Abstract This paper analyzes the differential impact of several territorial determinants of the economic performance of Italian provinces (NUTS-3 level), as measured by per capita GDP, export and employment growth from 1999 to 2014. It covers both the pre-crisis and the crisis period and stresses the role of geographical proximity in shaping local performance over a wide set of explanatory variables. In order to do so, we employ, firstly, a spatial Durbin model which enables us to discriminate between direct and indirect effects and to highlight the possible contagion or crowding-out spatial effects for each territorial dimension affecting growth. Then, we extend the analysis by allowing for the possibility of two regimes (pre-crisis and post-crisis). The performance of the provinces before and during the crisis relates to specific territorial components and geographic proximity appears to influence differently the results and their interpretation.

1. Introduction

The literature on factors affecting local and regional growth is large but the existing research does not fully explore the analysis of the differential impact of them on local performance. This happens for two reasons: on one hand, models include one or few variables at a time and the relative role of each determinant is not captured; on the other, spatial spillover effects are often overlooked while they may drive the total impact of each factor of growth. Both informations are important for policy. In periods of scarce resources, policy-makers should maximize the impact of their intervention in pushing the growth process by concentrating on those factors that display greater impact. Also, since spatial spillovers may be positive or negative, knowing the direction of the indirect effects can help to assess the geographical level at which policy should be conducted.

In our work we try to overcome these pitfalls. First, by adopting a more comprehensive spatial setting, we try to capture the sign and relative intensity of both direct and indirect effects concerning each territorial factor affecting local growth. Second, contrary to the current literature on regional growth that usually deals with a single outcome variable, we assess the differential impact of local growth determinants on three different growth performance variables over the same data set, namely per capita GDP growth, employment growth and manufacturing export growth. Through this comparison we are able to detect the spatial impact of different local growth factors by capturing several channels of spillovers transmission. Third, we perform the analysis in a period which fully includes the Great Recession and, by this way, we are able to discover whether the crisis has affected the relative impact of the territorial factors on growth and the characteristics of the diffusion process across space, eventually diversified according to the performance variable. An additional contribution of our analysis is that, through the estimation of a two-regime Spatial Durbin model (Elhorst and

Freret 2009), we try to discriminate between contagion and crowding-out effects before and after the crisis and detect whether two unevenly developed macro regions of Italy (North-Center and South) have been differently affected by (and reacted to) the crisis.

By making use of a general framework which encompasses a variety of territorial factors, we try to evaluate the relative importance of both tangible and intangible determinants of local performance in a spatial setting by looking explicitly at the components of growth which have mainly spatial *direct* effects (i.e., originating inside the region) *vis-à-vis*- those component which have mainly *indirect* effect (i.e., originating from spillovers coming out from a neighbour region or from the entire system of regions in which the area is included). Indeed, the omission of spatial variables may bias the measurement of local growth remarkably.

Aware of the potential misleading results that could arise from neglecting externalities across territorial units, we have applied spatial econometrics tools (Elhorst 2010) to test for the importance of spatial externalities and to discriminate the effects of spatial dependence from that of spatial heterogeneity and of omitted variables. The consideration for spatial models allows to stress the role of spatial spillovers in different fashions. The spatial Durbin model (SDM) comes out to be the preferred framework since it enables us to discriminate between direct and indirect effects of each dimension of territorial growth. In other words, we are able to distinguish if the performance of province A depends on that of its neighbour (B) being influenced by A's endowment or if the performance of province A is explained by B's performance due to B's endowment of a specific territorial factor.

Our panel analysis covers the 1999-2014 period and we focus on NUTS-3 level in order to better capture the effect of spillovers. Though the analysis is restricted to one country (Italy), we believe that it may deliver interesting insights for other countries, especially with respect to the legacy of the crisis period[1].

The structure of the paper is the following. In the next two sections we review the literature on the role of interregional spillovers in the growth process by considering separately the performance variables (section 2) and the territorial determinants included in the analysis (section 3). In section 4 we explain the methodology upon which we build our empirical work and describe the preferred specification (spatial Durbin model). In particular, in section 4.2 we define the operationalization of the empirical model for the problem at hand while in section 4.3 we propose an extension of the model that is useful to depict the local performance during the crisis. In section 5 we present the results for the different models and highlight the peculiarity of the crisis period. In section 6 we conclude and stress the policy implications of our analysis.

[1] An interesting attempt to assess the impact of economic crisis on NUTS-3 regions in Greece has recently been presented by Petrakos and Psycharis (2016). The analysis, however, covers the crisis period until 2012 and does not consider a spatial econometric specification.

2. Spillovers in local performance

As previously said, our empirical analysis focuses on three indicators of local economic performance, namely per capita GDP, manufacturing export and employment growth. The spatial dimension of these variables and of their determinants has to be taken into account explicitly. For that reason, in this and in the following section, we highlight the role of spatial spillovers in the literature and differentiate those pertaining the performance variables from those pertaining their determinants.

The diffusion process of spatial externalities is often considered as a black box. Though the relevance of spatial effects is usually captured in empirical analyses on regional and local growth, different types of externalities (knowledge, industrial, regional spillovers) concur in determining this result and the proximity approach is not sufficient in capturing the spillover effects (Capello 2009). The detection of the channels through which spatial spillovers operate for each specific factor of growth might be very useful in designing specific development policies (Abreu *et al*. 2005).

Going back to Easterly and Levine (1998), the policy implications of the spatial multiplier effect may help to understand the difference between the case in which the whole regional system may benefit from the spillover effect generated by the improvement of a factor of growth (*i.e.*, human capital) in one region and the one in which all the regions simultaneously raise that factor, thus inducing a greater effect.

Disentangling direct from indirect effects and global vs. local impacts has therefore important policy consequences. If a policy variable is shocked in one region, the *direct* effect will be the one which affects performance in that region while the *indirect* effect will be the one connected with spillovers to and from neighboring regions.

Both effects are however *local* since only the region in which the exogenous shock has originated and its neighbors will be affected. However, we may also be interested in the induced effect of this policy on higher order regions as well as on the feedback effects on regions which have already experienced the direct and the indirect effects. The simultaneous consideration for direct, indirect and induced effect will constitute the *global* effect of the policy (Abreu *et al.* 2005).

Looking at the causes of spillovers, knowledge externalities are mainly responsible for regional GDP growth since ideas and information diffuse among firms and organizations generating innovation and, by this way, affecting the growth of the economic system where firms operate (Henderson *et al.* 1995; Glaeser *et al.*1995). The nature of these spillovers is not necessarily spatial; they acquire a spatial connotation if knowledge accumulates through interaction of actors located in proximate locations.

Most works, however, do not explain how knowledge spreads at local level. The extent to which a region can access the knowledge inputs of another region is, indeed, dependent on spatial proximity and on its relational proximity to that region, where relational proximity stands for the intensity of research interactions between the two areas (Hoekman *et al.* 2009).

Hence, geographical proximity has a fundamental role for knowledge transmission and positive spatial spillovers connected to it (Paci *et al*. 2014). Spatial proximity, however, is not a sufficient condition for knowledge transfers to take place. Learning often requires trust and cognitive or social proximity, which of course may indeed be facilitated by spatial proximity itself (Karlsson and Gråsjö 2014).

Spatial externalities affect GDP growth also through the so-called *industry* spillovers. The presence of a large and productive firm in a sector or an area might create advantages in horizontally or vertically linked industries but it may also be detrimental by increasing competition for domestic firms. An assessment of the relevance of spatial spillovers which controls for intra and inter-industry effects in the spatial econometric specification for a knowledge production function is contained, among others, in Autant-Bernard and LeSage (2011).

Growth spillovers occur also through trade linkages and market relationships. Many studies in the literature highlight the role of "core" regions in transmitting GDP growth to the national economy over the business cycle through market interactions (Ertur *et al.* 2006, Fingleton and Lopez-Bazo 2006; Ramajo *et al.* 2017)

Benos *et al.* (2015) robustly demonstrate that interregional externalities do matter for growth in European regions, regardless of the definition of proximity. By considering different growth model specifications, arising from geographic, economic and technological proximity, they detect the importance of spillovers across regions.

For the Italian economy, Panzera and Postiglione (2014) confirm the presence of disparities among the Italian provinces and a positive role for GDP spillovers. The analysis, however, does not cover the post-crisis period.

Interregional spillovers in exports have been less analyzed. The literature on exports spillovers has been mainly concentrated on testing the empirical relevance of the *local export spillover hypothesis* (Aitken *et al.*1997). This theory suggests that the likelihood of a firm to be engaged in exports is positively associated with the local presence of many export firms but also on the level of knowledge spillovers, industry agglomeration, or other similarities between proximate firms (Andersson and Weiss 2012). Greenway and Kneller (2008**)** analyze the exporting behavior of UK manufacturing firms and show that spillovers associated with regional and industry agglomeration are relevant for the entry of new exporters. Nevertheless, the effect is stronger in the same region and industry and weaker for the interregional spillover component concerning the same industry and a different region. Therefore, interregional spillovers are usually considered less important for exports.

The literature on local and regional spillovers is more diversified in the case of employment and unemployment growth.

Niebuhr (2003) stresses the role of spatial interactions with respect to regional labor markets in Europe and finds that regions characterized by high unemployment rates and those characterized by low unemployment rates tend to cluster in space. Kosfeld and Dreger (2006) find strong spatial interdependencies in regional employment growth and unemployment rates (see, also, for the Italian economy, Pagnini 2003).

According to Zierahn (2012), the growth rate of unemployment in one region is interrelated with the employment growth in another region because of a productivity effect. The positive spillover does exist in some sectors (private and public services). A negative spillover may also occur because of the action of competitive forces (labor stealing), namely the attraction of an area for high skilled workers (share of qualified employees) in the nearby region.

The analysis of interregional spillovers and the detection of the exact spatial effects in local performance is crucial for those studies that incorporate the crisis period, such as the present one. Looking at the Canadian experience, Dubè and Polese (2016), by means of a spatial Durbin model, have recently shown that the main determinant of regional change in unemployment rates during the crisis has been the change of unemployment in neighboring regions. Indeed, if surrounding areas experience drastic drops in employment, a region having a fall in local demand may not suffer from the crisis in terms of unemployment due to immigration from adjacent regions. Fogli *et al.* (2012) find that, at the onset of the recession, the spatial correlation (clustering) of unemployment falls due to the increase in the spatial dispersion of unemployment rates driven by a sharp rise in unemployment in a few counties not necessarily close. As the recession progresses, the neighbors of counties in which unemployment initially increased are more likely to experience high unemployment; in such a way counties characterized by high unemployment rates cluster together. This in turn drives up spatial correlation. As the recession moves further, the increase in unemployment spreads across counties. As a consequence, the spatial dispersion in unemployment rates across counties decreases and the spatial correlation (clustering) also stabilizes. The uneven spatial effects of recessions on Italian employment, within a different framework, has also been explored recently by Di Caro (2017)[2].

In synthesis, there is a wide evidence on the importance of spatial effects in the growth process of different performance indicators. It emerges, however, a great variety of outcomes about the

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[2] As evidenced in Bachtler and Begg, (2018), the Italian case, especially in the South,, is also illustratory of a low-skill trap where labour mobility mechanisms are hampered because of low demand for skills

direction of the impacts, the types of spillover involved and the exact paths of the diffusion process. The type of spatial dependence may also differ according to the performance variables considered since some of them may display a contagion effect and some other a trade-off (competitive) effect across regions. Therefore, a more general empirical analysis that encompasses the spatial effects may help in the interpretation and disentangling of the results.

3. Spillovers in the determinants of local and regional growth

Changes in the determinants of local growth affect spatial interactions and may be responsible of spatial dependence. It is therefore useful to assess the differential role of territorial factors in affecting local growth and in producing spatial spillovers.

Most studies in the literature focus on a single territorial determinant of local/regional performance at a time by looking at within-regions and across-regions spillovers pertaining to it. In order to restrict the number of territorial factors to a meaningful subset of interest, in what follows we refer to the territorial capital concept, firstly introduced by the OECD (2001) and the European Commission (2005) and conceptualized by Camagni (2008). This framework classifies the determinants of growth according to their different characteristics in terms of public content and degree of materiality.

According to Camagni, territorial capital encompasses all material and immaterial resources, production factors, collective learning, knowledge and skills accumulated through time in a specific territory. Embedded in this definition there is the possibility of interactions between assets of different nature in the explanation of the economic performance.

