Outline

- History
- General features of T-DYMM
- The AD-SILC dataset
- Structure of T-DYMM 2.0
- Simulation Results
- Future Implementations
History

• T-DYMM has been developed in 2 phases:
  1. 1° European Project (2010-2012): based on MIDAS and EconLav, developed in Liam 1.0, covers 2005-2060;
  2. a) 2° European Project (2014-2016): new and improved AD-SILC, move to Liam 2.0, update of the legislation, addition of private pension module, indexation of pensions, unemployment benefits;
     b) Publication of ‘What are the consequences of the AWG 2018 projections and hypotheses on pension adequacy?’ and aftermath: update of the legislation, taxation module expanded and moved to Liam 2.0, modelization of net migration
General features of T-DYMM

- It is a Dynamic Microsimulation Model (long-term projections)
- The unit of analysis is the individual
- It treats time as discrete
- It has a sequential structure
- Socio-economic events occur according to conditional transition probabilities (estimated on data available)
- It uses alignment procedures on demographic and macroeconomic projections
The AD-SILC dataset

- AD-SILC is composed by matching the observations contained in the survey SILC delivered by ISTAT with administrative data from INPS.
- **Panel INPS**: longitudinal data of individuals’ working history since their entry in the LM: occupational status, income evolution, contribution accumulation, etc.
- **Panel SILC**: longitudinal data of individual socio-economic characteristics (up to 4 years): education, marital status, number of children, etc.
AD-SILC dataset: contents and features

- **AD-SILC 2.0** comprises all SILC waves from **2004** to **2012**
- It is an **unbalanced panel** dataset derived from both data sources (INPS and ISTAT)
- It can also make use of the panel component inherent to SILC
AD-SILC uses: **Analyses**, regressions and projections (1)

- Analyses of dynamics within the labor market:
  - Transition matrixes;
  - Earnings distribution trends;
  - Accumulation of pension contributions.
### Working conditions after 1 year of those employed in 2008 (by education)

#### At most lower-secondary

<table>
<thead>
<tr>
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<th>2008</th>
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#### Tertiary

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Note: workers aged 35-44 in 2008 are considered
### Working conditions after 3 years of those employed in 2008 (by education)

#### At most lower-secondary

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#### Upper-secondary

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#### Tertiary

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Note: workers aged 35-44 in 2008 are considered.
AD-SILC uses: Analyses, **regressions** and projections (2)

- Regressions used in T-DYMM are based on the **entire** dataset AD-SILC
- All individuals in SILC 2004-2012 and the respective working and contribution history carried out by INPS are considered over the period 1998-2011 for:
  - Modelling the demographic dynamics;
  - Modelling the working statuses;
  - Modelling the earnings process.
AD-SILC uses:
Analyses, regressions and **projections** (3)

- Simulations are based on a **single extract** of AD-SILC
- For T-DYMM 2.0, **2011** is the **starting point** of the simulation
- The dataset is **cross-sectional** (SILC 2011), integrated with retrospective information about working conditions, acquired work experience, total number of years of contribution, etc.
The 4 Modules of T-DYMM

2012 - 2070

AD-SILC 2011

Demographic module

Labor Market Module

Pension Module

Taxation Module

END
The Demographic Module

• Processes:

1. Ageing (no heterogeneity, mortality rates aligned*);
2. Births (probabilistic, fertility rates aligned*);
3. Immigration (cloning procedure);
4. Education (dependent on parents’ education);
5. Leaving household (deterministic);
6. Coupling / marriage and divorce (probabilistic)

* AWG 2018 Projections
The Labor Market Module

Are you in ‘active age’?

YES

Are you employed?

