Price and volume measurement of non-life insurance services:

A statistical approach

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Outline

- Views on nominal value, SNA
- Previous method at CBS
- New modelling approach for nominal value
- Service and volume characterisation
- Estimation of price and volume indices
- Results
- Closing remarks

It is complex…

Public service sectors

- Measurement is also difficult for health care, etc.
- No market prices, regulated tariffs in Netherlands
- But, at least, expenditures offer starting point

Insurance services

- What is nominal value of production?
- Prices are not directly observed

Net or gross value?

Gross approach

- Nominal value = Premiums + supplements
- Risk assumption is core of insurance service
- Hornstein & Prescott (1991): Claims viewed as intermediary consumption ➔ gross value

Net approach

- Nominal value = Premiums + supplements - claims
- It's a margin that the insurance industry retains
- Focus is on activities (e.g., policy administration)

SNA 2008 on non-life insurance

"If an expectations approach is being used, the formula to calculate output takes the following form:

Actual premiums earned *plus* premium supplements

minus adjusted claims incurred,

where adjusted claims are estimated from past experience."

(Chapter 17, par. 17.27)

Previous method at CBS

Nominal value

- Premiums + supplements – claims (SNA 1993)
- Hard data, no adjustments to claims

Volume indices

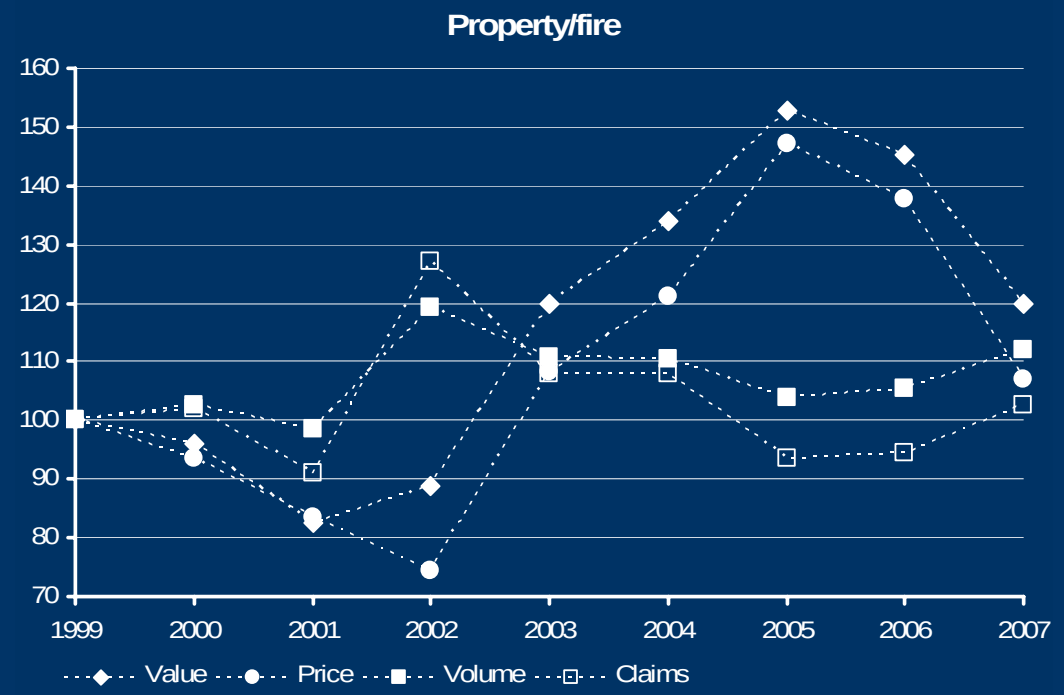
- Administration: #policies
- Acquisition: #new policies
- Claims: #claims handled
- Deflated index for insured value

“Direct service method” (Eurostat Handbook)

Problems

1. Negative nominal values
2. Inconsistent behaviour between volume and nominal value because of how claims are dealt with

Value and volume in old method



Model for nominal value

Notation

$P_{i,t}$ = Premiums for policy (type) i in year t
$\mathrm{E}L_{i,t}$ = Expected loss
$\mathrm{E}S_{i,t}$ = Expected investment income
μ_i = Parameter, with values $0 < \mu_i \leq 1$

