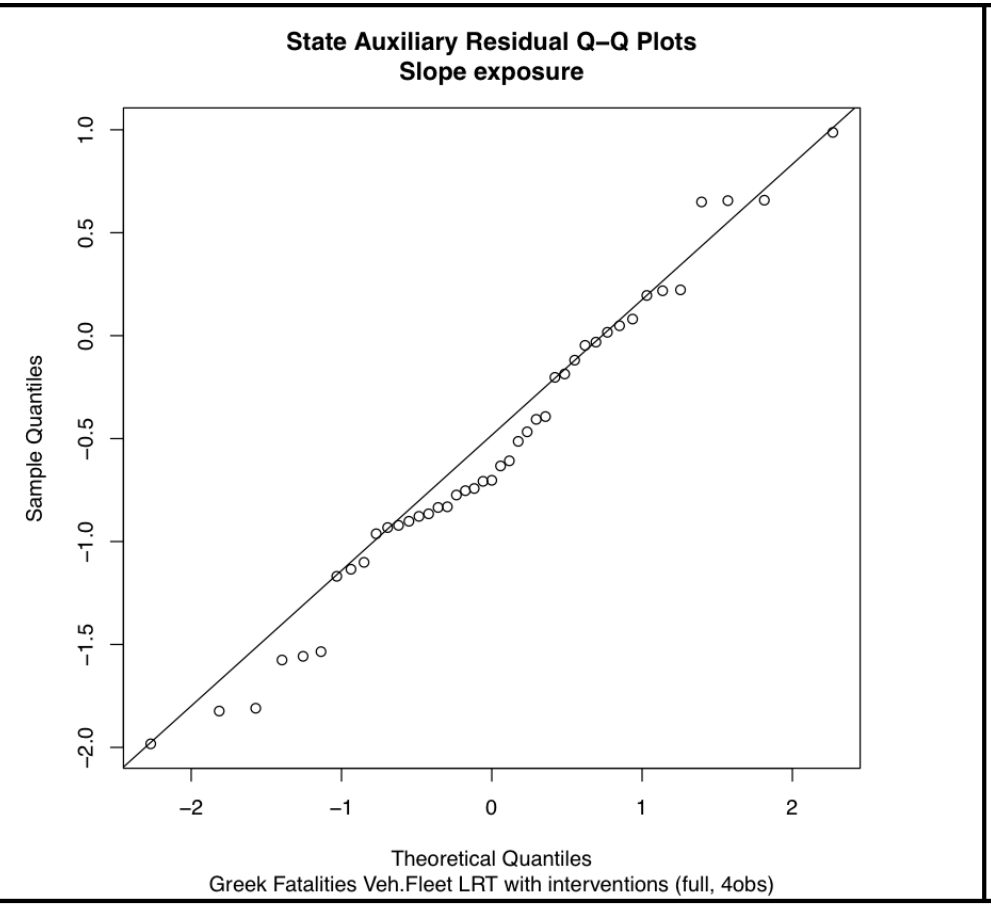


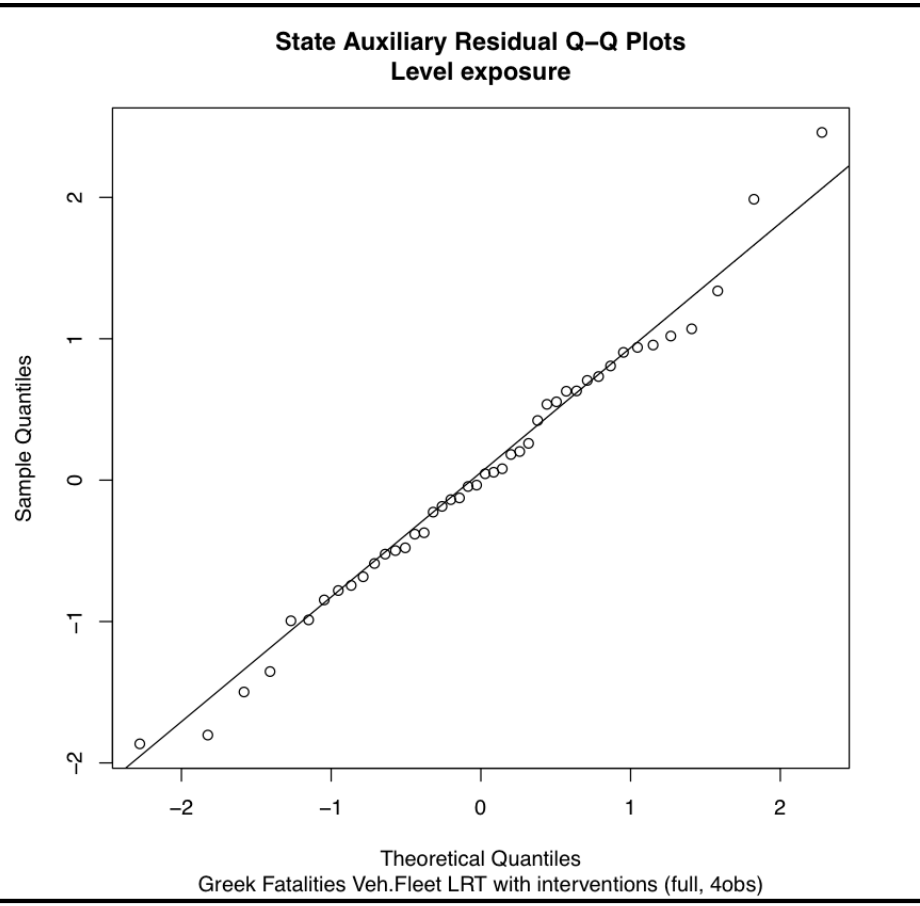


Interventions in the fatalities:

