SPATIAL HIERARCHICAL ANALYSIS OF ITALIAN REGIONS

by

Paolo Postiglione and Geoffrey J. D. Hewings

REAL 06-T-11 September, 2006

SPATIAL HIERARCHICAL ANALYSIS OF ITALIAN REGIONS[1]

Paolo Postiglione[2]
University of Chieti-Pescara, Italy

Geoffrey J.D. Hewings[3]
REAL, University of Illinois at Urbana-Champaign, USA

Abstract: Regional interactions and spillover effects should be considered as important factors in growth analyses of regional economies. In this paper, using a modified version of the Dendrinos-Sonis model (1990), we analyze the spatial hierarchical system of Italy. The interaction among Italian regions is considered at three different levels of spatial aggregation based on the NUTS classifications. The results from the model strongly depend on the choice of the region considered as the numeraire. In this paper, we define some general rules to help economic researchers in the choice of the reference region.

Keywords: Dendrinos - Sonis model, regional interactions, income variables, Italy.

JEL Classification: C21; R11; R12

---

[1] Part of this paper was completed while the first author was visiting the Regional Economic Analysis Laboratory of University of Illinois at Urbana-Champaign.

[2] Department of Business, Statistical, Technological and Environmental Sciences, University of Chieti-Pescara, Viale Pindaro, 42 – 65127, Italy (e-mail: postigli@unich.it)

[3] Regional Economics Applications Laboratory, University of Illinois, 607 S. Mathews, Urbana, Illinois, 61801-3671, USA (e-mail: hewings@uiuc.edu)

1. Introduction

In the application of spatial econometric techniques, there are a number of options for addressing the problem of spatial correlation in modeling a system of regions (see Anselin and Bera, 1998, Arbia, 2006 and Anselin et al., 2004). These options include the a priori specification of a weight matrix that captures, primarily, the effects of spatial contiguity (Anselin and Florax 1995); the endogenous generation of spatial influences by employing estimation methods that search for the influences of one spatial unit on another (e.g., Fingleton, 2003) and there are authors who promote the use of a priori "cleansing" of the data of spatial influences prior to formal econometric estimation (e.g., Getis and Griffith, 2002). A less popular alternative has been one that has adopted an approach in which each region's influence is modeled explicitly without regard to its location (see Magalhães et al., 2001, Marquez et al., 2006).

A further complication arises when regional data are available at different levels of spatial aggregation; the issue here shifts to concerns about the consistency of results over different spatial aggregations; the Modifiable Areal Units Problem (MAUP, see Arbia, 1989, Openshaw and Taylor, 1979) is well known and will be addressed in this paper through analysis of a set of three different sets of areal units.

The aims of the paper are to extend the Dendrinos-Sonis (DS) model to analyze the spatial hierarchical system of Italy. The model, originally developed to explain the dynamics of population changes, has been applied to income variables in several papers (Hewings et al., 1996, Nazara et al., 2006, Magalhães et al., 2001, Marquez and Hewings, 2003, Marquez et al., 2006, Dall'erba and Percoco, 2003). The DS model, in contrast with the classical spatial econometrics, does not use a spatial weight matrix to analyze the geographical interaction among the regions. Here, the central idea is to consider the growth in terms of relationships between regions using a particular macroeconomic variable (in this paper, shares of gross domestic product). The interaction between regions is modeled explicitly.

In particular, we want to analyze the horizontal and vertical interaction of Italian geographical units using three different levels of spatial aggregation based on the NUTS classifications, NUTS 1, NUTS 2 and NUTS 3, developed by Eurostat (2002). In the past, two papers used DS model to investigate interactions among Italian regions. Haddad and Hewings (2003) analyzed only horizontal interaction among NUTS 1 macro-regions of Italy and the issue that arose was the

degree to which the results were likely to be consistent across all spatial levels. Dall'erba and Percoco (2003) also examined only horizontal interaction using 11 Italians macro-regions and the obtained results were very different from the ones in Haddad and Hewings (2003) especially in terms of typology of relationship among regions. Probably, the different level of spatial aggregation and the length of the period under investigation used in the two papers have influenced the estimates (Dall'erba and Percoco, 2003)

In the literature, it is possible to find a small set of other papers that have analyzed horizontal and vertical interaction using two levels of spatial aggregation (e.g., Nazara et al., 2006) or have at least addressed the issue of spatial scale (e.g. Amos, 1988).

A further issue to be explored concerns the identification of an appropriate numeraire on which the DS model is based. The paper will evaluate the sensitivity of the results to the choice of the numeraire. In particular, we want to define some possible rule for the choice of the numeraire region and to show some possible behavior of the results as a function of differences in the numeraire chosen. While the DS model has the advantage of an endogenous specification of spatial influence, having the results somewhat dependent on the choice of numeraire has been seen as an important drawback.

The paper is organized as follows; in the next section, the basic model will be presented and interpreted. Section 3 will be devoted to the definition of some possible rules for the choice of the numeraire. In Section 4, we will describe the results of our empirical hierarchical analysis of Italian regions. Finally, in Section 5 we draw some concluding remarks and outline some possible further future development of DS model.

2. The Basic Model

Let us assume a national economy divided into a set of mutually exclusive regions at three spatial scales. The objective is to model the behavior of regional shares of a national aggregate, in this case, gross domestic product, over time in an attempt to ascertain the degree to which growth in the share in one region results in the loss of share in another region (competition) or generates an increase in the share of another region (complementarity). Define $y_i(t)$ as the GDP share of geographical units i, where i refers to the macro-region (NUTS 1 level), the region

(NUTS 2 level) or the province (NUTS 3 level) at time *t*. The general log-linear model may be defined as (see Dendrinos and Sonis, 1988):

$$\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t) \qquad (1)$$

where *j*=2,3,…,*n*; *k*=1,2,…,*n* are the geographical units at the same level of spatial aggregation, *t*=1,2,…, *T* denotes a finite time period and the region designated as 1 is the numeraire.

The coefficient $a_{jk} = \frac{\partial \ln G_j}{\partial \ln y_{kt}}$ is the pseudo-elasticity term; it is the percentage change of GDP share in unit *j* relative to that in unit 1, the numeraire region, with respect to a one percentage change of GDP share in unit *k*. According to Marquez et al., (2006), we use the notation pseudo-elasticity for the coefficient a_{jk} to stress the concept; in fact, more exactly, the coefficient measure the variation of relative GDP share of *j-th* region in terms of variation of absolute GDP share of *k-th* region.

A Cobb-Douglas type function G_j is used in this paper, defined as $G_j = A_j \prod_{k=1}^{n} y_k^{a_{jk}}(t)$, yielding the expression $\ln(G_j) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t)$, where the parameter A_j represents the locational and temporal advantages of geographical unit *j* (Sonis and Hewings, 2000).

A positive value of the coefficient a_{jk} indicates complementarity growth between the two units *j* and *k*, while a negative value of the coefficient a_{jk} indicates competition growth between the two units *j* and *k*.

Unfortunately, the model (1) analyzes only the horizontal relationship between two geographical units; in other words, it only considers horizontal interaction that might occur among the regions considered at the same level of spatial aggregation (i.e. NUTS 1 units with NUTS 1 units, NUTS 2 units with NUTS 2 units, and so forth). Vertical interaction, on the other hand, concerns the relationship among regions considered at different hierarchical levels (i.e. NUTS 2 units with NUTS 1 units, NUTS 3 units with NUTS 2 units, NUTS 3 with NUTS 2 and NUTS 1 units).

Therefore, to analyze the vertical interaction of first level (i.e. NUTS 2 units with NUTS 1 units, NUTS 3 units with NUTS 2 units) in addition to horizontal relationships, we have to consider the following model:

$$\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t) + \sum_{l=1}^{m} a_{jl} \ln y_l(t) \qquad (2)$$

where j=2,3,…, n; k=1,2,…, n are the geographical units at the same level of spatial aggregation, l=1,2,…,m are the geographical units at one higher level of spatial aggregation (i.e. j and k are NUTS 2 units and m are NUTS 1 units or j and k are NUTS 3 units and m are NUTS 2 units) and j=1 is the geographical unit considered as the numeraire or reference region.

The coefficient $a_{jk} = \frac{\partial \ln G_j}{\partial \ln y_{kt}}$ is the same as before. However, the coefficient $a_{jl} = \frac{\partial \ln G_j}{\partial \ln y_{lt}}$ is a new different pseudo - elasticity term; this coefficient measures the percentage change of GDP share in unit j relative to that in unit 1, the numeraire, with respect to a one percentage change of GDP share in units l, where l are the geographical units at one higher level of spatial aggregation with respect to the j units.

Finally, if we have available data at three different level of spatial aggregation, as in Italy, to analyze the horizontal interaction and the vertical interaction of first level and the vertical interaction of second level and, it is necessary to consider the following model:

$$\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t) + \sum_{l=1}^{m} a_{jl} \ln y_l(t) + \sum_{i=1}^{p} a_{ji} \ln y_i(t) \qquad (3)$$

where j=2,3,…, n; k=1,2,…, n are the geographical units at the NUTS 3 level of spatial aggregation, l=1,2,…, m are the geographical units at NUTS 2 level of spatial aggregation and i=1,2,…, p are the geographical units at NUTS 1 level of spatial aggregation.

Here, the pseudo – elasticity coefficient $a_{jk} = \frac{\partial \ln G_j}{\partial \ln y_{kt}}$ measures the percentage change of GDP share in NUTS 3 unit j relative to that in unit 1, the numeraire, with respect to a one percentage

change of GDP share in NUTS 3 units *k*, the pseudo – elasticity coefficient $a_{jl} = \frac{\partial \ln G_j}{\partial \ln y_{lt}}$ measures the percentage change of GDP share in NUTS 3 unit *j* relative to that in unit 1, the numeraire, with respect to a one percentage change of GDP share in NUTS 2 units *l*. Finally, the pseudo – elasticity coefficient $a_{ji} = \frac{\partial \ln G_j}{\partial \ln y_{it}}$ measures the percentage change of GDP share in NUTS 3 unit *j* relative to that in unit 1, the numeraire, with respect to a one percentage change of GDP share in NUTS 1 units *i*.

The general specification of models (1), (2), (3) can be relaxed, considering in the formulation, only some pseudo - elasticity coefficients. In such a way, we define alternative models where the regressors for each geographical unit are not the same. Hence, the SUR technique is the proper estimation method to analyze the different models.

3. The Choice of Numeraire

The problem of the choice of the numeraire of DS model has never been analyzed in a formal way in the economic literature. A first preliminary attempt in such direction is represented by Kamariakis and Kaslis (2005). The choice of the numeraire is neither trivial nor unimportant; in fact, in the DS model it plays a role that is of the same level of importance as the choice of the spatial weight matrix in classical spatial econometrics. Unfortunately, there is no general rule for the choice of the numeraire and the results are sensitive to the choice of numeraire. For instance, Dall'erba and Percoco (2003), in the case of Italian regions, chose Emilia Romagna as numeraire, because it has a good mix of industries, social capital and relevant performances of local government. Instead, to analyze Italian NUTS 1 units, Haddad and Hewings (2003) used Islands macro-regions as reference, without explaining the reason of such choice. Finally, in their analysis of Indonesian provinces, Nazara et al., (2006) chose different provinces for each region as numeraires.

More generally, the numeraire can be chosen according to the different objectives of the analysis (i.e., there may be different objectives that justify the use of different numeraires). Some possible choices that have been made include the following. We can choose the numeraire as the

richest geographical unit, if we want to compare each geographical unit with the most prosperous one; with this choice, we can make a benchmark analysis, and measure the distance from the best situation. Each geographical unit can thus be presented in terms of its difference in GDP share from the most prosperous geographical unit.

Alternatively, the poorest geographical unit could be chosen and the benchmarking would have the reverse interpretation from the one in which the wealthiest unit was chosen as numeraire. A third option would be the choice of the median geographical unit, if we want to compare each geographical unit with the one that, in terms of its ranking of per capita GDP, is in the median position. A fourth option would be to use a geographical unit that is the objective of analysis – perhaps a region that is the target for some development strategy, or a region with a level of GDP that is regarded as a minimum level to be achieved. Of course, it would be possible to use other definitions for the numeraire (i.e., per capita GDP average of the geographical units) but in this paper only the formulations that correspond to the real value of per capita GDP have been considered.

The richest or poorest region has been defined using per capita GDP, even if the DS model is defined with GDP shares. In fact, if we use GDP share to define richest or poorest region we generate problems; in Italy, using GDP share at NUTS2 level, the poorest region is Valle d'Aosta; but this result is obviously influenced by the small population of the region. In a more appropriate way, using per capita GDP, the poorest region is Calabria. In particular, to determine the richest and poorest region, we use the average of per capita GDP over the time period, 1980-2003.

4 The Empirical Analysis

The empirical study focuses on geographical units of Italy at three different level of spatial aggregation: NUTS 1, NUTS 2, NUTS 3. At the beginning of the 1970s, Eurostat set up the Nomenclature of Statistical Territorial Units (NUTS), as a coherent system to provide a geographical division of the EU's territory. The NUTS system is a hierarchical classification. Each member state of EU is divided into a number of regions at NUTS 1 level. Each of these is divided into regions at NUTS 2 level and these in turn into regions at NUTS 3 level. (Eurostat, 2002).

In Italy, the level NUTS 1 corresponds to 5 macro-region (North West, North East, Centre, South, Islands); the level NUTS 2 corresponds to 21 regions (19 administrative regions and the autonomous provinces of Trento and Bolzano); the level NUTS 3 corresponds to 103 administrative provinces of Italy (see figure 1).

<<insert figure 1 here>>

The data were derived from the Cambridge Econometrics data set. As it is well known, Italy is characterized by a North-South dualism, i.e., large disparities between North, more developed from an economic point of view, and South regions, not advanced economically. Paci and Saba (1998) pointed out that Italy has the highest spatial degree of inequality in terms of Gross Regional Product distribution among industrialized countries. To highlight this dualism, as a prelude to the implementation of the DS model, we analyze the average of per-capita GDP, over the time period 1980-2003, at the NUTS 1 and NUTS 2 level of spatial aggregation. The results are presented in figures 2 and 3.

