Inequality in Workers’ Lifelong Learning across European Countries: Evidence from EU-SILC Data-set

- Marco Biagetti* and Sergio Scicchitano*,**, ** -

*Ministry for Economic Development, Department for the Development and the Economic Cohesion. The views expressed in this article are those of the authors and, in particular, do not necessarily reflect those of the Ministry of Economic Development.

**University "La Sapienza", Faculty of Economics, Department of Public Economics
Outline

1. Introduction: motivation and goals
2. Previous literature
3. Our procedure: EU-SILC
4. The model
5. Results
   a) Whole sample and each European country
   b) Heteroscedasticity due to sex
6. Conclusions
Motivation: life-long learning in Europe

• There is a wide consensus that human capital plays a key role for economic growth.

• It can be accumulated not only before entering in the labor market, through initial education but also during working life through continuous education and/or training.

• Although the European Jobs Strategy’s emphasizes adult education during working life, empirical literature, by focusing on the growth effects of the initial education, does not seem to take sufficiently into account the contribution of workforce life-long learning (LLL) as an additional source of human capital and growth.

• So, what does affect workers’ accumulation of human capital during their working life?

• Many aspects are not clear…
Goals of the paper: 4 questions

1. What does affect inequality in workers’ human capital accumulation in Europe?
   - Individual-specific
   - Firm-specific
   - Job-specific
2. What is the extent of gender differences?
3. Is there a significant heterogeneity across European countries, even in terms of gender?
4. Is there a complementarity between past education and adult learning?
   In other words, are labor market Institutions able to avoid existing inequality in human capital as it results from education levels obtained before working?
Our interest

- We are interested in evaluating, for workers, gender differences in the incidence of formal LLL - in the whole sample and in each of the 21 countries - with regard to the following aspects:
  - **Personal characteristics:**
    - age
    - marital status
    - past education
  - **Job characteristics:**
    - permanent vs temporary contracts
    - full vs part-time contracts
    - recent job changes
  - **Firm characteristics:**
    - working in small vs medium and large companies
    - being involved in low vs high-skilled occupations.
Procedure

• First we estimate the determinants of LLL incidence, for the whole sample by using separate equations for men and women.

• Then, we also estimate, for each of the 21 European countries, separate equations for men and women, which to the best of our knowledge has not been done before in comparative analysis of life-long learning: this method allows for the identification of cross-country gender differences in the impact of observable characteristics on LLL inequality in Europe.

• We finally exploit the cross section nature of the EU-SILC data set to control for heteroscedasticity due to sex.
Previous empirical studies: main data sets

• The European Community Household Panel (ECHP) “Have you at any time since January in the previous year been in vocational education or training, including any part-time or short-courses?” And, if yes, which kind of course(s) was it? Vocational and/or Training and/or Language courses

• The International Adult Literacy Survey (IALS) The survey asks whether the workers have received any training or education during the 12 months prior to the survey but it includes details only about the three most recent courses (purpose, financing, training institution, duration, etc.).

• The European Union Labour Force Survey (ELFS) which provides information about workers’ participation in training and education schemes during a period of 4 weeks prior to the survey.

• CVTS: It provides information on employer-sponsored training, which is taken during the year prior to the survey, for employed persons, excluding apprentices and trainees

• OECD aggregate: obtained by aggregating and merging CVTS and IALS

• EU-SILC to the best of our knowledge has never been used for studying adult learning
2 trends of economic literature

• These surveys significantly differ in terms of the definition of learning adopted, which clearly affects how to gauge the extent of inequality in lifelong learning participation.

• As a matter of fact, on the one hand, some studies (Ariga and Brunello 2006, Arulampalam et al. 2004, Bassanini, et al. 2007, Brunello 2003, Pischke 2001) generally canvass a broad definition of training, by using different data-set.

• On the other hand, a few studies are able to show the incidence of a larger definition of adult learning during working life, which includes both education and training programs: Jenkins et al. (2002), Simonsen and Skipper (2008), Drewes (2008), Ok and Tergeist (2003)
Our definition: formal life-long learning (LLL)

- We adopt a procedure which is similar to the second line of research.
- Our aim is to verify whether or not a worker is currently involved in any formal life-long learning process which may improve its own skills, by including both regular education and training programs.
Previous literature: regularities..

