Exploring the Modelling on Company-Specific Mortality Rate Experiences

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Motivations

- Some questions un-answered by the literature
  - Are there significant differences between the (changes in) mortality rates of a company's insureds and those of the general population?
    - Underwriting
    - Information Asymmetry / Adverse Selection
    - Small-sample deviations
  - The significant differences will cause pricing and reserving errors that may affect profitability and risk assessment.

Motivations (cont.)

- Are there significant differences in the mortality rates across insured groups within an life insurer?
  - Gender: male vs. female
  - Residence: urban vs. rural
  - Occupations; educations
  - Large sum assured vs. small sum assured
  - Distribution channels
  - **The significant differences will cause pricing and reserving errors that may affect profitability, risk assessment, and premium fairness.**

Modeling Issues

- When there are significant differences, how can the insurer establish its own mortality models under the conditions:
  - Inadequate samples of deaths (zeros for some or many ages for a given year; fluctuating death rates across ages and times)
  - Few years of data

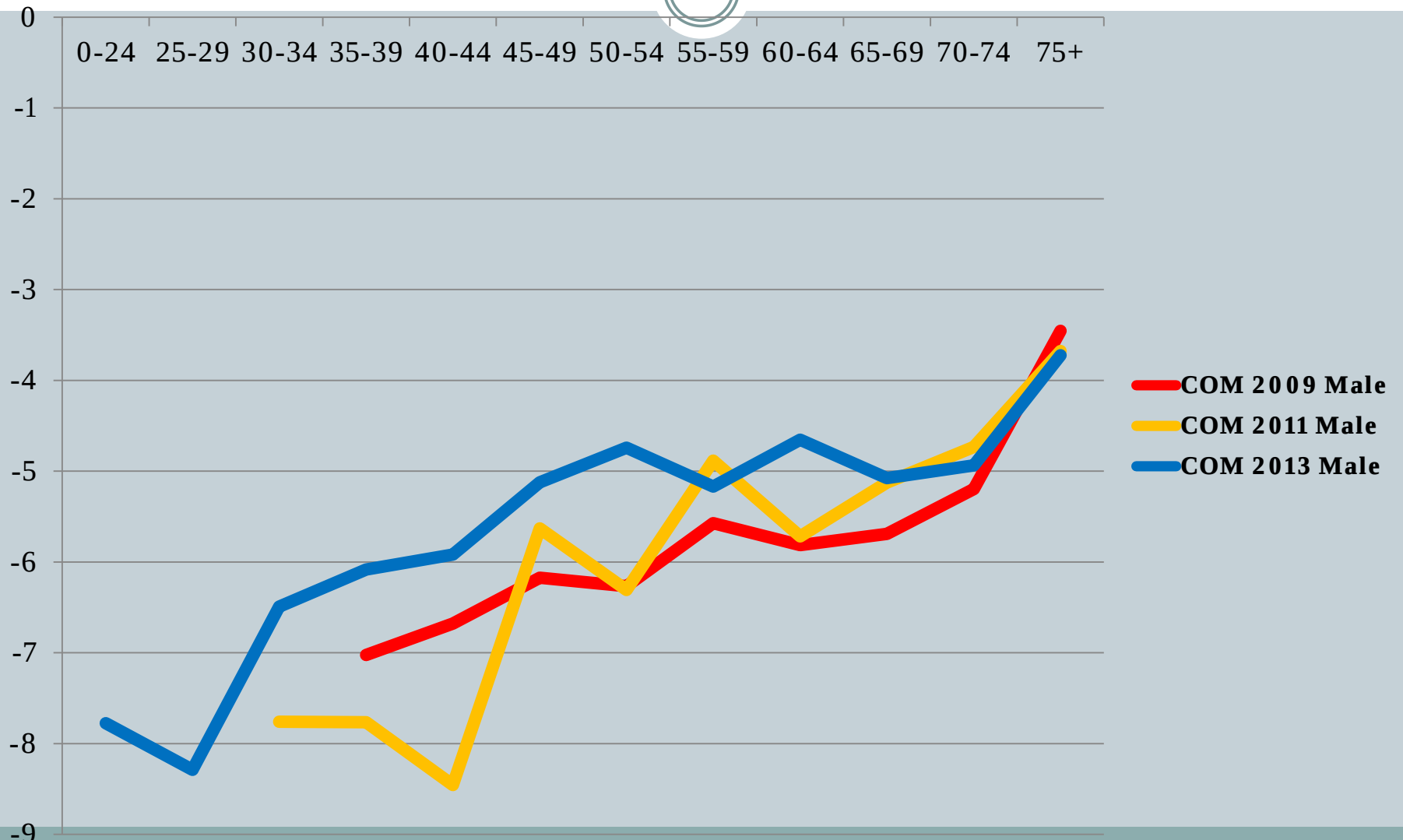
Purpose of the Study

- Exploring the modeling on company-specific mortality rate experiences
  - Examining the differences between the mortality rates of a company's insureds and those of the general population
  - Investigating the differences in the mortality rates across the insured groups
  - Establishing the company's dynamic mortality model by approximating the relations between the population's and company's mortality experiences

