CAPP_DYN
A DYNAMIC MICROSIMULATION MODEL FOR THE ITALIAN SOCIAL SECURITY SYSTEM

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Outline

1. Aims
2. Background:
   1. Why a Dynamic Microsimulation Model (DMM)?
   2. Review of existing Italian DMMs.

3. CAPP_DYN: features and general structure

4. The main modules:
   1. Demography;
   2. Health;
   3. Education, labour market and related incomes;
   4. Social security.

5. Discussion

Aim(s)

Building a model able to assess the long-run distributive impact of pension reforms in Italy

▶ which accounts for:
1. Observed/projected trends of the Italian population/economy (2010-2050);
2. The Italian pension system and the phasing-in of its reforms.

▶ which permits analysis using:
1. intra-temporal perspective;
2. inter-temporal perspective.

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Background

How evaluate the long-run distributive impact of a pension reform?

▶ **Considering representative individual(s)**
   ▶ using macroeconometric or cell-based models;
   ▶ Using EEG models:
      ▶ Introducing heterogeneity:
         ☐ a' la Auerbach and Kotlikoff (1987);
         ☐ a' la Fullerton and Rogers, (1993).
▶ **Considering explicitly heterogeneity**
   ▶ Using dynamic microsimulation model:
      ☐ Cohort models;
      ☐ Population-based models.

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Background (cont...)

▸ **Microsimulation methods** are increasingly used as an input to the process of policy setting in many developed countries;

▸ **DMM** are used as a tool for the evaluation of the long-run distributional effects of public policies
(O'Donoghue, 2001; Zaidi and Rake, 2002; Klevmarken, 2005);

▸ in *Italy* their use is recent and not completely developed:
  ▸ DYNAMITE (Ando and Nicoletti Altimari, 2004);
  ▸ MINT (Vagliasindi, Bianchi and Romanelli, 2004);
  ▸ The Italian version of LIAM (Dekkers et al);
  ▸ other cohort or agent-based models (see Borella and Coda Moscarola 2006; Leombruni and Richiardi 2006).

CAPP_DYN project

Started in 2004 under the auspices of the Ministry of Labour and Social Policies
(Ministero del Lavoro e delle Politiche Sociali, 2005)

▸ Further developments:
(Ministero della Solidarietà Sociale, 2008; Baldini, Mazzaferro, Morciano 2008; Mazzaferro and Morciano 2008; 2011; Mazzaferro, Morciano and Savegnago (2011)

▸ Radical updates under the PROGRESS project:
(Mazzaferro and Morciano ,2011; Ciani and Morciano, 2011; Flisi and Morciano, 2011; Ciani and Fresu, 2011);

CAPP_DYN

Simulates the likely evolution (2010 – 2050) of a representative sample of the Italian population

Features:

- ✓ Population based;
- ✓ Closed;
- ✓ Dynamic ageing process;
- ✓ Discrete time;
- ✓ Probabilistic with finite and discrete Markovian processes and MCmethod;
- ✓ Individual or household simulation unit.

The structure of CAPP_DYN

We use a large & representative sample of economic agents (individuals and households).

