Structural funds, regional convergence and agricultural employment in the enlarged EU

A panel-data approach

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Abstract

This paper aims to investigate the impact of structural funds policies on objective 1 regions over the past programming periods (1989-1993; 1994-1999). This impact is analysed by estimating a conditional convergence econometric model. According to this model, regional convergence is affected both by the policy treatment and by the regional economic structure (proxied by the agricultural employment share). This convergence model is specified in a panel-data dynamic form on a dataset of 206 NUTS II EU-15 regions observed over more than 10 years (from 1989 to 2000) and of 55 NUTS II regions of 12 accessing countries observed in the last five years of the sample period (1995-2000). A GMM estimation is applied to obtain consistent estimates of both the β-convergence and of the impact of the conditioning variables, mainly the objective 1 policies.

Keywords: Regional Convergence, Structural Funds, Agriculture Employment, Enlargement, Panel-data, GMM Estimation.

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1 Introduction: aims and structure of the work

This paper aims to identify the impact of the EU structural funds expenditure in objective 1 regions. The main idea driving this empirical analysis is to consider policy instruments applied over a sub-set of EU regions as a "treatment" and to evaluate the consequent impact as a "treatment effect". This effect is here evaluated as the capacity of the structural funds investments to affect the objective 1 (NUTS II) regions growth pattern and, in particular, to contribute to reduce the *per capita* income gap with respect to the EU average. More specifically, we assume that structural payments may condition the "natural" convergence process of the poorer European regions towards the average. Therefore, we estimate an augmented regional convergence model to assess if convergence is actually observed over the whole 1989-2000 period and if structural payments significantly affected it.

In addition, we also allow the convergence process to be also conditioned on the regional economic structure. In particular, our interest is on assessing if the share of agricultural sector in the regional economy plays some role, *ceteris paribus*, i.e. with the same level of structural founds payments. Many objective 1 regions are actually characterised by an high share of agricultural employment; however, this share greatly differs across countries and regions within each country, especially in Southern Europe. As Common Agricultural Policy (CAP) payments, these regions thus also receive an additional EU support from CAP. If an higher share of agriculture negatively affects regional growth patterns and the CAP support tends to maintain someway higher agricultural share within the regional economy, this support might eventually counter-balance the alleged growth-enhancing effect of objective 1 payments. In other words, and paradoxically, under these hypotheses CAP measures may act as a counter-treatment in objective 1 regions.

With respect to the treatment effect, we consider two different counterfactual case (i.e., off-treatment observations). On the one hand, we can observe the non-objective 1 regions in the EU-15. On the other hand, as counterfactual cases we also consider the accessioning countries NUTS II regions, observed over the period 1994-2000. In many respects, these regions are similar to the EU-15 objective 1 regions, in particular for the abovementioned agricultural share in the regional economy. They are analogous to the EU-15 objective 1 regions in the pre-1989 periods, since most of them will be included in the objective 1 treatment as soon as the respective countries will formally enter the European Union (May 2004 or later).

A data set of more than 200 NUTS II EU-15 regions (and 55 accessioning states regions) observed over about 10 years (5 years for the new members) allows to specify the convergence model in the dynamic form and using panel econometrics techniques. As widely reported in the literature, these specifications and estimation practice, may greatly enhance the model statistical performance as well as reduce a number of technical drawbacks of the traditional cross-sectional specification. The dynamic specification also explicitly emphasizes the possible presence of endogeneity bias. To take into account this further issue, the model is estimated by an appropriate GMM estimator, whose results are compared with more conventional estimators.

The structure of the paper is the following. Section 2 describes in detail how the assessment of the impact of objective 1 structural funds may formulated in terms of "treatment effect" analysis and discusses the consequent methodological implications. Section 3 introduces the regional growth convergence model in the extended conditional convergence specification. Section 4 presents the data set used to estimate the convergence model then described in section 5 together with the respective econometric implications. Section 6 discusses the major results and suggests possible further research steps on the topic.

2 Impact of regional policies as treatment effects

The major interest in approaching regional policy impact analysis according to the treatment effects literature (Manski, 1993) is to identify some key-points to be considered in the empirical applications; these may also be the driving rules of any *ex-post* evaluation of regional policies (Folmer, 1986).

A first major issue, is that the analysis of the treatment effects has to univocally identify the treatment target; this is just the variable (or the vector of variables) we want to affect with the treatment. In the empirical analysis the target variable becomes the outcome variable that is how we measure the effect of the treatment.[2] Once the outcome variable has been defined, a second methodological issue is to clearly identify the counterfactual case; in other words, those non-treated (or off-treatment) cases (regions, in our application) allowing us to measure the effect of the treatment by comparing the outcome of treated and non-treated cases.

More formally, the *ex post* evaluation of a treatment is based on a sample of *n* individuals-regions (with *N = 1,…., i,…,n* identifying the individuals set). We observe the treatment target variable *y* over the whole sample, that is we observe the individual outcome y_i. This outcome may refer to either treatment or off-treatment cases. If we admit the outcome variable is stochastic to some extent (regardless of the treatment), the evaluation problem becomes to identify the expected value of the outcome variable conditioned on the treatment as follows:

$$(1)\quad E(y_i|T_i)\ \ \forall i \in N,\quad where\ \begin{cases} T_i = 0 \ \ if\ \ i\ is\,not\,treated \\ T_i = 1\ \ if\ \ i\ is\ treated \end{cases}$$

Following this notation, the treatment effect (TE) is itself a random variable expressed as follows:

$$(2)\qquad TE_i = E(y_i|T_i = 1) - E(y_i|T_i = 0)$$

This is the so-called "*mean effect of treatment on the treated*"[3]. The treatment effect on any i-th region is calculated as difference between the outcome variable observed in the region under the treatment and the counterfactual case, which is the outcome variable of the region itself off-treatment. However, two basic problems make this simple approach unaffordable in regional policy analysis. First of all, in most regional polices the treatment magnitude M_i behaves as a continuous and not as a dichotomous variable; in other words, it can not be simply represented by a dummy variable. In fact, a more general version of equation (1) is the following:

$$(1bis)\quad E(y_i|T_i)\ \ \forall i \in N,\quad where\ \begin{cases} T_i = 0 \ \ if\ \ i\ is\,not\,treated \\ T_i = M_i\ \ if\ \ i\ is\ treated \end{cases}$$

and the *TE* becomes a generic function of M_i:

$$(2bis)\qquad TE_i = f(M_i) = E(y_i|T_i = M_i) - E(y_i|T_i = 0)$$

Secondly, many "treatments" can not afford this simple definition of the counterfactual case. With regional policies, in particular, is never possible to compare the outcome observed in the treated region with the outcome that would be observed in the same region off-treatment. Moreover, is not even possible to compare the outcome of a treated region with a non-treated one without taking into account the differences between them. In fact, assessing the TE according to the simple approach described above actually depends on the real experimental design that can be set up. Methodologies to measure the TE are usually divided in

2 The definition of the policy target/objective as the relevant outcome to be considered is widely analysed in the literature and is particularly relevant in those policy whose target is not explicit or is multiple. See Diamond and Spence (1983), Willis (1985), JURUE (1986), Cameron (1990), McEldowney (1991) and Storey (1990) for details. The case of objective 1 policies, however, seems to be less complex in this respect, since the target (and, consequently, the regional selection criteria) is very clearly defined.

3 Alternative definitions of the effect are proposed in Heckman (1992), Heckman, Smith and Clements (1997), Heckman and Smith (1997).

three groups: experimental, non-experimental and quasi-experimental techniques (Campbell and Stanley, 1966).

For regional policies evaluation, the non-experimental case is the common one. The counterfactual case can never be: a) the same region observed at the same time but off-treatment; b) the same region observed in another point of time before the treatment without significant autonomous changes in its own characters over time; c) another non-treated region with exactly the same characters of the treated one. Since none of these cases can be afforded, in policy effect evaluation the appropriate methodology has to consider both sample selection bias and omitted variable bias in correctly defining the counterfactual situation.

