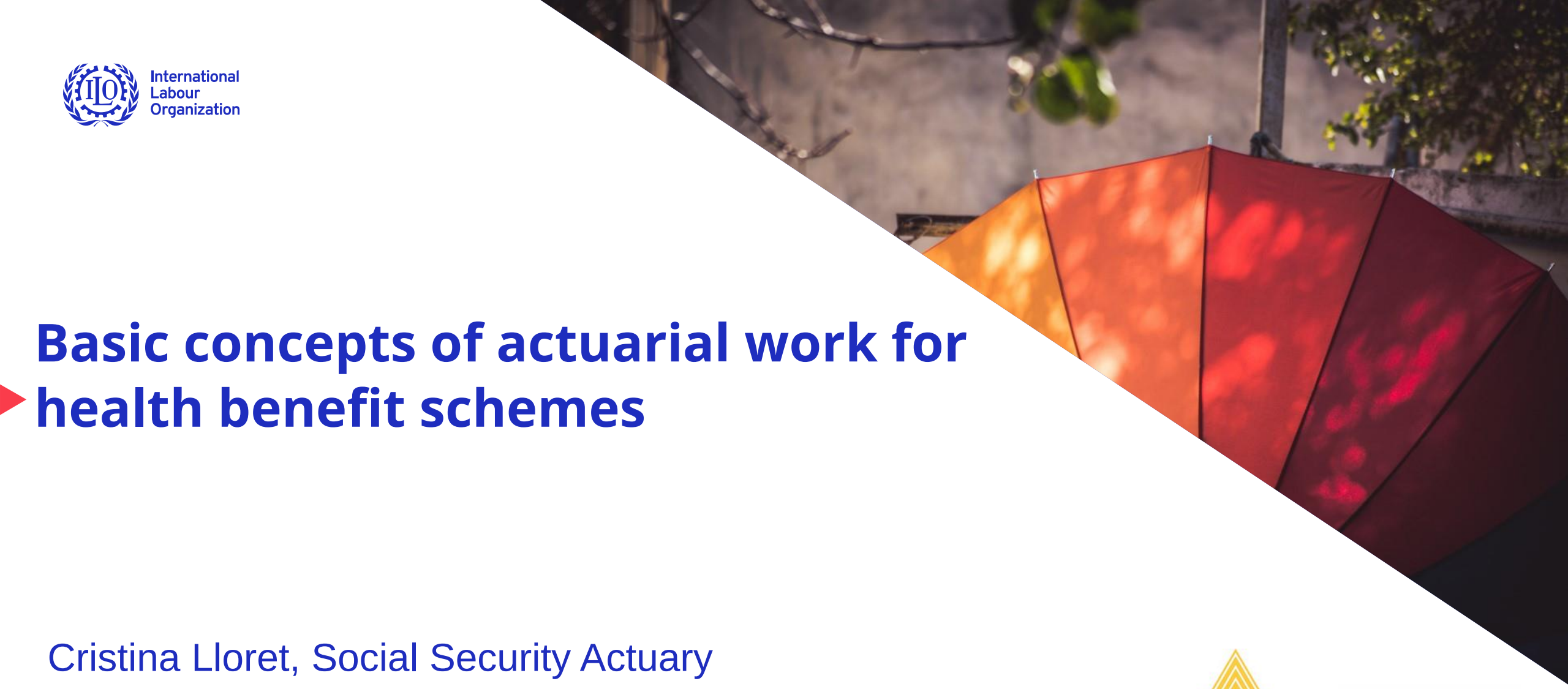
International Labour Organization



Basic concepts of actuarial work for health benefit schemes

Cristina Lloret, Social Security Actuary

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Concepts to be discussed

- What an actuary do
- What are actuarial models
- Examples of uncertainty in health care sector
- How to distinguish risk in health care sector
- Why insurance is the best response to risk and uncertainty
- Why is it important to know the risks

What do we mean by actuary?

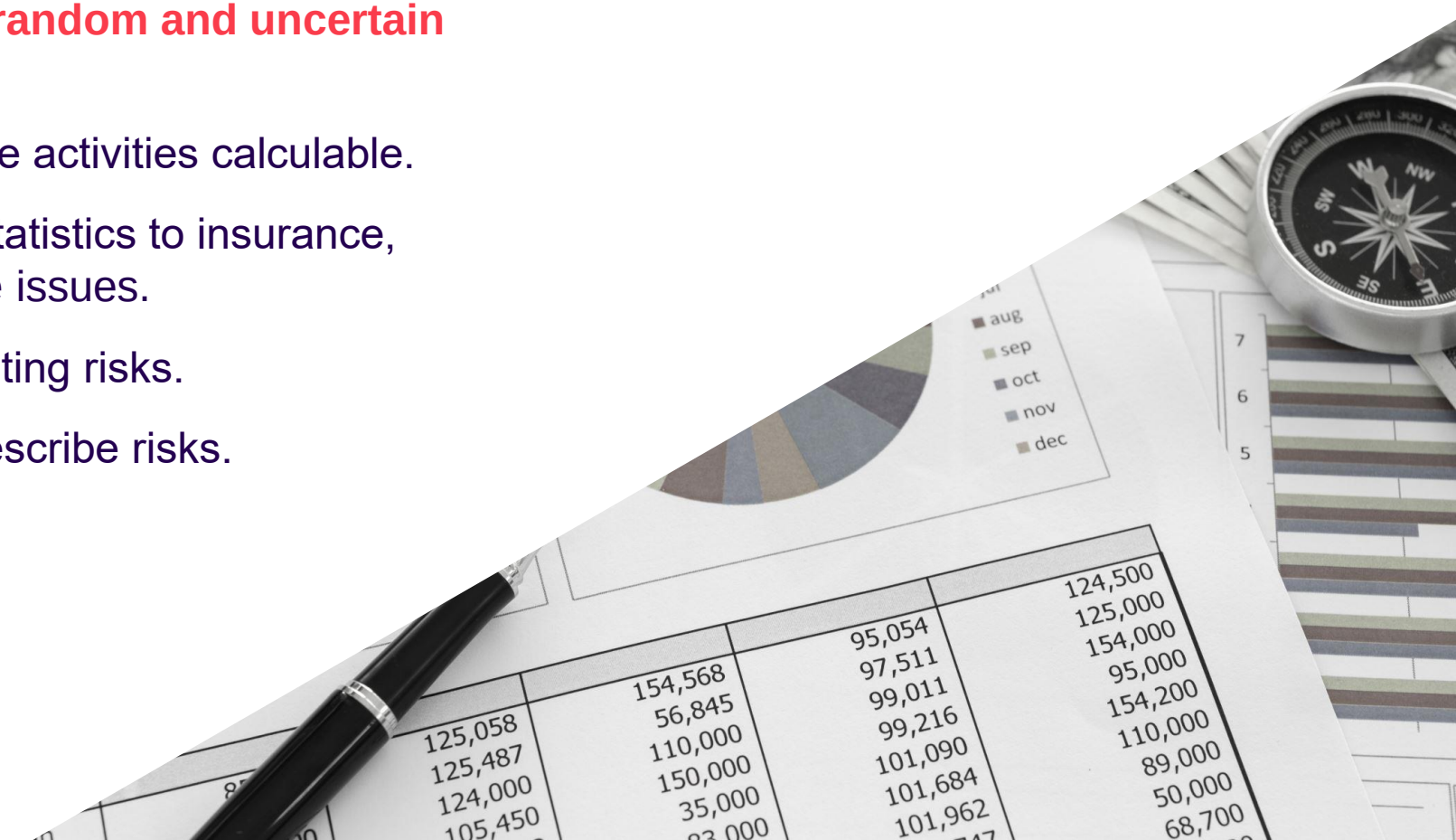
Insurance and finance are by nature random and uncertain sectors. This is why actuaries...

…make the risks that result from these activities calculable.

…apply probability calculations and statistics to insurance, prevention, finance and social welfare issues.

…develop statistical bases for calculating risks.

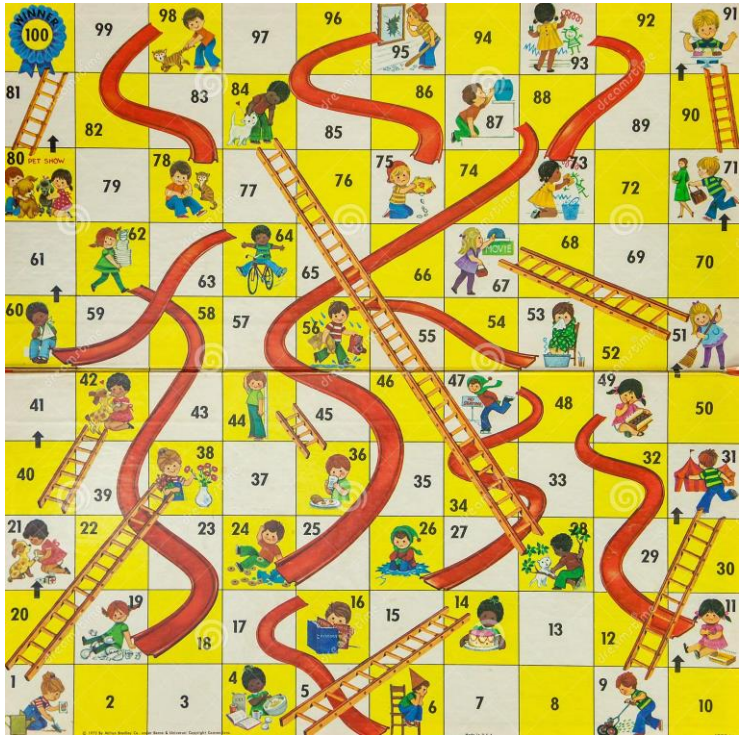
…develop mathematical models to describe risks.



What is an actuarial model?

Starting point based on data of the initial state (most recent year for which we have data)

Projections based on historical past data on the scheme experience



Uncertainty in the health care market

Uncertainty is a fundamental characteristic of the demand for medical services

Uncertainty about the volume of demand for health care services

- Uncertain morbidity rates, it is often not possible to anticipate the need for treatment or care.
- Many diseases are completely unexpected (Covid-19)
- Others are more predictable, but disease progression and the need for treatment may still be highly uncertain.
- Other factors also makes health care market uncertain such as : behavioural factors on the demand and supply side, technological and economic factors, and patients' ability to pay for services etc.

Uncertainty in the health care market

Uncertainty on individual cost of seeking care

- It is possible, even if unlikely, that an individual may face a very large bill for treatment. Significant source of anxiety.

- Prices of health care goods and services depend on factors such as behaviour, technology, economic developments, mostly unpredictable, and therefore uncertain from the analyst's perspective

This fundamental uncertainty distinguishes health care from many other services, such as housing, public utilities or nutrition, where the degree of uncertainty is only slight.

Quizz: What is the difference between uncertainty and risk?

1. Uncertainty and risk mean the same

2. Uncertainty means that outcomes are unknown, and risk means that possible outcomes and their probabilities are known, although the outcome in a specific case is unknown

3. Risk means that outcomes are unknown, and uncertainty means that possible outcomes and their probabilities are known, although the outcome in a specific case is unknown

Uncertainty vs risk

- Uncertainty means that outcomes are unknown.
- Risk, on the other hand, means that the possible outcomes and their probabilities are known, although the outcome in a specific case unknown.
- The normal response to risk is insurance
- The normal response to uncertainty is to adopt strategies that reduce the difference in consequences between uncertain outcomes. Insurance also does that, by providing compensation in the form of money or access to services.

Insurance as a response to risk and uncertainty

- Because of the inherent level of risk and uncertainty in health matters, there is a need for an insurance framework.
- Insuring the vulnerable and those in need of health services through a national insurance framework
  - ✓ Elderly people
  - ✓ Women of reproductive age
  - ✓ Chronically ill
  - ✓ Young children

Importance of knowing the risk

Insurance works best when:

- positive and negative outcomes can be specified with precision
- when probabilities are known with certainty
- when the distribution of various risks in the population is known in detail.
- When there is knowledge of the functioning of the system, particularly with regard to the determinants of price and demand for certain goods and services

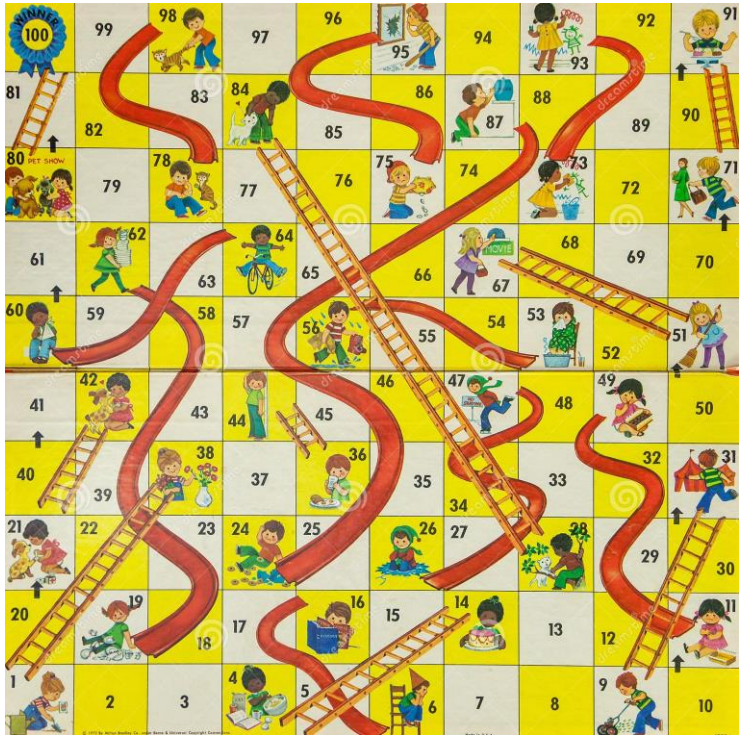
Data forms the statistical base that allows the quantification of risks.

Quizz: What are the essential elements to feed an actuarial model?

1. Uniquely data on the initial state (most recent year for which we have data)

2. Uniquely historical past data on the scheme experience without data on the initial state

3. Data on the initial state (most recent year for which we have data) and historical past data on the scheme experience



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The six steps of the modelling process of social health insurance schemes

Cristina Lloret, Social Security Actuary

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Concepts to be discussed

- The six steps of the modelling process of social health insurance schemes
- Quiz

What are the six steps for modelling health insurance schemes?

Step 1: Determining the scope of the model

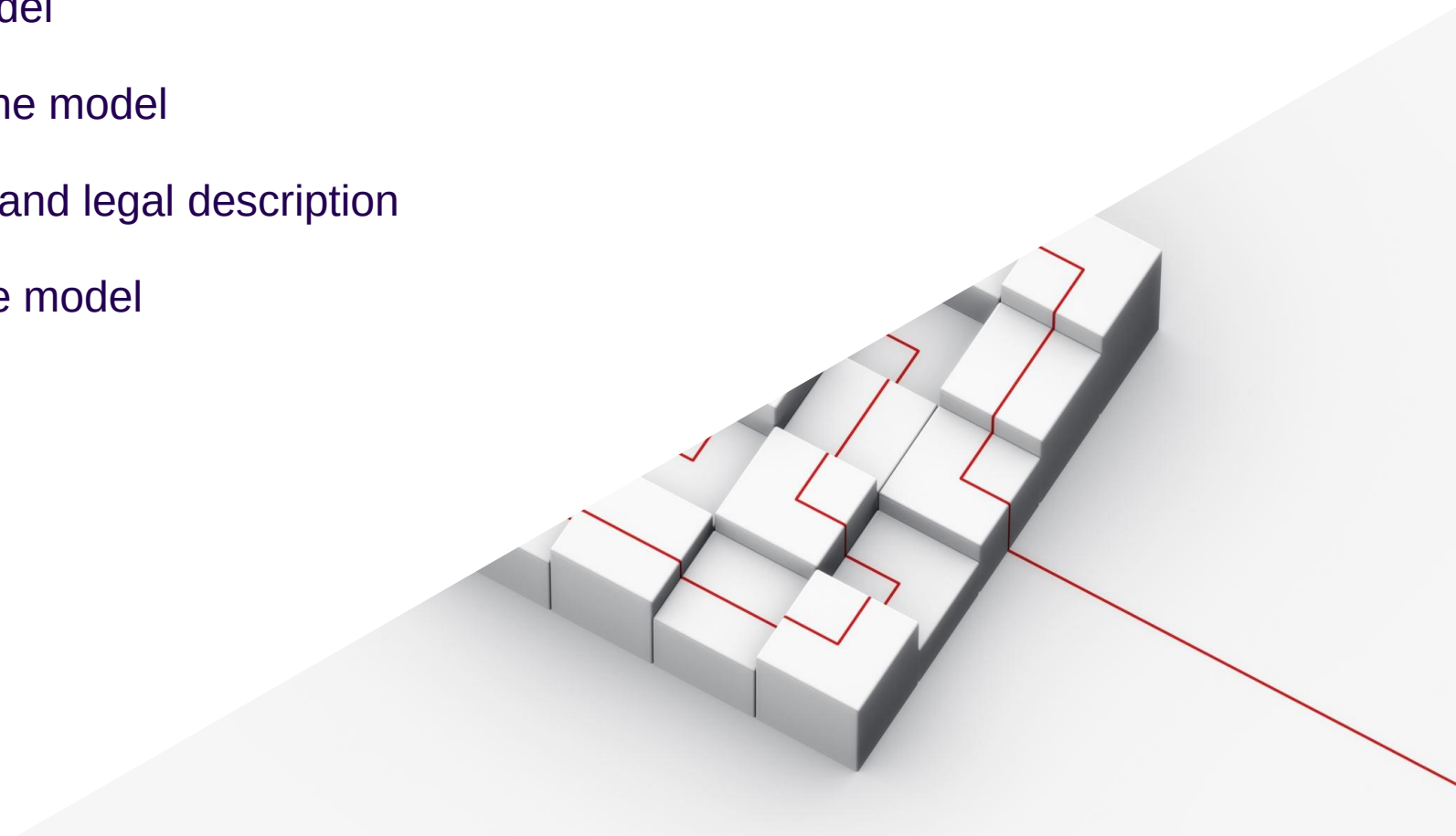
Step 2: Defining the logical structure of the model

Step 3: Establishing the data framework and legal description

Step 4: The mathematical mapping of the model

Step 5: Model calibration

Step 6: Sensitivity testing



Step 1. Determining the scope of the model

National health system or individual scheme?