Start

Base Population

Past history

Scenario

Future

Simulated year ≤ *2050*
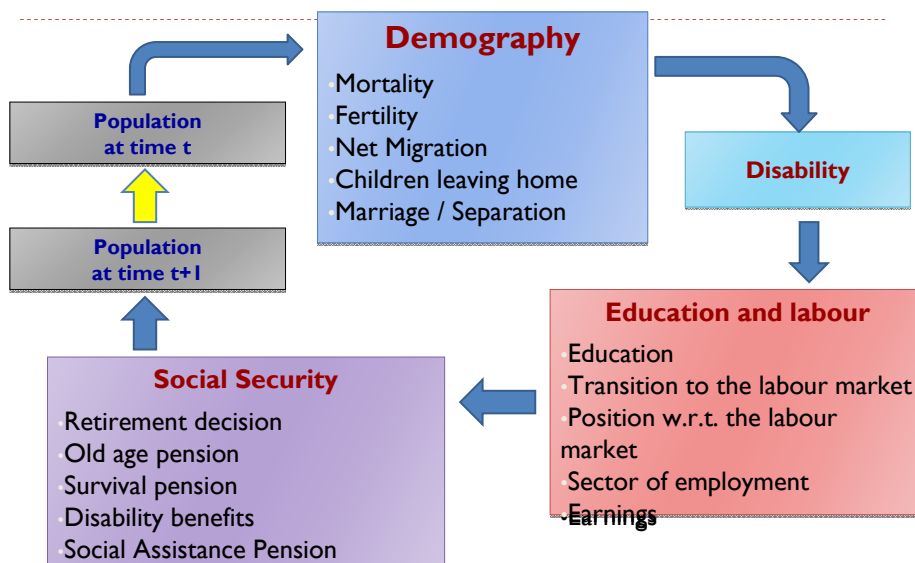
False *True*

Aggregation

End
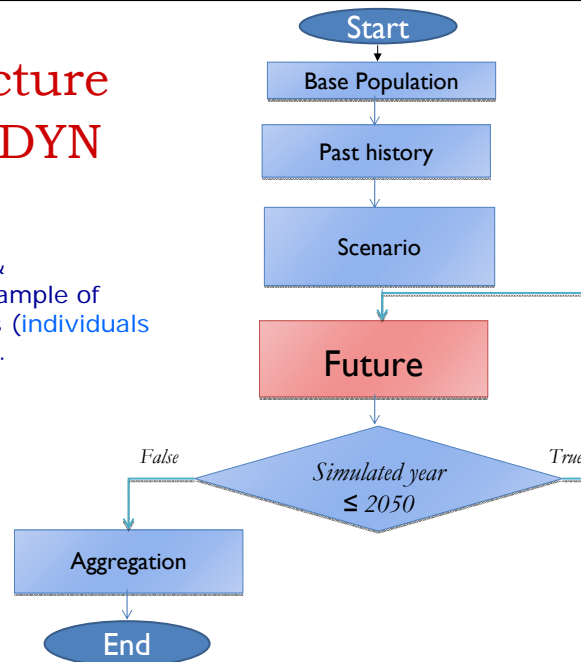
THE CAPP_DYN SCENARIO

CAPP_DYN makes projections on the basis of specific assumptions about the evolution of a number of (macro) exogenous variables

▸ Demographic scenario:
  ▸ The latest demographic projection (ISTAT, 2008, central scenario);
▸ Socio-economic structure of the population:
  ▸ We take into account cohort effects observed in the past;
▸ macroeconomic scenario:
  ▸ The latest RGS projections on GDP growth and productivity;
▸ Eligibility for retirement:
  ▸ In line with rules in force in Italy in June 2011.

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The block "FUTURE"

Demography
- Mortality
- Fertility
- Net Migration
- Children leaving home
- Marriage / Separation

Population at time t

Population at time t+1

Disability

Social Security
- Retirement decision
- Old age pension
- Survival pension
- Disability benefits
- Social Assistance Pension

Education and labour
- Education
- Transition to the labour market
- Position w.r.t. the labour market
- Sector of employment
- Earnings

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DEMOGRAPHY

▸ It uses *ISTAT official projections 2007* to simulate yearly flows of death, new born and (net) immigrant

   conditional on year of simulation, gender and age

It allows definition of the stock of the population in each of the simulated years

▸ Conditional probabilities of marriage, separation/divorce are derived from *ISTAT indagine multiscopo*
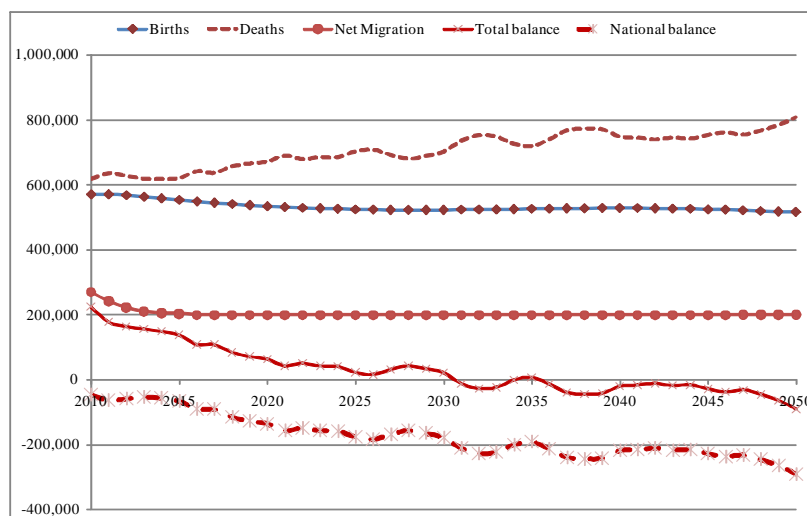
   Positive Assortative mating theory (Becker 1991)