The main issue in this respect is to acknowledge that the outcome evolves not only in reaction to the treatment but also as a consequence of the sample own characters. Being in a non-experimental condition, we can not easily get rid of these sample properties (*sample selection bias*) (Heckman, 1990, Heckman e Robb, 1985, Manski, 1993). A regional policy can be evaluated looking at the same region over time, that is before and after the treatment (time series), looking at treated and non-treated regions at the same point of time (cross section sample), or both (a panel-data sample), but in none of this case sample selection bias can be excluded.

The solution of the problem may be to find where the bias comes from. In any non-experimental case, the outcome variable evolves over time and differs across region due to a set of other uncontrolled conditioning variables X_i; if they are not considered, the change in the outcome is fully attributed to the treatment when actually should not. These omitted variables are the main source of errors in measuring the TE (*omitted variable bias*).

By considering the set of other conditioning variables the TE in region i should be computed as follows:

(3) $$TE_i = f(M_i, X_i) = E(y_i | T_i = M_i, X_i) - E(y_i | T_i = 0, X_i)$$

which, in the non-experimental case, has two alternative specifications. If we use time series data (the same region over time), we should write:

(3bis) $$TE_i = f(M_i, X_{it}, X_{it+1}) = E(y_{it+1} | T_{it} = M_i, X_{it+1}) - E(y_{it} | T_{it} = 0, X_{it})$$

If we use a cross-sectional data (comparison made among different regions), we should write:

(3ter) $$TE_i = f(M_i, X_i, X_j) = E(y_i | T_i = M_i, X_i) - E(y_j | T_j = 0, X_j) \quad \forall i, j \in N$$

A combination of (3bis) and (3ter) is also possible whenever panel-data are available.

One particular case of omitted variable bias occurs when the time span of the treatment-effect relation is not appropriately considered. When the treatment is some policy measure, it is reasonable to assume that the outcome variable is not instantaneously affected by the treatment. The effect will be rather observed with some lag and will be function of a weighted sum of the past treatments. Although this issue is often disregarded in empirical applications, it implies that, by defining S = 1,…, s,…, Z the set of lags taking into account the duration of the treatment effect, the TE can be calculated as follows:

(4) $$TE_{it} = f\left(\sum_{s=0}^{Z} w_s M_{it-s}, X_{it}\right) = E\left(y_{it} \middle| T_{it} = \sum_{s=0}^{Z} w_s M_{it-s}, X_{it}\right) - E(y_{it} | T_{it} = 0, X_{it})$$

where w_s is the weight indicating the "portion" of the treatment at time *t-s* affecting the outcome at time *t*. Also equation (4) can be written in the three abovementioned alternative versions (time series, cross section and panel data).

Folmer and Nijkamp (1985) emphasize that a full assessment of a regional policy treatment would imply an evaluation not only of the uncontrolled conditioning variables but also of the uncontrolled (or undesirable) effects. Besides the outcome variable, the treatment can also have collateral effects that are neither controlled nor expected by the policy maker. Also this aspect is often disregarded, though may be of major relevance.

In fact, we will follow this simplifying (though maybe simplistic) assumption: objective 1 structural funds payments will be assumed to have effects only on the variable they are targeted on, that is the *per capita* income growth. This is unquestionably the main (if not the only) purpose of objective 1 payments since the regions selection criteria is a significantly (<75%) lower *per capita* income (Y_i) with respect to the EU15 average. Therefore, dealing with this specific regional policy, we can easily define the y_{it} and M_i variables. The first is the *per capita* income growth observed in region i at time t: $y_{it} = \frac{Y_{it} - Y_{it-1}}{Y_{it-1}} \approx \ln Y_{it} - \ln Y_{it-1}$; the second is just the structural funds expenditure in the i-th regions over all the relevant past years.

Nevertheless, something remains undetermined to make policy evaluation empirically affordable. Firstly, we have to define which are the relevant conditioning variables X_i. Secondly, which is the functional relation linking the treatment and the other conditioning variables with the outcome; in the case of objective 1 funds, an answer to the first question should come from a consistent regional growth theory. It should indicate which is the autonomous regional growth pattern and which are the regional variables driving it; moreover, it has also to indicate how the treatment interferes with this pattern and its driving variables.

A consistent regional growth theory may also help us in finding the appropriate functional form linking the abovementioned variables. Moreover, data availability (time series, cross section or panel) may be binding and could prevent us from using some specification or estimation methodology. Among several methodologies and specifications proposed in the literature (see the survey in Bussoletti, 2004), we base the present analysis on a linear specification of the treatment-outcome relation and on a panel-dataset. This specification is directly derived by the regional growth theory here assumed to represent the interaction among the outcome, the treatment and other conditioning variables at the regional level. This is the growth convergence theory.

3 Convergence theory and regional development policy

In the last two decades, a significant and increasing amount of empirical studies about regional growth patterns have been based (explicitly or not) on the so-called convergence theory (Islam, 2003). These studies apply to the regional context models and methods originally elaborated to study the long-run growth of large (country) economies rather than local-regional medium or short-run growth. Nevertheless, the same theoretical foundation and, above all, empirical framework proved to be particularly suitable also to the regional context (Barro and Sala-i-Martin, 1995).

Actually, the first empirical convergence analysis is due to Baumol (1986) and concerned 16 OECD countries according to the long-term growth data from Maddison (1982). The theoretical justification of the estimated convergence model relied, in general terms, on the neoclassical growth model under the assumption that any economy could benefit from the same technological growth, thus achieving the same steady-state growth rate.[4] However, this theoretical justification was not strictly linked to the empirical specification of the convergence model which was "simply" a linear regression linking the *per capita* income growth to its initial level as the only conditioning variable (this is the *unconditional convergence* model).

Subsequent works added some other conditioning factors to this linear regression specification (Kormendi and Meguire, 1985; Grier and Tullock, 1989). Though these works may be now interpreted as first attempts to estimate *conditional convergence* models, they still used

[4] It must be reminded that according to Solow convergence implied by his own growth model has actually to be mainly interpreted as convergence within the economy (country or region) rather then across the economies (Islam, 2003).

substantially *ad hoc* specifications, not strictly derived from the underlying neo-classical growth model. This empirical strategy is what is now known as "informal" or "extensive" specification of the growth convergence model (Islam, 2003).

In 1992 two seminal empirical works by Barro and Sala-i-Martin (1992) and Mankiw *et al*. (1992), derived the linear regression specification rigorously from the transition dynamics of the neo-classical growth model (in both Solow-Swan and Cass-Koopmans versions). This is the "formal" or "model-based" specification of the growth convergence model. It still links the *per capita* income growth to the initial income level but other conditioning variables are strictly and exclusively indicated by the underlying theoretical framework, and no more coming from a somewhat *ad-hoc* selection.

Nevertheless, in many recent empirical works, also concerning the regional context, the selection of the conditioning variables remains conjectural (Sala-i-Martin, 1997), since they mainly aim just to assess the role of additional conditioning variables which, though, can be very hardly admitted by the underlying neo-classical growth model. As already mentioned, in policy impact analysis one major interest is to assess if the treatment affects somehow the regional growth convergence pattern. In this respect, most of the regional growth convergence empirical works trying to assess the effect of regional policies seem to revert back to the original informal or extensive specification for the difficulty to give them a stronger theoretical justification.

However, this difficulty depends how the model is specified and how the policy measure as conditioning variable is included in the model. The general specification of equation (4) implied by the regional convergence model would be:

$$(5)\ TE_{it} = E\left(y_{it} \middle| Y_{i0}, T_{it} = \sum_{s=0}^{Z} w_s M_{it-s}, X_{it} \right) - E\left(y_{it} \middle| Y_{i0}, T_{it} = 0, X_{it} \right)$$

where Y_{i0} indicates the i-th region initial *per capita* income, y_{it} the per capita income growth over the 0-t period, X_{it} the conditioning variables other than the initial *per capita* income and the treatment. The convergence theory makes these conditional expectations explicit as functions of the treatment and of the other conditioning variables.

3.1 Conditional β-convergence and policy treatment

Though growth convergence models are usually justified on the neo-classical growth theory, they have been proposed to explain country or regional growth dynamics also on the base of other theoretical explanations and approaches (Esposti, 2001). Therefore, the so called "informal" convergence models could be interpreted as a general empirical attempts to assess some stylised facts of growth, rather than to formally test a clear-cut growth theory. After the Barro and Sala-i-Martin (1992) and Mankiw (1992) *et al*. works, however, the linkage between these models and the underlying neoclassical growth theory became much more strict and limiting.

