Mortality Modeling and Challenge of Longevity Risk for Taiwan Insurers

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Cathay Life Insurance

Cathay Financial Holdings

OUTLINE

1. Taiwan Society Situation

2. Longevity Impact on Taiwan Insurer

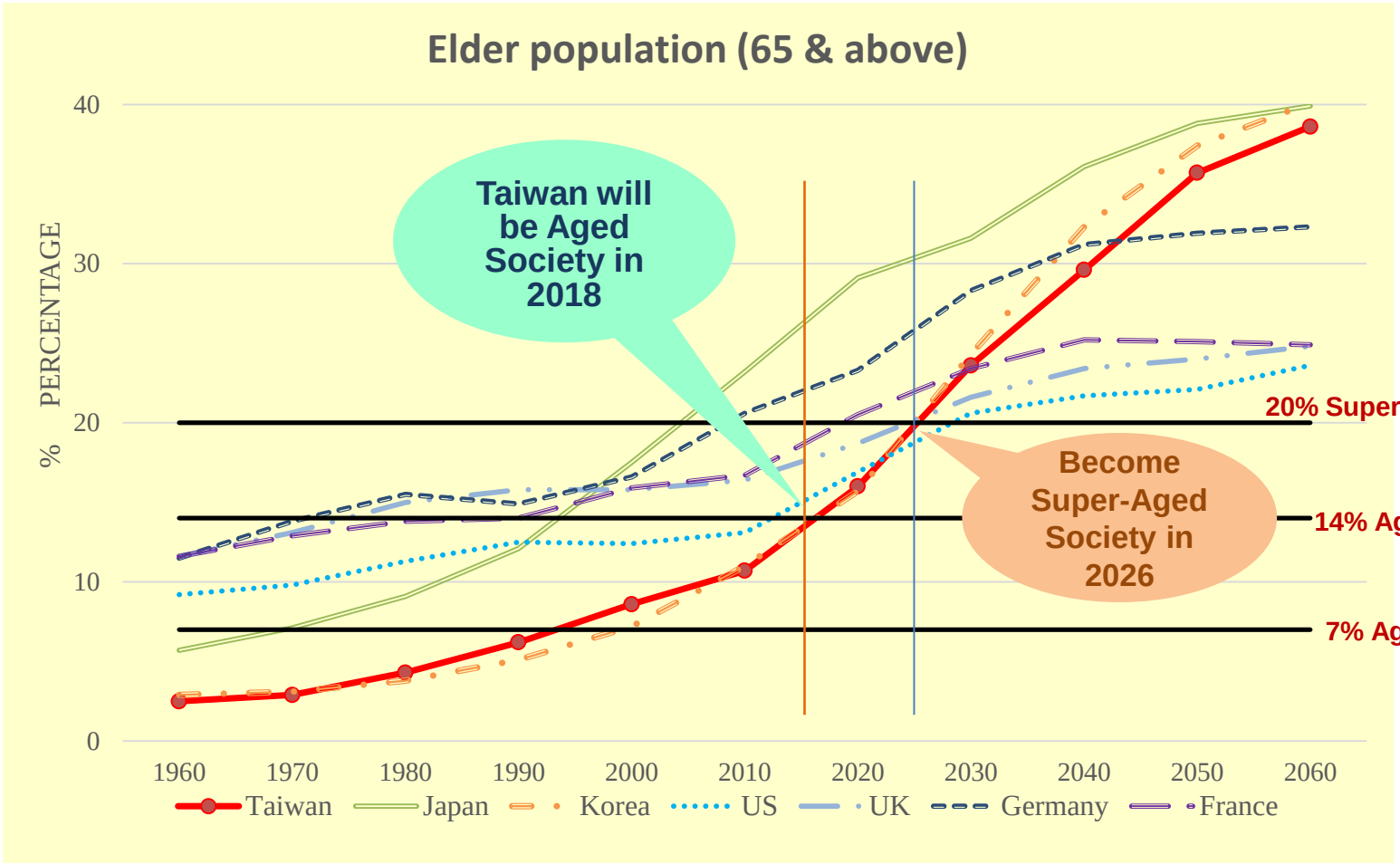
3. Longevity Risk management of Taiwan Insurer

4. Conclusions

1.