Territorial capital may be represented by a 3-by-3 taxonomy which classifies the different features of territorial assets in terms of their degree of materiality and rivalry. Territorial factors with high degree of materiality and high private content (such as fixed capital stock) coexist with factors with high degree of materiality and mainly public content (such as social overhead capital) as well as with factors in-between that have a mixture of private and public content (*i.e.*, natural/cultural capital). Moreover, immaterial territorial elements can be classified in terms of their degree of public content, which is lower for human capital, medium for institutional-relational capital and higher for social capital. This classification encompasses also elements with an intermediate level of materiality, being identified as entrepreneurial-relational capital (pertaining to network relations across both local and foreign-owned private firms), and local cognitive public capital, measured by Marshall-Arrow-Romer specialization externalities and Jacobs-like agglomeration externalities.

The importance of spillovers in the growth process of economic variables has been stressed for most components of territorial capital. However, the emphasis has being given to single factors in turn and very rarely to a combination of them.

For instance, Ramos *et al.*(2010) found positive spillover effects of *human capital* on production and GDP growth though they seem to vanish for more qualified jobs.

A positive impact, both direct and indirect, of human capital of the neighbors on economic performance of a region, has also been found by Ozyurt and Dees (2015) for per capita GDP and by Fisher *et al.* (2009) for labor productivity variation. In the second case, however, a positive and significant direct effect is offset by a negative and significant indirect effect that makes the total impact not significantly different from zero.

Also Olejnik (2008) finds that human capital in neighboring locations negatively influence the level of per capita income in a given region. The explanation is that, usually, the increase in human capital endowment in a region determines migration of skilled people from neighboring regions, which tends to have a negative impact in them[3].

In the case of *social capital*, Surinach and Moreno (2011) found that some structural aspects of it (i.e., participation in associations, among others) have a positive correlation with growth while other less cognitive aspects (i.e., trust, crime) display a negative relationship. The positive impact of associationism is however not too strong except in conjuction with human capital.

Lavecchia (2015) finds evidence of positive global spatial spillovers of social capital across European regions when this factor is measured through the principal components of four 'cultural' variables (generalized trust, autonomy, respect for others and control over life). Botzen (2016) points out that the geographical scope of social capital is locally concentrated at NUTS-3 level and this suggests the presence of social spillovers. The spatial spillovers effects of social capital also concern the presence of spatial externality on crime. Ratcliffe (2010) observes that the crime rate in one census U.S. area is partly influenced by the crime rate in a neighboring area. Torres-Preciado *et al.* (2015) find that crime has a negative total effect on economic growth across Mexican states and that a significant spillover effect seems to reinforce the negative impact on regional growth.

Tests for the importance of *amenities* in determining regional growth through spillovers have followed the original work by Glaeser *et al.* (2001). Most studies focus on a single concept of amenity such as cultural or natural endowment but, in more complete studies, the overall touristic appeal of a region is considered. Among others, Paci and Marrocu (2014) discovered that the positive effect of

[3] Regarding human capital mobility some further arguments come from analysis dealing with University students' mobility and retention. Employment opportunities have resulted in explaining inter-provincial students mobility in Italy (Dotti *et al.* 2013). Relevant pull and push factors for student mobility may differ, however, when considering differences in the “quality” of students (see Faggian and Franklin 2014, for US college leavers).

domestic and international tourism flows on regional growth may be the result of the presence of natural/cultural elements and of communication spillovers determined by previous tourism flows.

Since the work by Aschauer (1989), the role of infrastructures as social fixed capital in fostering economic growth has been stressed in many analyses.

Transportation plays a central role on regional economic activities, both inter-regionally and intra-regionally. The existence of *transport infrastructure* networks between two regions may benefit each other because of better connectivity and accessibility. Regional economic growth could then be achieved because of the significant reduction of transportation costs of both goods delivery and labor mobility (Krugman 1991). Conversely, economic agglomeration may happen because of declining spatial and temporal distance. Labor and raw material may start to flow into one region from other regions (Fujita *et al*. 1999).

Boarnet (1998) was the first to argument that effects induced by transport infrastructure extends to other regions. He analyzed the spatial spillovers in the case of street and highway infrastructures and found a positive effect on output within the same county and a negative effect elsewhere. The effect can be negative since investment in one location can draw resource away from other locations.

For Yu *et al.* (2013), there are two types of spillover effects stemming from infrastructure, namely positive spillovers, caused by productivity leakages because of the connectivity characteristics of transport facilities, and negative spillovers, arising from the migration of production factors. The magnitude of negative spillovers exceeds that of positive ones across a relatively short distance, so that they can be internalized within a larger area (Moreno and Lopez-Bazo 2007).

The advantages of *accessibility* are also stressed in Del Bo and Florio (2012), Fageda and Gonzales-Aregall (2014) and Chen and Haynes (2015). They all highlight the differential impact of spillovers according to the type of transport infrastructure with mixed results. In particular, the first authors point out that the quality and accessibility of a region's transportation network (measured by overall accessibility and time to reach the region's main market), displays a positive but slightly higher coefficient with respect to the simple endowment of traditional road and railway infrastructure[4]. The role of direct and spatial spillover effects is also highlighted, confirming the possibility of negative spatial spillovers in infrastructure endowment.

Very few studies analyze the role of transport infrastructures on growth *vis-à-vis* other determinants. One exception is the work by Crescenzi and Rodriguez-Pose (2012). The results of their analysis indicate that the impact of transport infrastructure endowment on regional growth is well

[4] The role of positive spillovers of highways infrastructures in shaping the growth pattern of Italian provinces has been recently analyzed by Cosci and Mirra (2016) in a spatial analysis of conditional convergence by considering the change in regional accessibility (in terms of transport time) produced by the new investment.

below what could be expected. Positive or negative infrastructure spillovers depend on the specification used.

As determinants of growth, *specialization* and *agglomeration* make the transmission of knowledge spillovers (both technical and informal) easier among economic actors and are responsible for important spatial spillovers. The evidence however, is quite mixed even in this case.

Brunow and Grunwald (2014) find that urbanization and localization externalities are important to increase exports. But a high degree of specialization and the density of economic activity may also be detrimental for economic growth (Deidda *et al.* 2006).

Glaeser *et al.* (1992) were the first to demonstrate that city/industries tend to grow faster if the surrounding areas are more diversified while Pede (2013) and Eriksson and Hane-Wejiman (2017) have shown recently that a high degree of unrelated variety increases the regional resilience through time, given that diversified economies are less subject to business cycle volatility.

For Italian provinces, some authors (Pagnini 2003) found a negative effect for specialization and density and a positive effect of diversity on regional manufacturing employment growth. Specialization has a negative impact also at a finer geographical level (Mameli *et al.* 2008, for local labor systems). Therefore, the role of specialization and diversity may depend on the level of aggregation.

The interregional impact of *entrepreneurial networks* on growth is related to the type of networks that are considered. The literature is wide for particular type of networks, for instance those between *FDI* and domestic firms.

At a country level, Phillips and Ahmadi-Eshafani (2010) observe that the presence of foreign firms contributes to exports in the host country through two different channels. A direct one, capturing knowledge spillovers, is through the action of *FDI* which serves as a production platform for domestic export to other countries; the indirect one is due to the fact that domestic firms learn to export from multinationals because of non market interaction (information, competition and imitation) and input-output relationships (see also Greenway *et al.* 2004). Negative effects may, however, occur because of the weak interaction with local firms, the congestion on local infrastructure and the increase in the cost of labor (Karpaty and Kneller 2011; Alvarez and Lopez 2008).

Crespo and Fontoura (2007) notice that the empirical evidence about FDI spillovers to domestic firms has provided mixed results. FDI spillovers depend on many factors, frequently with an indeterminate effect. Lin and Kwan (2016) examine the extent of FDI technology spillovers and their diffusion over time and across space in China. They found that domestic firms mainly benefit from FDI presence in the neighboring region while the direct effect is negative. By using a spatial Durbin model they find a direct negative effect due to the drawing of the labor force (poaching) and a positive knowledge spillover which is wider geographically.

Another important channel through which knowledge spillovers occur is through inter-firm relationships which generate *innovation*. As known, the innovation activities strongly depend on both internal R&D and from R&D networks, exchange of ideas and reverse engineering from technologically and spatially proximate firms. Since the pioneering work of Jaffe (1989), both industrial and University research were shown to be important determinants of patent activity. The effect of geographical spillovers concerning these two innovation inputs are quite remarkable and statistically significant in empirical estimations for both patented inventions and more direct measures of innovative activity though greater in the latter case (Feldman 1994).

In conclusion, the evidence on the magnitude and sign of the spillovers regarding the territorial factors affecting growth is quite mixed. A full comparison of the relative role of the different factors and of their (both direct and indirect) spatial effects is still lacking in the literature. Also, we may ask if the recession period has changed the direction and magnitude of the spatial effect. The answer to this question cannot be found in the current literature since most of it excludes the crisis period from the analysis.

4. The Empirical Framework

4.1 The Model

A better understanding of the causes of spatial disparities across territories can be achieved by looking at the causal spatial linkages among economic variables describing the performance of a certain area in terms of its own characteristics and of those of its neighbours. Needless to say, observations belonging to sample data collected for units in space, such as provinces, regions, individuals and so on, are characterized by a certain degree of dependence.

For that reason, if the true data generating process (DGP) is of spatial nature, we cannot assume a priori spatial independence, which is typical of OLS estimation, and the failure of this assumption leads to biased and inconsistent parameter estimates.

Panel data models are designed to deal with individual heterogeneity, which can also be of spatial nature, but not with individual interactions or spatial autocorrelation. The demeaning procedure, typical of the fixed effect framework, deals with heterogeneity due to individual characteristics, among others *absolute* geographical localization; however, the form of heterogeneity arising from differentiated feedback effects coming from cross-section interaction and based on *relative* geographical position of individuals with respect to each other, requires explicit modelling of spatial dependence. Spatial panel models are designed to deal with both forms of heterogeneity.

Spatial dependence among observations in a panel framework can be modelled in different ways. The choice should be made on the basis of which type of spatial interaction effect should be accounted for (Fingleton, 2017). Our analysis is based upon the estimation of a spatial Durbin model (SDM thereafter) by LeSage and Pace (2009) where the outcome variable of one unit is explained by the outcomes of neighbouring units and also by their features, through the inclusion of the spatially lagged dependent and independent variables:

$$y_{it} = \alpha + x_{it}\beta + \delta\sum_{j=1}^{N} w_{ij}y_{jt} + \sum_{j=1}^{N} w_{ij}x_{ijt}\theta + \mu_i + \lambda_t + \varepsilon_{it} \qquad (1)$$

Here, y_{it} is the dependent variable (in our case, as we will see, per capita GDP, manufacturing export or employment growth rates) for unit i (in our case, province) observed at time t, δ is the strenght of interaction, θ is a $K \times 1$ vector of fixed but unknown parameters and w_{ij} is the *(i,j)* element of the spatial weight matrix W[5] which describes the spatial dependence structure among provinces. In the case of a binary contiguity matrix w_{ij}=0 (a province cannot be neighbour of itself) and w_{ij}=1 if the province are contiguous. In such a way, the economic performance of unit *i* at time *t* depends not only on its own characteristics but also on the economic performance of the neighbouring units and on their characteristics. For robustness we have also considered a k=5 nearest neighbor matrix which, in general, is computed from the distance between the area' centroids and implies that each area is connected to the same number of neighbors.

The attractiveness of SDM model and of two restricted versions of it, namely the well known Spatial Lag Model (SLM) and the Spatial Error Model (SEM), introduced by Ord (1975) and widely used by Anselin and Le Gallo (2006), Elhorst (2010) amongst others, rests on the interpretation of the coefficients in terms of direct and indirect effects of a change in a given variable (LeSage and Pace 2009). The direct effect takes into account *feedback effects* (impacts passing through neighbouring units and back to the unit where the change started). These feedback effects are partly due to the coefficient of the spatially lagged dependent variable and partly due to the coefficient of the spatially lagged value of the explanatory variable itself (Elhorst 2014). The indirect effect gives a more accurate measure of spatial spillovers. It measures the impact of changing an independent variable in a particular unit on the dependent variable of all the other units. The distinction among them is, for the current analysis, crucial.