On the one hand, this contributes to demonstrate how the neo-classical growth theory can find much stronger empirical support than previously expected. On the other hand, however, the underlying theoretical foundation of convergence models encountered strong criticism by different streams of literature, either the so called endogenous growth theory (Romer, 1986, 1990, Lucas, 1988, Barro, 1990, Rebelo, 1991) and the so called new economy geography (Krugman e Venables, 1990, Krugman 1991, 1993); both, strongly contest on a theoretical ground the basic implication of the neo classic growth model that is the poorer has to grow faster due to the higher marginal productivity of capital and will convergence to the same long-term steady-state growth due to diffusion of the same technology from the richer to the poorer.

Here, we just want to emphasize how the empirical conjectural ground remains a strong, though sometime explicit, justification of the adopted specification of the growth convergence model. The first and easiest way to specify “informally” the unconditional (therefore off-treatment) model, also usually called β-convergence, is the following[5]:

(6) $$E\left(y_{it} \middle| T_{it} = 0, X_{i0}\right) = a + \beta \ln Y_{i0}$$

When formally derived from the neoclassical growth theory, this “reduced” linear form can be expanded as follows (Barro and Sala-i-Martin, 1995; Islam, 2003):

(7)
$$E\left(y_{it} \middle| T_{it} = 0, X_{i0}\right) = t\,g + \left(1 - e^{-\lambda t}\right)\ln A_{i0} + \left(1 - e^{-\lambda t}\right)\frac{\alpha}{1-\alpha}\ln s_{i0} - \left(1 - e^{-\lambda t}\right)\frac{\alpha}{1-\alpha}\ln\left(n_{i0} + g + \delta\right) - \left(1 - e^{-\lambda t}\right)\ln Y_{i0}$$

where g is the total factor productivity growth rate (assumed to be constant across regions)[6], λ is the speed (or rate) of convergence, A_{i0} is the i-th region initial total factor productivity, α is the coefficient of the underlying Cobb-Douglas production function (indicating the rate of technical substitution between capital and labour and the capital’s share within the economy), s_{i0} is the i-th region initial investment rate, n_{i0} is the i-th region initial population (or workforce) growth rate, δ is the capital depreciation rate.

Equation (7) establishes on a theoretical ground the vector of off-treatment conditioning variables, as we can write $X_{i0} = \left(A_{i0} \quad s_{i0} \quad n_{i0} \quad g \quad \alpha \quad \delta\right)$. When all these conditioning variables are equal across the observations (regions), we have an unconditional convergence model: equation (7) corresponds to equation (6) where:

$$a = t\,g + \left(1 - e^{-\lambda t}\right)\ln A_0 + \left(1 - e^{-\lambda t}\right)\frac{\alpha}{1-\alpha}\ln s_0 - \left(1 - e^{-\lambda t}\right)\frac{\alpha}{1-\alpha}\ln\left(n_0 + g + \delta\right)$$

$$\beta = -\left(1 - e^{-\lambda t}\right)$$

On the contrary we have conditional convergence, that is different steady-states, if regions differ in terms of initial technology, investment rate and population growth. These variables (or some appropriate proxy of them) are the only legitimate conditioning variables in a model-based or “formal” conditional convergence model.

The empirical identification of all parameters of equation (7) is not an easy task and involves some relevant econometric issues that will be dealt with in next sections. Moreover, data about the conditioning variables are not always available (particularly at the regional level and with particular reference to A_{i0}). Actually, when regional data are used, it is often assumed that the difference among regions in terms of initial productivity, investment rate and population growth rate is negligible or is assumed to be random, thus can be embedded in the error term of the estimated equation.[7]

For these reasons, many empirical works still estimate the “reduced” version of the convergence model, that is equation (6), with only the initial income as conditioning factor ($X_{it} = Y_{i0}$). After all, the main interest remains on the convergence process that is on parameter β (or λ). In addition, panel-data and equations (6)-(7) written in panel-data dynamic form allow to admit individual (regional) effects, that is differences in other conditioning variables across regions under the assumption that these differences are random or constant over time (see next sections).

Here we want to show how the treatment can be included in the convergence model above. Though the introduction of other conditioning variables may be criticized as only guided by

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5 Beside the concept of β-convergence, the idea of σ-convergence has been proposed (Barro and Sala-I-Martin, 1992; Quah,1993; 1996). Whereas the former tries to model the expected value of income growth conditional on initial value, the latter models its statistical distribution across regions, over time or both. Although β-convergence is a necessary condition to have σ-convergence, convergence may be observed according to the first concept and not in distributional terms.

6 The fixity of g, δ and α across regions is implied by the underlying growth model but can be relaxed within endogenous growth models and also in the extensive version of the model with human capital proposed by Mankiw *et al.* (1992). However, relaxing these assumptions would make the concept of growth convergence itself inherently ambiguous (Islam, 2003).

7 However, this assumption is much stronger when regions indeed belong to different countries as in the present case.

some conjectural criteria, the more obvious way to include the treatment is just to include the treatment $T_{it} = \sum_{s=0}^{Z} w_s M_{it-s}$ among the regressors. However, objective 1 expenditures can be prevalently considered as investments[8], so we can assume the following relation between the regional investment rate *s* and the past treatment:

(8) $\ln s_{i0} = \gamma + \phi \sum_{s=-Z}^{0} w_s M_{is}$

The growth convergence model conditional on the treatment thus becomes:

(9) $E\left(y_{it} \middle| T_{it} = \sum_{s=-Z}^{0} w_s M_{is}, Y_{i0} \right) = a + \varphi \sum_{s=-Z}^{0} w_s M_{is} + \beta \ln Y_{i0}$

where:

$$a = t\, g + \left(1 - e^{-\lambda t}\right) \ln A_0 + \left(1 - e^{-\lambda t}\right) \frac{\alpha}{1-\alpha} \gamma - \left(1 - e^{-\lambda t}\right) \frac{\alpha}{1-\alpha} \ln\left(n_0 + g + \delta\right)$$

$$\varphi = \left(1 - e^{-\lambda t}\right) \frac{\alpha}{1-\alpha} \phi$$

It follows that the treatment effect can be measured as follows:

(10) $TE_{it} = E\left(y_{it} \middle| T_{it} = \sum_{s=-Z}^{0} w_s M_{is}, Y_{i0} \right) - E\left(y_{it} \middle| T_{it} = 0, Y_{i0} \right) = \varphi \sum_{s=-Z}^{0} w_s M_{is}$

where φ is expected to be positive for the treatment to be effective.

3.2 The role of agriculture

Since most of convergence studies are derived from one-sector growth models, they can not take explicitly into account the role of regional structural transformation. This is clearly a major drawback of the approach. On the one hand, it has been widely demonstrated in may empirical studies how the change in sectoral composition of the regional economy is a major factor affecting the regional growth pattern (Esposti, 2001). On the other hand, although the convergence model depicted above does not allow sectoral composition to surface directly, it is still evident that it affects, directly or not, many conditioning variables of equation (7).

If we admit that initial total factor productivity, investment rate, workforce growth rate, total factor productivity growth rate, capital intensity and depreciation rate differ across sectors (and it is definitely the case comparing agriculture with manufacture, for instance), we implicitly admit that all these variables depend on sectoral weights within the regional economy. Also if we admit only three conditioning variables (the others being constant across regions) as in equation (7), we can not rule out the possibility that they differ across sectors; thus, their regional aggregate values are function of the sector shares.