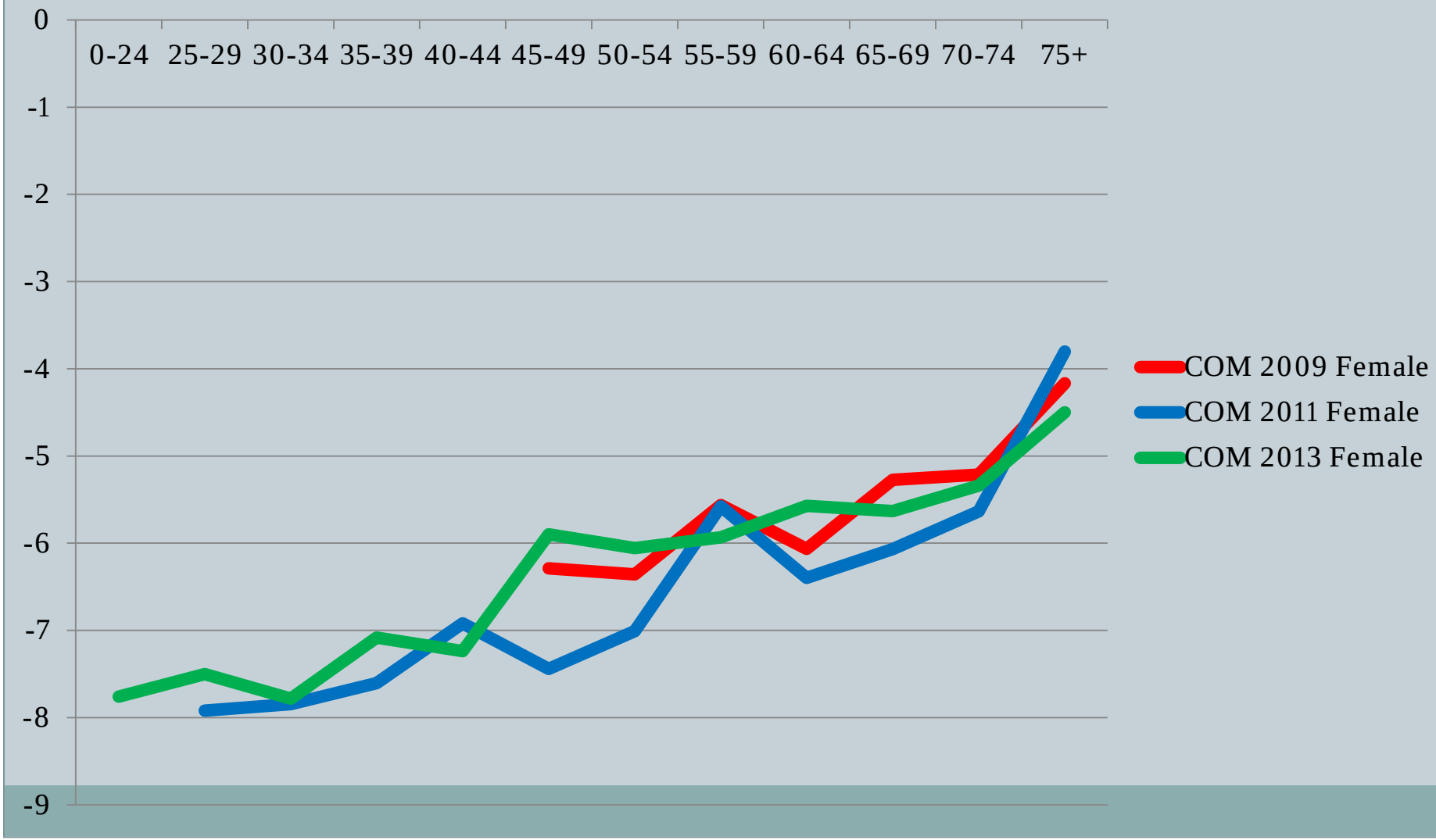
The Company's Mortality Data

- A medium-size life insurer specializing in unit-linked products and mortgage life insurance with most sales through bancassurance.
- Observing period: 2003 – 2013
- Total policies: Approximately 175,000 policies
  - Unit-linked products: 100,000
  - Mortgage life insurance: 37,500