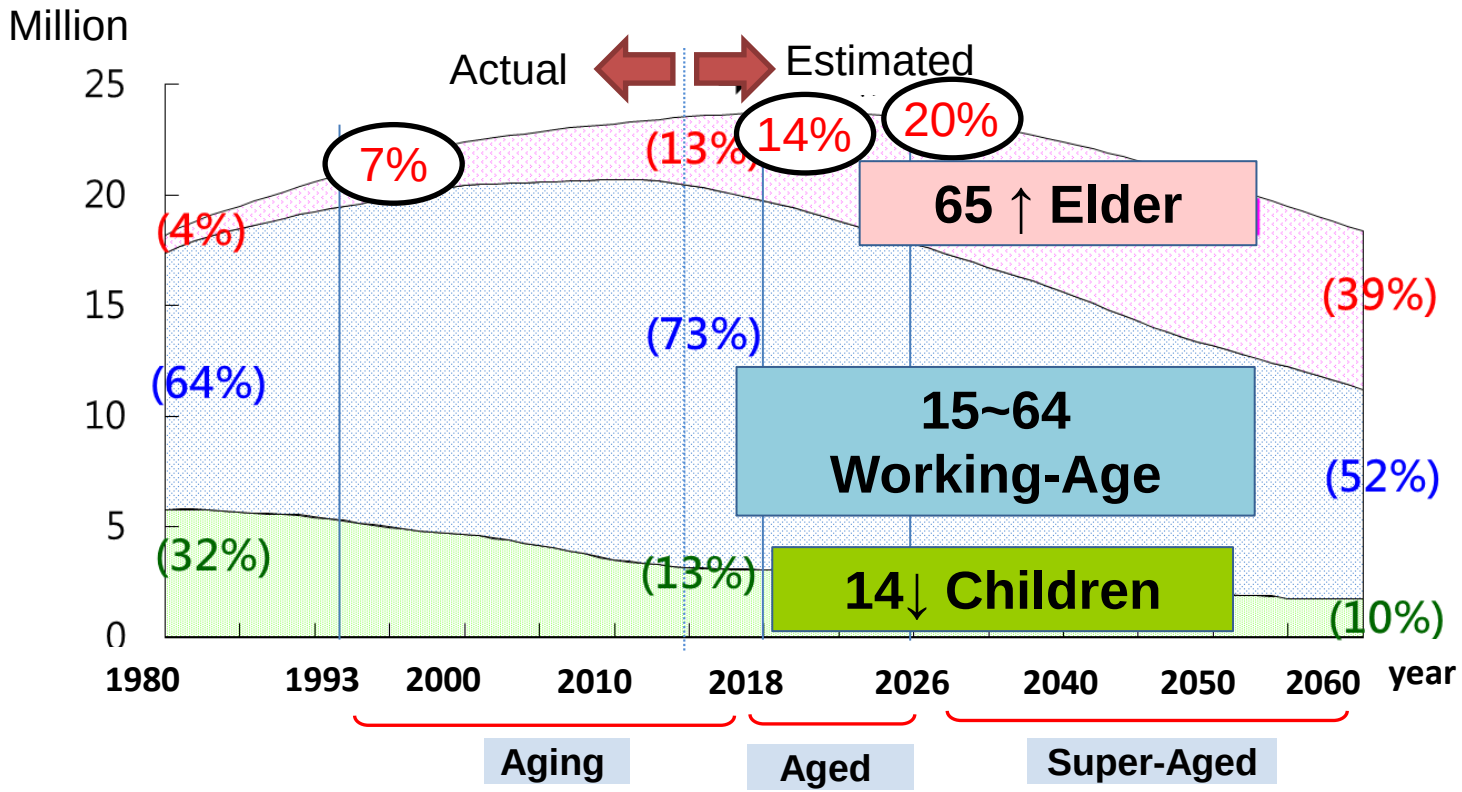
Taiwan Society Situation

Demographic Trends in Different Countries



Sources: National Development Council

Aging Timetable in Taiwan & Other Countries

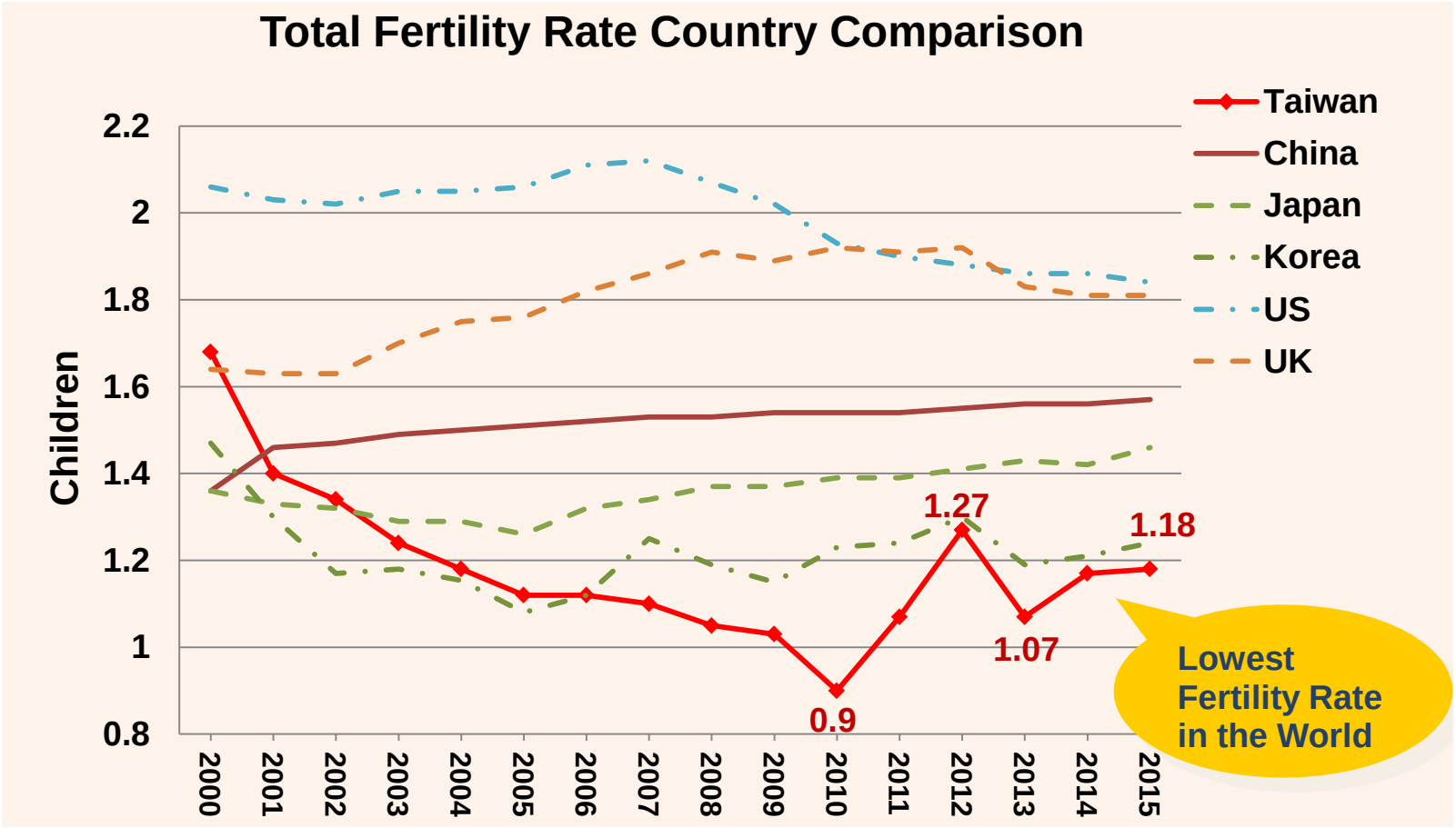


Aging Timetable (years)	Taiwan	Japan	U.S.	U.K.	Germany	Australia
Aging ⇨ Aged	**25***	24	71	47	40	72
Aged ⇨ Super-Aged	**8***	11	15*	51*	36	22*

Note: * means the estimated value.

Sources: Council for Economic Planning and Development

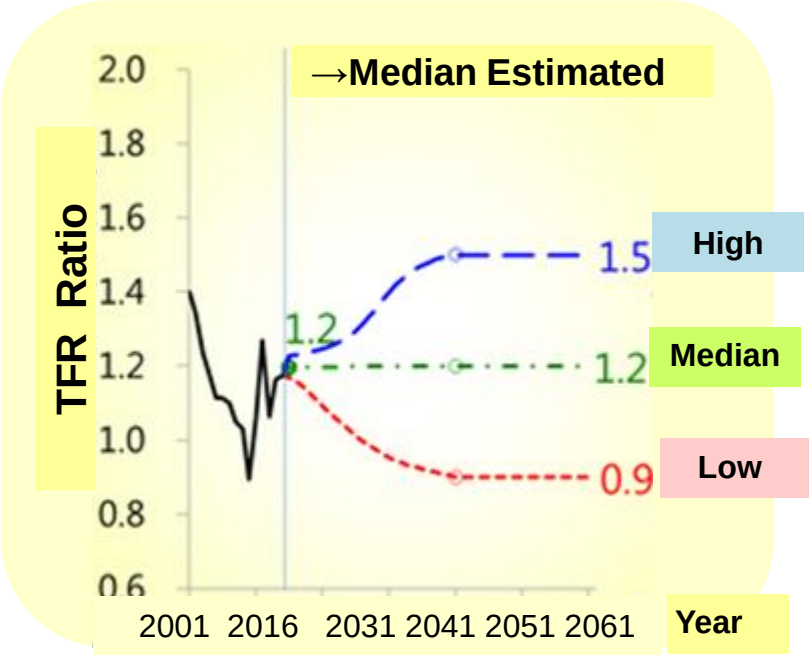
Low Total Fertility Rate (TFR) in Taiwan

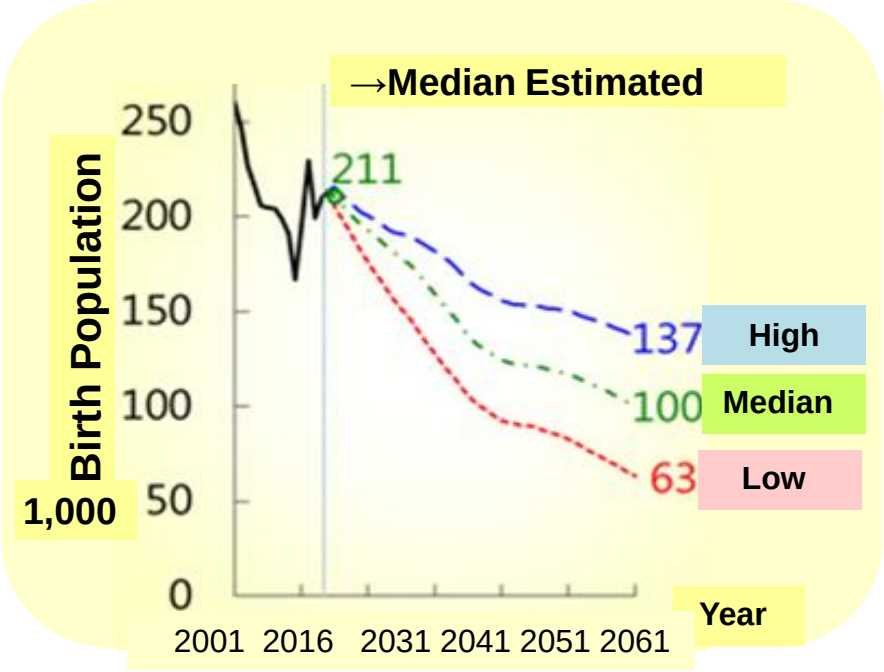


Sources: World Bank

Numbers of Birth are Hard to Raise

- Numbers of birth are hard to raise, even the fertility rate is increased.
- Numbers of birth will reduce by 50% by 2060.