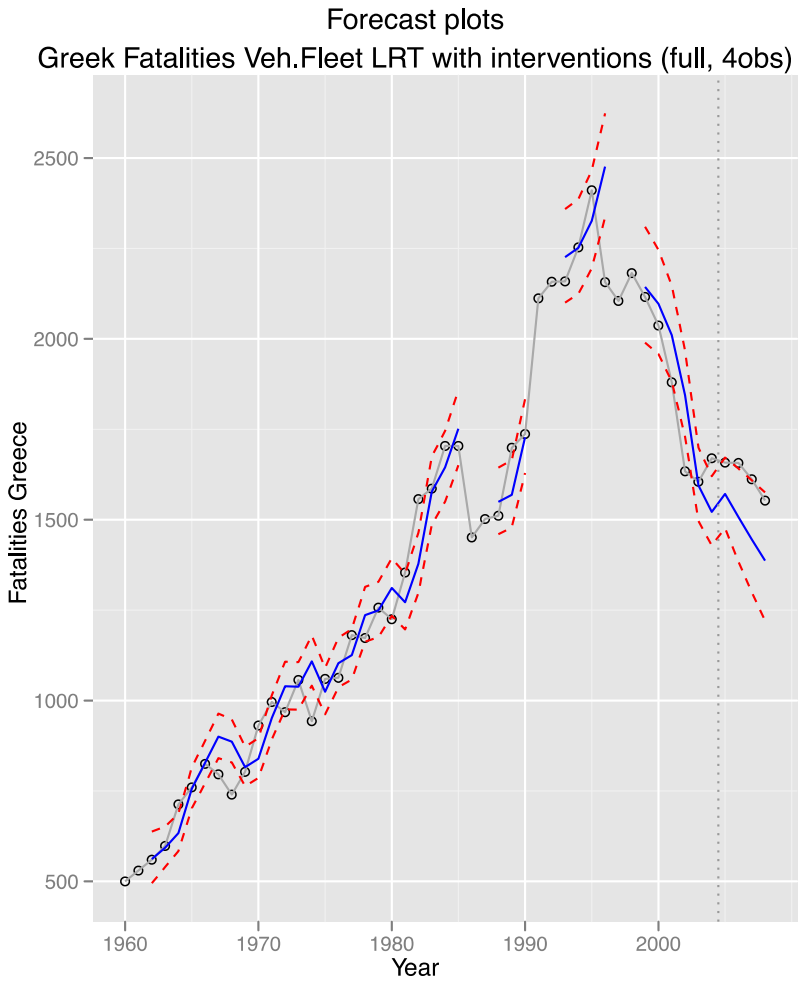
- 1986: financial crisis
- 1991: “old-car-exchange” scheme
- 1996: fatality recording change (24hr → 30 day)