Despite different concepts of adult learning, results from previous studies can be summarised. Some empirical results are quite recurrent in the literature:

- **Large firms** are more likely to provide some adult learning scheme: Bassanini, et al. (07), Ok and Tergeist (03) Drewes (08), Jenkins et al. (02) in UK

- **Complementarity between education obtained and adult learning:** Bassanini et al. (2007), Brunello, G. (03), Ariga, K. and Brunello, G. (02), Croce and Ghignoni (05) in Italy, Ok and Tergeist (03), Arulampalam et al. (03), Drewes (08), Jenkins et al. (02), Sargant et al. (97)

- Adult learning incidence decreases with **age** Bassanini et al. (07), Arulampalam et al. (03), Ok and Tergeist (03), Drewes (08), Sargant et al. (97), Simonsen and Skipper (08):

- Adult learning increases with the **skill-intensity of occupations** Pischke (01) in Germany, Bassanini et al. (07) in EU, Ok and Tergeist (03), Drewes (08).
Current state of knowledge

• Many papers have studied determinants of adult learning inequality
• Some regularities have been found
• Many aspects have to be clarified
  – Heterogeneity across nations?
  – How does labour market conditions (mobility) affect adult learning? Full/part, perm/temp, recent change job
  – Gender differences? Is there a heteroscedasticity due to sex?
  – Complementarity between past education and adult learning in every country?
The data: EU-SILC data set

- Our data are from the 2005 first wave of the European Union Statistics on Income and Living Conditions (EU-SILC)
- It is the **new homogenized panel survey that has replaced ECHP** since 2005, and actually **covers EU25** (old and new) member states.
- Similarly to ECHP, EU-SILC is an attractive source of information because it adopts the **same “community” questionnaire** used by the national data collection units in each included country, which obviously makes comparisons across nations easier. Furthermore, EU-SILC actually covers a larger increasing number of European countries with respect to the ECHP.
- Each wave includes a household and a personal file. In the 2005 wave **197,657 nationally representative households and 422,040 individuals** from EU-25 Countries were interviewed.
Variables description: dependent (1)

• Dependent:
  – 0 not in LLL
  – 1 in LLL

• The concept is whether the person is currently participating in an **learning program**, defined under ISCED-97, “an array or sequence of educational activities, which are organised to accomplish a pre-determined objective or a specified set of educational tasks” (UNESCO)
Variables description: dependent (2)

• It is defined as **education and training** with the following characteristics:
  ...
  – purpose and format are predetermined.
  – it is normally intended to lead to a **certification** recognised by national authorities qualifying for a specific education/programme).
  – corresponds to the programmes covered by the UOE-questionnaires.

• EU-SILC unfortunately does not distinguish between education and training and obviously does not provide informations about who pays the **cost of learning**
Dependent variable: definition

- All we can observe with these data is whether or not an individual participates in **any formal adult learning process**, over its own working-life cycle.
- Thus, similarly to Simonsen and Skipper (2008) and Drewes (2008), we empirically identify lifelong learning as education and training formal enrolment over the entire working life-cycle.
- Our dependent variable is **formal LLL**
# LLL Inequality in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>AT</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>GR</td>
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</tr>
<tr>
<td>LU</td>
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<td></td>
</tr>
<tr>
<td>CZ</td>
<td>11.5</td>
<td></td>
</tr>
<tr>
<td>HU</td>
<td>12.3</td>
<td></td>
</tr>
<tr>
<td>UK</td>
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<td>PT</td>
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<td>CY</td>
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<td>LV</td>
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<td>BE</td>
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<td>LT</td>
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<tr>
<td>SI</td>
<td>21.0</td>
<td></td>
</tr>
</tbody>
</table>

Observations are weighted by EU-SILC personal cross-sectional weights which account for non-random sample selection due to the survey design. The statistics can therefore be taken as representative of each country’s population.
Explanatory Variables (1): personal

- **Age:** only 16-64 workers
  (drop: unemployed, retired, pupils, students)

- **Marital status:**
  - 0 un-married in 2005 (never married, separated, widowed, divorced)
  - 1 married

- **Education attained:**
  - 0 Pre-primary - Upper secondary
  - 1 Post-second non tertiary - short & long tertiary
Explanatory Variables (2): job-specific

- **Full:**
  - 0 full-time
  - 1 part-time

- **Perm:**
  - 0 permanent
  - 1 temporary

- **Change job last year:**
  - 0 No
  - 1 Yes
Explanatory Variables (3): firm-specific