The SDM can be written in a vector form in the following way:

[5] W is a *NxN* non stochastic, non negative spatial weight matrix, normalized to have row sums of unity.

$$Y_t = (I - \delta W)^{-1}\alpha\iota_N + (I - \delta W)^{-1}(X_t\beta + WX_t\theta) + (I - \delta W)^{-1}\varepsilon_t^* \qquad (2)$$

with ε_t^* covering the error term and, whenever included, individual and/or time effects (μ_i and λ_t in (1)). The matrix $(I - \delta W)^{-1}$, common to the three terms in the RHS, is the spatial multiplier and can be written as:

$$(I - \delta W)^{-1} = I + \delta W + \delta^2 W^2 + \delta^3 W^3 + \cdots \qquad (3)$$

Spillovers involving the spatial multipliers can be classified as *global*. These are produced by the SDM and by the Spatial Lag model. Another spatial model involving only the lags of the covariates is the cross regressive spatial model (SLX), illustrated in Halleck-Vega and Elhorst (2015). This model does not involve the spatial multiplier matrix and, for that reason, generates only *local* spillovers. If one looks at (3), local spillovers are confined to what is multiplied by the first two terms of the multiplier, namely, features of unit *i* and its first order neighbour.

We will see in the empirical model section that, we consider, as determinants of changes in local performance, variables whose *network* features (mutual relationships among units in different locations, taking place through factor mobility, trade, knowledge transfers, transports, social interactions and so on) make global spillovers more likely to occur. We think, indeed, that the characteristics of a province in principle do not affect only immediate neighbors but their effects are felt also by all the other provinces.

The SDM model is appealing also because, not only produces unbiased estimates when the true DGP is SLM or a SEM[6] but also allows for both local and global spillovers without any restriction on the magnitude of the ratio between indirect and direct effects.

In drawing inference on the direct and indirect effects, we need also to know their distribution. LeSage and Pace simulate their distribution by using the variance-covariance matrix implied by the maximum likelihood estimates. Lacombe has provided a Matlab[7] routine for the estimation of these effects and for their statistical assessment, which is incorporated in the Matlab software for spatial panels written by Elhorst (2014). This software will be used in our empirical application.

One point to note is that, given the presence of K explanatory variables in the model, there will be K *NxN* matrices of direct and indirect effects and these effects will be different for different units. For that reason, to ease the interpretation of the results, LeSage and Pace (2009) report only one direct

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[6] The SDM reduce to the SLM if $H_0: \theta = 0$ is accepted; on the other hand, if $H_0: \theta + \delta\beta = 0$ holds, the spatial error model is valid. If both tests are rejected, the model that best describes our data is the SDM. If the first hypothesis cannot be rejected, the appropriate specification is the SLM, provided that also a robust version of the LM test points to the SLM. If the second hypothesis cannot be rejected, then, the SEM best describes the data, provided that also the robust LM test points to it. If it does not happen, in other words the robust LM test is in favour of a different model than the Wald/LR tests, then the SDM must be adopted because it generalizes the other two models.

[7] Available at myweb.Hu.edu/dolacomb/matlab.html

effect, representing the effect of changing an independent variable on the dependent variable of a particular spatial unit, and one indirect effect representing either the effect on the dependent variable for a particular unit in consequence of a unit change in all elements of an exogenous variable, or the effect of changing a particular element of an exogenous variable on the dependent variable of all other units (Elhorst, 2014).

In the context of our analysis, the fixed effect model turned out to be more appropriate than the random effect one on the basis of the Hausman test for all the performance variables. When we tested for the presence of one of the two forms of spatial dependence conditional on the other, by using the robust LM test (Debarsy and Ertur, 2010) adapted to a spatial panel setting, we were led to prefer and estimate a spatial Durbin model (SDM) in the context of which we have deeply analysed the effects described above.

4.2 The data

In order to fully analyze the spatial implications of the relationship between territorial capital and regional performance at NUTS-3 level we estimate a spatial Durbin model (SDM) for the outcome variables regressed over a set of explanatory variables capturing territorial capital components. Since the period under investigation covers the recent crisis, we have chosen, as performance variables, the provincial growth in per capita GDP, manufacturing exports and employment, i.e., three economic indicators particularly important in assessing the effect of the crisis. The estimation period varies for the three indicators due to restrictions on data availability for employment. Provincial data in Italy are available for per capita GDP and manufacturing exports from 1999 to 2014 and for employment only between 2004 and 2013[8]. Facing these data limitations, we employed a three period panel for per capita GDP and exports and a two period panel for employment. The growth rates of the performance variables are calculated as averages of percentage changes on annual basis. For GDP and manufacturing export growth rates, the three periods are 2000-2003, 2004-2007, 2008-2014. For the employment growth rates the two periods are 2005-2008 and 2009-2013. For all variables the last period may be defined as “the crisis period”[9].

[8] The creation of new provinces in Italy during the period under analysis was treated by referring to the number of provinces (103) existing at the initial year of the period (1999) and by aggregating provincial data referring to the new provinces when corresponding to the same old province. The number of cases in which this procedure was necessary was however limited (7 cases). Details about the correspondence between the set of 110 provinces and the set of 103 provinces will be provided by the authors upon request

[9] In this paper we assume the year 2008 as the starting year of the crisis for GDP and exports and the year 2009 for employment following most of he literature. For robustness check, we also performed the estimation using the year 2009 as the starting year of the crisis also for per capita GDP and manufacturing exports. For per capita GDP, results did not change in an appreciable way. Human capital, agglomeration economies and private capital still retained significance while social cooperatives and public libraries displayed an overall negative sign mainly because of the indirect effect. For manufacturing exports, the coefficients for human capital, social cooperatives, specialization, agglomeration economies, private capital and specialization maintain almost everywhere the same sign and ares still significant as in the original specifications. Full details are provided in the supplemental material.

The explanatory variables were chosen, among more than 30 indicators, with the intent of considering different dimensions of territorial capital such as those with high level of materiality (fixed social capital, cultural capital and physical private capital), non material components (human capital, institutional-relational capital and social capital) and the dimensions characterized by an intermediate level of materiality (entrepreneurial-relational capital, agglomeration economies and public-private capital). The variables chosen to represent each dimension were:

- for fixed social capital, an index capturing the endowment in economic infrastructure, separately considering road, rail, maritime and airport infrastructures (source: IstitutoTagliacarne). For some specifications an accessibility index was used as alternative;[10]
- for cultural capital, the number of public libraries per 10,000 inhabitants. We also tried as an alternative indicator the average lenght of stay in hotels by tourists. This indicator may be considered more appropriate to represent the ability of territories in jointly using public and private resources for the purpose of getting advantages from the exploitation of their cultural and natural endowments. The results were however very similar. The source of the data for both indicators was the Italian Institute of Statistics (ISTAT);
- for physical private capital, the provincial total capital stock divided by value added. The numerator was derived from the series of provincial gross fixed investments by means of the perpetual inventory method with a depreciation coefficient of 0.2 (source ISTAT);
- for human capital, the number of graduates divided by the total population aged 20-24. The data of graduates refer to the place of residence of the students and not to the province where the academic program is offered. For robustness check, we have also considered the proportion of people that has attained a tertiary degree, which is more related to the productive system. Data were obtained from the Italian Ministry of Education and University ;
- for institutional-relational capital, the number of social cooperatives per inhabitant (source: ISTAT);
- for social capital, the total number of crimes of all types per inhabitant (source: ISTAT); we have also considered the Institutional Quality Index based on measures of corruption, governance, regulation, law enforcement and social participation proposed by Nifo and Vecchione (2014) and available only from 2004 to 2012. For that reason that index has been used only for the explanation of employment;
- for entrepreneurial-relational capital, to capture inter-firm linkages, the amount of inward foreign direct investments over total investment (source: Italian Stock Exchange Bureau) and

[10] The index used was the provincial average of accessibility indices in local labor markets constructed by considering the average time spent in reaching transportation nodes from each location (source ISFORT).

the number of patents for 10,000 firms (source: EPO) considered as a measure of innovation capacity arising from as a system of relations among agents and firms[11];

- for local cognitive capital, to capture localization economies, the provincial average specialization index in manufacturing constructed from two-digit industries, given by the ratio between the provincial employment in a specific sector and the provincial total employment divided by the corresponding ratio at national level (source: Italian Census of Manufacturing). To capture agglomeration economies, the gross index of urbanization economies, such as the share of the most populated municipality over total provincial population expressed in logarithms;
- for public-private capital, the amount of provincial investments in *project financing* divided by the total fixed investment in the province (source: Italian Observatory for Project financing);

We restricted the analysis to the above indicators mainly for reasons related to data availability at provincial level. Following the main results in the literature (section 2 and 3), we have considered all of them for the explanation of the per capita GDP growth rate, whereas for the manufacturing exports and the employment growth rates only a subset of them has been chosen in a first step of our analysis. In particular, for exports, knowledge spillovers (proxied by human capital and patents), specialization and agglomeration economies, FDI, capital stock and infrastructures were considered in the set of regressors while, for employment, empirics support the same set of variables excluding FDI but including social capital endowments. In a second step, the results coming out from these restricted models were confronted with the ones originated in a more general framework (section 5.1). In all the analyses, the explanatory variables, for each period, were considered with respect to the starting period of the change or to the year immediately before it. This is to avoid potential endogeneity problems.

4.3 Model Extension: a two-regimes Spatial Durbin model

A second stage of our analysis aims at giving insights on the following issues: 1) the differential role of territorial determinants before and during the crisis; 2) if there has been contagion or crowding out effect among Italian provinces as a whole, before and during the crisis; and 3) how two differently developed macro-areas of Italy, Center-North and South, have been affected by (and reacted to) the crisis.

[11] The empirical choice for this dimension of territorial capital was determined by availability of data for Italy at NUTS-3 level for the whole period under analysis. Nevertheless, it appears in line with the original Camagni (2008) taxonomy which, as possible indicators of entrepreneurial-relational capital considered external linkages for firms, transfers of R&D results and universities' spin-offs

In order to give a possible answer to the three issues, we have used an extension of the SDM introduced by Elhorst and Freret (2009). The model seems interesting because it allows for the possibility of two regimes. The specification is the following:

$$y_{it} = \mathbf{x}_{it}\beta + \delta_1 d_{it}\sum_{j=1}^{N} w_{ij}y_{jt} + \delta_2(1-d_{it})\sum_{j=1}^{N} w_{ij}y_{jt} + \sum_{j=1}^{N} w_{ij}\mathbf{x}_{jt}\theta + \mu_i(+\lambda_t) + \varepsilon_{it} \quad (4)$$

where d_{it} is a binary variable taking value of 1 when unit i, observed at time t, has certain features (regime 1), zero otherwise (regime 2). The variables $d_{it}\sum_{j=1}^{N} w_{ij}y_{jt}$ and $(1-d_{it})\sum_{j=1}^{N} w_{ij}y_{jt}$ denote the interaction effects of the dependent variable with the dependent variable in neighbouring provinces, which belong, respectively, to the first and the second regime. $\sum_{j=1}^{N} w_{ij}\mathbf{x}_{jt}$ is the the $1\times K$ vector of the interaction effects of the independent variables $\mathbf{x}_{it}$ with the independent variables in the neighbouring provinces. The coefficients δ_1 and δ_2 describe the degree of interaction among units that belong to the first and the second regime respectively, and depict the contagion or crowding out effects (issue 2).

For what our analysis is concerned, we analyze the provincial performance with respect to the crisis and the pre-crisis periods, by letting d_{it} equal to 1 during the crisis and zero otherwise. In a robustness check, to exploit macro-regional differences, we considered the different role of geographic proximity among center-northern provinces and southern provinces by letting d_{it} equal to 1 for South and zero otherwise. To answer issues 3, we have proposed the simultaneous interactions between crisis/non crisis regimes and South/Center-North regimes and considered as first regime, in turn, crisis in the South, crisis in the Center-North, non crisis in the South and non-crisis in the Center North. The second regime, refer to all other cases not included in each of the regimes 1 just defined. Finally, to answer issue 1) we have estimated the two-regime spatial Durbin model by including interaction terms between the explanatory variables and the dummy crisis.

