



Measuring the impact of the 2008 and 2011 financial crises and the 2015 recovery on the unemployment rate in Italy

Lucio Masserini^{a,*}, Matilde Bini^b, Alessandro Zeli^c, Alessia Forciniti^d

^a Department of Economics and Management, University of Pisa, Pisa, Italy

^b Department of Human Sciences, European University of Rome, Rome, Italy

^c Italian Statistics Institute – Istat, Rome, Italy

^d Faculty of Communication, IULM University, Milan, Italy

ARTICLE INFO

Keywords:

Unemployment rate
Youth unemployment rate
Global financial crisis
European debt crisis
Interrupted time series analysis

ABSTRACT

Unemployment rate is one of the most important macroeconomic indicators used by governments for setting economic policy, as it provides worthwhile information on a country's labour market condition, on the health of its economic system and on its future growth. In Italy, since the turn of the century, this indicator steadily decreased until the onset of the 2007–2008 global financial crisis, after which it saw rapid growth that continued in the subsequent years and intensified with the 2011 European sovereign debt crisis. A reversal of this trend occurred only since 2015, after almost eight years of growth, when unemployment rate began a slow decline. Using quarterly data derived from official statistics produced by the Labour Force Survey, this study proposes a counterfactual approach based on interrupted time series analysis to measure the severity of the immediate impact and persistence of the 2008 global financial crisis and the 2011 European sovereign debt crisis on the Italian unemployment rate as well as the intensity of the economic recovery in the years after 2015. Differences across population age sub-groups were considered to highlight the effects on youth unemployment, gender, macro-regions, citizenship and level of education and thus obtain a more in-depth analysis.

1. Introduction

During the last fifteen years, two economic crises have had a severe impact on almost all countries around the world: the 2008 global financial crisis (GFC) following the bankruptcy of Lehman Brothers that resulted in the Great Recession, defined by the International Monetary Fund as the worst global recession since the Great Depression of the 1930s, and the sovereign debt crisis faced by European countries in 2011 that resulted in a second economic recession in the years after 2011–2015. These financial crises negatively affected Gross Domestic Product (GDP) growth, economic performance, labour productivity and, in general, labour markets and employment. The International Labour Organization [1] revealed that owing to the global economic crisis, in 2009, about 22 million people were unemployed worldwide, particularly in developed economies and in the European Union (EU). The impact of the two financial crises varied across not only countries but also age groups, gender, level of education, citizenship and geographic area [2].

Unemployment rate (UR) is the best-known labour market indicator

that can measure the mismatches between the labour supply and demand and reveal the inability of a country's economy to generate sufficient jobs for jobseekers [3]. Given its importance as a measure of underutilisation of labour supply, its relationship with the national economic performance and its effects on the lives of citizens, UR is widely recognised by governments and supra-national institutions as a leading indicator for setting social and economic policies and for the assignment of significant amounts of resources (European Commission regional development, social and cohesion funds, etc.) [4]. Further, UR was included as one of the indicators to measure progress towards the achievement of the sustainable development goal (SDG) 8 (promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all) [3]. In Italy, after each of the two financial crises, UR showed a dramatic increase with high and persistent levels of unemployment, affecting specific segments of the labour market, such as the younger generations, women and people residing in certain regions. Long-term and increasing rates of unemployment have important repercussions on not only governments, as this reduces the taxes collected and requires the provision of greater

* Corresponding author.

E-mail addresses: lucio.masserini@unipi.it (L. Masserini), matilde.bini@uniroma1.it (M. Bini), zeli@istat.it (A. Zeli), alessia.forciniti@iulm.it (A. Forciniti).

amounts on unemployment benefits and social subsidies, but also citizens, as this results in individuals' loss of income [5], social exclusion, risk of poverty [6], decreased well-being and satisfaction [7], poor health [8], an inclination to use alcohol and other drugs [9], crime [10] and the risk of marriage breakdown, among others.

Some studies have analysed the consequences of financial crises on unemployment. Most of these used the observed values of UR to assess the impact of the 2008 GFC on different segments and characteristics of the population. Baussola and Mussida [11] showed significant gender gap in Italy, finding increased disadvantage of men over women and higher male than female unemployment persistence owing to, among other possible causes, their differences in employment distribution by industries; males were mainly engaged in cycle-dependent industries (such as electronics, construction and manufacturing), whereas females were mainly employed in instruction, health and other sectors not exposed to competition. Regarding the impact of educational level, Pompei and Selezneva [12] found, for a large sample of EU countries, a negative correlation between the probability of remaining inactive in the job market and the years of education, further indicating that after the GFC, the probability of young people with only primary education being unemployed increased. Choudhry et al. [13] found that the negative impact of the GFC on employment was stronger and more persistent for young people because the youth unemployment rate (YUR) increased more than the overall UR; they also revealed a gender gap in the YUR, noting that the impact on females was more severe than that on males.

Unlike other studies on the longitudinal analyses of unemployment that use typical econometric models, such as the Arellano–Bond dynamic panel [13] and generalized methods of moments [14], or other methods such as fractional cointegration models [15] and the dynamic–spatial Durbin model [16], this study takes a different approach. Using quarterly data derived from official statistics produced by the Labour Force Survey (LFS), this study aims to (a) propose a counterfactual approach based on interrupted time series (ITS) analysis to measure the impact of three events on the Italian UR – the 2008 GFC, the 2011 European sovereign debt crisis and the so-called Jobs Act, a series of legislative measures and tax incentives implemented in Italy in 2015 for supporting employment – and (b) use these estimates instead of the raw data to assess the effects of each of the previous events on the overall UR and the UR in various population sub-groups, such as among people aged 15–24, highlighting the differences based on YUR, gender, macro-regions, citizenship and education level. In particular, the proposed approach, using ITS analysis, allows to define a measure of the impact of the three events on the Italian UR net of the trend in the pre-event period that serves as the baseline and compares the trend before with the trend after the event, where the trend before each event ideally projected into the period after it is the counterfactual – that is, the trend that would have been observed if the event in question had not occurred.

The remainder of the paper is organised as follows: Section 2 describes the data source and provides a trend analysis of UR in Italy as well as an international comparison among some southern EU countries. Section 3 presents the identification strategy of the empirical analysis and describes ITS analysis, and Section 4 describes the results. Finally, Section 5 discusses the results and concludes the study.