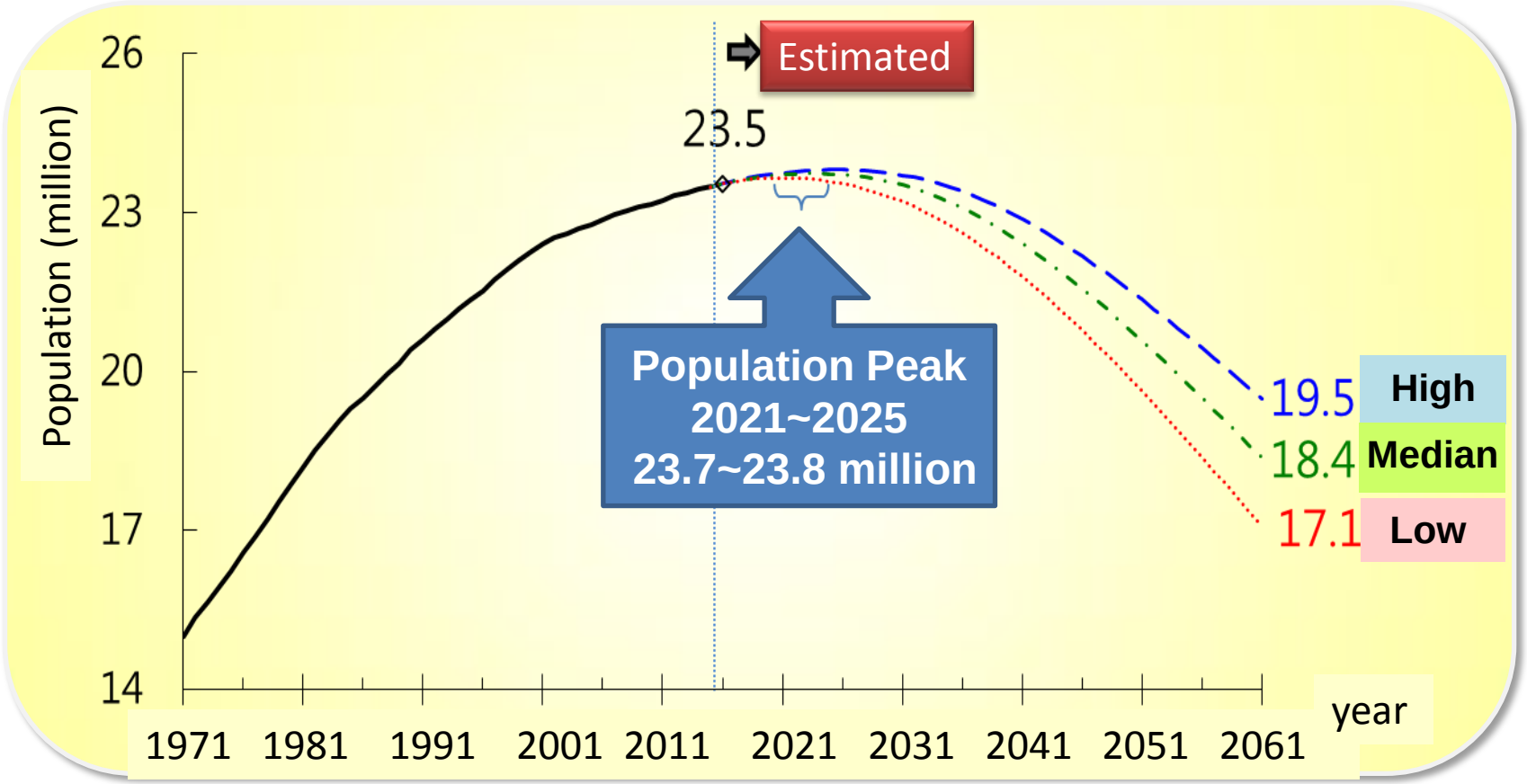




Sources: National Development Council (Population estimation from 105 to 150).

Population Growth

Population peak is estimated to be at 2021~2025.

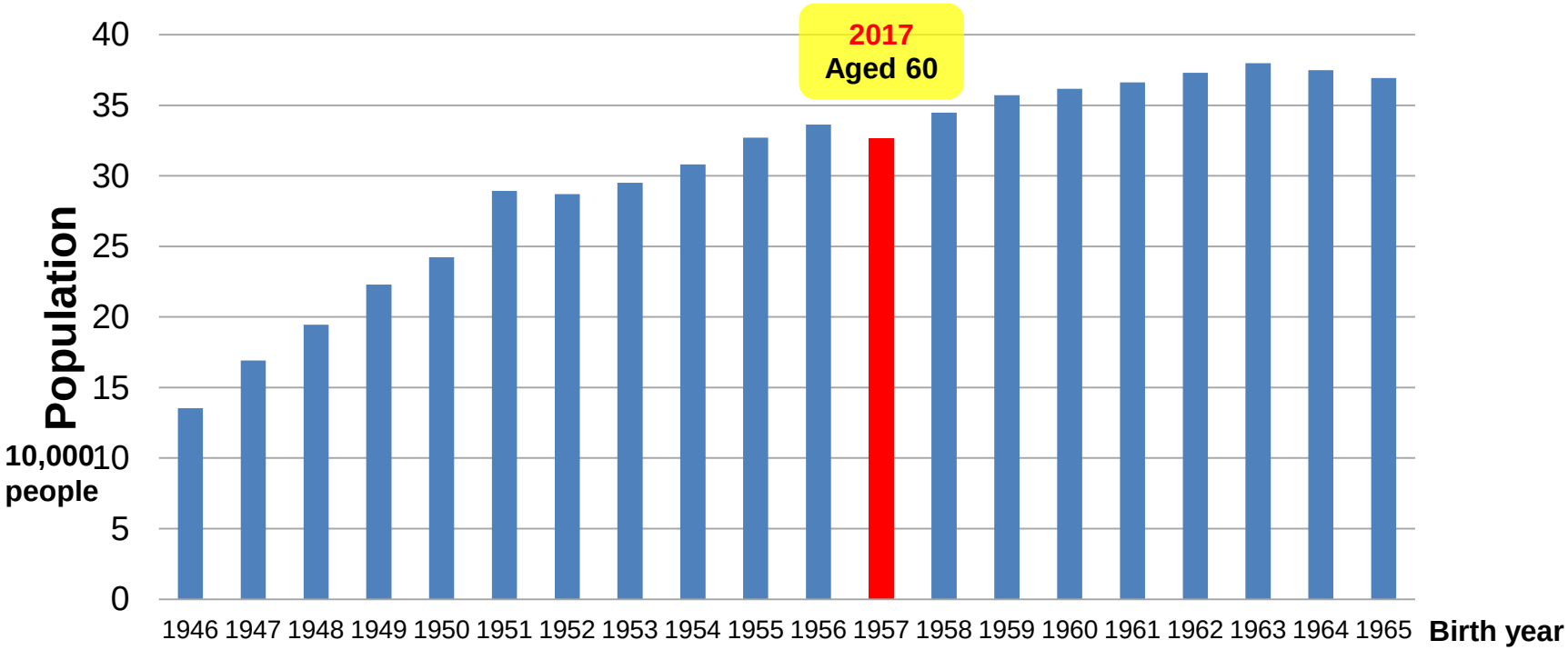


Sources: National Development Council (Population estimation from 105 to 150).

Generation of Baby Boomer is Coming

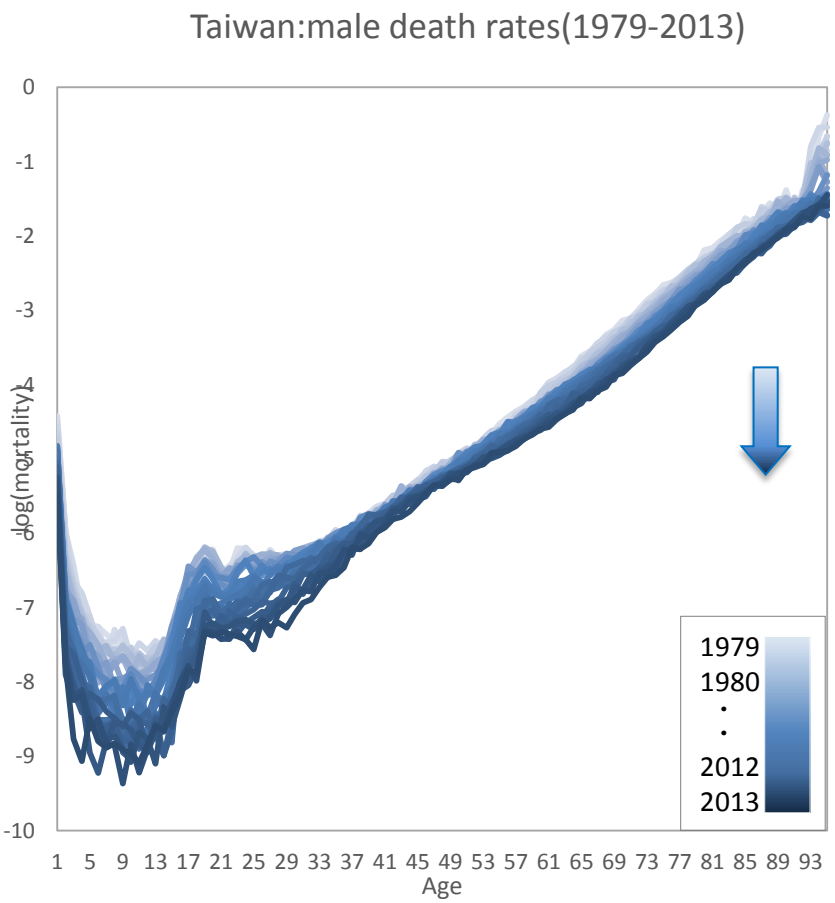
Baby Boomer(1946~1965)

