Labour market condition in Italy during and after the financial crises: a segmented regression analysis approach of interrupted time series

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Introduction

Economic framework

- During this past decade **two economic crises** had a severe impact in all countries around the world. More specifically, after the economic decline observed in world markets during the late 2000s and early 2010s ,which generated the **Great Recession** defined by the International Monetary Fund as the worst global recession since the Great Depression of the 1930s, a **Sovereign** (or Eurozone) **debt crisis** was faced by European countries at the end of 2009, resulting in a second economic recession in the years after (2010–2015).
- These **crises** produced **negative effects** on economic performance as a whole, including the gross domestic product (**GDP**) growth, the **labour productivity** and the **labour markets**.

Introduction

► A brief timeline

- …
- **2007**: first signs of the crisis on the world scene
- **2008**: US subprime mortgage crisis and collapse of Lehman Brothers, in Europe strong decrease of the industrial production
- **2009**: widespread economic crisis recessions collapse of the GDP
- **2010**: partial economic recovery in US
- **2011**: sovereign debt and public finances crisis especially in the Eurozone
- **2012**: between recession and restarting
- **2015** and after: what about?

Introduction

► Labour market indicators

- We consider two measures as indicators of labour market recession.
  - **Unemployment rate (UR)**: number of people unemployed as a percentage of the labour force. **Youth unemployment rate (YUR)**: number of unemployed 15–24 year-olds expressed as a percentage of the youth labour force (ILO, 2011).
  - **Neither employed nor in education or training (NEET)**: percentage of people aged 15–29 years who currently do not have a job, are not enrolled in training or are not classified as a student.
- Whereas UR is a well recognized indicator of a recession, NEET provides a measure of disengagement from the labour market and perhaps, more generally, quantifies also people who are sliding towards the margins of the active society.

Research objectives

► Motivation and approach

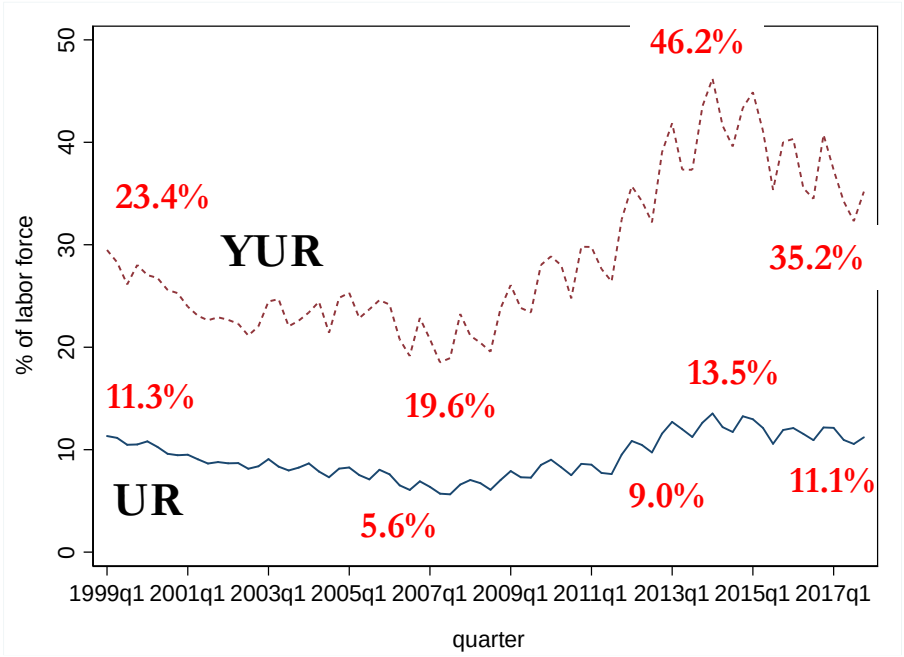
- ► The aim of this study is twofold:
  - to assess and measure whether and how much the two financial crises changed the level and trend in the UR and in the young people who are neither employed nor in education or training (NEET), immediately and over time, and to see if these changes are short-or long-term, in Italy
  - to identify the presence of an economic recovery after the two financial crises, also in comparison with other European countries
- ► Propose a **segmented regression approach of Interrupted Time Series** (ITS) for analysing quarterly data on UR and percentage of NEET collected from the Italian National Institute of Statistics (ISTAT).

