Regional Resilience in Italy: A Very Long-run Analysis

by

ROBERTO CELLINI [a] and *GIANPIERO TORRISI* [b]

[a] University of Catania, Department of Economics and Business; Catania, Italy;

[b] University of Portsmouth, Economics and Finance, Portsmouth Business School; Portsmouth, U.K.

Abstract: Resilience is a concept referring to the manner in which systems react to, and recover from, shocks. According to several recent analyses, 'resilience' can explain different regional economic performances. However, this study indicates that this explanation is quite unconvincing when applied to the Italian regions in the very long run (1890-2009). Only few shocks emerge to have specific impact effects differing across regions, while the recovery experience is ever spatially homogeneous. Hence, it is difficult to discern genuine differences in regional resilience. This evidence can be interpreted as a reason why the regional differences in Italy are huge and persistent.

Keywords: Regional growth; Economic resilience; Shock impact; Recovery.

JEL Classification: O40, R11, C32.

[a] CORRESPONDING AUTHOR:

Roberto Cellini – University of Catania, Department of Economics and Business.

Corso Italia 55 - 95129 Catania - Italy;

tel.: +39-095-7537728, fax: +39-095-7537710; e-mail cellini@unict.it

[b] Gianpiero Torrisi - University of Portsmouth, Economics and Finance,

Richmond Building, Portland Street, Portsmouth, Hampshire, PO1 3DE, U.K.;

tel. +44 (0) 23928444821 e-mail Gianpiero.Torrisi@port.ac.uk

Regional Resilience in Italy: A Very Long-run Analysis

Abstract: Resilience is a concept derived from engineering and ecology relating to the way in which systems react to, and recover from, shocks. According to several recent analyses, different 'resilience behaviours' are able to explain differences in the economic performance of regions. This study shows that this explanation is not fully convincing when applied to the Italian regions, observed in the very long run. This analysis focuses on real per capita income levels over the period 1890-2009. Only few (major) shocks emerge to have a specific impact effect differing across the regions, while the recovery experiences never differ significantly across regions. Hence, it is difficult to discern genuine differences in regional resilience behaviour. This evidence can be interpreted as a reason why the regional differences in Italy are huge and persistent.

Keywords: Regional growth; Economic resilience; Shock impact; Recovery.

JEL Classification:O40, R11, C32.

1. Introduction

Resilience is a broad concept, derived from engineering and ecological sciences pertaining to the manner in which systems react to, and recover from, shocks. Recently, a renewed interest in this topic has arisen, with specific emphasis on the analysis of economic growth, and regional growth in particular. In broad terms, the basic idea is that different resilience behaviours are the reason why regions within a country show different economic growth performance (FINGLETON*et al.*, 2012;MARTIN, 2012).

In mathematics and physics, several analyses have been developed about the reaction of stochastic systems to shock (see, for e.g., BATABYAL, 1999) with the applications to environmental and development economics (PERRINGS, 1998; LEVIN *et al.*, 1998). REGGIANI *et al.* (2002) suggested that resilience could be a topic of spatial and regional political economy. Two research lines can be marked. On the one side, a line of literature has developed, within economic geography, dealing with the effect of 'major shocks', like war bombing on city growth (DAVIS and WEINSTEIN, 2002; BOSKER *et al.*, 2007) or severe political change (REDDING and STURM, 2008). On the other side, a remarkable set of articles, around 2010, has focused on regional growth (PENDALL *et al.*, 2010; PIKE *et al.*, 2010;SIMMIE and MARTIN, 2010).

FINGLETON *et al.* (2012) and MARTIN (2012) make definitely clear that considering resilience can provide an interesting interpretation key, for understanding differences across regions. In particular, FINGLETON *et al* (2012) proposes a very simple regression analysis approach, to evaluate whether regions react to, and recover from, shocks in different ways. Such a perspective of analysis was absent from the wide body of theoretical and applied regional research developed over the 1980-90s, as a by-product of the success of endogenous growth theories (BARRO and SALA-I-MARTIN, 1991, 1992; BERNARD and DURLAUF, 1996, QUAH, 1996; TSIONAS, 2001).

The present study takes the FINGLETON*et al.* (2012) approach as a useful analytical point of departure, to analyse the case of Italy. The Italian experience is an interesting case-study in light of the long history of Italian persistent *economic dualism* dating back to the unification process in 1861, despite many regional policies implemented since then. Indeed, the resilience theoretical framework –applied to Italian regional disparities– represents a line of research not yet explored by the copious literature dealing with this subject. Such an approach allows tackling the task from a new promising angle. Furthermore, it is worth emphasizing that it has already proven its ability to provide a significant contribution once applied to the UK which is characterised by similar (but reversed) North-South divide.

Yet, here, some methodological changes are warranted. Specifically, annual data over a very long-run period of time (1890-2009) are considered, while FINGLETON *et al.* (2012) use quarterly data in a four-decade period (1971-2009). In that respect, pros and cons characterise the different options; however, the present very long-run perspective permits analysis of regional responses to "extreme" shocks (one can think of the World Wars, for instance), and to get insights into the characteristics of the growth and development process over the course of a century.

Furthermore, this study departs from the exercise of FINGLETON *et al.* (2011), in terms of its accounting for resilience with regard to per capita GDP data, rather than employment data; pros and cons of these different options will be discussed later.

The results from different estimation methods are provided by the present study: specifically, beyond SURE (Seemingly Unrelated Regression Equation) estimation (and the related test for parameter restrictions in order to detect differences pertaining to regional resilience), this study also presents a random-coefficient panel estimation to assess the same hypotheses with higher estimator efficiency. Nevertheless, it is found that the main conclusions remain robust to different estimators. Finally, evidence is provided about the permanent effect of a shock originating in different areas.

In overall terms this study suggests that the resilience story, as investigated from a perspective *à la* FINGLETON *et al.* (2011), does not readily offer a sound explanation for different economic performances across Italian regions –as long as 'reaction to shocks' and 'recovery from shocks' only vary in very few cases across regions. That said, the methodological framework offered by the FINGLETON *et al.* (2011) approach does allow the generation of some answers to a number of questions in a very simple and intuitive manner. In particular, informed by the results from the model estimates produced, the following questions, among others, can be addressed: Have regions answered the same shock in the same way?, Have regions recovered from the same shock in the same way?, Is there any difference, over time, in the way in which regions reacted to, and recovered from, shocks?, Which are the regions displaying the highest (or lowest) degree of impact resistance to recessionary shock?, Which are the regions displaying the best (or worst) ability to recover from recessionary shocks?, Have the recessionary shocks played some role in shaping regional performance?, Is there a relation between growth performance and the way in which regions react to- and recover from- shocks? This set of questions will be specifically answered in this present investigation.

The homogeneity displayed by Italian regions in the impact reaction and in the recovery from shocks, appears as somewhat surprising, given the well-known heterogeneity across these regions. Some implications about the long-run pattern of regional income dynamics can also be discerned.

The remainder of the paper is as follows. Section 2 sets forth the ideas behind the concept of economic resilience, with specific reference to regional growth, and makes close reference to the issues presented in FINGLETON *et al.* (2012) concerning the U.K. case. Section 3 presents the Italian data that are used in this study; in particular, the present study relies on a data bank recently made available by DANIELE and MALANIMA (2007), that is attracting substantial interest and is nourishing the debate on the reasons for and the roots of Italian dualism (e.g., FELICE, 2011a, 2011b; BRUNETTI *et al.* 2011). Given that the time series at hand are integrated of order 1, and co-integrating links emerge, this Section also discusses the meaning of 'resilience' in an environment of integrated / co-integrated time series. Section 4 presents the results concerning the resilience of Italian regions; in particular, the evidence of the SURE estimation *à la* FINGLETON *et al.* (2012) is firstly considered, along with the (more efficient) random coefficient model (RCM) estimation; then the evidence coming from a vector error correction model (VECM) estimation is presented; the exercises are also repeated, limiting the time sample under consideration to the most recent decades (1960-2009). Section 5 offers some answers to the specific research questions previously articulated in this Introduction. Section 6 concludes.

2. Economic resilience

Regional resilience derives from the ideas of resilience developed in engineering, ecological science and, more recently, social ecology (see, respectively, HOLLING, 1996; HOLLING, 1973; and WALKER *et al.*, 2006). It refers to the ability of a subject or a complex system to regain shape and position elastically, following a shock. The engineering perspective is primarily focussed on the immediate reaction of a system to shock and its subsequent recovery; the ecological perspective mainly focuses on how a shock is persistently changing the system behaviour. In social sciences and in economics more specifically, both of these perspectives make sense, as long as shocks affect the economy through their (homogenous or heterogeneous) immediate impact and recovery reaction and also the permanent performance in the long run.

With specific reference to regional economies, FINGLETON *et al.* (2012) analysed whether different performance in (employment) dynamics across 12 U.K. regions may be explained by different levels of resilience to a recessionary shock. They investigated whether the reaction to (the same) shock differ across regions, and the recovery from shock is different across regions. To this end, they previously identified recessionary shocks within the period of time under examination (simply, the quarters in which national employment exhibits a decrease), and then they evaluated whether there is any regional specificity in the reaction to shock and in the subsequent recovery.

Formally, let y_{it} denote the log of employment level in the region i in time t, with i=1,2 ...N and t=1,2,...T. The first difference of y_{it} , denoted by g_{it} , measures the growth rate of employment. Assume to have identified the time of the recessionary shocks (with a total number of shocks equal to K); and associate a dummy variable D_k to each shock (k=1,2,..,.K); finally consider the post-recession period following each shock and associate a dummy variable S_k to each post-recession period (S_k takes the value 1 in each time of the post-recession period following the k-shock, and 0 otherwise). Operationally, in the FINGLETON *et al.* analysis, the post-recession period lasts until the subsequent shock, but a different choice could be made, by assuming, for instance that each post-recession period has a fixed duration. Thus, for any region i, FINGLETON *et al.* consider the following regression:

$$(1) \qquad g_i = \alpha_i + \beta_{i,(1)} D_1 + \beta_{i,(2)} D_2 + ... + \beta_{i,(K)} D_K + \gamma_{i,(1)} S_1 + \gamma_{i,(2)} S_2 + ... + \gamma_{i,(K)} S_K \quad + \quad e_i$$

They consider the system of N equations as a SURE, and then compare the beta (β) and gamma (γ) coefficients across regions. If $\beta_{i,(k)} = \beta_{j,(k)}$, $\forall i, j$, then all regions have the same impact reaction to the k-th shock. Similarly if $\gamma_{i,(h)} = \gamma_{j,(h)}$, $\forall i, j$, then all regions display the same recovery effect to the h-th shock.