2. Data and historical trends

2.1. Data source

Country-level quarterly data on UR for the period 2004–2019 were collected by I.Stat (<http://dati.istat.it/>), the warehouse of the Italian National Institute of Statistics (Istat). Data were obtained from the LFS, the main source of statistical information on the Italian labour market. Every year, the LFS is administered to a sample of over 250 thousand household residents in Italy (a total of 600 thousand individuals) spread

over approximately 1400 Italian municipalities. Households are randomly selected from the National Resident Population Registry. The survey covers people aged 15 years and older who live in private households. Data collection is continuous, from January 1 to December 31 each year. Sample households are interviewed four times over a 15-month period. The first interview is conducted at the resident's home (computer assisted personal interviewing (CAPI)). Subsequent interviews are usually conducted by telephone (computer assisted telephone interviewing (CATI)). According to Eurostat [17], UR is defined as the number of people unemployed expressed as a percentage of the labour force. The YUR is the number of unemployed 15–24-year-olds expressed as a percentage of the youth labour force. Quarterly rather than annual data were considered, as the ITS approach requires a fairly large number of data points for the years before and after each interruption to provide reliable estimates of the underlying trends. Data before 2004 were not considered so as to ensure the use of the most recent data and obtain accurate UR trend estimates before the GFC. Further, data after 2019 were not included owing to the onset of the CoronaVirus Disease of 2019 (COVID-19) pandemic in early 2020, which caused what is now considered to be one of the largest global recessions in recent history.

To highlight any differences in the impacts of the three events on UR among subgroups of the Italian population, data were separately collected based on gender (males; females), age groups (15–24; 25–34; 35–44; 45–54; 55–64 years), level of education (low education; middle school license; high school; degree and post-graduate), citizenship (Italians; foreigners) and geographical area (north west; north east; centre; south).

2.2. Historical trend analysis

Fig. 1 illustrates the overall UR trend in Italy from 2004 to 2019; we observe that UR steadily declined from the first quarter of 2004 (2004q1) until the third quarter of 2007 (2007q3), falling to 5.6 %, which represents the minimum value observed throughout the period. Starting from the fourth quarter of 2007 (2007q4), the period in which the effects of the GFC following the bankruptcy of Lehman Brothers began to appear, UR suffered the first shock. Accordingly, UR had a trend reversal, albeit with some obvious fluctuations; its value increased in the subsequent two-year period, known as Great Recession, oscillating between 7 % and 9 % in 2010–2011, when it reached roughly the same level as that of a decade prior. The European sovereign debt crisis that occurred in the late 2011 (2011q4) caused the second shock, and UR even more dramatically increased up to 13.5 % at the end of 2014 (2014q4) after a six-quarter recession for the euro area economy. After this peak, at the beginning of 2015 (2015q1), UR showed a slight trend reversal, starting a constant decline until it reached a value of 9.9 % at the end of the observed period.

2.3. An international comparison

An international comparison among four southern EU countries – Italy, Spain, Portugal and Greece – was first conducted to place the Italian situation in a broader context of countries that suffered similar consequences after the two financial crises. Fig. 2 displays the trends in quarterly data of UR for the aforementioned countries as well as the average of the 27 EU countries.

In the period before 2007, we note a substantial convergence of the UR in the southern EU countries around the EU average (although the UR of Italy was well below the average); after the GFC, two groups of countries showed different trends: Spain and Greece experienced a sharp increase in UR, whereas in Italy and Portugal, the UR significantly increased but maintained a value close to the EU average. After 2011, Spain and Greece maintained their high UR, whereas the UR in Italy and Portugal increased relative to the previous period. Finally, whereas the UR in Greece, Spain and Portugal began a rapid decrease after the

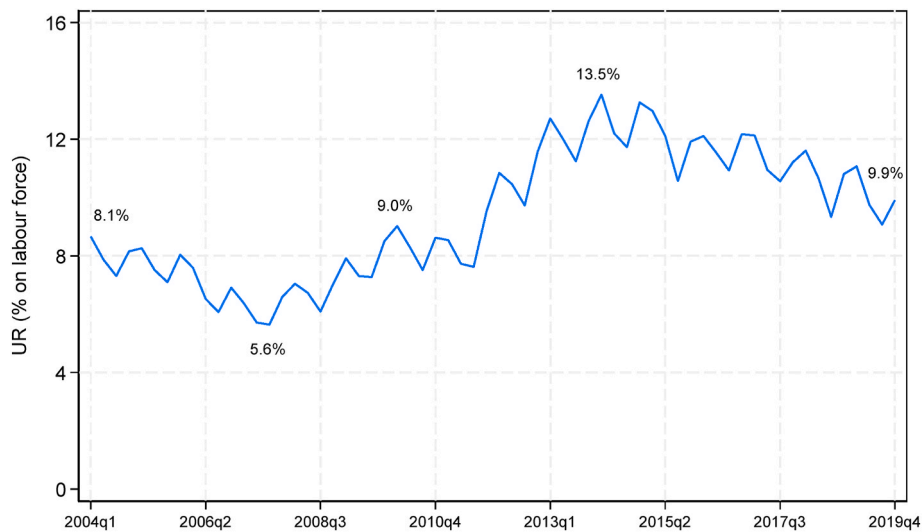


Fig. 1. UR in Italy over the study period.

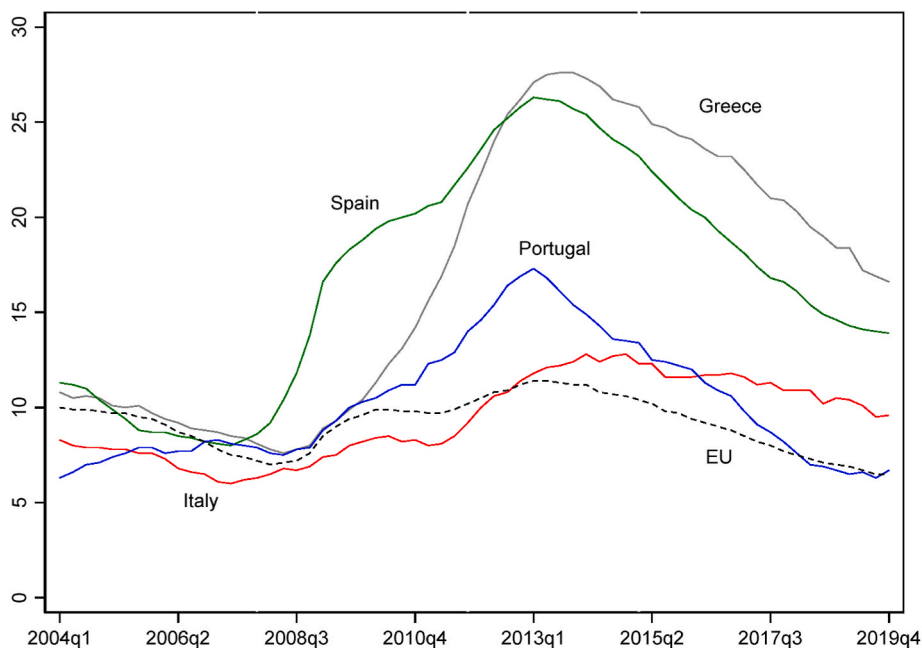


Fig. 2. UR in EU and in the four southern EU countries over the study period.

second half of 2012, in Italy, this decline began more than two years later and more slowly. Among these countries, at the end of the study period, only the UR in Portugal reached a value approximately equal to that at the beginning of the period. One possible explanation for these different impacts of financial crises on labour markets may lie in the different employment protection legislation across different countries. Indeed, in countries such as Spain with few labour protection measures, the crisis led to a significant increase in the UR; in contrast, in countries such as Italy with better labour protection measures, the UR showed, in the first instance, a smaller increase [18].

