DaCoTA

Models of road safety developments

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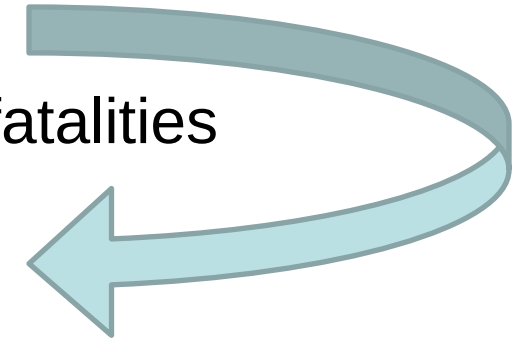
Plan

- Structural Models of trend
- Bivariate models
  - SUTSE model
  - LRT , the Latent Risk model
- Dependencies between fatalities and exposure
- Model choices
  - LLT , the Linear Local Trend model
  - LRT , the Latent Risk models

How to relate fatalities and exposure

- Bivariate SUTSE
  - Log exposure = trend log exposure
    - smooth trend
  - Log fatalities=trend log fatalities
    - local linear,
    - smooth,
    - deterministic linear trend



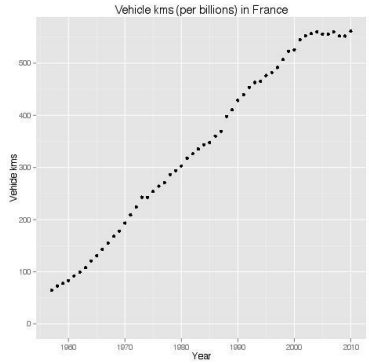
- Seemingly Unrelated Time Series Equations

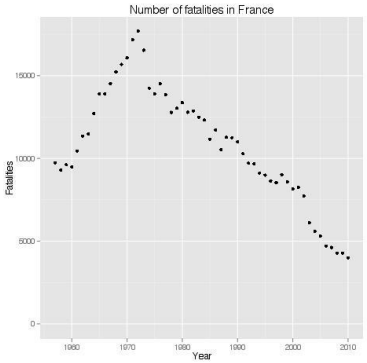
Latent Risk Model

- Fatalities = Risk * Exposure
- LRT
  - Log exposure = trend log exposure
    - smooth trend
  - Log fatalities= trend log risk +trend log exposure
    - local linear,
    - smooth,
    - deterministic linear trend

Dependencies between fatalities and exposure

- **Problem : non stationary time series, integrated of order 2**
- **Classical regression inoperative**





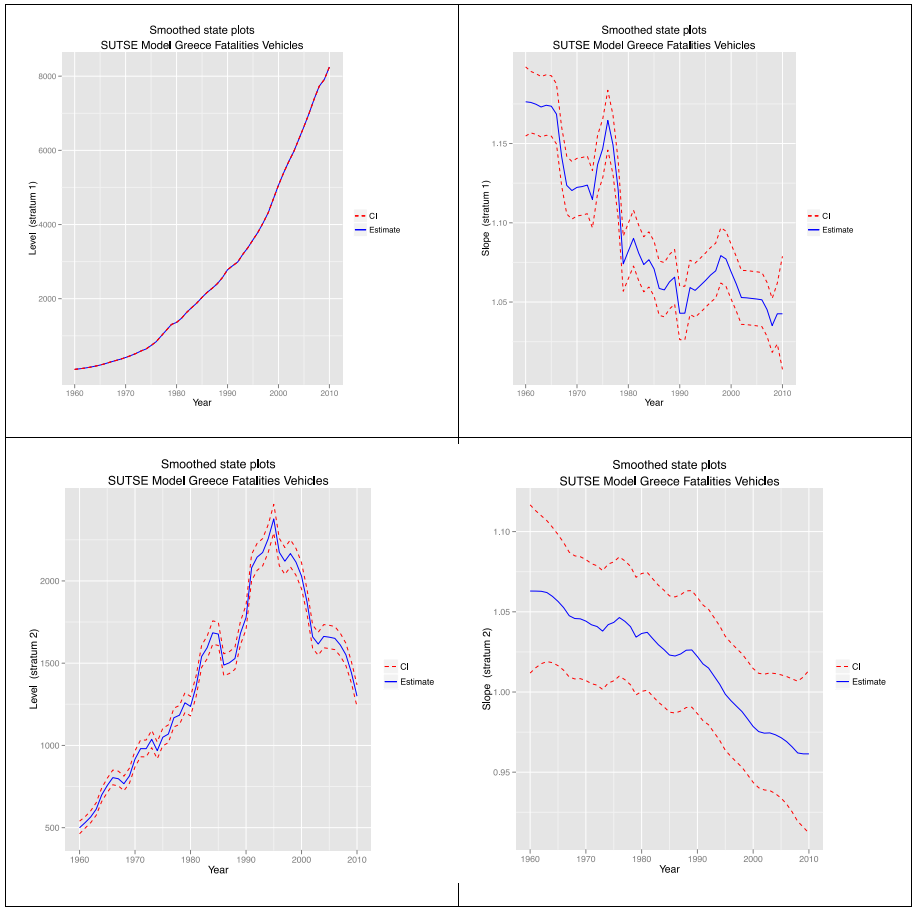
- **Solution: correlations between the stochastic components**
  - **Slopes**
  - **Levels**
  - **Irregulars**