Scope options:

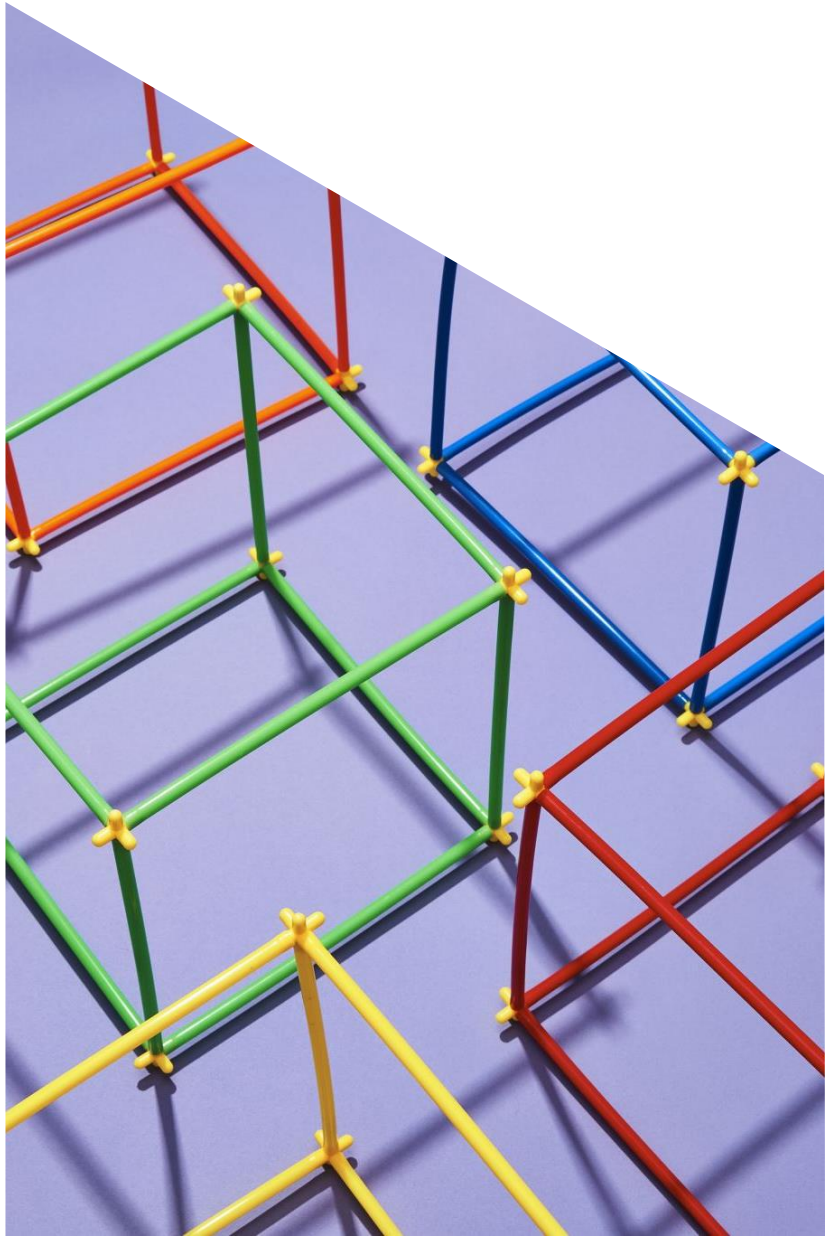
1. Entire national health system model: Explicit or implicit transfers between schemes (Ex. Financial equalization mechanism)
2. Specific scheme model

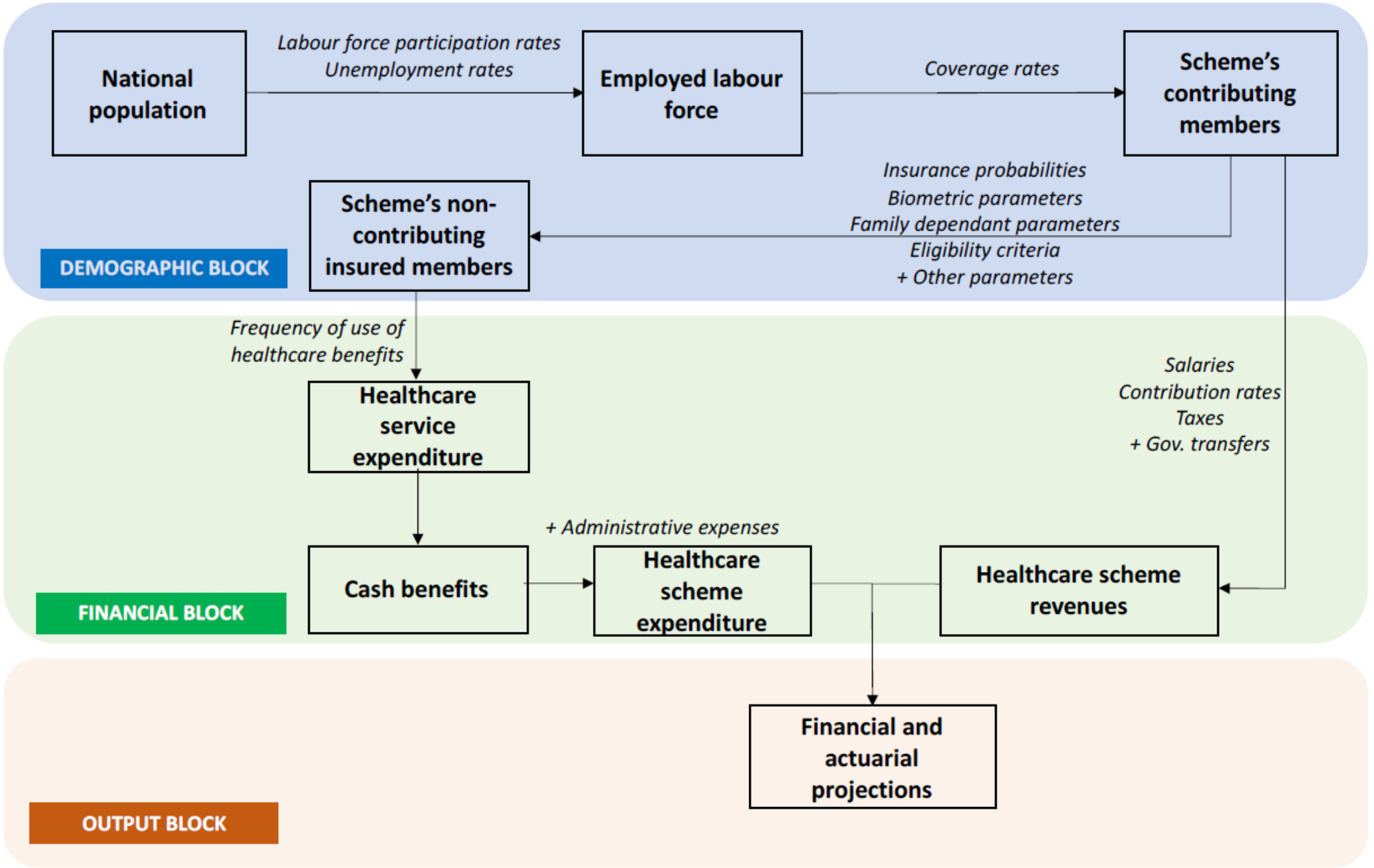
Step 2. Defining the logical structure of the model

Objective --> Answering the “how much” questions and consequences of policy goals and strategies

Logical relationships between:

- the data and information needed as inputs for the model
- the structure of model calculations
- and the desired model output.




National population
Labour force participation rates
Unemployment rates
Employed labour force
Coverage rates
Scheme's contributing members
Insurance probabilities
Biometric parameters
Family dependant parameters
Eligibility criteria
+ Other parameters
Scheme's non-contributing insured members
DEMOGRAPHIC BLOCK
Frequency of use of healthcare benefits
Salaries
Contribution rates
Taxes
+ Gov. transfers
Healthcare service expenditure
+ Administrative expenses
Cash benefits
Healthcare scheme expenditure
Healthcare scheme revenues
FINANCIAL BLOCK
Financial and actuarial projections
OUTPUT BLOCK

Step 3. Establishing the data framework and legal description

Sound quantitative and qualitative information essential to feed the model

Functioning and operations of the scheme information consist:

Data framework - Quantitative information

Legal description - Qualitative information

Step 3. Establishing the data framework and legal description

Collection of data framework	A list of data is used as a guideline by data collectors
	List adapted to the scheme
	Wish list – not all date may be available
	Without data it is difficult for policy makers to assess the performance and efficiency of the health care scheme

Step 3. Establishing the data framework and legal description

Data on the starting point and past experience is essential to quantify the expected financial evolution of the scheme and the impact of reforms

Data framework and *legal description* are two important outputs of an actuarial valuation and part of the report.

Step 4. The mathematical mapping of the model

Translation of real-world observations of the demographic, economic, expenditure and revenue structure of the model into mathematical equations

When data do not fit with the mathematical mapping, two alternatives:

1. Change the mathematical mapping of the model
2. Expand data sources
   - Ad-hoc sample survey
   - international experience
   - small samples

Step 5. Model calibration

The projected results can never be predicted exactly

Calibration consist to adjust the model to align projected values as much as possible to observed values

Calibration options

1. Sometimes aggregated data for first projection year is made available during the actuarial valuation process
2. Initiating the projection one year before

Projections are normally repeated each year, which permits continual adjustment and improvement of the projection basis

Step 6. Sensitivity testing

Effect of changing the value of one parameter

- ✓ For each sensitivity test, the value of one parameter is changed.
- ✓ New results are compared to the status quo results to understand how sensible is the model to that change
- ✓ Demonstrates to policy makers the relative importance of certain factors in the financial equilibrium of the system.

Step 6. Sensitivity testing

Typical parameters changed for sensitivity tests:

- ✓ inflation rate
- ✓ mortality rates
- ✓ utilization rates increases
- ✓ Medical inflation

Quiz

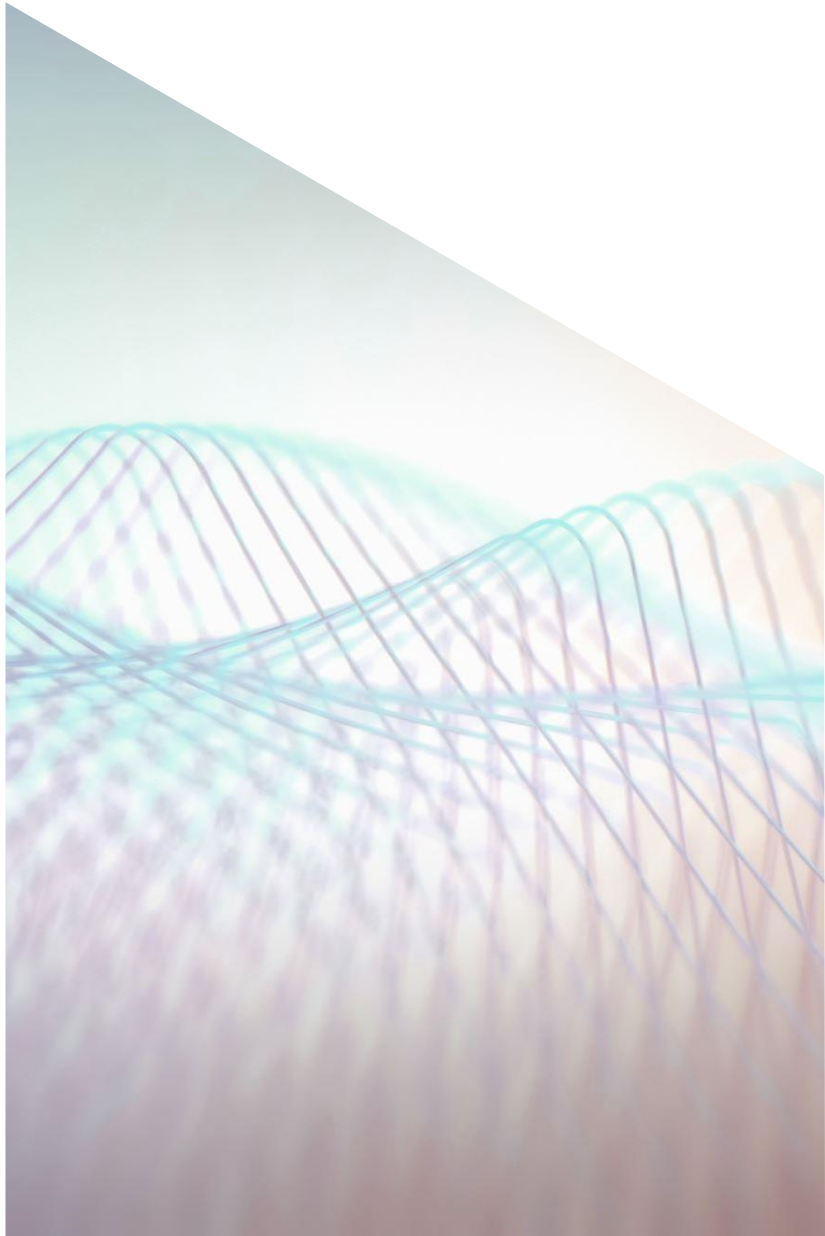
What is the difference between status quo scenario and sensitivity and policy (reform) scenarios?

1. Status quo scenario projects the financial situation of the scheme as if the scheme will run in the same conditions as it runs today

2. Sensitivity scenarios projects the financial situation of the scheme changing one specific variables in order to observe the sensitivity to the change

3. Policy scenarios projects the financial situation of the scheme targeting specific policy objectives

Sensitivity and policy scenarios are compared to Status quo scenario



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Legal framework of the scheme:
Design parameters on coverage, benefits, delivery and financing

Cristina Lloret, Social Security Actuary

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Concepts to be discussed

- Legal description of the scheme
- Basic elements
  1. Population coverage
  2. Benefits provided
  3. Delivery and reimbursement methods
  4. Financing rules

The legal description of the scheme

Description of the legal provisions which governs the operations of the scheme

Legal provisions govern two main aspects:

1. Provision of benefits
2. Nature of scheme's resources

It is necessary to have a clearer idea of key social health insurance design in mind **before** starting any financial estimate

Information is needed *to model the present and future functioning of the scheme*

The basic elements of the scheme design

1. **Population coverage**

✓ Population financing the scheme – **Who pays?**

✓ Population eligible for benefits – **Who gets?**

2. **Benefits provided**

✓Type and extent of benefits – **What is provided?**

✓Eligibility conditions – **Under which conditions?**

3. **Delivery and reimbursement methods**

✓Type of providers and relationships with them – **Who is providing services?**

✓Reimbursement to providers –**How providers are paid?**

4. **Financing rules – who pays how much?**

1. Population coverage

- ✓ Population financing the scheme – **Who pays?**
  - Who pays? (Contributors)
  - Who does not pay? (Dependants, pensioners, low revenue)
- ✓ Population eligible for benefits – **Who gets?**
  - Potential beneficiaries – For ex. Contributors + Dependants
  - Any special categories who needs special treatments (e.g. not contributing but provided benefits?)

2. Benefits provided

✓ Type and extent of benefits – **What is provided?**

- OP / IP both included?
- Prevention measures (e.g. medical check-up) included in addition to health care?
- Some preventions / treatments out of taxation (e.g. vaccination, highly infectious diseases stipulated in the law) or donor aid (vertical programmes such as HIV/AIDS)
- Any excluded treatments (e.g. cosmetic surgeries)?
- Prescribed drugs limited (essential drugs)?

2. Benefits provided

✓ Eligibility conditions – **Under which conditions?**

- What are qualifying conditions?
- Paying contributions for some months before insured persons get sick? – Qualifying period
- Residual coverage

3. Delivery and reimbursement methods

✓ Type of providers and relationships with them – **Who is providing services?**

- Physicians and hospitals under a global contract
- Scheme own facilities
- Private or public external providers

✓ Reimbursement to providers – **How providers are paid?**

- Fee-for-service
- Capitation
- Budget

4. Financing rules

✓ Sources of financing

- Contributions
- Government subsidies
- Co-payments
- Investment income
- Other income

Combinations of different sources of financing are both possible and likely

4. Financing rules

Raising resources have consequences and limitations

Receiving *donor grants* for health spending may create concerns about sustainability and could have effects on inflation of health-care prices

Increasing too much taxes may jeopardize economic performance → *optimal level of contribution rates*

Limits differ from country to country

4. Financing rules

Raising resources also through reduction of costs

- Synergy effects
- Improvement of efficiency that increases the cost-effectiveness of care

Introducing effective primary care, focusing on generic drugs, negotiating prices and quality with providers, using economies of scale, getting discounts for bundling orders, etc.

4. Financing rules

Contributors – **Who pays?**

- ✓ individuals or households?
- ✓ How many different categories are there as contributors and contribution rates?
  - e.g. employers / employees in the private sector
  - employers / employees in the public sector (Government as employers and civil servants as employees)
  - self-employed or anyone with income

Who are exempted to pay (e.g. dependents, poor, elderly, disabled)? Who is paying on their behalf?

4. Financing rules

Contributions – **How much?**

- ✓ How is contribution calculated ('ability' to pay)?
  - Fixed percentage of wages (with ceiling/floor)? defined ceiling/floor? household income? household assets?
  - Flat amount per person/household: Universal or different for specific groups (income, geography)

In case of dependents, is it assumed that household heads are liable for contributions? Or may they pay own contribution?

4. Financing rules

A **fixed percentage** of wages result in:

- ✓ Difference in the absolute amounts of contribution paid by different individuals for the same benefit
- ✓ Wealthiest people in a society may end up paying much more than the value of health services they use
- ✓ Upper limit or ceiling can be applied to contributions
- ✓ Regressive contribution – people with higher income pays lower proportion of their income

4. Financing rules

Government subsidies – **How much?**

- ✓ Should Government subsidies be paid or not to social health insurance?
- ✓ If yes, how and to where should Government subsidies be targeted (to poor etc.)?

4. Financing rules

Co-payments

- ✓ Who pays the co-payment?
- ✓ Any exemption categories of people not paying co-payment?
- ✓ How is the co-payment calculated
  - Fixed amount per service
  - Percentage of cost per service
- ✓ What level of co-payments are affordable? Any maximum for individuals / households?
- ✓ Different rates / amount of co-payment for different services (e.g. IP, OP, drugs, dental treatments)?

International Labour Organization

Basic financing principles of a social health insurance scheme

Cristina Lloret, Social Security Actuary

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Concepts to be discussed

- Individual versus collective equivalence
- Financial equilibrium
- Pay-as-you-go (PAYG) financing method
- Contingency reserves
- Quiz (*if time allows*)

Individual versus collective equivalence

Private insurance schemes follow the principle of individual equivalence

Individual equivalence means that total expected expenses incurred by an insured person throughout the insurance period should equal to the sum of the expected contributions

Total expenses=Total contributions

Private arrangements

Individual versus collective equivalence

70% of health expenses during an average person's life occur in later years

Technical reserves are built up charging actuarial premiums that are:

- ✓ Higher than the age-related costs for younger people
- ✓ Lower than the age-related costs for elderly people

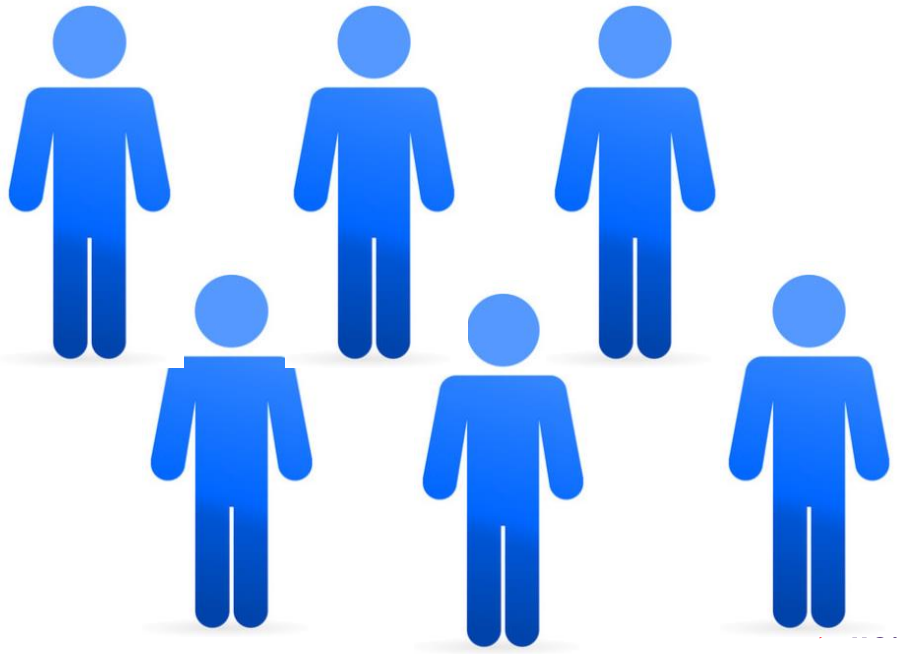
Sufficient funds left for each individual when they reach an elderly age

Individual versus collective equivalence

Social security schemes follow the principle of **collective equivalence**

Scheme's expenditure in a defined period (benefits and administrative expenditures) should equal the scheme's income during that period

Total expenses=Total income



Individual versus collective equivalence

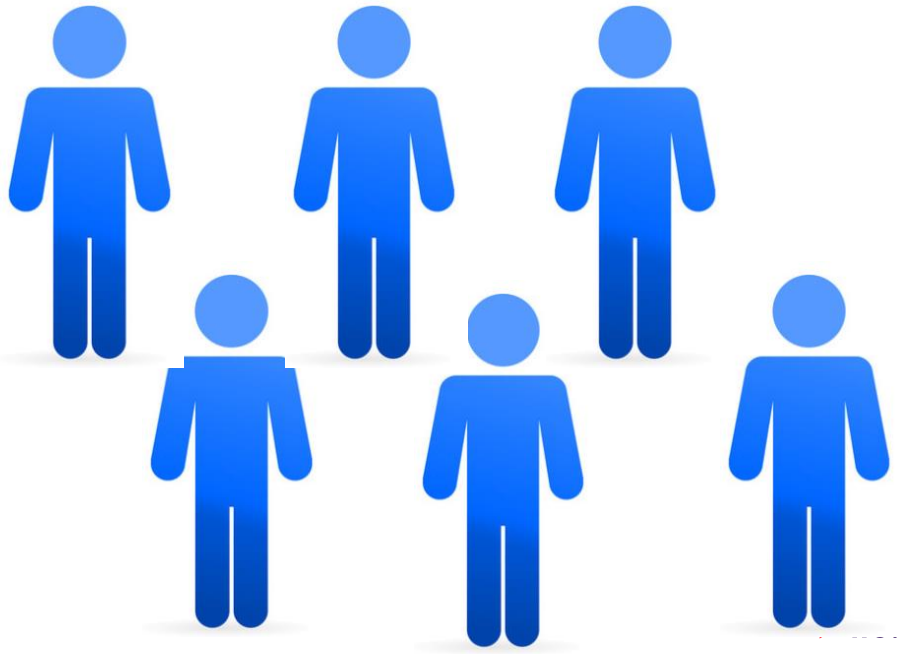
Social security schemes collective equivalence principle allows for **social transfers**