Heterogeneity across the beta and/or gamma coefficients pertaining to a specific shock, means different resilience behaviours across regions. Specifically, FINGLETON *et al.* (2012) identify 4 shocks hitting the U.K. regions in the period 1971-2009; apart from the most recent shock, occurred in 2008 (for which the beta coefficients are equal across regions), beta coefficients differ across regions for any given shock, so that the impact reaction is found to be different across regions. On the contrary, the gamma coefficients generally appear to be equal across regions, for each post-recession period. Hence, FINGLETON *et al.* (2012) conclude that U.K. regions do show different resilience to shocks, particularly in consideration of the heterogeneity across the regional impact reactions.[1]

The present study substantially rehearses this regression exercise but applied to the Italian cause. Even so, it deviates from the choices of FINGLETON *et al.* (2012) in a number of respects. In particular, this study considers data with annual frequency for a much longer period of time, so that it examines the behaviour of Italian regions in the very long run. On the one hand, the time frame of this study is more consistent with the interest in the long-run growth performance of regions. Moreover, cyclical components (not to mention the seasonal ones) are a less serious problem in annual data, as compared to quarterly data. However, on the other hand, the consideration of a very long period of time requires caution and check about structural stability.

Furthermore, data on income per capita are considered rather than employment. Thus there are good reasons for either choice. FINGLETON *et al.* argue that much of the impact of a recession is borne by the labour market, and declines in employment, after recessionary shock, are larger than decline in output; thus, the issue of regional resilience assumes particular relevance in relation to how regional labour markets are affected by and recover from shock. With respect to the Italian experience, where labour markets are more rigid as compared to the U.K. case, the focus on GDP appears to be more appropriate, precisely because the reaction of labour markets are deemed to be less variable across regions, due to institutional rigidities.

FINGLETON *et al.* (2012) find that the U.K. regions do differ when it comes to the impact reaction to shock (with the exception of the recent 2008/09 shock episode), while the regional behaviours do not differ in the recovery phase. However, in overall terms, they conclude that the different impact reaction to common shocks allows the argument to be made that different resilience behaviour in labour markets is a relevant factor in the economic experience of U.K. regions.

From a theoretical perspective it is worth stressing that such an approach allows to explore "the ability of a regional economy to maintain a pre-existing state (typically assumed to be an equilibrium state) in the presence of some type of exogenous shock" and the "extent to which a regional or national economy that has experienced an external shock is able to return to its previous level and/or growth rate of output" (HILL *et al*., 2008).

Although it has important limitations in capturing and explaining "the geographical diversity, variety and unevenness of resilience" (PIKE *et al.*, 2010) especially in terms "of what kind of resilience and for whom" (PIKE *et al.*, 2010), to the case at hand, and with the Italian spatial divide on the background, this approach has the potential to deliver a significant contribution to the still active debate on the relative performance of regions. Put differently, following HILL *et al.* (2008), this approach to resilience assumes that the regional performance can be characterised by multiple equilibria "not all of which are efficient (in a static and/or dynamic sense)". The homogeneous reaction to shocks, therefore, can be interpreted as evidence of the inability of regions to "avoid becoming locked-into such a low-level equilibrium or, if in one, to transition quickly to a 'better' equilibrium" (HILL *et al.*, 2008)

3. Italian data: Regional per capita GDP in the very long run

This analysis uses a time series of real per capita GDP computed by DANIELE and MALANIMA (2007) for the Italian regions over the period 1890-2009.[2] Even if the current Italian regions are 20 (at the NUTS II level), DANIELE and MALANIMA's data are articulated into 16 regions, as long as 4 regions were created after the II World War.[3] The DANIELE and MALANIMA databank is the only available databank with annual observations related to regional accounting for such a long period of time for Italy.

The contribution of DANIELE and MALANIMA is part of a lively research line, aiming at reconstructing regional data for Italy. The databank has generated an interesting debate among economic historians. The more contested issues do not concern the methodological choices of DANIELE and MALANIMA, nor the original sources, which can be considered as generally correct (or, at least, 'necessary'),[4] but rather the resulting general picture. The comparison of specific point data of this databank with different databanks provides evidence of its substantial correctness and reliability, but also offers hints for further interesting debates in economic history, as some surprises emerge in relation to the consolidated wisdom. For instance, the distribution of income across regions at the beginning of the time span under consideration is less dispersed as represented in other databanks (see, on this point e.g., FELICE, 2011b, p. 21; MALANIMA and ZAMAGNI, 2011); again, the reconstruction of DANIELE and MALANIMA provides a more modest economic performance of Italy during the Fascist period, as compared to the acquired wisdom, and sharply increasing regional disparities.

Insert about here:
Figure 1.(a),(b),(c).- Log of income per capita
Figure 2.- The annual growth rate of income per capita in Italy

Figure 1 shows the plot of the log of (real, per capita) GDP time series for: (a) Italy at the national level, (b) the 16 Italian regions, (c) Italy and the two richest and poorest regions (as evaluated at the outset of the period, which correspond to the average level; namely Liguria and Lombardia near the top, and Calabria and Sicily near the bottom). Figure 2 shows the plot of the first difference, that is the growth rate of real per capita GDP, for the national series. Table 1 provides some descriptive statistics on the time series, while Table 2 provides evidence concerning the test of integration / co-integration among the time series at hand. In particular:

- Time series of per capita GDP at the regional level, and the series at the national level, are integrated of order 1 (Table 2.I).
- If the 16 regional series are considered, co-integration with rank equal to 15 cannot be rejected; if 17 time series (namely, the 16 regional series and the national one) are considered, co-integration with rank equal to 16 cannot be rejected (Table 2.III).

The above pieces of evidence suggest that only one unit root enter the national and regional series (as clearly supported also by the group unit root test reported in Table 2.II). This issue is only partially different from previous results concerning Italian regions (over shorter periods of time), which detected a somewhat larger number of distinct unit root (see, e.g., CELLINI and SCORCU, 1997, D'AMATO and PISTORESI, 1997; DE SIANO and D'UVA, 2008).Under this view, one could affirm that the longer time span under consideration permits to get the unique unit-root driving all regional series. However, whatever the time span under consideration, the substance of evidence is similar: long-run relationships between regional (and national) per capita GDP are operative in the long run, admittedly with possible different intensity or with breaks.

Moreover,

- The correlation between any regional series (of real per capita GDP levels) on the one side, and the national series on the other is larger than 0.986 in any case.
- The pair-wise correlation between the regional series (of real per capita GDP levels) are larger than 0.957 in any case.

That is, there is a very large degree of correlation in levels among the series. More surprisingly, an analogous degree of correlation emerges as concerns the series of growth rates:

- The correlation between any regional series (of real per capita GDP levels) on the one side, and the national series on the other is larger than 0.878 in any case.
- The pairwise correlation between the regional series (the growth rate of real per capita GDP levels) are larger than 0.772 in any case.

Insert about here:
Table 1. - Descriptive statistics on time series, Italy and the regions
Table 2. - Results of integration and co-integration of regional time series

These pieces of evidence provide support in considering the first difference of (log) GDP in the analysis that follows: this study considers that regional time series are integrated of order 1, with the presence of long-run links –as documented by a large body of available research (see DE SIANO and D'UVA, 2008, and the references therein), and consistent with the evidence here provided in Table 2. The main interest in the present analysis is in evaluating whether different resilience behaviours play some role, firstly, in shaping the short-run dynamics –and for this reason it makes sense to focus on the series in first-difference; secondly, in analysing whether resilience can be considered responsible for the different growth performance of regions; considerations on the level of time series will be left for a final stage of the analysis.

4. Results on regional economic resilience

4.1 Indentifying recessionary shocks

Following FINGLETON *et al.* (2012), the present study identifies the years in which the national GDP growth rate is negative as years of ‘recessionary shocks’. More specifically, the present study considers recessionary shocks the years in which a decrease (of per capita income, in this case) larger than 0.1% occurs; moreover, the recessionary shocks occurring in subsequent years are consolidated in one shock. As a consequence, the following 14 recessionary shocks are detected on the Italian data, over the 118-year period under examination: 1892, 1910, 1914/15 (considered as one shock), 1920/21, 1926, 1929, 1931, 1933/34, 1940/41/42, 1944/45, 1975, 1993, 2003, 2008/09. As it is immediately obvious from a look at the data, the size of these shocks is different.

As to the identification of the ‘post-recession (recovery) period’, the study identifies the period of at least three years, following a shock, without the occurrence of a further recessionary shock. In sum, there are eight ‘post-recession’ periods: the post recession period following the shock of 1892; the one following the 1910 shock, the one following the 1914/15 shock, the one after the 1920/21 shock, the one after the 1929-1931-1933/34 shocks, and the ones after the 1944/45 shock, the 1973 shock, and the 1993 shock (the years following the 2003 shock are characterised by the fact that 2005 shows a negative growth rate, even if smaller than 0.1% in absolute value, so that no positive recovery follows this shock); 2008/09 are identified as a further recessionary shocks, but of course, there are no data, at the present moment, to consider the recovery from the 2008/09 shock). Some words have to be spent about the length of post-recession period. FINGLETON *et al.* (2011) consider the post-recession recovery lasting until the subsequent shock; such a choice would have implied, in the series under consideration in the present study, that, e.g., the post 1944/45 shock recovery covers the thirty year period until 1974; or the recovery post oil shock in 1975 lasts until 1993. It is hard to define as ‘post-shock recovery’ a period lasting 18 or 30 years! For this reason, the present study reports the results pertaining to recovery periods of a fixed length, namely three years. Thus, the recovery period after the 1892 shocks covers the years

1893 to 95, the recovery from the 1910 shock covers the period 1911 to 1913, and so on. Nevertheless, the key results are robust to this different choice concerning the duration of the recovery periods (of fixed length equal to three years, or during until the subsequent shock takes place), in nearly all instances (the two cases in which slightly different results emerge are noted in Table 3).