- **Local Unit size:**
  - 0 between 1 and 10 workers (small firms)
  - Dunsize 1: between 11 and 49 workers (medium firms)
  - Dunsize 2: 50 workers and more (large firms)

- **High-skilled occupations:**
  - 0 un-skilled: 35-93 ISCO code
  - 1 high-skilled: 1-34 ISCO code
## Summary statistics (employed only)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
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<td>1</td>
</tr>
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</table>
Model: probit function

• We estimate a probit model for incidence of formal LLL in 2005 across European countries

$$\Pr\{ob \mid T=1\} = \Phi(Z' \beta)$$

where:
• $Z$ is a set of explanatory variables
• $\beta$ is a vector of parameters
• $\Phi$ is the standard normal distribution
Probit estimations in the whole sample: marginal effects for men

Log pseudolikelihood = -8962.3322

<table>
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<th></th>
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</thead>
<tbody>
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<td>.0001222</td>
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<td>.0027921</td>
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<td>full*</td>
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<tr>
<td>hs*</td>
<td>.0247673</td>
<td>.002995</td>
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</tbody>
</table>

obs. P | .0550992
pred. P | .0291627 (at x-bar)

(*) dF/dx is for discrete change of dummy variable from 0 to 1. Observations are weighted by EU-SILC personal cross-sectional weights. Other controls included but not reported are dummies for managerial position and health.
Probit estimations in the whole sample: marginal effects for women

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>LLL</td>
<td>dE/dx</td>
<td>Std. Err.</td>
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<td>P&gt;</td>
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<td>7.55</td>
<td>0.000</td>
<td>.428269</td>
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</table>

Number of obs = 48792
Wald chi2(10) =1412.19
Prob > chi2   = 0.0000
Pseudo R2     = 0.1775

Log pseudolikelihood = -9136.8801

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
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</tr>
<tr>
<td>pred. P</td>
<td>.0372803 (at x-bar)</td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Main results for the whole sample

- **Personal characteristics**: young, better educated and unmarried workers are more likely to receive formal LLL.

- **Job-specific characteristics**: workers with temp and part time contracts, and who did not change job in the last year show a significant higher probability to get in adult learning.

- **Firm specific characteristics** as well are relevant because workers in small local units and in low-skilled sectors are less likely to undertake formal LLL.

  The relationship between **unit size and learning probability is also monotonic**: the predicted probability to get in LLL is, in particular, higher for workers in large local units with respect to workers in medium local units.

- Being a part-time and temp employee and working in a skilled occupation are the features with the strongest effect.

  For example, workers (men and women) with a temp contract have an almost 6 percentage point higher probability of undertaking life-long learning, than the base group of temporary workers.
Gender differences for the whole sample

- When examining gender differences, some particularities are obtained.
- The coefficients are generally stronger among men; the only exception is the past education which shows a stronger effect among female.
- Furthermore, marital status and medium unit explanatory variables are not significant respectively among men and women.
### Tab 4: LLL Probit for selected variables. Cross country analysis. Marginal effects for men

<table>
<thead>
<tr>
<th>Variable</th>
<th>AT</th>
<th>BE</th>
<th>CY</th>
<th>CZ</th>
<th>DE</th>
<th>DK</th>
<th>EE</th>
</tr>
</thead>
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<td>age</td>
<td>-0.010326***</td>
<td>0.002222</td>
<td>-0.000357</td>
<td>-0.00276</td>
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<td>0.000080**</td>
<td>0.00017</td>
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<tr>
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<td>perm (d)</td>
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<td>hs (d)</td>
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<td>0.035421**</td>
<td>0.012598**</td>
<td>0.045015***</td>
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</table>

**Significance:** * p<0.10, ** p<0.05, *** p<0.01. Observations are weighted by EU-SILC personal cross-sectional weights.

**Other controls included but not reported are dummies for managerial position and health.**
Tab 5: LLL Probit for selected variables. Cross country analysis. Marginal effects for women

<table>
<thead>
<tr>
<th></th>
<th>AT</th>
<th>BE</th>
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<th>CZ</th>
<th>DE</th>
<th>DK</th>
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<tr>
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<td>0.000037</td>
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|     | N      | pseudo R-sq | 0.419  | 0.209  | 0.087  | 0.176  | 0.154  | 0.112  | 0.068  |

Notes: see notes to Table 4.
Results across countries: personal character

- The probabilities of taking formal LLL decline with **age** in 8 countries for men (AT, DE, FR, GR, LV, DK, IT, LT) and for women (AT, DE, FR, GR, LV, BE, ES, UK).