Yes

Are you an atypical worker? (‘P.IVA’ + ‘parasubordinati’, probabilistic)

NO

Are you an employee? (probabilistic)

NO

You are an independent worker (residual category)

YES

Private or public (probabilistic)

Temporary or permanent (probabilistic)

Part-time or full-time (probabilistic)

NO

• In education
• Retired
• Other inactive

NO

• Disable (only 100% disability)
• On unemployment benefits
• Other unemployed

* AWG 2018 Projections
The Labor Market Module: LM transitions (1)

- Conditional probabilities of LM transitions across employment states are estimated based on a sequence of binary behavioural choices with the following logical order:

1. Probability to be **employed** (all individuals who are not students nor retired are included in the regressions);

2. Probability to be an **atypical worker** among all workers defined in step 1;

3. Probability to be an **employee** among workers defined in step 1 except atypical workers;

4. Probability to be **self-employed** (residual category).
The Labor Market Module: LM transitions (2)

Among employees the subsequent choices are concerned:

1. Economic sector (private vs public);

2. Contract duration (temporary vs permanent);

3. Time arrangements (part-time vs full-time).
The Labor Market Module: LM transitions

• Sample size: 1,105,456 observations, relative to 82,137 individuals aged 16-69 years old

• Estimation period: 1998-2011

• The estimations are carried out separately for men and women

• Random effect logit models for LM transitions in order to account for individual unobserved heterogeneity

NB: in none of our regressions do we include variables that are not present in the “simulation world” of T-DYMM because of the impracticability of projecting its evolution in time
The Labor Market Module: Estimations of earnings (1)

Yearly individual labour income gross of personal income taxation is the product of two components:

- **monthly gross wages**

  The earnings process is modelled separately for the three work typologies and by gender.

- **months worked**

  Modelled in two steps:
  
  1) The probability of being in work all year (concerns atypical and temporary workers)
  
  2) Define the months worked for those workers who are not assigned to the «work all year» status
The Labor Market Module: Estimations of earnings (2)

- The functions for monthly earnings and months in work within the year are modelled as such:

\[ y_{it} = X_{it}\beta + u_i + \nu_{it} \]

Where \( X_{it} \) consists of a vector of observed variables, while unobserved variables are represented by a random component that captures permanent heterogeneity between individuals \( (u_i) \) and by a stochastic error component \( (\nu_{it}) \):

- The permanent error component, \( u_i \), (i.e. intellectual ability, soft skills, motivation) represents a constant wage deviation for each individual, where \( u \sim N(0, \sigma_u^2) \)

- The transitory component, \( \nu_{it} \), (i.e. bonuses, illness, overtime) follows an AR(1) process plus a white noise error, \( \varepsilon_{it} \):

\[ \nu_{it} = \rho \nu_{i,t-1} + \varepsilon_{it} , \varepsilon \sim N(0, \sigma_\varepsilon^2) \text{ and } |\rho| < 1 \]
Estimations of monthly wages

• A random effect GLS estimator has been utilised to estimate the wage equation on the AD-SILC panel data.

• Estimation period: 1998-2011

• The estimations are carried out separately for the three work categories and for men and women.

• Sample size: 632,762 observations for 79,009 individuals aged 20-60: about 75% are employees, 19.5% are self-employed and 5.5% are atypical workers.
Estimations of months worked

1. Estimations of the probability of being in work all year:
   • Random Effect Logit model;
   • Sample size – 96,933 observations for 29,391 individuals: 48% are men and 52% are women;

2. Estimations of months worked:
   • Same model as for monthly wages;
   • Sample size– 50,264 observations for 12,768 individuals: 41% are men and 59% are women;
The Labor Market Module: Unemployment Benefits

• If individuals do not work and they fulfill entitlement criteria, they get unemployment benefits (i.e., take-up rate is assumed at 100%)

• Benefit amount and duration are both simulated, ‘figurative’ contributions are computed

• ‘Ante-Fornero’, ‘Fornero’ and ‘Jobs Act’ legislations are simulated
The occurrence of disability happens randomly

Ad hoc alignment processes ensure stability in size of the phenomenon

No difference is outlined between work-related disability and ‘invalidità civile’
The Pension Module
Public scheme (1)

Old-age / Seniority Pensions

Contribution payment
(according to employment category)

Benefit computation
(according to pertinent legislation)

Check for eligibility
(age, seniority, pension amount)

Retirement choice
(deterministic)