Insert about here:
Table 3. - Qualitative results in SURE estimation (general specification)

4.2 Economic resilience to shocks: impact and recovery

The present analysis starts by considering a regression equation in the form of eq. (1); specifically, it considers the growth rate of per-capita GDP in each of the 16 Italian regions. All series are stationary. For each region this growth rate is regressed against a constant term (which is intended to capture the autonomous regional growth), a set of 14 dummy variables in correspondence to the detected shocks, and a set of 8 dummy variables in correspondence to the detected post-recession periods. The 16 equations are estimated as a system of seemingly unrelated regression equations (SURE). It is worth underlining that this specification perfectly mimics the regression design of FINGLETON *et al.* (2012, eq. (1)) whose results are in their Table 3.

Verbally, the alpha coefficients capture the "autonomous growth", conditional on the reaction to- and recover from- shocks; the beta coefficients capture the specificity of the impact effect of a recessionary shock, upon the regional GDP growth rate; the gamma coefficients capture the effect –if any– of recovery after shock.

Considering the system estimation, the present interest is in evaluating whether for each shock the beta coefficients are equal across regions: in such a case, there is no "regional specificity" as concerns the impact and 'recovery' effect of the shock. Furthermore, if the restriction of equality among coefficients is accepted, the analysis evaluates whether the common coefficient is equal to zero or not: if equal to zero, there is no specific effect of that shock; if it is different from zero, the effect of the shock is significant and equal across regions.

Table 3 reports the qualitative results of the starting, general specification which takes into consideration 14 shocks and 8 periods of recovery. The results are a little bit surprising, in the sense that several beta and gamma coefficients are statistically insignificant. More specifically, in 8 out of the 14 considered shock cases, the beta coefficients appear to be equal to zero (both if considered as individual coefficients, on the basis of the *t*-statistics, and if considered jointly, on the basis of an appropriate *F* test): this means that each of these 8 shocks do not exhibit any significant effect on the growth rate of regional GDP. As to the 6 remaining cases, the response of regional growth rate to the shocks occurring in 1920/21, 1929, and 1944/45 appears to be statistically significant but equal across regions, according to an appropriate restriction *F*-test; the impact reactions to the shocks occurring in 1914/15, in 1975 and in 1973 appear to be different across regions (and statistically significant).

A similar surprising result emerges with respect to the significance of the recovery dummy variables: the coefficients for post-1982, post-1910, post-1920/21, post-33/34 dummies are equal across regions, and equal to zero (both if considered as individual coefficients in each specific regression equation, and if considered jointly). In the case of post-1914/15, gamma coefficients are statistically significant and equal across regions. Only the post-1944/45 and post-1975 recovery period present dummy variables that are different across regions: more precisely, the test on equality of gamma coefficients rejects the null of equality.

As a consequence of these issues, the authors of the present study decided to focus on a regression equation, which retains only a selected group of 6 shocks –called 'major' shocks– and specifically, the shock episodes are retained which show statistical significance for the impact or the recovery dummy variable. Thus, the final regression design considers the following equation :

(2) $$g_i = \alpha_i + \sum_{k=1}^{6} \beta_{i(k)} D_k + \sum_{k=1}^{6} \gamma_{i(k)} S_k + u_i$$

with:

k=1: 1914/15 shock (and relative recovery);

k=2: 1920/21 shock (and relative recovery);

k=3: 1929 shock (and relative recovery);

k=4: 1944/45 shock (and relative recovery);

k=5: 1975 shock (and relative recovery);

k=6: 1993 shock (and relative recovery).

It is important to emphasize that the distinction between 'major' shocks (as listed above) and other shocks has been left to data, without any discretionary intervention beyond the general (soft) criterion followed, that is, the significance of at least one of the dummy variables associated to the impact or the recovery. This list of major shocks in itself is interesting to comment. A very limited number of recessionary shocks appear to have significant specific effect on regional GDP dynamics: just six episodes over nearly 120 years, included two shocks related to the World Wars.[5]

It is worth pointing out how these results are consistent with the argument that wars – as a shock– could be very different from other types of shocks (BOSKER *et al.*, 2007, BOSKER *et al.*, 2008). A war shock is potentially able to heavily influence the performance in the long-run; usually, after the war, economies follow a very different path, and resilience to war shocks can have a very different nature. The empirical evidence represented by the '*Wirtschaftswunder*' in Germany is an important example corroborating the above argument. The same can be said for Italy: a period of thirty years of economic growth ('*Miracolo economico*') followed the II World War. Moreover, in the case at hand it is immediate to note that the magnitude of parameters associated with the post-1944/45 recovery (ranging from 0.12, Umbria datum, to 0.141, Lombardy datum) is substantially higher than those relative to all remaining recovery periods regardless of their statistical significance.

Consider also that some shocks, among the six major selected ones, have displayed a significant effect as far as the dummy variables are concerned, which is equal across regions, so that it is not possible to affirm that different regions have displayed different impact reaction or recovery.

Table 4 reports the results concerning the regression specification (2), with only the six major shocks considered; equations are estimated as a SURE system. All alpha coefficients, capturing the autonomous growth rate, are significant and included in the interval 2.0-2.7%.[6] Not surprisingly, beta coefficients are generally negative and significant: in only two cases they are positive, but are not statistically significant, even at the 10% level; the cases in which beta coefficient is negative, but not significant, include all regional coefficients pertaining to the 1993 shock. The gamma coefficients are generally positive, as expected (in most instances, however, they are not statistically significant); if negative, they are not statistically significant.

Insert about here:
Table 4. - Results from the SURE corresponding to eq. (2)

Insert about here:
Table 4. - Results from the SURE corresponding to eq. (2)

However, the SURE estimation of the set of regression equations (2) could be inefficient as compared to a *proper panel data estimation* (SINGH and ULLAH, 1974). Keeping in mind the final goal of evaluating regional specificities in facing common shocks, therefore, the authors of the present study suggest considering the following model:

$$
(3) \qquad
\begin{aligned}
g_i &= \alpha_i + \sum_{k=1}^{6} \beta_{i(k)} D_k + \sum_{k=1}^{6} \gamma_{i(k)} S_k + u_i \\
\alpha_i &= \alpha_0 + \varepsilon_i \\
\beta_{i(k)} &= \beta_{0(k)} + \zeta_{i(k)} \\
\gamma_{i(k)} &= \gamma_{0(k)} + \tau_{i(k)}
\end{aligned}
$$

where g_i, D_k, and S_k maintain the same meaning that they have in equation (1) while respective coefficients are composed by both a deterministic and a random part; deterministic parts are denoted by $\alpha_0, \beta_0, \gamma_0$, while random parts are denoted by $\varepsilon_i, \zeta_{i(k)}$ and $\tau_{i(k)}$ with *i*=1,2,...16.

The analysis is performed using the Random Coefficient Method (RCM). From a methodological perspective RCM represents an expansion (CASETTI, 1986) of model (1), openly accounting for potential heterogeneity across subjects –in this case, across regions (see also FOSTER, 1991, for a discussion about the pros of RCM regression analysis in the field of economic geography). Specifically, RCM allows to test zero restrictions on $\varepsilon_i, \zeta_{i(k)}$ and $\tau_{i(k)}$:[7] therefore, in order to test for heterogeneity in the regional resilience according to the RCM framework, the null hypothesis that the random part of the parameters is zero has been tested.[8] Furthermore, in order to overcome technical limitations related to the more-than-one random parameter estimation,[9] *in lieu* of estimating a model with random alpha coefficients, a dummy variable is inserted for each region performing the LR test only on the beta and gamma coefficients. Finally, in line with the precise objective to further improve the estimation efficiency, only the estimates which reports statistically significant coefficients are considered. Results are reported in Table 5.

Insert about here:
Table 5. - Results from Random Coefficient estimation

RCM results substantially confirm the story, as told by SURE estimates, with few minor discrepancies. Indeed, as far as the impact (random) coefficients are concerned, only in 1 out of the 3 shocks for which SURE rejects the null of equality at the 5% significance level (1914/15, 1975 and 1993), regional economies appear to be affected differently, according to the RCM estimation –namely, the 1914/15 shock. During the remaining recessionary episodes, RCM estimates suggest that shocks impacted all 16 regions considered with equal vividness. Furthermore, as to the three-year recovery periods, RCM results are entirely consistent with SURE estimates, accepting the null of equality between coefficients for all recovery periods considered, and the statistical insignificance of coefficients in most cases. Roughly speaking, the RCM estimation suggests that the degree of heterogeneity across regions is even more limited, as compared to what emerges from the SURE estimation. Although a more efficient panel approach allows to refine the interpretation of the resilience story as applied here to the Italian regional case-study, the main findings obtained using a SURE approach rest unchanged, indicating that the origins of Italian regional differences and consequent dualism, could not be explained in terms of differences in the impact and/or recovery behaviour of regional economies.

Lastly, a few words have to be spent about the equation structural stability. Given the regression design at hand, it is pointless to investigate whether the explanatory dummy variables have a force which moves over time. Then again, it is far from being surprising that a specific constant term covering the years after the II World War would emerge to be positive and significant, provided that the economic growth in these years is higher than over the previous decades. However, the consideration of such a structural break would not alter the substance of the answers concerning the regional coefficients of shock impact and recovery variables: sign, significance and especially the test results about coefficient equality across regions remain robust after controlling for such a break in the constant term.[10]

One more point is worth to be made: the reconstruction of data before the II World War is based on few original data points; missing data are obtained by linear interpolation, assuming that the effect of sectoral shocks across regions are symmetric (while the different sectoral composition of regions is properly taken into account) – see fn 5 and the Appendix of DANIELE and MALANIMA (2007) for further details. Hence, one could suspect that the limited heterogeneity in resilience behaviour across regions could derive from the data re-construction. This may impose some measure of symmetry. To assess this possibility, the exercise is repeated, by confining the attention to the sub-sample 1960-2009: the following Subsection provides evidence that the final result of limited regional heterogeneity is confirmed, even for the most recent sub-sample, for which the issue of data reliability is not under discussion.

4.3 Focus on the 1960-2009 sub-sample

A regression equation like (2) is run over the period 1960-2009, considering the 20 Italian regions that were operative in this period. All data are original from ISTAT, the Italian Statistic Office. The years in which recessionary shocks occurred are: 1975, 1993, 2003, 2008/09 (a contraction also occurred in 2005, but its absolute size is smaller than 0.1%); three 3-year recovery periods are considerable: the ones following the 1975, the 1993 and the 2003 shock.