Choice of models

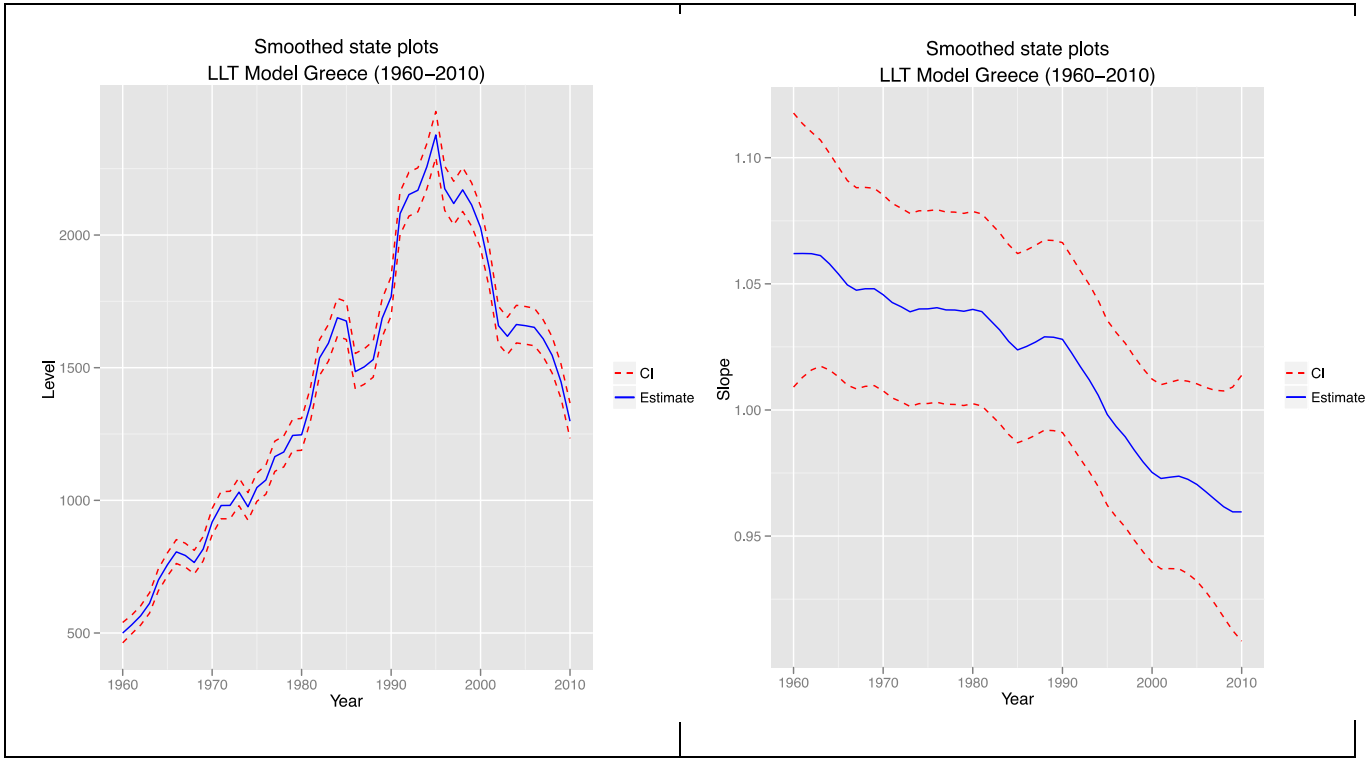
- **Tool : structural bivariate SUTSE model**

