

Regional Resilience in Italy: A Very Long-run Analysis [^]

by

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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. This is accounted for by systematic and persistent differences in the economic performance of Italian regions; hence, it is difficult to discern genuine differences in regional resilience behaviour.

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

JEL Classification: O40, R11, C32.

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[^]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. Last but not least, criticisms and suggestions from two anonymous referees have been very useful in improving the article.

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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. This is accounted for by systematic and persistent differences in the economic performance of Italian regions, hence, it is difficult to discern genuine differences in regional resilience behaviour.

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1. Introduction

Resilience is a broad concept, derived from engineering and ecological sciences, that pertains to the way in which systems react to, and recover from, shocks. Recently, a renewed interest in this theme has arisen, with specific reference to the concept has been applied to the analysis of economic growth, and more specifically to 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).

A large body of theoretical and applied research developed over the 1980-90s, as a by-product of the success of endogenous growth theories, with respect to regional growth in many country context (BARRO and SALA-I-MARTIN, 1991, 1992; BERNARD and DURLAUF, 1996, QUAH, 1996; TSIONAS, 2001). Some results are widely accepted: generally speaking, regional per capita real GDP are time series integrated of order 1

(which means that shocks have a persistent effect in the time series); co integration links among regional (and between regional and national) series do exist (meaning that long run relationships hold among regions); convergence whatever definition is considered sometimes does emerge (with different speeds), but it is not the rule in several countries. In some countries, convergence is at work only for limited period of times. Arguably, the focus on 'reaction to' and 'recovery from' specific shocks has been relatively scant in that body of literature.

Contemporarily, mathematics and physics have been developing several analyses about the reaction of stochastic systems to shock (see, for e.g., BATABYAL, 1999) with applications to environmental and development economics (PERRINGS, 1998; LEVIN *et al.*, 1998). REGGIANI *et al.* (2002) suggested that resilience could be a topic in spatial and regional economics. Two research lines can be distinguished. 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 appeared, around 2010, with a have focussed 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 interpretational 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 For this reason, the recent study of FINGLETON *et al.* (2012), on the U.K. regions, serves as approach as a useful analytical point of departure, to analyse the case of Italy and this study offers an analysis in the spirit of FINGLETON *et al.* (2012) and MARTIN (2012), with reference to Italian data. Here, in developing the analysis à la Fingleton *et al.* (2012) is kind of exercise, some

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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 this respect, pros and cons characterise the different choices; 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 obtain insights to the characteristics of the growth and development process in a century perspective.

~~Hence, the results of the present study could be of interest not only for regional economies, but also from an economic history perspective. In particular, evidence is obtained which can be useful within the long standing debate on the reasons for Italy’s persistent regional economic dualism, and its historical roots. 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 such Italian dualism (e.g., FELICE, 2011a, 2011b; BRUNETTI *et al.* 2011).~~

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

~~Finally,~~ The results from different estimation methods are provided by the present study: specifically, beyond SURE (Seemingly Unrelated Regression Equation) estimation (and the related test on 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. Yet it is found that the main conclusions remain robust to different estimators. Finally, evidence is provided about the permanent effect of 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 ~~resilience story~~ does allow the generation of some answers to a number of questions in a very simple and intuitive way. In particular, informed by the results from the model estimates produced, the following questions, among others, can be addressed:

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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? ~~Finally, is resilience a convincing story to explain regional economic differences across the Italian regions?~~ This set of questions will be specifically answered in this present investigation.

The ~~high degree of~~ 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 structured as follows. Section 2 sets out the ideas behind the concept of economic resilience, with specific reference to regional growth, and makes close reference to the results presented in FINGLETON *et al.* (2012) concerning the U.K. case. Section 3 presents the Italian data that are use in this study; in particualr, 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 such Italian dualism (e.g., FELICE, 2011a, 2011b; BRUNETTI *et al.* 2011).⁷ 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 from 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 and the regional impulse response functions are provided; the exercises are also repeated-, limiting the time sample under consideration to the most recent decades (1960-2009),-for which data are considered fully reliable.⁸ Section 5 offers some answers to the specific research questions previously articulated in this section. Sub s4.3H orld arabley 6; also

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~~in this case, the additional evidence does not appear at odds with the substance of the results coming from the analysis à la FINGLETON *et al.* (2012).~~ Concluding remarks are offered in the final section.