<<insert figures 2 and 3 here>>

Figures 2 and 3 reveal that large disparities, in terms of GDP per capita, are present in the Italian economy and have persisted over time. To evaluate the disparities among Italian regions we have also analyzed the σ-convergence over the same time period (1980-2003). The σ-convergence approach is based on the study of the time trend of the variance of the logarithms of the regional per capita GDP. In order to measure the σ-convergence, we compute the following:

$$\sigma_t^2 = \frac{1}{n}\sum_{i=1}^{n}\left(\ln y_{it} - \mu_t\right)^2 \qquad (4)$$

where y_{it} is per capita GDP of i^{th} economy a time t, μ_t is the mean of $\ln y_{it}$ and n the number of regions under investigation. If there is a decreasing long-term trend, then regions appear to converge to a common growth rate and so σ-convergence is verified. The σ-convergence has been calculated both at the NUTS 1 level and NUTS 2 level of spatial aggregation in terms of

coefficient of variation, with the results presented in figure 4. The path of the coefficient of variation of natural logarithm of per-capita GDP is quite stable; we can observe a decrease of the variance in the 1990s. However, the existence of σ-convergence is not verified. This result raises some questions about what is happening in the regions and the degree to which their growth or lack thereof has affected the performance of other regions.

4.1 The NUTS 1 Analysis of Italian Regions

In applying the DS model, we have chosen the numeraire in three different ways: (1) the richest macro-region in terms of per capita GDP (ITC=North West) (Model a); (2) the median macro-region in terms of per-capita GDP (ITE=Centre) (Model b); and (3) the poorest macro-region in terms of per capita GDP distribution (ITF = South) (Model c). Comparison of the results is then made to explore the degree to which the findings are consistent.

We have estimated different models. The first is $\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t)$, where all the pseudo - elasticity terms have been considered.

<<insert tables 1a, 1b, 1c here>>

The system of equations (a), with the richest macro-region as numeraire has, on the whole, the better results in terms of R^2. Only the first two equations of model (b) and model (c) yield good results in terms of R^2. The results certainly depend on the choice of numeraire. The coefficients that are significant in one system of equations are not always significant in another system. If comparison is made of the three different situations (a- numeraire the richest macro-region), (b- the median macro-region), (c- the poorest macro-region), we can observe the following percentage of different signs:

a/b	40%
b/c	80%
a/c	6.67%

Hence, the cases (a) and (c) are very similar; only 6.67% of the coefficients have different signs for the pseudo - elasticity terms (see tables 2a, 2b, 2c). Note that comparison was made only with the equations where the dependent variables were the same even if expressed as a function of different numeraires (i.e. North East with numeraire equal to ITC with North East with numeraire equal to ITE and so on).

<<insert tables 2a, 2b, 2c here>>

The cases (a) and (c) reveal a competitive interaction among macro-regions, while the situation (b) shows a more complementary interaction; thus, the choice of numeraire yields different results. Using the last specification for the numeraire, we obtain the largest number of significant coefficients. The competitive relationship, revealed by the results (a) and (c), confirm the results of Haddad and Hewings (2003) obtained using Islands macro-region as the numeraire. Considering the first law of geography (Tobler, 1970), the results are different from what should be expected. The complementary interactions are less than expected. However, the level NUTS1 may not be the most appropriate spatial scale for analysis.

Other different D-S models have been estimated, for instance, considering, as independent variables, only the macro-regions that are the neighbors of the macro-regions under investigation; but the results in terms of R^2 and significant pseudo – elasticity coefficients are not better than those obtained with the "complete" DS model.

4.2 The NUTS2 analysis of Italian regions

At this spatial scale, the criterion for the choice of the numeraire is the same as for NUTS1 analysis: the richest region in terms of per capita GDP (ITD1=Bolzano-Bozen); the median region in terms of per capita GDP distribution (ITC3= Liguria) and the poorest region in terms of per-capita GDP (ITF6 = Calabria). We have estimated two different models:

Model (1) to analyze horizontal interaction at NUTS2 level:

$$\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t)$$

and Model (2):

$$\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t) + \sum_{l=1}^{m} a_{jl} \ln y_l(t)$$

to analyze horizontal (among NUTS 2 regions) and vertical interaction among NUTS 2 provinces with NUTS 1 macro-regions.

The numeraire is always the same for all the regions. The model (1) considers for each NUTS 2 region, as the independent variable, only the natural logarithm of GDP share of the NUTS 2 regions belonging to the same NUTS 1 macro-region and the NUTS 2 region numeraire. The pseudo - elasticity terms of the numeraire-region are always considered in the analysis. A similar approach for the NUTS 2 regions is adopted in model (2), but we consider in this model all the other NUTS 1 macro-regions of Italy.

The systems of equations, with the richest and median macro-region as numeraire, generate, on the whole, the better results in terms of R^2 (see tables 3a, 3b, 3c) for the analysis of horizontal interactions in the NUTS 2 regions. In fact, there are no equations with R^2 <0.65 for the system of equations with the richest region (i.e. ITD1) as the numeraire, only two for the system of equations with the median region (i.e. ITC3) as numeraire, while we have eight equations for system of equations so categorized with the poorest region (i.e. ITF6) as numeraire.

<<insert tables 3a, 3b, 3c here>>

The results clearly depend on the choice of numeraire. The coefficients that are significant in one system of equations are not always significant in another system. If we compare the three different situations (a- numeraire the richest macro-region), (b- the median macro-region), (c-the poorest macro-region), we can observe the percentage of different signs:

a/b	35.22%
b/c	24.14%
a/c	48.83%

Comparing these three NUTS 2 situations with the similar procedures that were adopted for the NUTS 1 regions, we can observe a reduction of changes in (a/b) and (b/c) comparisons and a dramatic increase in the (a/c) comparison.

Recall that this model only captures the NUTS 2 interregional interactions within a particular NUTS 1 macro-region. The three different systems show a substantial complementarity interaction (a greater number of + than -) within the macro-regions in accordance with the first law of geography (Tobler, 1970). The pseudo - elasticity terms of the numeraire are not always significant in the three models. These results show that only some horizontal interactions between regions are significant (see tables 4a, 4b, 4c).

<<insert tables 4a, 4b, 4c here>>

To analyze vertical interaction we have to insert in the models the effects of NUTS1 macro-regions. The effects of NUTS1 macro-regions improve the results in terms of R^2; there are no equations with R^2 <0.65 for system of equations with the richest region (ITD1) numeraire, only one when the median region (ITC3) is used as numeraire and only two for the case with the poorest region (ITF6) as numeraire (see tables 5a, 5b, 5c).

<<insert tables 5a, 5b, 5c here>>

If we compare the three different situations (a- numeraire the richest macro-region), (b- the median macro-region), (c-the poorest macro-region), we can observe the percentage of different signs:

a/b	18.29%
b/c	33.13%
a/c	34.57%

If we compare, these three NUTS 2 situations including NUTS 1 effects with NUTS 1 ones, we can observe a reduction of changes in (a/b) and (b/c) comparisons and a dramatic increase in (a/c) comparison. If we compare, these three NUTS 2 situations including NUTS 1 effects with

NUTS 2 ones, we can observe a high reduction of changes in (a/b) and (a/c) comparisons and an increase in (b/c) comparison. In other words, the introduction of NUTS 1 effects decreases the difference of signs in two situations, generating a more stable analysis.

If we analyze the horizontal interaction in the three models (see tables 6a, 6b, 6c), we can observe that we have substantial complementarity relationships in the North East regions (ITD labels), in the South regions (ITF labels) and in the Islands (ITG labels), an intermediate situation (almost the same number of + and -) in the North West regions (ITC labels). The situation in the Centre regions is quite contradictory. We have one region (ITC4 Lazio) that reveals a complementarity relationship with all other regions belonging to the same NUTS 1 macro-region (the same situation of North East regions); the other regions show a competitive relationship.

<<insert tables 6a, 6b, 6c here>>

If we analyze vertical interactions (the signs of NUTS 1 effects), we can observe less changes in the signs of the pseudo - elasticity coefficients among the three different systems of equations defined in terms of the three different numeraires. The results, with reference to only NUTS 1, effects can be summarized in the following table:

a/b	17.10%
b/c	28.94%
a/c	32.89%

Furthermore, we can observe (see tables 6a, 6b, 6c) that the Centre regions (ITE labels), with the only exception of ITE4 Lazio, show competitive relationships, South (ITF labels) and the Islands regions (ITG labels) have substantial complementarity interactions with the NUTS 1 macro-regions. The relationships of North West (ITC) and North East regions (ITD) are different as a function of the numeraire chosen. The ITC regions have substantial complementarity with NUTS 1 macro-regions if we choose the richest and the median region as numeraire but have a competitive situation if we choose the poorest region. The ITD regions with NUTS 1 macro-

regions have substantial complementarity if we choose the richest and the median region as numeraire and have an intermediate situation if we choose the poorest region.

Inserting, the regional effect, we can observe that the significant coefficients in the models without macro-regional effects are not always significant in the models with NUTS 1 macro-region effects. From the better results in terms of R^2 and from the last consideration, we can affirm that the results change not only as a function of the different numeraire specification but also as a result of inserting the regional effects into the model .

4.3 The NUTS3 analysis of Italian regions

In Italy, the number of provinces has changed over time. From 1980 to 1992, there were 95 provinces, from 1992 to 2005 the number increased to 103 provinces and from 2006 there was a further increase to 107 provinces. For this reason, we have chosen only a portion of Italy, in particular, some provinces belonging to Centre Italy (ITE) and South Italy (ITF). The number of provinces in these regions has been stable throughout the period of investigation.

The criteria for the choice of the numeraire are the same of NUTS 1 and NUTS 2 analysis. In this case, the numeraire provinces are as follows: the richest province in terms of per capita GDP (ITE43=Roma); the median region in terms of per capita GDP distribution (ITF13= Pescara); and the poorest macro-region in terms of per-capita GDP (ITF45 = Lecce). Two different models were estimated:

Model (1): $\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t)$

to analyze horizontal interaction at NUTS 3 level and Model (2):

$$\ln y_j(t+1) - \ln y_1(t+1) = \ln(A_j) + \sum_{k=1}^{n} a_{jk} \ln y_k(t) + \sum_{l=1}^{m} a_{jl} \ln y_l(t) + \sum_{i=1}^{p} a_{ji} \ln y_i(t)$$

to analyze horizontal (among NUTS 3 regions), and vertical interaction of NUTS 3 provinces with NUTS 2 regions and NUTS 3 provinces with NUTS 1 macro-regions (see Nazara *et al*., 2006). The numeraire is not different for each group of regions.

Model (1) considers for each NUTS 3 province, as the independent variable, only the natural logarithm of GDP share of the provinces belonging to the same NUTS 2 region and additionally

the NUTS 3 province considered as numeraire. The pseudo - elasticity terms of numeraire-province is always considered in the analysis.

Model (2) adopts the same conventions for the NUTS 3 regions but the NUTS 2 regions belonging to the same NUTS 1 macro-region and all the other NUTS 1 macro-regions of Italy are also considered.

<<insert table 7a, 7b,7c here>>

The systems of equations for the analysis of horizontal interactions of NUTS 3 regions, with the median province as numeraire, has on the whole the better results in terms of R^2 (see tables 7a, 7b, 7c). There is only one equation with R^2 <0.65 for system of equations with the median region (ITF13) numeraire, five equations when the richest region (ITE43) numeraire is chosen and seven with the poorest region (ITF45) numeraire. The results depend on the choice of numeraire; as in the previous analysis, the coefficients that are significant in a system of equations are not always significant in another system. If we compare the three different situations (a- numeraire the richest macro-region), (b- the median macro-region), (c-the poorest macro-region) we can observe the percentage of different signs:

a/b	29.09%
b/c	30.00%
a/c	29.36%

The results reveal that the percentage of differences of signs is quite similar in the three different comparisons. Recall that this model only captures the NUTS 3 interregional interactions within a particular NUTS 2 region. The provinces belonging to ITF2 (Basilicata) show a quite similar behavior (complementarity) in the three different qualitative analyses (see tables 8a, 8b, 8c). The other provinces belonging to other regions show very different relationships in function of different numeraires.

<<insert tables 8a, 8b,8c here>>

The pseudo - elasticity terms of the numeraire are not always significant in the three models. These results show that only some horizontal interactions between regions are significant.
To analyze horizontal and vertical interactions, we have to insert in the models the effects of NUTS1 macro-regions and NUTS2 regions (see tables 9a, 9b, 9c).

<<insert tables 9a, 9b, 9c here>>

The effects of NUTS1 and NUTS2 improve the obtained results in terms of R^2; in fact, we have only one equation with R^2 <0.65 for system of equations with the richest region (ITE43) numeraire. There are no equations in this category for system of equations with the median region (ITF13) numeraire and only three for the system of equations with numeraire the poorest region (ITF45).
If we compare the three different situations (a- numeraire the richest macro-region), (b- the median macro-region), (c-the poorest macro-region), we can observe the percentage of different signs:

a/b	31.96%
b/c	36.07%
a/c	33.92%

This table shows that the percentage of differences of signs is quite similar in the three different comparisons. If we compare, these three NUTS3 situations including NUTS1 and NUTS2 effects with NUTS3 without effects, there are no differences in the changes of signs (see tables 10a, 10b, 10c).

<<insert tables 10a, 10b, 10c here>>

If we analyze the horizontal interaction in the three models, we can observe that we have substantial competitive relationships in the provinces of ITE2 (Umbria) and ITE3 (Marche), while we are in intermediate situation in the other provinces. If we analyze vertical interactions of first level (the signs of NUTS2 effects), we can observe the following situation:

a/b	30.43%
b/c	40.68%
a/c	27.82%

Furthermore, we can observe (see tables 10a, 10b, 10c) that ITE2 (Umbria), ITF3 (Campania), ITF4 (Puglia) show substantial complementarity relationships, while ITF1 (Abruzzo) ITF2 (Molise) show competitive relationship. ITE1 (Toscana), ITE3 (Marche), ITE4 (Lazio) show an intermediate situation and very different signs that depend on the numeraire chosen.
If we analyze vertical interactions of second level (the signs of NUTS1 effects), we can observe the following situation:

a/b	31.48%
b/c	42.72%
a/c	36.11%

Note that ITE (Centre) and ITG (Islands) show complementarity relationships while ITF (South) reveal competitive relationships. If we choose, as numeraire the richest or the poorest province, ITC (North East) and ITD (North West) show complementarity relationships.