5. Results

5.1 The spatial model estimation

As we said in Section 4, we have estimated, through Maximum Likelihood, a spatial Durbin model. The advantage of using maximum likelihood methods of estimation consists not only in producing consistent parameter estimates but also in the ability to compare models both in terms of different set of explanatory variables and of different specifications for the spatial matrix *W* through the likelihood ratio tests.

The spatial weight matrix *W* serves to specify the spatial dependence structure among observations. The elements of *W* are, in our analysis, zero in the main diagonal (a location cannot be neighbor to itself) and 1 if two locations are contiguous. We have also run the model by using a k=5 nearest neighbor matrix[12].

(TABLE 1 AROUND HERE)

The estimation of the spatial Durbin model allows us to discriminate between direct and indirect effects. The direct effects (second column of table 1) are different from the impact coefficients (first column in Table 1) because they include the feedback effects arising from the impacts passing through neighboring provinces and back to the *i-th* province itself.

From table 1, we can observe that agglomeration economies and human capital appear to have a significant positive impact effect on per capita GDP growth which (slightly) improves when we consider feedbacks effects (see the coefficients of the direct effects). Specialization economies have, instead, a significant negative direct effect (capturing vulnerability) which is fully counterbalanced by a highly significant positive indirect effect (i.e., a province performance benefits from other provinces' vulnerability). The indirect effects are positive also for agglomeration and for private capital stock, thus signalling that knowledge and industry spillovers are in place. As a consequence, positive total effects are significant or highly significant for human capital, private capital stock, agglomeration and specialization economies. Some other variables show coefficients that are close to significance. This happens for social capital, proxied by crimes per inhabitants which displays, as expected, almost significant negative direct effects and positive indirect effects. In addition, road infrastructure investment displays a clear stealing effect because the coefficient capturing the effect of infrastructure investment in neighboring regions is negative and close to 10% significance.

Overall, the picture of the territorial capital components appears quite diversified when we take fully into account the spatial setting. For some variables (agglomeration) the indirect effects reinforce the direct one, for others (specialization) there is a counterbalancing effect. In other cases only the direct (human capital) or the indirect (private capital) effect is relevant in the explanation of per capita

[12] Results are provided in the supplemental material.

GDP growth[13]. The results are not particularly affected by multicollinearity since the partial correlation coefficients concerning the explanatory variables were lower than 0,40 for all cases[14]. The coefficients for the spatially lagged dependent variable is positive and significant, signalling that a contagion phenomenon appears to prevail across local units. The tests for both spatial lags and spatial errors are significant showing the validity of the spatial Durbin model which does not simplify neither into the SLM nor into the SEM and the overall fit of the model appears to be quite good.

The last four columns of table 1 show the determinants of per capita GDP when an indicator of innovation (patents for 10,000 firms) is included in the analysis. As previously mentioned, this indicator may be partly considered as an additional proxy for the entrepreneurial-relational capital (FDI) whose coefficient was not significant in the base model[15]. When a patent indicator is included, previous results are confirmed for all significant variables, for both direct and indirect effects. The innovation variable displays a coefficient for impact and direct effects with a significance level around 20% but a non-significant total effect. The non significance of the patent coefficient can be also ascribed to the high collinearity found between this variable and the agglomeration variable. This last variable, nevertheless, retained significance when the innovation output indicator was included in the model. In order to check the advantages of a more parsimonious specification (which, however, preclude the investigation of global effects) we have also estimated, for each performance variable, the SLX model but not much difference was found in the results[16].

The analysis carried out for for manufacturing exports is shown in Table 2. We initially performed the model for a subset of explanatory variables suggested by the relevant literature, namely infrastructures, number of graduates, patents, FDI, specialization/agglomeration economies and capital stock; the results, indeed, were not very different from those of a more general specification including all the growth determinants considered in the territorial capital framework suggested by Camagni (2008)[17]. The estimation of the general specification confirms the positive direct effect of human capital but the contrasting role of indirect effects makes total effect for this variable not significant. Therefore negative knowledge interregional spillovers emerge in the export equation, thus confirmed the results Olejnik (2008) described in section 3. This may be the effect of a stealing phenomenon from dynamic neighboring local areas. Indeed, we may explain the negative impact of the share of graduate (qualified people) in nearby provinces by the competitive nature of the relationship between nearby labor markets for exporting goods.

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[13] For human capital, the results do not vary when graduates are divided for the total population of the province, rather than for 20-24 (young) population. Details for pc GDP and employment equations are provided in the supplemental material.

[14] The correlation matrix is available in the supplemental material.

[15] Patents may be considered as capturing, in part, human capital or private capital stock impact. These other determinants, nevertheless, retain their importance when the patent indicator was included in the model.

[16] Such results are available in the supplemental material.

[17] The results for the restricted models are available in the supplemental material.

The opposite is true for private capital where direct effects are negative and indirect effects are positive. A possible explanation may be that, at least in Italy, exporting performance of manufacturing industries is more favorable for less K-intensive industries while an area may benefit from a lower K-intensive bias with respect to its neighbors.

(TABLE 2 AROUND HERE)

The estimates for specialization and agglomeration externalities partly confirms the findings for the per capita GDP growth equation. Spillovers for agglomeration economies are positive and significant while a more specialized structure produces negative effects both inside and outside the region. In other words, a local export performance may be hampered by a highly specialized structure of the other regions in the system. An interesting result in the estimation of the manufacturing export equation is the significant positive role of (direct) institutional relational capital in the form of social cooperatives per capita and airport infrastructures. In the latter case a greater airport endowment in neighboring areas is more relevant for export growth than a greater airport endowment inside the region. A similar effect for transportation investment was also found by Rodriguez-Pose *et al.* (2012)[18]. This means that the effect of transport infrastructure relates to a more general concept of accessibility as we will see later in the paragraph when an explicit accessibility measure will be included. As for entrepreneurial relational capital, the FDI indicator shows a negative coefficient sign and an almost significant (between 10 and 20%) negative total effect, a circumstance which signals that, for export performance, competitive pressures are more relevant than positive knowledge spillovers in the relationships between domestic and foreign firms. This possibility arises, as mentioned before (Lin and Kwan, 2016), from the contrast between the poaching and knowledge spillover effects. The inclusion of patents in the model does not change the relative impact of the other explanatory variables, nor the coefficients of the added variable show any significant effect[19].

Finally, there is a negative and almost significant spatial autocorrelation implying that growth potentialities developed by one province negatively influence the manufacturing export growth trajectories of neighboring provinces which - instead of attracting export growth opportunities - become donors of tangible and intangible resources (Capello, 2009).

In the case of employment growth, results are shown in Table 3. Also in this case, we started the analysis by considering only a subset of variables suggested by the literature (infrastructures, human capital and patents, specialization/agglomeration, capital stock and social capital).

[18] See also the results by Moreno and Lopez-Bazo (2007) in section 3.

[19] This may also depend on the limited role of patents in capturing the innovation phenomenon at a finer geographical scale. Unfortunately, other measures of innovation (i.e., R&D) are not available for Italy at NUTS-3 level.

Nevertheless, the results turned out to be similar to the ones in the more general specification[20]. In particular, we do not observe any indirect effects apart from airport infrastructure for which, contrary to the export equation, we found a negative effect. The impact and direct effect are positive and significant for human capital and private capital and almost significant for agglomeration economies. Given the availability of data for the period after 2004, we were able to include in the analysis a better index of social capital, namely the institutional quality index suggested by Nifo and Vecchione (2014) whose coefficient, however, turned out to be non significant although with the expected positive sign[21]. Specialization economies lose significance for this performance variable. Also, the spatial lag for the dependent variable shows a non significant coefficient indicating an unclear evidence. The inclusion of patents as innovative index in this analysis did not change the general picture while human capital and agglomeration economies coefficients gain significance in the impact and direct effects. Airport infrastructure still displays a negative indirect effect and the patent indicator coefficient does not show significance. When we move to the assessment of total effect we find that only human capital appears to produce a positive effect on employment growth.

(TABLE 3 AROUND HERE)

Because of the peculiar and differentiated results obtained for airport infrastructure endowment, we have introduced explicitly an accessibility index in the equation with the idea that, more than a simple endowment measure, this variable would better capture the impact of transportation quality on performance. Indeed, positive spillovers in transportation infrastructure might exist when we consider accessibility rather than endowment measures. We also have introduced as additional variable an indicator of public-private partnership (PPP) which proxies the extent of institutional networks inside each local area. Both additional variables (accessibility and PPP) have been included only in the employment equation since they were available only for the second and the third period of our analysis. The results, reported in Table 4, show a positive total effect for the accessibility index thus suggesting the need for considering a more precise measure of transportation infrastructure in the analyses of growth dynamics[22]. The importance of direct effects for human capital, private capital and (weakly) agglomeration economies is confirmed. For PPP measure, we find a negative indirect effect that offsets an almost significant positive direct effect. Therefore, competitive forces seem to be at work among areas in this case. We also found a negative effect between the growth employment in one province and the presence of foreign firms in a neighboring province (which confirms that knowledge

[20] The results are available in the supplemental material.
[21] Also the coeffcient of crime resulted non significant when this variable was included in this equation in place of the institutional quality index.
[22] This confirms the results found by Del Bo and Florio (2012) reported in section 3

spillovers from the acquisition of foreign firms occurring in an area may exert a competive pressure on adjacient local areas).

Finally, the fourth column of table 4 indicates that, contrary to the other specifications, cultural capital (as measured by the number of public libraries per capita) and institutional quality have a positive total effect on employment growth mainly due to a favourable indirect effect. The inclusion of patents does not change the analysis though spillovers effects slightly increase for PPP and reduce for public libraries and FDI. The coefficient of the patent variable itself is not significant. Overall, the results of our analysis confirm that a more general framework with a more complete set of territorial variable components may generate additional insights to the analysis of growth for all the dependent variables considered.

(TABLE 4 AROUND HERE)

In order to be consistent with most of the literature that observes growth dynamics in the context of a convergence equation, in Tables 5 and 6 we extend the models of Tables 1 through 4 to include the initial level of the dependent variable (GDP, manufacturing exports and employment, respectively). As we know from the literature, growth models may not be correct if they omit the initial period level variable. In our case, however, the implicit assumption is that the territorial capital components act in conjuction as proxies of the initial level of the outcome variable in the description of the dynamic process and therefore the misspecification of the original model can be considered as limited.

Nevertheless, we re-runned the estimation of models 1-4 in order to include the initial level of the performance variable. As we may expect, for the per capita GDP specification (Table 5), the inclusion of the level of the outcome variable at the initial period pushes some of the explanatory variables that were significant in the original equations in the non significance territory (i.e., capital stock). However, most of the explanatory variables (human capital, specialization) retain significance and agglomeration and patents are almost significant at 10% level for the total effect.

The sign of the coefficient of the level of the dependent variable at the initial period is negative and significant, in line with the convergence hypothesis. However, the negative coefficient is significant only for the impact and the direct effects.

(TABLE 5 AROUND HERE)

For the export equation, agglomeration economies still retain significance together with human capital (in this case only in the direct effect as in the base model), social cooperatives and specialization index while the coefficient for airport infrastructure is almost significant.

In the case of employment (table 6), previous results are confirmed for airport infrastructure and human capital and, in the alternative specification, accessibility turns out to be highly significant while the coefficients for institutional quality and inward FDI display a significance level close to 10%.

(TABLE 6 AROUND HERE)

The overall picture stemming out from the analysis across different performance variables may then be summarized as follows. First, all the components of territorial capital appears to be relevant at least in one of the specification considered. Second, some variables are, however, consistently more relevant than others in the explanation of growth. Human capital, private capital, agglomeration and specialization economies turn out to be significant in most specifications. The greater impact of human capital investment over other types of public investment (i.e., transportation), mainly for direct effects, is in line with the findings of others studies (Rodriguez-Pose *et al.*, 2012). In some cases, a stealing indirect effect (competitive pressure) is at stake but the overall effect is usually positive. Third, spillover effects appear for many (especially intangible) dimensions and this should be taken into account in designing adequate policies. Fourth, indirect effects appear to be important for manufacturing export performance while for employment growth the relevance of the direct effects is confined to more traditional variables (private and human capital).