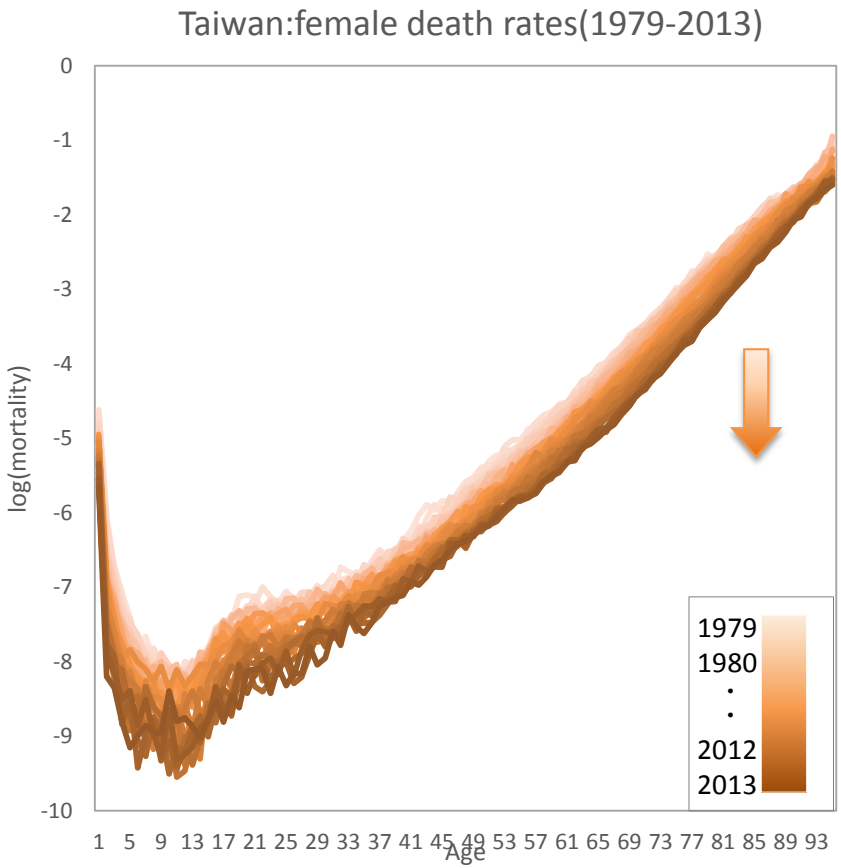
Estimated by 2016 population **0.33mn people will retire in every year**



Sources: Department of Household Registration, M.O.I.

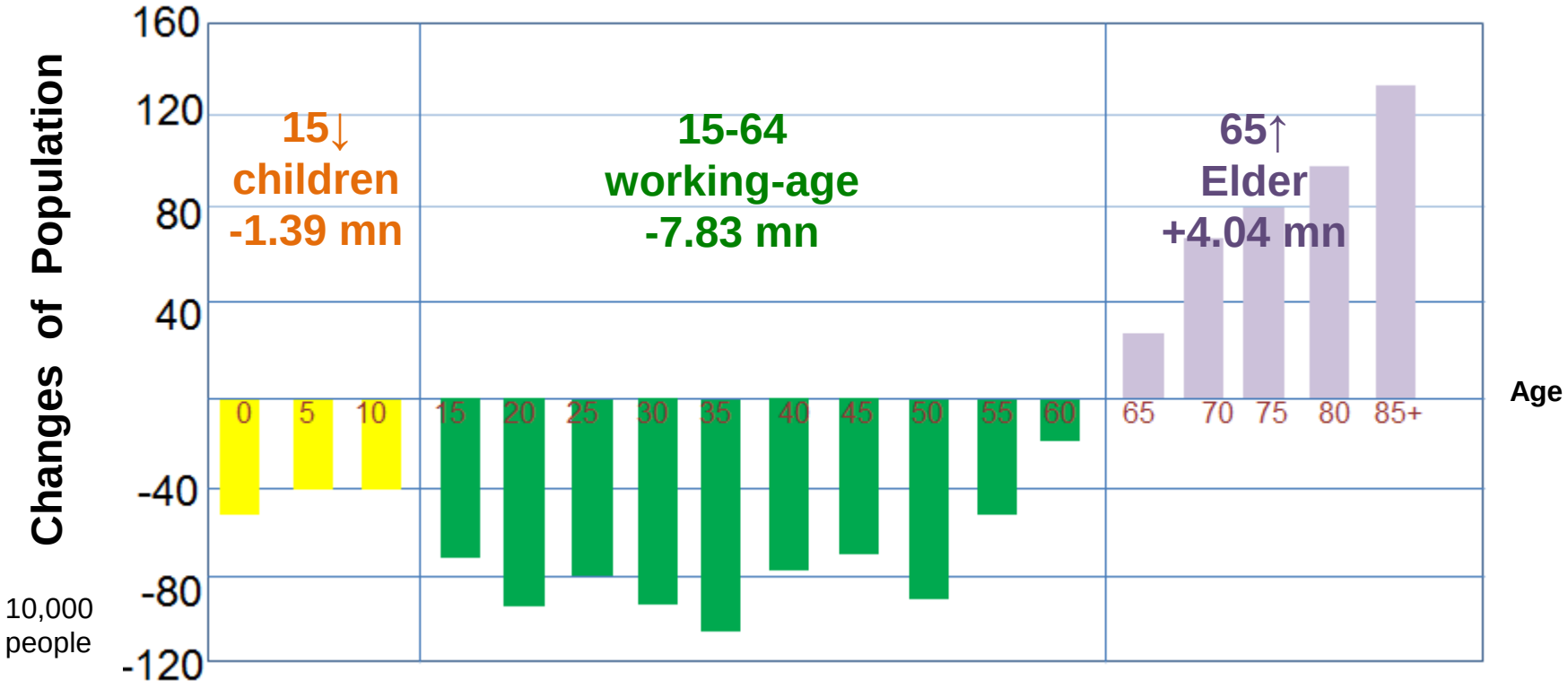
Mortality Improvement





Fewer Children, More Aging

- Total population will decrease about 5.17mn by 2061.



Sources: National Development Council (Population estimation from 105 to 150).

Working-age people should take more responsibility

- Dependency ratio will increase from 36.2% (2016) to 94.2% (2061).
- Contrary, working-age people have to take care of the elders instead of the children.

1971

Dependency Ratio 71.6%
Potential Support Ratio19.2

2016

Dependency Ratio 36.2%
Potential Support Ratio 5.6

2061

Dependency Ratio 94.2%
Potential Support Ratio 1.3

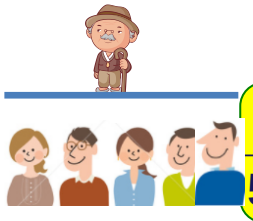
Dependency Ratio =

(*aged 0-14*+ *over aged 65*)