5. Concluding Remarks

In this paper we have used the Dendrinos-Sonis model to test the presence of complementarity/competitive relationship among Italian regions. Furthermore, we have analyzed the impact of different numeraires on the results. In particular, we have presented some possible ideas to help the researcher in the choice of numeraire, since there has been little guidance in the literature. Empirical analysis of Italian regions has revealed rather important sensitivity to both levels of spatial aggregation (NUTS1 NUTS2 and NUTS3) and of the choice of numeraire. Horizontal and vertical interactions were measured for these three levels of spatial aggregation.

The introduction of regional and macro-regional effects in the estimated models improved the results obtained in terms of R^2; however, the choice of numeraire region is crucial and influences the results obtained in terms of both the number of significant coefficients and the signs of the coefficients.

The choice of numeraire in terms of the richest geographical unit has given better results in terms of R^2 for NUTS 1 and NUTS2 analysis, while at NUTS 3 seems to be preferable the criterion of median geographical unit. So, if we choose the DS model according to the best value of R^2, at the NUTS 1 level (see tab. 2(a)), Italy shows prevalently competitive relationship among the macro- regions. Only the South presents significant complementarity relationship with other macro-regions. At the NUTS 2 level (see Tab. 6(a)), we have to underline the behavior of Lombardia (ITC4) and Lazio (ITE4), which show significant positive relationships both with each other region belonging to the same NUTS 1 area and with other remaining NUTS 1 macro-regions. At the NUTS 3 level, the provinces of Lazio are in an intermediate situation (see Tab. 10(b)). In fact, they prevalently show competitive relationships with the other NUTS 1 macro-regions, complementarity signs with the other NUTS 2 regions and, finally, almost the same number of + and – signs at NUTS 3 level. Therefore, the kind of interaction among regions strongly depends from the level of spatial aggregation used in the analysis.

More critically, there appears to be no general rule/changes in the behavior of the signs of the coefficients in response to the use of different numeraires; in general, we can only say that within the region, we mostly recognize complementarity relationships in according to first law of geography. However, in evaluating the results, the interpretation of the complementary/competitive relationships should be reviewed. They are not absolute but relative values and they are further conditioned by the choice of the numeraire; hence, one should not be surprised to find differences in signs when the conditioning region is changed. What this paper has not been able to do is offer a "best practice" approach. The results strongly suggest the need for adopting alternatives for the numeraire rather than the adoption of an arbitrary choice. The methodology does offer the attractive feature of being able to ascertain relationships between regions directly, although these relationships are derived from a competitive/complementary set of socio-economic processes that are only inferred but not directly observed. Thus, the results may be seen as useful in an exploratory sense, challenging analysts to develop more formal

economic models that would account for the suggested competitive/complementary relationships that the DS system proposes.

References

Amos, O. M. Jr. (1988) Unbalanced regional growth and regional income inequality in the latter stages of development, Regional Science and Urban Economics, 18, 549-66.

Anselin, L. and Bera, A. K. (1998) Spatial dependence in linear regression models with an introduction to spatial econometrics, in Handbook of Applied Economic Statistics, Ullah, A. and Giles, D. E. A. (eds.), Marcel Deker, New York, 237-290.

Anselin, L. and Florax, R. J. G. M. (1995) New directions in Spatial Econometrics, New York and Heidelberg, Springer-Verlag.

Anselin, L., Florax, R. J. G. M. and Rey, S. (2004) Advances in Spatial Econometrics: methodology, tools and applications. New York and Heidelberg, Springer- Verlag.

Arbia, G. (1989) Spatial data configuration in statistical analysis of regional economic and related problems, Kluwer Academic Publisher, Dordrecht.

Arbia, G. (2006) Spatial Econometrics. Statistical Foundations and Applications to Regional Convergence, Berlin, Springer- Verlag.

Dall'erba, S. and Percoco, M. (2003) North-South disparities, complementarity and competition within Italy, Scienze Regionali, n.2.

Dendrinos, D. S. and Sonis, M. (1988) Nonlinear relative discrete population dynamics of the US regions, Journal of Applied Mathematics and Computation, 23, 265-285.

Dendrinos, D. S. and Sonis, M. (1990) Chaos and Socio-Spatial Dynamics, Springer- Verlag.

Eurostat, (2002) European regional Statistics. Reference guide, European Communities, Luxembourg.

Fingleton, B. (2003) Externalities, Economic Geography and Spatial Econometrics: Conceptual and Modeling developments, International Regional Science Review, 26, 2 197-207.

Getis, A. and Griffith, D. A. (2002) Comparative spatial filtering in regression analysis, Geographical Analysis, 34, 130-140

Haddad, M. A. and Hewings, G. J. D. (2003) Italian Interregional Competition and its Implications to National and EU Regional Investments, unpublished paper, Regional Economics Applications Laboratory, University of Illinois, Urbana.

Hewings, G. J. D., Sonis, M.,. Cuello, F. A. and Mansouri, F.(1996) The Role of regional interaction in regional growth: competition and complementarity in the US regional system, Australasian Journal of Regional Studies, 2, 133-49.

Kamarianakis, Y. and Kaslis, V. (2005) Competition-complementarity relationship between Greek regional economies, ERSA Conference Papers, n. 552.

Magalhães, A., Sonis, M., and Hewings, G. J. D. (2001) Regional Competition and Complementarity Reflected in Relative Regional Dynamics and Growth of GSP: A Comparative Analysis of the Northeast of Brazil and the Midwest States of the U.S., in Structure and Structural Change in the Brazilian Economy Joaquim J.M. Guilhoto and Geoffrey J.D. Hewings (eds.). Aldershot, Ashgate.

Márquez, M. A. and Hewings, G. J. D (2003) Geographical interaction between regional economies: a new approach, Annals of Regional Science, 37, 559-580.

Márquez, M. A., Ramajo, J. and Hewings, G. J. D. (2006) Measuring externalities in regional growth: an empirical approach (Environment and Planning, A, forthcoming).

Nazara, S., Hewings, G. J. D., Sonis, M. (2006) An exploratory analysis of hierarchical spatial interaction: the case of regional income shares in Indonesia, Journal of Geographical Systems, 8, 3, 253-268.

Openshaw, S. and Taylor, P. J. (1979) A million or so of correlation coefficients: Three Experiments on the Modifiable Areal Unit Problem, in Statistical Methods in the Spatial Sciences N. Wrigley (ed.), Pion, London, 127–144.

Paci, R. and Saba, A. (1998) The empirics of regional economic growth in Italy, Rivista Internazionale di Scienze Economiche e Commerciali, 45, 515-542.

Sonis, M. and Hewings, G. J. D (2000) Regional competition and complementarity: comparative advantages/disadvantages and increasing/diminishing returns in discrete relative spatial dynamics, in Regional Competition Batey P.W.Y. and Friedrich P. (eds), Springer, Berlin, 139-158.

Tobler, W. R. (1970) A computer movie simulating urban growth in the Detroit region, Economic Geography supplement, 46, 234-240.

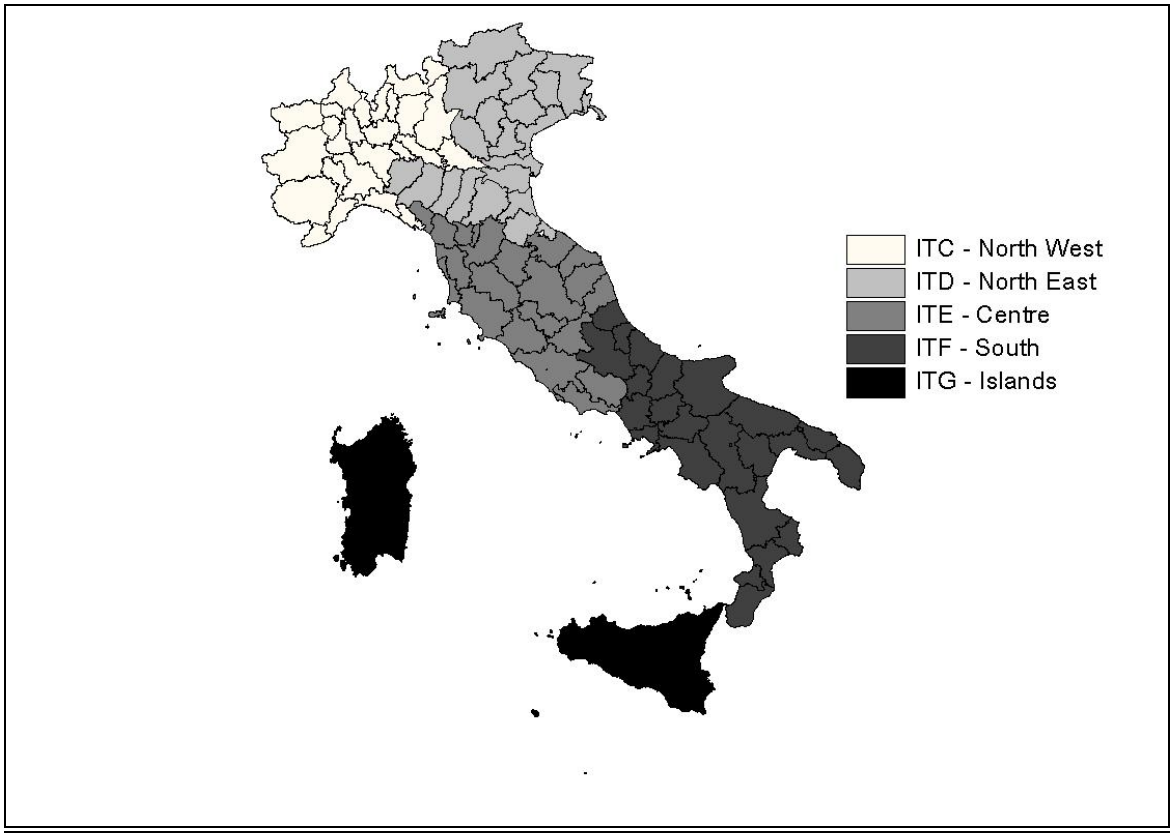

Fig.1: NUTS1 macro-region of Italy with the boundaries of provinces territory (NUTS3)

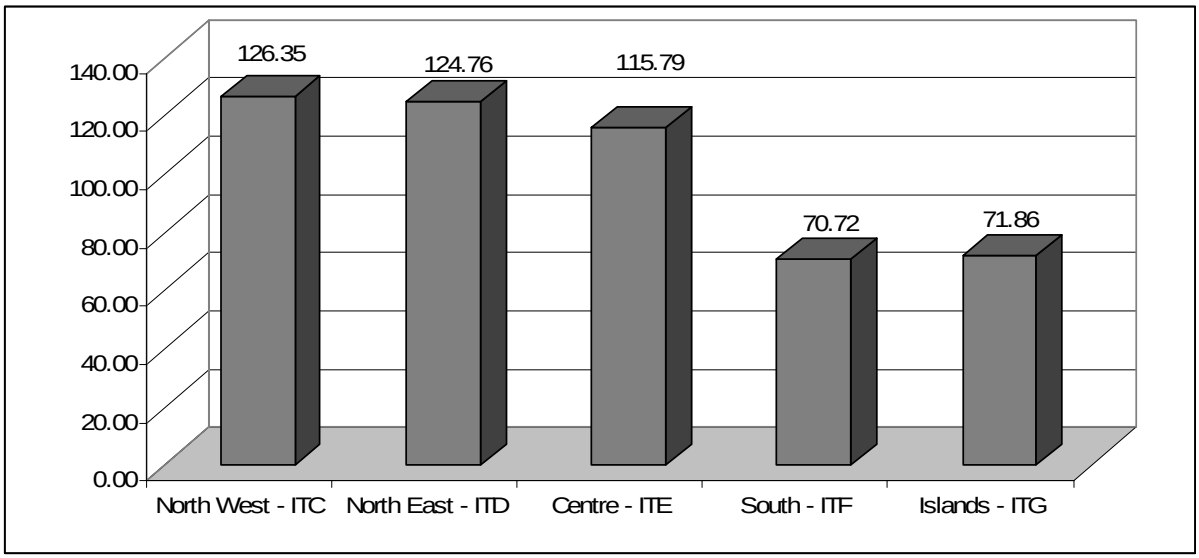

Fig.2: Per- capita GDP average along the time of NUTS1 macro-regions (Italy=100)

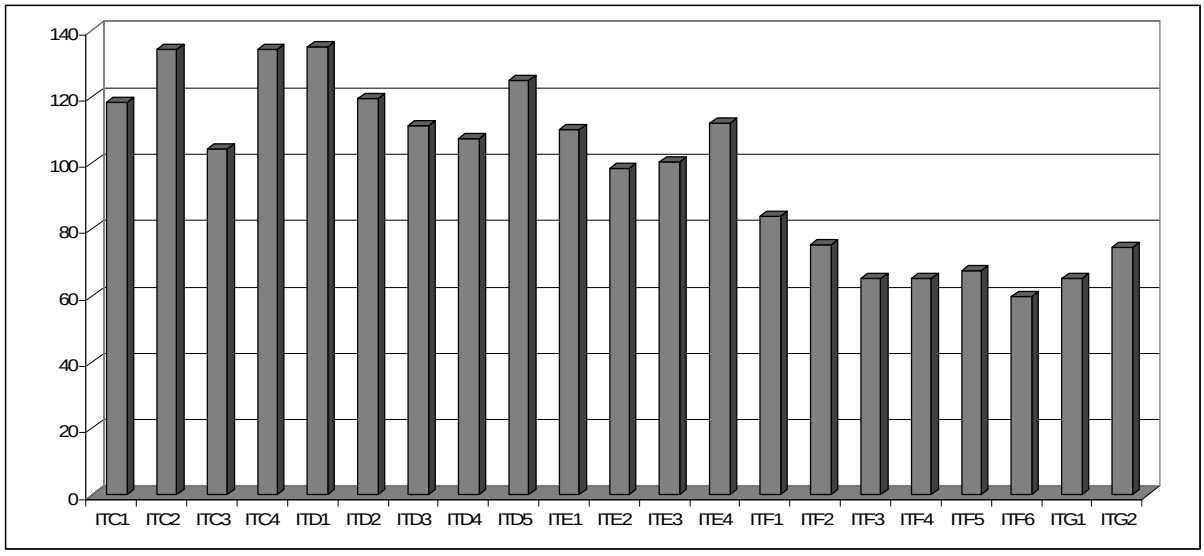

Fig.3: Per- capita GDP average along the time of NUTS2 regions (Italy=100)