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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 recover form and position elastically, following a shock. The engineering perspective is mainly focussed on the immediate reaction of a system to shock and its subsequent recovery; the ecological perspective mainly focuses on how a shock persistently changes the system behaviour. In social sciences and in economics more specifically, both of these perspectives make sense, as long as shocks affect the economic system 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 degrees of resilience to recessionary shocks. 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 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 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 length. Thus, for any region i , FINGLETON *et al.* consider the following regression:

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

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 opposite, 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, especially in consideration of the heterogeneity across the regional impact reactions.²

The present study substantially rehearses this regression exercise but applied to the Italian case. However, it departs 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 stage. However, in overall terms, they conclude that the different impact reaction to common shock allows the argument to be made that different resilience behaviour in labour markets is a relevant element in the economic experience of U.K. regions.

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 1890-2009.³ 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.⁴ 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'),⁵ 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 provides 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.

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Figure 1.(a),(b),(c).- Log of income per capita

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

Figure 1 presents 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 beginning of the period, which correspond to the average level; namely Liguria and Lombardia on the one side, and Calabria and Sicily at the opposite end). Figure 2 presents 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 can not 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 results is only partially different from previous results concerning Italian regions (over shorter periods of time), which detected a slightly 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 perspective, one could affirm that the longer

time span under consideration permits to capture 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 among series in level. ~~It is m~~More surprisingly, ~~that~~ 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.

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

Table 2. - Results on 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 takes for granted 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 consistently with the evidence here provided by 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;– also in this part of the analysis the focus will be on the growth rate of GDP, taking it as the indicator of~~

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~~regional economic performance.~~ ~~C~~ 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 Identifying the recessionary shock

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–~~(considered as one shock)~~, 1926, 1929, 1931, 1933/34–~~(considered as one shock)~~, 1940/41/42–~~(considered as one shock)~~, 1944/45–~~(considered as one shock)~~, 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 ~~(or negative growth rate in the national income).~~ 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–and 20/09 are identified as a further recessionary shocks, but –Of course, there are not ~~sufficient~~ 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 1989 shocks covers the years 1893 to 95, the recovery from the 1910 shock covers the period 1911 to 1913, and so on. However, the substantial results are robust to this different choice concerning the length of the recovery periods (of fixed length equal to three years, or during until the subsequent shock takes place), in nearly all cases (the two cases in which slightly different results emerge are noted in Table 3).

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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 possible effect 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 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 recovery periods. The shocks under consideration are country-wide. 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 show any significant effect on the growth rate of regional GDP. As to the 6 remaining cases, the reaction 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 results, 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 :

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

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 stress 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 World Wars.⁶ 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%.⁷ 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 are negative, but not significant, include all regional coefficients pertaining to the 1993 shock. The gamma coefficients are generally positive, as expected (in most cases, however, they are not statistically significant); if negative, they are not statistically significant.

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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 ~~to consider~~ing the following model:

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

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 $i=1,2,\dots,16$.

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); ~~hence, it is a natural candidate to make a step ahead from traditional approaches which "deny geography" (Foster 1991, p. 140).~~ Specifically, Indeed, RCM is a powerful tool in order to deal with potential heterogeneity in resilience and hysteresis among regions: RCM allows to test zero restrictions on $\varepsilon_i, \zeta_{i(k)}$, and $\tau_{i(k)}$.⁸ ~~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~~ performed.⁹ Furthermore, in order to overcome technical limitations related to the more-than-one random parameter estimation¹⁰, *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~~the estimate are considered in which only regressors with statistically significant coefficients are inserted~~. Results are reported in Table 5.

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Table 5. - Results from Random Coefficient estimation

RCM results substantially confirm the ~~resilience~~ 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 intensity. Furthermore, as to the three-year recovery periods, RCM results are completely 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 our interpretation of the resilience story as applied to the Italian regional case-study, the main findings obtained using a SURE approach rest unchanged, showing that the roots 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 an effect which moves over time. On the other hand, 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 growth in these years is higher than over the previous decades. However, the consideration of such a structural break would not modify the substance of the results concerning the regional coefficients of shock impact and recovery variables: sign, significance and especially the test results about coefficient equality across regions remain robust to the introduction of such a break concerning the constant term.¹¹ ~~Similarly, if two separate regressions are run –one covering the period 1890–1945, and one over the period 1946–2009– the substantial conclusions remain unchanged with respect to the unified regression. For these reasons, the evidence coming from the regression design in the absence of structural break can be considered as reliable.~~

One more point is worth to be made: the reconstruction of data before the II WW 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 45 and the Appendix of DANIELE and MALANIMA (2007) for further details. Hence, one could suspect that the result of limited heterogeneity of resilience behaviour across regions could derive from the data re-construction, which imposes some forms of symmetry. To evaluate this possibility, the exercise is repeated, by limiting the attention to the sub-sample 1960-2009: the following Subsection provides evidence that the outcome of limited regional heterogeneity is confirmed, even for the most recent sub-sample, for which the issue of data reliability is not under discussion.