✓better-of might subsidize the poor

✓the younger generation might subsidize the older generation

✓single persons might subsidize families

Transfers reflect principle of social solidarity

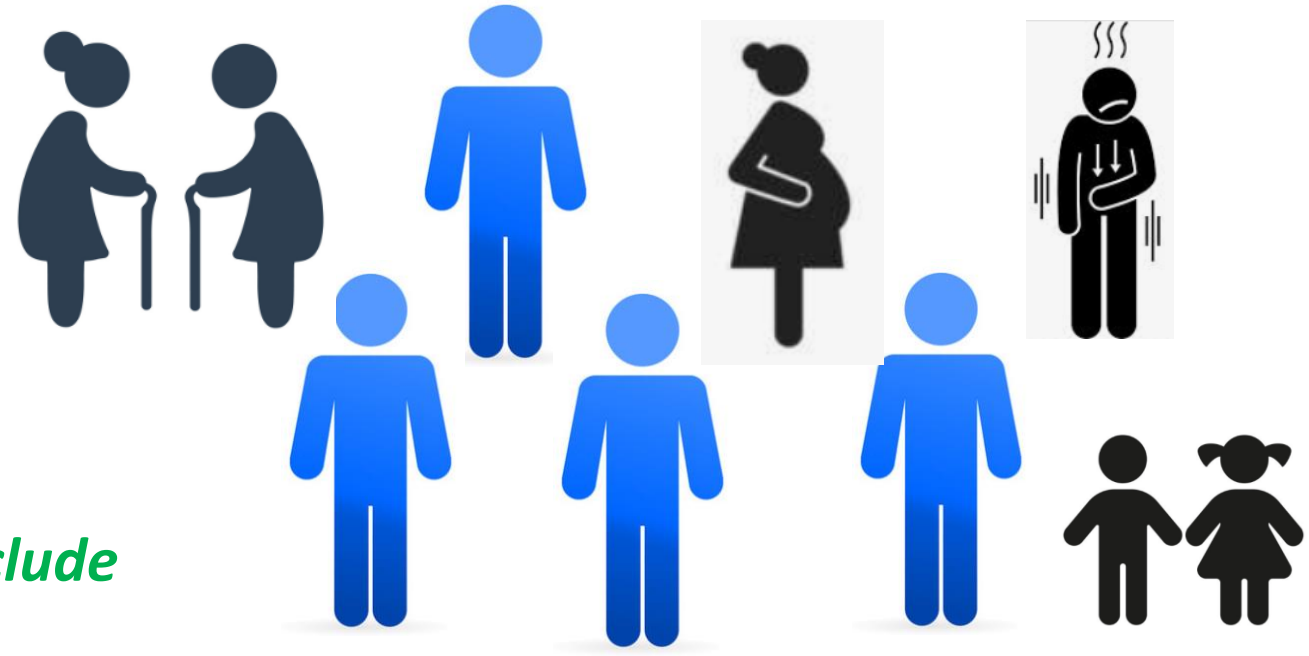


Individual versus collective equivalence

Insuring the vulnerable and those in need of health services through a national insurance framework

- Elderly people
- Women of reproductive age
- Chronically ill
- Young children
- Healthy population

Affordable and accessible schemes include everybody



Financial equilibrium

- ✓ Expenditure must match income

  Expenditure = Income + Reserve

- ✓ Collective equivalence for *all funding systems*
- ✓ Long-term equilibrium does not automatically guarantee solvency at each point in time
- ✓ Contribution rates should provide enough cash flow to cover current benefit expenditure
- ✓ Most of health care schemes are financed in a pay-as-you-go basis

Pay-as-you-go (PAYG) financing method

- ✓ Health care benefits are by nature short term benefits
- ✓ Necessary contribution rates are fixed at the beginning of the period so total income can be expected to cover all cost during the year

  Expenditure = Income + Reserve

- ✓ **No** major reserves are set aside, except limited contingency reserves and accidental surpluses

Contingency reserves

- ✓ Contingencies reserves are usually fixed as a *percentage of total annual expenditure*
- ✓ This percentage is called **funding ratio** (or **reserve ratio**)

  Funding ratio = Contingencies reserves / Total expenditures

- ✓ The more *stable* is the expenditure trend of the scheme, the *lower* is the funding ratio
- ✓ *Larger* schemes with *larger* insured population will have a more *stable average benefit expenditure* per insured person → Funding ratio can be relatively small
- ✓ Funding ratio might vary between **0.25** and **1** in most cases
- ✓ However, for some cases could be higher than 1

Quiz: What are the risks of a voluntary health insurance scheme?

1. Moral hazard: only persons in need of health care will be interested to join
2. Since only persons in need will be interested to join, the scheme will be expensive and will require high contribution rates which are not affordable for everybody (Moral hazard consequences)
3. Inaccessibility of vulnerable population without capacity to contribute (part of population with healthcare needs, but without access)

Unhealthy people need healthy people into the scheme. Healthy will become unhealthy too

Quiz: Social health insurance scheme are usually financed through…

1. A full funding basis
2. A PAYG basis with a relatively small contingency reserve
3. A partial funding basis

Quiz: Social health insurance scheme are usually financed through…

1. A full funding basis
2. **A PAYG basis with a relatively small contingency reserve**
3. A partial funding basis

Quiz: The contingency reserve will be smaller as…

1. The larger is the scheme
2. The more the unemployment rates are expected to decrease
3. The more stable is the expenditure per capita
4. The smaller is the scheme

Quiz: The contingency reserve will be smaller as…

1. **The larger is the scheme**
2. The more the unemployment rates are expected to decrease
3. **The more stable is the expenditure per capita**
4. The smaller is the scheme

Contingency reserves

- ✓ Long term considerations generally do not play a role in the process of setting contribution rate
- ✓ Should technical reserves start to be accumulated to smooth out the expected financial burden caused by the expected ageing of populations?

Financial projections – income side: health-scheme specific data and assumptions

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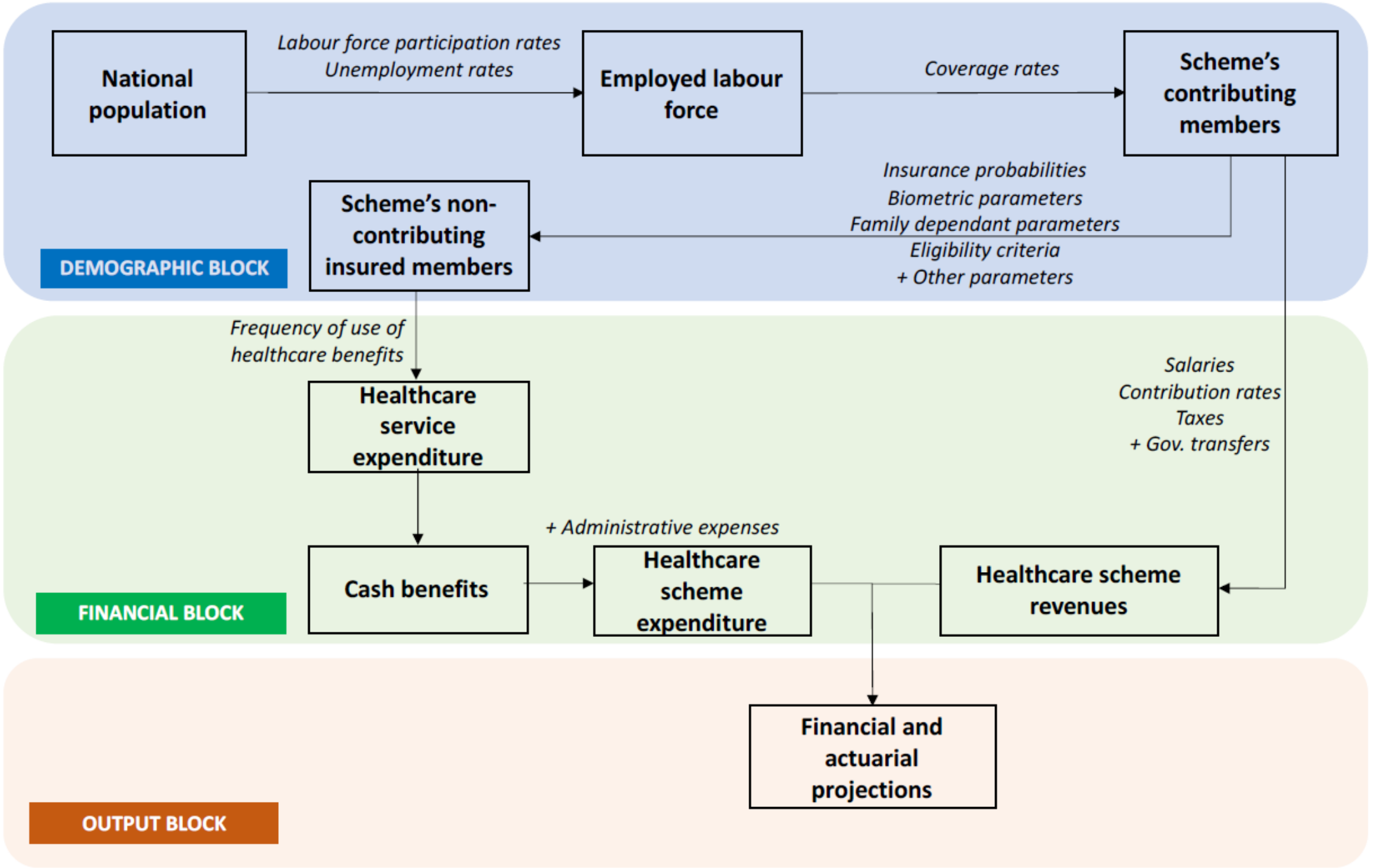
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Concepts to be discussed

- Model structure
- Economic and demographic module
- Income module: types, data needed and assumptions to project contributors and to project salary mass (assessment base), government subsidies, copayment and other income

Model structure

1. Economic and demographic module

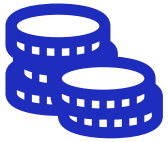
Population, labour force, employment levels, economic data

2. Income module

Assessment base for contributions, contributors and compliance ratio and other income

3. Expenditure module

Benefit, administrative and other expenditure on the basis of covered population, utilization rates and cost developments



4. Results module

Annual balance of income and expenditure and other results

1. **Economic and demographic** module

- ✓ Evolution of scheme contributors and beneficiaries are related to the demographic development of *total population*
- ✓ *Labour force and employment* conform the basis to estimate the number of contributors
- ✓ *General inflation* and *wage growth* may be used as references to set medical inflation assumptions
- ✓ Evolution of *real GDP growth* and *number of employed persons* affects labour productivity and impact wage growth

2. **Income** module: Types of income

- ✓ Contribution income
- ✓ Transfers and subsidies
  - Government
  - Social insurance
  - International community
- ✓ Co-payments
- ✓ Other income
  - Investment income

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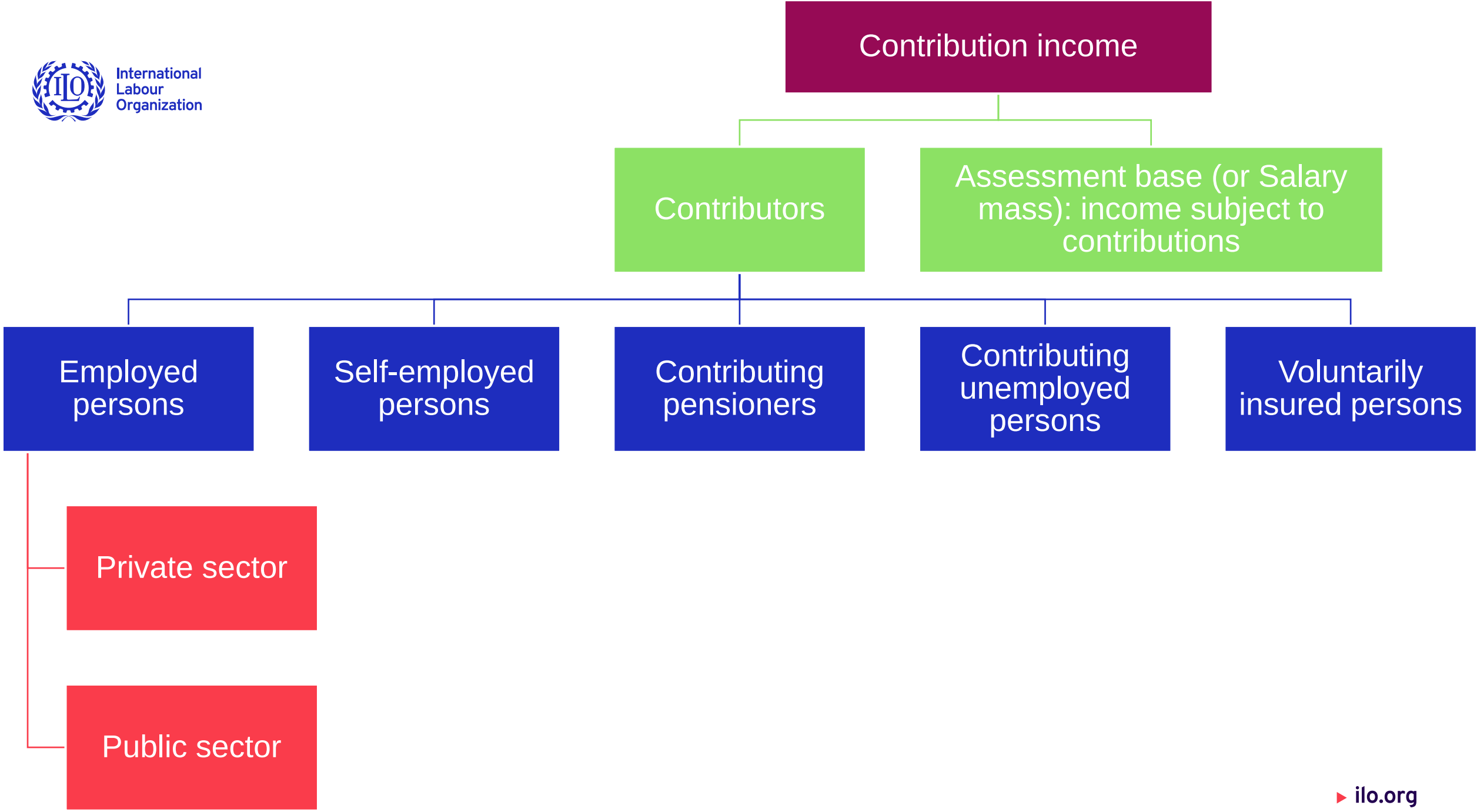
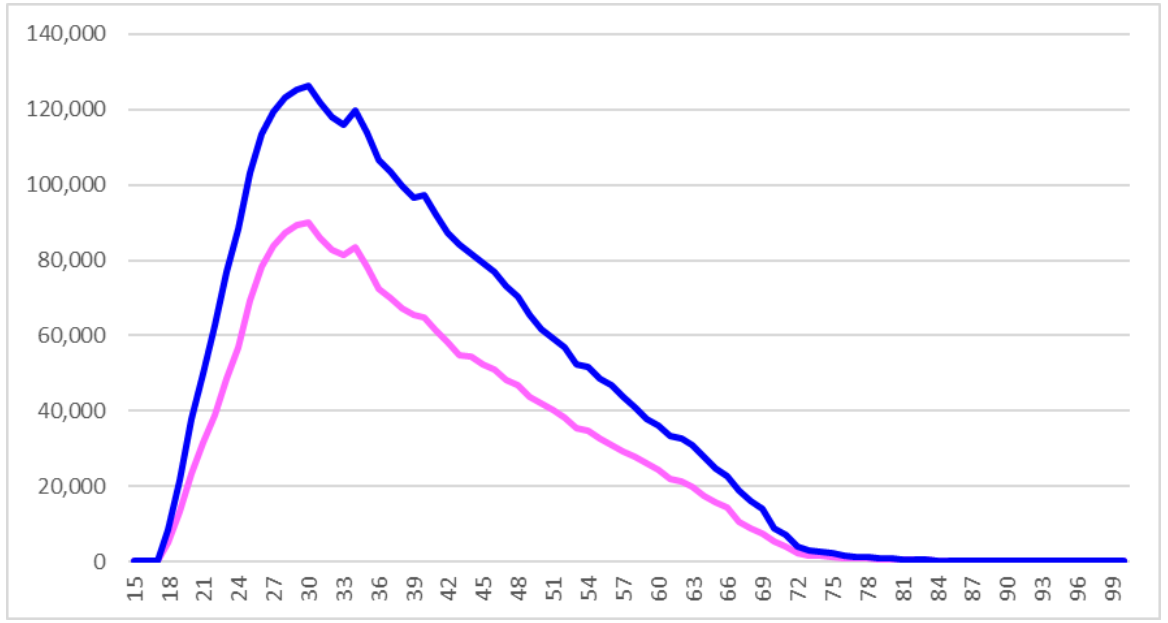


Contributors' projection: data needed and assumptions

- ✓ Initial year group-sex-age disaggregation of contributors
- ✓ Coverage rate assumptions
- ✓ Transition probabilities: past data on contributors

Contributors' projection: data needed and assumptions

- ✓ **Initial year group-sex-age disaggregation of contributors**
- ✓ Coverage rate assumptions
- ✓ Transition probabilities: past data on contributors



Contributors' projection: data needed and assumptions

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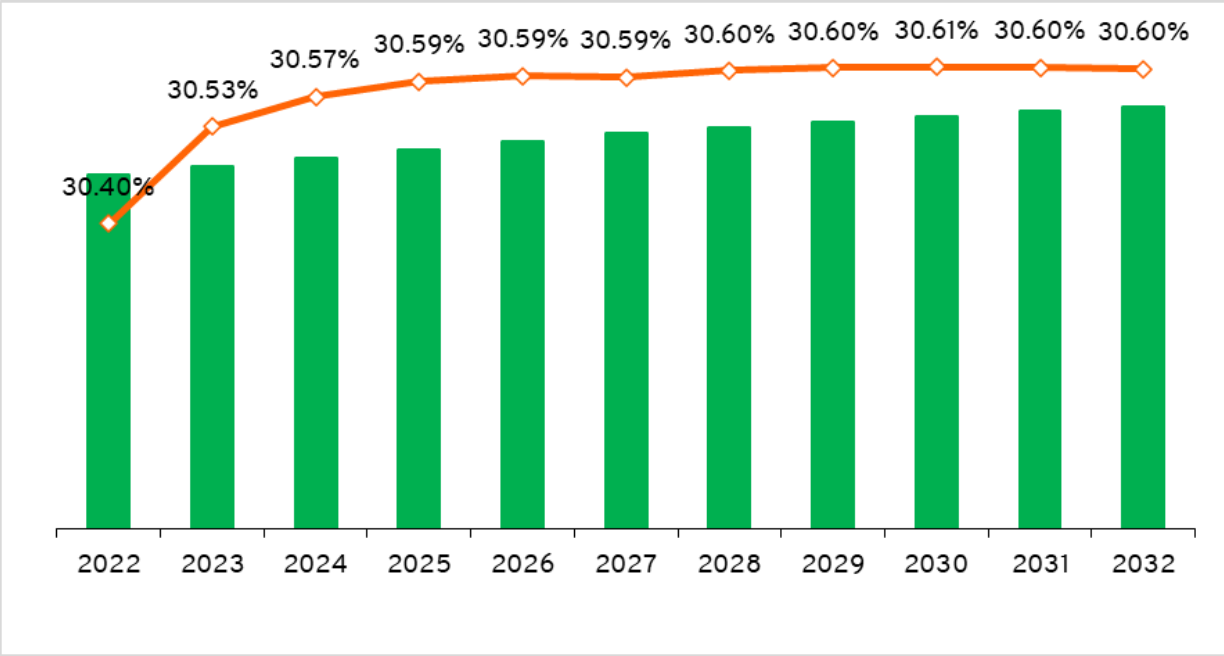
- ✓ **Coverage rate assumptions**
- ✓ Transition probabilities: past data on contributors



Contributors' projection: data needed and assumptions

- ✓ Initial year group-sex-age disaggregation of contributors
- ✓ Coverage rate assumptions
- ✓ **Transition probabilities: past data on contributors**

ID Number	Group	Gender	Birthdate	Month of contribution	Year of contribution
646	Public	Female	13/09/1985	January	2020
522	Private	Male	20/02/1970	January	2020
523	Pensioner	Male	01/07/1942	January	2020
295	Public	Male	16/07/1978	January	2020
173	Self-Insured	Female	05/05/1965	January	2020
520	Others	Female	07/08/1960	January	2020
76	Public	Male	04/05/1975	January	2020
515	Public	Male	08/10/1990	January	2020
745	Private	Female	10/03/1995	January	2020
804	Social Securi	Male	28/06/1988	January	2020

Contributors' projection: data needed and assumptions

Projected contributors by group, sex and age are the result of calculating…

- ✓ **Surviving contributors** = Initial year contributors * transition probabilities of exit (death, retirement, disability, other exits)
- ✓ **Total projected contributors**: coverage rate assumptions on the projected employment allow to compute total new entries
- ✓ Redistribution of **new entries** and addition to surviving contributors

Contributors' projection: data needed and assumptions **in new schemes**

Initial year group-sex-age disaggregation of contributors based on employed population by sex and age and coverage rate assumptions by sex and age for initial year. Coverage rate assumptions for future years group-sex-age disaggregated

*Alternative: assumption that insured population in another scheme **(pension scheme)** will be the same as in new health insurance scheme*

Assessment base or salary mass: data needed and assumptions

The total amount of earnings of insured persons which are subject to contributions

Persons with a *wage lower than a stipulated amount* may be exempt from contributions, while earnings above a *certain ceiling* may not be subject to assessment

Assessment base or salary mass: data needed and assumptions

- ✓ Assessment base might be multiplied by a **compliance rate**
- ✓ The **compliance rate** reflects the proportion of insurable earnings that are reported for contribution purposes.
- ✓ **Under-reporting** is a widespread phenomenon, especially in groups with highly fluctuating incomes, such as farmers and certain categories of the self-employed.