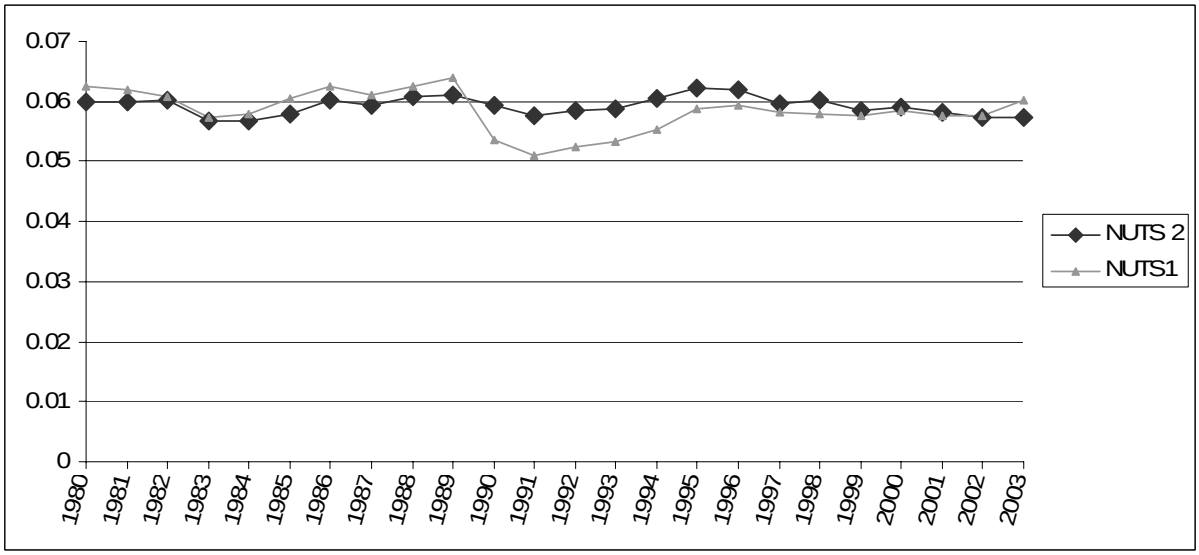

Fig.4: Coefficient of Variation of natural logarithm of per- capita GDP along the time of NUTS1 and NUTS2 regions

		ITC	ITD	ITE	ITF	ITG	R^2
		North West	**North East**	**Centre**	**South**	**Islands**	
ITD	**North East**	-5.51	-2.12	-1.81	-2.03	-1.45**	0.985
ITE	**Centre**	-4.47	-2.45	-0.82	-1.29	-1.46	0.916
ITF	**South**	8.81**	6.00*	6.71*	4.91*	1.96**	0.907
ITG	**Islands**	-1.31	-0.74	1.77	0.07	-0.70	0.800

*significant at 5%, ** significant at 10%.

Table 1(a): Estimates of DS model for NUTS1 Italian macro-regions, Numeraire=ITC, the richest macro-region in terms of per capita GDP.

		ITC	ITD	ITE	ITF	ITG	R^2
		North West	**North East**	**Centre**	**South**	**Islands**	
ITC	**North West**	4.47	2.45	0.82	1.29	1.46	0.916
ITD	**North East**	-1.04	0.33	-0.99	-0.74	0.01	0.936
ITF	**South**	13.28*	8.45*	7.53*	6.20*	3.42*	0.478
ITG	**Islands**	3.16	1.71	2.60	1.36	0.76	0.574

*significant at 5%, ** significant at 10%.

Table 1(b): Estimates of DS model for NUTS1 Italian macro-regions, Numeraire=ITE, median of per capita GDP.

		ITC	ITD	ITE	ITF	ITG	R^2
		North West	**North East**	**Centre**	**South**	**Islands**	
ITC	**North West**	-8.81**	-6.00*	-6.71*	-4.91*	-1.96**	0.907
ITD	**North East**	-14.32*	-8.12*	-8.53*	-6.95*	-3.41*	0.924*
ITE	**Centre**	-13.28*	-8.45*	-7.53*	-6.20*	-3.42*	0.478*
ITG	**Islands**	-10.12*	-6.74*	-4.93**	-4.84*	-2.66*	0.489

*significant at 5%, ** significant at 10%.

Table 1(c): Estimates of DS model for NUTS1 Italian macro-regions, Numeraire=ITF, the poorest macro region in terms of per capita GDP.

		ITC	ITD	ITE	ITF	ITG
		North West	North East	Centre	South	Islands
ITD	North East	-	-	-	-	-
ITE	Centre	-	-	-	-	-
ITF	South	+	+	+	+	+
ITG	Islands	-	-	+	-	-

Table 2(a): Qualitative analysis of NUTS1 Italian macro-regions, Numeraire=ITC, the richest macro-region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%

		ITC	ITD	ITE	ITF	ITG
		North West	North East	Centre	South	Islands
ITC	North West	+	+	+	+	+
ITD	North East	-	+	-	-	+
ITF	South	+	+	+	+	+
ITG	Islands	+	+	+	+	+

Table 2(b): Qualitative analysis of NUTS1 Italian macro-regions, Numeraire=ITE, median of per capita GDP, shaded grey denote statistically significant signs with α at least 10%

		ITC	ITD	ITE	ITF	ITG
		North West	North East	Centre	South	Islands
ITC	North West	-	-	-	-	-
ITD	North East	-	-	-	-	-
ITE	Centre	-	-	-	-	-
ITG	Islands	-	-	-	-	-

Table 2(c): Qualitative analysis of NUTS1 Italian macro-regions, Numeraire=ITF, the poorest macro region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2	R^2
ITC1	Piemonte	0.89**	0.22	0.50*	0.01	-0.70*																	0.973
ITC2	Valle d'Aosta	0.29	0.82*	0.51	-0.83	-0.88*																	0.968
ITC3	Liguria	0.65**	-0.04	1.06*	-0.57	-0.65*																	0.980
ITC4	Lombardia	0.38	0.10	0.44*	0.46	-0.61*																	0.971
ITD2	Trento					-0.46*	0.51*	-0.21	0.15	-0.23													0.685
ITD3	Veneto					-0.53*	0.14	0.20	0.13	-0.41													0.668
ITD4	Friuli Ven.Giulia					-0.62	0.13	-0.36	0.67**	-0.50													0.836
ITD5	Emilia Romagna					-0.23	-0.23	-0.84*	0.50*	0.41**													0.951
ITE1	Toscana					-0.76*					0.53**	0.22	-1.43*	-0.83*									0.966
ITE2	Umbria					-0.74*					0.13	0.52**	-1.06*	-0.53*									0.948
ITE3	Marche					-0.64*					0.17	0.01	-0.99*	-0.65*									0.941
ITE4	Lazio					-0.82*					0.17	0.03	-1.14*	0.40*									0.943
ITF1	Abruzzo					-0.99*									0.50*	-0.26	0.29**	0.24	0.09	-0.23			0.957
ITF2	Molise					-1.00*									0.25	0.12	0.12	0.17	0.25	-0.19			0.888
ITF3	Campania					-1.02*									-0.36	0.04	0.74*	-0.17	0.01	-0.28			0.950
ITF4	Puglia					-0.98*									0.03	-0.14	0.55*	0.09	-0.02	-0.38**			0.953
ITF5	Basilicata					-0.70*									-0.02	-0.78*	0.21	-0.07	0.55**	-0.07			0.857
ITF6	Calabria					-1.25*									0.01	-0.22	0.60*	-0.66**	0.52*	-0.89*			0.927
ITG1	Sicilia					-1.06*															0.41	-0.11	0.939
ITG2	Sardegna					-0.86*															0.52	0.21	0.905

*significant at 5%, ** significant at 10%.

Table 3(a): – Estimates of DS model for NUTS2 Italian regions, Numeraire=ITD1, the richest region in terms of per capita GDP.

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2	R^2
ITC1	Piemonte	0.33	0.27*	-0.55*	0.51																		0.555
ITC2	Valle d'Aosta	0.07	0.95*	-0.55*	-0.58																		0.821
ITC4	Lombardia	-0.33	0.13	-0.62*	1.08*																		0.660
ITD1	Bolzano-Bozen			-0.93*		0.35	0.25	0.49	-0.04	0.09													0.980
ITD2	Trento			-1.09*		-0.04	0.74*	0.12	0.12	-0.06													0.980
ITD3	Veneto			-0.39		-0.36	0.50**	1.20*	0.05	-0.54*													0.979
ITD4	Friuli Ven.Giulia			-0.49**		-0.42	0.47	0.54	0.60*	-0.58*													0.953
ITD5	Emilia Romagna			-0.28		-0.11	0.15	0.26	0.41**	0.24													0.926
ITE1	Toscana			-0.20							0.05	-0.14	0.49**	0.09									0.492
ITE2	Umbria			-0.60*							-0.12	0.33	0.46	0.17									0.785
ITE3	Marche			-0.59*							-0.25	-0.14	0.77	0.12									0.772
ITE4	Lazio			-0.61*							0.08	-0.19	0.17	1.05*									0.931
ITF1	Abruzzo			-0.78*											0.76*	0.08	0.05	0.08	-0.13*	-0.04			0.963
ITF2	Molise			-0.84*											0.44**	0.42**	-0.12	0.02	0.01	-0.01			0.898
ITF3	Campania			-0.77*											-0.15	0.37*	0.51*	-0.30**	-0.24*	-0.09			0.912
ITF4	Puglia			-0.92*											0.20	0.12	0.32**	-0.09	-0.24*	-0.20			0.900
ITF5	Basilicata			-1.35*											0.32	-0.59*	-0.06	-0.47**	0.57*	0.05			0.879
ITF6	Calabria			-0.26*											0.23	0.26	0.38*	-0.61	0.10	-0.65*			0.695
ITG1	Sicilia			-0.60*																	0.33	0.19	0.692
ITG2	Sardegna			-0.91*																	0.15	0.62*	0.874

* significant at 5%,** significant at 10%.

Table 3(b): Estimates of DS model for NUTS2 Italian regions, Numeraire=ITC3, the median region in terms of per capita GDP

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2	R^2
ITC1	Piemonte	0.62**	0.41*	-0.71*	0.75															0.60*			0.850
ITC2	Valle d'Aosta	0.37	1.07*	-0.67*	-0.39															0.49*			0.782
ITC3	Liguria	0.29	0.14	-0.15	0.23															0.58*			0.673
ITC4	Lombardia	-0.03	0.25*	-0.74*	1.27*															0.49*			0.592
ITD1	Bolzano-Bozen					0.07	0.58	0.32	1.07*	-0.17										1.03*			0.952
ITD2	Trento					-0.40	1.07*	0.17	1.15*	-0.38										0.95*			0.935
ITD3	Veneto					-0.51*	0.66*	0.73*	0.94*	-0.51*										0.76*			0.969
ITD4	Friuli Ven.Giulia					-0.62**	0.64**	0.23	1.42*	-0.58*										0.69*			0.903
ITD5	Emilia Romagna					-0.23	0.31	-0.35	1.37*	0.30										0.81*			0.850
ITE1	Toscana										-0.61*	0.05	0.32	-0.43*						0.69*			0.665
ITE2	Umbria										-0.99*	0.34	0.76*	-0.09						0.63*			0.638
ITE3	Marche										-1.12*	-0.13	1.06*	-0.14						0.63*			0.673
ITE4	Lazio										-1.06*	-0.11	0.46	0.71*						0.88*			0.879
ITF1	Abruzzo														0.99*	0.13	-0.40**	0.71*	-0.16	0.59*			0.736
ITF2	Molise														0.73*	0.51**	-0.57*	0.65*	-0.02	0.63*			0.610
ITF3	Campania														0.07	0.41**	0.06	0.32	-0.27*	0.55*			0.563
ITF4	Puglia														0.55*	0.26	-0.14	-0.26**	0.55**	0.43*			0.585
ITF5	Basilicata														1.06*	-1.98	-0.58	0.18	0.60*	0.66*			0.373
ITG1	Sicilia																			0.48*	0.06	0.32	0.312
ITG2	Sardegna																			0.42	-0.45	1.12*	0.484

*significant at 5%,** significant at 10%

Table 3(c): Estimates of DS model for NUTS2 Italian regions, Numeraire=ITF6, the poorest region in terms of per capita GDP.