In particular, Islam (2003) acknowledges how in many empirical works the regional initial total factor productivity A_{i0} is expressed as function of some structural variable, for instance the share of some key-sector within the economy. Objective 1 regions generally show grater agricultural share than the EU average (Bussoletti, 2004). Here we assume that this initial technological level depends on the share of agriculture AG_{i0} (expressed in terms of % of agricultural employment) according to the following linear relationship:

(11) $\ln A_{i0} = \kappa + \psi\, AG_{i0}$

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8 Actually most objective 1 funds concentrates on three main areas: infrastructure, human capital, support to other (mainly private) investments (Bussoletti, 2004).

the assumption being that agriculture has a lower total factor productivity with respect to other sectors and, therefore, the higher is its share the lower the initial overall regional productivity; thus, ψ is expected to be negative. By substituting in equations (7) and (9) we can rewrite the convergence model in reduced form as follows:

$$(12)\quad E\left(y_{it} \middle| T_{it} = \sum_{s=-Z}^{0} w_s\, M_{is}, Y_{i0}, AG_{i0} \right) = a + \varphi \sum_{s=-Z}^{0} w_s\, M_{is} + \xi\, AG_{i0} + \beta \ln Y_{i0}$$

where:

$$a = t\,g + \left(1 - e^{-\lambda t}\right)\kappa + \left(1 - e^{-\lambda t}\right)\frac{\alpha}{1-\alpha}\gamma - \left(1 - e^{-\lambda t}\right)\frac{\alpha}{1-\alpha}\ln\left(n_0 + g + \delta\right)$$

$$\xi = \left(1 - e^{-\lambda t}\right)\psi$$

Therefore ξ is positive if ψ itself is positive.

According to equation (12), β-convergence is now conditioned on two variables: the treatment and the initial sectoral structure. If the parameters estimate really confirm the role of these conditioning variables, we can reject the hypothesis of regional unconditional convergence; though there is convergence in regional growth (the poorer is the region, the higher its growth rate), regions will tend to different steady state levels.

Here we are interested in the estimation of the reduced form of the convergence model of equation (12). As shown, the inclusion of the two conditioning variables may be justified on the theoretical ground, that is may be expressed as functions of the conditioning variables admitted in the model-based specification (equation (7)). Nonetheless, the estimation of the reduced form has been criticized by some authors (Islam, 2003) since it disregards all the underlying relations and constraints between the estimated reduced-form parameters and the growth-model parameters. In particular, we might derive all the theoretical parameters, rather than only *a*, β, φ, ξ, and this could still be achieved by imposing the relations among the two group of parameters in estimating the reduced-form model. Here, however, the interest is just in the reduced form parameters: β allows us to assess if convergence occurs (it must be negative for convergence to hold) and which is the speed (since λ can be easily derived); φ and ξ indicates if the convergence is conditional or not. The former demonstrates if the treatment has an effect (it must be positive) and which is the magnitude of this effect. The latter indicates if the sectoral structure matters.

In this respect, we are interested in assessing if initial agricultural share really determines a lower steady state thus reducing the regional growth rate. This evidence is of major interest here, because it would support the idea that any policy eventually maintaining higher agricultural share, actually induces a sort of counter-treatment with respect to objective 1 funds. Past policies that supported agriculture in such a way to maintain relatively high employment levels in the sector, may actually reduce the impact of following objective 1 structural funds payments.[9]

3.3 Some evidence about convergence and objective 1 structural funds

A qualitative empirical support to the regional growth convergence hypothesis may derive by displaying the evolution of the dispersion of EU regional *per capita* income over time. Figure 1 reports the Coefficient of Variation (that is the standard deviation divided by the mean) for all EU-15 NUTS II regions (with and without German regions before 1991) over the period

[9] The idea behind this hypothesis is past Common Agricultural Policy (CAP) support might have generated this counter-treatment effect in some objective 1 regions. However, since long time series about regionalised CAP payments in the whole EU are not available, this hypothesis can not be explicitly tested by including these payments as “additional” treatment within the convergence model.

1980-2000. These data are evidently linked to the *σ-convergence* since express the statistical dispersion of regional *per capita* income. Therefore, the figure would suggest slight regional convergence at least in the eighties (the CV moves from 33-34% to 28-29%), whereras dispersion remain almost constant after 1992, thus questioning the real impact of objective 1 funds.

As mentioned, *σ-convergence* implies *β-convergence*. However, also for the latter a qualitative insight into statistical figures over the whole period provides some interesting evidence. Figure 2 displays the relation between initial (1980) regional *per capita* income and its growth rate over the period 1980-2000. While some evidence of *β-convergence* emerges for objective 1 regions (as indicated by the linear relation drawn from a conventional cross-section convergence regression), it seems questionable for non-objective 1 cases. This would suggest an impact of the objective 1 treatment. Nevertheless, it must be reminded that treatment intensity differs across objective 1 regions (regardless of the regional size) and figure 2 can not provide any kind of information about the relevance of the treatment intensity on the convergence process.

Table 1 reports the statistical dispersion of the objective 1 treatment intensity. It provides the mean, standard deviation and CV of the objective 1 regional *per capita* expenditure (in Purchasing Power Standard or PPS[10]). Especially when multiregional funds are considered, dispersion is relevant and significantly varying over the years. This clearly suggests that difference in treatment intensity across regions and over time can not be disregarded in evaluating the treatment impact by simply introducing it as a dummy.

The regional convergence issue within the EU will significantly increase its political relevance as soon as the new accessioning states will enter the Union, mostly in 2004, others probably in 2007. Central and Eastern European Countries (CEECs) will re-define the issue for two basic reasons: firstly, these countries are on average significantly poorer than most of the current EU-15 regions (figure 3); secondly, because they are more heterogeneous within and among them, that is their regions vary on a wider range of *per capita* income, as shown by the higher CV observed in the CEECs than in the EU-15 (figure 4). Moreover, it is more difficult to carry out convergence analysis for these regions due to limited availability and reliability of data especially during the first phase of the transition period (indicatively, 1989-1994), where regional decline rather than growth was frequently observed.

For these main reasons, CEECs regions are of major interest here, but can be considered only for the limited period 1994-2000. Nonetheless, they may still represent for this period alternative counterfactual cases, since their initial income level is often not so far from many EU-15 objective 1 regions, but they are not yet included in the objective 1 treatment. In fact, the dispersion of regional *per capita* income remains stable in EU-15 while increases in CEECs regions (figure 4), thus providing a rough support to the idea that the objective 1 actually helped to reduce (or at least to stabilize) the gap between poorest and richest regions in the EU-15.

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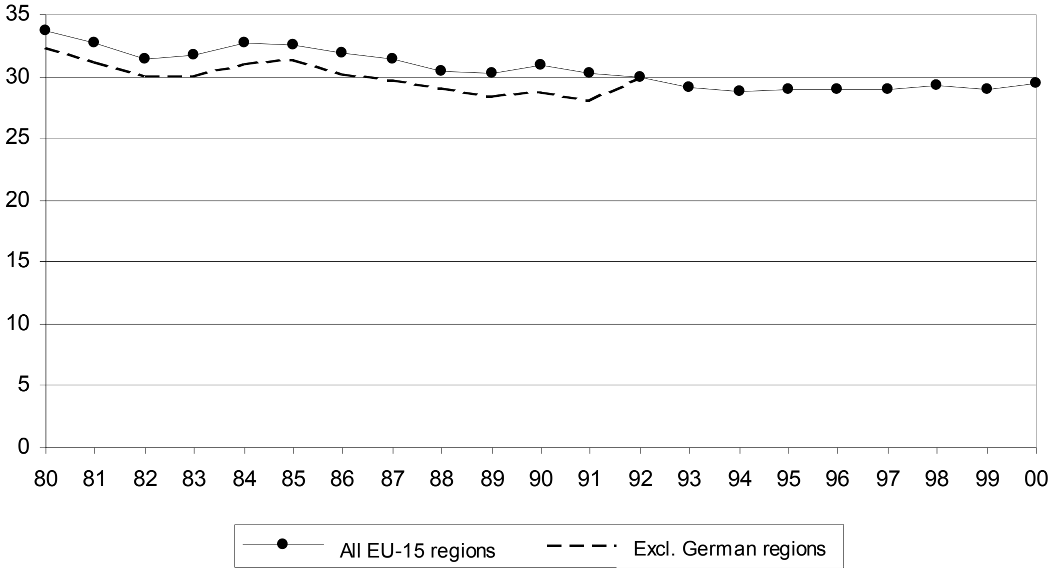
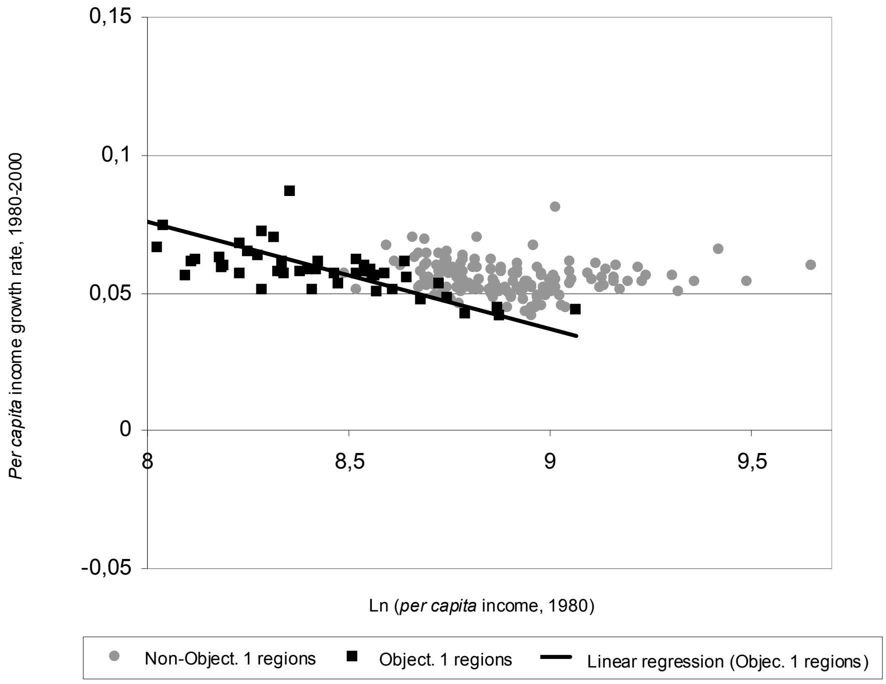
10 This virtual currency converts all national currencies to Euros-Ecus and adjusts for the different purchasing power within the countries.