/ *aged15-64*×100%

Potential Support Ratio =

aged15-64 / *aged over 65*

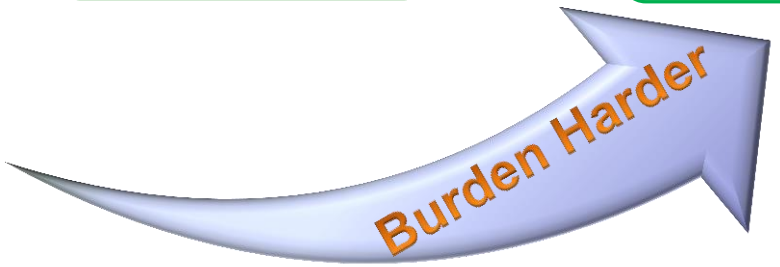


2016

1 Elder
5.6 Working-Age

2061

1 Elder
1.3 Working-Age

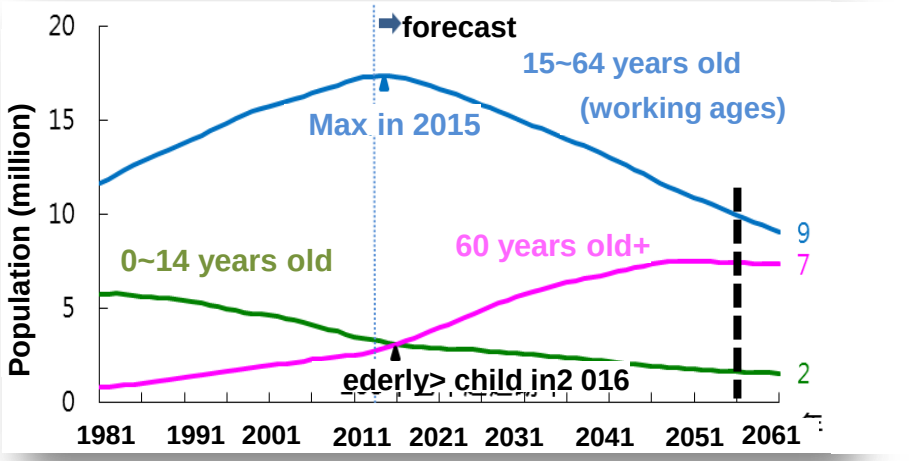


Sources: National Development Council

Business opportunity arise

Aging Demographic Structure

Population Projection

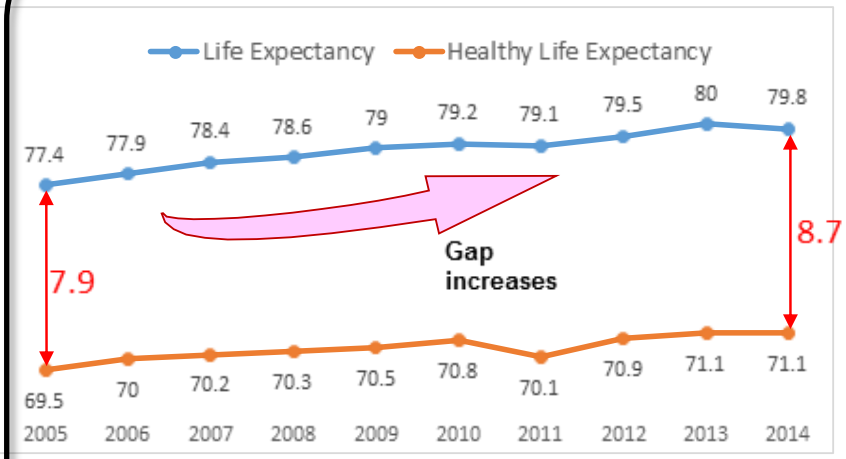


The elder seeks for financial security and more medical care protection.

Retirement Products

e.g. Life Annuity, Life with coupon payment, Long-term Care Insurance

Extended Period of Surviving with Illness



The gap between life expectancy and healthy life expectancy Increases!

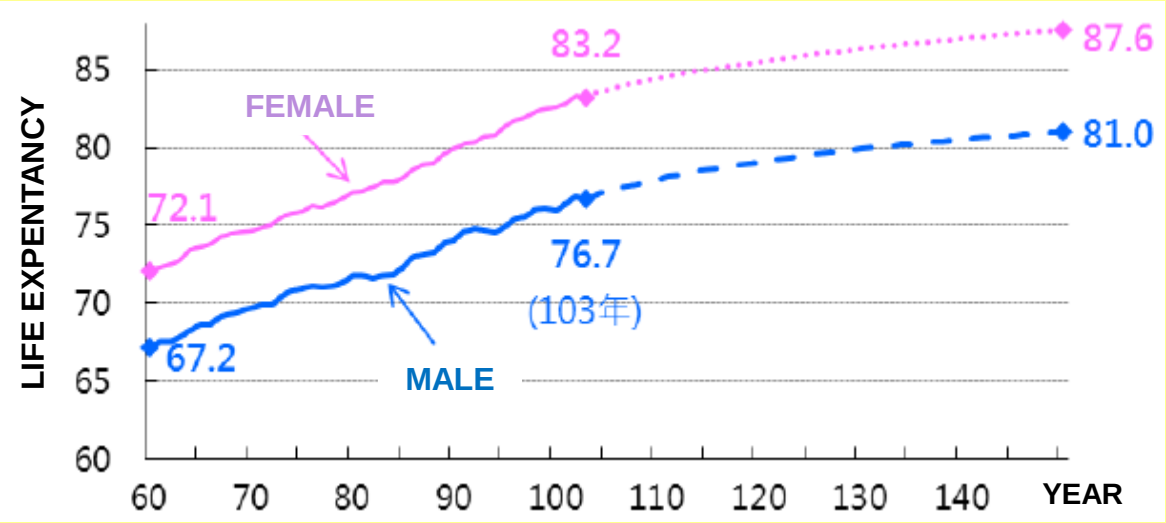
Medical Care Need

e.g. Surgery, Hospitalization

2.

Longevity Impact on Taiwan Insurer

Risks for Insurance Companies



Source : National Development Council

Life expectancy is increasing / improvement of mortality rate

Present value of future payment will be increased on longevity products

- **Annuity**
- **LTH**

Medical claim is increasing

Risk of health products are increasing

Single Premium Immediate Annuity (SPIA)

1000 NTD per year

NP	q	q of Annuity table×α			Impact on NP
Age		α=100%	α=70%	α=50%	
15		36,245	37,060	37,712	↑2~4%
30		32,798	33,881	34,752	↑3~6%
45		28,187	29,591	30,732	↑5~9%

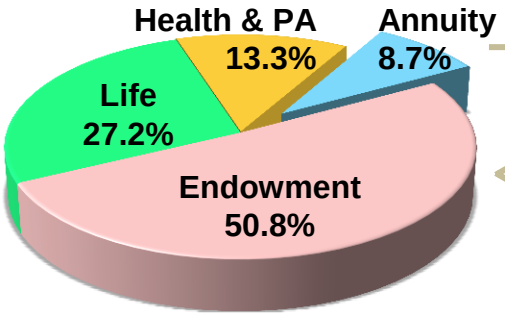
Long-term health product having the same result as SPIA

Note: Discount rate is 2.25%

Impacts of Longevity Risk in Insurance Companies

- **Sale Distribution of Insurance Product in Taiwan**

Premium Allocation in 2012



- Interest sensitive annuities are more popular
- With the saving behavior, endowments and whole life with coupon payments account for 50%

⇨ In Taiwan, we usually buy Whole Life with Coupon Payments for retirement purpose

- **The Impact of TSO improvement on Premium Rate of Insurance Products**

Whole Life with Coupon Payments

2% SA per year since the 7th year.

NP	q	2011TSO×α			Impact on NP
Age		α=100%	α=70%	α=50%	
15		8,224	8,201	8,183	↓0.3~0.5%
30		8,324	8,294	8,270	↓0.4~0.7%
45		8,458	8,419	8,388	↓0.5~0.8%

⇨ **Natural hedge between p and q risks**

Note: Single pay. SA=10,000. Discount rate is 2.25%.

Longevity Impact on Taiwan Life Insurers

Life Annuity Payments：

Status quo

- **Life Annuity：**
  Policyholders focus on short-term savings purpose and seldom choose to annuitize.
- **Whole Life wish Coupon Payments Products:**
  Death coverage provides natural hedge effects.