Indexation
(operates as discount)
The Pension Module
Public scheme (2)

Other benefits simulated

• “Quattordicesima”
• “Integrazione al minimo”
• “Assegno sociale”
• Disability Pensions
• Survivor Pensions
The Pension Module
Private scheme

2° and 3° pillar

Enrolment choice (probabilistic)

Contribution payment (amount deterministically imputed up to the tax-exemption bound)

Returns on contributions (portfolio composition and return rates aligned to historical data and AWG projections)

Benefit computation (all opt for annuity)

Access to public scheme retirement

Indexation (different from public scheme)

NO
# The Taxation Module

<table>
<thead>
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<th>Gross income</th>
<th>Taxable income</th>
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<tbody>
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<td>Social contributions</td>
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</tr>
<tr>
<td>IRPEF</td>
<td></td>
</tr>
<tr>
<td>Tax credits (employee, independent, pensioner, family-related)</td>
<td></td>
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<tr>
<td>=</td>
<td>Net income</td>
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Simulation Results (IESS project, 2016)

• T-DYMM has generally been used to assess the adequacy of the Italian pension system. Published results include:
  • Average retirement age;
  • Average duration of retirement at death;
  • Replacement rate at retirement;
  • Gini index;
  • Income quintile share ratio;
  • At-Risk-of-Poverty Rate.

• Results have generally been proposed on a number of sensitivity and policy scenarios.
Simulation results - IESS project, 2016

Sample evolution: computation rules

Stock of pensioners

2012-2021
- 37% DB
- 54% Mixed 2011
- 4% Mixed 1995
- 4% NDC

2030-2039
- 66% DB
- 16% Mixed 2011
- 9% Mixed 1995
- 9% NDC

2050-2059
- 58% DB
- 41% Mixed 2011
- 1% Mixed 1995
- 0% NDC
SIMULATION RESULTS - IESS PROJECT, 2016

Average effective retirement age

New pensioners

Note: Lowess smoothing
Source: T-DYMM 2.0 - own elaborations
## Condition at retirement by birth cohort (1)

### New pensioners. All pensions

<table>
<thead>
<tr>
<th>Birth cohort</th>
<th>Age</th>
<th>Years of contribution</th>
<th>Gross replacement rate</th>
<th>Pension / assegno sociale</th>
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<td>1980-89</td>
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<td>50%</td>
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Averages on simulation period, 2012-2059
## Condition at retirement by birth cohort (2)

**New pensioners. Pensions ≥ 3*AS**

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<th>Gross replacement rate</th>
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<td>50%</td>
<td>4.3</td>
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Averages on simulation period, 2012-2059
## Simulation results - IESS project, 2016

### Condition at retirement by birth cohort (3)

New pensioners. Pensions < 3*AS

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<td>31.3</td>
<td>50%</td>
<td>2.2</td>
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Averages on simulation period, 2012-2059
The evolution of inequality indicators

Stock of pensioners. Gini index

Net pension incomes are considered
Unemployment Benefits

Replacement rate of unemployment benefits, 2015-2059

**Overall**

<table>
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<tr>
<th></th>
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<th>Ante Fornero</th>
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<td>2015-2059</td>
<td>54.8%</td>
<td>58.4%</td>
<td>45.4%</td>
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**By income decile**

- Income decile 10
- Income decile 9
- Income decile 8
- Income decile 7
- Income decile 6
- Income decile 5
- Income decile 4
- Income decile 3
- Income decile 2
- Income decile 1

**Replacement rate**

- Baseline
- Fornero
- Ante Fornero
Future Implementations

• Development of a ‘Wealth Module’ (financial, real-estate wealth, TFR)
• Development of a ‘Migration Module’ (immigration and emigration, characterized patterns for migrant workers)
• Inclusion of working pensioners (retirement is now an ‘absorbment state’)
• Expansion of ‘Disability Module’ (probabilistic, improve alignment procedures)
• Expansion and update of welfare and fiscal modules
• Improvement of sample representativeness
• Focus on atypical workers
Thank you for your attention