Assessment base or salary mass: data needed and assumptions

- ✓ Initial salaries profile
- ✓ Wage growth assumption
- ✓ Projection of salaries distribution by group/sex/ages combined with projection of contributors will result in **projected assessment base**

Assessment base or salary mass: data needed and assumptions for **new schemes**

- ✓ Data from other social security scheme (**pensions**) might be very useful *if the contribution rules are the same*

- ✓ **Income surveys** as alternative sources for average wages

In any case, it is essential to build up for the new scheme, an own database on salaries subject to contribution

Government subsidies to SHI

1. Subsidies to cover deficits
   - Instead of increasing contributions, State may pay for the costs that exceed revenue
   - Temporary measure

Government subsidies to SHI

2. Subsidies to cover contributions (partially or entirely) on behalf of certain groups
   - Greater population coverage including people who cannot afford contributions
   - Contribution defined in advance vs reimbursement of treatment costs (room for manipulation or political change in priorities)
3. General subsidies paid by the State
   - Defined in advance to avoid to fall victim of political changes

Government subsidies to SHI

4. Subsidies to cover certain services provided by SHI: immunization, prevention, etc.

5. Subsidies to cover investments or start-up costs
   - Useful to ensure that contributions are only used to purchase health services

Co-payments

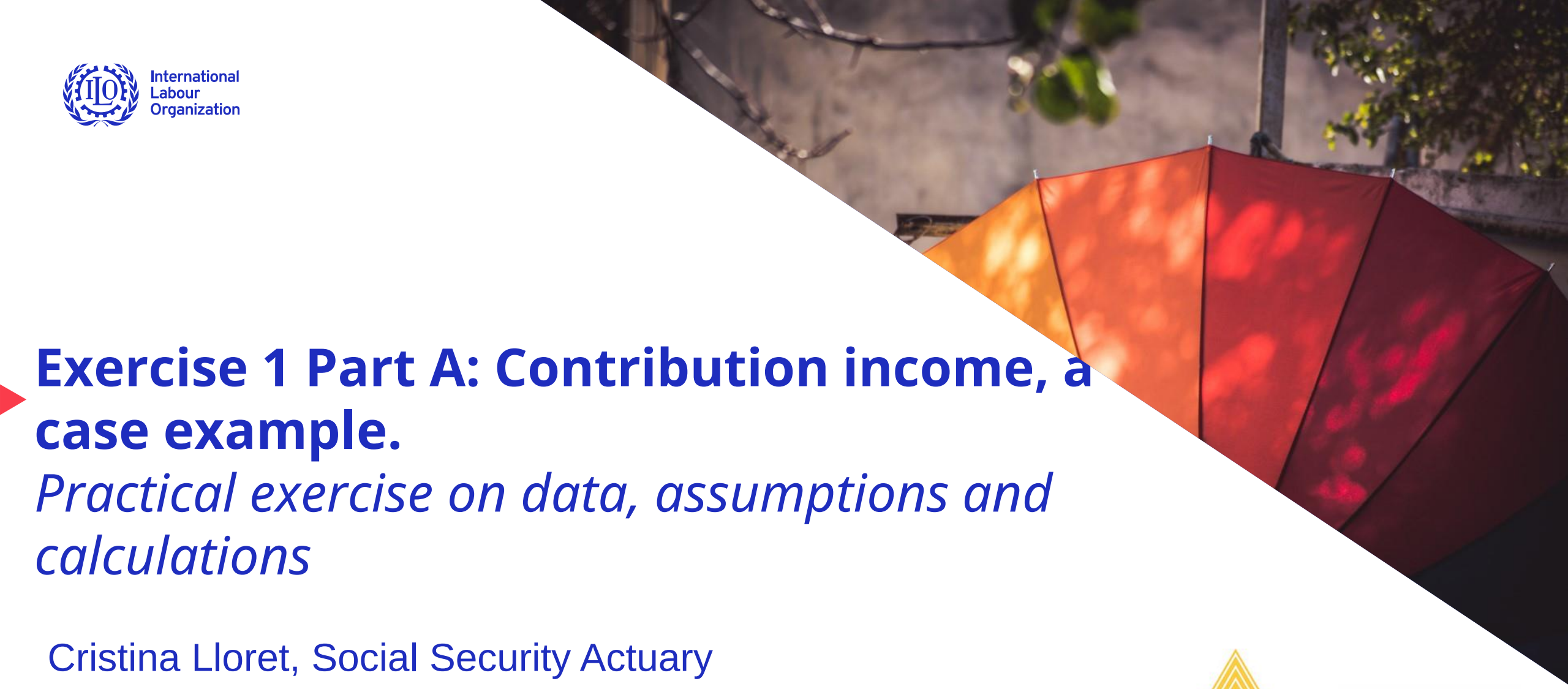
Co-payments have an impact on **consumer behaviour** and **distribution of health care costs**

1. Awareness of cost and containing consumption
2. Reinforcing prevention behaviour
3. Discourage people from unnecessary and excessive utilization of services
4. Generate additional sources of financing

Adequate exemption mechanism or maximum co-payment limits to avoid deter the poor from using health services

Other income

- ✓ Investment income: interest on reserves that health funds hold depends on
  - Amount of reserves
  - Quality of financial management
- ✓ Other income: can be modelled as an aggregate



Exercise 1 Part A: Contribution income, a case example.

Practical exercise on data, assumptions and calculations

Cristina Lloret, Social Security Actuary

First ILO Regional Actuarial Valuation Training, November 2023, Bangkok, Thailand

Objective of the exercise

- Calculate the projected contribution income of a scheme
  - Number of contributors
  - Salary subject to contributions

Definitions

- Legal coverage: share of persons (for example, share of employed) within each group that should pay contributions according to law
- Effective coverage: the share of those who should, in theory, be contributing and pay contributions
- Wage compliance ratio: part of the wage reported and submitted for contributions

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Financial projections – expenditure side: health-scheme specific data and assumptions

Cristina Lloret, Social Security Actuary

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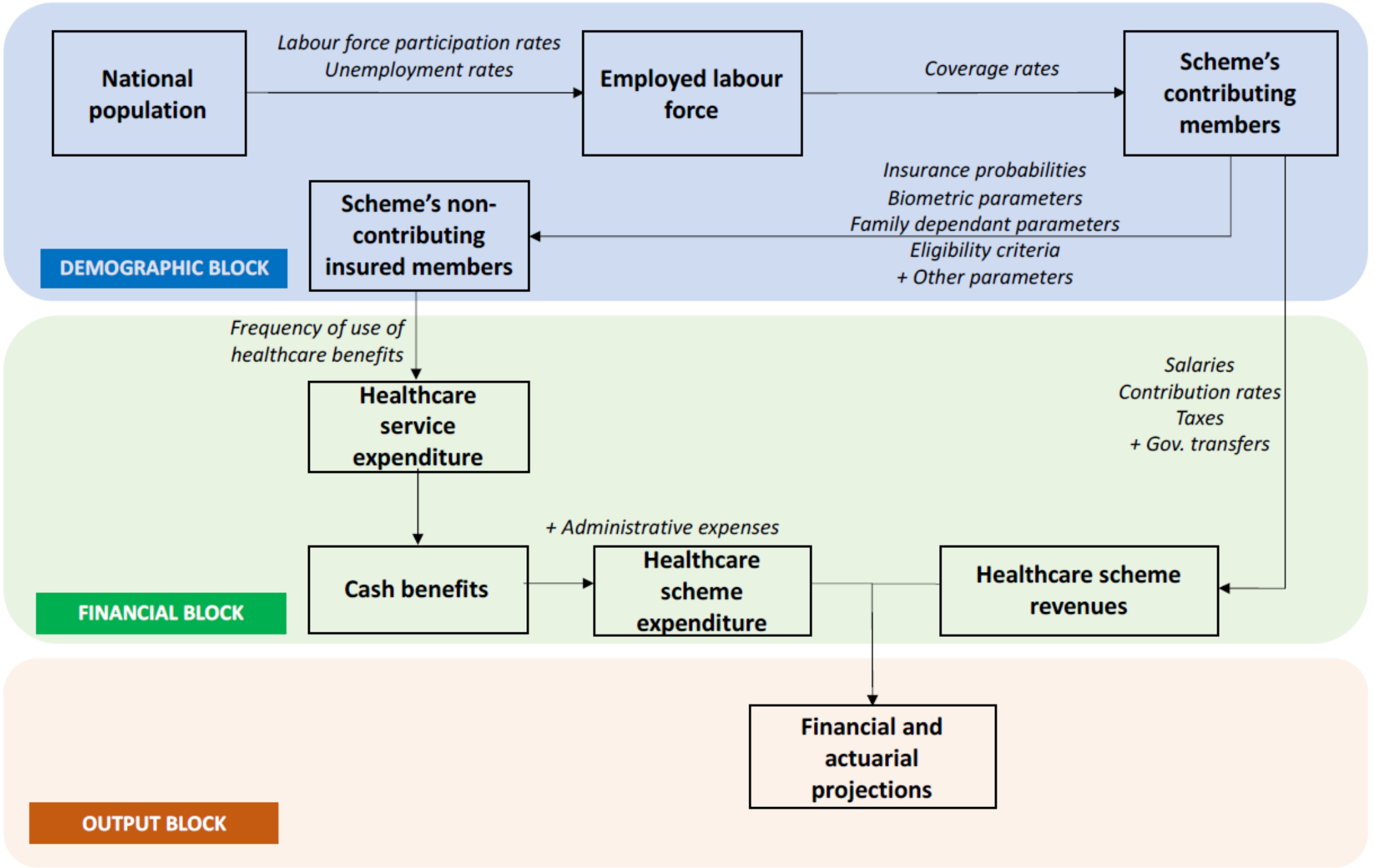

National population
Labour force participation rates
Unemployment rates
Employed labour force
Coverage rates
Scheme's contributing members
Insurance probabilities
Biometric parameters
Family dependant parameters
Eligibility criteria
+ Other parameters
Scheme's non-contributing insured members
DEMOGRAPHIC BLOCK
Frequency of use of healthcare benefits
Salaries
Contribution rates
Taxes
+ Gov. transfers
Healthcare service expenditure
+ Administrative expenses
Cash benefits
Healthcare scheme expenditure
Healthcare scheme revenues
FINANCIAL BLOCK
Financial and actuarial projections
OUTPUT BLOCK

Concepts to be discussed

- Types of expenditures
- Covered population
- Benefit package
- Frequencies
- Unit cost

2. **Expenditure** module: Types of expenditure

- ✓ Benefit expenditure
- ✓ Administrative expenditure
- ✓ Other expenditure: may be modelled in a fairly crude way (tiny fraction of total expenditure)

2. Expenditure module: benefit expenditure

The calculation of **benefit expenditure** implies the estimation of…

- ✓ Covered population
  - different from contributing population
  - all persons entitled to benefit (contributors + dependents)
- ✓ Benefit package
- ✓ Utilization rate
- ✓ Unit cost or unit of care

$$\text{Benefit expenditure} = \text{Covered population} * \text{Utilization rate} * \text{Unit cost}$$

2. Expenditure module: covered population

The calculation of covered population could be done either…

- ✓ by applying dependents probabilities to contributors
  - Dependents probabilities can be derived from family statistics on how many dependents are expected by the contributors of a specific group, sex and age
- ✓ by applying a coverage ratio to the total population

2. Expenditure module: benefit package

A typical disaggregation of the benefit package for projection purposes would be:

- ✓ Ambulatory care
  - provided by general practitioners
  - provided by specialists
- ✓ Inpatient care
- ✓ Pharmaceuticals
- ✓ Dental care
- ✓ Medical technology (prosthetic devices)
- ✓ Other benefits

2. Expenditure module: utilization rate

- ✓ The average number of units of care per covered person is the frequency rate or utilization rate
- ✓ Cases per capita
- ✓ Example: utilization rate of ambulatory care by general practitioners of 2.1 means that a covered persons makes use of ambulatory care in average 2.1 times per year.

2. Expenditure module: unit cost

- ✓ It usually is a basket of goods and services provided to patients.
  - Example 1. A hospital day: various nursing and catering inputs, medical technology inputs, as well as physician services.
  - Example 2. Physician contact

2. Expenditure module: unit cost

- ✓ It does not suffice to project the cost per unit with the general price index
- ✓ A special price index must be established for every category of care, reflecting
  - ✓ relative share of staff and non-staff costs
  - ✓ medical content
  - ✓ technological changes

which affect the capital-to-labour cost ratio in the basket.

- ✓ The establishment of these cost indicators is one of the major challenges of the modelling exercise

2. Expenditure module: new schemes

- ✓ A proposed solution is to use the experience of other domestic schemes which service a similar population
  - Particularly useful when the new scheme is designed to replace an existing one
  - New scheme will have new benefit entitlement provisions and perhaps more attractive benefits → might actually increase utilization rates.

2. Expenditure module: new schemes

✓ Another solution to use international experience.

- Highly risky and should only be applied until the first scheme-based experience data are available.
- National data always reflect national performance, behaviour, benefit provisions, entitlement conditions, organizational aspects and infrastructure conditions, all of which are rarely similar between countries.
- However, in many cases, this approach cannot be avoided.

In any case, it is essential to build up an own database on frequencies and unit cost for the new scheme

2. Expenditure module: providers

Benefits that can be provided under an insurance scheme depends:

- Available resources that also depends on the ability and willingness to pay contributions by members and the feasibility to collect contributions

- Availability of appropriate providers of services that depends on the level of health development of the country

Exercise 1 Part B: Benefit expenditure, a case example of inpatient benefit cost.

Practical exercise on data, assumptions and calculations

Cristina Lloret, Social Security Actuary

First ILO Regional Actuarial Valuation Training, November 2023, Bangkok, Thailand

Objectives of this exercise

- Calculate the projected benefit expenditure of inpatient services
  - Number of beneficiaries (who gets?)
  - Total hospital days (how many days in total?)

Assumptions

- For simplification covered population are contributors (no addition of dependants)
- Annual increase of frequency rate is 1%

Useful equations

Beneficiaries=Covered members x frequency rate

Total hospital number of days = Beneficiaries x Average number of days per beneficiary

Benefit expenditure = Total hospital number of days x Average cost per day

Benefit expenditure = Covered members x frequency rate x Average number of days x Average cost per day

Unit cost of a hospital stay

Conclusions

- **Expenditure** growths at **5.1% annually**
- **Expenditure** is influenced by the growth of:
  - **Total hospital days** that grows **2%** annually
  - average day cost increase that grows **3%** annually (medical inflation).
- **Total hospital days** is influenced by the growth of
  - **Beneficiaries** that grows **2%** annually
  - total number of days per beneficiary (constant)
- **Beneficiaries** is influenced by the growth of:
  - Number of covered that grows **1%** annually (employed growths at 1% annually)
  - Utilization rate that grows **1%** annually

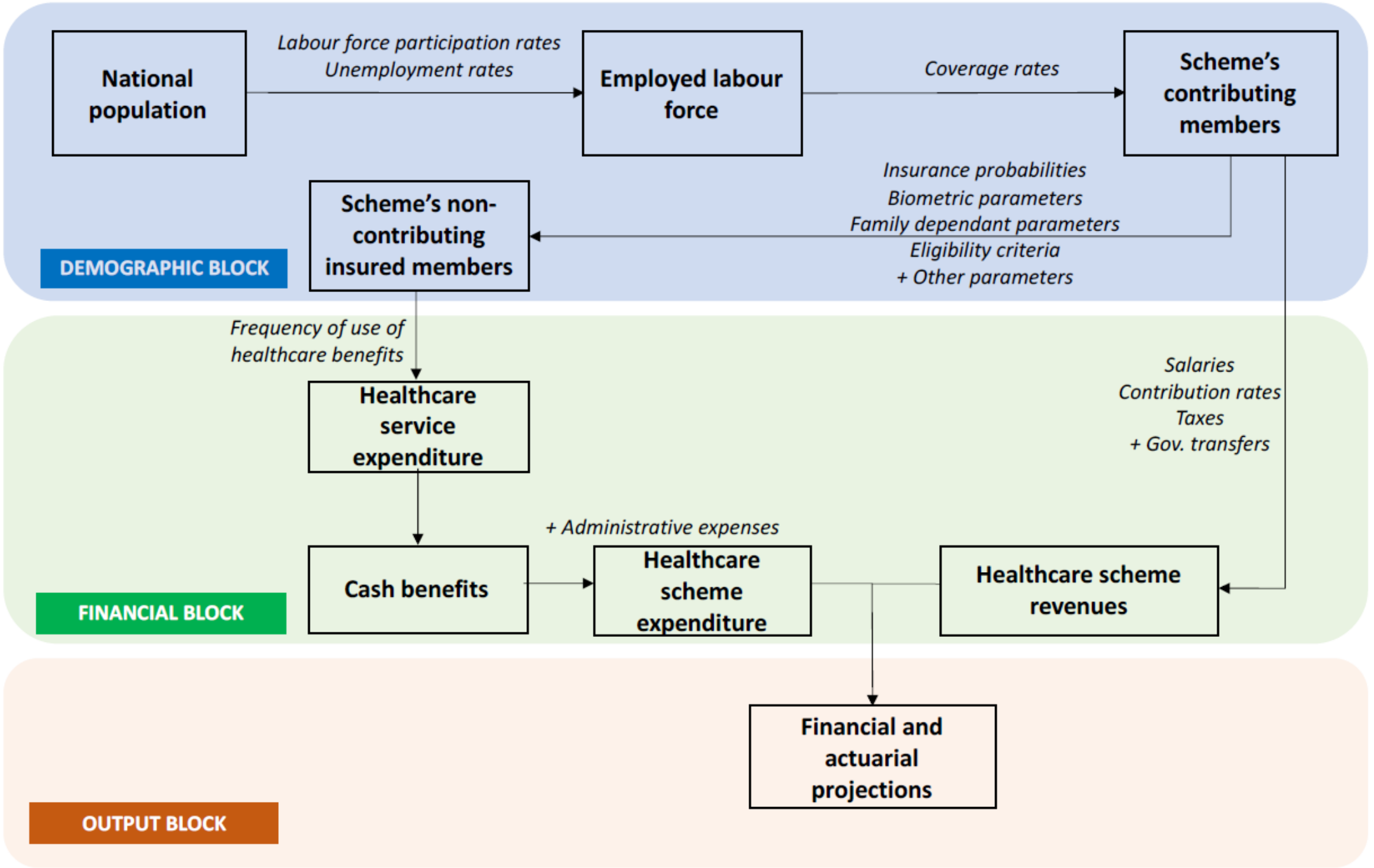
Financial projections – Results and indicators of the financial projections

Cristina Lloret, Social Security Actuary

First ILO Regional Actuarial Valuation Training, November 2023, Bangkok, Thailand