5.2 The effect of the crisis

In order to better detect the impact of the Great Recession on local performance we have estimated the two regimes SDM described in section 4.3. In the two-regime framework (crisis vs non-crisis) we cannot distinguish between direct and indirect effects. Nevertheless, this model can be used to address two important questions. First, to discover whether some explanatory variables changed their relative role and relevance during the crisis. Second, to identify if, during the crisis, a positive (contagion) effect or a negative (crowding-out) effect prevailed in the spatial dynamic process of growth (*vis-à-vis* the period before the crisis). Such a phenomenon can be depicted by looking at the sign and significance of the coefficient of each regime.

Therefore, we have extended our investigation along two directions. We first investigated the potentially changed role for territorial components during the crisis. Along this direction, we estimated a two-regime model for the full period of analysis (1999-2014) introducing interaction terms for each explanatory variable and spatially lagged counterpart. In Table 7, the first column shows the coefficients for each explanatory variable of the baseline specification and the second column shows the coefficient of the interaction terms between the dummy crisis and each explanatory variable. We have performed this exercise only for per capita GDP and manufacturing export growth due to data restrictions for employment.

(TABLE 7 AROUND HERE)

We observe that, in the two-regime model, variables that had a significant effect in the original models of table 1 (human capital, specialization economies, agglomeration economies) still retain their importance. For capital stock and specialization economies we still found a positive spatial effect as in table 1. In addition, crimes (with negative sign) displays a negative impact effect while cultural capital and FDI also turned out to be relevant in the spatially lagged determinants. When we look at the crisis interaction terms we see that some variables (specialization economies, capital stock and agglomeration effects) appears to be negatively affected by the crisis while for others no significant effect arises. Even more interesting are the results for the manufacturing export equation. Here, some variables appear to have strongly decreased their relevance during recession (i.e., road infrastructure). Other variables (human capital, institutional-relational capital) appear to have increased their positive effect during the crisis while specialization in this period displays a positive impact effect instead of a negative one. In synthesis, a specific role emerges for more immaterial variables while some more "traditional" factors of growth have diminished their role during the crisis. Also, the crisis seems to have diminished the role of agglomeration economies. For manufacturing exports there appears to be a significant crowding-out effect in the non crisis period that disappears during the crisis, maybe because of its global feature.

As additional robustness test, given the diversity of socio-economic structure between the North-Center and the South of Italy, we have also analyzed the different role of proximity in macroregions by comparing the provincial performance in the North-Center with the one in the South (table 7, columns 5 and 6). All the variables maintain the same signs of the first column of tables 1 and 2. For the GDP per capita there appears to be a contagion effect both in the South (regime 1) and in the North-Center (Regime 2), but only in the first macro-region the effect is significant. In the manufacturing export equation, there appears to be a significant contagion effect in the South while in the North there is a significant crowding-out effect. This means that the export behaviour of neighboring provinces affects positively in the South while it affects negatively in the North-Center (more competion between geographical units).

We then tried to decompose the effect of the crisis period by macroregion by isolating (as a first regime), in turn, the crisis period in the South, the crisis period in the North, the non-crisis period in the South and the non-crisis period in the North (Table 8). In these specifications, the second regime is meant to be referred simultaneously to all the other three cases different from the one considered in the first regime. In this case, we can only compare the coefficient of the crisis period when the South and the North-Center are chosen for the first regime or the coefficient of the crisis period in one macroregion versus the coefficient of the non-crisis period in the same macroregion.

(TABLE 8 AROUND HERE)

By comparing these coefficients, for per capita GDP, there does not appear any significance in the contagion effect neither in the North-Center nor in the South in the crisis period while in the non-crisis period there is a significant contagion effect only in the South. For manufacturing exports (columns 5-8 of table 8), a crowding-out effect dominates in the North Center before and during the crisis but the effect is significant only in the non crisis period. We may conclude that the crisis has reduced spatial dependence in manufacturing export growth instead of increasing it. There is also an interesting difference between macroregions since a contagion effect (positive coefficient) is found for the regime “South” and a crowding-out (competitive) effect in the North-Center. In particular, the crowding-out in the North is slightly more relevant in the non-crisis period. Before the crisis the crowding-out effect exists also in the South but the coefficient is not significant. As for the explanatory variables, when we take into account the crisis period, the sign and significance of the coefficients is similar to what we found in the base model of table 2 but there is much more evidence of spatial spillovers since almost all variables display significant spatial coefficients. Spillovers effects are therefore better detected if we control for the crisis period, for the whole country and for specific macroregions.

The two-regime model was not performed for the employment variable because data in this case were available only for two periods and the lack of sufficient degrees of freedom limited the reliability of the estimates.

6. Conclusions

This paper shows how spatial effects are important for growth at local level. We investigated the dynamics of three performance variables at NUTS-3 level during a time span covering also the crisis period. We find that for most of the chosen explanatory variables there are substantial spatial effects. The significant spatial effects may be direct or indirect according to the variable considered; for different performance variables, specific determinants were found to be more relevant and either the direct or the indirect effect prevails.

Significant variables for per capita GDP growth in a spatial setting are human capital and agglomeration economies and, for some specifications, private capital. Specialization economies cause negative direct effects but positive indirect effects. Road transportation displays negative indirect effects while airport transportation show positive indirect effects. For the other performance variables (manufacturing exports and employment) the results are mainly confirmed. In addition, other, more intangible, factors (related to social and relational capital) show significant coefficients in some specifications.

Overall, some territorial determinants appear to have a greater role in affecting growth: among them, agglomeration economies which turns out to have positive effects in all three performance variables and human capital whose impact is positive and relevant in GDP and employment growth. For the latter explanatory variable, the spillover effect is weak and sometimes negative in the case of exports (stealing effect). Our results confirm those obtained in the literature (Eriksson and Hane-Wejiman 2017, see section 3) which show a negative impact of specialization economies on growth. This is particularly true for exports where vulnerability hampers the growth process. Conversely, a region may be affected positively by an excess of specialization in other regions of the system. Other interesting results concern transport infrastructure: though the sign of the indirect effect of transportation infrastructure endowment may depend on the type of transportation, an area may benefit indirectly from a better accessibility of the neighboring areas.

In analysing the impact of the Great Recession, the two-regime spatial framework enabled us to detect weak contagion effects for per capita GDP which persists in the crisis period. The contagion is bigger in the North-Center macroregion in the crisis period and in the South in the non crisis period.

The Great Recession appears to have improved the role for most of the territorial determinants included in the analysis. In particular, human capital and agglomeration economies have become even more relevant for areas' resilience. Conversely, traditional factors of growth (such as road infrastructure endowment) have lost relevance during the crisis period.

The variety of results according to different model specifications (both in terms of methodology and in terms of the selected set of variables) suggests interesting conclusions for the design of policy in local areas. When a full spatial setting is considered, a local policy maker is able to pick the main factors affecting growth by taking into account the effects on neighbor regions and the feedbacks from spatial spillovers. On the other hand, since the direction of spatial effects is not clear, policy should be designed more carefully by considering the different spatial implications in all the areas belonging to the whole regional system. In this sense, the more the indirect effects are important, the more a national or supra-regional approach becomes relevant in making regional policy choices coherent one each other. The impact of the Great Recession has also been noticeable since human capital, agglomeration economies and diversity emerged as crucial determinants in the growth and resilience processes of local areas. This suggests a policy strategy aimed at concentrating expenditure on these components in the eve of and during downturns. The role of social capital remains, instead, still controversial though it appears to be increased if we include the crisis in the analysis. Finally, the relevance of infrastructures should be better assessed: for instance, accessibility is more important than the endowment of social overhead capital in transportation and the analysis somewhat supports also the Krugman argument about the potential negative role of the reduction of the transportation cost in local areas (given the presence of potentially negative direct effect of transportation infrastructure). This should induce policy makers to consider also such a possibility in the analyses of growth impact assessment of this component of territorial capital.

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Tab. 1:Spatial effects of growth determinants - Per capita GDP (SDM panel fixed effect model:1999-2014)

	PER CAPITA GDP				PER CAPITA GDP			
Variable	***Impact and Spatial Effects***	***Direct Effects***	***Indirect Effects***	***Total Effects***	***Impact and Spatial Effects***	***Direct Effect***	***Indirect Effects***	***Total Effects***
Road Infrastructure Index	-0.0001	-0.0008	-0.0299	-0.0297	0.0012	0.0009	-0.0238	-0.0229
(social overhead capital)	(-0.014)	(-0.116)	(-1.481)	(-1.418)	(0.163)	(0.126)	(-1.251)	(-1.094)
Airport Infrastructure Index	-0.0010	-0.0010	-0.0028	-0.0039	-0.0010	-0.0010	-0.0022	-0.0032
(social overhead capital)	(-0.741)	(-0.805)	(-0.666)	(-0.840)	(-0.771)	(-0.743)	(-0.546)	(-0.734)
Graduates/young population	0.353	0.3575	0.1013	0.4588	0.3310	0.3306	0.1146	0.4452
(human capital)	(1.725)*	(1.800)*	(0.386)	(2.339)**	(1.616)*	(1.698)*	(0.438)	(2.355)**
Crimes per capita	-0.5296	-0.5019	1.5250	1.0232	-0.5166	-0.5054	1.4818	0.9764
(social capital)	(-1.352)	(-1.281)	(1.482)	(0.946)	(-1.320)	(-1.291)	(1.458)	(0.888)
Social Cooperatives per capita	0.0242	0.0204	-0.1098	-0.0894	0.0268	0.0226	-0.1194	-0.0968
(institutional relational capital)	(0.515)	(0.446)	(-0.977)	(-0.772)	(0.571)	(0.483)	(-1.055)	(-0.858)
Public libraries[A]	-0.2078	-0.2062	-0.0267	-0.2328	-0.2128	-0.2373	-0.0191	-0.2564
(natural/ cultural capital)	(-0.627)	(-0.602)	(-0.042)	(-0.365)	(-0.645)	(-0.735)	(-0.032)	(-0.423)
Specialization Index	-2.2542	-1.9661	12.1664	10.2003	-2.3040	-2.0201	11.9058	9.8856
(local cognitive capital)	(-1.986)**	(-1.824)*	(3.545)***	(2.857)***	(-2.035)**	(-1.747)*	(3.520)***	(2.854)***
Capital Stock	1.3236	1.6440	14.0043	15.6484	1.2793	1.5530	13.6944	15.2474
(private fixed capital)	(0.491)	(0.625)	(3.400)***	(4.324)***	(0.476)	(0.605)	(3.463)***	(4.344)***
Inward FDI (entrepreneurial	0.0013	0.0013	-0.0009	0.0004	0.0012	0.0013	-0.0009	0.0005
relational capital)	(1.109)	(1.113)	(-0.298)	(0.133)	(1.066)	(1.058)	(-0.299)	(0.171)
Agglomeration	1.8316	1.8822	2.9416	4.8238	1.9217	1.981	2.9460	4.9273
(local cognitive capital)	(2.406)***	(2.435)***	(1.667)*	(2.575)***	(2.524)***	(2.557)**	(1.758)*	(2.775)***
Patents[B] (entrepreneurial					0.0166	0.0168	0.0113	0.0281
relational capital)					(1.255)	(1.270)	(0.290)	(0.659)
W*GDP	0.1489				0.1370			
	(1.708)*				(1.559)			
W*Road Infrastructures Index	-0.0248				-0.0212			
	(-1.509)				(-1.225)			
W*Airport Infrastructure Index	-0.0023				-0.0019			
	(-0.647)				(-0.522)			
W*Graduates/young population	0.0261				0.0638			
	(0.101)				(0.247)			
W*Crimes per capita	1.3729				1.3420			
	(1.499)				(1.468)			
W*Social Cooperatives per capita	-0.1065				-0.1051			
	(-1.081)				(-1.069)			
W*Public libraries[A]	0.0119				-0.0148			
	(0.022)				(-0.027)			
W*Specialization Index	10.8835				10.7377			
	(3.617)***				(3.560)***			
W*Capital Stock	12.0048				11.7872			
	(3.168)***				(3.063)***			
W*Inward FDI	-0.0009				-0.0011			
	(-0.393)				(-0.429)			
W*Agglomeration	2.2478				2.3471			
	(1.465)				(1.531)			
W*Patents[B]					0.0063			
					(0.182)			
N	309				309			
R^2	0.700				0.697			
LR_Spatial lag	50.555***				49.431***			
LR_spatial error	62.059***				61.924***			

Note: t-statistics in parentheses***: significant at 1% level , **: significant at 5% level, *: significant at 10% level.
A: number of public libraries per 10,000 inhabitants.
B: number of patents per 10,000 firms