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2
ITC1	Piemonte	+	+	+	+	-																
ITC2	Valle d'Aosta	+	+	+	-	-																
ITC3	Liguria	+	-	+	-	-																
ITC4	Lombardia	+	+	+	+	-																
ITD2	Trento					-	+	-	+	-												
ITD3	Veneto					-	+	+	+	-												
ITD4	Friuli Ven.Giulia					-	+	-	+	-												
ITD5	Emilia Romagna					-	-	-	+	+												
ITE1	Toscana					-					+	+	-	-								
ITE2	Umbria					-					+	+	-	-								
ITE3	Marche					-					+	+	-	-								
ITE4	Lazio					-					+	+	-	+								
ITF1	Abruzzo					-									+	-	+	+	+	-		
ITF2	Molise					-									+	+	+	+	+	-		
ITF3	Campania					-									-	+	+	-	+	-		
ITF4	Puglia					-									+	-	+	+	-	-		
ITF5	Basilicata					-									-	-	+	-	+	-		
ITF6	Calabria					-									+	-	+	-	+	-		
ITG1	Sicilia					-															+	-
ITG2	Sardegna					-															+	+

Table 4(a): Qualitative analysis of NUTS2 Italian regions, Numeraire=ITD1, the richest region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2
ITC1	Piemonte	+	+	-	+																	
ITC2	Valle d'Aosta	+	+	-	-																	
ITC4	Lombardia	-	+	-	+																	
ITD1	Bolzano-Bozen			-		+	+	+	-	+												
ITD2	Trento			-		-	+	+	+	-												
ITD3	Veneto			-		-	+	+	+	-												
ITD4	Friuli Ven.Giulia			-		-	+	+	+	-												
ITD5	Emilia Romagna			-		-	+	+	+	+												
ITE1	Toscana			-							+	-	+	+								
ITE2	Umbria			-							-	+	+	+								
ITE3	Marche			-							-	-	+	+								
ITE4	Lazio			-							+	-	+	+								
ITF1	Abruzzo			-											+	+	+	+	-	-		
ITF2	Molise			-											+	+	-	+	+	-		
ITF3	Campania			-											-	+	+	-	-	-		
ITF4	Puglia			-											+	+	+	-	-	-		
ITF5	Basilicata			-											+	-	-	-	+	+		
ITF6	Calabria			-											+	+	+	-	+	-		
ITG1	Sicilia			-																	+	+
ITG2	Sardegna			-																	+	+

Table 4(b): Qualitative analysis of NUTS2 Italian regions, Numeraire=ITC3, the median region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2
ITC1	Piemonte	+	+	-	+															+		
ITC2	Valle d'Aosta	+	+	-	-															+		
ITC3	Liguria	+	+	-	+															+		
ITC4	Lombardia	-	+	-	+															+		
ITD1	Bolzano-Bozen					+	+	+	+	-										+		
ITD2	Trento					-	+	+	+	-										+		
ITD3	Veneto					-	+	+	+	-										+		
ITD4	Friuli Ven.Giulia					-	+	+	+	-										+		
ITD5	Emilia Romagna					--	+	-	+	+										+		
ITE1	Toscana										-	+	+	-						+		
ITE2	Umbria										-	+	+	-						+		
ITE3	Marche										-	-	+	-						+		
ITE4	Lazio										-	-	+	+						+		
ITF1	Abruzzo														+	+	-	+	-	+		
ITF2	Molise														+	+	-	+	-	+		
ITF3	Campania														+	+	+	+	-	+		
ITF4	Puglia														+	+	-	-	+	+		
ITF5	Basilicata														+	-	-	+	+	+		
ITG1	Sicilia																			+	+	+
ITG2	Sardegna																			+	-	+

Table 4(c): Qualitative analysis of NUTS2 Italian regions, Numeraire=ITF6, the poorest region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2	R^2
ITC1	Piemonte	0.33	0.43*	-0.12	0.65	-0.14	-1.63*						-1.90*					-0.56				0.45	0.978
ITC2	Valle d'Aosta	-0.75	1.08*	-0.51	-1.51	-0.07	-3.53						-3.04					-1.58				-0.22	0.977
ITC3	Liguria	1.26	0.30*	0.70	2.44	0.28	0.14						0.69					1.26				1.09	0.992
ITC4	Lombardia	0.75	0.29*	0.40	2.81	-0.23	0.85						0.45					1.24				0.93	0.978
ITD2	Trento		6.63**			-0.03	0.49**	1.26	0.80*	1.65			3.53					2.88**				1.59*	0.741
ITD3	Veneto		6.78*			-0.38	1.02*	1.78*	0.26	-0.10			3.53*					1.48				1.59*	0.820
ITD4	Friuli Ven.Giulia		1.49*			-0.85*	1.02**	0.06	0.26	-1.57*			0.18					-0.61				0.10	0.875
ITD5	Emilia Romagna		-1.11			-0.45**	0.41	-1.00**	0.02	-1.41*			-1.66					-2.09**				-0.18	0.976
ITE1	Toscana		-15.16*			0.12		-11.76*			-2.91*	-1.20*	-2.31*	-5.04*				-8.28*				-3.71*	0.992
ITE2	Umbria		-12.56			-0.11		-9.56**			-2.58	-0.50	-1.96*	-3.83				-6.86**				-3.31	0.971
ITE3	Marche		-12.76*			0.06		-9.99*			-2.52*	-0.89**	-2.08*	-3.66**				-7.39*				-3.69*	0.981
ITE4	Lazio		3.70			-0.21		0.73			0.70	0.09	-0.35	1.87				1.35				0.29	0.960
ITF1	Abruzzo		3.01			-0.26		0.39					1.20		1.18*	-0.14	0.54	0.59	0.04	0.08		0.29	0.977
ITF2	Molise		0.67*			-0.33		-0.67					-1.49*		0.74*	0.17	0.02	0.10	-0.01	-0.04		0.39	0.910
ITF3	Campania		8.09			-0.19		3.74					3.17		0.42	0.17	1.81	0.73	-0.10	0.33		2.27	0.968
ITF4	Puglia		-2.63			-0.69*		-2.19					-1.93		-0.08	-0.08	-0.05	-0.34	-0.18	-0.55*		-0.53	0.953
ITF5	Basilicata		22.12*			0.24		12.79*					10.57		1.32**	-0.60*	3.64*	2.59**	0.61*	1.40*		6.49*	0.921
ITF6	Calabria		14.37**			0.42*		5.70					8.32**		1.24*	0.24	2.28**	1.05	0.54**	0.10		3.06**	0.976
ITG1	Sicilia		23.63*			0.01		12.61*					14.81*					10.00*			3.70*	1.78*	0.971
ITG2	Sardegna		17.23			0.02		8.99					10.94**					7.64**			2.81	1.44	0.942

*significant at 5%, ** significant at 10%.

Table 5(a): Estimates of DS model of NUTS2 Italian regions with NUTS1 macro-region effects, Numeraire=ITD1, the richest region in terms of per capita GDP.

		ITC1	ITC2	ITC4	ITC3	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2	R^2
ITC1	Piemonte	3.98**	0.36*	9.02**	0.93			8.85**				8.20**					5.99**				3.49**		0.616
ITC2	Valle d'Aosta	-0.39	0.90*	-0.63	-0.79			-0.81				-0.35					-0.56				-0.07		0.844
ITC4	Lombardia	3.03**	0.20	7.90*	0.79			7.72**				7.33**					5.31**				2.69**		0.718
ITD1	Bolzano-Bozen		-1.22*		-0.42**	0.35	-0.27	0.46**	0.23	0.42		1.05*					-0.08				-0.47**		0.989
ITD2	Trento		2.11		-0.60*	0.24	0.21	0.82	0.72*	1.05		3.07					1.11				0.53		0.993
ITD3	Veneto		6.54*		-0.34**	0.04	0.75*	2.53*	0.58*	0.63		5.22*					1.93				1.36**		0.989
ITD4	Friuli Ven.Giulia		0.52		-0.58*	-0.42	0.81*	0.44	0.48**	-1.17*		1.28*					-0.72*				-0.32		0.966
ITD5	Emilia Romagna		-0.13		-0.27	0.01	0.15	0.09	0.46**	-0.30		0.84					-1.01				-0.11		0.958
ITE1	Toscana		-3.16		0.30**			-1.63			-0.21	-0.30	-0.14	-0.23			-1.56				-1.27		0.816
ITE2	Umbria		-8.57		-0.35			-5.30			-1.42	-0.07	-0.73	-1.72			-4.28				-2.67		0.863
ITE3	Marche		-1.82		0.20			-0.73			-0.03	-0.07	-0.04	0.79			-1.26				-1.51		0.932
ITE4	Lazio		18.76*		0.37			12.07*			3.89*	1.03	2.25*	7.69*			9.24*				3.30		0.962
ITF1	Abruzzo		9.17*		0.01			6.40*				7.38*			0.92*	0.24*	1.86*	1.88*	0.01	0.60*	1.59**		0.986
ITF2	Molise		17.69*		-0.43			11.59*				11.25*			1.31*	0.53*	3.07*	2.66*	0.39**	1.16*	4.14*		0.919
ITF3	Campania		17.54*		-0.01			11.94*				11.45*			0.35	0.55*	3.72*	2.48*	-0.01	1.05*	4.35*		0.936
ITF4	Puglia		0.47		-0.99*			0.01				1.63*			-0.01	0.23	0.28	-0.03	-0.11	-0.27*	-0.14		0.918
ITF5	Basilicata		-1.01		-1.14**			-0.05				-1.53			-0.20	-0.55*	-0.23	-0.65	0.29	-0.09	0.76		0.898
ITF6	Calabria		28.11*		1.07*			18.93*				20.16*			0.85*	0.66*	5.49*	4.01*	0.59*	1.12*	6.36*		0.887
ITG1	Sicilia		23.06*		-0.16			14.52*				16.54*					10.54*				3.26*	1.74*	0.888
ITG2	Sardegna		12.11		-0.48**			7.73				9.58**					5.81				1.56	1.20	0.922

*significant at 5%, ** significant at 10%.

Table 5(b): Estimates of DS model of NUTS2 Italian regions with NUTS1 macro-region effects, Numeraire=ITC3, the median region in terms of per capita GDP**.**

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2	R^2
ITC1	Piemonte	-2.66	0.44*	-2.13*	-6.04			-7.25**				-8.68*					-5.52**			0.72*	-2.04		0.908
ITC2	Valle d'Aosta	-7.53*	0.93*	-3.99*	-16.62*			-18.08*				-18.04*					-12.71*			0.44*	-6.06*		0.859
ITC3	Liguria	-6.74*	0.08	-3.09*	-15.24*			-16.32*				-17.03*					-11.63*			0.67*	-5.61*		0.846
ITC4	Lombardia	-3.78*	0.27*	-2.32*	-7.46*			-8.75*				-9.80*					-6.41*			0.63*	-2.99*		0.793
ITD1	Bolzano-Bozen			-3.41*		0.33	-0.75**	-0.38	1.36*	0.82**			-1.36*				-0.07			0.83*	-0.26		0.972
ITD2	Trento			7.51**		0.51	-0.14	1.82**	2.54*	3.62*			5.40*				4.75*			0.86*	2.61*		0.963
ITD3	Veneto			4.55**		-0.01	0.29	1.68*	1.70*	1.06			2.89**				1.98**			0.81*	1.61*		0.974
ITD4	Friuli Ven.Giulia			-1.84*		-0.56**	0.17	-0.15	1.47*	-0.46			-0.98				-0.37			0.62*	-0.21		0.909
ITD5	Emilia Romagna			-3.75**		-0.09	-0.33	-1.19*	1.42*	-0.35			-2.54*				-1.77**			0.80*	-0.26		0.888
ITE1	Toscana			-10.66*				-7.16*			-3.03*	-0.42	-0.58**	-3.11*			-5.61*			0.87*	-2.88*		0.852
ITE2	Umbria			-0.43				-0.67*			-1.27*	0.71*	0.47	0.40			-0.98*			0.84*	-0.71*		0.626
ITE3	Marche			-6.27				-4.30**			-2.33*	0.04	-0.22	-1.11			-3.99*			0.92*	-2.42*		0.885
ITE4	Lazio			15.97*				9.43*			1.76	1.43*	1.94*	6.23*			6.85*			1.08*	2.84**		0.931
ITF1	Abruzzo			-2.99				-1.27					-2.45		0.52	-0.23	-0.57	0.60*	-0.48	0.58	-0.83		0.883
ITF2	Molise			16.35**				11.23*					8.32		1.34*	0.14	2.63**	3.08	0.06*	1.86	4.31*		0.816
ITF3	Campania			3.91				3.35					0.71		-0.14	0.07	1.04	1.00*	-0.54**	0.93	1.58		0.803
ITF4	Puglia			9.40				6.75					5.31		0.37	-0.05	1.78	2.09	-0.34**	1.13	2.53		0.781
ITF5	Basilicata			3.03				3.78					-0.84		-0.16	-0.83*	0.46	0.87	-0.12	1.00	2.33		0.775
ITG1	Sicilia			8.29				5.18					6.69*				4.28**			0.38*	1.17	0.33	0.484
ITG2	Sardegna			-1.19*				-0.38**					1.12				0.69			0.21	-0.13	-0.40	0.674

*significant at 5%, ** significant at 10%.

Table 5(c): Estimates of DS model of NUTS2 Italian regions with NUTS1 macro-region effects, Numeraire=ITF6, the poorest region in terms of per capita GDP.