Figure 1: Coefficient of Variation of regional per capita income in PPS (EU average =



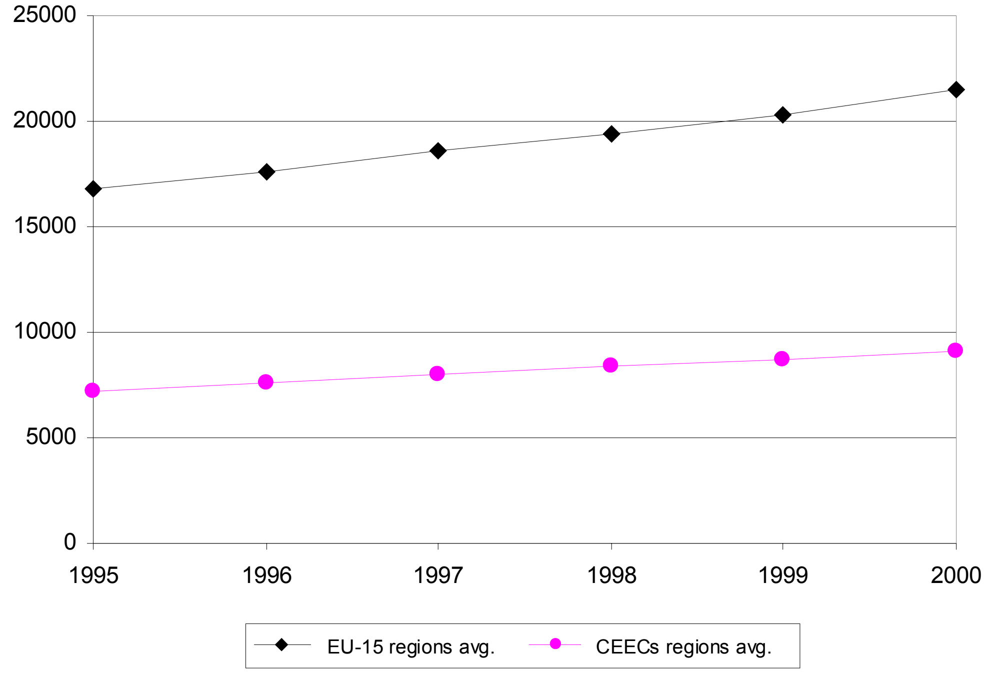
Source: Our elaboration on Regio Database - Eurostat

Figure 2: Initial level and growth rate of the EU-15 regional *per capita* income (1980-



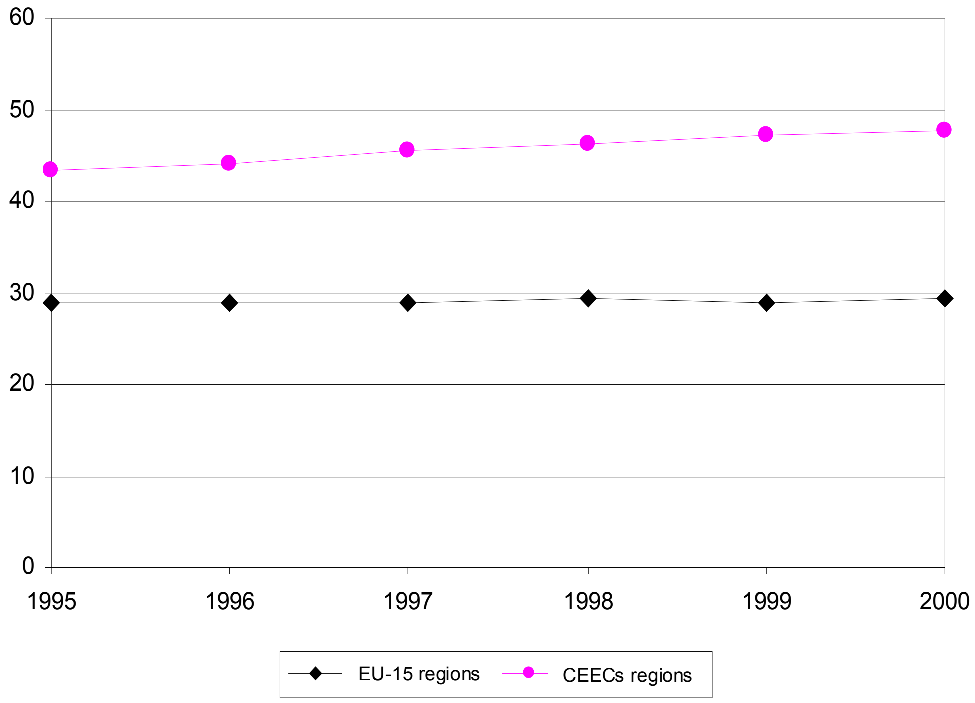
Source: Bussoletti (2004)

Figure 3: Regional per capita income (in PPS) in EU-15 and CEECs



Source: Our elaboration on Regio Database – Eurostat

Figure 4: Coefficient of Variation of regional *per capita* income (in PPS) in EU-15 and CEECs (EU/CEECs average = 100)



Source: Our elaboration on Regio Database – Eurostat

Table 1: Statistical dispersion of the objective 1 regions *per capita* payments 1989-1999 (in PPS)

		Mean			Standard Deviation			Coefficient of Variation (CV)		
Year	N. of Regions	Regional Funds	Multiregional Funds	Total	Regional Funds	Multiregional Funds	Total	Regional Funds	Multiregional Funds	Total
1989	45	81,9	67,0	148,9	65,6	69,9	85,9	80,2	104,2	57,7
1990	45	98,6	89,4	174,3	132,0	173,2	203,8	133,8	193,8	116,9
1991	51	85,6	64,2	149,7	75,0	78,4	97,7	87,6	122,2	65,2
1992	51	147,7	73,7	221,4	174,4	108,7	198,0	118,1	147,5	89,4
1993	51	132,2	99,5	231,7	103,2	106,3	135,9	78,1	106,9	58,7
1994	58	130,9	211,6	342,5	143,1	664,4	790,7	109,4	314,0	230,9
1995	58	132,4	155,0	287,4	106,5	213,7	302,9	80,4	137,9	105,4
1996	58	127,2	228,8	356,0	158,6	641,1	785,4	124,7	280,2	220,6
1997	57	146,9	197,5	344,4	143,4	429,3	559,1	97,6	217,4	162,4
1998	57	157,5	285,7	443,2	153,5	649,0	777,0	97,4	227,2	175,3
1999	57	159,6	177,2	336,8	123,1	249,1	321,8	77,1	140,5	95,5