Relation between premiums and risk

$$\mu_i P_{i,t} = \mathrm{E}L_{i,t} - \mathrm{E}S_{i,t}$$

Nominal value

SNA 2008: $P_{i,t} + \mathrm{E}S_{i,t} - \mathrm{E}L_{i,t} = (1 - \mu_i)P_{i,t}$

$$= \frac{1-\mu_i}{\mu_i}\left(\mathrm{E}L_{i,t} - \mathrm{E}S_{i,t}\right)$$

Gross approach: $\frac{1}{\mu_i}\left(\mathrm{E}L_{i,t} - \mathrm{E}S_{i,t}\right) + \mathrm{E}S_{i,t}$

Data in this model

Main types of insurance

- Health and accident
- Motor vehicles
- Fire/property
- Legal aid, liability
- Transport

For each type, from 1995:

- Earned and unearned premiums
- Incurred losses

Investment income, from 1995:

- Direct and total income (aggregate values)

What is estimated

Expected investment income

Expected loss

- $\mathrm{E}L_{i,t} = \mu_i P_{i,t} + \mathrm{E}S_{i,t}$
- μ_i assumed to be time-independent

Method: 'adjusted' maximum likelihood

- Uses a classical likelihood function
- With a penalty term for #parameters

Price and volume summary

Characterisation of services

- By μ_i and expected loss for insurance type i

Volume measures

- Number of policies
- Represent ‘bundles’ of activities per time unit
- Quantities available per quarter k ($q_{i,k,t}$)

Nominal values and prices

- Nominal value: $(1 - \mu_i)P_{i,k,t}$
- Average price: $(1 - \mu_i)P_{i,k,t}/q_{i,k,t}$

Volume and value indices

Value index

$$\frac{\sum_{i=1}^{N}(1-\mu_i)P_{i,t}}{\sum_{i=1}^{N}(1-\mu_i)P_{i,t-1}}$$

Volume index (Laspeyres)

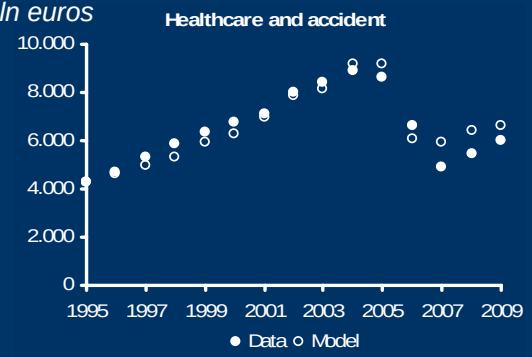
$$\sum_{k=1}^{4}\sum_{i=1}^{N}\frac{(1-\mu_i)P_{i,k,t-1}}{\sum_{m=1}^{4}\sum_{j=1}^{N}(1-\mu_j)P_{j,m,t-1}}\frac{q_{i,k,t}}{q_{i,k,t-1}}$$

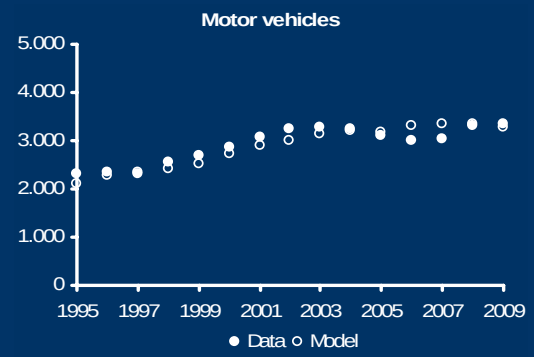
Values of $1-\mu_i$

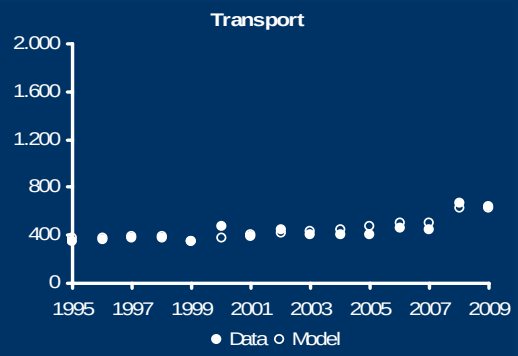
- Health care, accident: 0.279
- Motor vehicles; transport: 0.370
- Fire; legal aid, liability: 0.504