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2
ITC1	Piemonte	+	+	-	+	-			-				-					-				+
ITC2	Valle d'Aosta	-	+	-	-	-			-				-					-				-
ITC3	Liguria	+	+	+	+	+			+				+					+				+
ITC4	Lombardia	+	+	+	+	-			+				+					+				+
ITD2	Trento			+		-	+	+	+	+			+					+				+
ITD3	Veneto			+		-	+	+	+	-			+					+				+
ITD4	Friuli Ven.Giulia			+		-	+	+	+	-			+					-				+
ITD5	Emilia Romagna			-		-	+	-	+	-			-					-				-
ITE1	Toscana			-		+			-		-	-	-	-				-				-
ITE2	Umbria			-		-			-		-	-	-	-				-				-
ITE3	Marche			-		+			-		-	-	-	-				-				-
ITE4	Lazio			+		-			+		+	+	-	+				+				+
ITF1	Abruzzo			+		-			+				+		+	-	+	+	+	+		+
ITF2	Molise			+		-			-				-		+	+	+	+	-	-		+
ITF3	Campania			+		-			+				+		+	+	+	+	-	+		+
ITF4	Puglia			-		-			-				-		-	-	-	-	-	-		-
ITF5	Basilicata			+		+			+				+		+	-	+	+	+	+		+
ITF6	Calabria			+		+			+				+		+	+	+	+	+	+		+
ITG1	Sicilia			+		+			+				+					+			+	+
ITG2	Sardegna			+		+			+				+					+			+	+

Table 6(a): Qualitative analysis of NUTS2 Italian regions with NUTS1 macro-region effects, Numeraire=ITD1, the richest region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITC1	ITC2	ITC4	ITC3	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2
ITC1	Piemonte	+	+	+	+			+					+					+				+
ITC2	Valle d'Aosta	-	+	-	-			-					-					-				-
ITC4	Lombardia	+	+	+	+			+					+					+				+
ITD1	Bolzano-Bozen		-		-	+	-	+	+	+			+					-				-
ITD2	Trento		+		-	+	+	+	+	+			+					+				+
ITD3	Veneto		+		-	+	+	+	+	+			+					+				+
ITD4	Friuli Ven.Giulia		+		-	-	+	+	+	-			+					-				-
ITD5	Emilia Romagna		-		-	+	+	+	+	-			+					-				-
ITE1	Toscana		-		+			-			-	-	-	-				-				-
ITE2	Umbria		-		-			-			-	-	-	-				-				-
ITE3	Marche		-		+			-			-	-	-	+				-				-
ITE4	Lazio		+		+			+			+	+	+	+				+				+
ITF1	Abruzzo		+		+			+					+		+	+	+	+	+	+		+
ITF2	Molise		+		-			+					+		+	+	+	+	+	+		+
ITF3	Campania		+		-			+					+		+	+	+	-		+		+
ITF4	Puglia		+		-			+					+		-	+	+	-	-	-		-
ITF5	Basilicata		-		-			-					-		-	-	-	-	+	-		+
ITF6	Calabria		+		+			+					+		+	+	+	+	+	+		+
ITG1	Sicilia		+		-			+					+					+			+	+
ITG2	Sardegna		+		-			+					+					+			+	+

Table 6(b): Qualitative analysis of NUTS2 Italian regions with NUTS1 macro-region effects, Numeraire=ITC3, the median region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITC1	ITC2	ITC3	ITC4	ITD1	ITD2	ITD3	ITD4	ITD5	ITE1	ITE2	ITE3	ITE4	ITF1	ITF2	ITF3	ITF4	ITF5	ITF6	ITG1	ITG2
ITC1	Piemonte	-	+	-	-			-					-				-			+		-
ITC2	Valle d'Aosta	-	+	-	-			-					-				-			+		-
ITC3	Liguria	-	+	-	-			-					-				-			+		-
ITC4	Lombardia	-	+	-	-			-					-				-			+		-
ITD1	Bolzano-Bozen			-		+	-	-	+	+			-				-			+		-
ITD2	Trento			+		+	-	+	+	+			+				+			+		+
ITD3	Veneto			+		-	+	+	+	+			+				+			+		+
ITD4	Friuli Ven.Giulia			-		-	+	-	+	-			-				-			+		-
ITD5	Emilia Romagna			-		-	-	-	+	-			-				-			+		-
ITE1	Toscana			-				-			-	-	-	-			-			+		-
ITE2	Umbria			-				-			-	+	+	+			-			+		-
ITE3	Marche			-				-			-	+	-	-			-			+		-
ITE4	Lazio			+				+			+	+	+	+			+			+		+
ITF1	Abruzzo			-				-					-		+	-	-	+	-	+		-
ITF2	Molise			+				+					+		+	+	+	+	+	+		+
ITF3	Campania			+				+					+		-	+	+	+	-	+		+
ITF4	Puglia			+				+					+		+	-	+	+	-	+		+
ITF5	Basilicata			+				+					-		-	-	+	+	-	+		+
ITG1	Sicilia			+				+					+				+			+	+	+
ITG2	Sardegna			-				-					+				+			+	-	-

Table 6(c): Qualitative analysis of NUTS2 Italian regions with NUTS1 macro-region effects, Numeraire=ITF6, the poorest region in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	R^2
ITE21	Perugia	0.78*	-0.21							-0.85*									0.837
ITE22	Terni	0.01	0.58*							-0.89*									0.856
ITE31	Pesaro e Ur.			1.82*	0.05	-1.16	-0.46			-1.00									0.845
ITE32	Ancona			1.29*	0.87	-0.87	-1.11			-1.06*									0.878
ITE33	Macerata			1.27*	0.17	-0.44	-0.89			-1.06*									0.858
ITE34	Ascoli Pic.			1.23*	-0.31	0.17	-0.87			-0.98*									0.835
ITE41	Viterbo							1.30*	-1.24*	-0.14	-0.05	0.08							0.995
ITE42	Rieti							0.19*	-0.18	-0.22	-0.65*	0.84*							0.970
ITE44	Latina							-0.05	-0.61*	0.35*	-0.01	0.39*							0.981
ITE45	Frosinone							0.31*	-0.89*	-0.50*	0.55*	0.48*							0.833
ITF11	L'Aquila									-0.43*			0.89*	-0.29	-0.07	-0.21			0.987
ITF12	Teramo									-0.51*			-0.09	-0.80*	0.98*	0.18			0.828
ITF13	Pescara									-0.33**			-0.29*	-0.62**	0.80*	0.20			0.914
ITF14	Chieti									-0.25			0.33*	-0.91*	1.16*	-0.37**			0.451
ITF21	Isernia									-0.52*							0.47*	-0.15	0.383
ITF22	Campobasso									-0.53*							0.10	-0.05	0.463

		ITE43	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52	R^2
ITF31	Caserta	-0.88*	1.80	-0.07	-0.44	-0.84	0.04								0.778
ITF32	Benevento	-0.83*	3.13	1.48*	-0.66	2.08*	-1.45*								0.942
ITF33	Napoli	-0.75	1.39	0.08	0.12	-1.24	-0.10								0.770
ITF34	Avellino	-0.90*	2.95	-0.06	-0.91	-1.46	0.03								0.776
ITF35	Salerno	-0.74*	2.07	0.72*	-0.06	-1.56	-0.78								0.867
ITF41	Foggia	-0.25**						0.29	-0.27	-0.17	0.13	-0.01			0.827
ITF42	Bari	-0.23						0.46	-1.09	0.29	-0.39*	0.69			0.479
ITF43	Taranto	-0.25						1.39**	-0.41	-0.07	-0.19	-0.62			0.802
ITF44	Brindisi	-0.31*						-0.53	-0.31	-0.10	1.07*	-0.06			0.987
ITF45	Lecce	-0.22						-1.14	-1.02	0.73	-0.04	1.37**			0.314
ITF51	Potenza	-0.75*											0.53*	0.07	0.685
ITF52	Matera	-0.55*											-0.14	0.90*	0.705

*significant at 5%,** significant at 10%.

Table 7(a): Estimates of DS model of some NUTS3 Italian provinces, Numeraire=ITE43, more rich in terms of per capita GDP.

		ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	R^2
ITE21	Perugia	0.63*	-0.03												-0.88*				0.933
ITE22	Terni	0.01	0.55**												-0.98*				0.946
ITE31	Pesaro e Ur.			0.71	-1.07**	2.58*	-1.68*								-0.80*				0.924
ITE32	Ancona			0.84	-0.10	2.18**	-2.49*								-0.94*				0.966
ITE33	Macerata			0.52	-0.88	3.01*	-2.22*								-0.89*				0.949
ITE34	Ascoli Pic.			0.13	-1.37*	3.76*	-2.02*								-0.79*				0.924
ITE41	Viterbo							1.59*	-1.44*	0.48	-0.81**	0.38			0.11				0.993
ITE42	Rieti							0.41*	-0.53**	0.62	-1.31*	1.21*			-0.22				0.965
ITE43	Roma							0.23*	-0.34	0.82**	-0.67**	0.37			-0.19				0.921
ITE44	Latina							0.14	-1.02*	1.27*	-0.60	0.81*			-0.40				0.667
ITE45	Frosinone							0.59*	-1.13*	0.14	-0.20	0.80*			0.07				0.877
ITF11	L'Aquila												1.16*	0.32**	-0.92*	-0.44*			0.998
ITF12	Teramo												0.17*	-0.23	0.12	-0.07			0.858
ITF14	Chieti												0.64*	-0.26	0.39	-0.55*			0.938
ITF21	Isernia														-0.68*		0.19	0.15	0.813
ITF22	Campobasso														-0.82*		0.10	0.22	0.805

		ITF13	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52	R^2
ITF31	Caserta	-0.93*	1.80	0.39	0.01	-0.74	-0.91**								0.949
ITF32	Benevento	-0.85*	3.16*	2.02*	-0.21	-2.04*	-2.44*								0.978
ITF33	Napoli	-0.63*	1.56	0.97*	0.59	-1.48	-1.32*								0.927
ITF34	Avellino	-0.97*	2.90*	0.34	-0.46	-1.27	-0.89**								0.944
ITF35	Salerno	-0.76*	2.16**	1.36*	0.37	-1.60**	-1.80*								0.964
ITF41	Foggia	-0.16						-0.47	0.15	-0.23	0.65*	-0.10			0.961
ITF42	Bari	-0.14						-0.34	-0.71	0.25	0.14	0.64			0.769
ITF43	Taranto	-0.33						0.63	-0.13	-0.06	0.24	-0.47			0.949
ITF44	Brindisi	0.03						-1.18	0.16	-0.27	1.66*	-0.44			0.990
ITF45	Lecce	-0.07						-1.83*	-0.53	0.59	0.53*	1.15			0.833
ITF51	Potenza	-0.68*											0.81*	-0.20	0.830
ITF52	Matera	-0.54*											0.17	0.56*	0.556

* significant at 5%,** significant at 10%.

Table 7(b): Estimates of DS model of some NUTS3 Italian provinces, Numeraire=ITF13, median of per capita GDP.

		ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	ITF45	R^2
ITE21	Perugia	0.65*	0.35																-0.61*	0.701
ITE22	Terni	-0.10	1.06*																-0.75*	0.850
ITE31	Pesaro e Ur.			-0.08	-1.36**	2.97**	-0.77												-0.54*	0.607
ITE32	Ancona			-0.67	-0.57	3.38**	-1.40												-0.59*	0.725
ITE33	Macerata			-0.68	-1.28	3.82*	-1.19												-0.59*	0.693
ITE34	Ascoli Pic.			-0.71	-1.70*	4.33*	-1.17												-0.50*	0.671
ITE41	Viterbo							1.27*	-1.16*	0.43	-0.49	0.13							0.03	0.990
ITE42	Rieti							0.16	-0.08	0.31	-1.02*	0.90*							-0.12	0.901
ITE43	Roma							-0.02	0.07	0.56	-0.46	0.06							0.05	0.247
ITE44	Latina							-0.07	-0.53**	0.90**	-0.47	0.42							0.10	0.789
ITE45	Frosinone							0.29*	-0.84*	0.06	0.13	0.55**							-0.03	0.475
ITF11	L'Aquila												0.93*	-0.66	0.01	-0.08			-0.18	0.981
ITF12	Teramo												-0.06	-1.25*	1.12*	0.30			-0.25	0.497
ITF13	Pescara												-0.23**	-0.95**	0.91**	0.34			-0.16	0.815
ITF14	Chieti												0.40*	-1.03*	1.07*	-0.29			0.08	0.528
ITF21	Isernia																0.07	0.20	-0.38**	0.163
ITF22	Campobasso																-0.25	0.32	-0.45*	0.421

		ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52	R^2
ITF31	Caserta	-0.10	-0.19	-0.46	0.26	0.76					-0.77*			0.694
ITF32	Benevento	1.36	1.43*	-0.66	-1.08	-0.84					-0.67*			0.929
ITF33	Napoli	-0.38	0.05	0.17	-0.23	0.48					-0.59*			0.656
ITF34	Avellino	1.07	-0.15	-0.93	-0.38	0.71					-0.77*			0.697
ITF35	Salerno	0.41	0.72*	-0.04	-0.62	-0.26					-0.57*			0.852
ITF41	Foggia						1.41*	0.75*	-0.89*	0.17*	-1.40*			0.980
ITF42	Bari						1.51*	-0.16	-0.38*	-0.35*	-0.58*			0.886
ITF43	Taranto						2.53*	0.57	-0.78*	-0.16	-1.99*			0.931
ITF44	Brindisi						0.63	0.63	-0.82*	1.09*	-1.46*			0.994
ITF51	Potenza										-0.62*	0.85*	-0.07	0.691
ITF52	Matera										-0.50*	0.08	0.80*	0.705

*significant at 5%, ** significant at 10%.

Table 7(c): Estimates of DS model of some NUTS3 Italian provinces, Numeraire=ITF45, more poor in terms of per capita GDP.

		ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22
ITE21	Perugia	+	-							-								
ITE22	Terni	+	+							-								
ITE31	Pesaro e Ur.			+	+	-	-			-								
ITE32	Ancona			+	+	-	-			-								
ITE33	Macerata			+	+	-	-			-								
ITE34	Ascoli Pic.			+	-	+	-			-								
ITE41	Viterbo							+	-	-	-	+						
ITE42	Rieti							+	-	-	-	+						
ITE44	Latina							-	-	+	-	+						
ITE45	Frosinone							+	-	-	+	+						
ITF11	L'Aquila									-			+	-	-	-		
ITF12	Teramo									-			-	-	+	+		
ITF13	Pescara									-			-	-	+	+		
ITF14	Chieti									-			+	-	+	-		
ITF21	Isernia									-							+	-
ITF22	Campobasso									-							+	-

		ITE43	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF31	Caserta	-	+	-	-	-	+							
ITF32	Benevento	-	+	+	-	+	-							
ITF33	Napoli	-	+	+	+	-	-							
ITF34	Avellino	-	+	-	-	-	+							
ITF35	Salerno	-	+	+	-	-	-							
ITF41	Foggia	-						+	-	-	+	-		
ITF42	Bari	-						+	-	+	-	+		
ITF43	Taranto	-						+	-	-	-	-		
ITF44	Brindisi	-						-	-	-	+	-		
ITF45	Lecce	-						-	-	+	-	+		
ITF51	Potenza	-											+	+
ITF52	Matera	-											-	+

Table 8(a): Qualitative analysis of some NUTS3 Italian provinces, Numeraire=ITE43, more rich in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22
ITE21	Perugia	+	-												-			
ITE22	Terni	+	+												-			
ITE31	Pesaro e Ur.			+	-	+	-								-			
ITE32	Ancona			+	-	+	-								-			
ITE33	Macerata			+	-	+	-								-			
ITE34	Ascoli Pic.			+	-	+	-								-			
ITE41	Viterbo							+	-	+	-	+			+			
ITE42	Rieti							+	-	+	-	+			-			
ITE43	Roma							+	-	+	-	+			-			
ITE44	Latina							+	-	+	-	+			-			
ITE45	Frosinone							+	-	+	-	+			+			
ITF11	L'Aquila												+	+	-	-		
ITF12	Teramo												+	-	+	-		
ITF14	Chieti												+	-	+	-		
ITF21	Isernia														-		+	+
ITF22	Campobasso														-		+	+