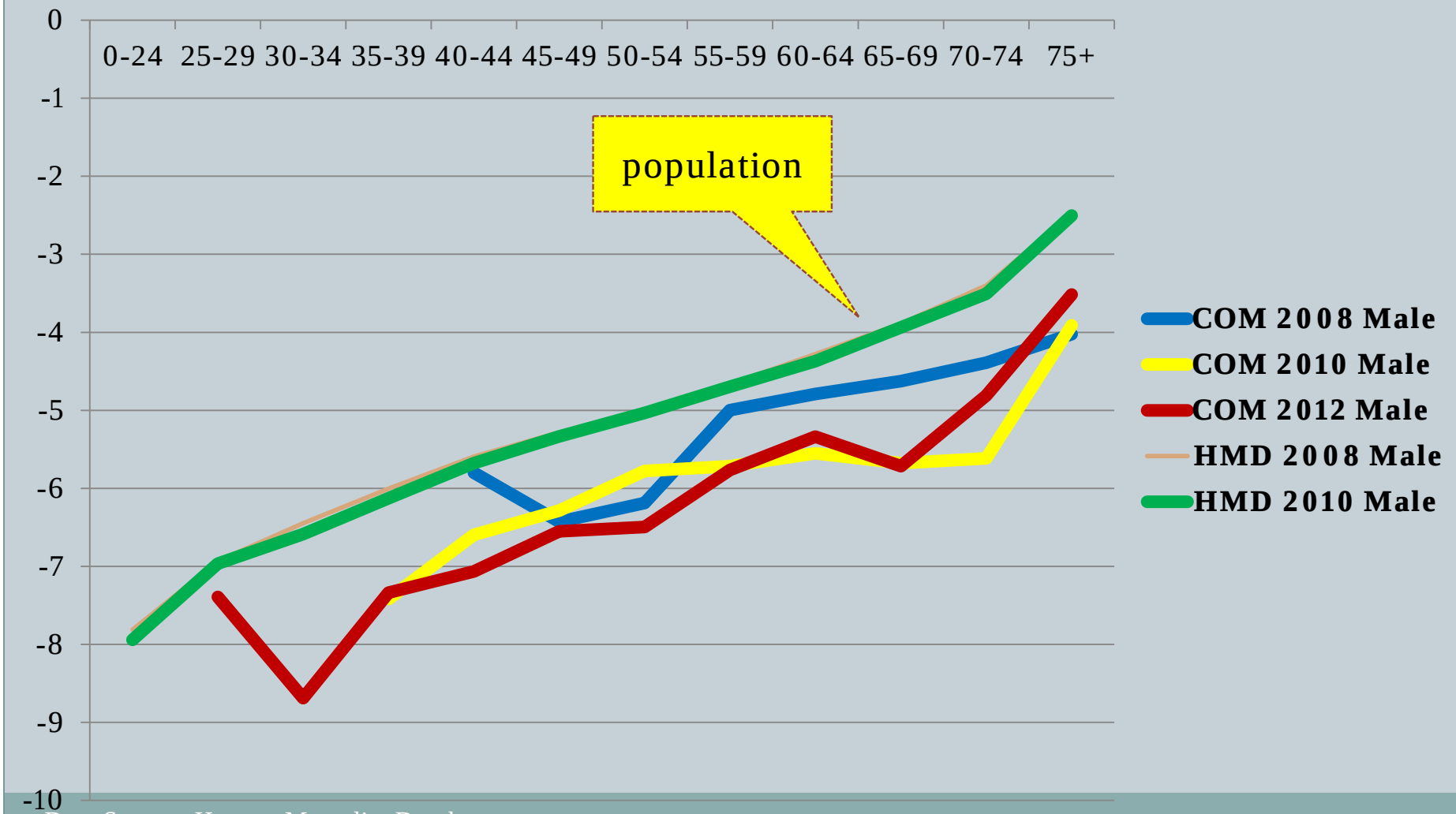
Analysis Results- mortality rate of the company(**male**)



Analysis Results-mortality rate of the company(**Female**)



Analysis Results-
Company vs population mortality(male)