Data

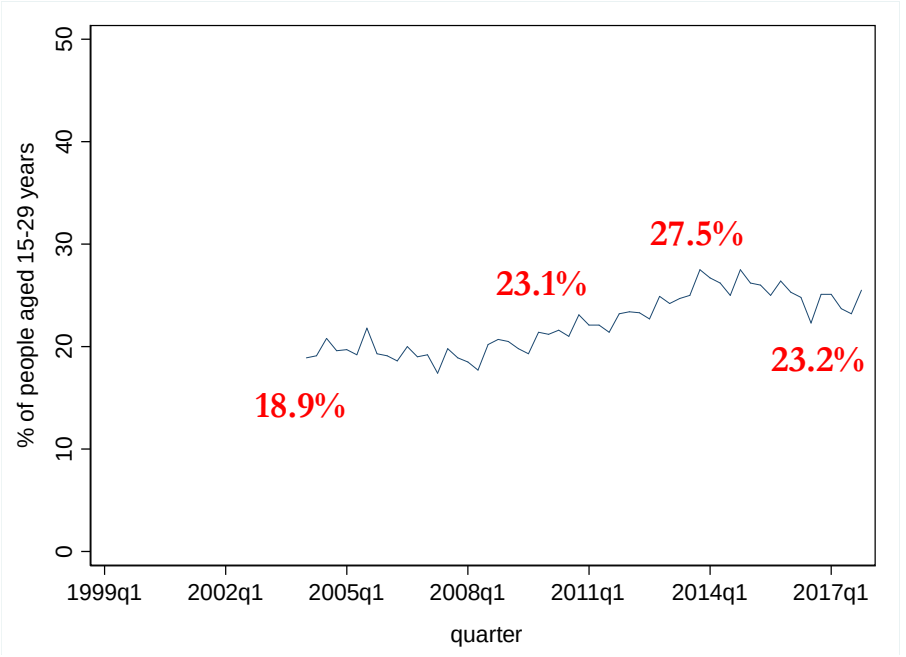
► Description of trends

- Quarterly data were downloaded from the theme 'Labour and wages' of '**I.Stat**', the warehouse of statistics currently produced by the Italian National Institute of Statistics (ISTAT) which provides an archive of about 1,500 time series (http://dati.istat.it/). **UR**: period 1999–2017; **NEET**: period 2004–2017.

Unemployment



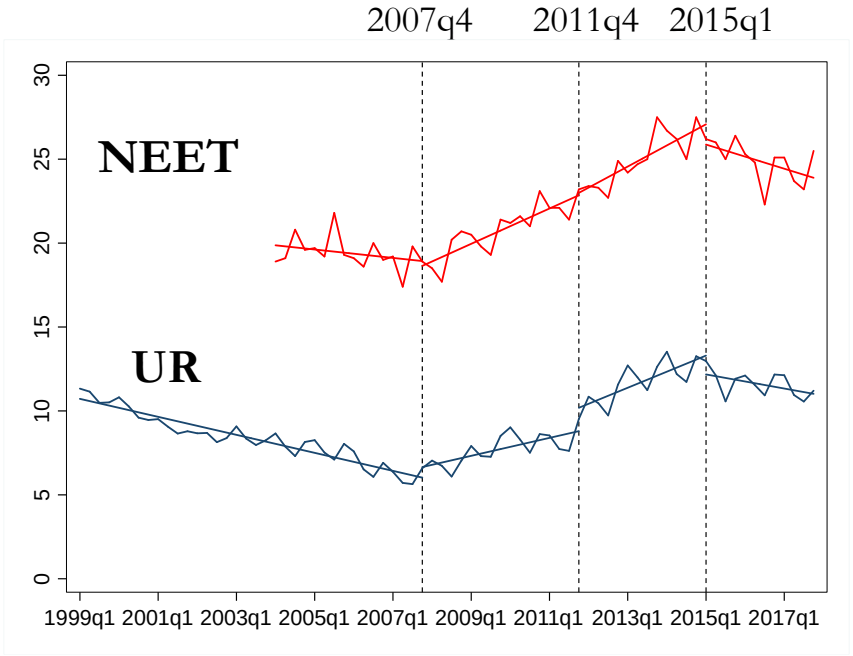
Percentage of NEET



Data

► Empirical strategy

- ► Analysis of four sub-periods by segmented regression of interrupted time series:
  - before the 2007q4 global financial crisis
  - the three-year period of Great Recession (2008 – 2011)
  - the 2011q4 European sovereign debt crisis (2012 – 2015)
  - after 2015q1…



Statistical approach

► Interrupted time series (ITS) model

- Interrupted time series (ITS) analysis is a simple but powerful tool used in quasi-experimental designs **for estimating the impact** of population-level or large scale interventions on an **outcome variable** observed at regular intervals **before and after the intervention**.

- In ITS, the underlying trend in the outcome variable before the intervention is determined and used to estimate the **counterfactual scenario**, which represents what would have happened if the intervention had not taken place and serves as the basis for comparison (Bernal, Cummins and Gasparrini, 2016).

- In this study a segmented regression approach of ITS is used with **UR** and **percentage of NEET** as outcome variables and two real-world events, the well recognized **financial** crises, as 'interventions'.

Statistical approach

► Interrupted time series (ITS) model

- The ITS regression model (Linden and Adams, 2011) with three 'interventions', given by the two financial crisis (2007q4 and 2011q4) and a possible trend reversal (2015q1):

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_{t2007q4} + \beta_3 T_{t2007q4} X_{t2007q4} +$$
$$+ \beta_4 X_{t2011q4} + \beta_5 T_{t2011q4} X_{t2011q4} + \beta_6 X_{t2015q1} + \beta_7 T_{t2015q1} X_{t2015q1} + \varepsilon_t$$

$\mathbf{Y_t}$: outcome variable at each equally-spaced time-points t (quarterly)

$\mathbf{T_t}$: time since the start of the study (1999q1–2017q4)

$\mathbf{X_{t...}}$: dummy variables indicating the 'interventions' (before = 0 and after = 1)

$\mathbf{T_{t...}X_{t...}}$: interaction terms (switch terms)

$\boldsymbol{\varepsilon_t}$: correlated error terms which follows a first auto-regressive (AR1) process $\Rightarrow \varepsilon_t = \rho\varepsilon_{t-1} + u_t$

Statistical approach

► Interrupted time series (ITS) model

- The error terms ε_t can be specified as follows:

$$\boldsymbol{\varepsilon_t} \begin{cases} E(\varepsilon_t) = 0 \\ Var(\varepsilon_t) = \sigma^2 \\ Cov(\varepsilon_t, \varepsilon_{t'}) = \sigma_{tt'},\ \sigma_{tt'} \neq 0 \text{ for some } t \neq t' \\ \text{Specifically: } \sigma_{tt'} = \sigma_{|t-t'|} \text{ for all } t,\ t' \end{cases}$$

- **Cumby-Huizinga test**: to ensure that we fit a model that accounts for the correct autocorrelation structure

  Cumby-Huizinga test for autocorrelation
  H_0: error is Moving Average process up to order q (by default q = 0)
  H_A: serial correlation present at specified lags > q

  - Test results confirm that autocorrelation was present at lag 1, but not at higher orders (up to the 9 lags were tested).