		ITF13	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF31	Caserta	-	+	+	+	-	-							
ITF32	Benevento	-	+	+	-	-	-							
ITF33	Napoli	-	+	+	+	-	-							
ITF34	Avellino	-	+	+	-	-	-							
ITF35	Salerno	-	+	+	+	-	-							
ITF41	Foggia	-						-	+	-	+	-		
ITF42	Bari	-						-	-	+	+	+		
ITF43	Taranto	-						+	-	-	+	-		
ITF44	Brindisi	+						-	+	-	+	-		
ITF45	Lecce	-						-	-	+	+	+		
ITF51	Potenza	-											+	-
ITF52	Matera	-											+	+

Table 8(b): Qualitative analysis of some NUTS3 Italian provinces, Numeraire=ITF13, median of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

		ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	ITF45
ITE21	Perugia	+	+																-
ITE22	Terni	-	+																-
ITE31	Pesaro e Ur.			-	-	+	-												-
ITE32	Ancona			-	-	+	-												-
ITE33	Macerata			-	-	+	-												-
ITE34	Ascoli Pic.			-	-	+	-												-
ITE41	Viterbo							+	-	+	-	+							+
ITE42	Rieti							+	-	+	-	+							-
ITE43	Roma							-	+	+	-	+							+
ITE44	Latina							-	-	+	-	+							+
ITE45	Frosinone							+	-	+	+	+							-
ITF11	L'Aquila												+	-	+	-			-
ITF12	Teramo												-	-	+	+			-
ITF13	Pescara												-	-	+	+			-
ITF14	Chieti												+	-	+	-			+
ITF21	Isernia																+	+	-
ITF22	Campobasso																-	+	-

		ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF31	Caserta	-	-	-	+	+					-		
ITF32	Benevento	+	+	-	-	-					-		
ITF33	Napoli	-	+	+	-	+					-		
ITF34	Avellino	+	-	-	-	+					-		
ITF35	Salerno	+	+	-	-	-					-		
ITF41	Foggia						+	+	-	+	-		
ITF42	Bari						+	-	-	-	-		
ITF43	Taranto						+	+	-	-	-		
ITF44	Brindisi						+	+	-	+	-		
ITF51	Potenza										-	+	-
ITF52	Matera										-	+	+

Table 8(c): Qualitative analysis of some NUTS3 Italian provinces, Numeraire=ITF45, more poor in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

	ITE1	ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE44	ITE45	ITE43	ITC	ITD	ITF	ITG	R^2
ITE21	-3.21*	-0.67	0.09		-1.55*				-7.11*			1.49	-15.31*	-9.43*	-7.83*	-3.15**	0.917
ITE22	-3.56**	-0.87	0.40		-1.98*				-7.41*			1.50	-17.08**	-11.01**	-9.08*	-3.67	0.909
ITE31	-0.49*	0.21*		1.79*	-0.24	-1.21*	-1.17*		0.04			-1.34**	-1.22**	-0.67**	-2.21*	0.11	0.974
ITE32	0.13	0.61*		1.47**	0.49	-0.89	-1.64*		0.04			-0.28	1.74*	0.80*	-0.89*	0.62*	0.935
ITE33	-0.06	0.48*		1.86*	-0.12	-0.71	-1.89*		1.47			-2.04**	0.87	0.46	-1.46*	0.51**	0.964
ITE34	0.13	0.13*		2.75*	-0.31	-0.62	-2.37*		4.02			-4.36**	1.94*	1.29*	-0.76*	0.89*	0.967
ITE41	0.24	0.13			-0.25			1.29*	-1.34*	-0.19	0.19	0.44	1.08*	0.62*	-0.01	0.21	0.996
ITE42	0.40	0.22			-0.17			0.17*	-0.24**	-0.70*	0.97*	0.48	2.33	1.32	0.55	0.62	0.976
ITE44	-0.17	0.09			-0.16			-0.11*	-0.63*	-0.05	0.52*	0.13	-1.08	-0.91	-0.52	-0.42	0.987
ITE45	0.48*	0.19			-0.13			0.35*	-0.98*	0.47*	0.54*	0..34	2.43*	1.58*	0.68	0.61*	0.872

	ITE43	ITF6	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF11	-0.10	-0.09	0.82*	0.10	-0.56**	-0.21	-0.49*				-0.40					0.01			-0.10	
ITF12	-0.48**	0.09	-0.10	-0.22	0.36	0.20	-0.36*				0.06					0.53*			1.64	
ITF13	-0.37	0.53*	-0.22*	0.53	-0.22	0.44*	-0.49*				1.30*					1.64*			0.33*	
ITF14	-1.04*	-0.04	0.33*	-0.66	0.89*	-0.54	0.06				0.11					0.65*			-0.09	
ITF21	0.02	1.17*		0.70			0.02	-0.17			2.47					2.32**			0.56*	
ITF22	0.55	0.74		0.59			0.01	-0.38**			1.35					1.28			0.25	
ITF31	-0.43	-0.03		-1.34*			-0.09		1.45	0.13	-0.47	-0.14	-0.31			0.29			-0.07	
ITF32	-0.10	0.01		-1.48*			-0.35		2.11**	2.13*	-0.33	-0.81	-2.48*			0.43			0.04	
ITF33	-1.00*	0.37*		-0.63**			0.33		3.19*	0.38	0.11	-2.09*	0.14			0.98*			-0.02	
ITF34	-0.49	-0.13		-1.61*			-0.09		2.52*	0.27	-0.97*	-0.69	-0.65			0.30			-0.05	
ITF35	-0.05	-0.28*		-1.88*			-0.12		1.96**	1.32*	-0.54	-1.08	-1.63*			-0.32			-0.12	
ITF41	0.94*	0.01		-0.71*			-0.73*				0.33*			-1.13*	0.37	0.19	0.55*	0.17	-0.02	
ITF42	0.84*	-0.05		-0.95*			-0.44*				0.31*			-0.83**	-1.31*	0.96*	-0.13	1.28*	-0.09	
ITF43	0.50	-0.05		-0.95*			-0.60*				0.37*			0.14	0.32	0.21	0.21	-0.41	0.01	
ITF44	0.32	0.13		0.06			-0.47**				0.48			0.74	0.15	-0.09	1.16*	-0.22	-0.17	
ITF45	1.09*	-0.12**		-0.87*			-0.53*				0.01			-2.36*	-1.30*	1.28*	0.16	1.79*	-0.17*	
ITF51	-0.99**	0.88**		-0.05			-1.05*				2.06					2.10**			0.89*	-0.24
ITF52	0.53	0.22		-1.69*			-1.11*				0.52**					0.04			0.50	0.01

	ITC	ITD	ITE	ITG	R^2
ITF11	-1.52	-0.70	-2.08	-0.09	0.993
ITF12	0.54	0.75*	0.10	0.23	0.906
ITF13	7.43*	5.15*	5.17*	1.45*	0.957
ITF14	-0.16	0.51	1.08	0.30	0.615
ITF21	15.74**	10.30**	7.60	4.25*	0.795
ITF22	10.85	6.73	3.08	3.41	0.727
ITF31	0.89**	0.87*	0.46	0.74	0.893
ITF32	0.69	0.80*	0.83	0.18	0.968
ITF33	6.78*	5.22*	3.94**	2.61*	0.890
ITF34	-0.51	-0.03	0.44	0.19	0.899
ITF35	-3.28*	-1.47**	-1.94	-0.44	0.934
ITF41	2.13*	1.51*	-0.74	0.74*	0.948
ITF42	1.57*	1.37*	-1.08*	0.90*	0.876
ITF43	1.57*	1.11*	0.47	0.43	0.933
ITF44	3.93	2.73	-0.41	1.80*	0.993
ITF45	0.32	0.54	-2.84*	0.76*	0.850
ITF51	12.05**	9.09*	6.92	4.25*	0.906
ITF52	1.87*	3.07	-0.77	1.71*	0.903

* significant at 5%,** significant at 10%.

Table 9(a): Estimates of DS model of some NUTS3 Italian provinces with NUTS1 macro-region and NUTS2 region effects, Numeraire=ITE43, more rich in terms of per capita GDP.

	ITE1	ITF13	ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITC	ITD	ITF	ITG	R^2
ITE21	-2.51	-0.44*	-0.43	-0.10			-0.82				-4.01			-11.91	-7.92	-6.32**	-2.44	0.959
ITE22	-2.84	-0.39	-0.62	0.20			-1.26				-4.29			-13.47	-9.45	-7.53**	-2.91	0.965
ITE31	-0.35	-0.16	0.10		-0.15	-1.27*	1.84*	-0.94**			-0.62			-0.85	-1.21	-2.29*	0.01	0.972
ITE32	-1.38**	-0.41*	-0.16		0.08	-0.65**	1.80*	-2.08*			-2.06**			-6.84**	-5.09*	-4.56*	-1.69**	0.985
ITE33	-0.39	-0.31**	0.19		-0.28	-1.22*	2.50*	-1.73*			-0.54			-1.31	-1.52	-2.55*	-0.24	0.982
ITE34	0.02	-0.17	0.23		-0.54	-1.51*	3.02*	-1.34**			0.06			1.28*	0.08	-1.47*	0.55*	0.964
ITE41	0.01	0.78*	-0.30				0.27		1.39*	-0.99*	-0.30	-0.81*	0.60*	-0.01	-1.31*	-0.81*	-0.08	0.996
ITE42	0.07	0.38	-0.18				0.13		0.23*	-0.17	0.03	-1.33*	1.44*	0.32	-0.96*	-0.57	0.02	0.978
ITE43	-0.01	0.35**	-0.28				0.47**		0.10	0.10	-0.10	-0.55*	0.49*	-0.27	-1.17	-0.325	-0.164	0.964
ITE44	0.12	0.09	-0.03				0.33**		-0.01	-0.66*	0.58	-0.51*	1.09*	0.03**	-1.09*	-0.19	-0.29**	0.899
ITE45	0.21	0.68*	-0.22				0.34		0.44*	-0.71*	-0.33	-0.16	0.99*	1.12**	-0.47	-0.22	0.23	0.938

	ITF6	ITF11	ITF12	ITF14	ITF13	ITF21	ITF22	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF11	-0.43*	1.09*	-0.25	-0.59*	-0.41*	0.07				-1.11*					-1.07*			-0.33*	
ITF12	-0.34	0.13**	-0.69*	-0.20	0.55*	0.10				-0.99					-0.93**			-0.23**	
ITF14	-1.26*	0.44*	-1.75*	-1.23*	1.28*	0.46*				-3.14*					-2.87*			-0.75*	
ITF21	1.19*		0.89		0.10	-0.08	0.25			2.73**					2.22**			0.50**	
ITF22	1.01		0.92		0.37	-0.10	0.14			2.38					1.97			0.27	
ITF31	0.01		-1.42**		0.23		-0.14	-0.28	1.06**	0.39	0.70*	-1.17			0.21			-0.07	
ITF32	0.35*		-1.65*		0.66**		-0.38*	0.46	3.50*	1.05*	0.08	-3.46*			1.25*			0.19	
ITF33	-0.08		-1.56*		0.66		-0.01	0.01	1.43*	0.43	-0.51*	-1.00			-0.38			-0.24**	
ITF34	-0.11		-1.87*		0.40		-0.21	0.45	1.32*	-0.06	0.38	-1.60*			0.19			-0.06	
ITF35	0.02		-2.03*		0.59**		-0.11	0.54	2.64*	0.70**	-0.39	-2.61**			0.39			-0.01	
ITF41	0.07		-0.55		0.23		-0.09			0.80*			-0.14	0.86	-0.54	0.77*	-0.45	-0.10	
ITF42	-0.35*		-1.44*		0.66**		0.10			-0.24			-0.12	-1.01	0.04	0.21	0.41	-0.36*	
ITF43	-0.18**		-0.61		-0.21		-0.07			0.26**			1.47**	0.61	-0.78	0.14	-1.21**	-0.13	
ITF44	-0.23		0.07		-0.02		-0.05			-0.30			0.52	0.41	-1.30**	1.10*	-1.28	-0.44*	
ITF45	-0.21**		-1.19*		0.66**		0.12			0.12			-1.59*	-0.86	0.51	0.58*	1.06	-0.33*	
ITF51	0.64		-1.17		0.69		-1.12*			1.28					1.16			1.52*	-0.89*
ITF52	0.91		-1.61		0.50		-0.71*			2.69					1.89			1.37**	-0.45

	ITC	ITD	ITE	ITG	R^2
ITF11	-5.83*	-3.79*	-4.71*	-0.87	0.999
ITF12	-5.31	-3.46	-4.25**	-0.87	0.897
ITF14	-18.47*	-11.62*	-12.28*	-3.57*	0.977
ITF21	18.24*	10.76*	8.85**	5.08*	0.894
ITF22	17.99**	9.98	7.78	5.44*	0.900
ITF31	2.06*	0.59	1.21	0.72	0.963
ITF32	7.15*	3.72*	5.44*	1.38*	0.988
ITF33	0.59	-0.19	-1.25	0.92	0.952
ITF34	0.59	-0.48	0.94	0.17	0.963
ITF35	2.36	0.99	2.24	0.57	0.981
ITF41	4.39*	2.51*	2.51*	1.43*	0.977
ITF42	-1.66*	-1.25*	-1.66*	0.35	0.877
ITF43	0.73	0.06	1.15**	0.31	0.974
ITF44	-0.47	-0.73	-2.44	0.89	0.994
ITF45	0.55	0.25	-0.69	0.99*	0.908
ITF51	9.11	5.64	4.08	3.29	0.921
ITF52	14.33	9.96	9.00	4.31	0.780

* significant at 5%, ** significant at 10%

Table 9(b): Estimates of DS model of some NUTS3 Italian provinces, with NUTS1 macro-region and NUTS2 region effects Numeraire=ITF13, median of per capita GDP.