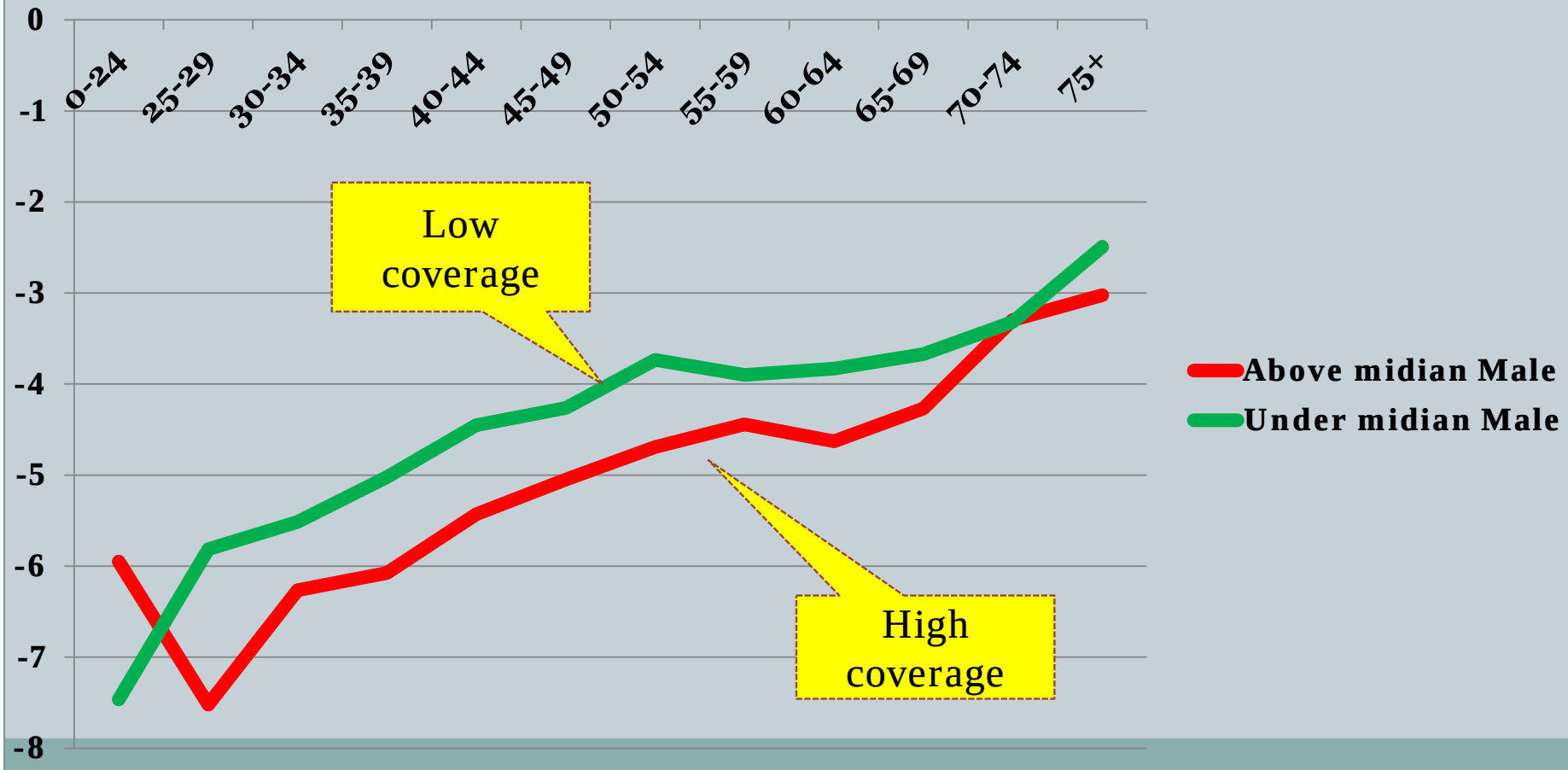
Data Source: Human Mortality Database

Analysis Results- Company v.s. population mortality(Female)