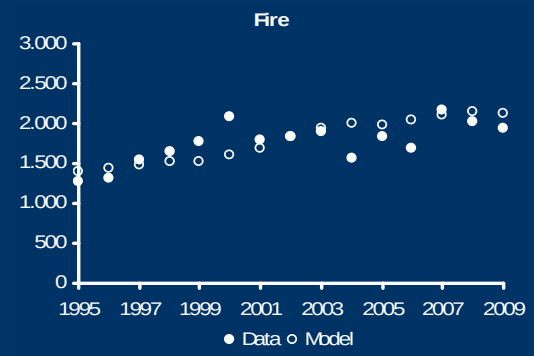
Fits of expected loss to data

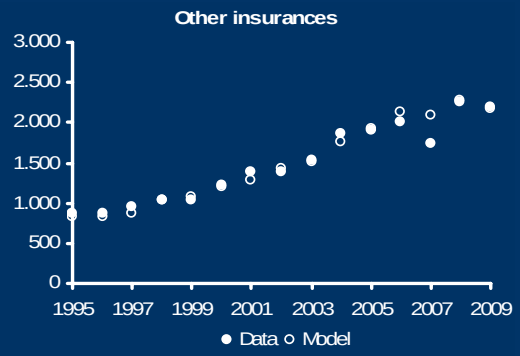
in mln euros

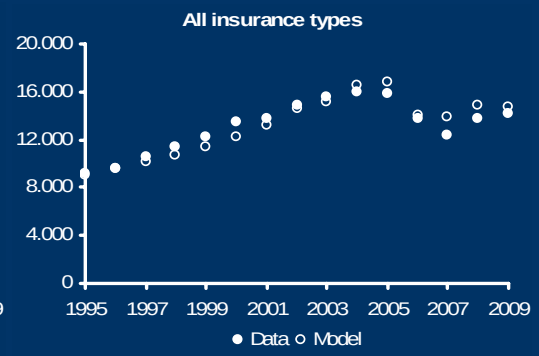




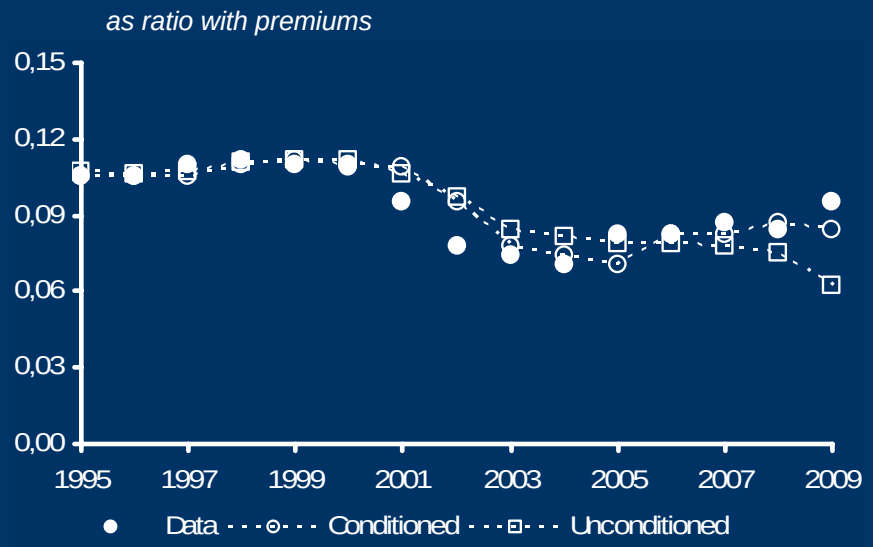




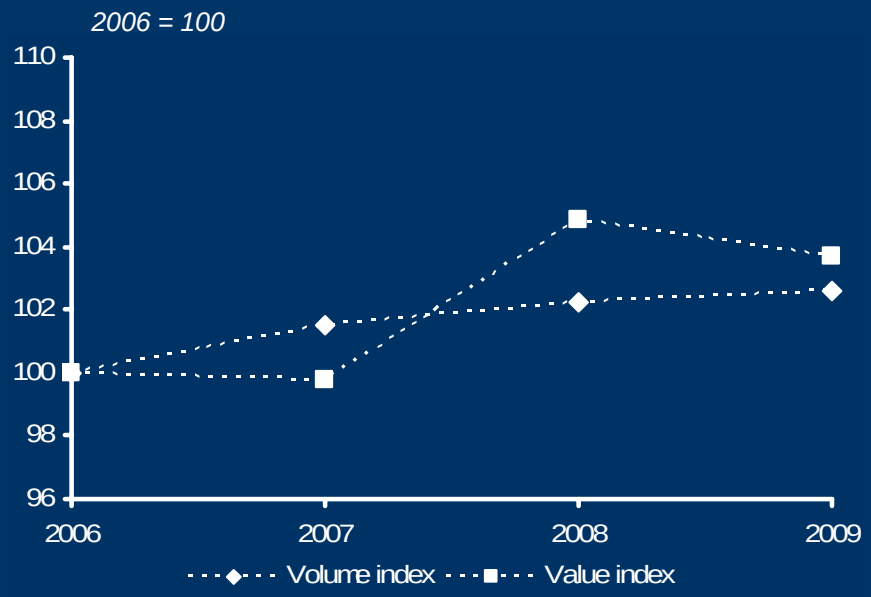




Fits of expected investment income



Value and volume indices (1)



Average yearly growth rates:

- Value: 1.21%
- Volume: 0.86%

Other model choices

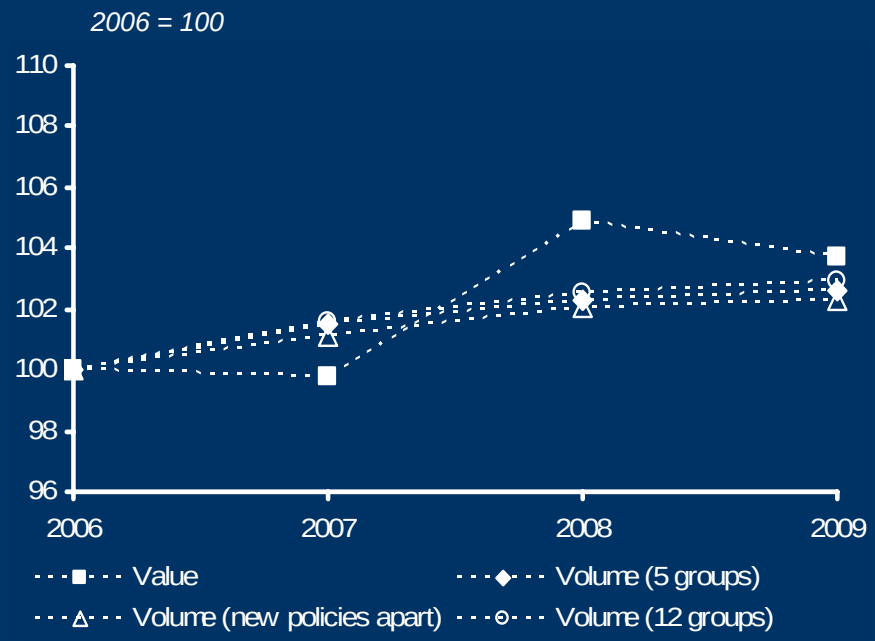
Loss and investment income

- Different parameter settings/model versions
- Moving average models (Chen & Fixler, 2003)

Refinement of product groups/service types

- Groups may be quite heterogeneous, so we
  - extended from 5 to 12 product groups, and
  - distinguished between existing and new policies.
  - Additional assumptions are needed (w.r.t. μ_i).

Value and volume indices (2)



Average yearly growth rates:

- Value: 1.21%
- Volume (5 groups): 0.86%
- Volume (12 groups): 0.97%
- Volume (new policies apart): 0.76%

Concluding remarks

Old vs new method

- Old method violates essential conditions (nom.value)
- New method is well defined
- Fits SNA 2008 and Eurostat guidelines
- Parameterisation ➔ different model versions can be studied

Results of new method

- Product groups may be heterogeneous
- Refinements give small variations in volume indices