Tab. 2:Spatial effects of growth determinants - Manufacturing Exports (SDM panel fixed effect model:1999-2014)

	MANUFACTURING EXPORTS				MANUFACTURING EXPORTS			
Variable	***Impact and Spatial Effects***	***Direct Effects***	***Indirect Effects***	***Total Effects***	***Impact and Spatial Effects***	***Direct Effects***	***Indirect Effects***	***Total Effects***
Road Infrastructure Index (social overhead capital)	0.0699 (1.125)	0.0726 (1.167)	-0.0435 (-0.339)	0.0290 (0.225)	0.0671 (1.065)	0.0679 (1.118)	-0.0527 (-0.388)	0.0152 (0.109)
Airport Infrastructure Index (social overhead capital)	0.0101 (0.877)	0.0085 (0.747)	0.0459 (1.576)	0.0544 (1.835)*	0.0095 (0.811)	0.0090 (0.773)	0.0468 (1.626)*	0.0558 (1.882)*
Graduates/young population (human capital)	3.4725 (1.909)*	3.5871 (1.940)**	-3.5819 (-1.650)*	0.0052 (0.004)	3.4945 (1.915)**	3.6107 (1.857)*	-3.6474 (-1.598)\	-0.0367 (-0.027)
Crimes per capita (social capital)	-4.6435 (-1.335)	-5.1221 (-1.464)	12.4289 (1.667)*	7.3065 (0.958)	-4.5833 (-1.315)	-4.8351 (-1.348)	12.8247 (1.6709*	7.9896 (1.045)
Social Cooperatives per capita (institutional relational capital)	1.0665 (2.555)***	1.0548 (2.492)***	0.5150 (0.620)	1.5698 (2.125)**	1.0666 (2.552)***	1.0650 (2.476)***	0.5037 (0.607)	1.5686 (2.076)**
Public libraries[A] (natural/ cultural capital)	0.4338 (0.147)	0.3158 (0.105)	4.605 (0.991)	4.9208 (1.184)	0.4261 (0.145)	0.3027 (0.102)	4.5560 (0.977)	4.8587 (1.165)
Specialization Index (local cognitive capital)	-9.6259 (-0.960)	-7.6816 (-0.762)	-58.4225 (-2.287)**	-66.1040 (-2.684)***	-9.4231 (-0.938)	-8.2383 (-0.792)	-56.9970 (-2.280)**	-65.2353 (-2.722)***
Capital Stock (private fixed capital)	-49.2123 (-2.060)**	-51.5840 (-2.082)**	84.6637 (2.749)***	33.0787 (1.426)	-48.9156 (-2.045)**	-51.8449 (-2.149)**	89.0271 (2.721)***	37.1822 (1.479)
Inward FDI (entrepreneurial relational capital)	-0.0061 (-0.586)	-0.0055 (-0.531)	-0.0232 (-1.224)	-0.0288 (-1.379)	-0.0059 (-0.565)	-0.0049 (-0.461)	-0.0216 (-1.162)	-0.0265 (-1.308)
Agglomeration (local cognitive capital)	0.2170 (0.032)	-0.3902 (-0.057)	22.4643 (1.838)*	22.0741 (1.885)*	0.1492 (0.022)	-0.3428 (-0.051)	22.7976 (1.869)*	22.4548 (1.888)*
Patents[B] (entrepreneurial relational capital)					-0.0125 (-0.106)	-0.0123 (-0.106)	-0.0935 (-0.340)	-0.1058 (-0.375)
W*EXP	-0.1580 (-1.612)				-0.1540 (-1.572)			
W*Road Infrastructures Index	-0.0352 (-0.242)				-0.0543 (-0.352)			
W*Airport Infrastructure Index	0.0529 (1.657)*				0.0524 (1.632)*			
W*Graduates /young population	-3.4425 (-1.528)				-3.5067 (-1.548)			
W*Crimes per capita	13.1564 (1.617)				13.3328 (1.636)*			
W*Social Cooperatives per capita	0.7244 (0.820)				0.7249 (0.821)			
W*Public libraries[A]	5.1249 (1.042)				5.1908 (1.054)			
W*Specialization Index	-67.3820 (-2.506)***				-66.0852 (-2.442)***			
W*Capital Stock	87.2691 (2.688)***				89.8913 (2.704)***			
W*Inward FDI	-0.0261 (-1.246)				-0.0258 (-1.231)			
W*Agglomeration	25.5220 (1.904)*				25.2811 (1.884)*			
W*Patents[B]					-0.1045 (-0.342)			
N	309				309			
R^2	0.480				0.485			
LR_Spatial lag	37.158***				37.354***			
LR_spatial error	36.395***				36.591***			

Note: see note to Tab. 1

Tab. 3: Spatial effects of growth determinants - Employment; base model (SDM panel fixed effect model:2004-2013)

	EMPLOYMENT				EMPLOYMENT			
Variable	***Impact and Spatial Effects***	***Direct Effects***	***Indirect Effects***	***Total Effects***	***Impact and Spatial Effects***	***Direct Effect***	***Indirect Effects***	***Total Effects***
Road Infrastructure Index (social overhead capital)	-0.0066 (-0.796)	-0.0065 (-0.812)	-0.0140 (-0.691)	-0.0206 (-0.906)	-0.0060 (-0.782)	-0.0061 (-0.721)	-0.0128 (-0.584)	-0.0190 (-0.785)
Airport Infrastructure Index (social overhead capital)	-0.0006 (-0.488)	-0.0005 (-0.389)	-0.0067 (-1.919)*	-0.0072 (-1.909)*	-0.0007 (-0.569)	-0.0005 (-0.392)	-0.0071 (-1.839)*	-0.0076 (-1.789)*
Graduates/young population (human capital)	0.5186 (1.851)*	0.5167 (1.766)*	0.1101 (0.307)	0.627 (3.153)***	0.5701 (2.003)**	0.5725 (1.951)**	0.0519 (0.145)	0.6245 (3.178)***
Institutional Quality Index (social capital)	0.3518 (0.134)	0.2047 (0.076)	3.2680 (0.567)	3.4727 (0.589)	-0.0872 (-0.033)	-0.0673 (-0.024)	3.3762 (0.584)	3.3089 (0.575)
Social Cooperatives per capita (institutional relational capital)	0.0029 (0.049)	0.0040 (0.067)	-0.0751 (-0.607)	-0.0710 (-0.591)	0.0055 (0.093)	0.0080 (0.131)	-0.0754 (-0.621)	-0.0675 (-0.575)
Public libraries[A] (natural/ cultural capital)	0.2591 (0.815)	0.2482 (0.752)	0.4004 (0.578)	0.6486 (0.912)	0.3173 (0.979)	0.2994 (0.934)	0.4291 (0.617)	0.7285 (0.999)
Specialization Index (local cognitive capital)	-0.7330 (-0.307)	-0.8963 (-0.373)	3.8409 (0.7890)	2.9446 (0.569)	-0.6306 (-0.265)	-0.7086 (-0.301)	3.4653 (0.689)	2.7567 (0.503)
Capital Stock (private fixed capital)	5.2974 (1.971)**	5.3870 (1.963)**	-5.0469 (-0.873)	0.3402 (0.051)	5.2279 (1.876)*	5.3020 (1.895)*	-3.6778 (-0.565)	1.6242 (0.217)
Inward FDI (entrepreneurial relational capital)	-0.0002 (-0.227)	-0.0003 (-0.221)	-0.0021 (-0.945)	-0.0024 (-0.970)	-0.0002 (-0.216)	-0.0002 (-0.154)	-0.0023 (-1.095)	-0.0025 (-1.062)
Agglomeration (local cognitive capital)	1.1048 (1.494)	1.0959 (1.454)	0.5085 (0.341)	1.6044 (1.024)	1.2576 (1.664)*	1.2594 (1.610)	0.2476 (0.155)	1.5069 (0.881)
Patents[B] (entrepreneurial-relational capital)					-0.0335 (-0.542)	-0.0379 (-0.609)	0.0968 (0.687)	0.0589 (0.387)
W*EMPL	-0.1420 (-1.180)				-0.1410 (-1.173)			
W*Road Infrastructures Index	-0.0166 (-0.727)				-0.0151 (-0.646)			
W*Airport Infrastructure Index	-0.0074 (-1.950)**				-0.0079 (-1.933)**			
W*Graduates/young population	0.1905 (0.525)				0.1508 (0.414)			
W*Institutional Quality index	3.5079 (0.559)				3.6882 (0.587)			
W*Social Cooperatives per capita	-0.0870 (-0.659)				-0.0847 (-0.641)			
W*Public libraries[A]	0.4840 (0.644)				0.4760 (0.620)			
W*Specialization Index	4.1543 (0.773)				3.6298 (0.674)			
W*Capital Stock	-4.6216 (-0.688)				-3.1822 (-0.440)			
W*Inward FDI	-0.0025 (-1.034)				-0.0026 (-1.094)			
W*Agglomeration	0.6949 (0.414)				0.4570 (0.268)			
W*Patents[B]					0.1039 (0.723)			
N	206				206			
R^2	0.787				0.788			
LR_Spatial lag	20.621**				20.329**			
LR_spatial error	20.005**				19.852**			

Note: see note to Tab.1

Tab. 4: Spatial effects of growth determinants - Employment; alternative specifications (SDM panel fixed effect model:2004-2013)

	EMPLOYMENT				EMPLOYMENT			
Variable	***Impact and Spatial Effects***	***Direct Effects***	***Indirect Effects***	***Total Effects***	***Impact and Spatial Effects***	***Direct Effect***	***Indirect Effects***	***Total Effects***
Accessibility Index (social overhead capital)	0.0185 (0.595)	0.0151 (0.480)	0.0715 (1.572)	0.0867 (2.951)***	0.0170 (0.549)	0.0150 (0.469)	0.0690 (1.498)	0.0840 (2.836)***
Graduates/young population (human capital)	0.4803 (1.869)*	0.5152 (2.034)**	-0.4526 (-1.306)	0.0627 (0.267)	0.5297 (2.029)**	0.5355 (1.995)**	-0.4640 (-1.333)	0.0718 (0.317)
Institutional Quality Index (social capital)	2.8847 (1.107)	2.6769 (0.988)	5.9052 (1.113)	8.5822 (1.587)	2.556 (0.970)	2.196 (0.802)	6.846 (1.213)	9.042 (1.563)
Social Cooperatives per capita (institutional relational capital)	-0.0438 (-0.780)	-0.0457 (-0.775)	-0.0290 (-0.254)	-0.0747 (-0.701)	-0.043 (-0.769)	-0.038 (-0.660)	-0.043 (-0.376)	-0.081 (-0.787)
Public libraries[A] (natural/ cultural capital)	0.1819 (0.598)	0.1429 (0.477)	0.9692 (1.575)	1.1121 (1.729)*	0.229 (0.745)	0.188 (0.617)	0.853 (1.337)	1.041 (1.571)
Specialization Index (local cognitive capital)	-0.7969 (-0.356)	-0.9094 (-0.406)	1.8839 (0.427)	0.9745 (0.212)	-0.745 (-0.334)	-0.887 (-0.386)	1.636 (0.369)	0.749 (0.163)
Capital Stock (private fixed capital)	6.4478 (2.522)***	6.3145 (2.451)***	1.8077 (0.340)	8.1223 (1.384)	5.848 (2.234)**	5.774 (2.267)**	1.163 (0.198)	6.936 (1.072)
Agglomeration (local cognitive capital)	0.9274 (1.353)	0.9522 (1.359)	-0.3040 (-0.213)	0.6482 (0.429)	1.015 (1.441)	1.002 (1.355)	-0.284 (-0.198)	0.718 (0.475)
Inward FDI (entrepreneurial relational capital)	-0.0010 (-0.949)	-0.0008 (-0.757)	-0.0027 (-1.358)	-0.0036 (-1.729)*	-0.001 (-0.948)	-0.001 (-0.841)	-0.003 (-1.317)	-0.004 (-1.684)*
PPP/INV (public-private capital)	0.0008 (0.986)	0.0010 (1.224)	-0.0045 (-1.887)*	-0.0035 (-1.389)	0.000 (0.847)	0.001 (1.082)	-0.005 (-2.062)**	-0.004 (-1.579)
Patents[B] (entrepreneurial relational capital)					-0.060 (-1.071)	-0.057 (-0.991)	0.017 (0.164)	-0.041 (-0.407)
W*EMPL	-0.2410 (-1.972)**				-0.232 (-1.899)**			
W*Accessibility index	0.0862 (1.735)*				0.087 (1.761)*			
W* Graduates/young population	-0.3915 (-1.038)				-0.440 (-1.165)			
W*Institutional Quality Index	7.4139 (1.152)				-8.808 (1.324)			
W*Social Cooperatives per capita	-0.0489 (-0.386)				-0.060 (-0.478)			
W*Public libraries[A]	1.155 (1.601)				1.022 (1.398)			
W*Specialization Index	1.9097 (0.372)				1.653 (0.321)			
W*Capital Stock	3.5973 (0.536)				2.779 (0.391)			
W*Agglomeration	0.0365 (0.022)				-0.068 (-0.041)			
W*Inward FDI	-0.0036 (-1.463)				-0.003 (-1.464)			
W*PPP/INV	-0.0051 (-1.840)*				-0.005 (-1.945)**			
W*Patents[B]					0.010 (0.089)			
N	206				206			
R^2	0.809				0.810			
LR_Spatial lag	31.589***				32.422***			
LR_spatial error	29.943***				30.999***			