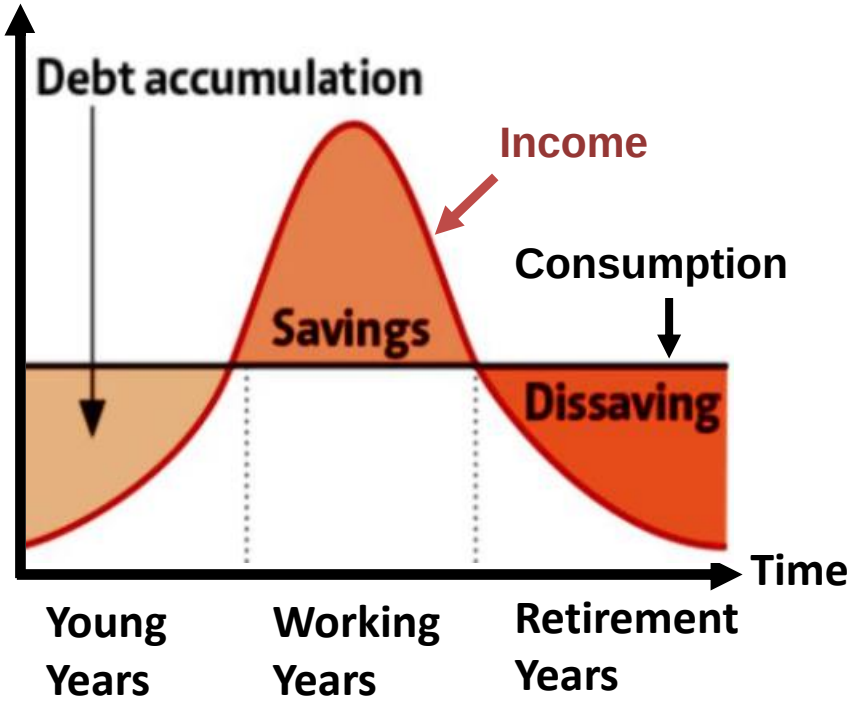
➡ **Longevity has limited influence.**

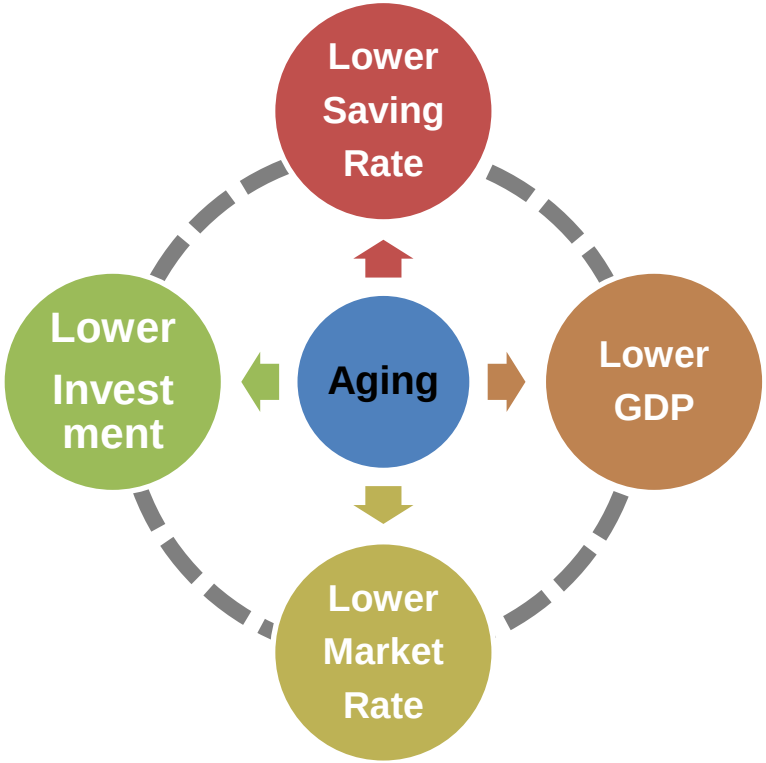
Medical Claim Payments:

With the extended life expectancy and the medical advances, the medical expenses will rise. The medical claim payment will increase.

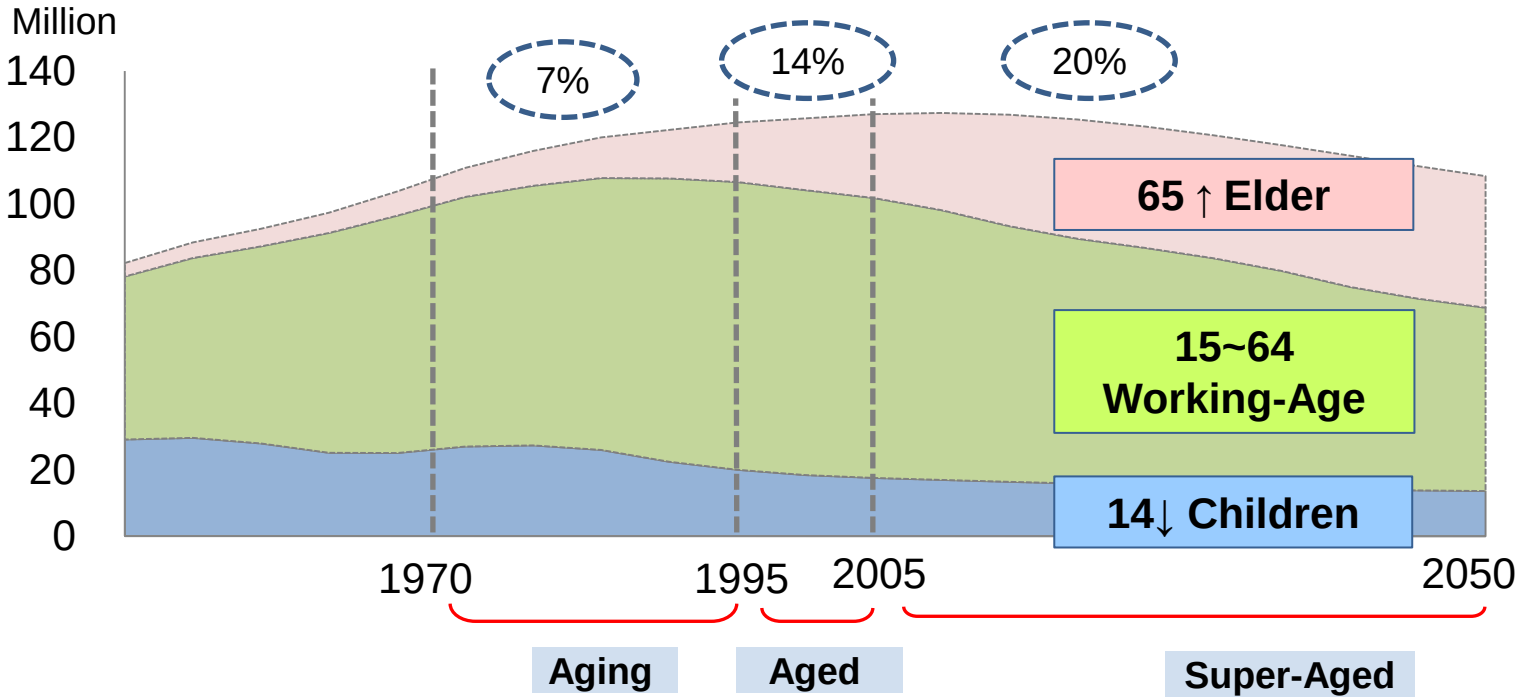
The Effects of Demographic change

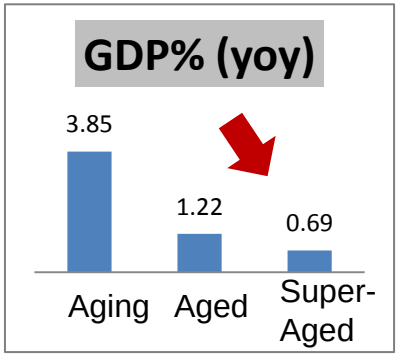
- Under the life-cycle hypothesis, finally people would being dis-savers in their elderly years.
- If the share of elder in the population rises, aggregate savings would fall, lead to lower investment growth, and lower GDP growth. (Fed, Sep2016)

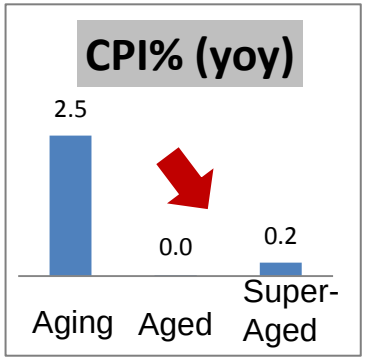


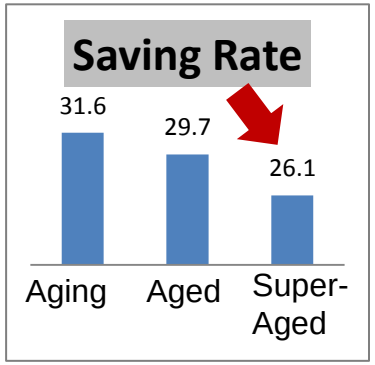


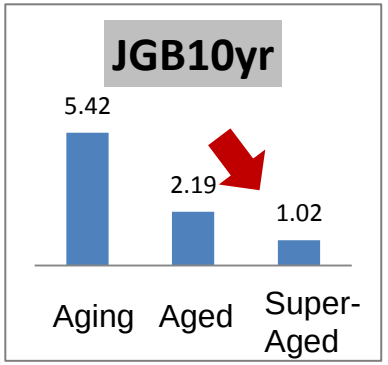
The Effects of Demographic change in Japan