Statistical approach

- **Interrupted time series (ITS) model**
  - **Estimation method**: Ordinary least-squares (OLS).

    But when the Gauss–Markov covariance assumption is violated:

    $$Cov(\varepsilon_t, \varepsilon_{t'}) = \sigma_{tt'},\ \sigma_{tt'} \neq 0 \text{ for some } t \neq t'$$

    The OLS formula for **estimated standard errors** is incorrect

  - **OLS method and corrected standard errors**: OLS with the **Newey-West (1987) standard errors**, also termed heteroskedasticity- and autocorrelation consistent (HAC) standard errors, since they produce consistent estimates in presence of autocorrelation in addition to possible heteroskedasticity.

$$e.s.e.\left(\hat{\beta}_1\right) = \sqrt{\sum_{t=1}^{T} \sum_{t'=t-L}^{t+L} \frac{x_t x_{t'}}{\left(\sum_{s=1}^{T} x_s^2\right)} e_t e_{t'}}$$

where e_t are the residuals

Statistical approach

► Interrupted time series (ITS) model

- The model parameters:

  β_0 : intercept or starting level of the outcome variable at T = 1999 (UR) and T = 2004 (NEET)

  β_1 : slope (trajectory or secular trend) of the outcome variable until the first 'intervention' (2007q4 global financial crisis)

  β_2 , β_4 , β_6 : level change that occurs immediately following the interventions (global financial crises), as compared to the counterfactual

  β_3 , β_5 , β_7 : difference between pre-intervention and post-intervention slopes

- Additional measures of interest:

  $\beta_1 + \beta_3$: trend after 2007q4 crisis until 2011q3

  $\beta_1 + \beta_3 + \beta_5$: trend after 2011q4 crisis until 2015q1

  $\beta_1 + \beta_3 + \beta_5 + \beta_7$: trend after 2015q1

Results

► Analysis of UR

- Separate segmented regressions of ITS were estimated by **gender, age groups and macro regions**.

Tab. 1: Estimates of the impact of the financial crises on the UR in Italy

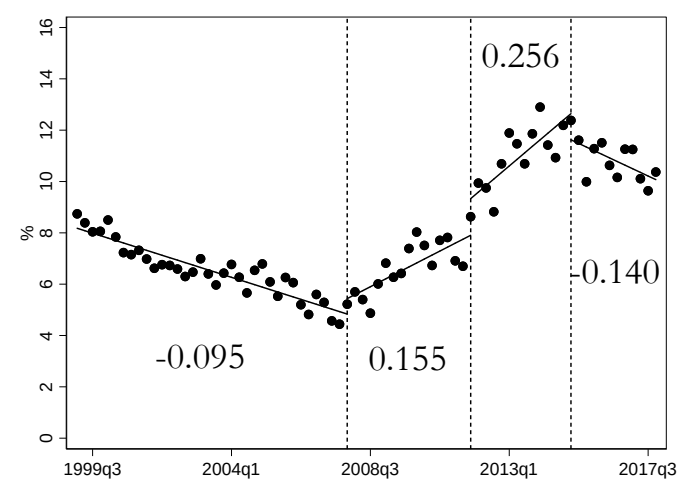
…	Base rate (1999) β_0	Trend 1999q1-2007q3 β_1	Rate change 2007q4 β_2	Trend change 2007q4 β_3	Rate change 2011q4 β_4	Trend change 2011q4 β_5	Rate change 2015q1 β_6	Trend change 2015q1 β_7
Overall	10.754***	-0.137***	0.788**	0.253***	1.540***	0.136**	-1.234**	-0.357***
Males	8.177***	-0.095***	0.602*	0.250***	1.426***	0.101	-1.018	-0.396***
Females	14.655***	-0.202***	1.061***	0.261***	1.675***	0.187***	-1.515***	-0.304***
15–24 (YUR)	26.726***	-0.182***	0.955	0.717***	3.676**	0.350	-3.371	-1.607***
25–34	11.074***	-0.068***	0.127	0.290***	1.566**	0.246**	-1.811*	-0.600***
35–44	7.771***	-0.095***	0.997***	0.177***	1.245***	0.166***	-1.225***	-0.285***
45–54	6.401***	-0.099***	0.725***	0.196***	1.111***	0.109**	-0.869*	-0.242***
55–64	7.901***	-0.166***	0.847***	0.219***	1.350***	-0.005	-0.143	-0.031
Northwest	5.831***	-0.067***	0.800**	0.221***	0.892**	0.008	-0.776	-0.320***
North East	4.538***	-0.037***	0.220	0.166***	0.855	0.007	-0.673	-0.269***
Center	8.540***	-0.097***	1.047***	0.188***	1.364***	0.134**	-1.021	-0.329***
South	20.211***	-0.266***	0.978**	0.365***	2.611***	0.355***	-2.290***	-0.501***