Note: see note to Tab.1

Tab.5: Spatial effects of growth determinants- Per capita GDP and Manufacturing Exports (Convergence Framework)

Variable	PER CAPITA GDP				MANUFACTURING EXPORTS			
	Impact and Spatial Effects	*Direct Effects*	*Indirect Effects*	*Total Effects*	*Impact and Spatial Effects*	*Direct Effects*	*Indirect Effects*	*Total Effects*
Road Infrastructure Index (social overhead capital)	0.0035 (0.599)	0.034 (0.597)	0.0008 (0.047)	0.0042 (0.226)	0.0594 (0.951)	0.0588 (0.923)	-0.0195 (-0.142)	0.0392 (0.272)
Airport Infrastructure Index (social overhead capital)	0.0005 (0.408)	0.0004 (0.372)	-0.0013 (-0.382)	-0.0009 (-0.234)	0.0107 (0.919)	0.0091 (0.727)	0.0400 (1.354)	0.0491 (1.608)
Graduates /young population (human capital)	0.5105 (2.928)***	0.5099 (3.105)***	-0.2286 (-1.023)	0.2813 (1.644)*	3.7130 (2.059)**	3.8620 (2.088)**	-4.3974 (-2.008)**	-0.5354 (-0.402)
Crimes per capita (social capital)	-0.2827 (-0.866)	-0.2709 (-0.820)	0.5078 (0.578)	0.2369 (0.254)	-3.7040 (-1.070)	-4.1487 (-1.163)	11.0139 (1.576)	6.8652 (0.991)
Social Cooperatives per capita (institutional relational capital)	0.0145 (0.372)	0.0160 (0.420)	-0.0197 (-0.210)	-0.0037 (-0.039)	0.9562 (2.302)**	0.9477 (2.192)**	0.5641 (0.752)	1.5118 (2.168)**
Public libraries[A] (natural/ cultural capital)	-0.2373 (-0.865)	-0.2419 (-0.869)	-0.5171 (-0.999)	-0.7589 (-1.472)	0.9711 (0.333)	0.7589 (0.252)	3.2453 (0.706)	4.0041 (0.985)
Specialization Index (local cognitive capital)	-2.5468 (-2.694)***	-2.3290 (-2.570)**	10.5218 (3.633)***	8.1929 (2.747)***	-10.2468 (-1.032)	-8.0423 (-0.813)	-64.5813 (-2.684)***	-72.6236 (-3.168)***
Capital Stock (private fixed capital)	-2.0011 (-0.852)	-1.9453 (-0.847)	-5.3204 (0.995)	-7.2657 (-1.229)	-51.7010 (-2.153)**	-54.0519 (-2.088)**	62.4112 (1.845)*	8.3593 (0.275)
Inward FDI (entrepreneurial relationship capital)	0.0007 (0.674)	0.0006 (0.657)	0.0019 (0.826)	0.0025 (0.993)	-0.0061 (-0.595)	-0.0049 (-0.457)	-0.0176 (-0.095)	-0.0224 (-1.113)
Agglomeration (local cognitive capital)	0.6113 (0.938)	0.6338 (0.971)	1.6172 (1.023)	2.2510 (1.317)	0.5968 (0.089)	0.1196 (-0.017)	19.6390 (1.612)	19.5194 (1.665)*
Patents[B] (entrepreneurial relational capital)	-0.0026 (-0.233)	-0.0020 (-0.186)	0.0555 (1.714)*	0.0535 (1.543)	-0.0159 (-0.137)	-0.0164 (-0.136)	-0.0937 (-0.361)	-0.1101 (-0.411)
pcGDP_0	-0.0001 (-9.556)***	-0.0008 (-9.533)***	0.0001 (0.291)	-0.0008 (-4.097)***				
EXP_0					-10.4508 (-2.421)**	-10.4122 (-2.334)**	0.5923 (0.076)	-9.8199 (-1.254)
W*pcGDP	0.1210 (1.360)							
W*EXP					-0.1710 (-1.738)*			
W*Road Infrastructures Index	0.0002 (0.011)				-0.0142 (-0.092)			
W*Airport Infrastructure Index	-0.0012 (-0.396)				0.0475 (1.496)			
W*Graduates/young population	-0.2561 (-1.178)				-4.3339 (-1.898)*			
W*Crimes per capita	0.5235 (0.682)				11.3368 (1.402)			
W*Social Cooperatives per capita	-0.0181 (-0.216)				0.8171 (0.935)			
W*Public libraries[A]	-0.4270 (-0.918)				3.8071 (0.776)			
W*Specialization Index	9.5613 (3.781)***				-73.5852 (-2.729)***			
W*Capital Stock	-4.4972 (-0.927)				61.1535 (1.5890)			
W*Inward FDI	0.0015 (0.771)				-0.0208 (-0.989)			
W*Agglomeration	1.3564 (0.985)				22.3399 (1.665)*			
W*Patents[B]	0.0491 (1.683)*				-0.1081 (-0.359)			
W*pcGDP_0	0.0001 (0.845)							
W*EXP_0					-0.7256 (-0.081)			
N	309				309			
R^2	0.791				0.500			
LR_Spatial lag	44.1594***				31.3274***			
LR_spatial error	38.5898***				30.4322***			

Note: see note to Tab.1

Tab.6: Spatial effects of growth determinants - Employment (Convergence Framework)

	EMPLOYMENT				EMPLOYMENT			
Variable	***Impact and Spatial Effects***	***Direct Effects***	***Indirect Effects***	***Total Effects***	***Impact and Spatial Effects***	***Direct Effect***	***Indirect Effects***	***Total Effects***
Road Infrastructure Index (social overhead capital)	-0.0057 (-0.748)	-0.0058 (-0.750)	-0.0208 (-0.940)	-0.0266 (-1.053)				
Airport Infrastructure Index (social overhead capital)	0.0003 (0.240)	0.0003 (0.236)	-0.0101 (-2.484)**	-0.0098 (-2.167)**				
Accessibility Index (social overhead capital)					0.0388 (1.282)	0.0369 (1.159)	0.0453 (0.958)	0.0822 (2.662)***
Graduates/young population (human capital)	0.4511 (1.704)*	0.4538 (1.786)*	0.1659 (0.516)	0.6198 (3.104)***	0.3938 (1.553)	0.3956 (1.526)	-0.3237 (-0.913)	0.0719 (0.307)
Institutional Quality Index (social capital)	1.7716 (0.695)	1.8028 (0.689)	2.8877 (0.473)	4.6905 (0.727)	2.8878 (1.312)	2.6642 (1.060)	5.5399 (0.960)	8.2040 (1.376)
Social Cooperatives per capita (institutional relational capital)	-0.0166 (-0.300)	-0.0133 (-0.238)	-0.0757 (-0.625)	-0.0890 (-0.739)	-0.0548 (-1.016)	-0.0528 (-0.962)	-0.0072 (-0.065)	-0.0600 (-0.552)
Public libraries[A] (natural/ cultural capital)	0.2963 (0.990)	0.2868 (0.936)	0.5559 (0.779)	0.8427 (1.079)	0.1366 (0.463)	0.1120 (0.384)	0.8913 (1.332)	1.0033 (1.468)
Specialization Index (local cognitive capital)	-2.5436 (-1.131)	-2.5569 (-1.074)	5.0067 (0.954)	2.4498 (0.421)	-1.8555 (-0.856)	-1.9901 (-0.908)	3.6076 (0.773)	1.6175 (0.325)
Capital Stock (private fixed capital)	6.6583 (2.491)**	6.5739 (2.404)**	-2.1268 (-0.286)	4.4470 (0.513)	6.4867 (2.511)**	6.3885 (2.492)**	-0.9687 (-0.151)	5.4198 (0.741)
Inward FDI (entrepreneurial relational capital)	-0.0007 (-0.725)	-0.0007 (-0.749)	-0.0013 (-0.593)	-0.0021 (-0.807)	-0.0011 (-1.119)	-0.0011 (-1.043)	-0.0021 (-1.030)	-0.0031 (-1.383)
Agglomeration (local cognitive capital)	1.2027 (1.722)*	1.1966 (1.736)*	0.1488 (0.090)	1.3453 (0.757)	1.0481 (1.554)	1.0604 (1.596)	-0.0271 (-0.019)	1.0333 (0.664)
Patents[B] (entrepreneurial relational capital)	-0.0216 (-0.374)	-0.0225 (-0.397)	0.1032 (0.739)	0.0807 (0.519)	-0.0516 (-0.957)	-0.0518 (-0.993)	0.0001 (0.001)	-0.0516 (-0.482)
PPP/INV					0.0006 (0.764)	0.0007 (0.867)	-0.0036 (-1.433)	-0.0029 (-1.065)
EMPL_0	-0.0256 (-3.763)***	-0.0260 (-4.012)***	0.0362 (2.092)**	0.0101 (0.558)	-0.0218 (-3.262)***	-0.0219 (-3.137)***	0.0139 (0.931)	-0.0080 (-0.507)
W*EMPL	-0.0160 (-0.1385)				0.0130 (0.775)			
W*Road Infrastructures Index	-0.0195 (-0.900)							
W*Airport Infrastructure Index	-0.0101 (-2.656)***							
W*Accessibility Index					0.0538 (1.091)			
W*Graduates/young population	0.1662 (0.493)				0.311 (0.842)			
W*Institutional Quality Index	2.946 (0.508)				6.241 (0.977)			
W*Social Cooperatives per capita	-0.0742 (-0.596)				-0.0156 (-0.127)			
W*Public libraries[A]	0.5866 (0.812)				1.0037 (1.430)			
W*Specialization Index	5.1207 (0.997)				3.6283 (0.719)			
W*Capital Stock	-1.8037 (-0.245)				-0.0708 (-0.009)			
W*Inward FDI	-0.0015 (-0.649)				-0.0024 (-1.079)			
W*Agglomeration	0.1333 (0.083)				0.1158 (0.073)			
W*Patents[B]	0.1084 (0.794)				-0.0005 (-0.004)			
W*PPP/INV					-0.0040 (-1.467)			
W*EMPL_0	0.0366 (2.233)**				-0.1350 (-1.123)			
N	206				206			
R^2	0.820				0.827			
LR_Spatial lag	33.8184***				24.6107**			
LR_spatial error	33.5405***				24.5170**			

Note: see note to Tab.1

Tab.7:Two-regime Spatial Durbin Model (Crisis and Macroarea Effects) - Per capita GDP and Manufacturing Export Growth (1999-2014)