The upshot of the SURE estimation can be summarised as follows. Each of the autonomous growth coefficients is positive and statistically significant at the 5% level, and equality among these coefficients is rejected (p=0.0267). As to the coefficient of the dummy variable pertaining the impact effect of the 1975 shock, in 12 out of 20 regions, it is statistically significant; consistently, the equality of these coefficients is not accepted by the appropriate test (p=0.000). The impact effect of the 1993 shock is statistically significant in 7 out of 20 cases, but the equality of these coefficients is accepted at the 5% significance level (p=0.0967); however, the joint restriction to zero is rejected (p=0.000). The impact effect of the 2003 shock is significant in only 2 regions: not surprisingly, the tests lead to accept the equality of these coefficients (p=0.864), and also the joint restriction to zero (p=0.382). The impact effect of the

2008/09 shock is significant in 18 out of 20 regions, and the constraint of equality across these coefficients is rejected. As to the dummy variables pertaining the recovery, for each of the three instances, tests lead to accept the null that coefficients are equal across regions, at the 95% confidence level (some doubts could be cast for the post-1975 recovery, whose test on coefficient equality provides p=0.0546, and the joint restriction to zero is accepted with p= 0.0578). In words, the Italian regions, over the last forty years, when original regional data are available, show heterogeneous impact reactions to recessionary shock, in only a subset of recessionary episodes, while the recovery experience never emerges to differ across regions. The (more efficient) RCM estimation provides only slightly different results: significant shock-specific coefficients emerge as to the impact reaction, for all recessionary shock episodes, while the recovery dummies emerge to be neither significantly positive nor statistically different across regions.

In essence, a clear-cut conclusion emerges: even over the 1960-2009 period, the regional reaction to recessionary shocks, and especially the recovery from that shocks, does not seem to display sufficient heterogeneity to explain the vast differences of economic performance across the Italian regions: the same conclusion obtained for the whole period of more than a century, holds for the sub-period for which fully reliable and original data are available. Therefore, it would be wrong to say that the scanty heterogeneity in the resilience behaviour of Italian regions in the very long-run is an outcome of data re-construction.

4.4 Evidence on the impulse responses

Here, the fact that the shocks have a permanent effect (that is, series are integrated of order 1) is explicitly taken into account. Following FINGLETON *et al.* (2012, Section 5), once tested for the non-stationary I(1) nature of the processes, for the number of lags imposed (1), and for the number of cointegrating vectors (1), a VECM, is estimated and the OIRFs (orthogonalized impulse responses functions) are analysed: such functions quantify the responses over time in all the endogenous variables to (one standard error) negative shock to one specific variable, everything else equal. This FINGLETON *et al.* The procedure is applied to the data at hand, combining the Italian regions into 5 macro-areas: Northwest, Northeast, Centre, South, Islands. Then, the graphical analysis is provided, to evaluate how a shock originated in a given area affects the dynamics (of real income per capita) in the same and in the other areas – see Figure 3; in particular, graphs (a) and (c) correspond to Fig. 8-11 and 12 of FINGLETON *et al.*: graph (a) report how a shock originated in the relatively wealthier Northwest area affects the dynamics of all areas, and graph (c) reports how the relatively poorer Southern macro-area is affected by its own shock and by shocks originating in remaining areas. Finally, the graph (b) reports the effect that a shock in each of the 5 areas has in the same area.

Insert about here:
Figure 3.(a),(b),(c).- Impulse response functions (from VECM estimation, 1890-2009)

The comparative analysis of the whole set of impulse response functions permits to observe that: (a)the effect of a shock originated in any given area is the largest in the same area; (b) the Northwest is the area where its own recessionary shocks have the largest (impact and cumulated) effect; (c) South and islands are the areas where shocks originating elsewhere have the smallest effect.

Hence, the impulse response function analysis, explicitly taking into account the permanent effect of shocks (consistent with the I(1) nature of the series in log levels) leads to see that Italian areas show differences, as far as the effects of shocks are concerned, like in FINGLETON *et al.* (2012) analysis; at the same time, the point of the heterogeneity across areas appears to be quantitatively small, to explain the large and permanent differences of economic performance of Italian regions. The results from this part of the analysis are not at odds with the evidence of the previous Sections: the impulse response analysis takes into account all the shocks hitting the regions every year, whereas the first part of the analysis focuses solely on the specificity of the 'major' recessionary shocks. What the two parts of the analysis say is that shocks have permanent effects, and the permanent effects of shocks are different across areas, but there is limited heterogeneity in the ways in which different regions react and recover from common 'major' recessionary shocks.

5. Performance of Italian regions

On the basis of statistical description of data, and the results of the present estimation exercises, one can provide clear-cut answers to specific questions concerning the regional growth performance in Italy over the very long run. In what follows, comments are developed with reference to the estimation over the whole time sample (1890-2009), if not differently stated.

1. Is the growth performance of Italian regions homogenous?

The income levels across regions differ significantly, as is well known and confirmed by formal test also on the data in the databank at hand; for example, an ANOVA F test for equality of the mean level across the 16 Italian regions, rejects the null of equality: $F_{15,1888}$=11.067, p=0.000. The issue about the growth rates is a little bit more involved: indeed, an ANOVA F test would not reject the equality across the mean values of the growth rates across regions ($F_{15,1872}$=0.131, p=1.000).[11] However, a formal test for equality of alpha coefficients in the regression equation (2) rejects the null of equality. This implies that the autonomous growth rates differ across regions, after having controlled for the effect of shocks and recoveries from shock. Put differently, the consideration of the occurrence of shocks and post-shock recovery leads to say that regions differ as far as the "autonomous" growth rate is concerned, while in the absence of the explicit consideration of recessionary shock, the growth rates would appear equal across regions (as documented by the ANOVA F test). Provocatively, recessionary shocks give a contribution to the equality, instead of inequality, of the regional growth rates in Italy.

2. How many recessionary shocks have significant effect on the regional GDP dynamics?

Per capita GDP levels of regions are integrated series: shocks, hitting any region in any year, have permanent effects. However, a very limited number of recessionary shocks have emerged to deliver a significant specific effect on the growth rate of regions, or to have a significant effect during the period of recovery following it. On the basis of statistical significance of dummy variable, only six significant shocks over a 120 year period can be found.

3. Accept all major shocks the same effect on any given area?

No, the six considered shocks have different impact effects on any region. This result derives from a series of formal test of the null hypotheses $\beta_{i,(1)} = \beta_{i,(2)} = \ldots = \beta_{i,(6)}$ for each *i*-th region, *i*=1,2,…16. The result is comprehensible, provided that each shock has specific source, characteristic, intensity, and so on.

4. Has any single major shock a similar or different impact effect on the Italian regions?

According to the SURE estimation, only three shocks appear to have a different impact effect across regions: the 1914/15 shock, the 1975 shock, and the 1993 shock. The 1920/21, 1929 and 1944/45 shock have significant impact upon the regions, but the appropriate test cannot reject that the effect is equal across regions. The degree of heterogeneity across regions, as their impact reaction to common shock is concerned, appears to be even more limited according to the RCM estimator: basing on such estimator, the homogeneity across regions can be rejected only for the 1914/15 shock. From an econometric point of view, the RCM estimator has to be judged as more efficient. The substantial conclusion, however is quite robust: regional differences in reaction to common shock are the exception rather than the rule.

5. Is the recovery from any single shock equal or heterogeneous across regions?

In all cases, the recovery effect from any single shock is equal across regions. This result is robust to the consideration of different length of recovery periods, and to different estimators. (By the way, an analogous result, to this respect, emerges in FINGLETON et al (2012) as concerns the employment in the U.K. regions over the last 40 years). In most cases (namely, the recovery periods starting in 1922, 1930, 1976 and 1994), the recovery period dummy variables present coefficients that are not only equal among regions, but also equal to zero, indicating that there is no ‘statistically relevant’ difference in the recovery years after the shock.

6. Can the story of different resilience behaviour across the Italian regions represent a sound explanation of the persistent difference in their growth performance?

The answer to this question has to be '*no*', at least according to the interpretation of the authors of the present study: evidence is provided here that no more than three shocks (in a period of about 120 years) have had a different impact effect on GDP growth rates across regions; the three cases reduce to one if one refers to RCM rather than SURE estimation. In no cases, differences emerge as far as the recovery from the shocks is concerned. Hence, it appears that the story of resilience –though conceptually intriguing and worth analyzing– is unable to provide a clear account of the persistent differential of growth performances across the Italian regions. Of course, the reason of why persistent differences across regions remain over the centuries remain open and it is beyond the end of the present article.

7. Which are the best (worst) Italian regions, as far as the economic performance is concerned, according to the following criteria: (i) income level, (ii) growth rate, (iii) ability to determine the impact of recessionary shock, (iv) the recovery from shocks, (v) the autonomous growth rate (i.e., the growth rate conditional on the shock impact and recovery effects)?

Understandably, the resilience story can shed new light on these long-debated issues, only as concerns the analysis perspective (iii), (iv) and (v). However, prior to deal with such perspectives, it is worth remarking that:

- The three regions with the highest GDP average level are: Liguria, Lombardia and Piemonte (the three highest GDP levels of the first decade of the period under examination, 1891-1900, pertain to Lazio, Liguria and Lombardia; the three highest peaksin the final decade,2000-09, pertain to Lombardia, Emilia-R., Lazio). At the opposite end of the list, the three regions with the lowest GDP average level areCalabria, Basilicata and Sicilia (the three lowest GDP levels at the beginning of the periodpertain to Calabria, Abruzzo and Basilicata; the three lowest scores at the end of the periodpertain to Campania, Calabria and Puglia). Thus, a substantial degree of stability characterizes the distribution of regional income levels.

- Over the whole sample under consideration, the three regions with the highest average value of annual growth rate are Veneto, Emilia-R. and Lombardia, while the three regions with the lowest growth rates are Campania, Puglia, Sicilia.

To answer point (iii) consider the results of the regression equation (2) and look at the size of beta coefficients; in particular:

- To assess the general ability of regions to resist to the impact effect of shocks, it makes sense to view the 'average' level of their beta coefficients. If a simple average of beta coefficients for each region is computed, the regions showing the smallest negative impact effect emerges to be Sardegna, Umbria and Basilicata; here it is of interest to note that Sardegna is an island, whose economic dynamics are quite unrelated to national industrial shocks, while Umbria and Basilicata are small regions: adverse shocks have the most limited negative impact in these areas. At the opposite end of the list, the regions with the highest negative impact effect are Liguria, Lazio and Abruzzo (which are the worst performers as the impact reaction to shock is concerned).
- To answer point (iv) one can look at the gamma coefficients and compute the simple average of gamma coefficients pertaining to each region; it is necessary, however, to recall that coefficients are not statistically different across regions, so that the present conclusion is simply a 'numerical curiosity' without statistical significance support. Anyway, the best recovery performances appear to pertain to Liguria, Piemonte and Lombardia, while the worst ones belong to Calabria, Basilicata and Sicilia.[12]
- As to the autonomous growth (alpha coefficients), that is, the growth performance after having controlled for the effects of major shocks, the highest values pertain to Veneto, Marche, Abruzzo, while the lower ones belong to Puglia, Campania, Sicilia.