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4.3 Focus on the 1960-2009 sub-sample

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A regression equation like (2) is run over the period 1960-2009, considering the 20 Italian regions that are 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 outcome 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 coefficient is rejected ($p=0.0267$). As to the coefficient of the dummy variable pertaining the impact effect of the 1975 shock, only in 12 out of 20 regions, it is statistically significant; consistently, the equality of these coefficient 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

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across these coefficients is rejected. As to the dummy variables pertaining the recovery, for each of the three cases, tests lead to accept the null that coefficients are equal across regions, at the 95% confidence level (some doubts could be casted 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 never emerge to be neither significantly positive or and statistically different across regions.

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In sum, a clear-cut conclusion can be drawn: even over the 1960-2009 period, the regional reaction to recessionary shocks and -especially- the recovery from that shocks do not seem to display sufficient heterogeneity to explain the huge 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. Thus, it would be incorrect to state that the scanty heterogeneity in resilience behaviour of Italian regions in the very long-run is an outcome of data re-construction. In what follows, comments are developed with reference to the estimation over the whole time sample, if not differently stated.

4.4 Evidence on the impulse responses

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Here, the fact that the shocks have permanent effect (that is, series are integrated of order 1) is explicitly considered. 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 (orthogonalised 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.* procedure is applied to the data at hand, aggregating the Italian regions into 5 macro-areas: Northwest, Northeast, Centre, South, Islands. Then, the graphical analysis is

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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, graph (b) reports the effect that a shock in each of the 5 areas has in the same area.

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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 note 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 all shocks (consistently with the I(1) nature of the series of GDP in log-levels) leadpermits 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 degree 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 only on the specificity of the ‘major’ recessionary shocks. What the two parts of the analysis evidence says 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.

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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 instance, an ANOVA F test on 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 ($F_{15,1872}=0.131, p=1.000$).¹² However, a formal test on equality of alpha coefficients in regression equation (2) rejects the null of equality. This means that the autonomous growth rates differ across regions, after having controlled for the effect of shocks and recoveries from shock. In other words, 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, ~~this enables to say that thanks to shocks, growth rates appear equal across regions:~~ 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 have a significant specific effect on the growth rate of regions, or to have a significant effect in the period of recovery following it. On the basis of statistical significance of dummy variable, only six significant shocks over a 120 year ~~the~~ period ~~1890-2009~~ can be detected.

3. *Have all major shocks the same effect on any given region?*

No, the six considered shocks have different impact effects on any region. This result derives from a series of formal test on the null hypotheses $\beta_{i,(1)} = \beta_{i,(2)} = \dots = \beta_{i,(6)}$ for each i -th region, $i=1,2,\dots,16$. 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 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 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 shocks is concerned. Hence, it seems that the story of resilience –though conceptually intriguing and worth analyzing– is unable to provide a sound explanation of the persistent differential of growth performances across Italian regions. Of course, the reason of why persistent differences across regions remain over the centuries remain open and it is beyond the goal of the present article.

7. Which are the ~~three~~-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 limit the impact ~~of recessionary reaction to shock~~, (iv) the recovery from shocks, (v) the autonomous growth rate (~~i.e., that is, the growth rate conditional on the shock-impact and recovery effects-of shocks~~)?

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

- The three regions with the highest GDP average level are: Liguria, Lombardia and Piemonte (the three highest GDP levels at the first decade of our period, 1891-1900, pertain to Lazio, Liguria and Lombardia; the three highest GDP levels in the final decade of our period, 2000-09, pertain to Lombardia, Emilia-R., Lazio. At the opposite end of the list, the three regions with the lowest GDP average level are Calabria, Basilicata and Sicilia (the three lowest GDP levels at the beginning of the period under consideration, 1890, pertain to Calabria, Abruzzo and Basilicata; the three lowest GDP levels at the end of the period, 2009, pertain to Campania, Calabria and Puglia).
- 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) one can consider the results of regression equation (2) and look at the size of beta coefficients; in particular:

- ~~Just to curiosity, the lowest beta coefficient (the highest one in absolute value) corresponding to the worst impact effect is associated to the 1944/45 shock in Campania. Of course,~~ to evaluate the general ability of regions to resist to the impact effect of shocks, it makes sense to look at the ‘average’ level of their beta coefficients. If a simple average of beta coefficients for each regions 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 rather unrelated to national industrial shocks, while Umbria and Basilicata are small regions: adverse shocks have the most limited negative impact in these regions. 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 just a ‘numerical curiosity’ without statistical significance support. In any case, the best recovery performances appear to pertain to Liguria, Piemonte and Lombardia, while the worst ones belong to Calabria, Basilicata and Sicilia.¹³ ~~(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 $\chi^2_1 = 3.529$, 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.)~~

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- 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 lowest ones belong to Puglia, Campania, Sicilia.