Source: Our elaboration on European Commission

Previous empirical works on regional convergence within the EU provides mixed and controversial results. This may be explained by the substantial difficulty in econometrically identifying general patterns across regions and over time. However, confusion is also generated by a large amount of different model specifications, data and econometric methods used in the literature. First regional studies by Barro and Sala-i-Martin (1991) and Sala-i-Martin (1996) suggest unconditional regional convergence both in the EU and in the USA, at an annual convergence speed of about 2%. These first results have been often regarded as reference point for the following analogous studies. Nevertheless, they have been also contested on a number of aspects. Firstly, this empirical evidence unquestionably depends on the adopted regional aggregation level (i.e. the NUTS level) and the countries included in the study. Initial Barro and Sala-i-Martin works referred only to some EU countries, with the exclusion of more recent member states (Greece, Spain and Portugal) also including the currently less developed regions in the EU. Moreover, they limited the analysis to the eighties therefore before structural funds really started having some impact on the regional economies.

Using a wider database, Armstrong (1995) demonstrates that during the very long 1950-1990 period regional convergence occurred at the lower rate of 1% per year, but actually stopped (and even reverted) from the early eighties. It was also demonstrated that convergence observed across NUTS I regions does not exclude divergence across NUTS II regions, the period and countries being the same. And, indeed, several studies actually provide evidence against the regional β-convergence (Abraham and van Rompuy, 1995; Molle and Boeckhout, 1995).

Very different results, particularly in terms of convergence speed, are also obtained when a panel and dynamic specification is used. Canova and Marcet (1995) report a very high (about 11% for the EU countries, 23% for the regions) convergence speed. On the contrary, other studies strongly support the idea that most results suggesting convergence in conventional models might be actually generated by other processes. Quah (1996) suggests that a 2% β-convergence rate could be indeed generated by a stochastic trend in the time series used for the analysis, and this would be supported by the lack of any significant evidence of σ-convergence.

In general terms, there is an increasing number of recent works supporting the idea that there is no clear evidence of unconditional convergence across EU countries and, above all, regions (Boldrin and Canova, 2001); conditional convergence is strongly supported by some empirical works (Fagerberg and Verspagen, 1996; Neven and Gouyette, 1995; De Freitas, 2003), while contested by others. However, many empirical studies are increasingly supporting the idea of the so-called club-convergence, that is convergence observed within subgroups of regions (Chatterji and Dewhurst, 1996; Chatterji, 1993; Canova, 1999; Quah, 1997).[11]

Many other studies on this topic might be mentioned (see Bussoletti, 2004, for an extensive review of this literature), whereas there is far less abundance of empirical analyses about regional convergence and the impact of objective 1 payments and, even less, about convergence in the CEECs regions. Providing insight into these two relatively less studied topics is the main objective of this study.

4 Data description

Income and other economic data about NUTS II EU regions are taken from the Eurostat Newcronos Regio database; income data are expressed in Purchasing Power Standard (PPS) currency. The EU-15 database thus obtained contains data for all the 206 EU-15 NUTS II regions over the whole 1989-2000 period.[12] Despite the well-known problems of comparability, also data for CEECs regions are taken from the EUROSTAT Newcronos Regio database.[13] Availability of reliable and comparable data is limited to the period 1995-2000. 12 candidate countries are considered (Bulgaria, Cyprus, Czech Republic, Estonia, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia and Hungary) with the corresponding 55 NUTS II regions.

Data about structural funds in objective 1 regions refer to yearly expenditure in the two programming periods1989-1993 and 1994-1999. To have an overall computation of the expenditure, all structural funds payments have been considered (ERDF, which is the main contributor to objective 1 regions, ESF, EAGGF and FIFG). Unfortunately, there is not an unique centralised database about structural funds expenditure at the regional level. Therefore, this was created on the base of the information provided by the European Commission Annual Reports on structural funds payments. This kind of information is not always sufficient to regionalize all expenditure data, particularly in the first programming period. When the distribution of the national payments to the respective NUTS II regions is not available, the allocation is made using the same regional proportion calculated *ex post* over the whole programming period, as indicated by the European Commission study on the impact of structural policies (European Commission, 1997). Although data about regional structural funds expenditure (still referring to the 1994-1999 period) were available also for 2000, this year was considered off-treatment both because these data are incomplete and unreliable and because, as will be discussed in next section, expenditure affects growth with some lag so the 2000 payments impact is entirely out of the sample period.

A final relevant issue about structural funds payments in objective 1 regions refers to multiregional programmes. Objective 1 regions receive part of the structural funds payments as participant to multiregional programmes, often concerning wide investment plans, for instance new infrastructures. Although no complete and reliable data exist about the real allocation of multiregional programmes funds among participant regions, it is possible to state that these payments are definitely a very relevant part of the total funds received by a region (as shown in table 1, multiregional programmes cover largely more that 50% of total payments in the 1994-1999 programming period). Therefore, allocation of this expenditure is

11 Distinguishing between conditional and club convergence may be indeed difficult (Islam, 2003). Club convergence is, in fact, a particular case of conditional convergence. The latter implies an individual regional-specific steady-state level, whereas club convergence implies multiple steady-state equilibria, one for any group (club) of regions.

12 Current NUTS classification actually contains 211 NUTS II regions. However, due to data availability, Ireland is included as one region as well as NUTS I German regions Sachsen and Sachsen-Anhalt.

13 When needed, statistical information about new members regions has been completed with data taken from the REAPBALK-project database (website: www.reapbalk.unian.it/).

particularly critical in evaluating the treatment intensity across regions. Here, multiregional funds have been distributed among participant regions by using the same proportion of exclusively regional funds observed in a given country. Although it may introduce some distortion, this remains the only feasible way to allocate multiregional funds.

All objective 1 payments here considered have been expressed in PPS, by using the same conversion index used by the EUROSTAT for converting the regional income in the common comparable currency.

5 The estimated model

The regional conditional convergence model in equation (12) is estimated for the whole 1989-2000 including the two programming sub-periods (1989-93 and 1994-00).[14] The model is estimated on two different groups of regions. Firstly, it is applied to all the 206 EU-15 regions; then, it is estimated on the sample made by only objective 1 EU-15 regions and CEECs regions. For this latter sample, the estimation period is 1995-2000 and the sample size is 113 (58+55) regions. Besides the different sample periods, the two groups basically differ for the counter-factual (non-treated) cases: non-objective 1 EU-15 regions and CEECs regions, respectively.

Two alternative specifications of the model are also estimated. Both are panel-data models; the first is static, the second is dynamic. For both specifications, appropriate panel-data estimators are used. The use of panel-data specifications, instead of the traditional cross-sectional ones, has become frequent in growth convergence studies (Coulombe, 2003; Kim, 2001; Cermeño, 1999; Gaulier *et al.*, 1999; Travaglini, 1998; Tondl, 1997; Canova and Marcet, 1995). Temple (1999) and Islam (2003) review in detail the main advantages of the panel-data specifications with respect to the cross-section case. Of main interest here is the great increase in the number of observations implied by the panel-data specifications since panel-data allow to specify the model on a yearly growth base. However, the major advantage is to admit individual (regional) fixed or random effects. As mentioned in section 3 and reviewed in Islam (2003), model-based growth convergence involves some possibly region-specific underlying parameters, but they are hardly included as conditioning variables in the model specification. Panel-data specifications allow to re-introduce this specificity either in the intercept or in the random term of the model.

The panel-data static specification of equation (12) is the following:

(13) $y_{it} = a + \varphi\, T_{it} + \xi\, AG_{it-1} + \beta \ln Y_{it-1} + \varepsilon_{it}$

where the definition of the variables have been already presented in section 3; T_{it} indicates the regional treatment affecting i-th region growth at time t and is specified in two different ways: firstly as a simple dummy identifying the treatment status at time t-1 (0 if non-treated, 1 if treated); secondly as treatment intensity, that is $T_{it} = M_{it-1}$, where M_{t-1} indicates the lagged structural funds *per capita* expenditure.[15] Finally, a set of (*j-1*) (where j is the number of countries) national dummies have been added to admit the possibility of club convergence.