Data Source: Human Mortality Database

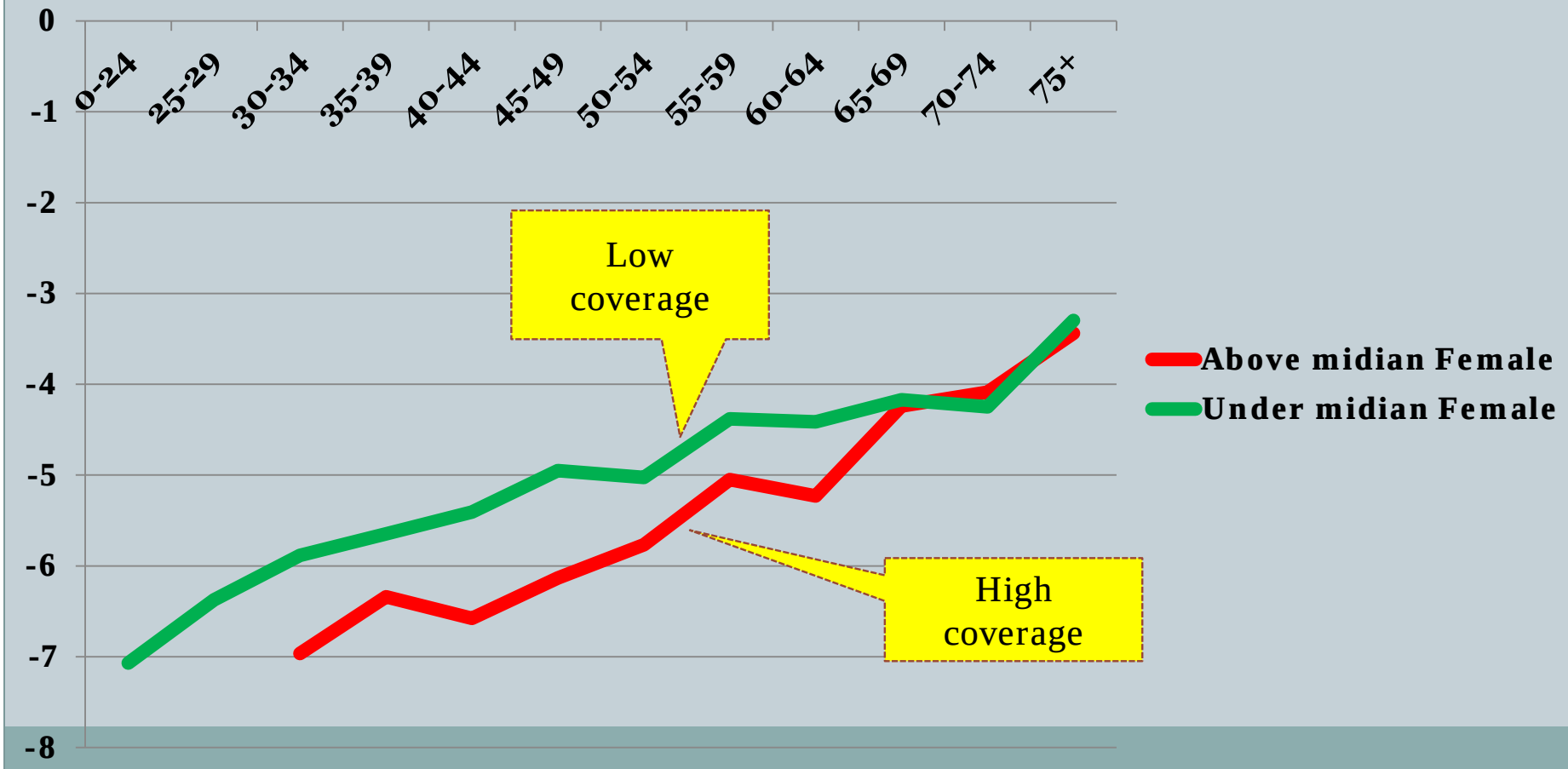
Data Analysis

comparison between policy face amount, the criteria is 1M NTD(male)