Correlation between slopes	**0** **No correlation**	**1** **Full correlation**	**[0.1 - 0.9]** **Medium correlation**
relationships	**independence between fatalities and exposure**	**strong dependency (cointegration)**	**Weak dependency**
consequences	**E(fatalities/exposure) = E(fatalities)**	**common components (same stochastic slope)** **long-term linear relationship** **log fatalities = β log exposure + a + bt**	
Model	**univariate LLT**	**LRT with deterministic risk trend** **By constraining β =1**	**LRT with stochastic risk trend**
Exemple	**Greece**	**France**	**Slovenia**

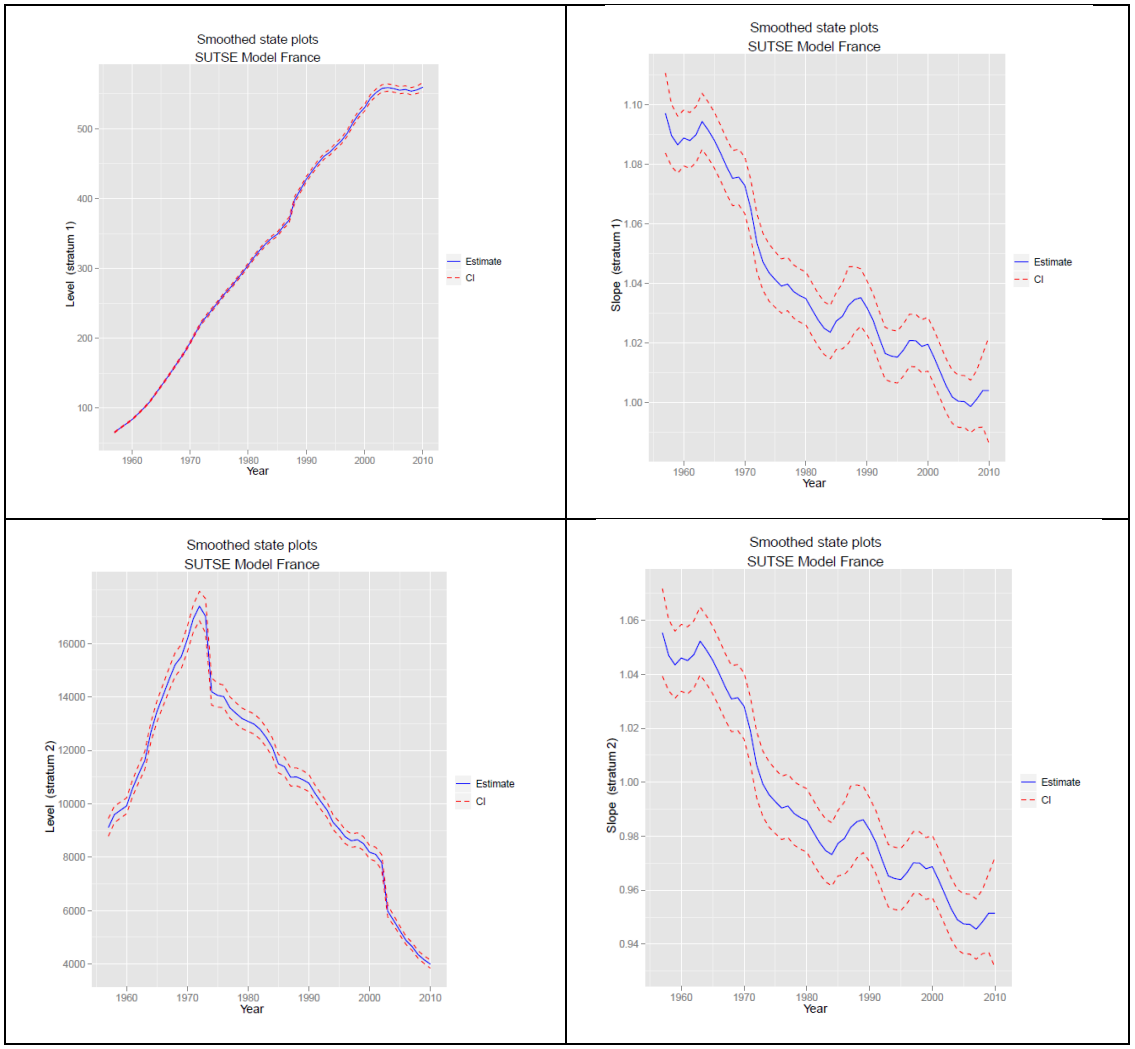
SUTSE Greece



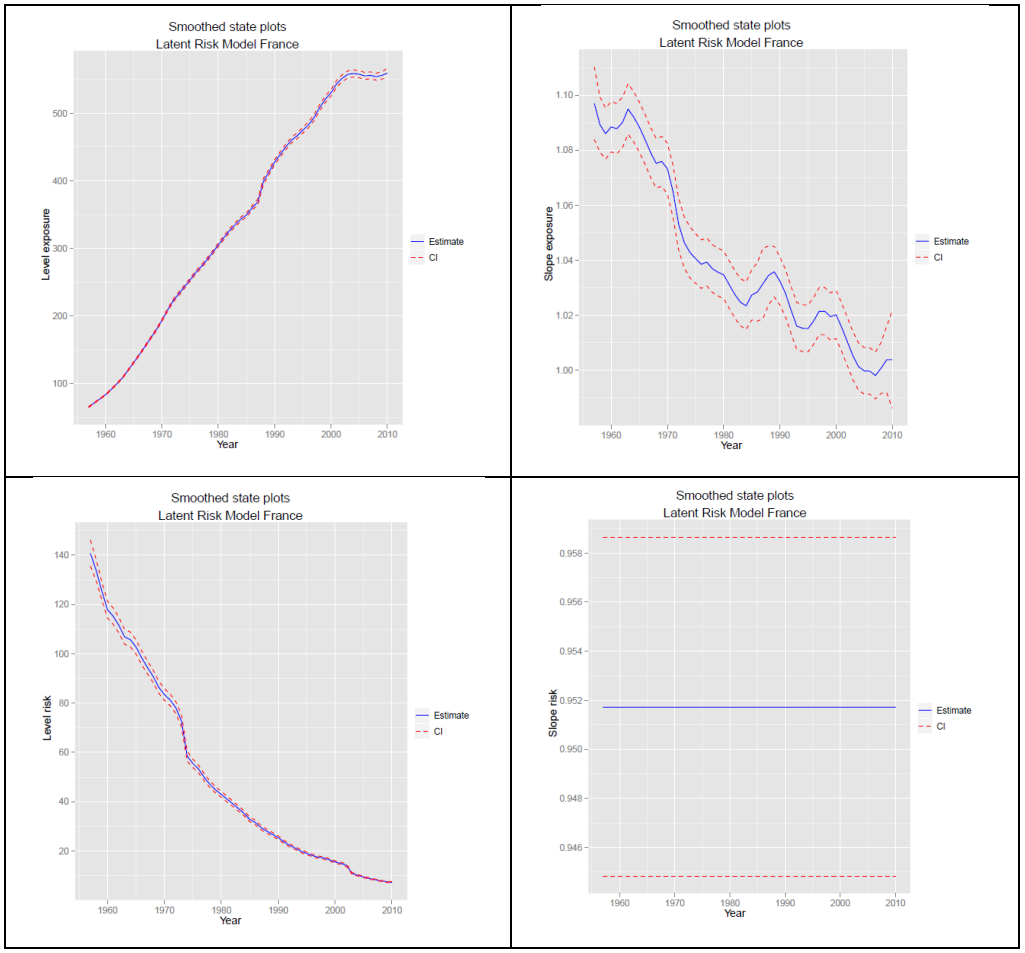
LLT Greece


Smoothed state plots
LLT Model Greece (1960–2010)
Level
2000
1500
1000
500
1960
1970
1980
1990
2000
2010
Year
CI
Estimate
Smoothed state plots
LLT Model Greece (1960–2010)
Slope
1.10
1.05
1.00
0.95
1960
1970
1980
1990
2000
2010
Year
CI
Estimate