The error term of equation (13) contains the region-specific effect as it is defined as follows:

(14) $\varepsilon_{it} = \mu_i + \nu_{it}$

In other words, the error term contains a time-costant and a time-varying component but both varying over the *cross section* dimension (Baltagi, 1995). According to different hypotheses about these components, different estimators have been proposed. One very strongly simpli-

14 The year 2000 is included in the sample period to take into account the effect on growth of the last year of payments (1999).

15 Though equation (12) admits longer lags of the treatment intensity, the shortness of single sub-periods of treatment suggested to consider only one lag. In fact, the specification with two lags, not presented here, indicated not significant effect of the t-2 expenditure.

fying hypothesis assumes that the time-constant component is indeed non-random, while the time-varying one is an usual i.i.d error term with $E(\nu_{it}) = 0$ and $\sigma(\nu_{it}) = \sigma_\nu$. That is:

(14a) $\varepsilon_{it} = \mu + \nu_{it} \Rightarrow E(\varepsilon_{it}) = \mu; \quad \sigma(\varepsilon_{it}) = \sigma_\nu$

and the constant term thus becomes ($a + \mu$).

Under this assumption, the model can be estimated with OLS by simply pooling the data (*pooled estimator*) since there is no region-specific effect. Due to this strong assumption, however, pooled estimator results are not presented here.

To really take into account the region-specific effects, the error term should be specified differently. If the individual effect is assumed to be fixed (non-random), it follows:

(14b) $\varepsilon_{it} = \mu_i + \nu_{it} \Rightarrow E(\varepsilon_{it}) = \mu_i; \quad \sigma(\varepsilon_{it}) = \sigma_\nu$

The constant term now becomes ($a + \mu_i$), i.e. region-specific; estimating the model and these individual constant terms requires the so-called *within estimator* (Baltagi, 1995, Arellano, 2003).

Alternatively, a random region-specific effect may be assumed, with $E(\mu_i) = 0$ and $\sigma(\mu_i) = \sigma_i$.[16] It follows:

(14c) $\varepsilon_{it} = \mu_i + \nu_{it} \Rightarrow E(\varepsilon_{it}) = E(\mu_i) + E(\nu_{it}) = 0_i; \quad \sigma(\varepsilon_{it}) = \sigma_\nu + \sigma_i + E(\mu_i \nu_{it})$

Even assuming $E(\mu_i \nu_{it}) = 0$, the variance-covariance matrix of the error term (Σ) is not diagonal, that is $\Sigma \neq \sigma^2 I$. Therefore, to achieve consistent and efficient estimates a *Feasible GLS estimator* (FGLS) is used. These two alternative estimates, concerning two alternative error term specifications, are presented in next section.

These estimators, however, do not provide consistent estimates of the dynamic specification of the model. This dynamic version is written as follows[17]:

(15) $y_{it} = a + \rho\, y_{it-1} + \varphi\, T_{it} + \xi\, AG_{it-1} + \beta \ln Y_{it-1} + \varepsilon_{it}$

where $\varepsilon_{it} = \mu_i + \nu_{it}$ as before. This dynamic specification explicitly takes into account the serial correlation which often affects income growth variables. Disregarding this aspect would make the static specification not appropriate and the aforementioned estimators inconsistent due to the omitted variable bias. In fact, many recent convergence studies use the dynamic specification (Carmeci and Mauro, 2002; Yudong and Weeks, 2000; Caselli *et al.*, 1996), also for the evaluation of the objective 1 funds (Beugelsdijk and Eijffinger, 2003; Ederveen *et al.*, 2002).

Introducing the lagged values of the dependent variable eventually implies that the i.i.d hypothesis of the ν_{it} term over time does not hold (Baltagi, 1995), as it is correlated with the lagged dependent variable. In other words, y_{it-1} is endogenous and the aforementioned estimators would encounter the *endogenity bias* problem when applied to the dynamic model. In addition, this bias increases as the time period shortens, so is expected to be high for short periods, as in the present case.

To achieve consistent estimates of equation (15), an instrumental variable estimator has to be used. Here, we use a GMM estimator; any y_{it-s} (provided that s > 1), can be a legitimate

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16 However, Islam (2003) criticizes this assumption in growth convergence models.

17 Due to the limited time period, only one lag of the dependent variable has been considered in the dynamic specification.

candidate since it is orthogonal with respect to the error term.[18] As GMM estimator, we used the so-called one-step GMM estimator proposed by Arellano and Bond (1991), which is consistent for the dynamic model in equation (15).[19]

6 Results

6.1 The static model

Table 2 reports the estimates of the static model (equation (13)) obtained with the *within* and *FGLS* estimators, respectively. Results are presented through a sequence of different specifications: starting from the unconditional convergence case, the conditioning variables (the treatment, the agricultural share and the national dummies) are then progressively added. Some common result emerges in both specifications (fixed and random regional effects, respectively). First of all, growth convergence across regions is clearly accepted and observed also without the inclusion of the conditioning variables. Therefore, unconditional convergence emerges, even if, when statistically significant, the conditioning variables may slightly increase the consequent rate of convergence. This latter is consistent, at least in the order of magnitude, with results obtained in previous works using the same model specification (Canova and Marcet, 1995; De la Fuente, 1996, 1998; Tondl, 1997)[20]. These studies also confirm the tendency of the fixed effects estimator to generate slightly higher convergence rates.

Much more mixed results are obtained about the role of the conditioning variables. First of all, structural funds have very different estimated impact if the treatment is represented just as a dummy instead of treatment intensity. In the former case the impact is not statistically different from 0 with fixed effects, while is negative with random effects. In the latter case, however, both estimators indicate a positive and similar (in magnitude) impact, though it remains not significant in the FGLS case. In this respect, the introduction of national dummies does not seem to relevantly affect the results. A positive impact, though not fully clear, confirms previous results presented by Solanes and Maria-Dolores (2001), while is in contrast with the evidence emerging in Rodrìguez-Pose and Fratesi (2002) and De Freitas (2003) suggesting a negative or, at least, not significant impact of structural funds on objective 1 regions growth pattern.[21]

The role of agricultural share in the regional economy is quite unclear. With the fixed effects specification, the respective parameter is not statistically significant, whereas is significantly negative (as expected) in the random effects case. Therefore, there is not a clear support to the idea that other policy measures supporting agriculture might eventually play a counter-treatment effect. In any case, despite signs and statistical significance, the impact of conditioning variables seems to be quite low in magnitude. Even if we accept that they operate in the expected direction according to the hypotheses mentioned in section 3, this effect does not change very much the underlying regional growth patterns.

These patterns are indeed mostly determined by the underlying convergence process and by the regional-specific effects. In particular, the fixed effects specification demonstrates how regions tend to convergence to different steady states which, however, are not "controlled" by the explanatory variables introduced in the model. Due to limits of space, it is not possible to report here all estimated individual effects. However, it is helpful to remind that the higher fixed effects are observed in non-objective 1 regions (Bruxelles, Oberbayern, Hamburg, Inner

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18 The model have been estimated after having re-written equation (15) in the first-difference; this allows to get rid of the fixed individual effects μ_i. Instruments have been selected over the all available lagged income growth variables, included the out-sample observations; that is, also the annual income growth observed in the period 1980-1988 has been considered.

19 More details about advanced GMM estimator for panel-data model can be found in Arellano (2003).

20 It must be noted that the closer β is to 0, the closer λ to β.

21 It must be reminded, however, that difference in results might actually be generated by important details in the empirical applications, such as the treatment lags, the countries and regions included in the analysis, the calculation of structural funds expenditure (for instance inclusion of multiregional programmes), etc..