All these elements of information are reported in Table 6, which represents –in terms of a competitive sport analogy– a list for the 'best' and 'worst' Italian regions, in terms of ranking of economic performance.

Insert about here:
Table 6. - Ranking list of Italian regions' economic performance

8. Is there a relation between the way in which regions react to- and recover from- shocks? Is there a relation between resilience behaviour and general growth performance?

It could be interesting to note that Liguria is the worst performer according to the impact effect of shocks, but the best performer according to the recovery ability; Basilicata is among the best performers as far as the impact reaction is concerned, but among the worst according to the ability to recover. Nevertheless, this negative trade-off between impact and recovery abilities is far from being the rule: Sicily shows a bad performance according to both the impact and the recovery reaction, while Umbria is a good (or very good) performer along both directions, just to mention two opposite faces. Moreover, at first glance, no clear-cut relations emerge between the regional resilience behaviour and the general economic performance. The same conclusion is supported by a simple (and admittedly rough) cross-regional rank correlation analysis between the performance growth, as measured by the average of annual growth rate of per capita GDP, on the one side, and the individual regional coefficients related to resilience on the other side: the cross-regional rank correlation between the average value of per capita GDP growth rate and the average value of beta coefficients is +0.152 (while it should be negative, if one believes that a better impact reaction associates with a better growth performance); the cross-regional rank correlation between the average value of the annual growth rate of GDP and the average value of gamma coefficients is +0.402: it is positive, as expected on the basis of the guess that a better ability to recover associates with a better growth performance; however, the size of the rank correlation coefficient is rather limited to be a signal of a strong association. The picture is a little bit different if the association is considered between the resilience coefficients and the income *levels*: the rank correlation between the average value of per capita income and the average value of beta coefficients is equal to -0.270 (which means that a "better" impact reaction to recessionary shock is associated with a higher average income level), while the rank correlation between the average level of per capita income and the average gamma coefficients is equal to +0.930 (or +0.739 if one takes only significant coefficients into consideration): this rank correlation coefficient, in fact, may denote a significant association between the income levels and the ability to recover from recessionary shock, as captured by the gamma coefficients in the regression specifications at hand. Needless to say, the evaluation of these rank correlations is far from being a rigorous analysis. Furthermore, the rank correlation coefficients cannot tell anything about causal links.

6. Concluding remarks

This article has evaluated the economic resilience of Italian regions, that is, the regional behaviour in reacting to shock and in recovering from shock. This study has followed a well established procedure in this (relatively new) research line, especially as concerns the regression analysis design. At the same time, some innovative elements have been introduced; they are worth mentioning: the very long run analysis perspective –the databank under consideration covers about 120 years; the consideration of per capita GDP instead of employment; the efficiency check through proper panel data estimation. Indeed, this study has documented that shocks have permanent effects and such effects differ across areas, but there is limited heterogeneity in the way in which different regions react to and recover from major, common, recessionary shocks. Specifically, a very limited number of significantly heterogeneous impact effects have been counted: three cases, or just one case, according to different estimators, over a period longer than a century. Moreover, no regional significant specificities have emerged as far as the recovery from shock is concerned. These pieces of evidence are quite surprising, provided that huge differences characterize Italian regions, and their long-run economic performances.

From a theoretical perspective it is worth emphasizing that the adopted approach to resilience allows to explore to what extent a regional economy is able to sustain a pre-existing state (typically assumed to be an equilibrium state) absorbing an exogenous shock. This approach is based on the assumption that regional performance is characterised by multiple equilibria, not all efficient statically and/or dynamically; according to this framework, therefore, homogeneous reaction to shocks, can be understood as the inability of regions to quickly switch from a low-level equilibrium to a better (more efficient) one as a result of a shock.

Admittedly, this approach has important limitations in both capturing the uneven geographical nature of resilience, and explaining the reasons; nevertheless, it is potentially able to give insight on the spatial divide. In particular, from the present analysis the conclusion can be drawn that differences in economic resilience behaviours are not able to explain the different economic performance of Italian regions with a convincing interpretation. On the other hand, the absence of different resilience behaviours across regions can be distinguished as a reason why differences across regions are so vast and persistent in Italy.

Of course, the reasons for these persistent differences in economic performance across the Italian regions remain a fascinating issue that extends beyond the scope of the present study. Nonetheless, the analysis hitherto developed provides insights able to influence the research agenda both in terms of adaptation and adaptability. Indeed, it is worth further exploring the causes of the observed ‘lock-in’ reproducing similar scenarios across regions in the long-run, while not ignoring, in an interdisciplinary perspective, its qualitative dimensions looking also at the interaction between agents, mechanisms, and sites. It can be of interest, for instance, to understand to which specific economic, social and/or institutional variables the resilience behaviour of regions is mainly linked. Without a doubt, a deeper knowledge of these aspects, in a future research agenda, could be crucial in designing and implementing more effective spatial policies.

Acknowledgements. Although the authors alone are responsible for what is written here, thanks go to Vittorio Daniele and Emanuele Felice for useful discussion on data construction and their interpretation, as well as for having made available data in electronic format. Thanks go also to Alan Collins and Tiziana Cuccia for helpful comments, and especially to Prof. Ron Martin for his kind cooperation. The authors have also benefitted from comments from the audience at different seminars and conferences. Last but not least, criticisms and suggestions from two anonymous referees and the Editor have been very useful in improving the article.

REFERENCES

BARRO, R.J., SALA-I-MARTIN, X. (1991) Convergence across states and Regions, *Brooking Papers on Economic Activity* **1**, 107-57.

BARRO, R.J., SALA-I-MARTIN, X. (1992) Convergence, *Journal of Political Economy* **100**, 223-51.

BERNARD, A., DURLAUF, S. (1996) Interpreting Tests of the Convergence Hypothesis, *Journal of Econometrics* **71**, 161-74.

BATABYAL, A.A. (1999) The Stability of Stochastic System: The Case of Persistence and Resilience, *Mathematical and Computer Modelling* **30**, 27-34.

BLOCK, J.,KREMEN, A.M. (1996) IQ and ego-resiliency: conceptual and empirical connections and separateness, *Journal of Personality and Social Psychology* **70**, 349-61.

BOSKER, A., BRAKMAN, S., GARRETSEN, H., SCHRAMM, M. (2007) Looking for Multiple Equilibria when Geography Matters: German City Growth and the WWII Shock, *Journal of Urban Economics* **61**, 152-69.

BOSKER, A., BRAKMAN, S., GARRETSEN, H., SCHRAMM, M. (2008) A Century of Shocks: the Evolution of the German City Size Distribution 1925 – 1999. *Regional Science and Urban Economics* **38**, 330–347.

BRUNETTI, A., FELICE, E., VECCHI, G. (2011) *Reddito* in G. VECCHI (Ed.), *In ricchezza e in povertà: Il benessere degli Italiani dall'Unità a oggi*, il Mulino, Bologna, 209-34.

CASETTI, E. (1986) The Dual Expansion Method: An Application for Evaluating the Effects of Population Growth on Development, *Systems, Man and Cybernetics, IEEE Transactions* **16**, 29-39.

CELLINI, R., SCORCU, A.E. (2007) How many Italies? What Data Show about Growth and Convergence across Italian Regions, 1970-91, *Rassegna di lavori dell'ISCO* **13**, 93-124.

CICCARELLI, C., FENOALTEA, S. (2009), *La produzione industriale delle regioni d'Italia 1861-1913: Una ricostruzione quantitativa – Le industrie non manifatturiere Vol. 1*, Banca d'Italia, Roma.

CICCARELLI, C., FENOALTEA, S. (2010) Attraverso la lente d'ingrandimento: aspetti provinciali della crescita industriale nell'Italia post-unitaria, *Economic History Working Papers – Quaderni di Storia Economia*, No 4-2010, Banca d'Italia.

D'AMATO M., PISTORESI, B. (1997), Statistical Evidence on Regional Cohesion in Italy, *Giornale degli Economisti e Annali di Economia* **56**, 211-34.

DANIELE, V., MALANIMA, P. (2007) Il prodotto delle regioni e il divario Nord-Sud in Italia 1861-2004, *Rivista di Politica Economica* **97**, 267-316.

DAVIS, D., WEINSTEIN, D. (2002) Bones, Bombs, and Break Points: The Geography of Economic Activity, *American Economic Review* **92**, 1269-89.

DE SIANO, R. AND D'UVA, M. (2008) Beta-convergence in Italy using a trend break date model, *The Empirical Economic Letters* **7**, 589-596.

FAZIO, G. AND PIACENTINO, D. (2010) A Spatial Multilevel Analysis of Italian SMEs' Productivity, *Spatial Economic Analysis* **5**, 299-316.

FELICE, E. (2011a) The determinants of Italy's regional imbalances over the long run: exploring the contributions of human and social capital, Oxford University Economic and Social History working paper series No. 088, Nuffield College, Oxford University.

FELICE, E. (2011b) Regional value added in Italy over the long run (1891-2001): linking indirect estimates with official figures, and implications, *UHE Working Paper* 2011_04, Universitat Autonoma de Barcelona.

FINGLETON, B., GARRETSEN, H., MARTIN R. (2012) Recessionary Shocks and Regional Employment: Evidence on the Resilience of U.K. Regions, *Regional Science* **52**, 109-33.

FOSTER, S. A. (1991) The expansion method: Implications for geographic research, *The Professional Geographer* **43**, 131-142.

HILL, E. W., WIAL, H. AND WOLMAN, H. (2008) Exploring Regional Resilience, *Working Paper* 2008-04. Berkeley, CA: Macarthur Foundation Research Network on Building Resilient Regions, Institute for Urban and Regional Development, University of California.

HOLLING, C. S. (1973) Resilience and Stability of Ecological Systems, *Annual Review of Ecology and Systematics* **4**, 1-23.