3. Empirical analysis

3.1. Identification strategy

In the light of the previous considerations, the study period was divided into four sub-periods, identified by three historically well-

recognised events, each with a different relevance. The first was the 2008 GFC following the USsubprime mortgage crisis, which had more or less enhanced worldwide consequences; the second was the 2011 European sovereign debt crisis, the implications of which were particularly accentuated in some Eurozone countries such as Greece, Portugal, Ireland, Italy, Spain and Cyprus; and the third was the introduction of the so-called Jobs Act [19], a series of legislative measures and tax incentives implemented in Italy in 2015 for supporting employment, the effects of which were limited at the national level.

As shown in Fig. 3, the four sub-periods were as follows: the years before the 2008 GFC (2004q1–2007q3); the subsequent three-year period known as the Great Recession in the aftermath of the GFC, characterised by a general economic decline observed in world markets (2007q4–2011q3); the period following the European sovereign debt crisis, which resulted in a second economic recession (2011q4–2014q4); and the five successive years until the end of the study period (2015q1–2019q4), during which the improved economic conditions

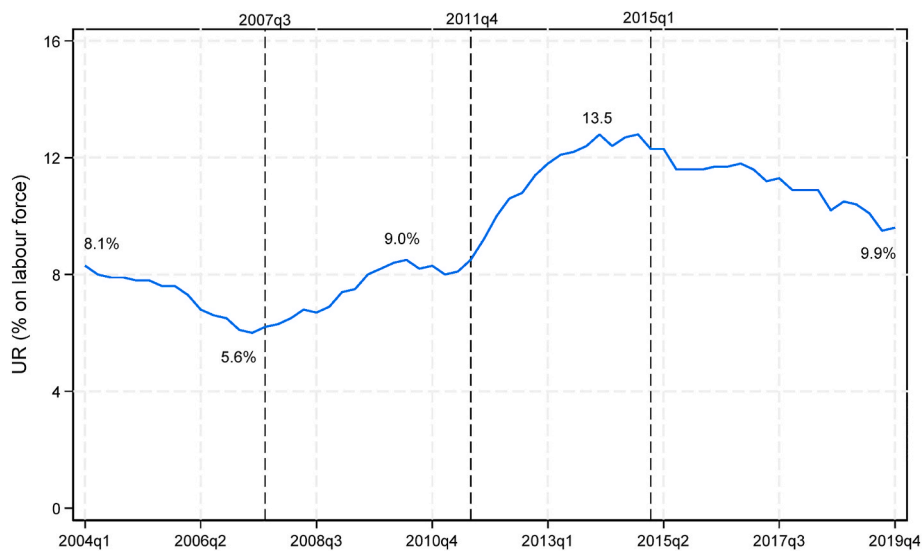


Fig. 3. Total UR in Italy over the period 2004–2019.

favoured a slight decrease in the UR. Accordingly, the study period was subdivided by setting breaks at 2007q3, 2011q4 and 2015q1, respectively. Such breaks allowed to highlight the effects of each of the three events in the subsequent years using ITS analysis, wherein the UR trends before and after the event are compared using a counterfactual approach to estimate the impact of the event under study.

This was accomplished using a segmented regression analysis of the ITS [20]. The approach allowed to measure, in statistical terms, the recessive effects of the two financial crises and the effect of the subsequent economic recovery on UR both in the period immediately after their occurrence and over time as well as to determine whether the changes in UR were short- or long-term [21]. One of the strengths of ITS studies is that they are generally unaffected by typical confounding variables, such as population age distribution or socioeconomic status, as these remain fairly constant, changing relatively slowly over time; they are generally taken into account when modelling the underlying long-term trend. Nevertheless, ITS can be affected by time-varying confounders that change more rapidly. Such time-varying confounders can be controlled for by including variables representing them in the regression model [22].

3.2. Interrupted time series analysis

ITS is a simple but powerful tool used in quasi-experimental designs for estimating the impact of population-level or large-scale interventions (or events) on an outcome variable observed at regular intervals before and after the intervention. In ITS design, the impact of the intervention is estimated by comparing the trend before the intervention projected forward in time with the trend obtained based on the observed data [23]. In particular, observations before the intervention, projected forward, represent the counterfactual with which data after the intervention are compared. Differences in the level and slope of the time series between the projected trend and the actual trend are considered as an estimate of the impact of the intervention. In a nutshell, ITS allows to examine any change on the outcome variable in the post-intervention period given the trend in the pre-intervention period [22].

As previously described, for the purposes of our study, the interventions were the three unplanned real-world events: the 2008 GFC, the 2011 European sovereign debt crisis and the Italian Jobs Act provision. In segmented regression analysis of ITS, each sub-period of the series is allowed to exhibit its own level and trend, which can be respectively represented by the intercept and slope of a regression model. The intercept indicates the value of the series at the beginning of

an observation sub-period, and the slope is the rate of change during a segment (or sub-period). This approach allows a comparison between the pre-crisis- and post-crisis-level trends and an estimation of the magnitude and statistical significance of their differences.