Concepts to be discussed

- Results module
- Results
- Indicators
- Sensitivity scenarios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Healthcare scheme revenues
FINANCIAL BLOCK
Financial and actuarial projections
OUTPUT BLOCK

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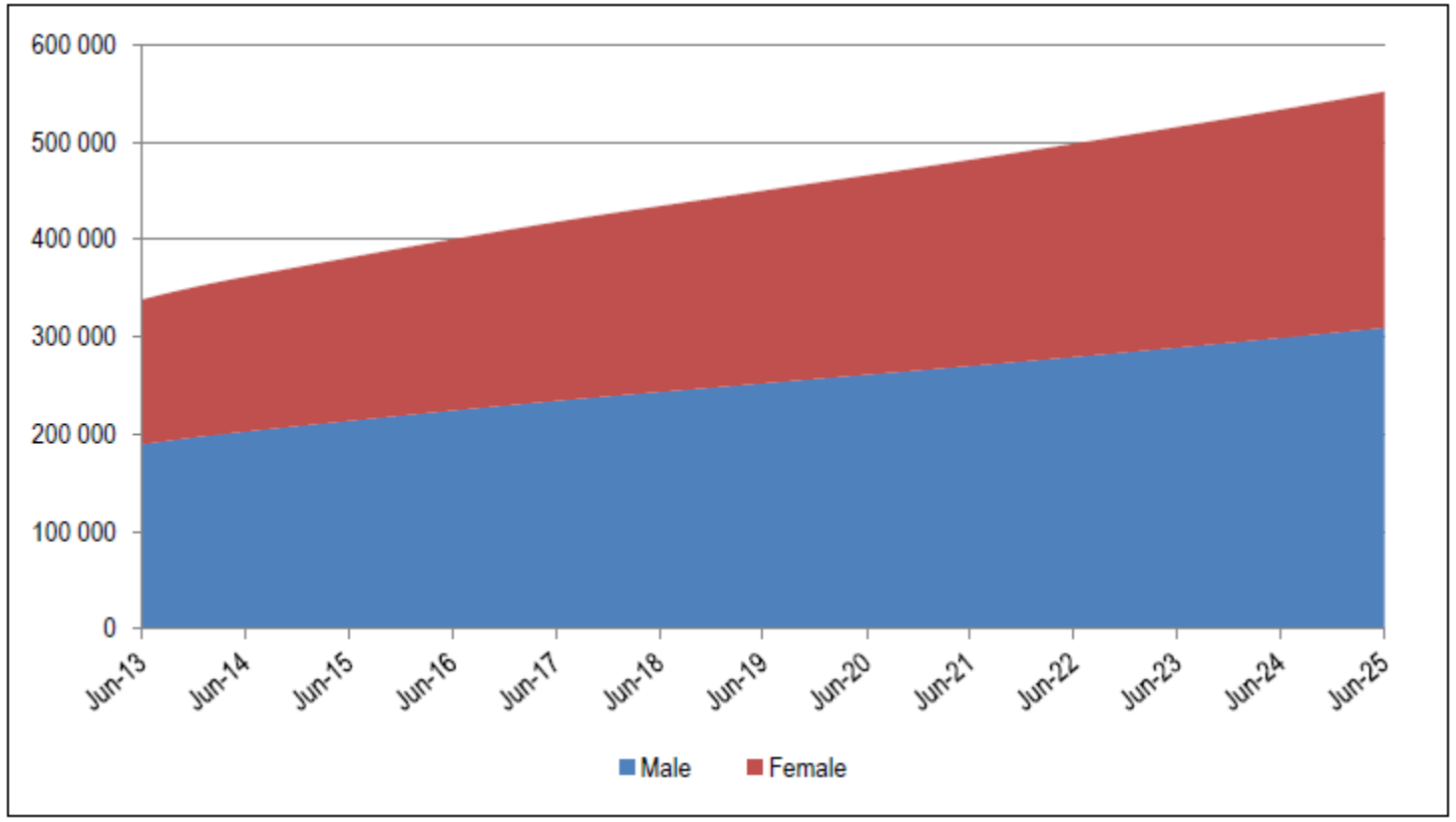
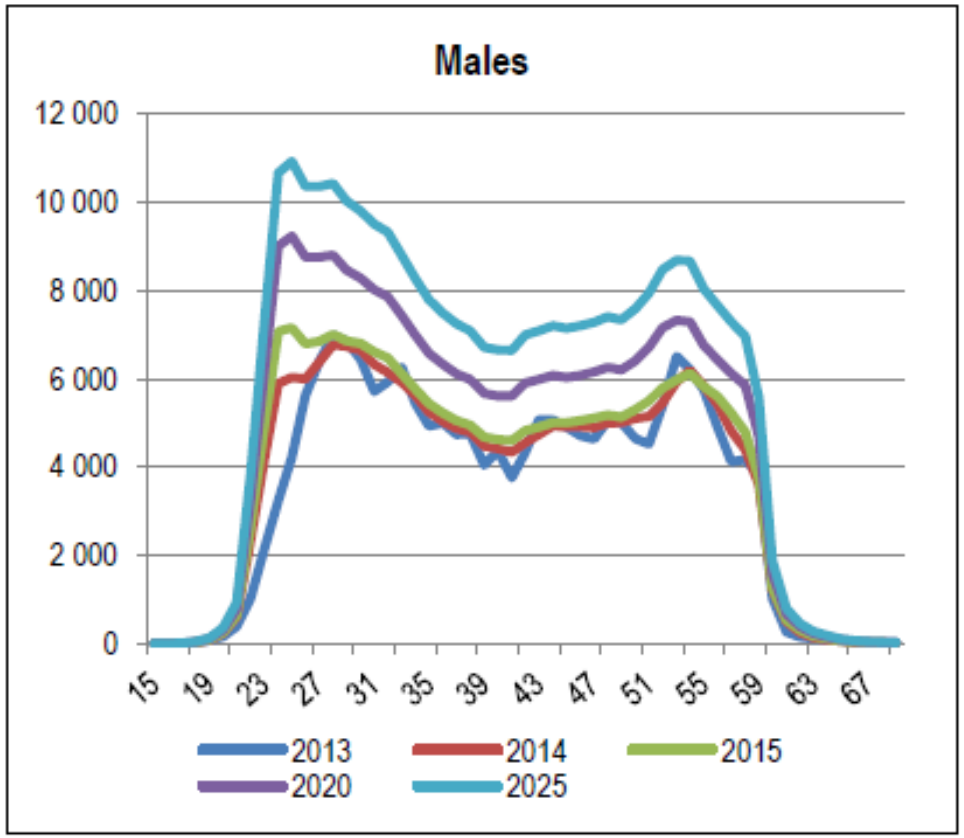
Results

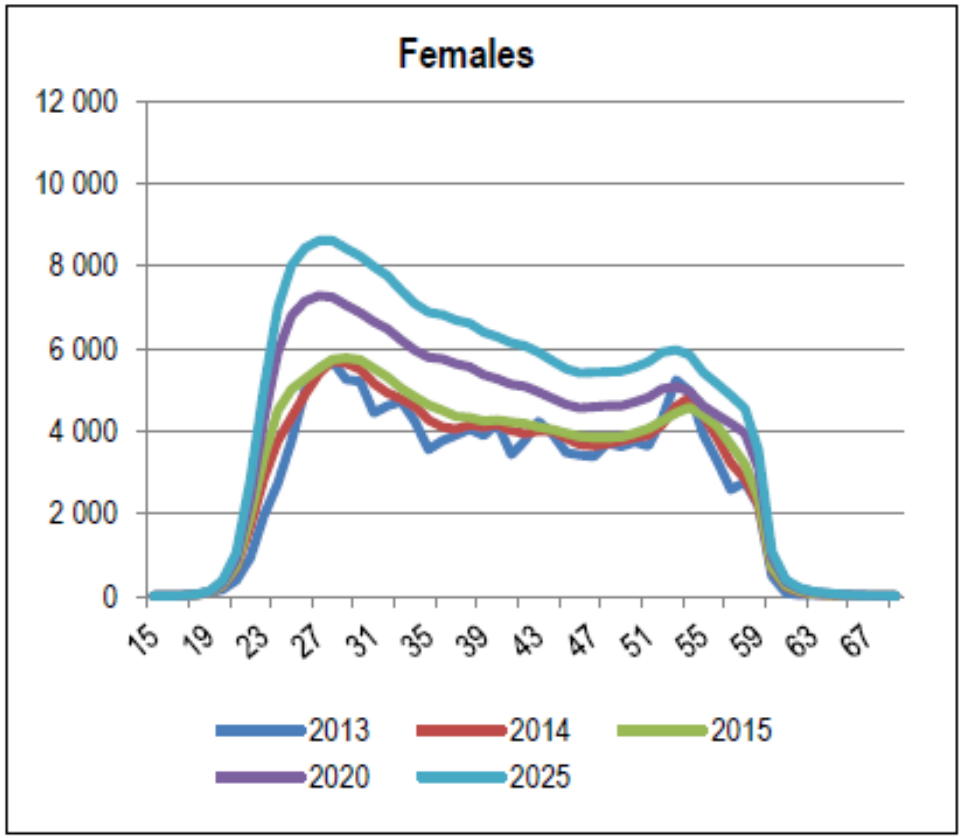
- Income and expenditure balance
- Reserve
- Required contribution rates

Intermediate results: projected number of contributors

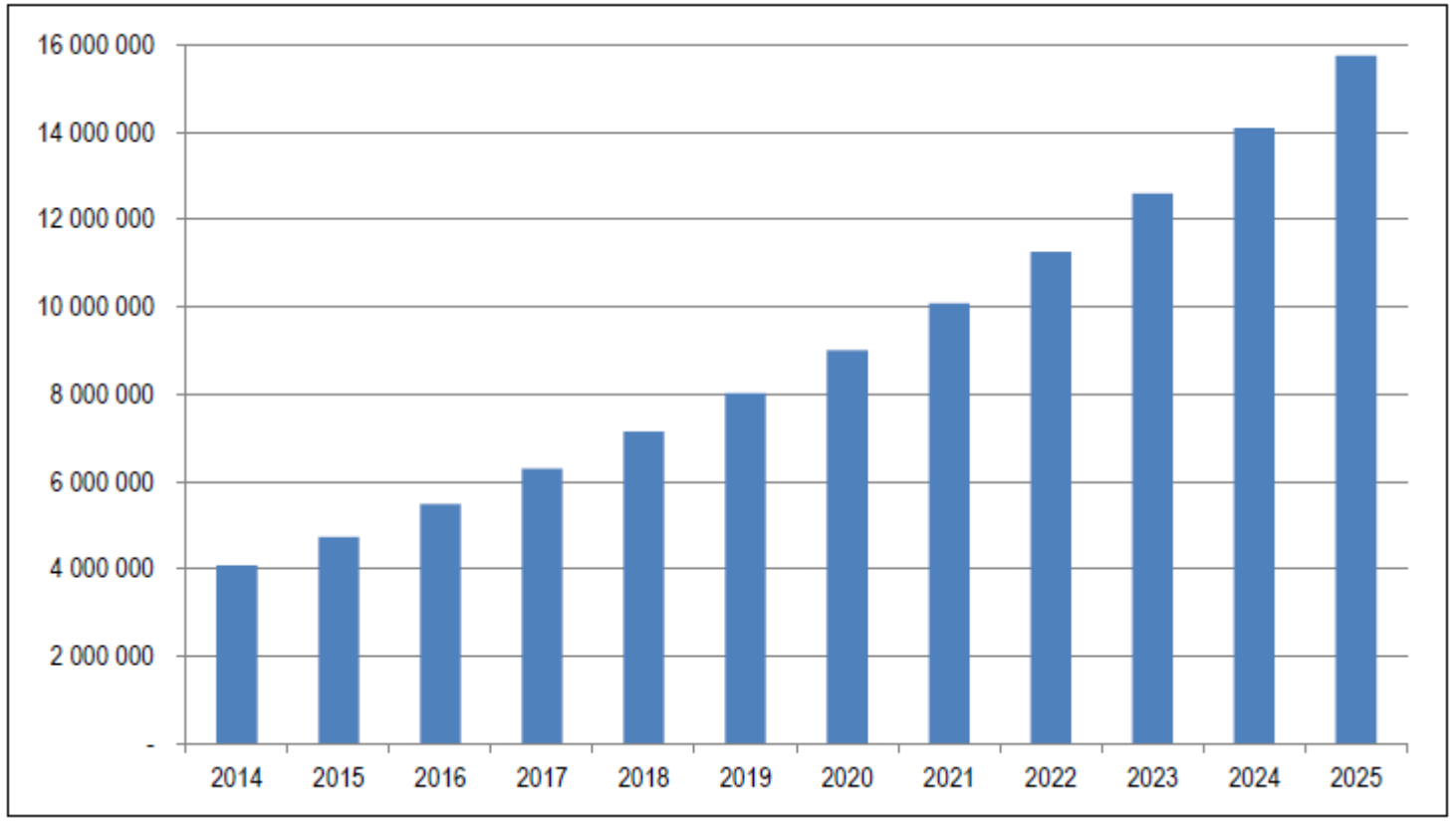


Intermediate results: projected distribution of contributors

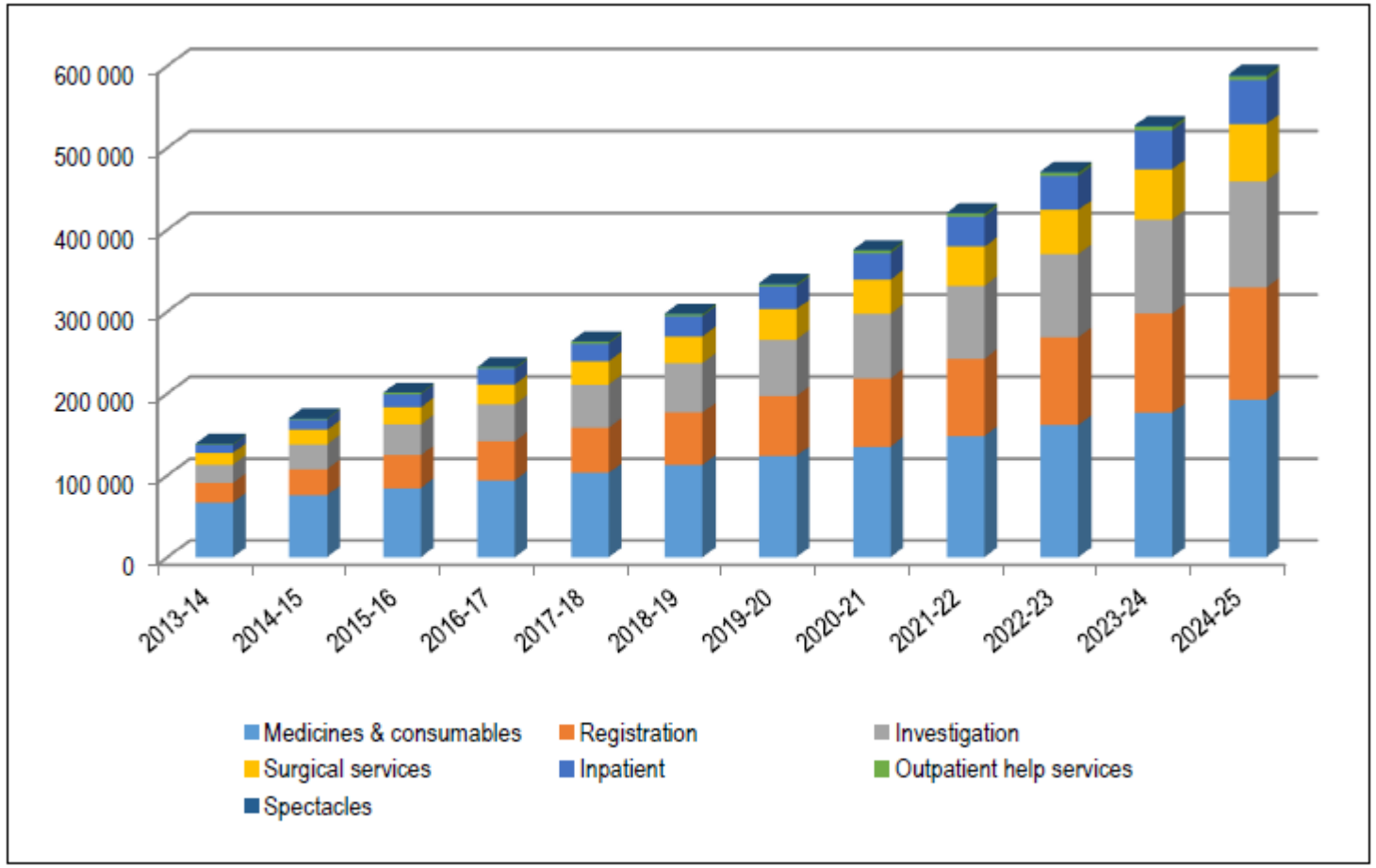




Intermediate results: projected salary mass



Intermediate results: projected medical benefit expenditure by service

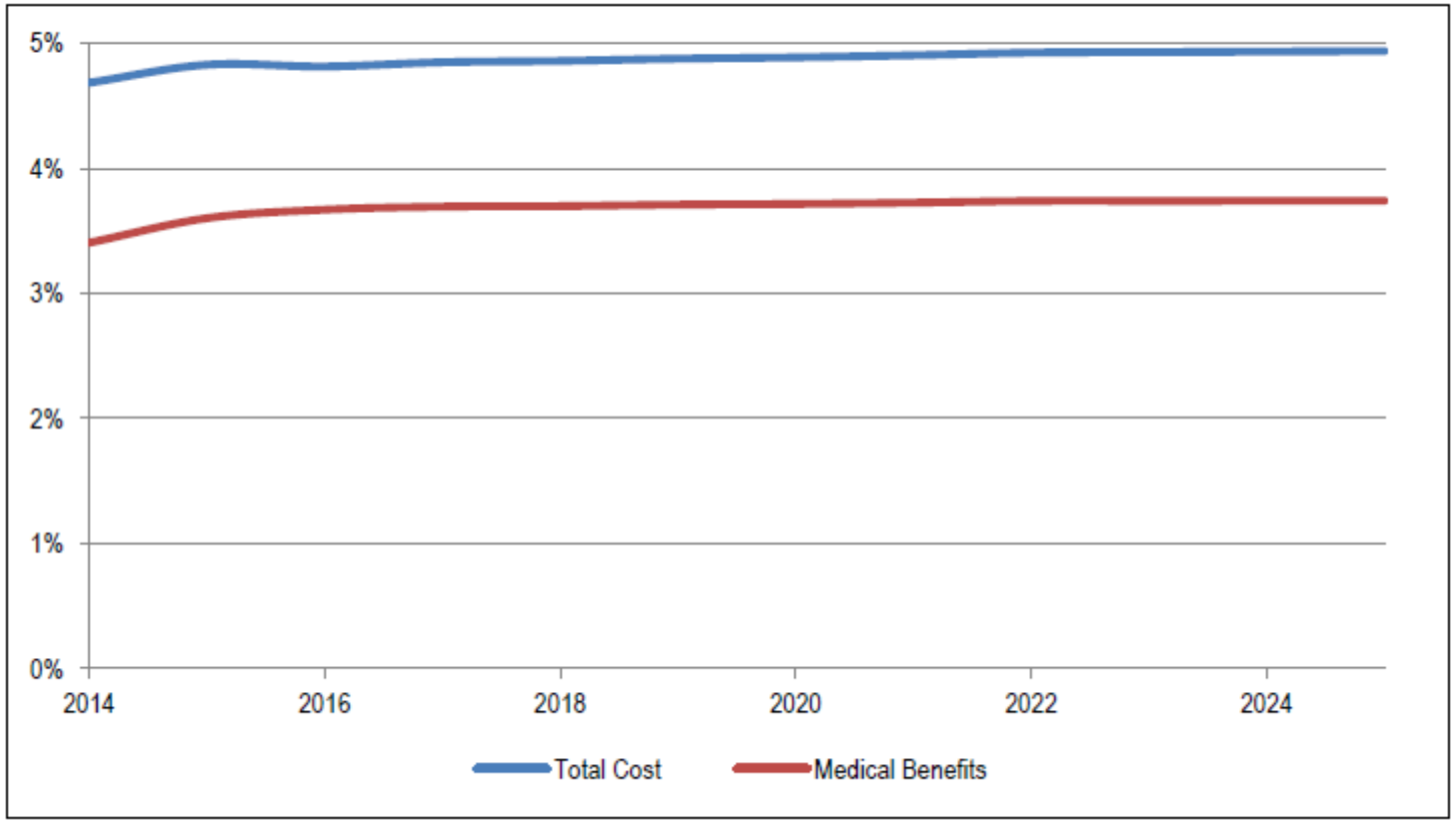


Indicators

- PAYG cost rate → $$\text{PAYGR} = \frac{\text{Total Expenditure} - \text{Other Income}}{\text{Total Salary Mass}}$$