- **Marital status** variable confirms its stronger relevance amongst women by also controlling for cross-country differences.

As to men, being unmarried in 2005 is associated to a higher probability to be involved in LLL only in ES, while in AT, CZ, DE, EE, ES, FI, HU, **IT**, LV, NL, PT and SL married women are less likely to receive LLL with respect to the unmarried women (i.e. the base group).
Complementarity between past education and curr learning

- Past education is the explanatory variable with the most significant heterogeneity across countries: 3 groups

- Clubs of Countries
  - Complementarity (inequality in acc. human capital):
    - Men AT, ES, FR SL
    - Women: AT, DE, ES
  - No significance in some countries
  - Negative sign (reducing inequality):
    - Men: FI, LV, DK
    - Women: FI, HU, LT, UK
Complementarity: Scandinavian countries

A couple of results are quite interesting with regard to Scandinavian countries.

1. **Finland** is the only country in the sample where, for both men and women, higher education reduces the incidence of formal LLL.

2. **Denmark** is the only country where, for women, being less educated is the most relevant variable for increasing the probability of undertaking adult formal learning scheme: Danish women with at most upper secondary education have a 4.6 percentage point higher probability to get in adult formal learning course, than women with at least post secondary education.

According to Simonsen and Skipper (2008) this particular result confirms that Denmark is a very special country with regard to training schemes.
Results across countries: job character

- In ten countries for men (AT, DE, FR, ND, UK, ES, FI, IT, LV, PT) and eleven countries (CY, CZ, EE, GR, HU, LT, ES, FI, IT, LV, PT) for women, workers with a **part-time contract** are significantly more likely to get LLL than the base group of those with a full-time contract.

- Workers with a **temporary contract** are associated to a higher probability of LLL, in 8 countries (AT, BE, DE, FI, FR CZ, LT, NL) for women and 6 countries (AT, BE, DE, FI, FR UK) for men.

- The negative correlation between training and **turnover** is a widespread idea in the economic literature (AP '98, '99..). Nonetheless we find a weak evidence with regard to formal LLL, as changing job in the last year is negatively and significantly associated with adult learning in just a few European countries. Workers who changed job in the last year are less likely to receive adult learning for both sexes only in DE and FR. For men it also holds in DK, GR, NL, SK.
Results across countries: firm charact

- In some countries, **the larger the local unit**, the higher the probability to be involved in adult learning.
  - **Large units**: in ES, LV, FI, GR, NL for men and in ES, LV, CY, IT for women.
  - **Medium units**: in DK, GR and LV for men and DK, ES, FR, LU, SK for women.
- The most homogeneous result is found for the **type of occupation**. Workers engaged in high-skilled occupations are more likely to undertake formal LLL than the base group of workers in low-skilled jobs in 13 countries (CZ, EE, ES, FI, HU, IT, LT, LV, SL, SK CY, DE, PT) for men and 12 countries (CZ, EE, ES, FI, HU, IT, LT, LV, SL, SK, GR, NL) for women.
Search for heteroscedasticity due to sex: procedure (1)

- Next, we control for possible heteroscedasticity of error variance across groups which may cause parameter estimates to be biased, inconsistent and inefficient.
- Indeed, as is well known in a probit model the residual variance is assumed to be \( \text{Var}(\varepsilon) = 1 \) while in the logit model it is set to \( \pi^2 / 3 \).
- That means in binary regression models coefficients are inherently standardized. More precisely, while in the OLS model the standardization is carried out by rescaling all variables to have a variance of 1, in a probit or logit model the standardization is accomplished by scaling the variables and residuals so that the residual variances are 1 or \( \pi^2 / 3 \):
  \[
  \Pr(y_i = 1) = \Phi\left(\frac{x_i \beta}{\sigma}\right)
  \]

- Thus, following Alvarez and Brehm (1995) we model the following equation to account for a possible heteroscedasticity:
  \[
  \Pr(y_i = 1) = \Phi\left(\frac{x_i \beta}{\exp(z_i \gamma)}\right)
  \]
  where \( \exp(z_i \gamma) = \sigma_i = f(z_i) \) and z’s are a set of regressors.
Search for heteroscedasticity due to sex: procedure (2)

- Following Allison (1999), a variance equation only depending on the \textbf{sex variable} is built up: indeed, unmeasured variables affecting life-long learning decisions may be strongly affected by gender differences

$$\sigma_i = \exp(sex_i \gamma)$$

- 3 models:
  1. homoscedastic un-weighted;
  2. homoscedastic weighted;
  3. heteroscedastic model.