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

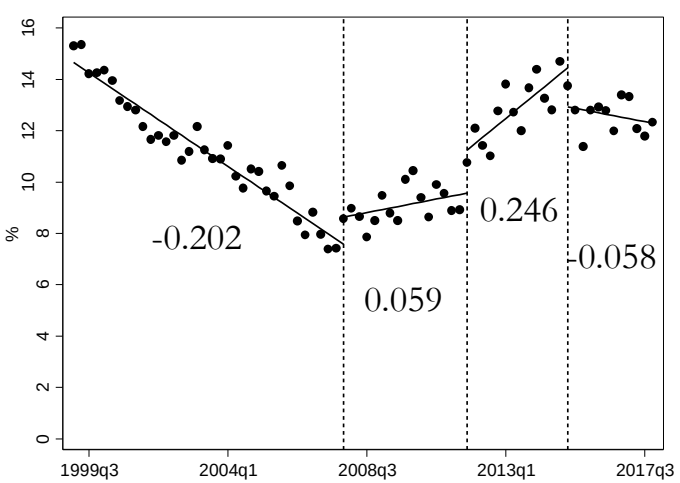
Results

► Analysis of UR: Gender

Males



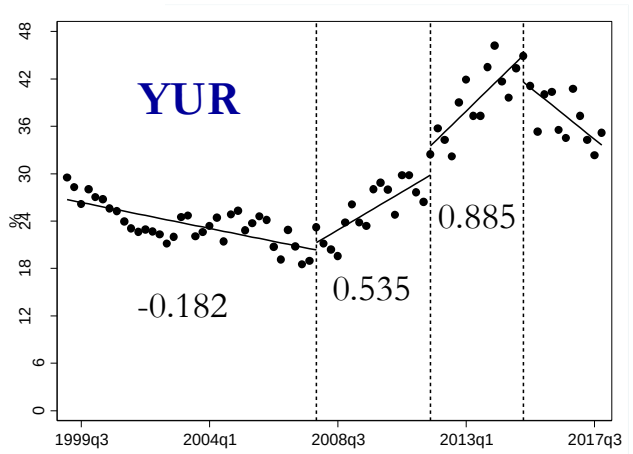
Females



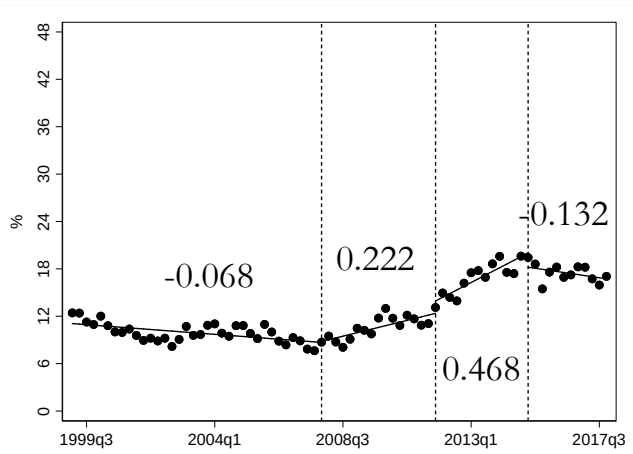
Results

► Analysis of UR: Age groups

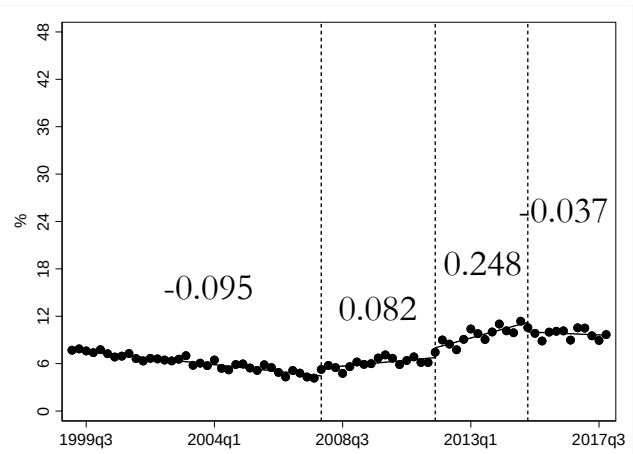
15–24



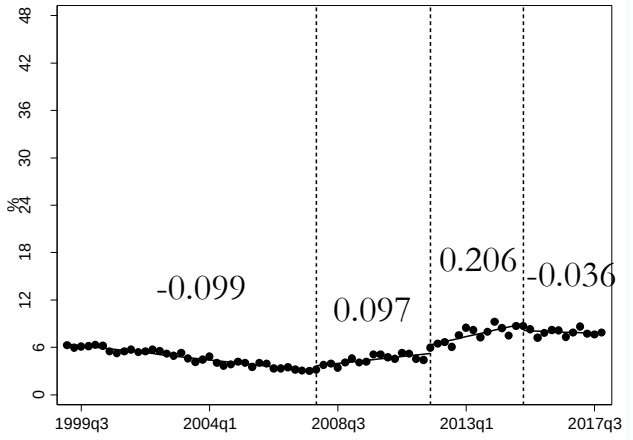
25–34



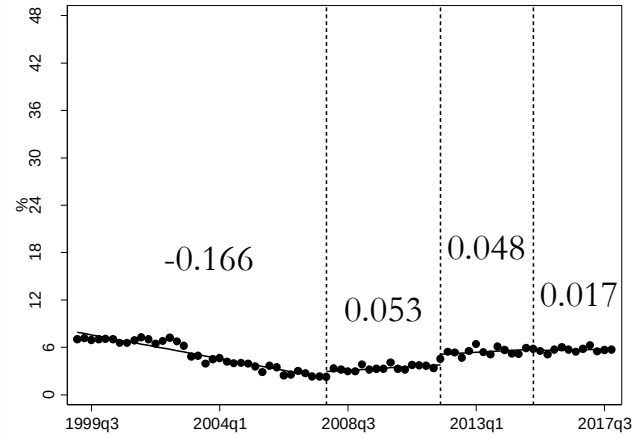