	ITE1	ITF45	ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITC	ITD	ITF	ITG	R^2
ITE21	-5.07*	0.05	-0.88	-0.27		-2.29*					-8.52*			-26.09*	-16.49*	-12.16*	-6.05*	0.862
ITE22	-5.38*	-0.02	-1.08*	0.06		-2.65*					-8.66*			-27.42*	-17.78*	-13.15*	-6.48*	0.939
ITE31	1.24*	0.44*	0.91*		-0.02	-1.35*	1.81**	-0.97*			0.82**			4.52*	2.80*	0.44	1.11*	0.848
ITE32	0.68*	0.69*	0.74*		-0.24	-0.79**	1.88**	-1.65*			-0.41**			0.01	-0.43	-1.54*	-0.18	0.906
ITE33	0.99*	0.52*	0.91*		-0.48	-1.41*	2.53*	-1.50*			0.39			2.74*	1.49**	-0.57	0.57*	0.903
ITE34	0.48*	0.52*	0.57*		-0.66	-1.80*	3.01*	-1.41*			-0.38*			0.37	0.12	-1.53*	0.13	0.898
ITE41	0.44	0.23	0.19			-0.23			1.30*	-1.28*	0.76	-0.70	0.32	-0.04	0.01	-0.03	-0.34	0.990
ITE42	-0.03	-0.23	0.25			-0.21			0.13	-0.11	0.26	-0.97**	1.06*	0.12	-0.13	0.19	-0.16	0.908
ITE43	0.55	0.13	0.22			0.24			0.04	0.10	0.76	-0.38	0.16	1.22	0.84	1.04	0.04	0.314
ITE44	0.39	0.26*	0.25			0.01			-0.08	-0.55	0.78	-0.50	0.67	-0.55	-0.48	0.19	-0.55**	0.842
ITE45	0.53	0.07	0.27			-0.11			0.34*	-0.92*	0.56	0.04	0.71**	1.30	0.87	0.66	0.07	0.494

	ITF6	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF11	0.53*	0.96*	-0.16	-0.09	0.36	-0.,12				0.64					1.67*		-0.82**	0.36*	
ITF12	0.54	-0.04	-1.36*	1.52*	0.74*	0.15				0.72					2.59*		-1.85*	0.36*	
ITF13	1.00*	-0.12	0.09	0.34	0.95*	-0.20				1.89*					2.88*		-0.87*	0.69*	
ITF14	0.16	0.39*	-0.86	1.04**	-0.13	0.05				-0.24					0.28		-0.13	0.18	
ITF21	1.20*		1.01*			-0.11	0.38**			2.06**					3.39*		-1.28*	0.78*	
ITF22	0.86*		1.36*			0.16	-0.28**			1.11					0.72		0.72*	0.48*	
ITF31	0.02		-0.66			0.18		-0.81*	-0.66	-0.62	1.10	1.04*			1.03**		-1.40*	0.01	
ITF32	0.49*		-0.13			-0.23		-0.29	1.55*	0.53	0.71	-1.34			1.45*		-0.53	0.32**	
ITF33	0.17		-0.24			0.41		0.01	-0.52	-0.36	-0.27	1.42			0.86		-1.37*	-0.05	
ITF34	0.02		-0.81			0.10		0.01	-0.46	-0.86**	0.80**	0.61			1.03		-1.19*	0.08	
ITF35	0.11		-0.55			-0.02		-0.46	0.70	0.22	0.37	-0.57			0.36		-0.37	0.10	
ITF41	0.27*		0.29*			-0.26*				0.65*			1.08*	1.87*	-1.01*	0.44*	-1.56*	0.22*	
ITF42	-0.09**		-0.18*			-0.02				-0.20**			1.46*	-0.07	-0.47*	-0.35*	-0.63*	0.01	
ITF43	0.02		-0.12			-0.31*				0.05			2.33*	1.81*	-1.25*	0.04	-2.40*	0.16*	
ITF44	0.01		0.70*			-0.23**				-0.47			1.45*	1.42*	-1.68*	0.92*	-2.33*	-0.13	
ITF51	0.13		-0.14			-1.13*				-0.94					-0.69		0.17	0.54	-0.13
ITF52	0.47		-0.79			-0.74*				0.67					0.45		0.18	0.57	-0.13

	ITC	ITD	ITE	ITG	R^2
ITF11	4.94	2.93	3.01	0.69	0.988
ITF12	4.61	3.11	2.99	0.68	0.768
ITF13	11.46*	7.19*	8.15*	1.73*	0.888
ITF14	-0.67**	-0.70**	-0.08	-0.58	0.614
ITF21	12.91**	8.59**	7.86**	2.68	0.770
ITF22	10.33**	5.48	4.32	2.62*	0.887
ITF31	-1.47**	-0.87**	-1.04	-0.29	0.829
ITF32	5.35*	3.04*	3.83*	0.75	0.957
ITF33	0.12	0.56	-1.36	0.57	0.764
ITF34	-1.39	-0.97	-0.40	-0.51	0.836
ITF35	0.01	-0.20	0.16	-0.18	0.899
ITF41	3.88*	2.18*	3.04*	0.47*	0.991
ITF42	-1.27**	-0.91*	-0.33	-0.46*	0.971
ITF43	0.16	-0.42*	1.46*	-0.63*	0.972
ITF44	-0.93	-1.05	-1.96	-0.04	0.997
ITF51	-2.86	-1.58	-4.08	0.32	0.840
ITF52	3.31	3.36	1.74	1.46	0.816

* significant at 5%, ** significant at 10%

Table 9(c): Estimates of DS model of some NUTS3 Italian provinces, with NUTS1 macro-region and NUTS2 region effects Numeraire=ITF45, more poor in terms of per capita GDP.

	ITE1	ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE44	ITE45	ITE43	ITC	ITD	ITF	ITG
ITE21	-	-	+			-				-		+	-	-	-	-
ITE22	-	-	+			-				-		+	-	-	-	-
ITE31	-		+	+	-	-	-			+		-	-	-	-	+
ITE32	+		+	+	+	-	-			+		-	+	+	-	+
ITE33	-		+	+	-	-	-			+		-	+	+	-	+
ITE34	+		+	+	-	-	-			+		-	+	+	-	+
ITE41	+		+			-		+	-	-	+	+	+	+	-	+
ITE42	+		+			-		+	-	-	+	+	+	+	+	+
ITE44	-		+			-		-	-	-	+	+	-	-	-	-
ITE45	+		+			-		+	-	+	+	+	+	+	+	+

	ITE43	ITF6	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF11	-	-	+	+	-	-		-			-					+				-
ITF12	-	+	-	-	+	+		-			+					+				+
ITF13	-	+	-	+	-	+		-			+					+				+
ITF14	-	-	+	-	+	-		+			+					+				-
ITF21	+	+	+				+	-			+					+				+
ITF22	+	+			+		+	-			+					+				+
ITF31	-	-			-			-	+	+	-	-	-			+				-
ITF32	-	+			-			-	+	+	-	-	-			+				+
ITF33	-	+			-			+	+	+	+	-	+			+				-
ITF34	-	-			-			-	+	+	-	-	-			+				-
ITF35	-	-			-			-	+	+	-	-	-			-				-
ITF41	+	+			-			-			+			-	+	+	+	+		-
ITF42	+	-			-			-			+			-	-	+	-	+		-
ITF43	+	-			-			-			+			+	+	+	+	-		+
ITF44	+	+			+			-			+			+	+	-	+	-		-
ITF45	+	-			-			-			+			-	-	+	+	+	-	
ITF51	-	+			-			-			+					+			+	-
ITF52	+	+			-			-			+					+			+	+

	ITC	ITD	ITE	ITG
ITF11	-	-	-	-
ITF12	+	+	+	+
ITF13	+	+	+	+
ITF14	-	+	+	+
ITF21	+	+	+	+
ITF22	+	+	+	+
ITF31	+	+	+	+
ITF32	+	+	+	+
ITF33	+	+	+	+
ITF34	-	-	+	+
ITF35	-	-	-	-
ITF41	+	+	-	+
ITF42	+	+	-	+
ITF43	+	+	+	+
ITF44	+	+	-	+
ITF45	+	+	-	+
ITF51	+	+	+	+
ITF52	+	+	-	+

Table 10(a): Qualitative analysis of some NUTS3 Italian provinces with NUTS1 macro-region and NUTS2 region effects, Numeraire=ITE43, more rich in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

	ITE1	ITF13	ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITC	ITD	ITF	ITG
ITE21	-	-	-	-			-				-			-	-	-	-
ITE22	-	-	-	+			-				-			-	-	-	-
ITE31	-	-		+	-	-	+	-			-			-	-	-	+
ITE32	-	-		-	+	-	+	-			-			-	-	-	-
ITE33	-	-		+	-	-	+	-			-			-	-	-	-
ITE34	+	-		+	-	-	+	-			+			+	+	-	+
ITE41	+	+		-			+		+	-	-	-	+	-	-	-	-
ITE42	+	+		-			+		+	-	+	-	+	+	-	-	+
ITE43	-	+		-			+		+	+	-	-	+	-	-	-	-
ITE44	+	+		-			+		-	-	+	-	+	+	-	-	-
ITE45	+	+		-			+		+	-	-	-	+	+	-	-	+

	ITF6	ITF11	ITF12	ITF14	ITF13	ITF21	ITF22	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF11	-	+	-	-	-		+			-					-				-
ITF12	-	+	-	-	+		+			-					-				-
ITF14	-	+	-	-	+		+			-					-				-
ITF21	+		+		+	-	+			+					+				+
ITF22	+		+		+	-	+			+					+				+
ITF31	+		-		+		-	-	+	+	+	-			+				-
ITF32	+		-		+		-	+	+	+	+	-			+				+
ITF33	-		-		+		-	+	+	+	-	-			-				-
ITF34	-		-		+		-	+	+	-	+	-			+				-
ITF35	+		-		+		-	+	+	+	-	-			+				-
ITF41	+		-		+		-			+			-	+	-	+	-		-
ITF42	-		-		+		+			-			-	-	+	+	+		-
ITF43	-		-		-		-			+			+	+	-	+	-		-
ITF44	-		+		-		-			-			+	+	-	+	-		-
ITF45	-		-		+		+			+			-	-	+	+	+		-
ITF51	+		-		+		-			+					+			+	-
ITF52	+		-		+		-			+					+			+	-

	ITC	ITD	ITE	ITG
ITF11	-	-	-	-
ITF12	-	-	-	-
ITF14	-	-	-	-
ITF21	+	+	+	+
ITF22	+	+	+	+
ITF31	+	+	+	+
ITF32	+	+	+	+
ITF33	+	-	-	+
ITF34	+	-	+	+
ITF35	+	+	+	+
ITF41	+	+	+	+
ITF42	-	-	-	+
ITF43	+	+	+	+
ITF44	-	-	-	+
ITF45	+	+	-	+
ITF51	+	+	+	+
ITF52	+	+	+	+

Table 10(b) – Qualitative analysis of some NUTS3 Italian provinces with NUTS1 macro-region and NUTS2 region effects Numeraire=ITF13, median of per capita GDP, shaded grey denote statistically significant signs with α at least 10%.

	ITE1	ITF45	ITE21	ITE22	ITE31	ITE32	ITE33	ITE34	ITE41	ITE42	ITE43	ITE44	ITE45	ITC	ITD	ITF	ITG
ITE21	-	+	-	-			-				-			-	-	-	-
ITE22	-	-	-	+			-				-			-	-	-	-
ITE31	+	+		+	-	-	+	-			+			+	+	+	+
ITE32	+	+		+	-	-	+	-			-			+	-	-	-
ITE33	+	+		+	-	-	+	-			+			+	+	-	+
ITE34	+	+		+	-	-	+	-			-			+	+	-	+
ITE41	+	+		+			-		+	-	+	-	+	-	+	-	-
ITE42	-	-		+			-		+	-	+	-	+	+	-	+	-
ITE43	+	+		+			+		+	+	+	-	+	+	+	+	+
ITE44	+	+		+			+		-	-	+	-	+	-	-	+	-
ITE45	+	+		+			-		+	-	+	+	+	+	+	+	+

	ITF6	ITF11	ITF12	ITF13	ITF14	ITF21	ITF22	ITF31	ITF32	ITF33	ITF34	ITF35	ITF41	ITF42	ITF43	ITF44	ITF45	ITF51	ITF52
ITF11	+	+	-	-	+		-			+					+		-		+
ITF12	+	-	-	+	+		+			+					+		-		+
ITF13	+	-	+	+	+		-			+					+		-		+
ITF14	+	+	-	+	-		+			-					+		-		+
ITF21	+			+		-	+			+					+		-		+
ITF22	+			+		+	-			+					+		+		+
ITF31	+			-			+	-	-	-	+	+			+		-		+
ITF32	+			-			-	-	+	+	+	-			+		-		+
ITF33	+			-			+	+	-	-	-	+			+		-		-
ITF34	+			-			+	+	-	-	+	+			+		-		+
ITF35	+			-			-	-	+	+	+	-			+		-		+
ITF41	+			+			-			+			+	+	-	+	-		+
ITF42	-			-			-			-			+	-	-	-	-		+
ITF43	+			-			-			+			+	+	-	+	-		+
ITF44	+			+			-			-			+	+	-	+	-		-
ITF51	+			-			-			-					-		+	+	-
ITF52	+			-			-			+					+		+	+	-

	ITC	ITD	ITE	ITG
ITF11	+	+	+	+
ITF12	+	+	+	+
ITF13	+	+	+	+
ITF14	-	-	-	-
ITF21	+	+	+	+
ITF22	+	+	+	+
ITF31	-	-	-	-
ITF32	+	+	+	+
ITF33	+	+	-	+
ITF34	-	-	-	-
ITF35	+	-	+	-
ITF41	+	+	+	+
ITF42	-	-	-	-
ITF43	+	-	+	-
ITF44	-	-	-	-
ITF51	-	-	-	+
ITF52	+	+	+	+

Table 10(c): **Qualitative analysis of some NUTS3 Italian provinces with NUTS1 macro-region and NUTS2 region effects Numeraire=ITF45, more poor in terms of per capita GDP, shaded grey denote statistically significant signs with α at least 10%**

.