The second differs from the first in using the inverse of the probability for an individual to be included in the sample due to the survey design.
Table 6. Heteroscedasticity due to sex. Un-weighted homoscedastic model, weighted homoscedastic model and heteroscedastic model

<table>
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<th>homosk w</th>
<th>het-sex</th>
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<td>0.00149*** (20.54)</td>
<td>0.00155*** (19.26)</td>
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<td>sex</td>
<td>0.08447*** (5.64)</td>
<td>0.01767 (0.76)</td>
<td>-0.10838* (-1.70)</td>
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<td>-0.13761*** (-8.16)</td>
<td>-0.11033*** (-4.15)</td>
<td>-0.10622*** (-3.78)</td>
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<td>0.09680*** (3.59)</td>
<td>0.10264*** (3.62)</td>
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<td>full</td>
<td>0.23220*** (11.47)</td>
<td>0.20297*** (6.51)</td>
<td>0.21050*** (6.35)</td>
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<tr>
<td>perm</td>
<td>0.35046*** (19.32)</td>
<td>0.56486*** (22.21)</td>
<td>0.58791*** (20.54)</td>
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<td></td>
<td>0.08529** (2.25)</td>
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N 104297 104297 104297

Significance: * p<0.10, ** p<0.05, *** p<0.01.
Heteroscedasticity due to sex: results

• In the homoscedastic weighted model women seem to be more likely to get in LLL than men (see tab.1)

• In the homoscedastic weighted specification there is no huge change in any regressor compared to the homoscedastic un-weighted model except for the sex variable which becomes statistically un-significant.

• While no variation can be noted in any other regressor, the corresponding sign for sex on the heteroscedastic model becomes negative and quite significative with respect to the homoscedastic weighted specification.

• Following this specification, sex heteroskedasticity appears a serious issue for LLL incidence.
Conclusions: contribute to the literature

• We have explored the potential for EU-SILC data-set that has never been used yet, to our knowledge, in studying inequality in the incidence of workers’ learning process.

• To do so, first we have estimated the LLL incidence in the whole sample of 21 European countries with separate equations for men and women. Then we have estimated 21 country-specific equations, also for both sexes. This method allows to investigate cross-country gender differences. To the best of our knowledge, it has not been done before in comparative analysis of life-long learning.
Conclusion: formal LLL incidence

1. **LLL incidence** depends on:
   - **Personal**: young, better educated and never married workers are more likely to be involved in formal LLL
   - **Job specific**: temporary, part-time, those not having recently changed job are associated with a much higher LLL probability
   - **Firm specific characteristic**: large firms, high-skilled intensive industries are more likely to provide adult learning
   - **Gender differences**:
     - Marginal effects generally stronger among men; the only exception is the past education.
     - Marital status and medium unit variables are not significant respectively among men and women.

2. **Heteroscedasticity by sex**

3. **Clear heterogeneity across European countries** with respect to p-values
Complementarity: Scandinavian countries

4. Evidence of complementarity between past education and adult learning in all sample but strong differences across countries:

- Clubs of Countries
  ✓ Complementarity (inequality in acc. human capital):
    ✓ Men: AT, ES, FR, SL
    ✓ Women: AT, DE, ES
  ✓ Negative sign (reducing inequality):
    ✓ Men: FI, LV, DK
    ✓ Women: FI, HU, LT, UK
  ✓ No significance in other countries

- Finland is the only country in which, for both men and women, adult learning system is able to avoid existing inequality in human capital as it results from education level.

- Denmark is the only country where, for women, being less educated is the most relevant variable: Danish women with at most upper secondary education have a 4.6 percentage point higher probability to get in adult formal learning course, than women with at least post secondary education. 39
Further research

• **Regions**: NUTS-2
• **Mincerian equations**: the returns to education in European countries:
  – OLS vs Semi-parametric (QR)
  – Is LLL useful… in terms of wage?
  – Gender discrimination: **Oaxaca** decomposition
Thank you very much..

http://mpra.ub.uni-muenchen.de/17356/

sergio.scicchitano@uniroma1.it
sergio.scicchitano@tesoro.it