The ITS regression model applied to a single group under study (here, the Italian population) and considering three events – the two economic recessions in 2007q4 and 2011q4 and the introduction of the Italian Jobs Act in 2015q1 – can be represented as follows [22,24].

$$y_t = \beta_0 + \beta_1 T_t + \beta_2 x_{t2007q3} + \beta_3 T_{t2007q3} x_{t2007q3} + \beta_4 x_{t2011q4} + \beta_5 T_{t2011q4} x_{t2011q4} + \beta_6 x_{t2015q1} + \beta_7 T_{t2015q1} x_{t2015q1} + \epsilon_t$$

Here, y_t is the aggregated outcome variable – in this study, UR – observed at each equally spaced time-points t , here represented by quarters; T_t is the time elapsed since the start of the study, where t varies between 2004q1 and 2019q4; $x_{t2007q3}$ is a dummy variable indicating the onset of the GFC in the third quarter of 2007, coded as 0 (pre-crisis period) and 1 (post-crisis period); $T_{t2007q3} x_{t2007q3}$ is the interaction term between time and the 2007q4 GFC; $x_{t2011q4}$ is a dummy variable indicating the onset of the 2011q4 European sovereign debt crisis, coded as 0 (pre-crisis period) and 1 (post-crisis period); and $T_{t2011q4} x_{t2011q4}$ is the interaction term between time and 2011q4 European sovereign debt crisis. Finally, $x_{t2015q1}$ is a dummy variable indicating the time when the Italian Jobs Act came into effect, coded as 0 (before its entry into force) and 1 (after its entry into force); and $T_{t2015q1} x_{t2015q1}$ is the usual interaction term. Accordingly, β_0 is the intercept and represents the starting level of UR at $T = 2004q1$; β_1 is the slope representing the UR trajectory (or secular trend) until the 2007q3 GFC; β_2 is the level change in the UR that occurs immediately following the 2007q3 GFC (compared with the counterfactual); β_3 is the difference between the slope before and after the GFC; β_4 is the level change that occurs immediately following the 2011q4 European sovereign debt crisis (compared with the counterfactual); β_5 is the difference between the slope before and after the European sovereign debt crisis; β_6 is the level change that occurs immediately following the 2015q1 Italian Jobs Act (compared with the counterfactual); β_7 is the difference between the slope before and after the introduction of the Italian Jobs Act; and ϵ_t represents the random error term, which is assumed to follow a first auto-regressive (AR1) process. The regression coefficients are estimated using the ordinary least-squares (OLS) method with the Newey–West standard errors to overcome autocorrelation and heteroskedasticity in the error terms, which typically occur in time series data [25].

4. Results

Four periods of linear trend were considered to analyse UR with interruptions at 2007q3, 2011q4 and 2015q1. Separate segmented regression models were then estimated for Italy and for the different population sub-groups. As mentioned in Section 3, model estimates were obtained via OLS using Newy–West standard errors to handle one-lag autocorrelation. To account for the correct autocorrelation structure, the Cumby–Huizinga test [26] was performed, and the results confirm that autocorrelation was present at lag 1 but not at higher orders of lag (up to 9 lags were tested). The results were obtained using the Stata command *itsa* [27] and are presented in Table 1 and Figs. 4–6, where the estimated interrupted regressions are represented to highlight the different trajectories within each sub-group.

4.1. Base level and trend before the GFC

At the beginning of the study period (2004q1), the Italian average UR baseline level was at its lowest value (in percentage), but it showed substantial variability across the considered population sub-groups. In fact, starting from a value of 8.662 at national level, the UR was much higher for the youth (25.231) and for the south macro-region (16.127). In contrast, UR was significantly lower in the north east (4.214) and north west (4.833) macro-regions, for people with an educational level degree or post-graduate degree (5.945), for males (6.850) and for the age groups of 45–54 or 55–64 years (4.546). Moreover, before the 2008 GFC (2004q1–2007q3), UR exhibited a decreasing trend, both at the national level (−0.185; $p < 0.01$) and for the different population sub-groups. In particular, the decreasing trend was more pronounced in the groups considered as the most vulnerable in Italy – that is, those who typically have lower levels of employment, such as the south macro-region (−0.376; $p < 0.01$), YUR (−0.357; $p < 0.01$) and females (−0.250; $p < 0.01$).

4.2. Impact of the GFC

The 2008 GFC (2007q4) caused an immediate and substantive increase in the UR, quantified as more than one percentage point at the national level (+1.046; $p < 0.05$) on average, but a significant increase was also recorded in almost all considered sub-groups. The most severe

and direct consequences of the crisis were observed for the south macro-region (1.766; $p < 0.01$), for females (+1.309; $p < 0.01$) and for workers with low education levels (1.229; $p < 0.01$) or middle school license (1.776; $p < 0.01$). The most resilient subgroups were those with an educational degree and post-graduate degree and those residing in the north east macro-region. The aftermath of this crisis was quite strong and resulted in the Great Recession in the subsequent years, during which a substantial and significant trend change compared with the previous sub-period was observed (+0.301; $p < 0.01$). Thus, the trend changed sign and become positive, leading to an annual average UR increase (+0.116; $p < 0.01$). In this case, the highest trend change was observed for YUR (+0.891; $p < 0.01$) and, to a much lesser extent, for the south macro-region (+0.475; $p < 0.01$) and for workers with low education levels (+0.465; $p < 0.01$).

4.3. Impact of the European sovereign debt crisis

The immediate consequences of the European sovereign debt crisis (2011q4) were more severe than those of the GFC; it resulted in a second economic recession. Indeed, the resulting national UR increase was almost double of that after the GFC and reached about one and half percentage point (+1.540 %; $p < 0.01$). The consequences were more severe again for YUR (+3.676; $p < 0.01$), for the south macro-region (+2.611; $p < 0.01$), for workers with low education levels (2.611; $p < 0.01$) or middle school license (2.504; $p < 0.01$) and for foreigners (2.276; $p < 0.01$), whereas no significant increase in UR was noted in the north east macro-region and for people with an educational degree or post-graduate degree.

Moreover, the slope of the UR trend estimated at the national level after the European sovereign debt crisis was steeper than that after the GFC (0.136; $p < 0.05$). Such acceleration was particularly high for the south macro-region (+0.355; $p < 0.01$), age group 25–34 (+0.246; $p < 0.05$), workers with low education levels (0.207; $p < 0.01$) or middle school license (0.218; $p < 0.01$) and females (+0.187; $p < 0.01$), whereas no further significant increase was detected for YUR.

4.4. Impact of the Italian Jobs Act

After the introduction of the Jobs Act (2015q1), a clear upturn in the UR was noted, quantified in more than one percentage point decrease in

Table 1

Estimates of the impact of the 2007q4 and 2011q4 financial crises on the UR in Italy and recovery after 2015q1.