   conditional on age, level of education and area of residence

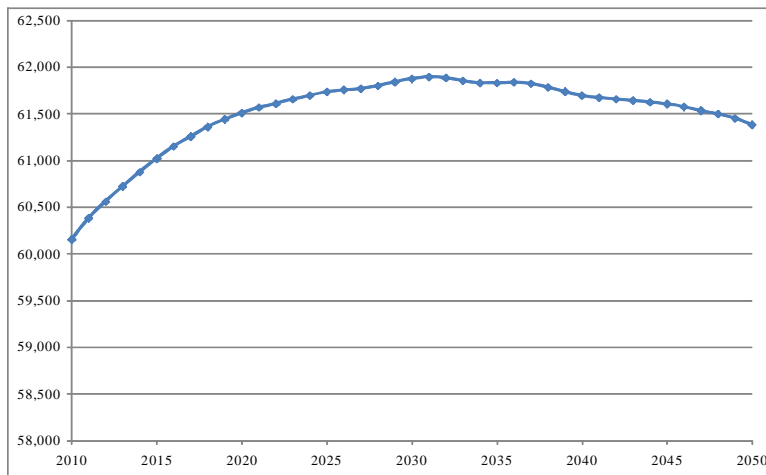It allows definition of household size and composition in each of the simulated years

▸ 11

NEW BIRTHS, DEATHS AND NET MIGRATION IN ITALY. 2010 - 2050

▸

THE EVOLUTION OF THE TOTAL POPULATION IN ITALY. 2010 – 2050

DEMOGRAPHIC AND ECONOMIC STATISTICS FOR THE ITALIAN POPULATION IN 1990, 2010, 2030 AND 2050

Year	1990	2010	2030	2050
Average age total population	38.2	43.1	47.1	47.5
>=65 /Population	13.6%	21.0%	27.2%	30.3%
>=80 / >=65	23.1%	27.5%	34.1%	41.9%
<=15/>=65	119.0%	69.9%	52.0%	46.7%
Immigrants/whole population	0.6%	5.7%	11.8%	17.4%

The block "FUTURE"


```
         ┌──────────────────┐          Demography
         │  Population      │◄────      ·Mortality
         │  at time t       │          ·Fertility
         └──────────────────┘          ·Net Migration          ┌──────────────┐
                  ▲                     ·Children leaving home  │  Disability  │
                  │                     ·Marriage / Separation  └──────────────┘
         ┌──────────────────┐                                          │
         │  Population      │                                          ▼
         │  at time t+1     │                               Education and labour
         └──────────────────┘                               ·Education
                  ▲                                         ·Transition to the labour market
         Social Security                                    ·Position w.r.t. the labour
         ·Retirement decision                               market
         ·Old age pension        ◄───────                   ·Sector of employment
         ·Survival pension                                  ·Earnings
         ·Disability benefits
         ·Social Assistance Pension
```

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DISABILITY

- It account for the Health/SES gradient
  (Cutler et al 2010; Goldman 2001; Deaton 2011; Case and Paxson 2005)

- 4 j-states of disability: none; lower; medium; severe

$$y_i^* = X_i \beta$$
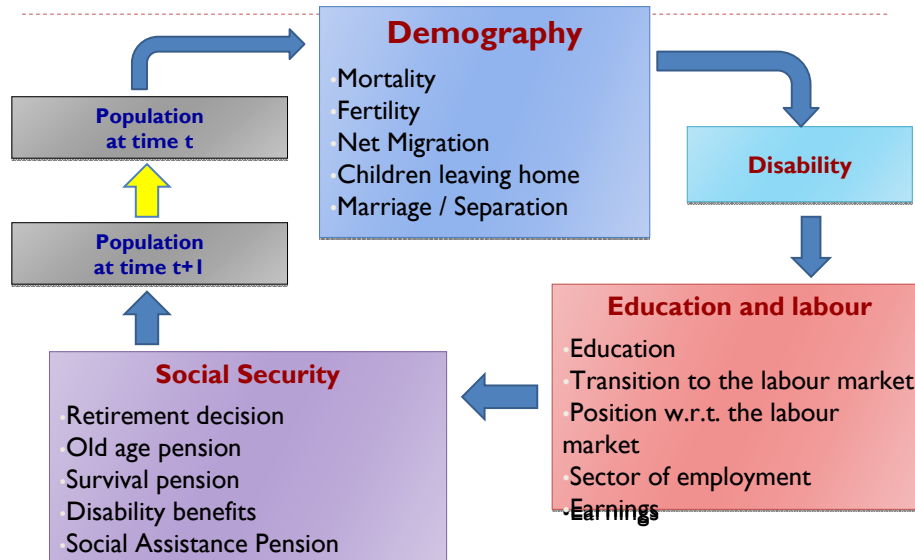$$y_i = j \quad \text{if} \quad c_{j-1} < y_i^* \le c_j$$