HOLLING, C. S. (1996) Engineering Versus Ecological Resilience". In: P. SCHULZE (Ed.), *Engineering within Ecological Constraints*, National Academy Press, Washington, DC, 31-44.

LEVIN, S.A., BARRETT, S., ANIYAR, S., BAUMOL W., *et al.* (1998) Resilience in Natural and Socioeconomic Systems, *Environment and Development Economics* **3**, 222-35.

MACKINNON G., HAUG A., MICHELIS L. (1999) Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration, *Journal of Applied Econometrics*, **14**, 563-577.

MALANIMA, P., ZAMAGNI, V. (2010) 150 years of the Italian economy, 1861-2010, *Journal of Modern Italian Studies* **15**, 1-20.

MARTIN, R. (2012) Regional Economic Resilience, Hysteresis and Recessionary Shocks, *Journal of Economic Geography* **12**, 1-32.

MCLACHLAN, G. J. AND. BASFORD, K.E.(Eds), (1988) *Mixture Models,* New York, Marcel Dekker.

ONG, A. D., BERGEMAN, C.S. *et al.* (2006) Psychological resilience, positive emotions, and successful adaptation to stress in later life, *Journal of Personality and Social Psychology* **91**, 730-49.

PENDALL, R., FOSTER, K.A., COWEL, M. (2010) Resilience and Regions: Building Understanding of the Metaphor, *Cambridge Journal of Regions, Economy and Society* **3**, 71-84.

PERRINGS, C. (1998) Resilience in the Dynamics of Economy-Environment System, *Environmental and Resource Economics* **11**, 503-20.

PIKE, A., DAWLEY, S., TOMANEY, J. (2010) Resilience, Adaptation and Adaptability, *Cambridge Journal of Regions, Economy and Society* **3**, 50-70.

QUAH, D. (1996) Regional Convergence Clusters across Europe, *European Economic Review* **40**, 951-58.

RASPE, O., VAN OORT, F. (2007) What when space matters little for firm productivity? A multilevel analysis of localised knowledge externalities, *Papers in Evolutionary Economic Geography* No. 0706.

REGGIANI, A., DE GRAFF, T., NIJKAMP, P. (2002) Resilience: An Evolutionary Approach to Spatial Economic Systems, *Network and Spatial Economics* **2**, 211-29.

REDDING, S.J., STURM, D.M. (2008) The Cost of Remoteness: Evidence from German Division and Reunification, *American Economic Review* **98**, 1766-97

SELF, S.G., LIANG, K.Y. (1987) Asymptotic Properties of Maximum Likelihood Estimators and Likelihood Ratio Tests Under Nonstandard Conditions, *Journal of the American Statistical Association*, **82**, 605-610.

SIMMIE, J., MARTIN, R. (2010) The Economic Resilience of Regions: Towards an Evolutionary Approach, *Cambridge Journal of Regions, Economy and Society* **3**, 27-44.

SINGH, B., ULLAH, A. (1974),"Estimation of Seemingly Unrelated Regressions with Random Coefficients, *Journal of the American Statistical Association* **69**, 191-195.

STRAM, D. O., WON, L.J. (1994) Variance Components Testing in the Longitudinal Mixed Effects Model, *Biometrics* **50**, 1171-1177.

TORRISI, G. (2011) A Multilevel Analysis on the Economic Impact of Public Infrastructures and Corruption in Italia Regions, *The IUP Journal of Infrastructure* **9**, 17-51.

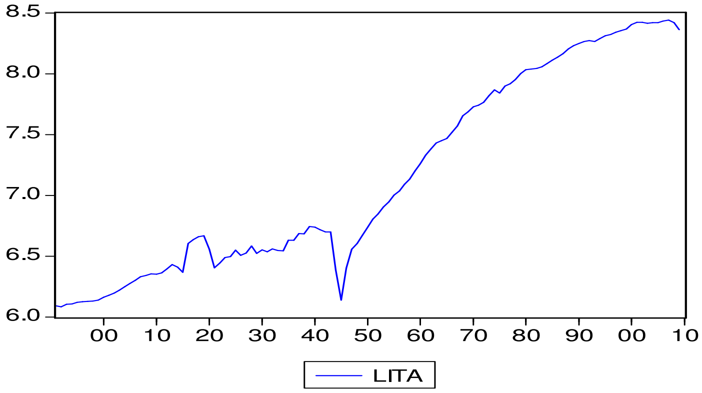
TSIONAS, E.G. (2001) Regional Convergence and Common, Stochastic Long-run Trends: A Re-examination of the US Regional Data, *Regional Studies* **35**, 689-96.

WALKER, B., GUNDERSON, L., KINZIG, A., FOLKE, C., CARPENTER, S., SCHULTZ, L. (2006) A Handful of Heuristics and Some Propositions for Understanding Resilience in Socio-Ecological Systems, *Ecology and Society* **11**, art. 13.

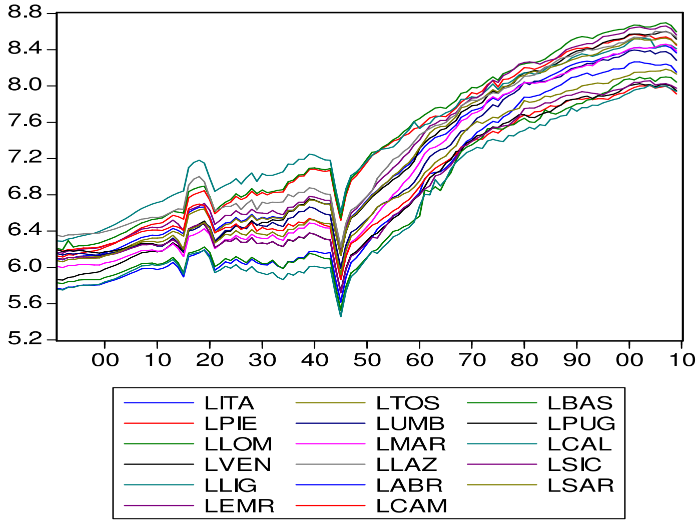
FIGURES

Figure 1. Log of income per capita

(a) in Italy



(b) in the 16 Italian regions



(c) Italy and the two richest and poorest regions

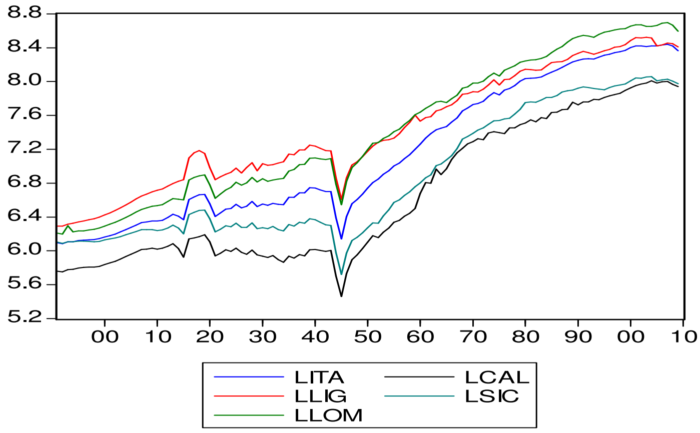


Figure 2. The annual growth rate of income per capita in Italy

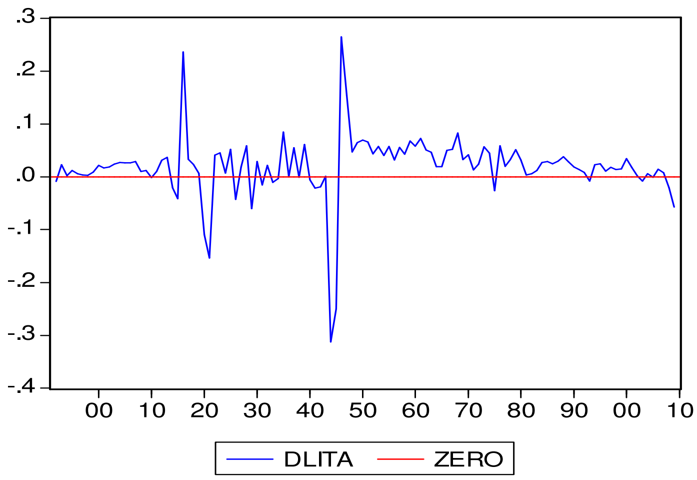
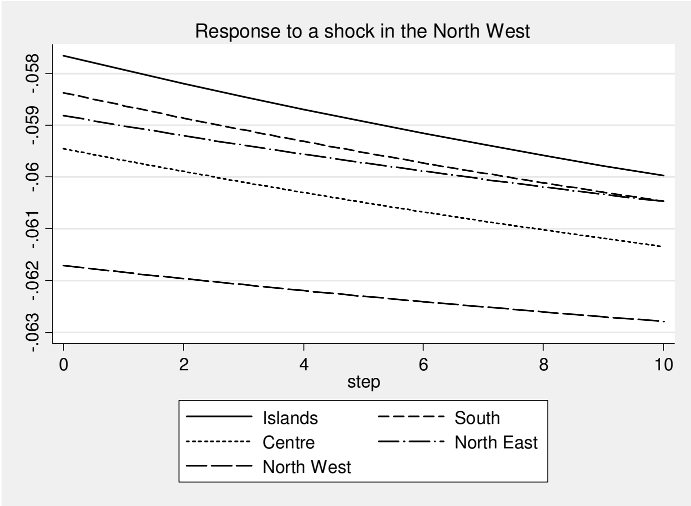
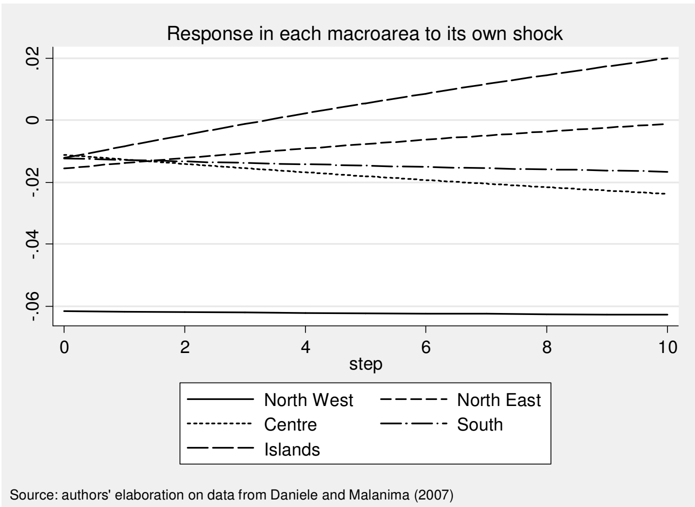
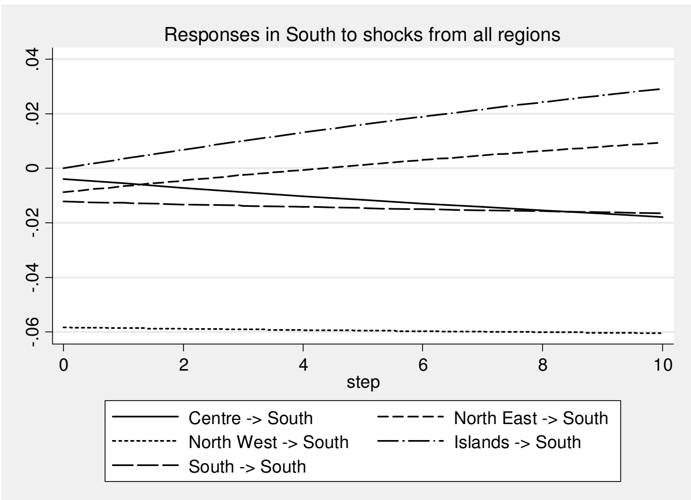