	Base rate (2004)	Trend 2004q1–2007q3	Rate change 2007q4	Trend change 2007q4	Rate change 2011q4	Trend change 2011q4	Rate change 2015q1	Trend change 2015q1
Overall (entire Italian population)	8.662 ^c	−0.185 ^c	1.046 ^b	0.301 ^c	1.540 ^c	0.136 ^b	−1.090 ^a	−0.384 ^c
Males	6.850 ^c	−0.140 ^c	0.294 ^a	0.250 ^c	1.426 ^c	0.101	−0.958	−0.403 ^c
Females	11.331 ^c	−0.250 ^c	1.309 ^c	0.309 ^c	1.675 ^c	0.187 ^c	−1.255 ^b	−0.357 ^c
15–24 years	25.231 ^c	−0.357 ^c	1.766	0.891 ^c	3.676 ^b	0.348	−3.430	−1.589 ^c
25–34 years	11.050 ^c	−0.190 ^c	0.813	0.412 ^c	1.566 ^b	0.246 ^b	−1.461	−0.671 ^c
35–44 years	6.190 ^c	−0.119 ^c	1.163 ^c	0.202 ^c	1.245 ^c	0.166 ^c	−1.094 ^c	−0.310 ^c
45–54 years	4.441 ^c	−0.092 ^c	0.696 ^c	0.189 ^c	1.111 ^c	0.109 ^b	−0.768	−0.256 ^c
55–64 years	4.546 ^c	−0.154 ^c	0.863 ^c	0.206 ^c	1.350 ^c	−0.005	0.206	−0.057 ^a
North west	4.833 ^c	−0.084 ^c	0.779 ^b	0.238 ^c	0.893 ^a	0.008	−0.860 ^b	−0.300 ^c
North east	4.214 ^c	−0.064 ^c	0.277	0.194 ^c	0.855	0.007	−0.770	−0.247 ^c
Centre	7.048 ^c	−0.121 ^c	1.088 ^c	0.212 ^c	1.364 ^c	0.134 ^b	−0.854	−0.358 ^c
South	16.127 ^c	−0.376 ^c	1.766 ^c	0.475 ^c	2.611 ^c	0.355 ^c	−1.840 ^b	−0.590 ^c
Low education	10.761 ^c	−0.233 ^c	1.229 ^b	0.465 ^c	2.504 ^c	0.207 ^b	−1.573 ^b	−0.486 ^c
Middle school license	10.297 ^c	−0.226 ^c	1.570 ^c	0.364 ^c	2.130 ^c	0.218 ^b	−1.328	−0.496 ^c
High school	7.758 ^c	−0.160 ^c	1.004 ^b	0.277 ^c	1.420 ^b	0.124 ^b	−0.945	−0.365 ^c
Degree and post-graduate	5.945 ^c	−0.080 ^b	−0.105	0.154 ^c	0.500	0.069 ^b	−0.921 ^c	−0.231 ^c
Italians	8.568 ^c	−0.188 ^c	1.013 ^c	0.291 ^c	1.455 ^c	0.141 ^b	−1.037 ^a	−0.372 ^c
Foreigners	10.822 ^c	−0.196 ^c	1.357	0.389 ^c	2.276 ^a	0.068	−1.465	−0.428 ^c

^a $p < .10$.

^b $p < .05$.

^c $p < .01$.

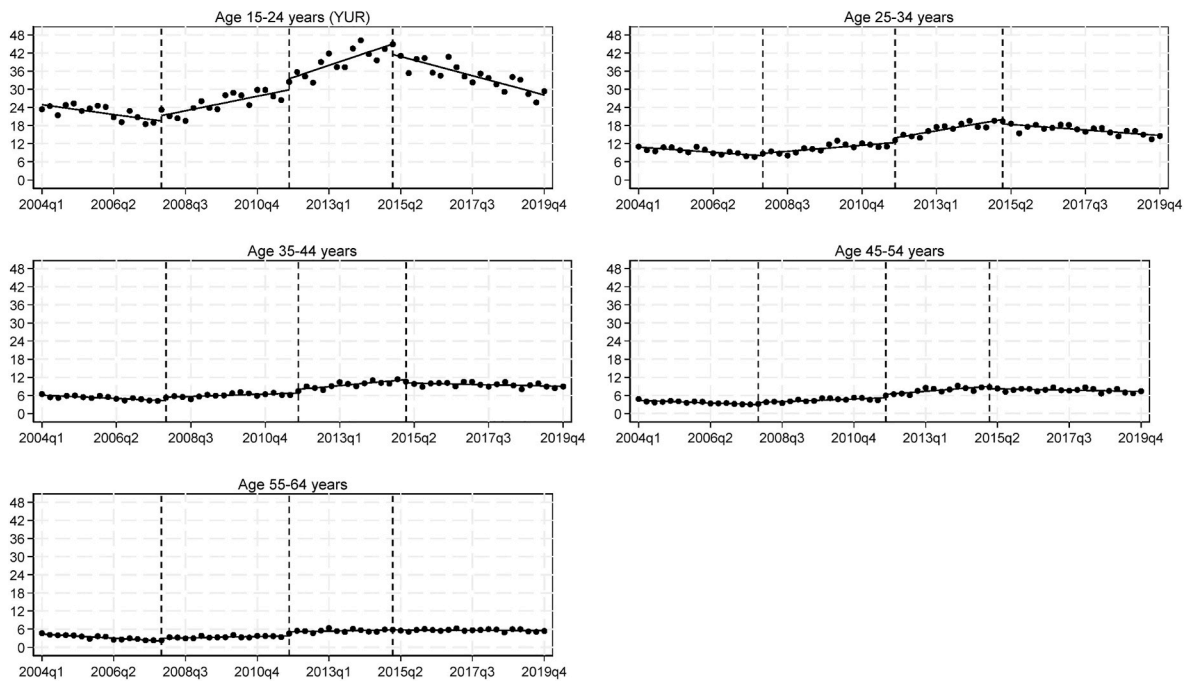


Fig. 4. ITS estimates for age groups over the period 2004–2019.