35–44



45–54



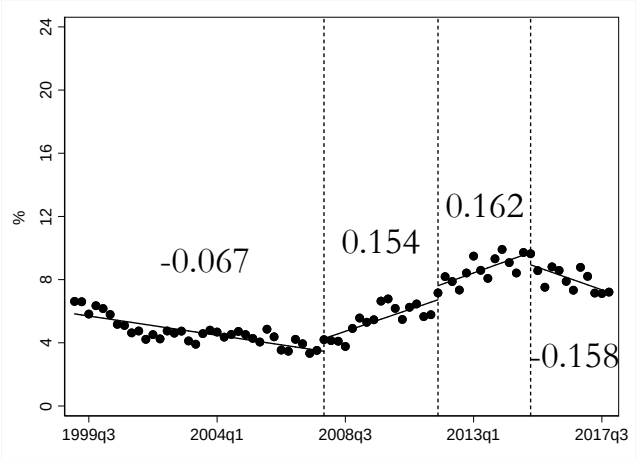
55–64



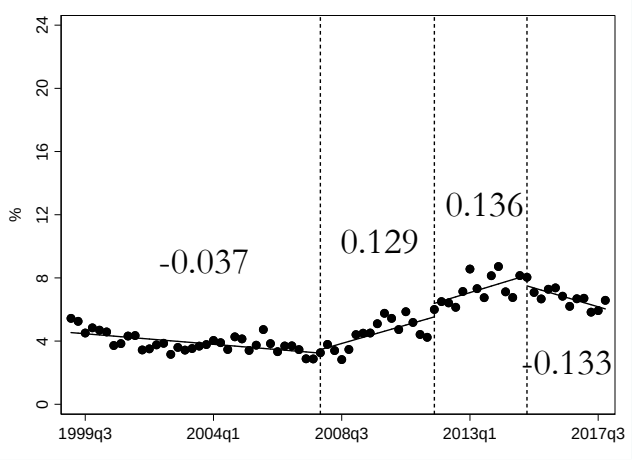
Results

► Analysis of UR: Macro regions

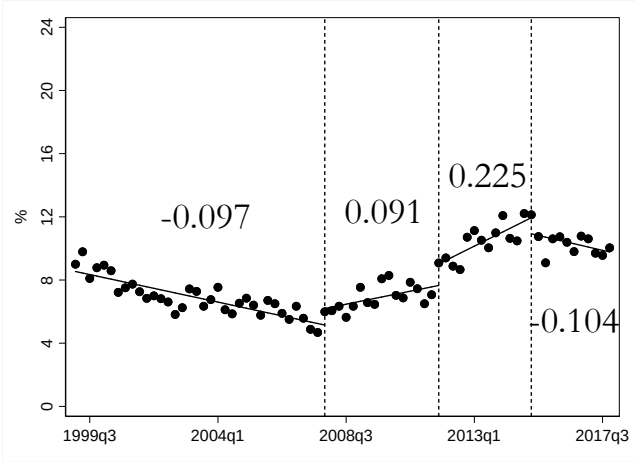
North-West



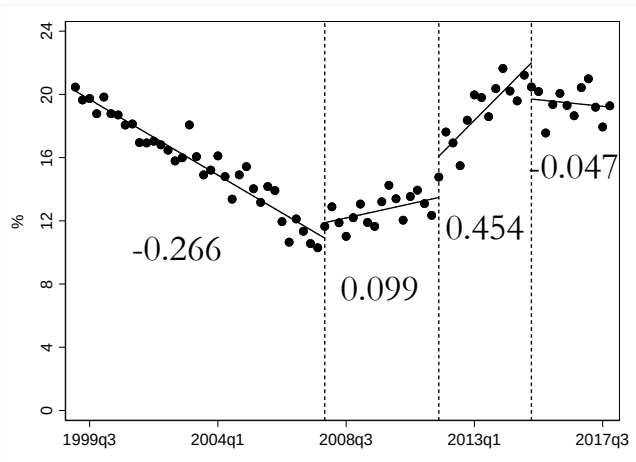
North-East



Center



South



Results

► Analysis of NEET

- Separate segmented regressions of ITS were estimated by **gender and macro regions**.