Figure 3.(a),(b),(c).- Impulse response functions (from VECM estimation, 1890-2009)







TABLES

Table 1. Descriptive statistics on time series, Italy and the regions

		Mean	Median	Maximum	Minimum	St. Dev.	Skewness	Kurtosis
ITA	Italy	7.148	6.745	8.440	6.084	0.814	0.341	1.535
PIE	Piemonte	7.348	7.160	8.568	6.113	0.807	0.130	1.602
LOM	Lombardia	7.413	7.194	8.696	6.197	0.828	0.192	1.586
VEN	Veneto	7.136	6.752	8.598	5.860	0.930	0.304	1.553
LIG	Liguria	7.424	7.236	8.522	6.290	0.692	0.111	1.719
EMR	Emilia-R.	7.267	6.784	8.660	6.157	0.877	0.363	1.512
TOS	Toscana	7.178	6.744	8.527	6.088	0.861	0.331	1.497
UMB	Umbria	7.058	6.651	8.397	5.992	0.830	0.452	1.550
MAR	Marche	7.024	6.491	8.460	5.864	0.894	0.395	1.472
LAZ	Lazio	7.303	6.974	8.601	6.226	0.781	0.379	1.570
ABR	Abruzzo	6.801	6.257	8.265	5.618	0.924	0.445	1.507
CAM	Campania	6.932	6.574	8.003	5.867	0.657	0.446	1.564
BAS	Basilicata	6.717	6.192	8.100	5.527	0.834	0.489	1.544
PUG	Puglia	6.861	6.438	8.025	5.730	0.721	0.466	1.511
CAL	Calabria	6.646	6.167	8.010	5.459	0.819	0.453	1.513
SIC	Sicilia	6.860	6.428	8.056	5.720	0.743	0.475	1.527
SAR	Sardegna	6.962	6.527	8.185	5.921	0.757	0.414	1.507

Note: log of income per capita, 1891-2009; 119 obs.

Table 2. Results of integration and co-integration of regional time series

I. Augmented Dickey-Fuller test

	ADF on level	ADF on first-difference		ADF on level	ADF on first-difference
ITA	-2.050	-8.261**			
PIE	-2.753	-8.601**	LAZ	-2.129	-8.130**
LOM	-2.649	-8.403**	ABR	-1.603	-8.153**
VEN	-2.037	-8.363**	CAM	-1.803	-8.257**
LIG	-2.988	-8.630**	BAS	-1.550	-9.242**
EMR	-1.862	-8.256**	PUG	-1.789	-8.510**
TOS	-2.030	-8.060**	CAL	-1.481	-9.399**
UMB	-1.932	-8.164**	SIC	-1.712	-8.451**
MAR	-1.824	-8.164**	SAR	-1.659	-8.563**

II. Group Unit Root tests

Test statistics	Null	Statistic	p-value	Conclusion
Levin, Lin & Chu t*-stat	(a)	2.01041	0.9778	Null accepted
Breitung t-stat	(a)	5.93592	1.0000	Null accepted
Im, Pesaran and Shin W-stat	(b)	6.77079	1.0000	Null accepted
ADF - Fisher Chi-square	(b)	2.36880	1.0000	Null accepted
PP - Fisher Chi-square	(b)	2.13142	1.0000	Null accepted
Hadri Z-stat	(c)	28.6755	0.0000	Null rejected

III. Johansen Trace and Max-Eigenvalue cointegration tests

Hypothesized No. of CE(s)	Eigenval	Trace Statistic	Crit Value	Prob.	Max-Eigen Statistic	Crit Value	Prob
None	0.9978	3772.6	NA	NA	696.9	NA	NA
At most 1	0.994	3075.6	NA	NA	585.5	NA	NA
At most 2	0.978	2490.1	NA	NA	436.8	NA	NA
At most 3	0.969	2053.3	NA	NA	397.3	NA	NA
At most 4	0.930	1656.0	NA	NA	303.3	NA	NA
At most 5	0.884	1352.7	334.98	0.0000	245.83	76.58	0.0001
At most 6	0.844	1106.9	285.14	0.0000	211.57	70.54	0.0000
At most 7	0.819	895.33	239.23	0.0001	194.39	64.50	0.0001
At most 8	0.729	700.94	197.37	0.0001	148.91	58.43	0.0000
At most 9	0.701	552.02	159.52	0.0000	137.67	52.36	0.0000
At most 10	0.675	414.40	125.61	0.0000	128.04	46.23	0.0000
At most 11	0.509	286.36	95.753	0.0000	81.131	40.08	0.0000
At most 12	0.441	205.23	69.818	0.0000	66.248	33.88	0.0000
At most 13	0.422	138.98	47.856	0.0000	62.499	27.58	0.0000
At most 14	0.287	76.489	29.797	0.0000	38.600	21.13	0.0001
At most 15	0.259	37.889	15.494	0.0000	34.250	14.26	0.0000
At most 16	0.031	3.642	3.8414	0.0563	3.642	3.841	0.0563

Notes:
Sample 1891-2009; 17 time series of log of income per capita are always considered: the 16 regional series and the national one (as listed in Table1). Automatic selection of lags based on SIC.
Panel I: Intercept (and linear trend) are introduced for the test on the first difference (and the level, respectively); ** (*) denotes significance at the 5% (10%) level.
Panel II: The null are: (a) Presence of Unit root (assuming common unit root process); (b) Presence of Unit root (assuming individual unit root process); (c) No unit root (assuming common unit root process); (Lags between 0 and 2 in all cases);
Panel III: a linear deterministic trend is considered, along with the constant term; lags interval 1 to 4; MacKinnon-Haug-Michelis (1999) p-values; Critical values at the 5% confidence level.

Table 3. Qualitative results in SURE estimation (general specification)

	(a)	(b)	(c)
Impact effect: Beta coeffs	All individual beta coeffs equal to zero	Equality across individual beta coefficients	All beta coeffs equal to zero (jointly)
1892-shock	OK	OK	OK
1910-shock	OK	OK	OK
1914/15-shock	**	**	===
1920/21-shock	**	OK	**
1926-shock	OK	OK	OK
1929-shock	**	OK	*
1931-shock	OK	OK	OK
1933/34-shock	OK	OK	OK
1940/41/42-shock	OK	OK	OK
1944/45-shock	**	OK	**
1975-shock	**	**	==
1993-shock	**	**	==
2003-shock	OK	OK	OK
2008-09-shock	OK	OK	OK
Recovery effect: Gamma coeffs	All individual gamma coeffs equal to zero	Equality across individual gamma coefficients	All gamma coeffs equal to zero (jointly)
Recovery starting in 1893	OK	OK	OK
Recovery starting in 1910	OK	OK	OK
Recovery starting in 1916	**	OK	**
Recovery starting in 1922	OK	OK	OK
Recovery starting in 1935	OK	OK	OK
Recovery starting in1946	**	OK^	**
Recovery starting in 1976	OK	OK^	OK
Recovery starting in 1994	OK	OK	OK

Notes:

Column (a) reports whether all individual coefficients are statistically insignificant (at the 5% significance level): OK means that all coefficients are statistically insignificant; ** means that at least one coefficient is statistically significant; Column (b) reports the result of an F test on the equality across the coefficients pertaining the 16 regions: OK means that the test accepts the null of equality at the 5% significance level; ** means that the test rejects the null; Column (c) reports the result of an F test on joint equality to zero of all the coefficients pertaining the 16 regions: OK means that the null is accepted, * means that the null is rejected, and == means that the test was not performed, since the equality across the coefficients is already rejected.

The results refer to the specification in which the recovery length is a three year period; in the case of recovery lasting till to the subsequent shock, all results remain unchanged, apart from the two cases marked by ^, in which the equality across regional coefficients is rejected.