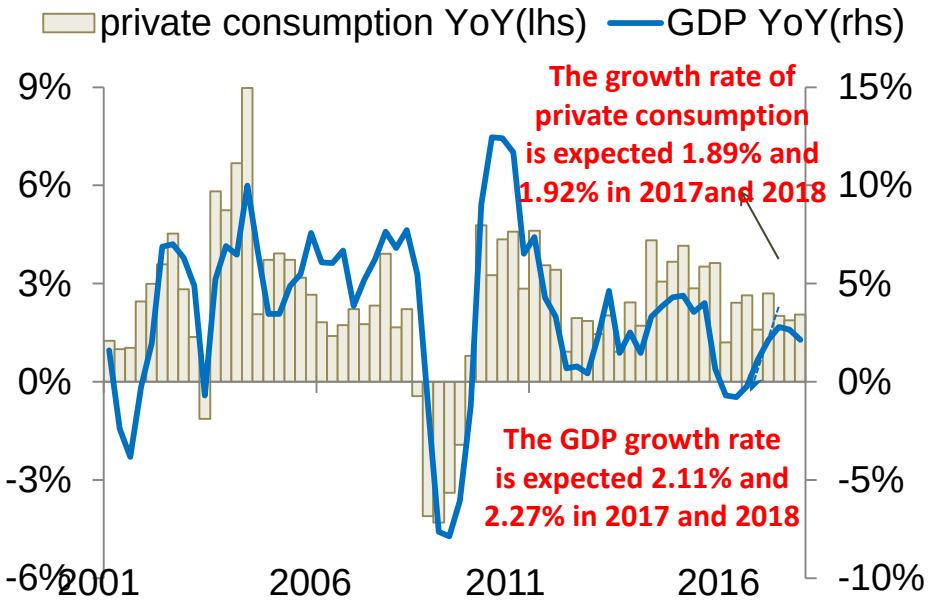




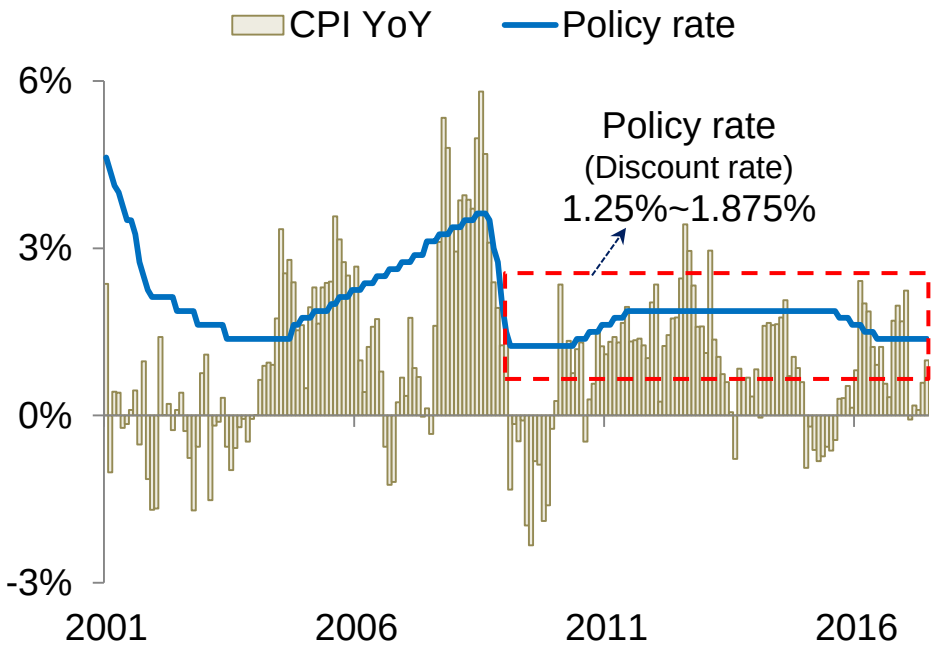


Sources: UN, IMF, MoF,1980~2017/8

CBC may keep the policy rate low due to smooth private consumption and mild inflationary



Source: Directorate-General of Budget, Accounting and Statistics(DGBAS), R.O.C. (Taiwan)



Source: Directorate-General of Budget, Accounting and Statistics, R.O.C. (Taiwan)、CBC (Taiwan)

- DGBAS indicates the growth rate of private consumption will be smoother due to lower birth rate and aging society. Private consumption is expected to grow by 1.89% and 1.92% in 2017 and 2018. Projected GDP growth is 2.11% and 2.27% in 2017 and 2018.

Major Impact

We expect that

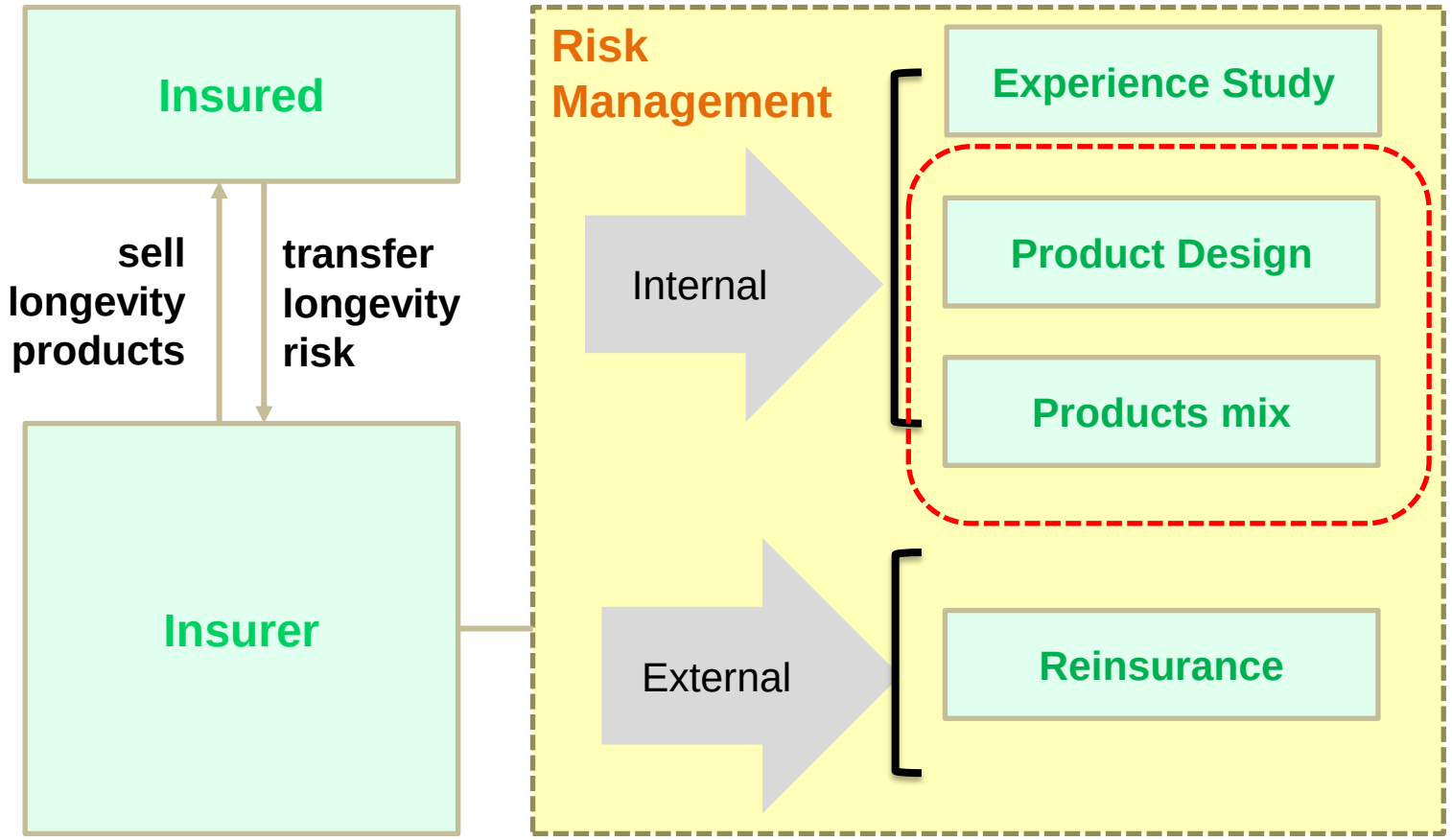
CBC may keep the policy rate at relatively low level under the circumstances of mild private consumption growth, moderate GDP growth, and stable inflation rate.

Demographic changes cause LOW INTEREST RATE.

3.