- Reserve coefficient → $$\text{Reserve Coefficient} = \frac{\text{Reserve Begining of Year}}{\text{Total Expenditure}}$$

Typical PAYG cost rate example



Indicators

- Expenditure of **health benefits** as % of GDP
- Expenditure of **cash benefits** as % of GDP
- Expenditure of **total benefits** as % of GDP
- **Total expenditure** (including administrative costs) as % of GDP

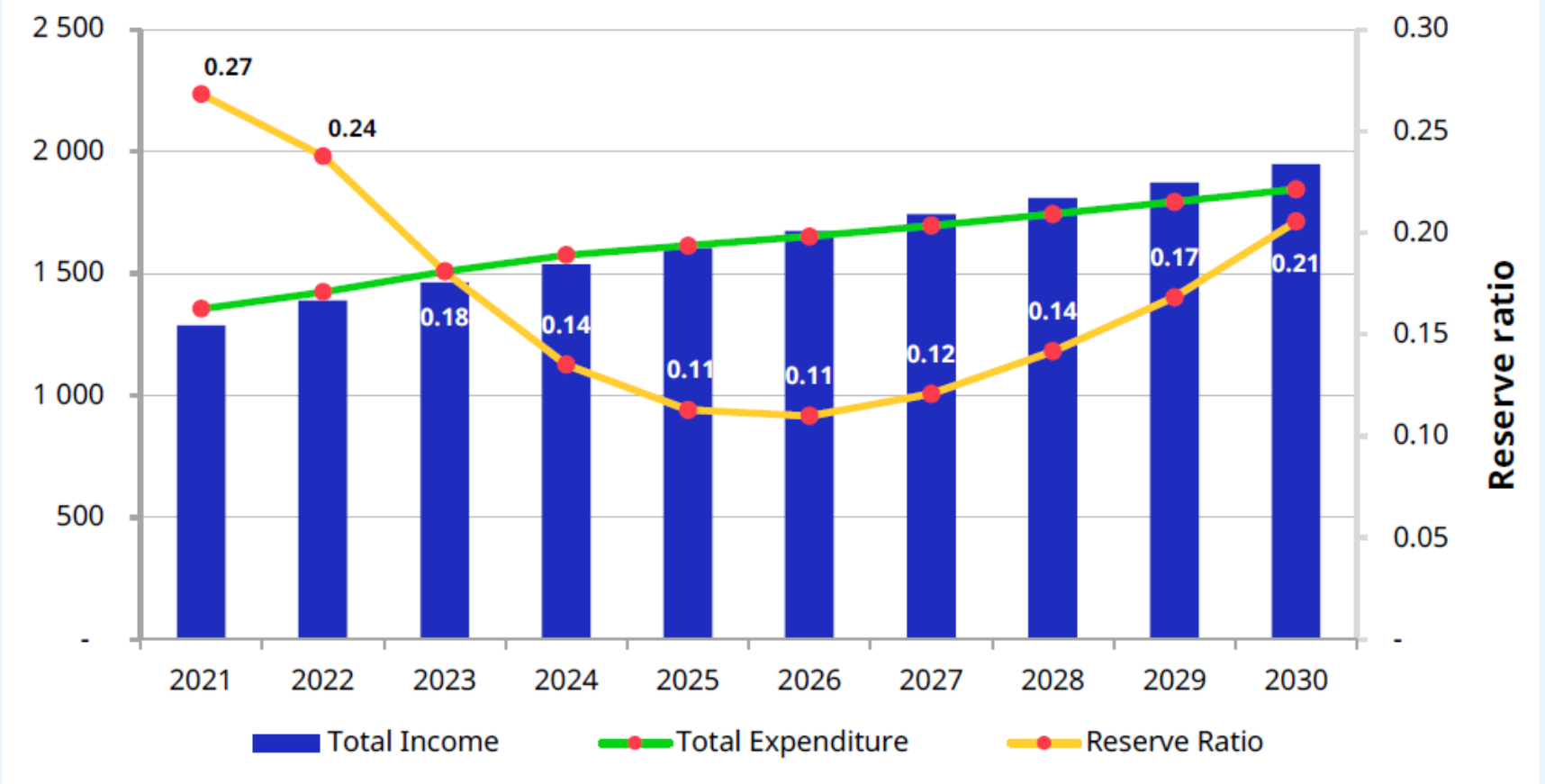
Indicators

- Expenditure of **health benefits** as % of Government expenditure
- Expenditure of **cash benefits** as % of Government expenditure
- Expenditure of **total benefits** as % of Government expenditure
- **Total expenditure** (including administrative costs) as % of Government expenditure

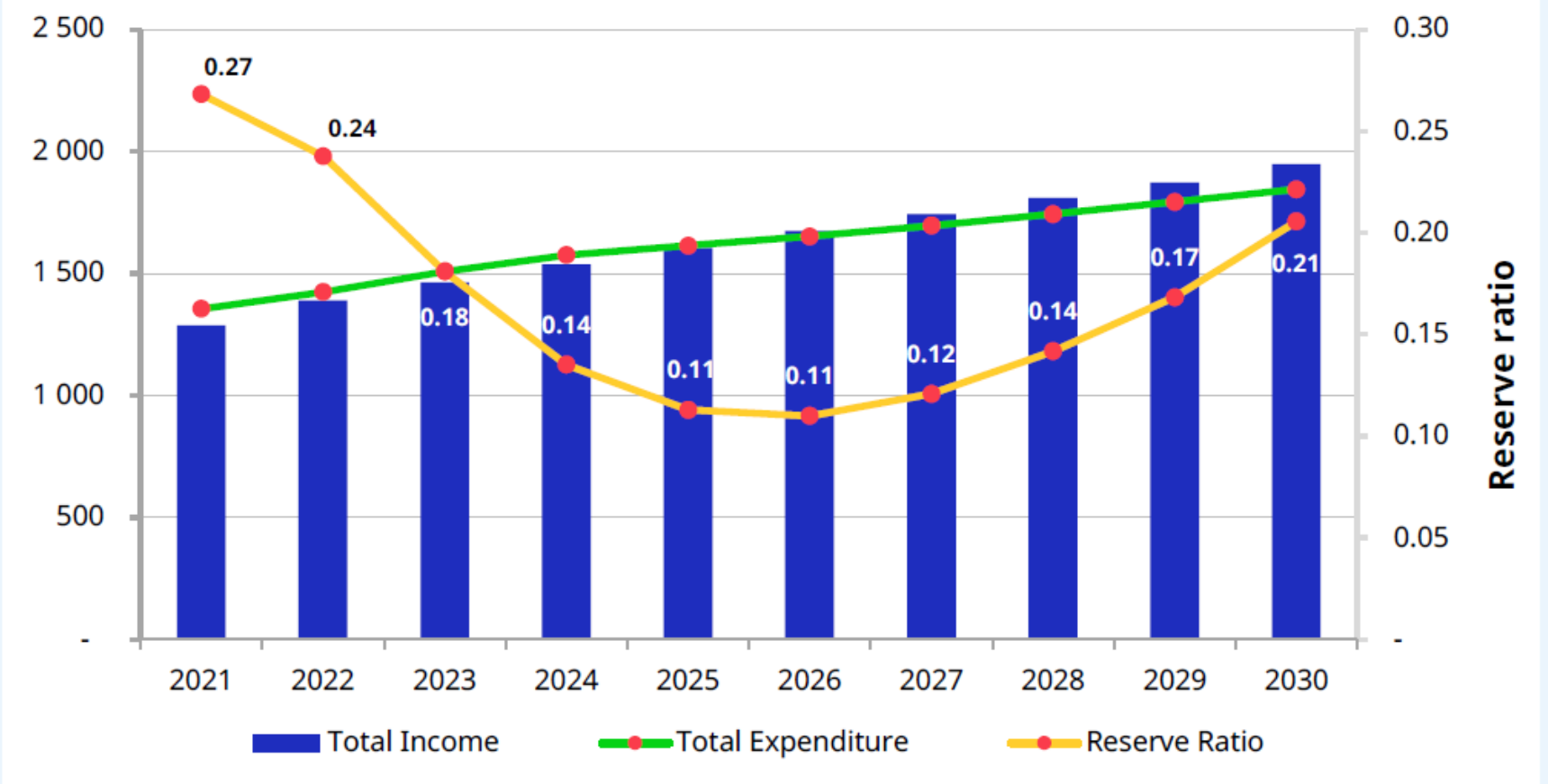
Indicators

- Average expenditure per insured person
- Share of total health expenditure of each health package

Indicators


2 500
2 000
1 500
1 000
500
-
0.30
0.25
0.20
0.15
0.10
0.05
-
Reserve ratio
0.27
0.24
0.18
0.14
0.11
0.11
0.12
0.14
0.17
0.21
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Total Income
Total Expenditure
Reserve Ratio

Indicators (Tanzania)



Sensitivity scenarios examples

- All projections have a degree of uncertainty,
- Sensitivity scenarios have the objective to measure the sensitivity of projected financial position of a scheme to future changes in the demographic and economic environments as well as the activation of certain scheme measures

Sensitivity scenarios examples

- Example 1: cost from the introduction of new/innovative drugs and specialized laboratory tests;
- Example 2: medical inflation: progressive growth to a higher or a lower level by 0.5 per cent over the projection period;
- Example 3: Specific items price: increase or decrease of ± 5 per cent; and
- Example4: increases or decreases in utilization rates.
- Examples 2, 3 and 4 present two sides: less and more favourable changes

International Labour Organization

Exercise 1 Part C: Balances and reserve, continuation with the case example

Cristina Lloret, Social Security Actuary

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Objective of the exercise

To be able to calculate for each projection year…

1. Total income
2. Total expenditure
3. Balance
4. Reserves
5. PAYG cost rate
6. Reserve coefficient

1. Total income

Total income = Contribution income + Other income

2. Total expenditure

Total expenditure = Benefit expenditure + Administrative expenditure + Other expenditure

3. Balance

Balance = Total income - Total expenditure

4. Reserves

Reserve at the end of the year (t+1) = Reserve at the end of the year (t) + Balance

5. PAYG cost rate

$$\text{PAYGR} = \frac{\text{Total Expenditure} - \text{Other Income}}{\text{Total Salary Mass}}$$

6. Reserve coefficient

$$\text{Reserve Coefficient} = \frac{\text{Reserve Begining of Year}}{\text{Total Expenditure}}$$

Questions

1. Is current contribution rate enough to ensure financial sustainability during the projection period?
2. What indicates the PAYG cost rate based on its definition?
3. What indicates the Reserve coefficient based on its definition?
4. Do you think that the Reserve coefficient is high enough?
5. Do you remember usual values for Reserve coefficients in other countries?

Conclusions

1. Current contribution rate level is enough to make the scheme financially sustainable
2. PAYG cost rate indicates that a percentage of around 1.5% of total salary mass is needed to cover the net expenditures
3. Reserve coefficient indicates the proportion of annual total expenditures that could be covered by current reserves

Conclusions

4. Reserves coefficient seems to be far enough to cover for contingency expenditures
5. Reserve coefficient ranges from 0.13 to 2.85 in 2031, compared to values in other countries, reserve coefficient often is between 0.25 and 1.

International Labour Organization

Social health insurance reimbursement methods

Cristina Lloret, Social Security Actuary

First ILO Regional Actuarial Valuation Training, November 2023, Bangkok, Thailand

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Concepts to be discussed

- Typical categories of services that are modelled in an actuarial valuation
- Types of reimbursement methods per category
- Formulas for each reimbursement method

Typical categories of services

1. Ambulatory care
2. Specialist and dental services
3. Supply of pharmaceuticals
4. Supporting laboratory and diagnostic services
5. Hospital care
6. Other care

Method to model expenditures

The method used to model expenditure depends on…

- method of delivery of care or
- method of payment to the provider

1. Ambulatory care

Method to model expenditure → **Budgeting**

when…

- outpatient facilities are owned by the scheme
- services are contracted out to external providers paid by Budget

Benefit expenditure = Fixed Cost + Variable Cost

1. Ambulatory care

Budgeting → Benefit expenditure = Fixed Cost + Variable Cost (VC)

$$VC = \sum_{s,x} VC_{s,x} * COVPOP_{s,x} * f_{s,x}$$

$VC_{s,x}$ = Variable cost per case for a patient of sex s and age x

$COVPOP_{s,x}$ = Number of covered eligible persons of sex s and age x

$f_{s,x}$ = Frequencies of cases per covered person of sex s and age x

1. Ambulatory care

Method to model expenditure → **Capitation**

when…

- a provider receives a **fixed fee** for each patient registered with the provider for a defined period of time

1. Ambulatory care

Method to model expenditure → **Fee-for-service (FFS)**

when…

- all benefit costs are variable for the scheme
- providers reimbursement is made based on a volume of services utilized with a defined unit cost per service

1. Ambulatory care

Fee-for-service → Benefit expenditure = Variable Cost (VC)

$$VC = \sum_{s,x} C_{s,x} * COVPOP_{s,x} * f_{s,x}$$

$C_{s,x}$ = Unit cost per case for a patient of sex s and age x

$COVPOP_{s,x}$ = Number of covered eligible persons of sex s and age x

$f_{s,x}$ = Frequencies of cases per covered person of sex s and age x

1. Ambulatory care

Fee-for-service

Unit case definition is predetermined by quantity units reported statistically

For example: visits to doctor, sessions, etc.

Unit case is a set of medical acts for which fees are often paid according to a fee schedule

2. Specialist and dental services

Budgeting method might by applied when…

facilities and hospitals owned by the scheme

Fee-for-service method might by applied when…

services are contracted out to private providers

2. Specialist and dental services

Since specialists normally act upon referral of a patient by a general practitioner…

> *…the frequency rate of ambulatory care might be one explanatory variable for the frequency of specialist sessions*

3. Supply of pharmaceuticals

Budgeting method might by applied when…

drugs are provided entirely or in part by scheme-owned dispensaries

Fee-for-service method might by applied when…

drugs are purchased from external provider in each case of sickness

3. Supply of pharmaceuticals

Fee-for-service

Unit of service = prescription

Frequency for prescriptions would be linked with frequencies of ambulatory, specialist and dental care

4. Supporting laboratory and diagnostic services

- Provided based on the prescription of a general practitioner or specialist
- Link with general practitioner or specialist services

5. Hospital care

Budgeting method might by applied when…

hospital care is provided in scheme owned hospitals (or external hospitals are paid by Budget)

Fee-for-service method might by applied…

in case of per diem payments to private or public hospitals

5. Hospital care

Fee-for-service → Benefit Expenditure (BE) calculated as…

$$BE = \sum_{s,x} HD_{s,x} * CHD_{s,x} * COVPOP_{s,x}$$

$HD_{s,x}$ = Number of hospital days per insured person of sex s and age x

$CHD_{s,x}$ = Average cost per hospital day per insured person of sex s and age x

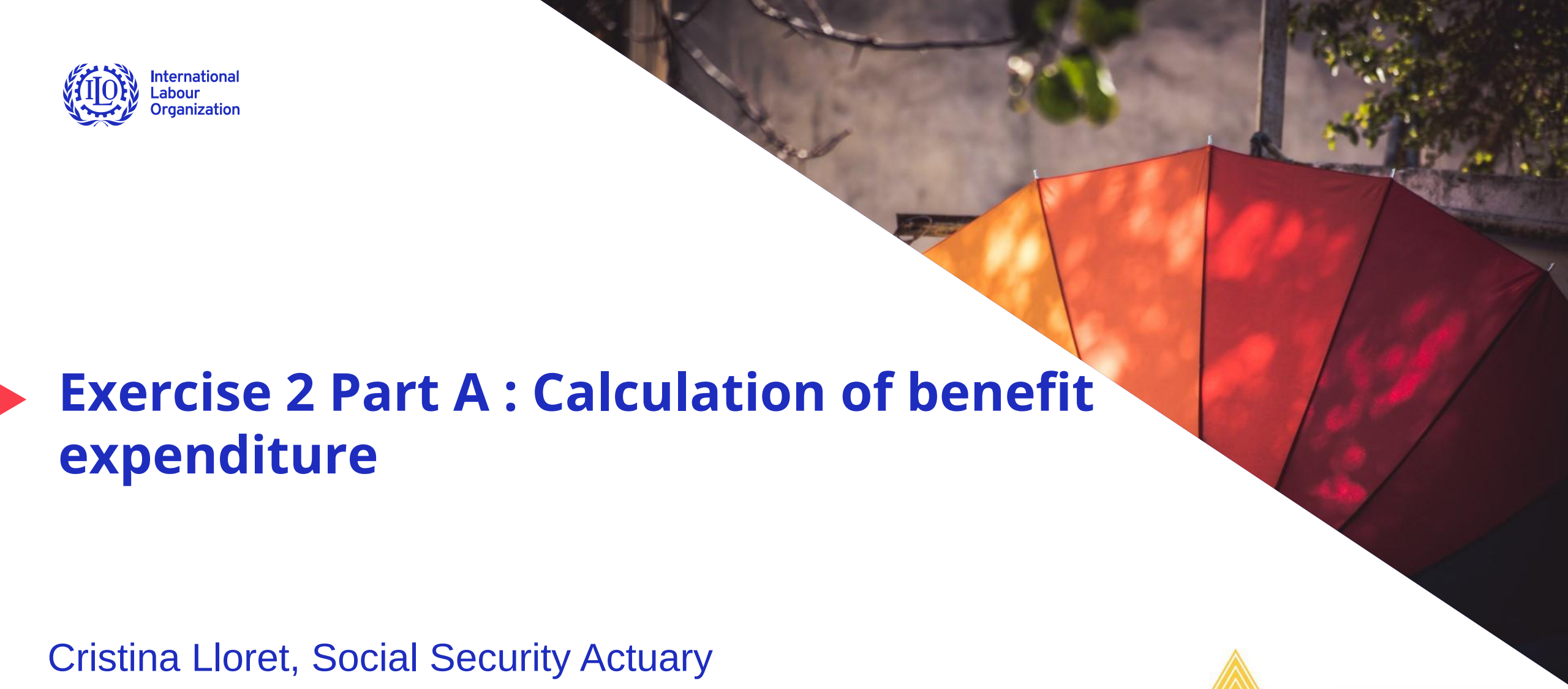
$COVPOP_{s,x}$ = Number of covered eligible persons of sex s and age x

6. Other care

- Normally a residual quantity
- Variety of services provided under the scheme
- Expenditure of “other care” might be modelled as:

$$\text{average expenditure per protected persons} * \text{number of protected persons}$$

International Labour Organization



Exercise 2 Part A : Calculation of benefit expenditure

Cristina Lloret, Social Security Actuary

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Objective of the exercise

Compute the cost of outpatient services separately by three group ages:

- Age group 0-14
- Age group 15-59
- Age group +60

Fee-for-service cost formula

$$\text{Cost} = \sum_{s,x} C_{s,x} * \text{COVPOP}_{s,x} * f_{s,x}$$

$C_{s,x}$ = Unit cost per case for a patient of sex s and age x

$\text{COVPOP}_{s,x}$ = Number of covered eligible persons of sex s and age x

$f_{s,x}$ = Frequencies of cases per covered person of sex s and age x

Observation and results

- The **biggest** group are the adults in ages **15-59 years old**
- However, the **most expensive** group are children from **0-14 years old**
  - ✓ *Higher utilization frequency* than adults
  - ✓ *Higher unit cost* than adults
- Frequencies and unit cost follow a *J-curve* trend with age
- Elderly cost is around **half of the cost** for adults and children
  - ✓ However, they represent **one fifth (1/5)** of total covered (around 21%)

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Exercise 2 Part B : Analysis of the factors influencing the benefit expenditure growth