- Data: ISTAT "Indagine sulle Condizioni di Salute" (2003)

- Different scenario(s) can be applied:

  - Pure ageing (Costello and Przywara, 2007);
  - Compression of disability (Fries, 1980; Manton, 1982) ;
  - Expansion of disability (Grunenberg, 1977).

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EDUCATIONAL ACHIEVEMENT

▸ It account for the impact of family background on pupils achievement
(Backer, 1975; Ermisch and Francesconi,2001; Brunello and Checchi,2003)

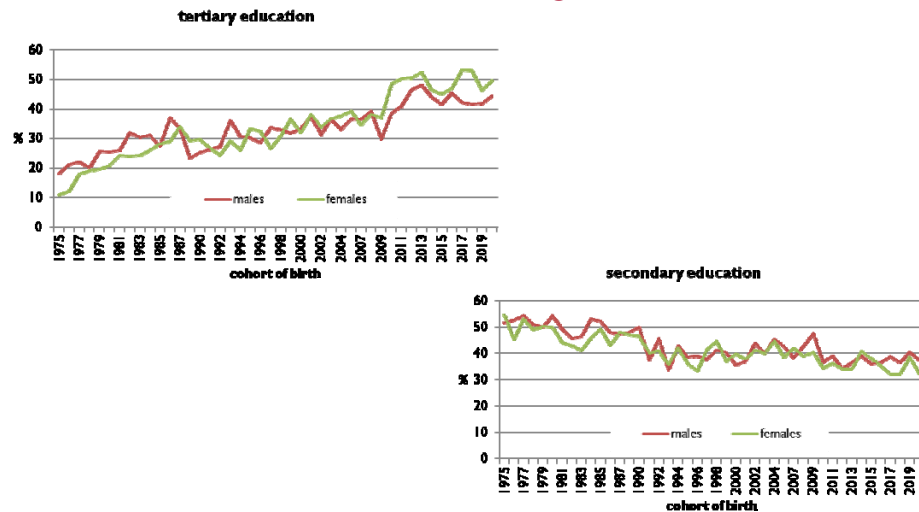▸ J-categories: 0 compulsory education, 1 secondary school, 2 undergraduate education, 3 postgraduate education

$$y_i = j \qquad \text{iff} \quad c_{j-1} \leq \tilde{y}_i < c_j, \qquad r = 1...J$$

$$\tilde{y}_i = \beta' x_i + \varepsilon_i$$

▸ Data: IT-SILC 2005

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PERCENTAGE OF MALE AND FEMALES BY COHORT OF BIRTH AND EDUCATIONAL ATTAINMENTS*

*Educational attainment observed at age of 30. This avoids taking into account in the figure those who have not yet completed their educational career. On the other hand, it does not allow the educational attainments of those born before 1975 or after 2020 to be considered.

TRANSITION IN THE LABOUR MARKET

▸ We model transitions conditional on individual's observables

     Pastorello (1992), Bellman et. al. (1995), Chies et. al. (1998)