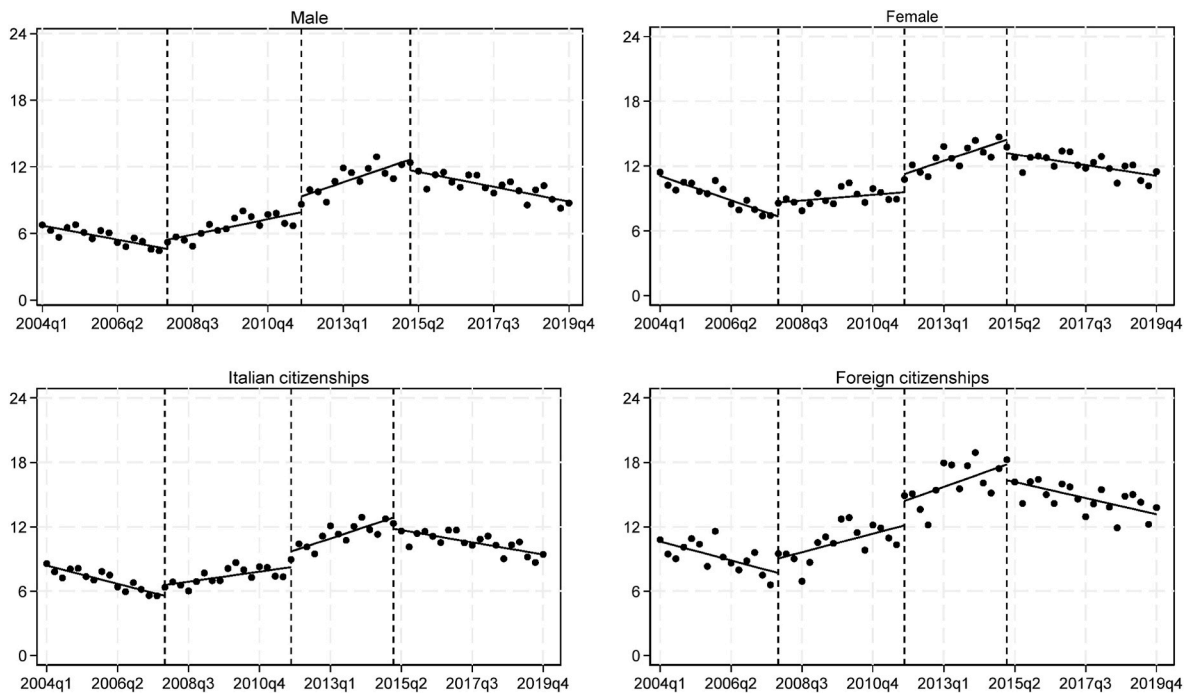


Fig. 5. ITS estimates for gender and citizenship.

UR (-1.090 ; $p < 0.05$) at national level on average. An even more pronounced recovery was registered for the south macro-region (-1.840 ; $p < 0.05$), for workers with low education level (-1.573 ; $p < 0.05$) and for females (-1.255 ; $p < 0.05$). The subsequent UR trend exhibited a downward trend, with the slope at the national level significantly changing (-0.384 ; $p < 0.01$). This trend reversal was observed more or less in all the population sub-groups, but it was clearly evident for YUR (1.587 ; $p < 0.01$), age group 25–34 (-0.671 ; $p < 0.01$), the south macro-region (0.590 ; $p < 0.01$) and workers with low education level (0.486 ; $p < 0.01$) or middle school license (0.496 ; $p < 0.01$).

4.5. Comparison of trends after the two crises and the subsequent recovery

The different effects of the two financial crises (2007q4 and 2011q3) can now be further analysed by comparing the trends before and after each of these events. The corresponding trend coefficients are shown in Table 2. Note that after the first sub-period, the UR trend reversed, exhibiting a growth rate of about one-twelfth of a percentage point each quarter at the national level (0.116 ; $p < 0.01$). The increase in UR was high for YUR (0.534 ; $p < 0.01$) and, to a lesser extent, for people with

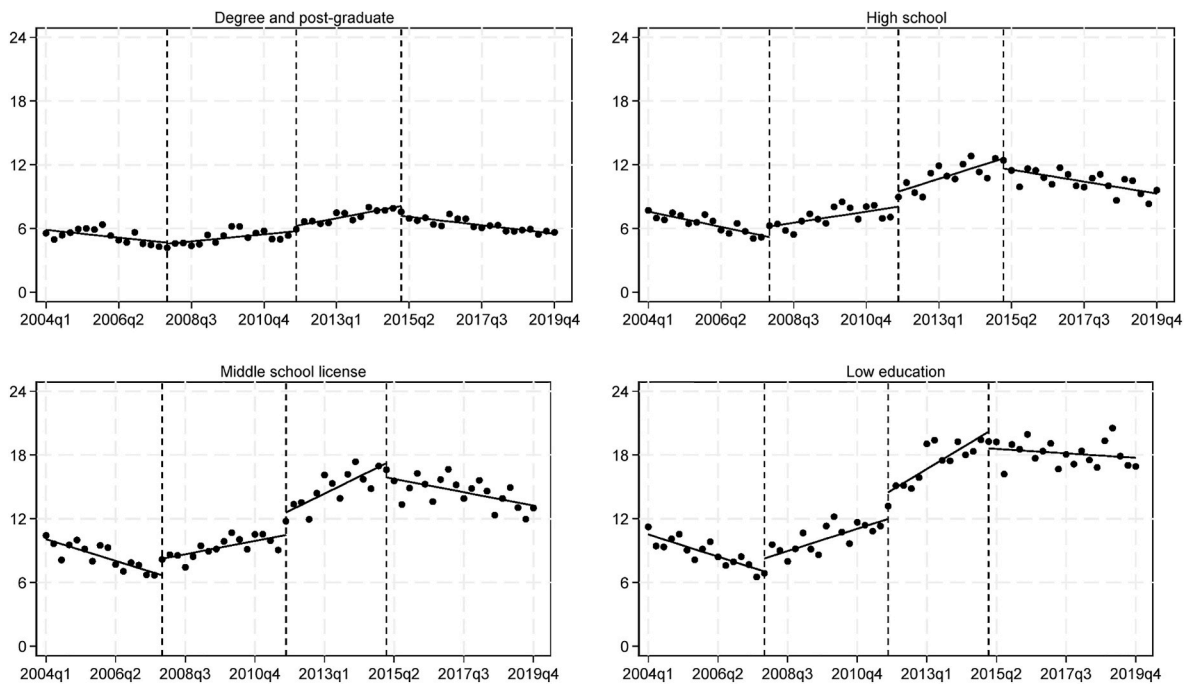


Fig. 6. ITS estimates for level of education over the period 2004–2019.

Table 2
Estimates of UR trends.