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Objective of the exercise

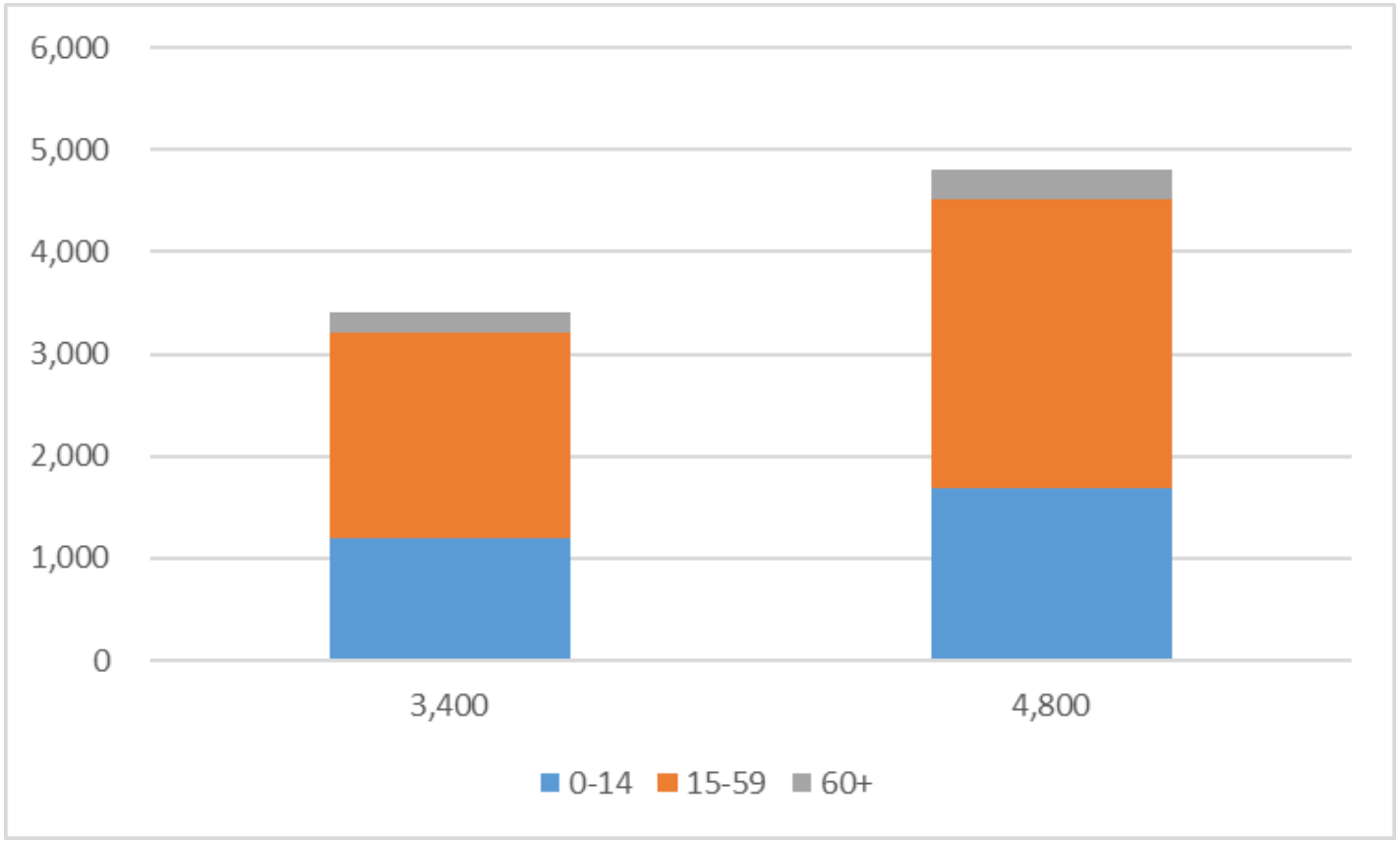
Analyse how specific factors influence the cost by changing them

Factors:

1. Number of insured
2. Ageing (distribution of insured)
3. Frequencies
4. Unit cost per patient

1. Number of insured

- Number of insured increases
- Same distribution by ages

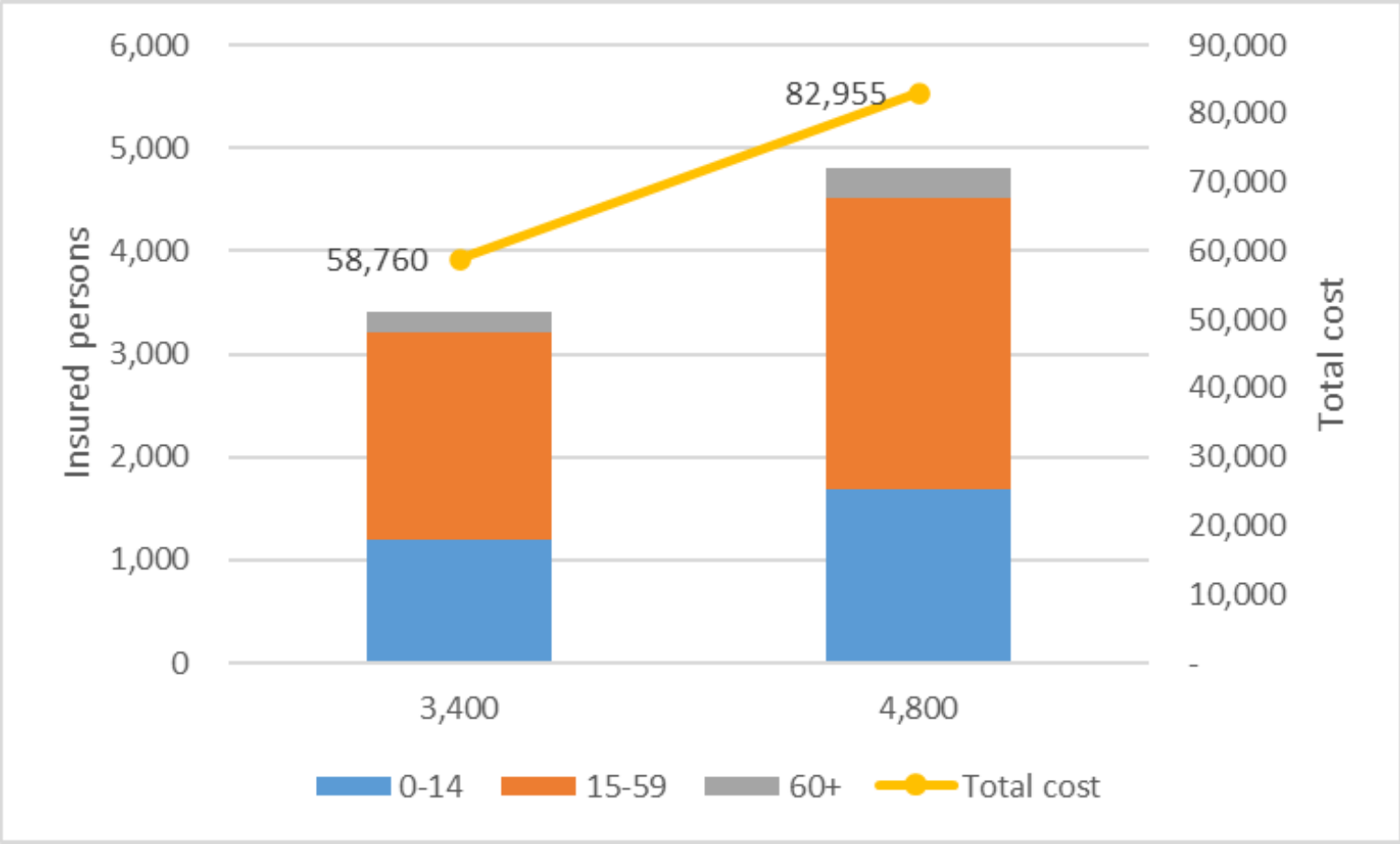


1. Number of insured

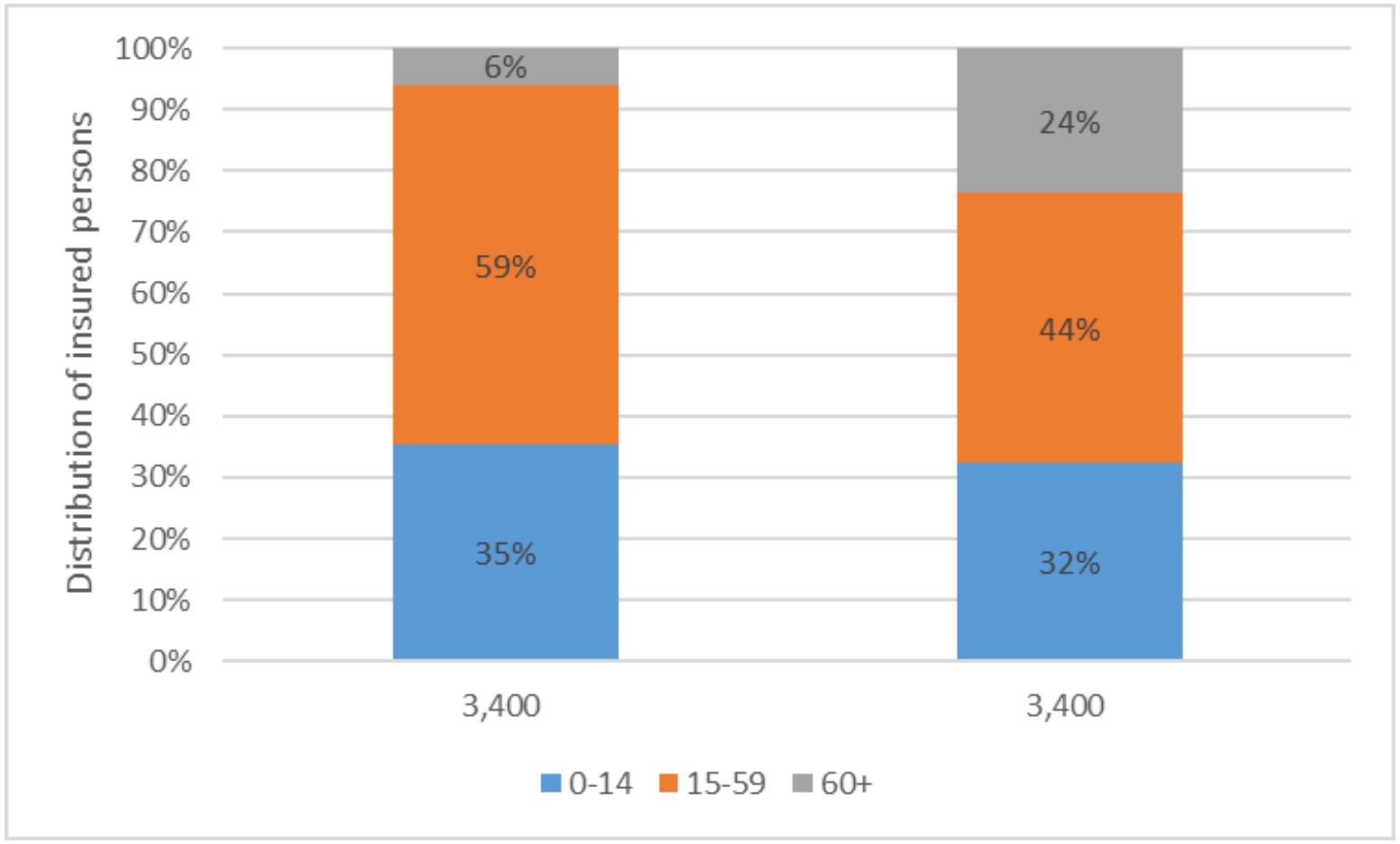
Total cost	Number of insured	Frequency	Unit cost per patient
Increases	Increases	Constant	Constant

$$\text{Cost} = \sum_{s,x} C_{s,x} * \text{COVPOP}_{s,x} * f_{s,x}$$

1. Number of insured



2. Ageing (distribution of insured)

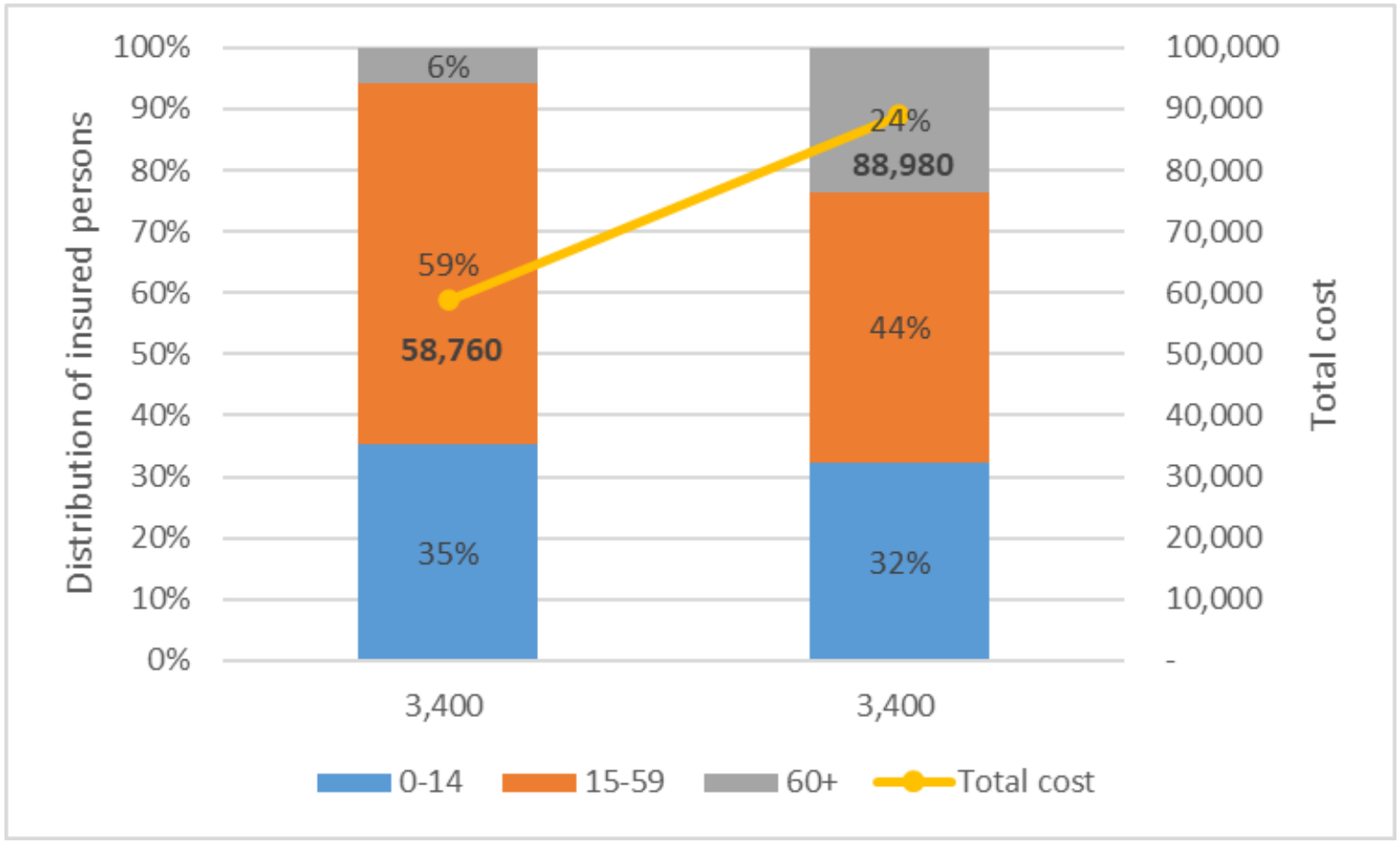


2. Ageing (distribution of insured)

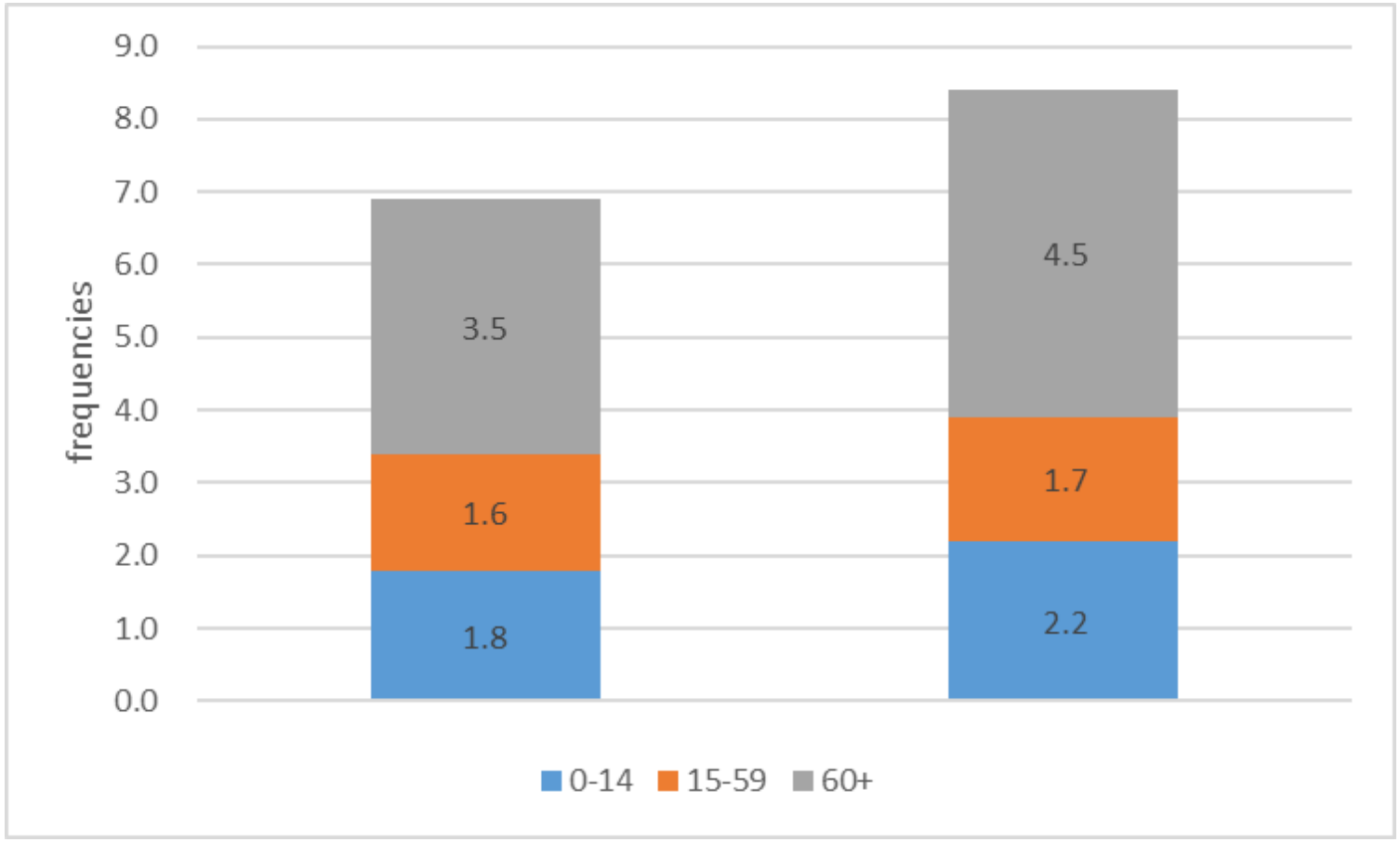
Total cost	Number of insured	Frequency	Unit cost per patient
Increases	Older ages increase	Constant	Constant