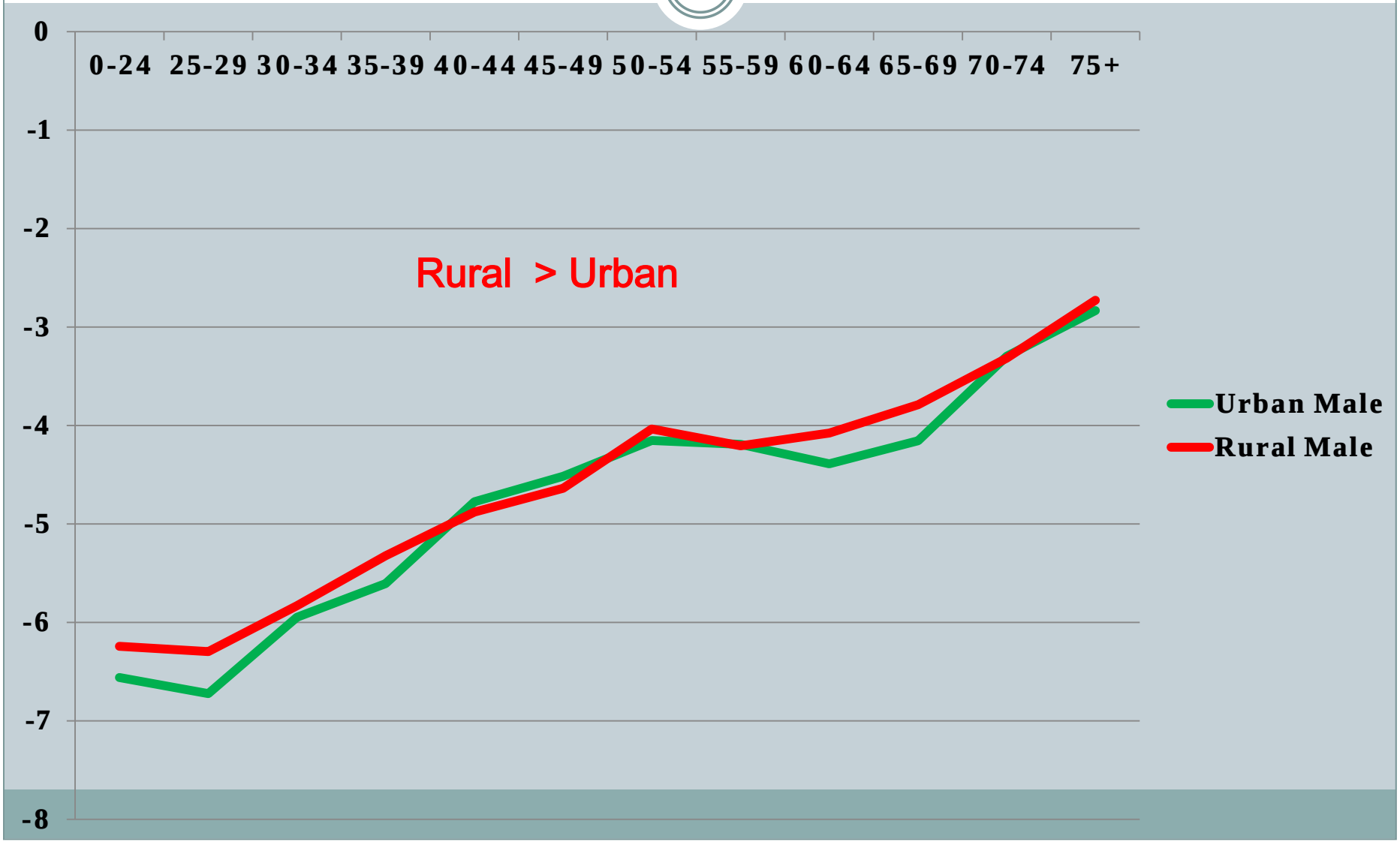


Data Analysis

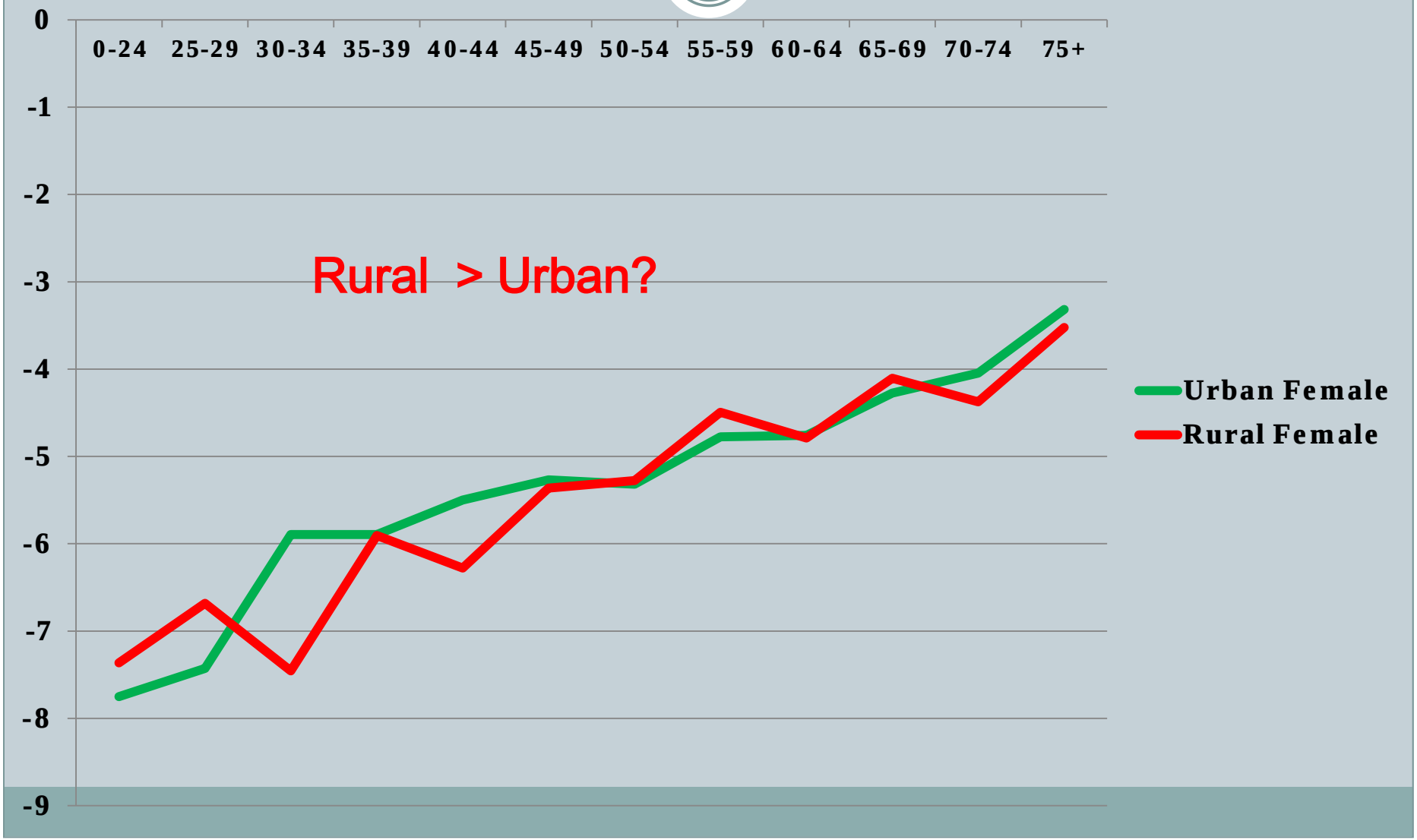
Comparison between **policy face amount**, the criteria is 1M NTD**(female)**