Tab. 2: Estimates of the impact of the financial crises on the percentage of NEET in Italy

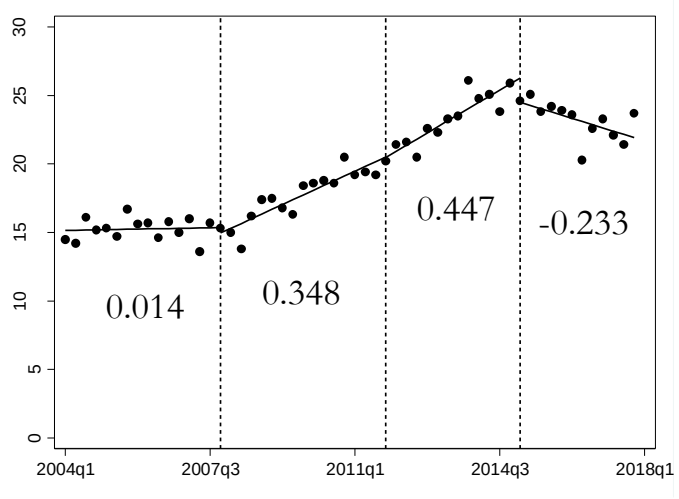
	Base rate (2004) β_0	Trend 2004q1-2007q3 β_1	Rate change 2007q4 β_2	Trend change 2007q4 β_3	Rate change 2011q4 β_4	Trend change 2011q4 β_5	Rate change 2015q1 β_6	Trend change 2015q1 β_7
Overall	19.866***	-0.062	-0.250	0.316***	0.103	0.094	-1.510**	-0.529***
Males	15.152***	0.014	-0.398	0.334***	-0.037	0.099	-1.787**	-0.680***
Females	24.584***	-0.125*	-0.221	0.285***	0.269	0.084	-1.135	-0.369***
Northwest	12.575***	-0.079	0.664	0.382***	-1.242	0.103	-1.632	-0.572***
North East	10.522***	-0.009	-0.558	0.364***	-0.268	-0.069	-1.169	-0.545***
Center	15.406***	-0.090	-0.995	0.404***	0.989	-0.001	-1.053	-0.561***
South	29.798***	-0.072	0.295	0.258***	0.564	0.204***	-1.801***	-0.482***