$$\text{Cost} = \sum_{s,x} C_{s,x} * \text{COVPOP}_{s,x} * f_{s,x}$$

2. Ageing (distribution of insured)



3. Frequencies

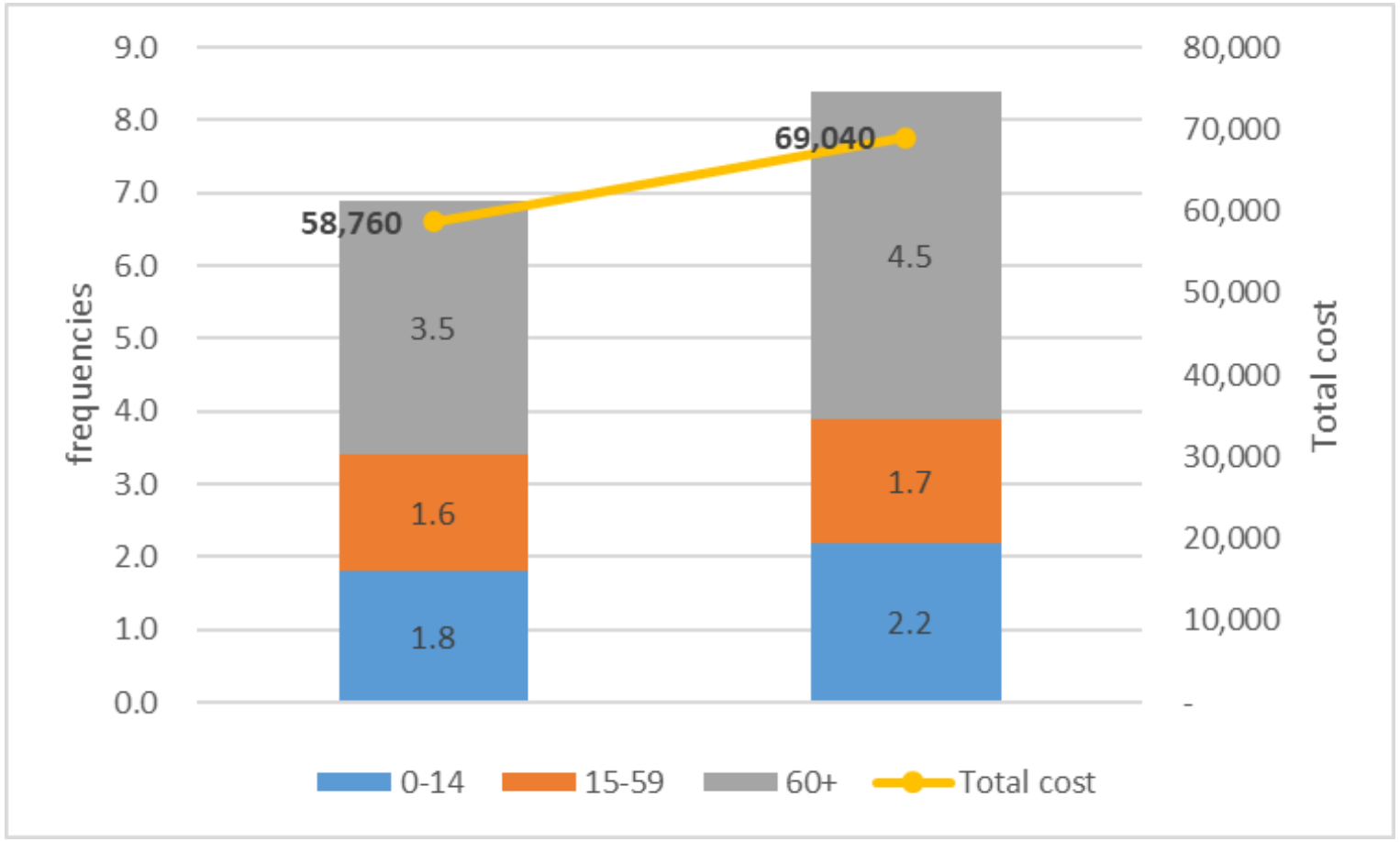


3. Frequencies

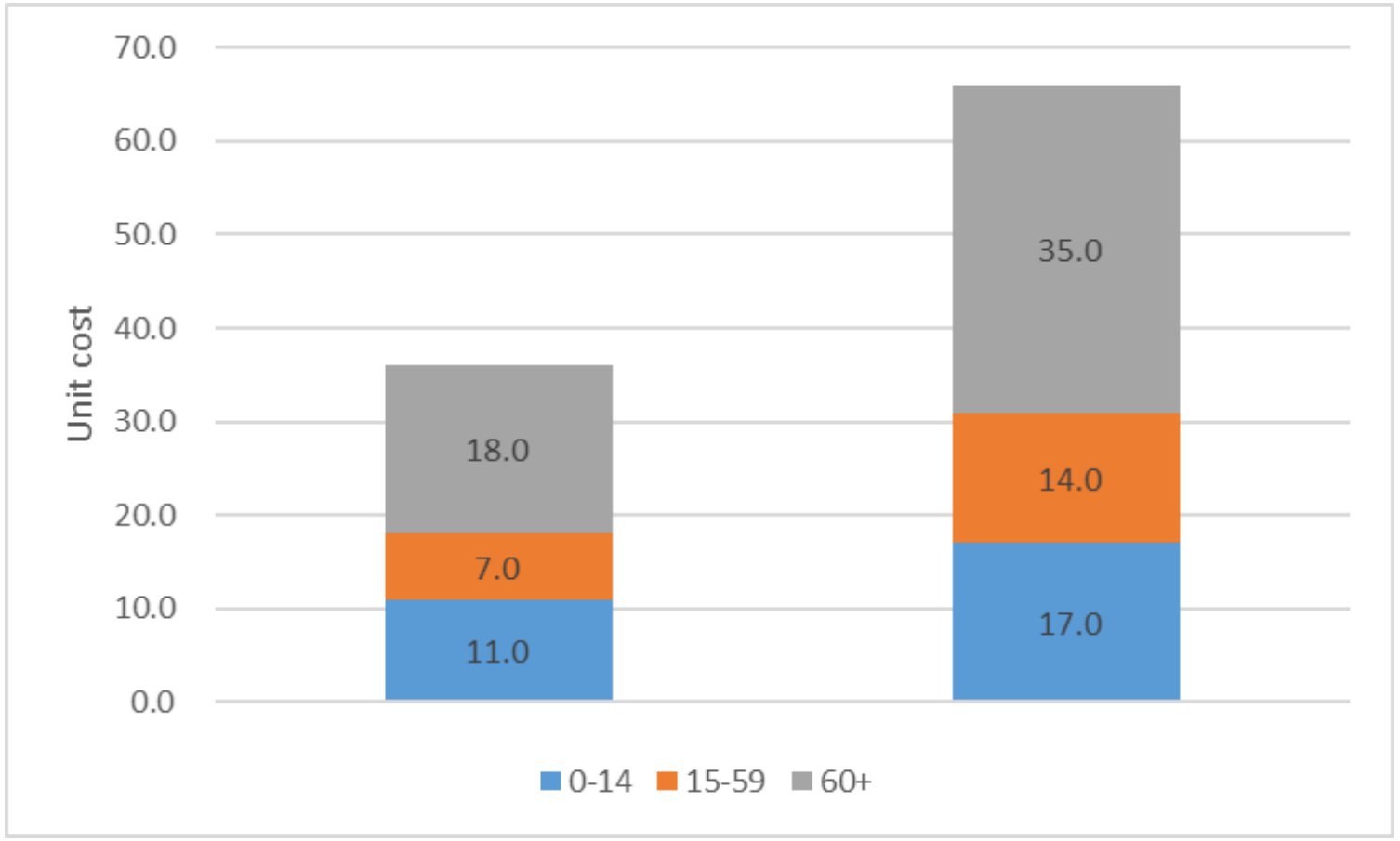
Total cost	Number of insured	Frequency	Unit cost per patient
Increases	Constant	Increases	Constant

$$\text{Cost} = \sum_{s,x} C_{s,x} * \text{COVPOP}_{s,x} * f_{s,x}$$

3. Frequencies



4. Unit cost per patient

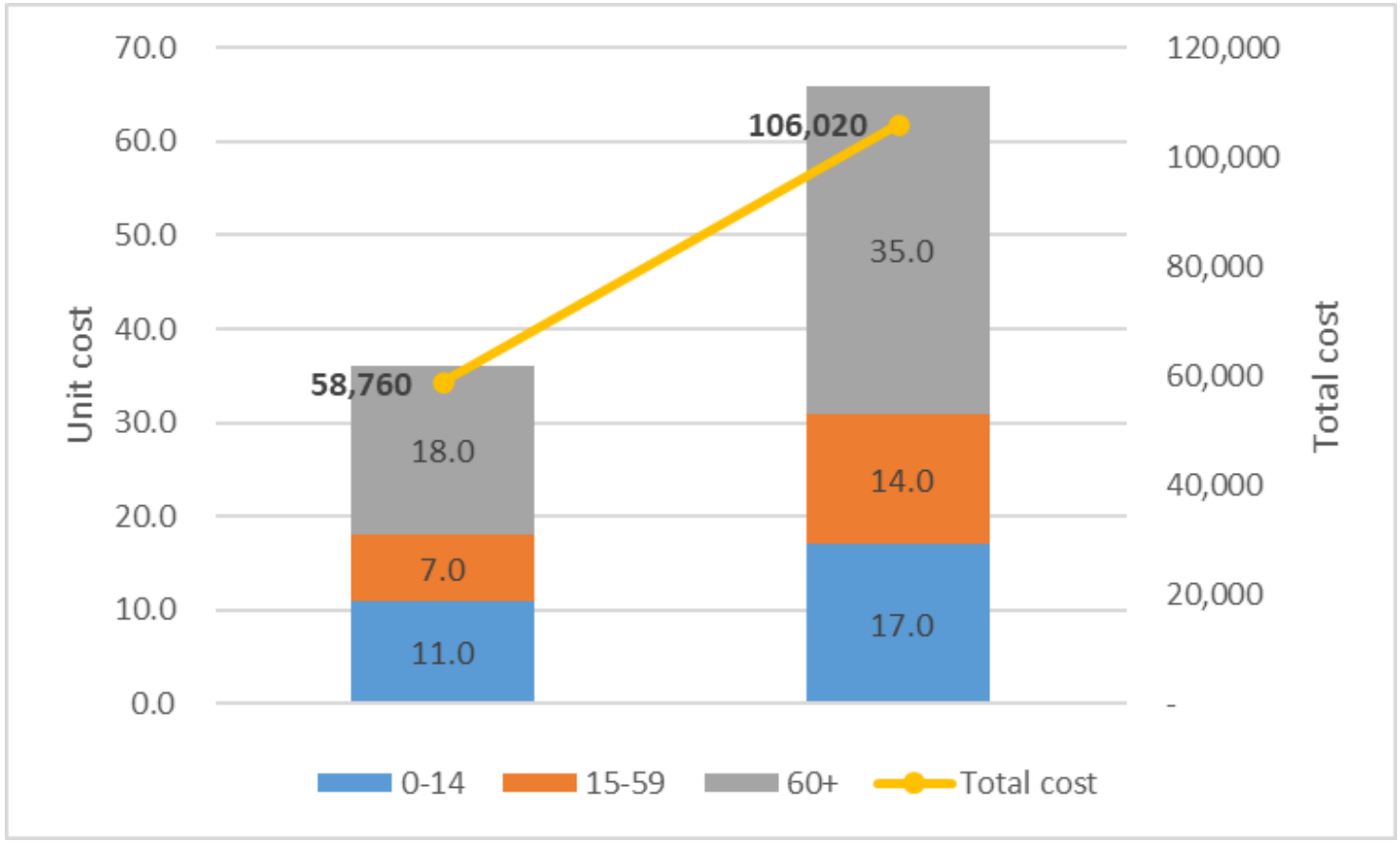


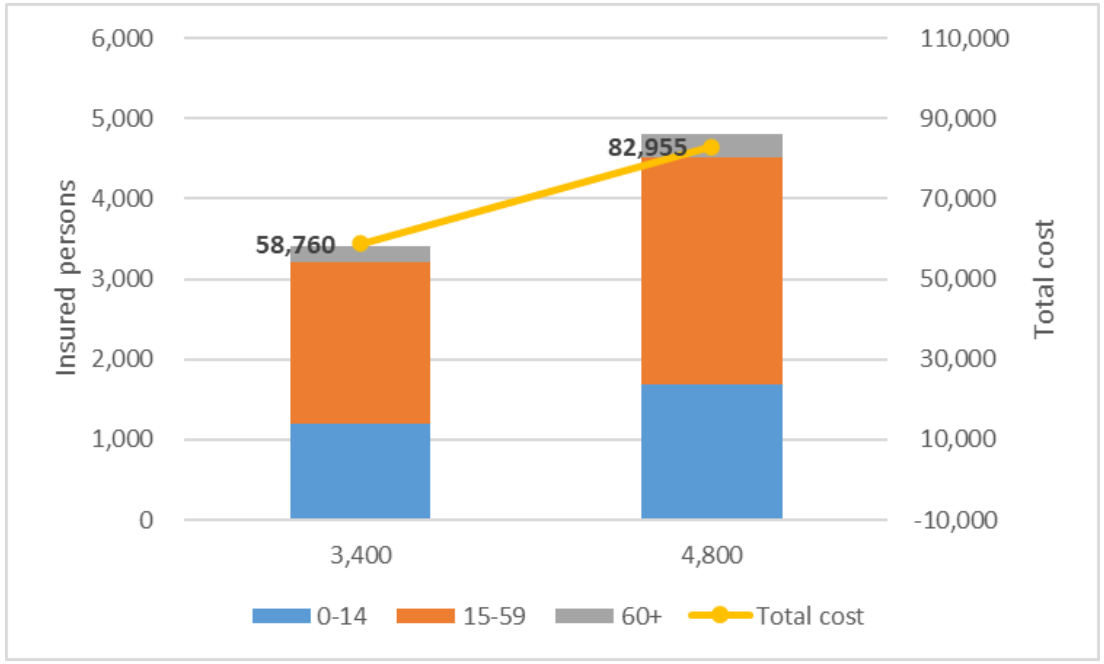
4. Unit cost per patient

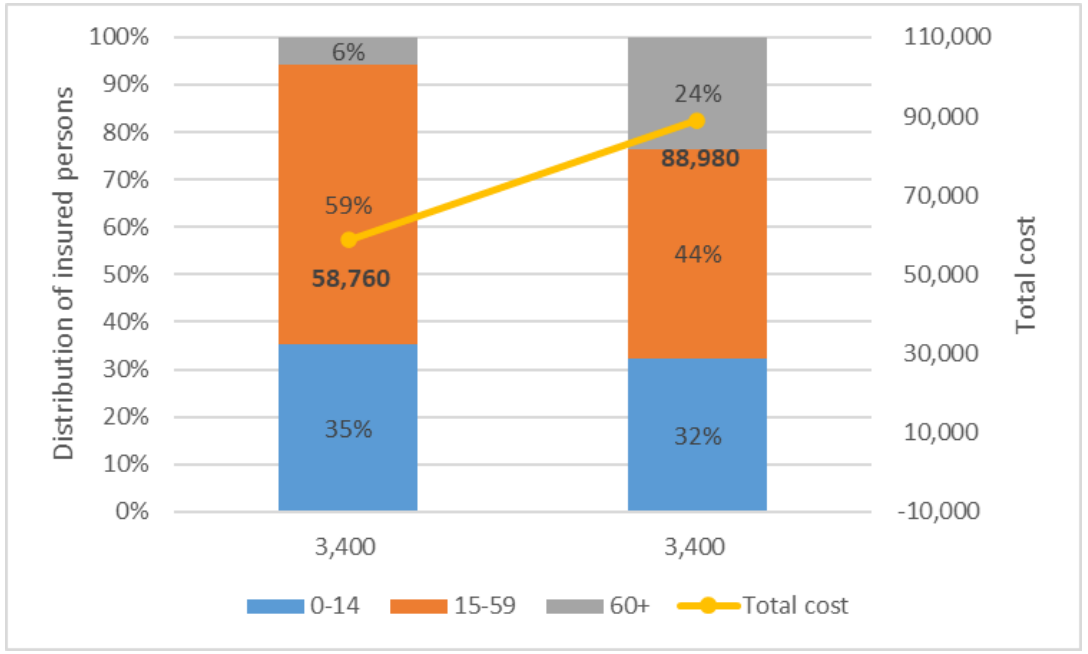
Total cost	Number of insured	Frequency	Unit cost per patient
Increases	Constant	Constant	Increases

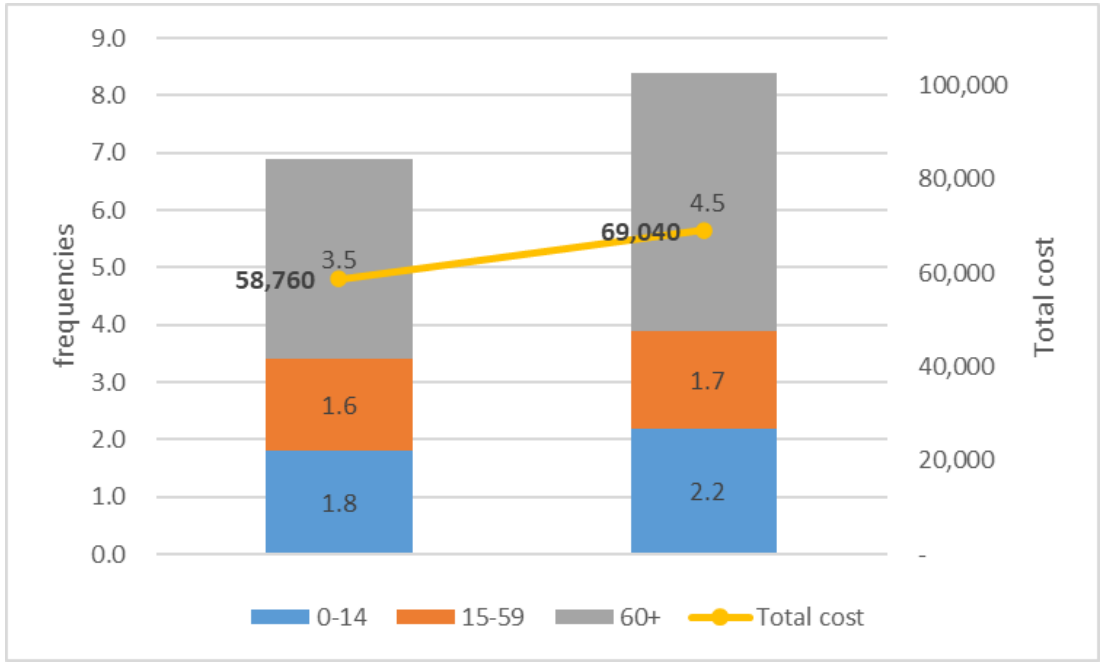
$$\text{Cost} = \sum_{s,x} C_{s,x} * \text{COVPOP}_{s,x} * f_{s,x}$$

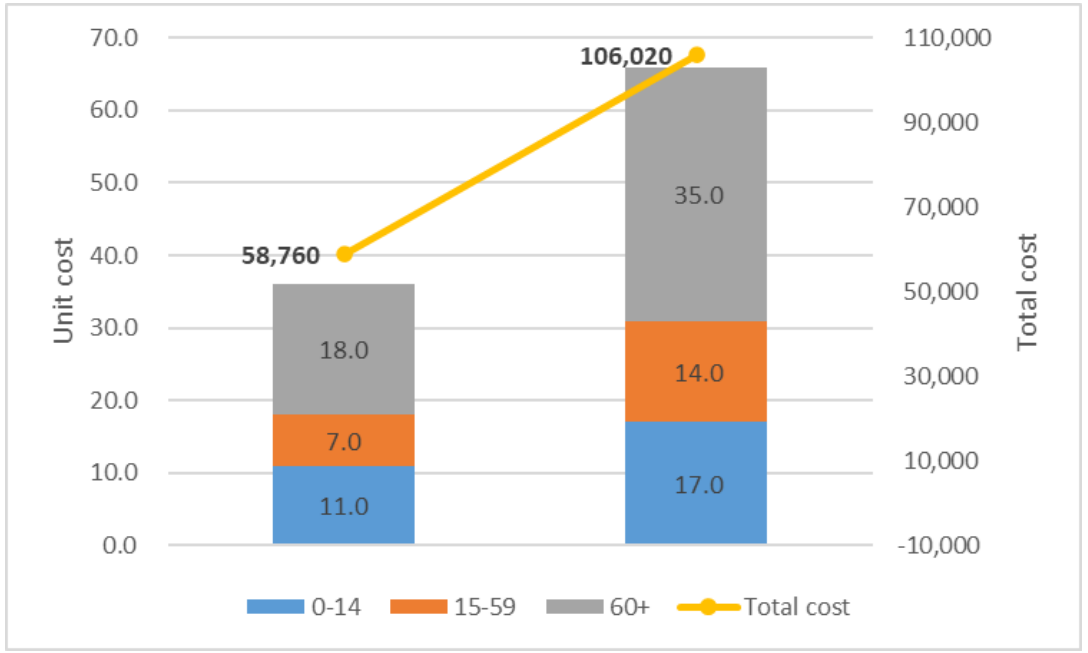
4. Unit cost per patient




6,000
5,000
4,000
3,000
2,000
1,000
0
Insured persons
110,000
90,000
70,000
50,000
30,000
10,000
-10,000
Total cost
58,760
82,955
3,400
4,800
0-14
15-59
60+
Total cost


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Distribution of insured persons
110,000
90,000
70,000
50,000
30,000
10,000
-10,000
Total cost
6%
59%
35%
24%
44%
32%
58,760
88,980
3,400
3,400
0-14
15-59
60+
Total cost


9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
frequencies
100,000
80,000
60,000
40,000
20,000
-
Total cost
58,760
69,040
3.5
1.6
1.8
4.5
1.7
2.2
0-14
15-59
60+
Total cost


70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Unit cost
110,000
90,000
70,000
50,000
30,000
10,000
-10,000
Total cost
58,760
106,020
18.0
7.0
11.0
35.0
14.0
17.0
0-14
15-59
60+
Total cost