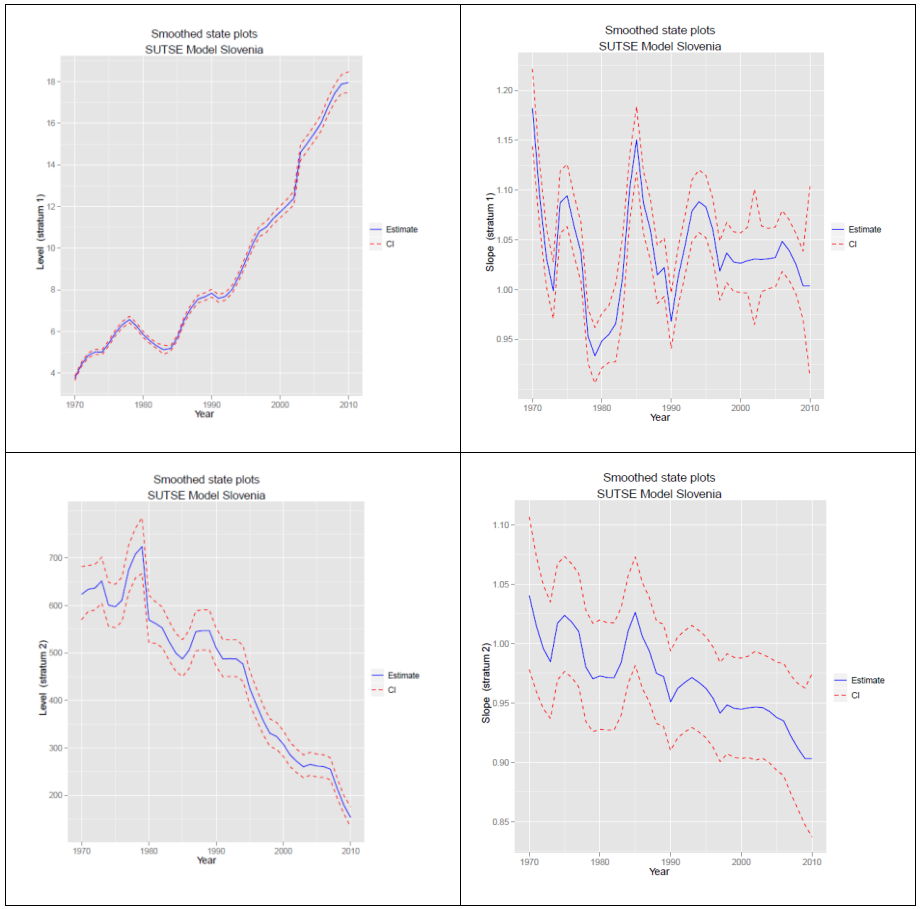
SUTSE France



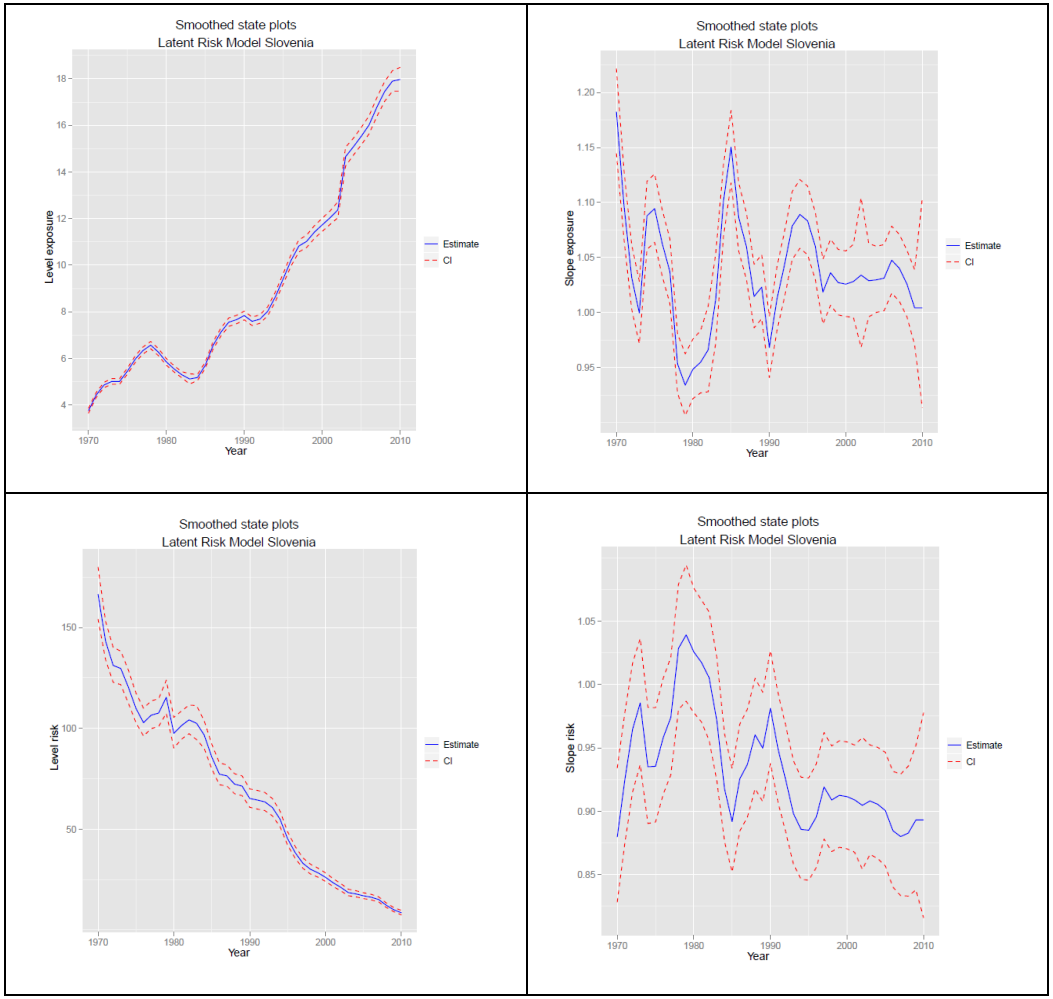
LRT France


Smoothed state plots
Latent Risk Model France
Level exposure
Year
Estimate
CI
Smoothed state plots
Latent Risk Model France
Slope exposure
Year
Estimate
CI
Smoothed state plots
Latent Risk Model France
Level risk
Year
Estimate
CI
Smoothed state plots
Latent Risk Model France
Slope risk
Year
Estimate
CI

SUTSE Slovenia



LRT Slovenia



Conclusions

- Importance of the slope of the trend
  - Easy to interpretate as rate of change
  - Either deterministic
  - Or stochastic (random walk)
- Necessity to introduce some interventions on levels
- Choice of models based on correlation between stochastic slopes of log fatalities and exposure
- Bivariate LRT model as a standard for relating fatalities and exposure
- Univariate LLT as substitute when no correlation or no exposure data

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