	Trend after GFC (2007q4–2011q3)	Trend after the European debt crisis (2011q4–2015q1)	Trend after the Jobs Act (2015q1–2019q4)
Overall	0.116 ^b	0.252 ^b	-0.132 ^b
Males	0.154 ^b	0.255 ^b	-0.148 ^b
Females	0.059 ^a	0.246 ^b	-0.111 ^b
15–24 years	0.534 ^b	0.882 ^b	-0.707 ^b
25–34 years	0.222 ^b	0.468 ^b	-0.203 ^b
35–44 years	0.082 ^b	0.248 ^b	-0.061 ^b
45–54 years	0.097 ^b	0.207	-0.049 ^a
55–64 years	0.052 ^b	0.047	-0.011
North west	0.153 ^b	0.162 ^b	-0.138 ^b
North east	0.129 ^b	0.137 ^b	-0.110 ^b
Centre	0.091 ^b	0.225 ^b	-0.133 ^b
South	0.099 ^a	0.454 ^b	-0.136 ^b
Low education	0.233 ^b	0.439 ^b	-0.046
Middle school license	0.138 ^b	0.356 ^b	-0.140 ^b
High school	0.116 ^b	0.240 ^b	-0.124 ^b
Degree and post- graduate	0.074 ^b	0.143 ^b	-0.088 ^b
Italians	0.103 ^b	0.244 ^b	-0.128 ^b
Foreigners	0.193 ^b	0.261 ^a	-0.167 ^b

*p < 0.10.

^a p < .05.

^b p < .01.

low education level (0.233; p < 0.01) and in the age-group 25–34 (0.222; p < 0.01). After the 2011 sovereign debt crisis (2011q3), the increase in UR became even steeper, both at the national level (0.252; p < 0.01) and across all the population subgroups, albeit with some

differences. Even after the sovereign debt crisis, as for the GFC, the increase in UR was high especially for YUR (0.882; p < 0.01), for people in the age-group 25–34 (0.468; p < 0.01), for the south macro-region (0.454; p < 0.01) and for people with low education level (0.439; p < 0.01). After the introduction of the legislative measures contained in the Jobs Act (2015q1), a new trend reversal occurred, and UR began to steadily decrease. Similar to the effects of the shocks caused by the two financial crises, the slope was steep especially for YUR (-0.707; p < 0.01), whose trend showed a markedly greater decline than that of the other population sub-groups.

In the four sub-periods considered, the changes in, as well as the positive and negative slopes of, the different trajectories are more pronounced and clearly evident in the age group 15–24 compared with the other age groups, for females than males – although in the second period, the UR growth is slower than that in the rest of the periods – and finally in the south macro-region compared with the other regions.

5. Conclusions

This study proposed ITS analysis to measure the impact of three unplanned real-world events – the 2008 GFC, the 2011 European sovereign debt crisis and the so-called Jobs Act – on the Italian UR and, using these estimates, to evaluate the effect of such events overall and in various population sub-groups. The novelty of this analysis, different from the other approaches proposed in extant literature, is the use of a counterfactual approach for examining the changes in the Italian UR during the post-intervention period relative to the UR trend observed in the pre-intervention period. We thus obtain a measure of the impact net of the trend in the pre-intervention period, which differs from what would be obtained by considering the raw data. The high statistical significance of the estimated trends is encouraging and justifies the choice of the analysis method.

Our results show that the 2008 GFC caused an immediate UR increase in Italy, especially for the south macro-region, females and workers with low education level or middle school license, whereas the impact on the UR trend in the subsequent years was more pronounced for YUR and, albeit to a lesser extent, for the south macro-region and workers with low education level. Moreover, the analysis shows that the

consequences of the European sovereign debt crisis were more severe than those of the GFC and persisted in the subsequent three years. The consequences of this second financial crisis were more severe for YUR, the south macro region, workers with low education level or middle school license and foreigners. The UR for females registered high positive changes in 2011 and quite high recovery capacity in 2015. Since 2015. However, this decrease in UR recovers only partially the increase in UR observed in the first years of the decade (the rate change in 2011q4 with respect to the rate change in 2015q1) and mainly for the older class groups and for the central and north east regions.

In general, the subgroups most affected by the two financial crises are young people, females, the south macro-region and workers with low education levels. This marked phenomenon, highlighting the differences in the immediate impacts on and subsequent trajectories of UR among the various subgroups, reflects their high vulnerability. Young people are typically employed under fixed-term contracts or have precarious and flexible employment. In addition, females remain the most at-risk category in terms of job employment, and the southern regions represent an area of the country where the economy is weaker and the labour market is less stable. Both YUR and female UR may be, with great probability, linked to the inflow and outflow of the non-labour force basin. For younger workers, the probability of returning to the non-active part of the population is higher when the economy is in decline. Regarding education, the higher the level of education, the less pronounced the changes, and the increase in UR is mitigated. Therefore, even for this subgroup, vulnerability is typical for those who have a low level of education and those who are more at risk of the impact of economic changes and typically are engaged in precarious jobs. However, sometimes this greater vulnerability, often a consequence of a greater flexibility of the contractual forms under which they are employed, proves to be more reactive at the time of recovery. This is what we found after 2015, when the most vulnerable subgroups experienced the greatest recovery. The conclusions drawn from results of this study align with the findings from previous studies [16] indicating that the efficiency of local labour markets can be enhanced through the introduction of policies that include job protection, reduction of tax burdens and reduction of share temporal contracts. Finally, targeted policies aimed at reducing YUR should be implemented through active labour policies, supported by school-to-work pathways and comprehensive job training and matching programmes. Such analysis on the UR, which allowed us to highlight the different behaviours of certain subgroups in the presence of relevant events with their different impacts, could subsequently be broadened by considering other events, not necessarily of an economic nature, such as the recent COVID-19 pandemic or the outbreak of war in Ukraine, which, as we know, have generated consequences on the economies of countries and labour markets.

CRediT authorship contribution statement

Lucio Masserini: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Matilde Bini:** Writing – original draft, Visualization, Supervision, Writing – review & editing, Validation. **Alessandro Zeli:** Writing – review & editing, Visualization, Writing – original draft. **Alessia Forciniti:** Data curation, Visualization, Writing – review & editing.

Data availability

Data will be made available on request.