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

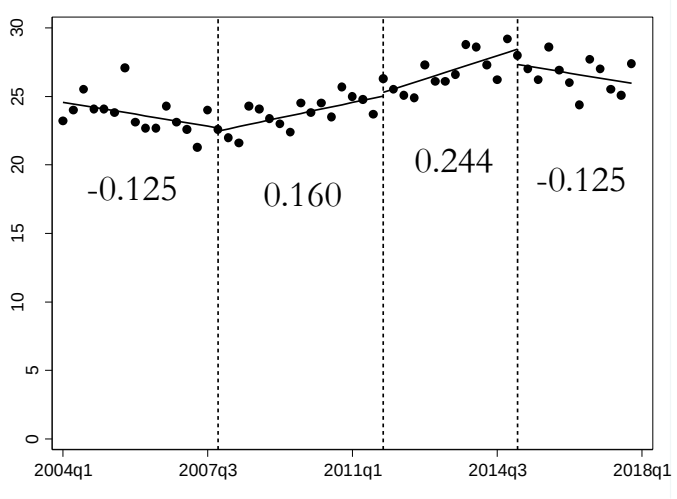
Results

► Analysis of NEET: Gender

Males



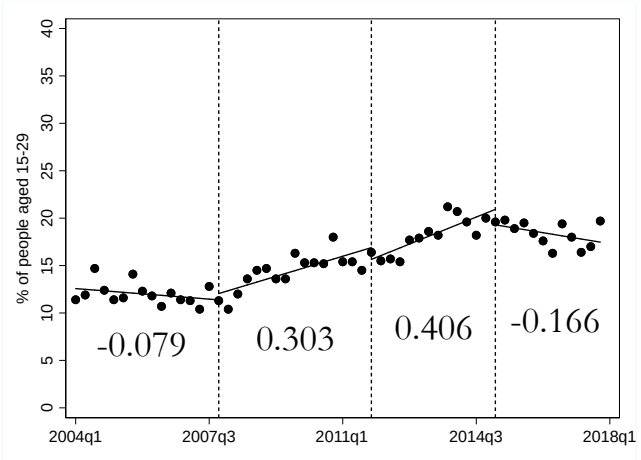
Female



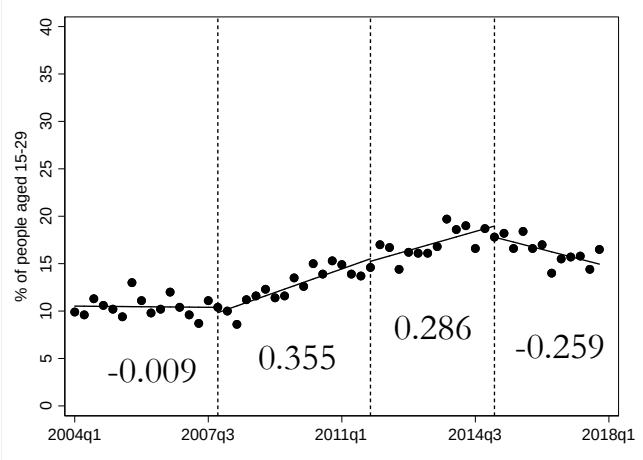
Results

► Analysis of NEET: Macro regions

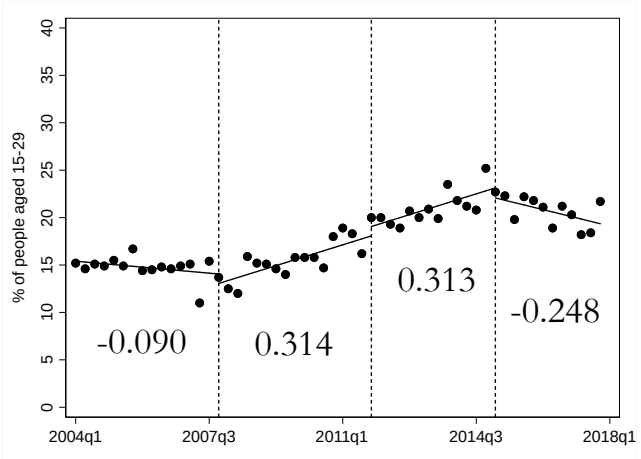
North-West



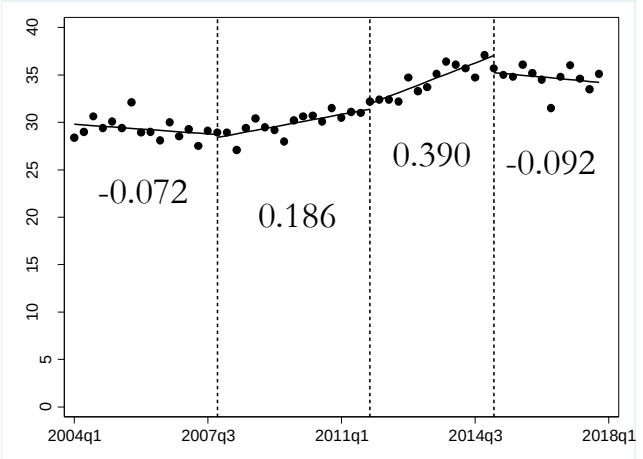
North-East



Center



South



Results

► Comparing trends after the two financial crises

► Results of estimated trends: **UR**

Tab. 3: Estimates of UR trends

	Trend 2007q4 – 2011q3 ($\beta_1 + \beta_3$)	**Trend 2011q4 – 2015q1 ($\beta_1 + \beta_3 + \beta_5$)**	**Trend 2015q1 – 2017q4 ($\beta_1 + \beta_3 + \beta_5 + \beta_7$)**
Overall	**0.116**	**0.252**	**-0.105**
Males	0.155	0.267	-0.129
Females	0.062	0.252	-0.052
15 – 24 (YUR)	**0.533**	**0.878**	**-0.729**
25 – 34	**0.222**	**0.468**	-0.132
35 – 44	0.082	0.248	-0.037
45 – 54	0.097	0.206	-0.036
55 – 64	0.053	0.048	0.017
Northwest	0.155	0.169	-0.151
North East	0.133	0.144	-0.125
Center	0.095	0.235	-0.094
South	0.102	**0.462**	-0.039