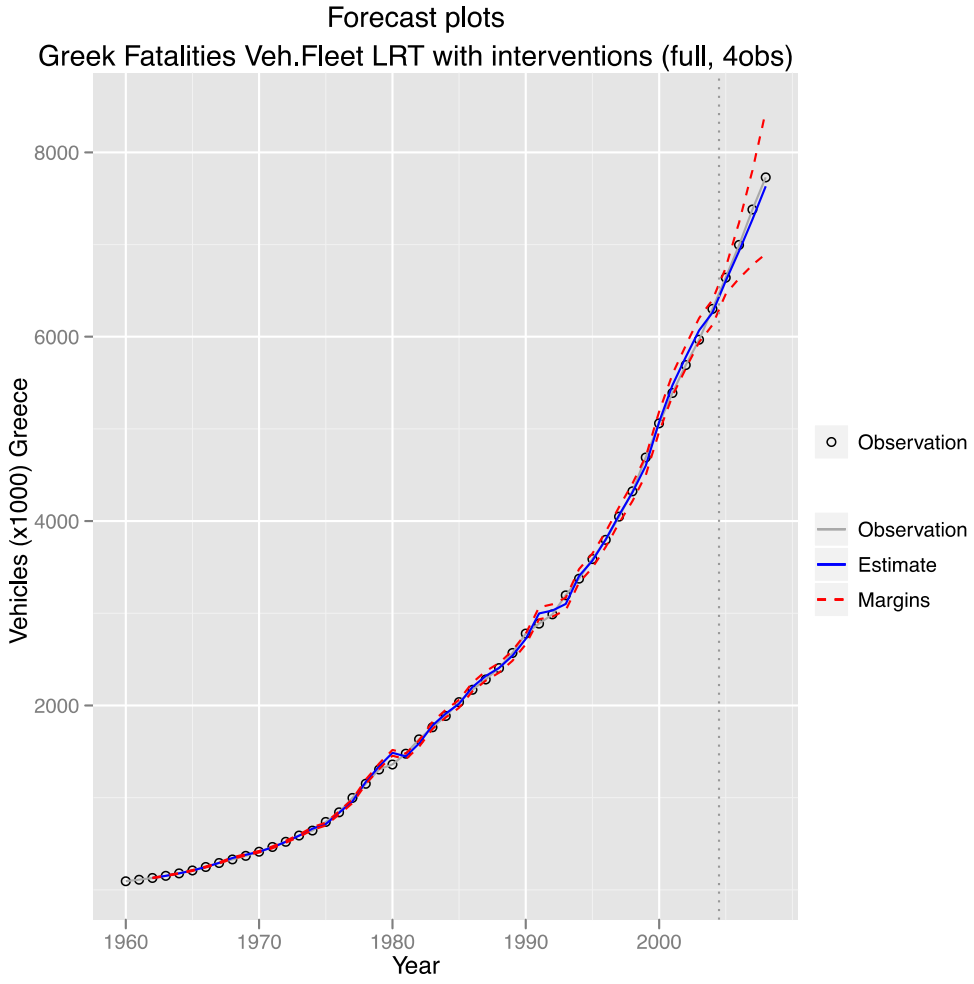
Residual analysis for final LRT model



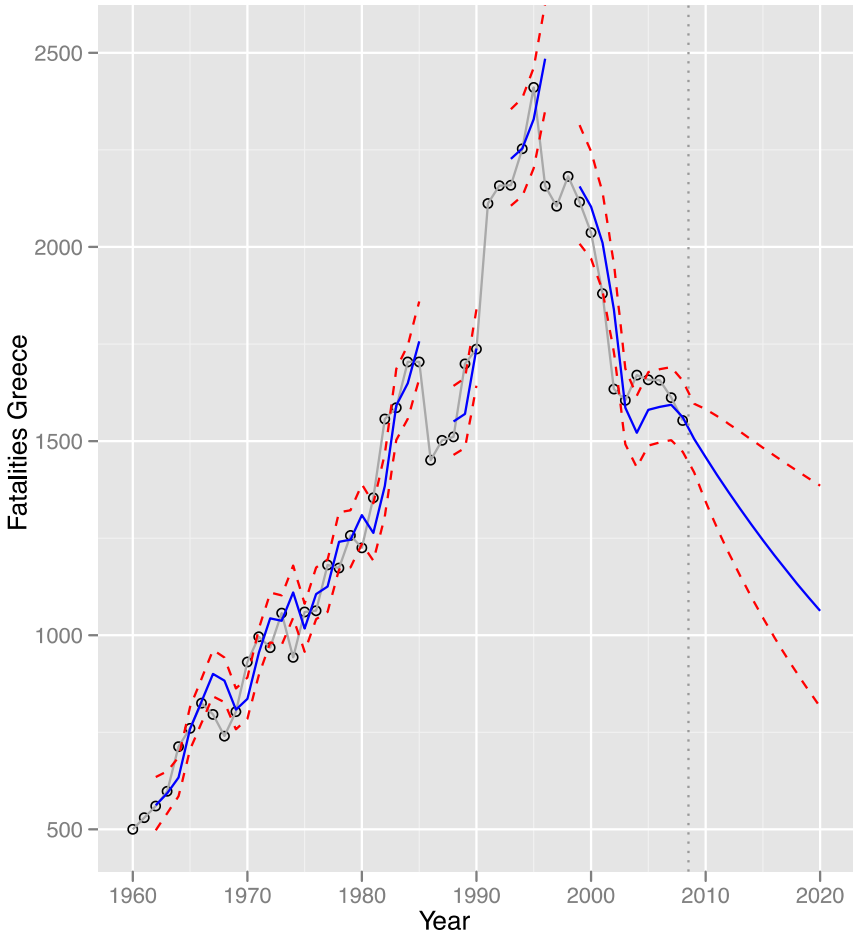


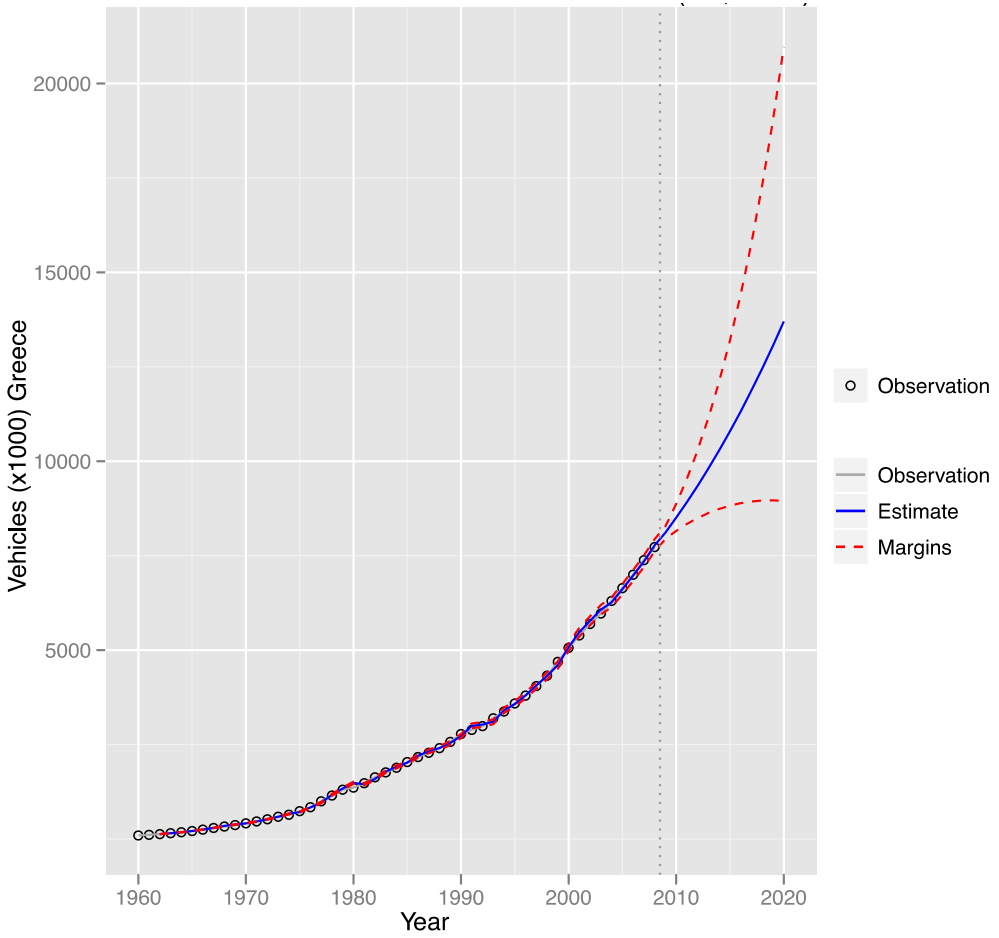
Validation Results





Forecasting Results





Conclusion

- Multivariate state-space models were developed for the analysis and forecasting of macroscopic road safety trends in Greece
  - Inclusion of exposure measures
  - Modeling of interventions

- Validation and forecasting results are presented
  - Useful in confirming that there is no overfitting
  - Comparisons with final actual data (2009-2010) indicate that the models perform properly, even in unusual situations, like the current strong financial crisis in Greece.

Directions for further work

- Other functional forms and model specifications
- Additional parameters (e.g. GDP) to separate exogenous effects and isolate road safety trends
- Comparison across countries and regions

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