All these pieces of information, are reported in Table 6, which represents –just to joke– a sort of provocative medal-list for best and worst Italian regions, as far as the economic performance concerns.

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Table 6. - The resulting medal-list for the Italian regions

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. However, 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 cases. 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 ~~gamma~~ 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. ~~Thus, it appears correct to conclude that the high income level regions are able to show a better recovery from shock, rather than to say that a better ability to recover from shock leads to higher income levels.~~

6. Concluding remarks

This article has evaluated the economic resilience of Italian regions, that is, the regional behaviour in reacting to ~~common~~ 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.

~~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. The findings of the present study have documented that Italian regions show a surprisingly low degree of heterogeneity across regions, as far as their reactions to recessionary shocks and recovery from shocks are concerned.~~ 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.

~~In sum, this study has~~ ~~Thus,~~ ~~at the conclusion~~ can be drawn that differences in economic resilience behaviour are not able to explain the different economic performance of Italian regions with a convincing interpretation. Of course, the reasons

of huge and persistent differences in economic performance across Italian regions remains a fascinating issue, that goes beyond the scope of the present study.

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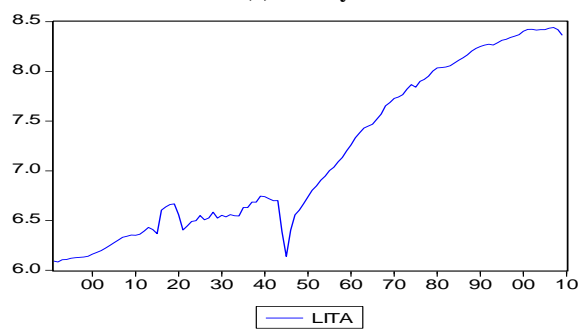
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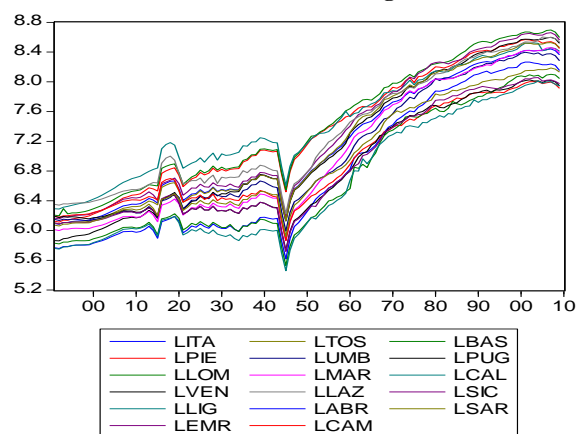
FIGURES