▸ Separate gender and level of education multinomial logistic models applied
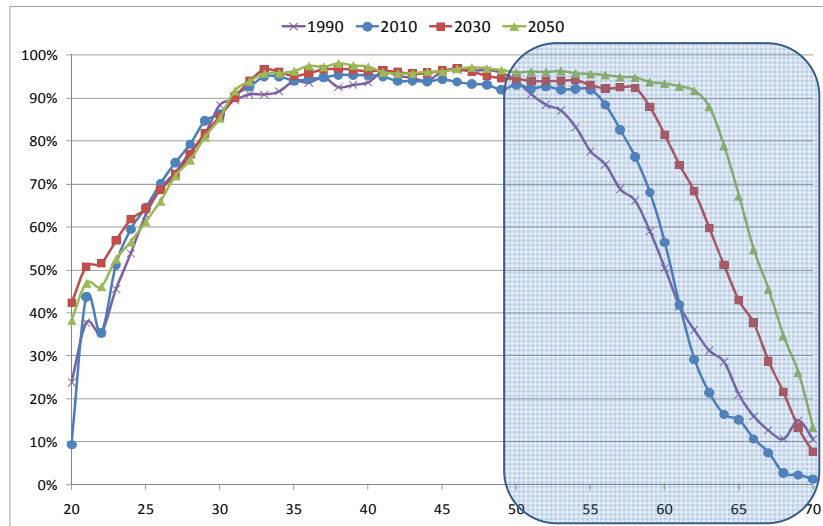
▸ 4 possible status:

    ▸ full time workers;

    ▸ part-time workers;

    ▸ unemployed;

    ▸ outside the labour market;

$$P(J_{t+1} = j_{t+1} \mid j_t, X_{it}) = \frac{\exp(X_{it}B_j)}{1 + \sum_{j=1}^{4} \exp(X_{it}B_j)} \qquad j = 1,...,4.$$
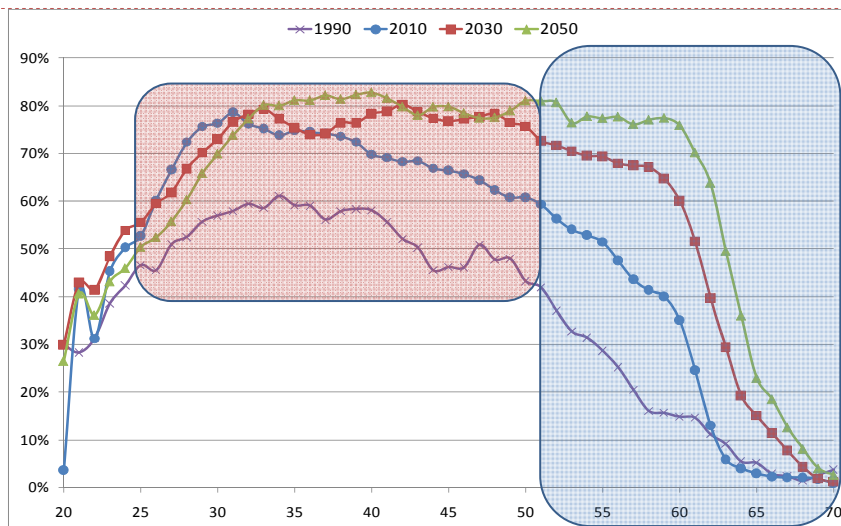
▸ Data: RFL 1993-2007

    ▸ 20

# PARTICIPATION RATE BY AGE. MEN. YEARS 1990, 2010, 2030 AND 2050

*Notes: The participation rate is the number of people in the labour force (occupied, unemployed) divided by the size of the adult population by age. Source: (1990) SHIW data 1991 (reference period 1990). Estimates for 2010, 2030 and 2050 are obtained using CAPP_DYN, central

PARTICIPATION RATE BY AGE. WOMEN. YEARS 1990, 2010, 2030 AND 2050

*Notes: The participation rate is the number of people in the labour force (occupied, unemployed) divided by the size of the adult population by age. Source: (1990) SHIW data 1991 (reference period 1990). Estimates for 2010, 2030 and 2050 are obtained using CAPP_DYN, central

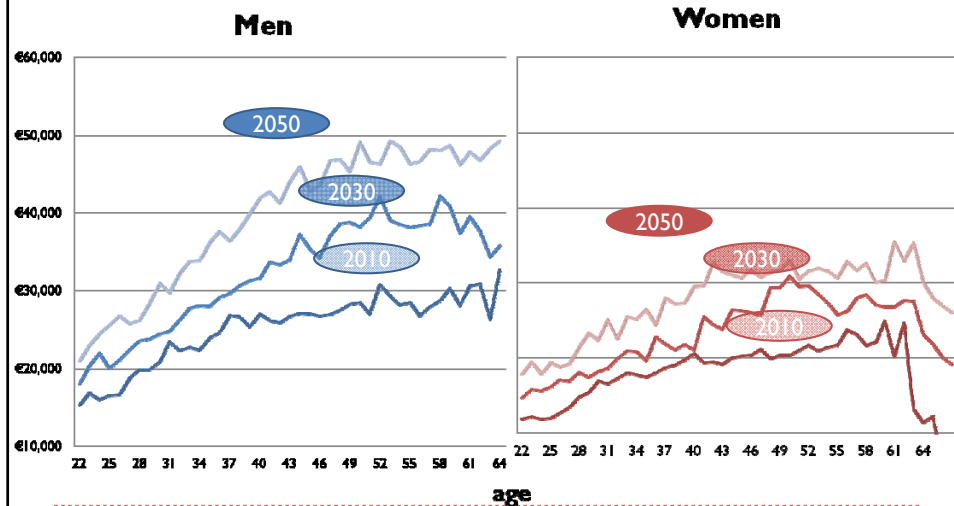# EMPLOYED POPULATION BY DEMOGRAPHIC CHARACTERISTICS. 2010 – 2050.