Results

► Comparing trends after the two financial crises

► Results of estimated trends: **NEET**

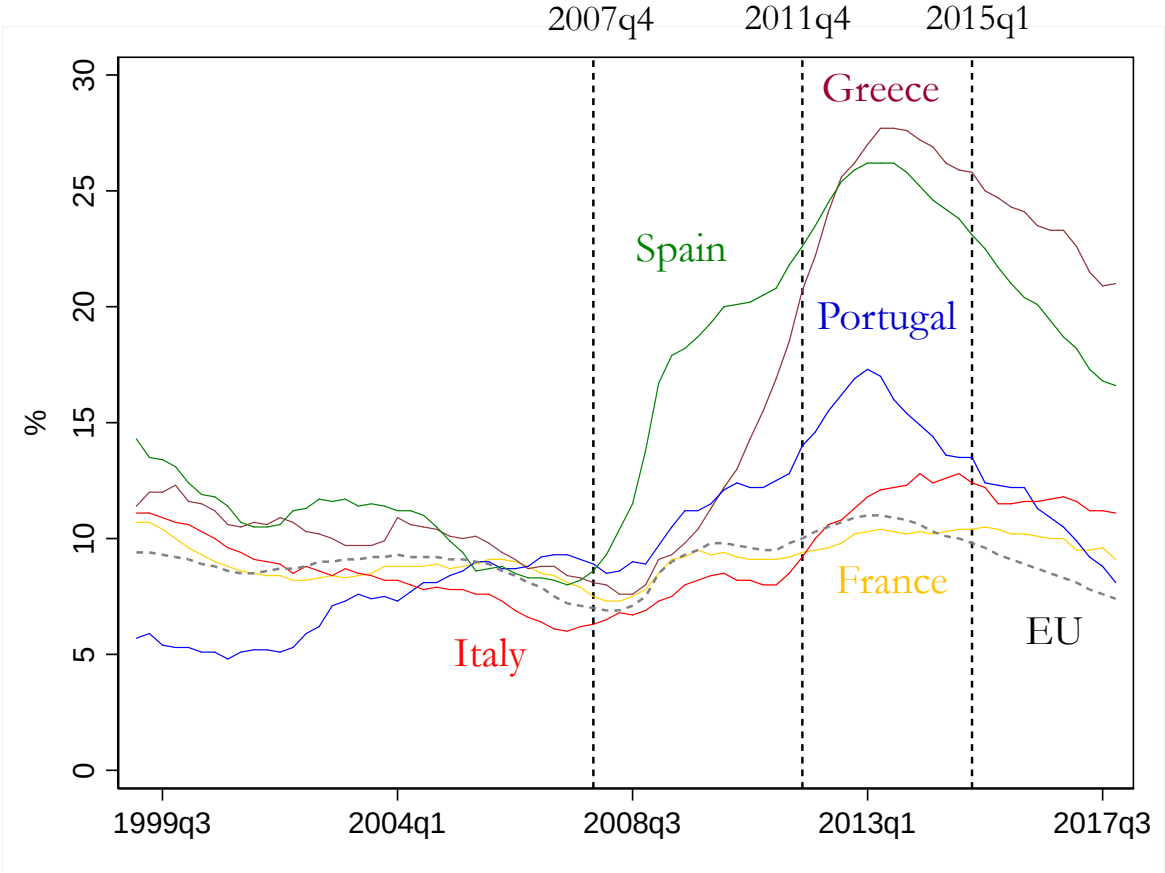
Tab. 4: Estimates of NEET trends

	Trend 2007q4 – 2011q3 ($\beta_1 + \beta_3$)	**Trend 2011q4 – 2015q1 ($\beta_1 + \beta_3 + \beta_5$)**	**Trend 2015q1 – 2017q4 ($\beta_1 + \beta_3 + \beta_5 + \beta_7$)**
Overall	**0.254**	**0.348**	**-0.181**
Males	0.348	0.447	-0.233
Females	0.16	0.244	-0.125
Northwest	0.303	0.406	-0.166
North East	0.355	0.286	**-0.259**
Center	**0.314**	0.313	**-0.248**
South	0.186	0.39	-0.092

Results

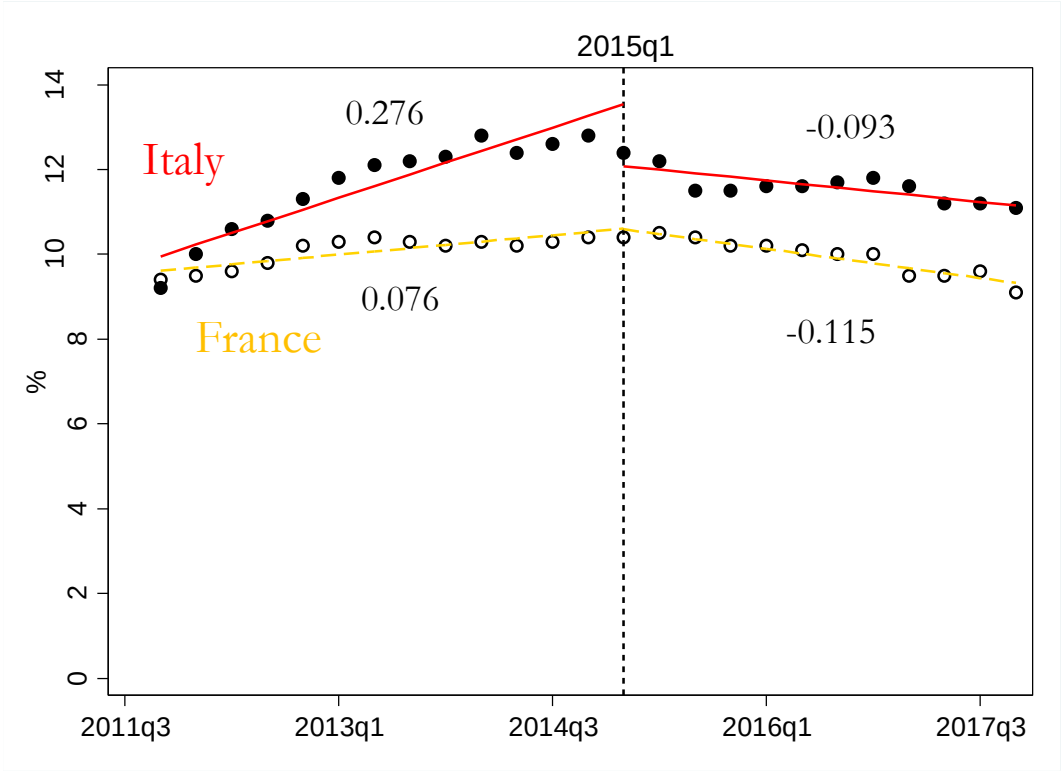
► An international comparison

- Considering trends in the **UR** of countries of south Europe, in order to identify a potential control group to detect the presence of an economic recovery after the two financial crises.



Results

- **An international comparison: Italy vs France**
  - Italy and France have a similar UR at the onset of the Eurozone debt crisis so they can be compared both in terms of post-crisis effects and subsequent recovery.



Final remarks

- **In terms of UR and NEET**
  - The use of ITS allows to obtain a more accurate analysis of the differences among segments of the labour market, during and after the financial crises
  - The effects of the financial crises are different across the considered sub-populations
  - Moreover, the unemployment problem was particularly worrying for South and young generation, especially after the second financial crisis, while NEET seems to be particularly affected during the first financial crisis
  - An economic recovery is in sight after 2015: in UR it is stronger for males, YUR and North macro-regions; in NEET for males and for North-East and Center macro-regions
  - From an international point of view, Italy shows a stronger UR increase after the Eurozone debt crisis but a weaker recovery after 2015: this is particularly evident in comparison with France.

Final remarks

- **In terms of data integration**
  - This research has been carried out using quarterly data from different sources, ISTAT and Eurostat
  - A deeper analysis could be possible if quarterly data on some economic indicators were also available, such as inflation rate, real interest rate, …

References

► Just the most important

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