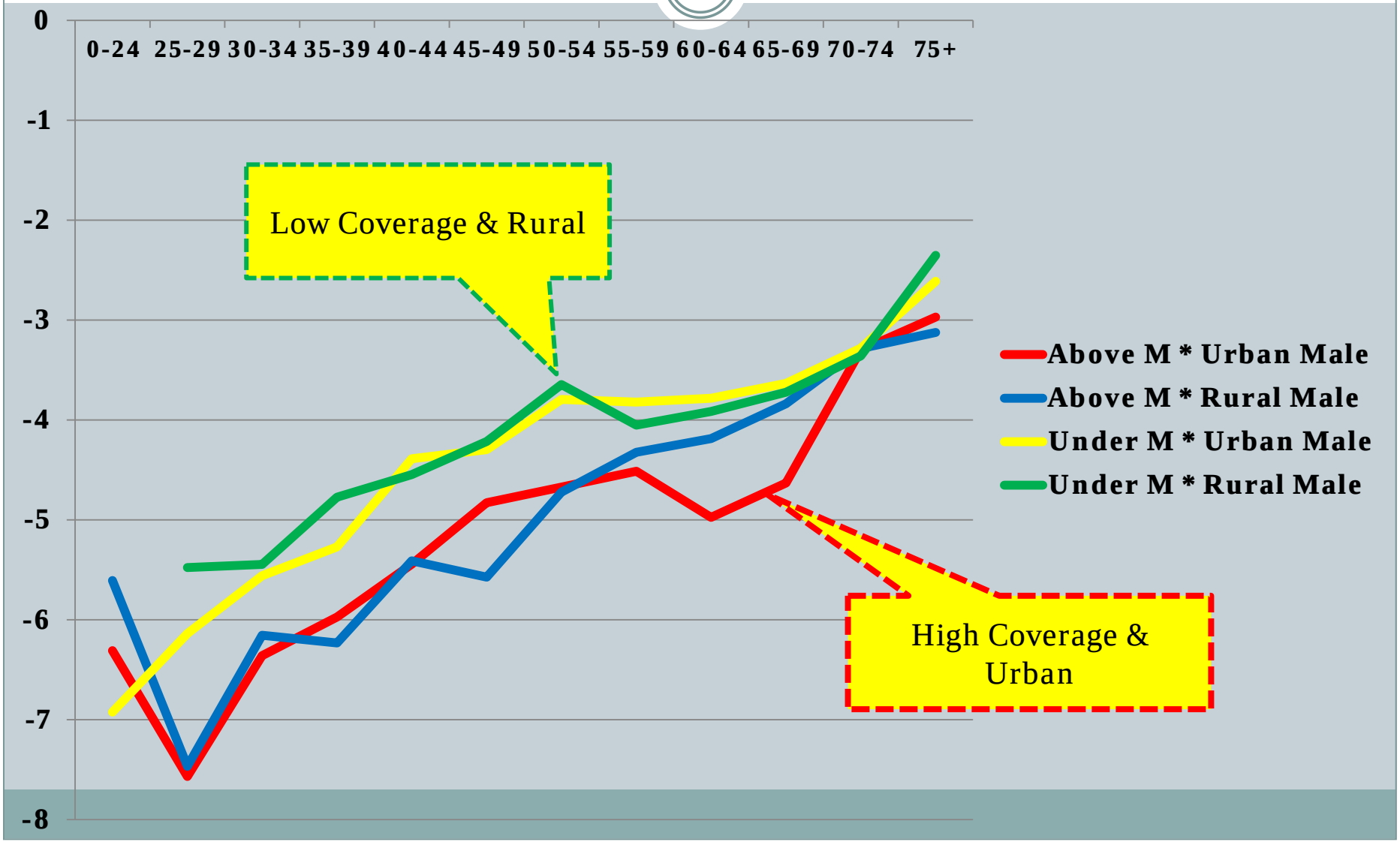
Data Analysis-
rate between urban and rural(male)