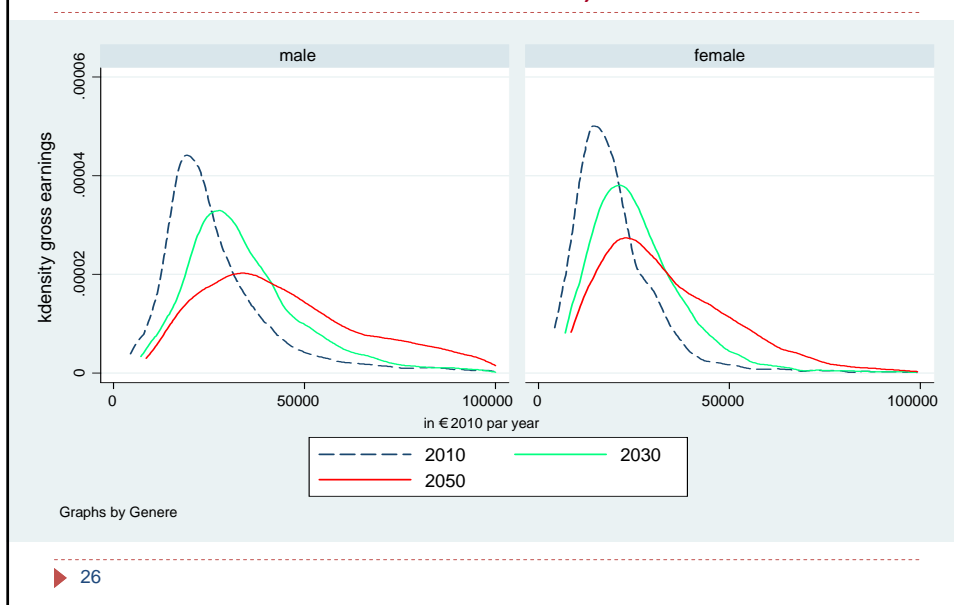Immigrants

employed population aged 51+

23
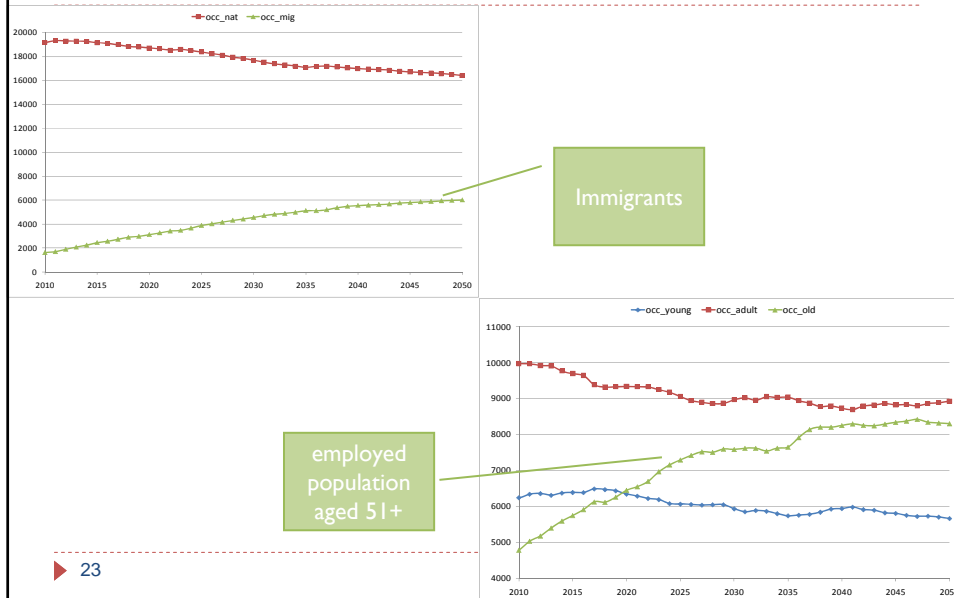
EARNINGS

▸ Once a position in the labour force is simulated, monthly ln-earnings are imputed for employees and self-employed workers;