Table 4. Results from the SURE corresponding to eq. (2)

	Alpha coeffs.	sh1914/15	sh1920/21	Sh1929	sh1944/45	sh1975	sh1993	recov1916	recov1922	recov1930	recov1946	recov1976	recov1994
PIE	0.024 **	-0.045 *	-0.151 **	-0.068 **	-0.297 **	-0.089 **	-0.039 ns	0.074 **	0.018 ns	-0.014 ns	0.139 **	0.015 ns	-0.002 ns
LOM	0.024 **	-0.032 ns	-0.161 **	-0.078 **	-0.295 **	-0.059 *	-0.039 ns	0.071 **	0.018 ns	-0.016 ns	0.141 **	0.016 ns	-0.0006 ns
VEN	0.027 **	-0.080 **	-0.139 **	-0.076 **	-0.311 **	-0.051 ns	-0.025 ns	0.077 **	0.011 ns	-0.008 ns	0.125 **	0.011 ns	-0.0001 ns
LIG	0.022 **	0.0003 ns	-0.177 **	-0.117 **	-0.309 **	-0.081 **	-0.041 ns	0.092 **	0.008 ns	0.001 ns	0.127 **	0.013 ns	-0.003 ns
EMR	0.025 **	-0.083 **	-0.141 **	-0.066 *	-0.305 **	-0.049 ns	-0.024 ns	0.066 **	0.006 ns	-0.017 ns	0.131 **	0.023 ns	0.003 ns
TOS	0.025 **	-0.050 **	-0.156 **	-0.083 **	-0.306 **	-0.052 ns	-0.019 ns	0.071 **	0.009 ns	-0.014 ns	0.130 **	0.014 ns	-0.0001 ns
UMB	0.023 **	-0.096 **	-0.125 **	-0.045 ns	-0.316 **	-0.044 ns	-0.028 ns	0.067 **	0.015 ns	-0.016 ns	0.120 **	0.027 ns	-0.010 ns
MAR	0.026 **	-0.097 **	-0.134 **	-0.061 *	-0.310 **	-0.054 ns	-0.035 ns	0.064 **	0.005 ns	-0.017 ns	0.126 **	0.007 ns	0.007 ns
LAZ	0.023 **	-0.012 ns	-0.181 **	-0.135 **	-0.312 **	-0.036 ns	-0.031 ns	0.096 **	-0.009 ns	0.004 ns	0.124 **	0.008 ns	-0.010 ns
ABR	0.026 **	-0.106 **	-0.137 **	-0.064 *	-0.299 **	-0.037 ns	-0.056 ns	0.062 **	-0.001 ns	-0.021 ns	0.137 **	0.023 ns	-0.009 ns
CAM	0.020 **	-0.043 *	-0.169 **	-0.108 **	-0.312 **	-0.036 ns	-0.033 ns	0.076 **	-0.001 ns	-0.012 ns	0.124 **	0.015 ns	-0.019 ns
BAS	0.025 **	-0.111 **	-0.135 **	-0.059 ns	-0.309 **	-0.032 ns	-0.016 ns	0.059 **	-0.002 ns	-0.023 ns	0.127 **	-0.010 ns	0.003 ns
PUG	0.020 **	-0.079 **	-0.147 **	-0.083 **	-0.309 **	-0.026 ns	-0.047 ns	0.071 **	0.000 ns	-0.013 ns	0.128 **	0.011 ns	-0.008 ns
CAL	0.025 **	-0.106 **	-0.149 **	-0.081 *	-0.297 **	-0.036 ns	0.003 ns	0.056 **	-0.008 ns	-0.028 ns	0.139 **	-0.008 ns	-0.011 ns
SIC	0.022 **	-0.075 **	-0.151 **	-0.087 **	-0.312 **	-0.019 ns	-0.033 ns	0.070 **	-0.001 ns	-0.014 ns	0.124 **	0.003 ns	-0.018 ns
SAR	0.023 **	-0.101 **	-0.136 **	-0.065 *	-0.304 **	-0.031 ns	-0.012 ns	0.064 **	0.005 ns	-0.018 ns	0.132 **	0.006 ns	-0.021 Ns

Note: ** (*) denotes significance at the 5% (10%) level; n denotes insignificant coefficients (at the 10% level).

Table 5. Results from Random Coefficient estimation

	(a)	(b)	(c)	(d)
Shock (year)	Impact coefficient (beta)	Equality in impact across regions (zero restrictions on sigma)	Recovery coefficient (gamma)	Equality in recovery across regions (zero restrictions on tau)
1914/1915	-0.070**	2.08	0.071**	0.000
		(0.075)*		(1.00)
1920/21	-0.149**	0.000	==	==
		(1.00)		
1929	-0.080**	0.000	==	==
		(1.00)		
1944/1945	-0.306**	0.000	0.130**	0.000
		(1.00)		(1.00)
1975	-0.046**	0.000	==	==
		(1.00)		
1993	-0.030**	0.000	==	==
		(1.00)		

Notes: Column (b) reports the result of an LR test on the zero restriction of random component of impact coefficients for the 16 regions, while Column (d) reports result of an LR test on the similar test on recovery coefficients. P-values reported in parenthesis refer to the distribution of the LR test statistic consisting in a 50:50 mixture of a chi-squared with no degrees of freedom (that is, a point mass at zero) and a chi-squared with 1 degree of freedom (see footnote 8). **(*) denotes significance at the 5% (10%) level.

Table 6. Ranking list of Italian regions' economic performance

	(a)	(b)	(c)	(d)	(e)
	Level	Growth	Autonomous growth	Impact to shocks	Recovery from shock
Piemonte	3rd				2nd
Lombardia	2nd	3rd			3rd
Veneto		1st	1st		
Liguria	1st			Last	1st
Emilia R.		2nd			
Toscana					
Umbria				2nd	
Marche			2nd		
Lazio				2nd-last	
Abruzzo			3rd	3rd-last	
Campania		Last	2nd-last		
Basilicata	2nd-last			3rd	2nd-last
Puglia		2nd-last	Last		
Calabria	Last				Last
Sicilia	3rd-last	3rd-last	3rd-last		3rd-last
Sardegna				1st	

Note: the Table reports the first, second and third region according to (a) level of per capita income; (b) growth rate of per capita income; (c) autonomous growth as resulting according to alpha coefficients in regression analysis on SURE (2), that is, growth conditional on the effects of impact to- and recovery from- (major) shocks; (d) best impact reaction to negative shocks (lowest average value of beta coefficients in absolute value); (e) best recovery from shocks (highest average value of gamma coefficients).

ENDNOTES

[1]As a by-product of the analysis, FINGLETON et al (2012) find that the α coefficients (autonomous growth) differ across regions; this amounts to say that, in general, the performances of employment growth differ across regions (conditional on the variable accounting for the impact reaction to- and recover from- shocks). Not surprisingly, they also find that the β coefficients concerning different shocks for one region are not equal, i.e., the null $\beta_{i,(1)} = \beta_{i,(2)} = ... = \beta_{i,(K)}$ is rejected for any given region, and similarly the different γ coefficients concerning the recovery periods for any given region differ: this means that different shocks have different effects on a given region, and are associated to different specific behaviour in post-shock recoveries: this is comprehensible, since different shocks have different intensity, source, characteristic, and so on. In the second part of their analysis, FINGLETON *et al.* (2012) consider the propagation effect of a given shock over time and across regions, on the basis of a VECM (Vector Error Correction Model) specification; here, this aspect will be briefly dealt with in Sub-section 4.4.

[2] In DANIELE and MALANIMA (2007), the data are published for the period 1891-2004. The authors of the present study thank Vittorio Daniele who provided them with the time series updated till to 2009, on the basis of the subsequent data from Istat (the Italian Statistical Office). An Appendix, in electronic format, containing all data and supplementary elaborations is available from the Authors of the present study upon request.

[3] In DANIELE-MALANIMA's data, which are considered here: Valdaosta is included in Piemonte, Trentino A.A. and Firuli V.G. are included in Veneto, and Molise is included in Abruzzo. Data reconstruction is based on the current boundaries of regions.

[4] However, it is honest to report that some criticism can be moved, for instance, to the 'strong' hypothesis that the national sectoral cycles have the same impact on every region, in proportion to each regional sectoral share (FELICE, 2011a); or the linear interpolation in the absence of specific annual information for some series (CICCARELLI and FENOALTEA, 2010). See also CICCARELLI and FENOALTEA (2009) and MALANIMA and ZAMAGNI (2010).

[5] Consider, however, that the 2008/09 shock appears to be insignificant as far as its impact is concerned, but is impossible to evaluate its consequences. Moreover, consider that 2011 and 2012 displayed negative growth rate for the national income (regional data are not yet available

at the moment); hence similar future analyses will have to consider a unified shock including 2008/09/11/12, whose significance can not be evaluated now.

[6] Alpha coefficients show structural break, if considered before and after the II World War; this is far from being a surprise, since the growth rate of GDP has been much larger in the decades after the II World War, as compared to the previous decades. However, the consideration of this structural break does not modify the substantial evidence concerning the coefficients of all other regressors; moreover, no specific reason is available to consider such a structural break in the constant terms. Hence, the regression results in the presence of the break are not printed in this article, but they are of course available from the Authors upon request. Estimations on different sub-samples have also been performed (in addition to the exercise focussed on the sub-sample 1960-2009, whose results are reported in Section 6 below), to check structural stability, and the substantial evidence of the unique regression equation has always emerged to be confirmed, as to the significance of dummy variables concerning impact and recovery effects.

[7] RCM can be seen as an estimator within the multilevel analysis (MA), that is, the analysis applied to data grouped or nested in more than one category (state, regions, in this case). MA has been applied to empirical analysis concerning *psychological* resilience (e.g., ONG *et al.*, 2006); psychological resilience is defined as "the capacity of the individual to effectively modulate and monitor an ever-changing complex of desires and reality constraints" (BLOCK and KREMEN, 1996, p. 359). However, to the best of the authors' knowledge, this is the first attempt to apply MA to the analysis of regional economic resilience. More generally, only recently MA has found application to regional economics (FAZIO and PIACENTINO, 2010; RASPE and VAN OORT, 2007; TORRISI, 2011).

[8] In order to test the heterogeneity in coefficient among regions, a likelihood-ratio (LR) test comparing the fitted mixed model to standard regression with no group-level random effects was performed for each regression. The null hypothesis of the test is that the random part of the parameter is zero. Thus, a rejection of the null hypothesis can be interpreted in the sense that regions do differ in their behaviour with respect to economic shocks.

[9] While the exact distribution of the test is known for the one-random-parameter case (SELF and LIANG, 1987), an appropriate and sufficiently general computation method for the more-than-one-parameter case has yet to be developed. Therefore, reference distributions for the latter are based on theory (e.g., STRAM and WON, 1994) and empirical studies (e.g. MCLACHLAN and BASFORD, 1988) and related tests are to be considered as *conservative*.

[10] With reference to the RCM, the introduction of a post 1946 dummy variable makes the coefficients of the recoveries starting in 1930 and in 1993 significant, but no heterogeneity across regions emerges.

[11] These pieces of evidence about (dis)equality of levels and equality of growth rates, as they appear from raw data, are not inconsistent and provide a simple story: similar growth rates apply to different levels, so that it is not surprising that the current levels across regions are heterogeneous.

[12] Consider that a restriction test with the null that the average value of gamma coefficients of Liguria, Piemonte and Lombardia is equal to the average value of gamma coefficients of Calabria, Basilicata and Sicilia gives $\chi_1^2 = 3.529$, with p=0.0603, so that one can say that the three best performers in recovery show a different performance from the three worst performers, even if only at 6% significance level.