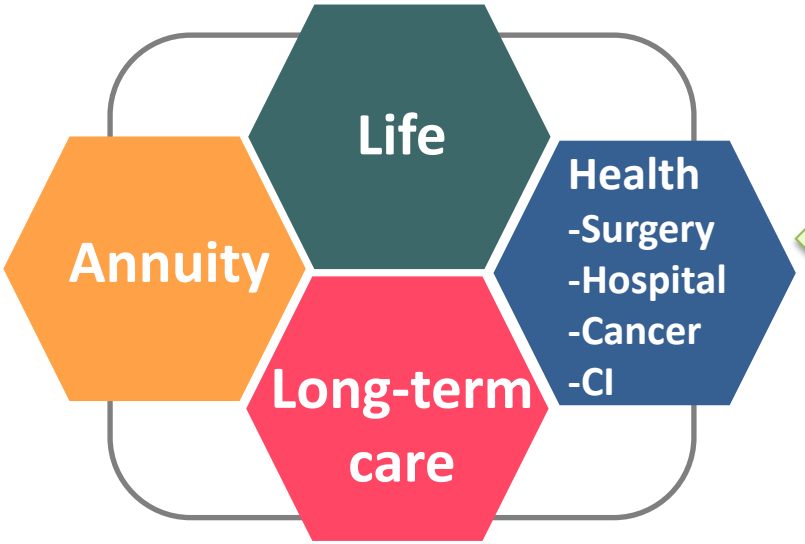
Longevity Risk management of Taiwan Insurer

Longevity Risk Management for Insurance Company



Longevity Risk Management

Product Design & Products mix



Health Product Control

- Limit Pay
- Fixed Benefit
- Cap
- Rarely Pay as you go

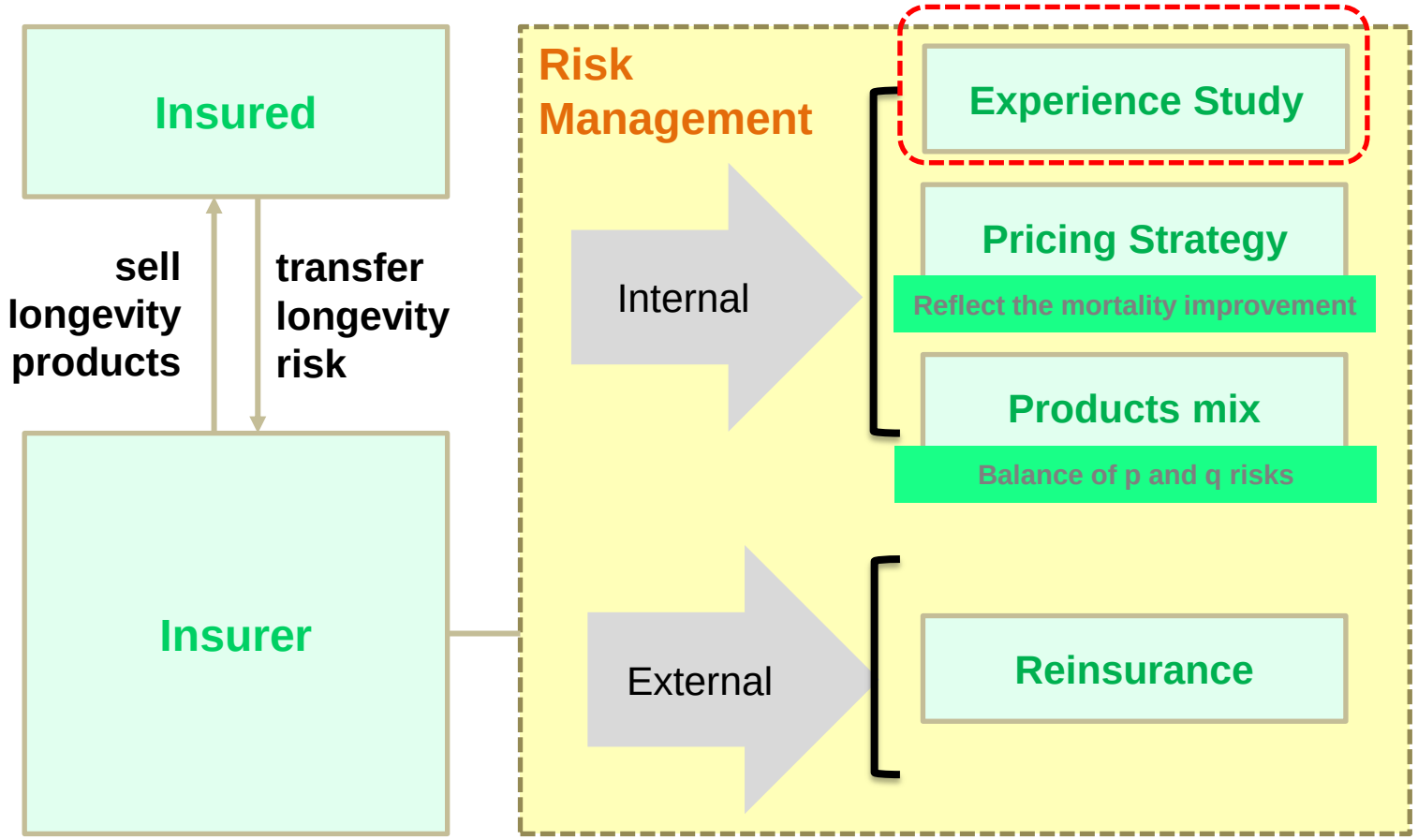
Product Design

- Reflect mortality improvement in pricing
- Natural hedge in one product
  (Life + Health、Life + Coupon)

Products mix

- Natural hedge between product lines
  (Life + Health、Life + Annuity)

Longevity Risk Management for Insurance Company

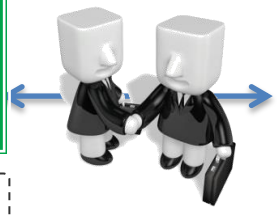


Construct Dynamic Experience Models

Latest Technique

Cathay Life

Experience Data

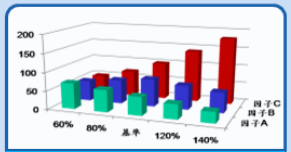


Academy

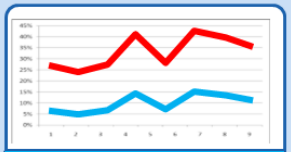
Academic Research

General Methods

Pricing Adequacy Test



Sensitivity Tests



Add Margin on Incidence Rate

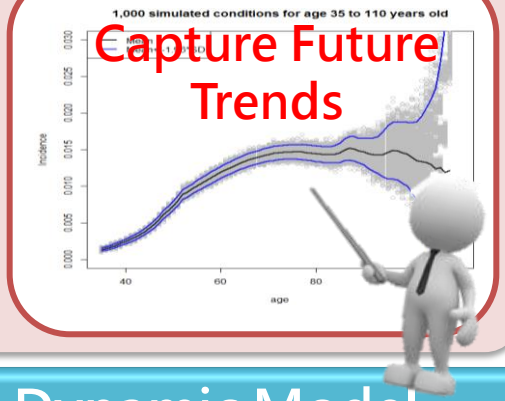
Experience Incidence Rate Analysis

- Experience Investigation Report
- P&L Analysis
- Contribution of Product Value

Dynamic Incidence Rate Model

Incidence of

- Mortality
- Lapse
- Critical Illness
- First Diagnosis Cancer
- Medical Related
- Mortality after Morbidity



Applications of the Dynamic Model

- Reserve Adequacy Assessment and EC measurement
- Product Pricing

Cathay Life Mortality Study

Lee-Carter model with Select Effect：

$$ln(m_{xts}) = \alpha_x + \beta_x \kappa_t + C_{xs} \times I\{S \leq S_x\} + \varepsilon_{xts}$$

- $m_{xts}$is the central death rate for age *x* and time *t* and policy year *s*.
- α_x 、β_x 、κ_t are parameters as in LC model
- C_{xs} is the size of select effect for age x and policy year s
- S is the policy year
- S_x is the length of select period for age x

- ☑ **Age, the main effect**
- ☑ **Mortality improvement**
- ☑ **Select Effect**

Note: This is a joint work with Jack C. Yue, National Chengchi Univ.

Cathay Life Mortality Study Result

Model Completed (2017/6，Internal)

2017 APRIA (2017/7，Poznan)

Submit to IME (Insurance Mathematics and Economics) (2017/8)

Longevity 13 (2017/9，Taipei)

Note: This is a joint work with Jack C. Yue, National Chengchi Univ.

4.

Conclusions

Conclusions

Risk

- Longevity itself has limited impact on Taiwan Insurers. (Product type, product design, product mix etc...)
- The **LOW INTEREST RATE** environment driven by demographic changes will remain for a prolonged period.

v.s

Opportunity

- Demand for retirement and medical care related insurance products will increase.
- Consciousness of the need for long-term care product will rise from both government and private demand.

Thanks for your Attention