▸ CAPP_DYN allows the use of different econometric methods, applied on both the cross-sectional and longitudinal component of IT-SILC, paying particular attention to the assumptions regarding:
  ▸ unobservable heterogeneity;
  ▸ and expected earnings growth over the simulated period.
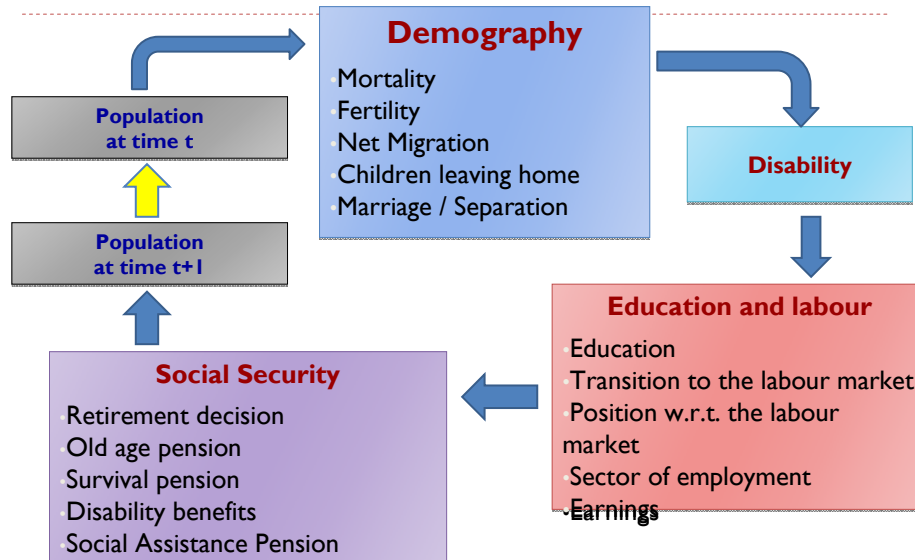
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MEDIAN REAL GROSS EARNINGS BY AGE AND GENDER
YEARS 2010, 2030 AND 2050

Men

Women

2050

2030

2010

2050

2030

2010

age

Source: Age profiles estimated using CAPP_DYN.
Notes: Value expressed in € 2010 computed among those with positive earnings.

KERNEL DENSITY ESTIMATORS OF GROSS EARNINGS BY GENDER 2010, 2030 AND 2050

male

female

kdensity gross earnings

in € 2010 par year

2010   2030

2050

Graphs by Genere

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- Retirement decision
- Old age pension
- Survival pension
- Disability benefits
- Social Assistance Pension

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SOCIAL SECURITY MODULE

▸ Retirement decisions:

1. Eligibility conditions;
2. Intertemporal maximization (Stock and Wise, 1990) ;
3. Adequacy of the treatment (Spataro, 2003).

▸ We take account of the majority of pension benefits paid by the Italian social security system:

- ☐ Old age pensions;
- ☐ Survival pensions;
- ☐ Disability benefits;
- ☐ Social Assistance Pensions.

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SUMMING UP:

- CAPP_DYN makes projections on the basis of specific assumptions;
- Demographic and macroeconomic scenarios linked with official forecasts;
- Socio-economic characteristics of sample members evolve over time taking into account trends observed in "real" data;
- CAPP_DYN replicates with details pension rules in force in June 2011;
- CAPP_DYN is a powerful tool for evaluation of the long-run distributional effects of public policies. It can be used for other applications (i.e LTC and its reform).

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SUMMING UP THE ITALIAN TRANSITION PROCESS

Italian society and its economy are expected to experience important structural changes:

- "greying" of the population:
  - Increase in life expectancy;
  - Ageing of the "baby boom" generation;
- Change in the socio-demographic structure of the population:
  - Increase of the share of migrants;
  - changes in the structure of the population according to civil status and household size;
- Increase in educational attainments
- Increase in labour market participation

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