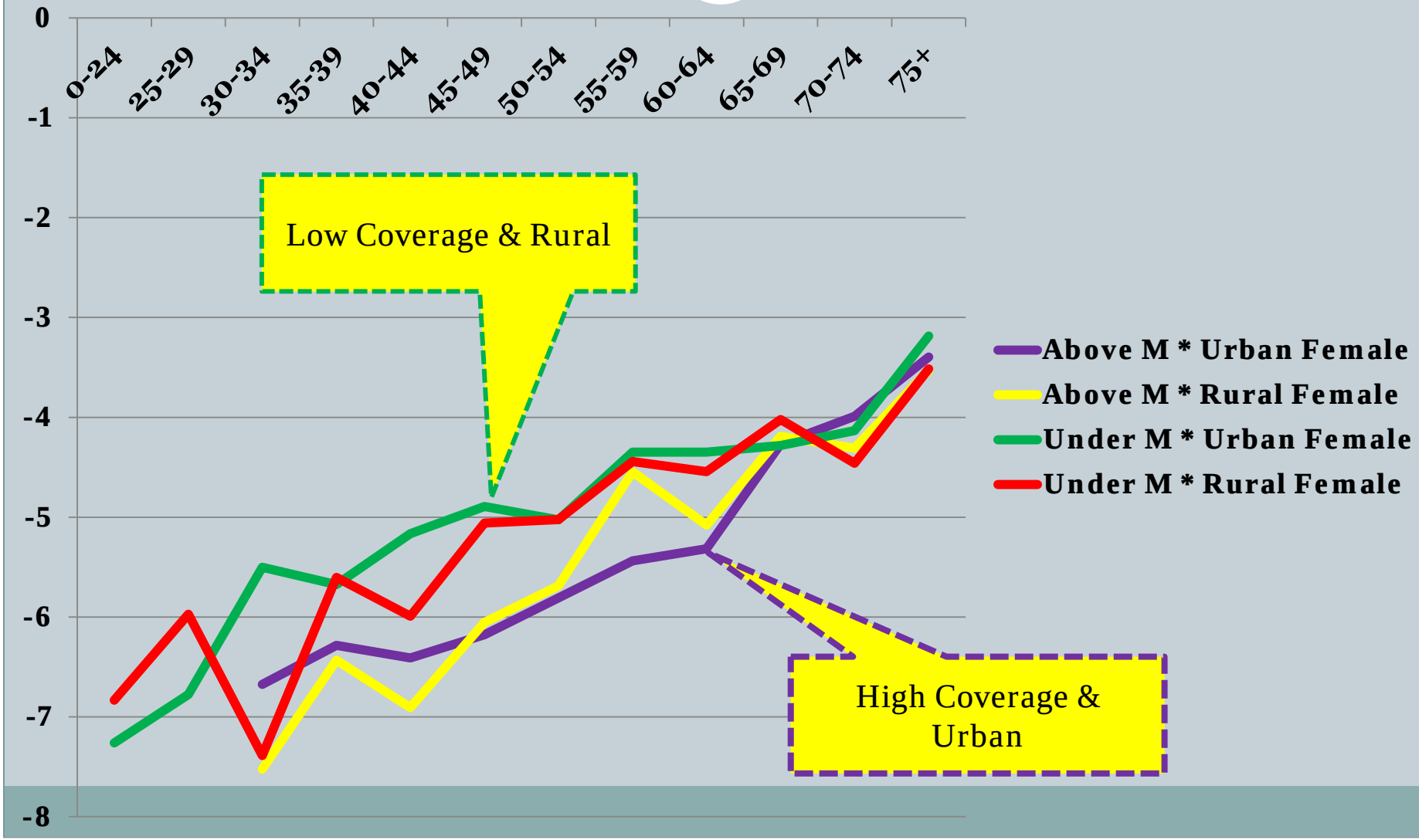
Data Analysis-urban and rural(female)



Data Analysis-face amount and residence(male)



Data Analysis-face mount and residence(F)



Modelling Issues

- To build mortality projection models for general population
- To construct approximate functional relationship between the mortality of the company and general population.
- To construct mortality projection for company by utilizing the results above

To build mortality projection models for general population

Example:

- Lee Carter Model
  - $\log(m_{x,t}) = \alpha_x + \beta_x k_t + \varepsilon_{x,t}$
  - Sampled period: 1970 to 2010 Taiwan mortality data from HMD

To construct approximate functional relationship between the mortality of the company and general population

Example:

Assume linear relationship between the mortality of the company and general population

$$\ln m_{(x,COMf2011)} = -1.451814 - 0.842413 * ln\, m_{(x,HMDf2011)}$$

To construct approximate functional relationship between the mortality of the company and general population

Pooled regression on female data

- Use COM 2007 to 2010 mortality data and HMD 2007 to 2010 mortality data to construct a panel data regression model
  - Run Hausman Test

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random		1.240353	1	0.2654

  - Can't reject H0
  - Run F Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.68231	10.98409	-1.245649	0.2273
HMDF	-1.402428	2.016021	-0.695642	0.4947

  - Can't reject H0

=> Run OLS

To construct approximate functional relationship between the mortality of the company and general population

Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.451814	0.341989	-4.245208	0.0002
HMDF	0.842413	0.061181	13.76909	0.0000

R-squared	0.867330	Mean dependent var	-6.041506
Adjusted R-squared	0.862755	S.D. dependent var	1.149065
S.E. of regression	0.425689	Akaike info criterion	1.192125
Sum squared resid	5.255119	Schwarz criterion	1.284640
Log likelihood	-16.47793	Hannan-Quinn criter.	1.222282
F-statistic	189.5880	Durbin-Watson stat	2.823233
Prob(F-statistic)	0.000000		

To construct mortality projection for the company

Future Research

- Dynamic relations between the population's and company's mortality experiences?
- Establishing the company's mortality models by the curve-fitting method?
- Differentiating reserves or even premiums across groups?