	PER CAPITA GDP (Regime 1= crisis)		MANUFACTURING EXPORTS (Regime 1= crisis)		PER CAPITA GDP (Regime 1= South)	MANUFACTURING EXPORTS (Regime 1= South)
Variable	Effects in non-crisis periods	Interaction Effects (dummy crisis*Xs)	Effects in non-crisis periods	Interaction Effects (dummy crisis*Xs)		
Road Infrastructure Index (social overhead capital)	0.0055 (0.929)	-0.0047 (-1.191)	0.0799 (1.817)*	-0.0616 (-2.094)**	0.0012 (0.210)	0.0688 (1.391)
Airport Infrastructure Index (social overhead capital)	-0.0008 (-0.704)	-0.0003 (-0.254)	-0.0004 (-0.047)	-0.0082 (-1.016)	-00010 (-0.944)	0.0072 (0.777)
Graduates /young population (human capital)	0.3947 (2.303)**	-0.0371 (-0.207)	1.1998 (0.948)	2.7004 (2.027)**	0.3306 (1.978)**	3.1830 (2.218)**
Crimes per capita (social capital)	-0.6342 (-1.8433)*	-0.0832 (-0.322)	-2.1557 (-0.848)	-4.5043 (-2.354)**	-0.5207 (-1.629)*	-4.5698 (-1.667)*
Social Cooperatives per capita (institutional relational capital)	0.0237 (0.501)	0.0121 (0.365)	0.6063 (1.732)*	0.4992 (2.018)**	0.0254 (0.658)	0.9962 (3.028)***
Public libraries[A] (natural/ cultural capital)	-0.2367 (-0.738)	0.0470 (0.262)	1.1448 (0.483)	-1.8097 (-1.366)	-0.2176 (-0.806)	0.2198 (0.095)
Specialization Index (local cognitive capital)	-2.8344 (-2.992)***	-0.9950 (-2.332)***	1.9822 (0.284)	24.9650 (7.749)***	-2.2909 (-2.468)***	-10.2198 (-1.288)
Capital Stock (private fixed capital)	-1.9017 (-0.684)	-0.8475 (-1.694)*	-18.0240 (-0.884)	-0.5356 (-0.145)	1.1424 (0.514)	-43.7280 (-2.324)**
Inward FDI (entrepreneurial relational capital)	0.0038 (0.8432)	0.1301 (0.224)	-0.0005 (0.016)	2.1800 (0.507)	0.0012 (1.314)	-0.0053 (-0.098)
Agglomeration (local cognitive capital)	1.5520 (2.006)**	-0.0008 (-0.642)	-6.5524 (-1.138)	-0.0020 (-0.212)	1.8929 (3.022)***	-0.5241 (-0.098)
Patents[B] (entrepreneurial relational capital)	0.0160 (1.488)	-0.0051 (-0.163)	-0.0007 (-0.008)	-0.1807 (-0.776)	0.0165 (1.530)	-0.0054 (-0.058)
W*Road Infrastructures Index	-0.0055 (-0.363)	-0.0047 (-0.573)	-0.0392 (-0.348)	0.0116 (0.191)	-0.0210 (-1.484)	-0.0158 (-0.130)
W*Airport Infrastructures Index	-0.0026 (-0.855)	-0.0039 (-1.232)	0.0310 (1.350)	0.0119 (0.511)	-0.0019 (-0.646)	0.0448 (1.772)*
W*Graduate/young population	-0.3041 (-1.251)	0.0453 (0.140)	1.3941 (0.776)	-3.0517 (-1.278)	0.0880 (0.389)	-2.9164 (-1.638)*
W*Crimes per capita	1.1885 (1.436)	0.7780 (1.351)	14.682 (2.400)**	6.8558 (1.614)*	1.3708 (1.827)*	13.1176 (2.047)**
W*Social Cooperatives per capita	0.0107 (0.093)	-0.0358 (-0.470)	0.1453 (0.171)	-0.2019 (-0.3580)	-0.1105 (-1.351)	0.7428 (1.062)
W*Public libraries[A]	-1.2840 (-2.000)**	-0.5607 (-1.128)	-2.2854 (0.485)	-2.2030 (-0.594)	-0.0594 (-0.127)	1.3821 (0.356)
W*Specialization Index	8.6019 (3.055)***	-0.3111 (-0.401)	-39.9003 (-1.913)**	-4.1644 (-0.641)	10.8712 (4.369)***	-83.8117 (-3.900)***
W*Capital Stock	17.1093 (4.009)***	1.3405 (1.441)	36.1031 (1.166)	-8.5051 (-1.231)	11.3018 (3.999)***	72.6107 (2.763)***
W*Inward FDI	0.0230 (1.734)*	0.0629 (0.043)	0.1838 (1.874)*	-12.2966 (-1.139)	-0.0009 (-0.511)	-0.0223 (-1.351)
W*Agglomeration	0.9821 (0.529)	-0.0069 (-1.790)*	48.5498 (3.550)***	-0.0569 (-1.970)**	2.3022 (1.816)*	25.7706 (2.439)***
W*Patents[B]	0.0057 (0.202)	0.0688 (0.904)	-0.1146 (-0.549)	0.6288 (1.116)	0.0063 (0.226)	-0.0543 (-0.226)
Regime 1	0.0124 (0.134)		-0.0497 (-0.509)		0.1594 (1.648)*	0.2931 (2.913)***
Regime2	-0.0324 (-0.235)		-0.4684 (-2.157)**		0.1192 (1.106)	-0.4991 (-3.038)***
Regime1-Regime2	0.0449 (0.387)		0.4188 (1.9139)*		0.0402 (0.376)	0.7922 (4.128)***

Note: see note to Tab. 1

Tab.8:Two-regime Spatial Durbin Model (Crisis/Non-Crisis and South/North-Center)- Per-capita GDP and Manufacturing Export Growth (1999-2014)

	PER CAPITA GDP				**MANUFACTURING EXPORTS**			
	CRISIS		**NO-CRISIS**		**CRISIS**		**NO-CRISIS**	
Variables	**South**	**North-Center**	**South**	**North-Center**	**South**	**North-Center**	**South**	**North-Center**
Road Infrastructure Index (social overhead capital)	0.0012 (0.213)	0.0011 (0.205)	0.0014 (0.251)	0.0013 (0.226)	0.0681 (1.351)	0.0657 (1.291)	0.0671 (1.308)	0.0693 (1.364)
Airport Infrastructure Index (social overhead capital)	-0.0010 (-0.933)	-0.0010 (-0.938)	-0.0009 (-0.923)	-0.0010 (-0.933)	0.0078 (0.825)	0.0090 (0.9459	0.0095 (0.990)	0.0088 (0.924)
Graduates/young population (human capital)	0.3289 (1.968)**	0.3317 (1.984)**	0.3263 (1.954)**	0.3316 (1.986)**	3.3739 (2.309)**	3.3935 (2.299)**	3.4598 (2.325)**	3.4153 (2.318)**
Crimes per capita (social capital)	-0.5137 (-1.607)	-0.5130 (-1.604)	-0.5210 (-1.633)*	-0.5165 (-1.617)*	-4.8744 (-1.745)*	-4.6662 (-1.655)*	-4.5019 (-1.583)	-4.4924 (-1.596)
Social Cooperatives per capita (institutional relational capital)	0.0282 (0.736)	0.0280 (0.728)	0.0254 (0.664)	0.0262 (0.685)	1.0320 (3.080)***	1.0338 (3.056)***	1.0606 (3.110)***	1.0596 (3.138)***
Public libraries[A] (natural/ cultural capital)	-0.2092 (-0.775)	-0.2044 (-0.756)	-0.2200 (-0.817)	-0.2067 (-0.767)	0.1660 (0.070)	0.3256 (0.137)	0.4516 (0.188)	0.4088 (0.172)
Specialization Index (local cognitive capital)	-2.2874 (-2.468)***	-2.3017 (-2.482)***	-2.2306 (-2.403)**	-2.2703 (-2.447)***	-10.3955 (-1.289)	-9.7434 (-1.198)	-9.3308 (-1.137)	-9.5729 (-1.178)
Capital Stock (private fixed capital)	1.3917 (0.631)	1.3531 (0.613)	1.1227 (0.510)	1.1713 (0.532)	-45.4555 (-2.371)**	-49.6839 (-2.564)***	-48.7396 (-2.495)***	-45.1600 (-2.335)**
Inward FDI (entrepreneurial relationship capital)	0.0012 (1.301)	0.0012 (1.295)	0.0012 (1.322)	0.0012 (1.303)	-0.0057 (-0.686)	-0.0054 (-0.652)	-0.0058 (-0.682)	-0.0059 (-0.707)
Agglomeration (local cognitive capital)	1.9389 (3.113)***	1.9393 (3.106)***	1.8780 (3.012)***	1.9032 (3.059)***	0.0037 (0.001)	-0.4120 (-0.075)	0.0388 (0.007)	0.3409 (0.062)
Patents[B] (entrepreneurial relationship capital)	0.0166 (1.301)	0.0165 (1.533)	0.0165 (1.532)	0.0164 (1.521)	-0.0095 (-0.101)	-0.0148 (-0.155)	-0.0118 (-0.123)	-0.0062 (-0.065)
W*Road Infrastructures Index	-0.0210 (-1.486)	-0.0213 (-1.504)	-0.0202 (-1.433)	-0.0209 (-1.504)	-0.0504 (-0.408)	-0.0347 (-0.278)	-0.0470 (-0.374)	-0.0514 (-0.412)
W*Airport Infrastructures Index	-0.0018 (-0.604)	-0.0018 (-0.609)	-0.0018 (-0.605)	-0.0018 (-0.609)	0.0502 (1.951)**	0.0482 (1.853)*	0.0513 (1.956)**	0.0523 (2.017)**
W*Graduates/young population	0.0416 (0.192)	0.0521 (0.243)	0.0927 (0.430)	0.0893 (0.413)	-3.0603 (-1.686)*	-3.1481 (-1.718)*	-3.4995 (-1.895)*	-3.5221 (-1.927)**
W*Crimes per capita	1.2961 (1.724)*	1.3253 (1.773)*	1.3419 (1.801)*	1.3682 (1.833)*	13.9088 (2.131)**	13.2865 (2.014)**	13.1308 (1.976)**	13.2504 (2.013)**
W*Social Cooperatives per capita	-0.099 (-1.233)	-0.1011 (-1.254)	-0.1102 (-1.369)	-0.1083 (-1.254)	0.7767 (1.091)	0.6261 (0.871)	0.7140 (0.986)	0.8360 (1.165)
W*Public libraries[A]	0.0195 (0.043)	0.0422 (0.091)	-0.0776 (-0.170)	0.0039 (0.008)	3.4638 (0.875)	3.6747 (0.916)	4.8263 (1.199)	4.5583 (1.144)
W*Specialization Index	10.5697 (4.272)***	10.7071 (4.341)***	10.7971 (4.385)***	10.9273 (4.426)***	-80.2477 (-3.669)***	-70.3599 (-3.201)***	-66.0793 (-2.981)***	-72.0342 (-3.273)***
W*Capital Stock	12.2649 (3.753)***	12.0157 (3.736)***	11.3760 (3.570)***	12.3442 (3.736)***	80.5730 (3.022)***	78.6623 (2.909)***	88.6597 (3.261)***	91.0958 (3.390)***
W*Inward FDI	-0.0010 (-0.539)	-0.0010 (-0.538)	-0.0009 (-0.510)	-0.0010 (-0.538)	-0.0251 (-1.491)	-0.0237 (-1.389)	-0.0253 (-1.473)	-0.0260 (-1.532)
W*Agglomeration	2.3390 (1.849)*	2.3675 (1.870)*	2.2300 (1.752)*	2.3164 (1.835)*	25.2141 (2.342)**	24.1461 (2.223)**	25.4009 (2.317)**	26.6909 (2.459)***
W*Patents[B]	0.0059 (0.211)	0.0056 (0.200)	0.0061 (0.216)	0.0054 (0.191)	-0.0866 (-0.354)	-0.1151 (-0.466)	-0.0985 (-0.395)	-0.0660 (-0.267)
Regime 1	0.1222 (1.364)	0.1421 (0.200)	0.1670 (1.869)*	0.1099 (1.1360)	0.0338 (0.347)	-0.2337 (-2.136)**	-0.1070 (-0.977)	-0.2732 (-2.167)**
Regime2	0.1829 (1.500)	0.1010 (0.847)	0.0566 (0.446)	0.1840 (1.835)*	-0.6027 (-2.190)**	0.2222 (1.377)	-0.2795 (-1.398)	0.1692 (1.375)
Regime1-Regime2	-0.0607 (-0.566)	0.0411 (0.427)	0.1104 (0.446)	-0.0741 (-0.790)	0.6365 (2.201)**	-0.45559 (-2.451)**	0.1725 (0.765)	-0.4424 (-2.650)***

Note: see note to Tab.1