References

- [1] ILO. World of work report 2011: making markets work for jobs. Geneva: International Labour Office; 2011.
- [2] Bruno GSF, Choudhry MT, Marelli E, Signorelli M. The short- and long-run impacts of financial crises on youth unemployment in OECD countries. *Appl Econ* 2016;49(34):3372–94.
- [3] ILO. World employment social outlook. Trend 2019. Geneva: International Labour Office; 2019.
- [4] Navarro ML, Hendrickson MA. The social meaning of employment and unemployment. *Eur J Soc Sci* 2000;2(2):51–7.
- [5] Gerdttham U-G, Johannesson M. The relationship between happiness, health, and social economic factors: results based on Swedish microdata. *J Soc Econ* 2001;30(6):553–7.
- [6] Pohlan L. Unemployment and social exclusion. *J Econ Behav Organ* 2019;164:273–99.
- [7] Friedland DS, Price RH. Underemployment: consequences for the health and well-being of workers. *Am J Community Psychol* 2003;32(1–2):33–45.
- [8] Krug G, Eberl A. What explains the negative effect of unemployment on health? An analysis accounting for reverse causality. *Res Soc Stratif Mobil* 2018;55:25–39.
- [9] Popovici I, French MT. Does unemployment lead to greater alcohol consumption? *Ind Relat J Econ Soc* 2013;52(2):444–66.
- [10] Raphael S, Winter-Ebmer R. Identifying the effect of unemployment on crime. *J Law Econ* 2001;44(1):259–83.
- [11] Baussola M, Mussida C. Regional and gender differentials in the persistence of unemployment in Europe. *Int Rev Appl Econ* 2017;31(2):173–90.
- [12] Pompei F, Selezneva E. Unemployment and education mismatch in the EU before and after the financial crisis. *J Policy Model* 2021;43(2):448–73.
- [13] Choudhry MT, Marelli E, Signorelli M. Youth unemployment rate and impact of financial crises. *Int J Manpow* 2012;33(Iss1):76–95.
- [14] Bruno GSF, Marelli E, Signorelli M. The rise of NEET and youth unemployment in EU regions after the crisis. *Comp Econ Stud* 2014;56:592–615.
- [15] Caporale GM, Gil-Alana L. Youth unemployment in Europe: persistence and macroeconomic determinants. *Comp Econ Stud* 2014;56:581–91.
- [16] Rios V. What drives unemployment disparities in European regions? A dynamic spatial panel approach. *Reg Stud* 2017;51(11):1599–611.
- [17] Eurostat. Glossary. Luxembourg: Eurostat. <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Eurostat>; 2017.
- [18] Cazes S, Verick S, Al Hussami F. Why did unemployment respond so differently to the global financial crisis across countries? *IZA J Labor Policy* 2013;2(10):9–10.
- [19] Law 183/2014. https://www.lavoro.gov.it/documenti-e-norme/normative/Documents/2014/Legge_10_dicembre_2014_n183.pdf.
- [20] Shadish WR, Cook TD, Campbell DT. Experimental and quasi-experimental designs for generalized causal inference. Boston, MA: Houghton Mifflin; 2002.
- [21] Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *J Clin Pharm* 2002;27(4):299–309.
- [22] Bernal JL, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health interventions: a tutorial. *Int J Epidemiol* 2017;V46(Iss1):348–55.
- [23] Reichard CS. Quasi-experimentation. A guide to design and analysis. The Guilford Press; 2019.
- [24] Linden A, Adams JL. Applying a propensity-score based weighting model to interrupted time series data: improving causal inference in program evaluation. *J Eval Clin Pract* 2011;17:1231–8.
- [25] Newey WK, West KD. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica* 1987;55(3):703–8.
- [26] Cummy RE, Huizinga J. Testing the autocorrelation structure of disturbances in ordinary least squares and instrumental variables regressions. *Econometrica* 1992;60:185–95.
- [27] Linden A, Adams JL. Conducting interrupted time-series analysis for single- and multiple-group comparisons. *STATA J* 2015;15(2):480–500.

Lucio Masserini is Associate Professor of Economic Statistics at the Department of Economics and Management at the University of Pisa. He holds a PhD in Applied Statistics at the University of Florence. His research interests are in macroeconomics and business analyses and include analysis of the labour market, evaluation of public policies, evaluation of educational processes, market research and evaluation of the quality of services, among others. Regarding methods, he works on structural equation models, mixture models and latent growth models, longitudinal and panel data, multilevel analysis, multivariate analysis and econometric techniques for policy evaluation and causal inference. He is a member of the Doctorate in “Person, Wellbeing and Innovation” of the European University of Rome. He is a member of the SIS - Italian Statistical Society, as well as of their groups “Statistics for Evaluation and Quality in Services (SQVS)” and “Data, Indicators and Sustainability Analysis”. Moreover, he is a member of The Camilo Dagum / Tuscan Universities Research Centre –on Advanced Statistics for the Equitable and Sustainable Development – ASESD. He has been reviewer for various international journals and author of more than 80 papers published in Scientific Journals and in proceedings of national and international conferences.

Matilde Bini Ph.D. in Applied Statistics (1995), University of Florence, she is now professor of Economic Statistics at the Department of Human Sciences of European University of Rome. Her research areas of interest are in macroeconomics and business analyses, labour markets, evaluation of higher education processes and public services. In statistical methodology, she works on Generalized Linear Latent and Mixed Models (GLLAMMs), structural equation models, multivariate methods, longitudinal models. Robust approach of the forward search for diagnostic analyses for outlier detection and data quality, in surveys and censuses of economic and social populations. She was visiting Student at the Department of Statistics of the University of Florida (USA), visiting Professor at School for

Advanced Studies di Institutions, Markets, Technologies of Lucca, and at Department of Estadística, Econometría, Investigación operativa, Organización de Empresas y Economía Aplicada of the University of Cordoba (Spain). She is member of various national and international Scientific Societies of Statistics.

Alessandro Zeli is a senior researcher in economics and statistics at the National Statistical Institute (Istat) in Rome, Italy, since 1996. His primary research interests include R&D dynamics, innovation analysis, labor issues, productivity analysis, industrial policy, public expenditure, and policy evaluation. He has extensive experience in data management and analysis using major statistical and econometric packages. Zeli's research focuses on firm productivity, competitiveness, efficiency, and the impact of innovative behavior and R&D policies. He has employed methodologies such as cluster analysis, efficiency frontier estimations, statistical distribution analysis, quantile regression, and panel econometric models. Recently, his work has included studying the Italian productivity slowdown, R&D financing, and the effects of tax policy on firm behavior. He was responsible for the Istat Business Statistics survey for 15 years, gaining substantial experience in data collection,

editing, and dissemination. His work supported the creation of macro-economic indicators like GDP, regional accounts, and Maastricht parameters. Zeli developed a panel of economic microdata for enterprises, integrating cross-sectional survey data with administrative sources. Zeli served as the Italian delegate for the OECD WPIA working group and participated in technical discussions for the approval of SBS European Regulation at the European Commission. He contributed to the MORE3 surveys on researcher mobility and collaborated on HR evaluation surveys for FP7. His publications include articles in national newspapers and scientific magazines.

Alessia Forciniti holds a Ph.D. in Statistics and Social Sciences. She is a researcher at IULM University, where she teaches courses in "Business Analytics" and "Probability and Statistics for Marketing". She is also a member of HumanLab, where works as a quantitative expert specializing in natural language processing, multivariate methodologies, and social network analysis. She has collaborative experience on European research projects as a junior statistician.