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

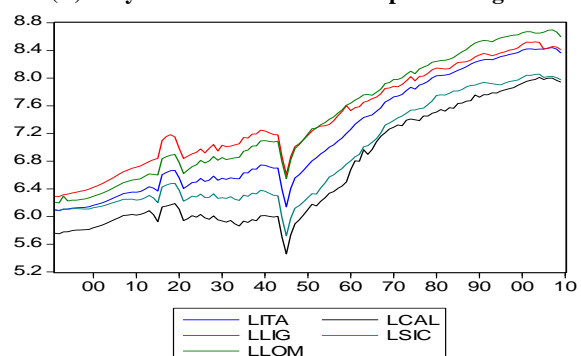


Figure 2. The annual growth rate of income per capita in Italy

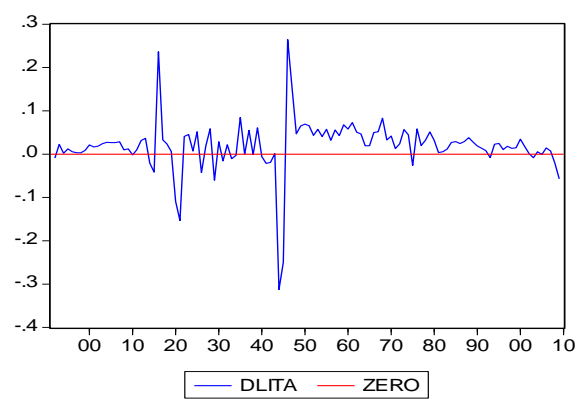
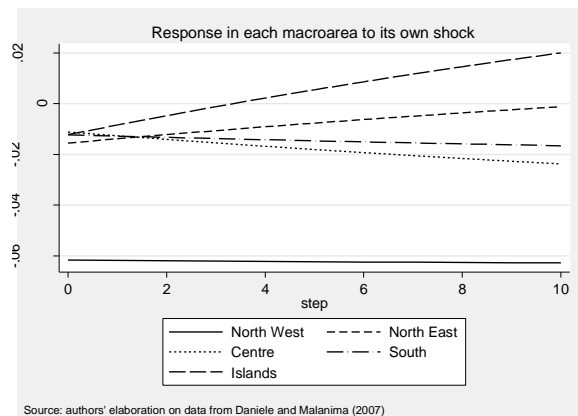
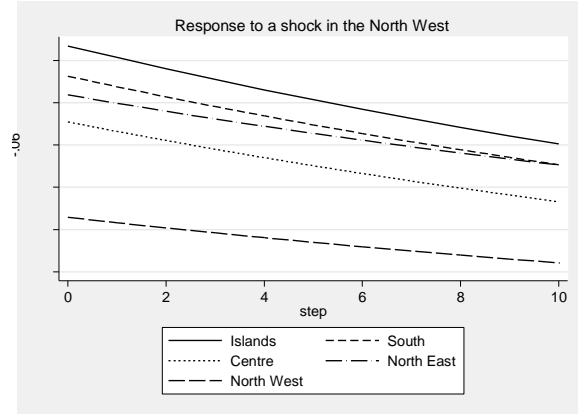
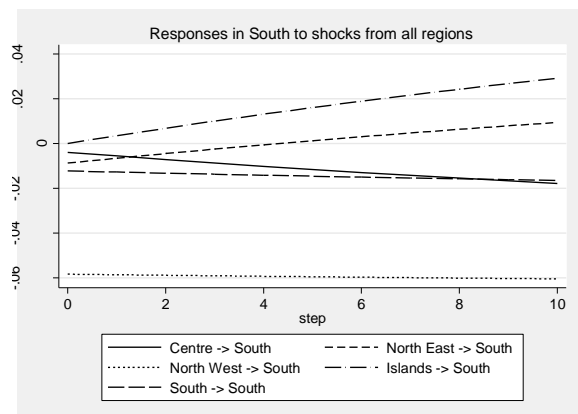


Figure 3.(a),(b),(c).- Impulse response functions (from VECM estimation, 1890-2009)



Source: authors' elaboration on data from Daniele and Malanima (2007)



TABLES

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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 on 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		Trace	Crit	Max-Eigen	Crit		
No. of CE(s)	Eigenval	Statistic	Value	Prob.	Statistic	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 in 1946	**	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	Table 4: Results from the SURGE corresponding to Eq. (2)												
	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 (0.075)*	0.071**	0.000 (1.00)
1920/21	-0.149**	0.000 (1.00)	==	==
1929	-0.080**	0.000 (1.00)	==	==
1944/1945	-0.306**	0.000 (1.00)	0.130**	0.000 (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 [87](#)). **(*) denotes significance at the 5% (10%) level.

Table 6. The resulting medal-list for the Italian regions

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

¹The reliability of the data referring to the previous decades, and in particular the data before the II World War, is debateable, provided that they are built starting from few original data points. However, the results pertaining to the whole sample are substantially in line with the results based on the 1960-2009 sub sample.

²As 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). Moreover, equally ~~n~~Not surprisingly, they also find that the β coefficients concerning different shocks for one region are not equal, i.e., the null $\beta_{i,(1)} = \beta_{i,(2)} = \dots = \beta_{i,(K)}$ 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 4.47, we do not deal with this aspect in our present research, and for this reason we do not report their results here.~~

³ 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.

⁴ In DANIELE-MALANIMA's data, which are considered here: Valdaosta is included in Piemonte, Trentino A.A. and Friuli V.G. are included in Veneto, and Molise is included in Abruzzo. Data reconstruction is based on the current boundaries of regions.

⁵ 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).

⁶ 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.

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⁷ 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.

⁸ 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), ~~while the very recent study on the resilience of U.K. regions of FINGLETON *et al.* (2012), as already mentioned, still adopts a SURE approach to achieve different estimates on regional basis.~~

⁹ 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.

¹⁰ 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*.

¹¹ 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.

¹² 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.

¹³ 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 $\chi^2_1 = 3.529$, with $p=0.0603$, so that one can say that the three best

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[performers in recovery show a different performance from the three worst performers, even if only at 6% significance level.\)](#)