London and Outer London), while mixed values are obtained for objective 1 regions. They are quite high for German, Irish and French overseas regions, whereas other objective 1 regions present the lowest fixed effects, particularly Hainaut (Belgium), Ionia Nisia and Ipeiros (Greece), Extremadura and Ceuta y Melilla (Spain), Corsica (France), Campania and Sicilia (Italy), Alentejo (Portugal) and Merseyside (UK). These results make even more evident how the effect of the objective 1 treatment, though positive in general terms, present a very relevant individual specificity.

6.2 The dynamic model

Table 3 reports the GMM estimates of the dynamic model (equation (15)). In principle, this model specification is more general than the static one, since it admits serial correlation in the dependent variable (therefore, in the error term) excluded by assumption in the static case. However, this does not necessarily imply that the consequent results are better (that is, more realistic). Actually, the estimation of the dynamic model raises a number of additional econometric issues which may, indeed, mix up the results rather than make them more clear (Arellano, 2003; Islam, 2003). In particular, Islam (2003) reminds that the GMM estimator may have poor small sample properties and performance; though it is asymptotically consistent and efficient, its small sample results might be statistically poorer than the static model estimators presented above.[22]

Results in table 3 somehow confirm this trade-off. On one hand, autocorrelation significantly occurs in any specification and implies that the static specification may really encounter omitted variable bias. On the other hand, however, other estimates seem questionable. In particular, β-convergence occurs thus confirming static-model results; also GMM estimates suggest unconditional convergence whose rate is just slightly accelerated by the conditioning variables. Nevertheless, the estimated convergence rate is much (about ten times) higher. Although this very high convergence speed is not new in empirical works (Bussoletti, 2004), it seems not completely realistic. One possible explanation could be that the static model underestimates the role of the initial income level because it does not consider the cyclical component of the regional growth pattern, which is fully accounted for by the dynamic model, as demonstrated by the negative sign of the lagged income growth.

Besides the magnitude of convergence, however, the GMM estimates provide much clearer evidence about the role of the structural funds. They always have a positive and significant impact, though the magnitude remains small and varying according to how the treatment is specified (as a dummy or as *per capita* expenditure levels). This result confirms previous works estimating the structural funds impact on regional convergence process and using a similar model specification and estimation approach. In particular, Beugelsdijk and Eijffinger (2003) find similar results about the objective 1 funds, though they apply the convergence model to the EU-15 countries and not, as seems more appropriate, to NUTS II regions. Moreover, they specify the treatment as structural payments growth rate instead of payments level, as in the present application, the former being much less regular and potentially more statistically “noisy” over a short time period.

On the contrary, the estimated parameter of the agricultural share rejects the hypothesis about the negative impact of the sector on regional growth. It is significantly positive, though almost negligible in magnitude, thus confirming that there is no empirical support to the possible counter-treatment effect of any measure supporting high share of agriculture within the regional economy. Moreover, this result would suggest a somehow surprising lack of relevance of the regional economic structure in terms of sectoral weights. In this regard, caution in commenting these estimates and further research effort is required.

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22 The number of observations for the GMM estimation is further reduced by one since it relies on the first differences transformation of the model.

6.3 Results for the enlarged EU

Final interesting empirical evidence can be obtained by replicating the above estimates on a different regional sample and time period. Applying the static and dynamic models to the 155 EU-15 objective 1 and accessioning states regions for the period 1995-2000 implicitly provides a relevant information about the crucial role of the counter-factual cases. Whereas in previous estimates the treatment effect was obtained by using the non-objective EU-15 regions, now the counter-factual cases are provided by the accessioning states regions. Moreover, both treated and non-treated cases are now observed over a shorter time period.

Results reported in tables 4 and 5 clearly confirm how this aspect may be critical. Puzzling results emerge for β-convergence. It is significantly observed in the fixed-effects specification but the parameter is totally unreliable since it is greater than 15 while should be always lower than 1. This makes these values, in fact, meaningless. Some more reasonable β values are obtained in the FGLS estimation and in the dynamic specification (GMM); nonetheless, meaningful results are always not statistically different from 0. Therefore, for this group of regions over the mentioned period there is no evidence of either conditional or unconditional growth convergence process.

Also the impact of structural funds payments does not clearly emerge. The dynamic model would suggest a not significant impact of the treatment, while the static model estimates indicate few specifications where the treatment has a positive and significant impact when expressed as *per capita* expenditure. Even less clear, and statistically significant, are the parameter estimates about the agricultural share. For this latter conditioning variable it must be also noted that, due to lack of data about sectoral employment composition in the CEECs regions, the role of agriculture is here proxied by the share on the regional Value Added.

It may be interesting to note how the only significant variable driving the regional income growth in the dynamic specification is the lagged regional income growth rate itself. The other conditioning variables, though apparently with a stronger impact in terms of parameters magnitude, act in a confusing and puzzling way, thus suggesting that the sample and the period of observation do not allow to clearly identify their effect. In particular, they do not allow to “use” the counter-factual cases clearly enough to identify the effect of the treatment on the treated cases. This is also confirmed by the random fixed effects; the lowest values are actually observed mostly in CEECs regions (mainly in Romania and Bulgaria). But some CEECs region also appears among the highest values (for instance Közép-Magyarország in Hungary and the region of Prague). Moreover, the structural differences among objective 1 EU-15 regions and the poorest CEECs ones may be much more relevant than represented in the estimated model. Although we may assume these regions converge to different steady states, it remains difficult to identify and include all those conditioning factors actually defining these individual steady states.

Table 2: Estimates of the static model (equation (13)) (standard errors = SE and t statistics = t below the estimated values)

WITHIN ESTIMATES[a]

Specification	*a* (SE) t	β (SE) t	φ (SE) t	ξ_i (SE) t	λ
Unconditional convergence	([a])	-0,062			0,064
		(0,005)			
		-13,10			
Treatment as dummy D=0,1	([a])	-0,063	0,004		0,065
		(0,005)	(0,005)		
		-12,54	0,70		
Treatment as expenditure level (T = M)	([a])	-0,065	0,1E-04		0,067
		(0,005)	(0,5E-05)		
		-13,40	2,74		
Treatment (T = M) and agricultural employment share	([a])	-0,082	0,1E-04	0,6E-03	0,087
		(0,006)	(0,5E-05)	(0,0005)	
		-12,84	2,93	1,33	

FGLS ESTIMATES[b]

Specification	*a* (SE) t	β (SE) t	φ (SE) t	ξ_i (SE) t	λ
Unconditional convergence	0,39	-0,035			0,036
	(0,029)	(0,003)			
	13,46	-11,62			
Treatment as dummy D=0,1	0,42	-0,038	-0,007		0,039
	(0,032)	(0,003)	(0,003)		
	13,36	-11,70	-2,54		
Treatment as expenditure level (T = M)	0,39	-0,035	0,3E-05		0,036
	(0,030)	(0,003)	(0,4E-05)		
	13,22	-11,43	0,85		
Treatment as expenditure level (T = M) and national dummies[c]	0,42	-0,039	0,5E-05		0,040
	(0,030)	(0,003)	(0,4E-05)		
	13,89	-12,35	1,42		
Treatment (T = M), national dummies and agricultural employment share	0,48	-0,045	0,5E-05	-0,6E-03	0,046
	(0,034)	(0,004)	(0,4E-05)	(0,0002)	
	14,34	-12,78	1,41	-3,25	

[a] The WITHIN estimator does not admit the national dummies due to data singularity. Since fixed effects are assumed, the *a* parameter is estimated for any region. The list of these estimates are available upon request.
[b] The estimates of the region-specific random effects are available upon request.
[c] The coefficient estimates of the national dummies are available upon request.

Table 3: GMM estimates of the dynamic model (equation (15))

Specification[a]	ρ (SE) t	β (SE) t	φ (SE) t	ξ (SE) t	λ
Unconditional convergence	-0,330	-0,286			0,337
	(0,004)	(0,002)			
	-91,21	-146,05			
Treatment as dummy D=0,1	-0,316	-0,309	0,056		0,370
	(0,004)	(0,003)	(0,003)		
	-82,29	-96,78	19,64		
Treatment as expenditure level (T = M)	-0,276	-0,293	0,8E-04		0,347
	(0,003)	(0,003)	(0,1E-04)		
	-80,37	-102,31	10,72		
Treatment (T = M) and agricultural employment share	-0,250	-0,322	0,4E-04	0,009	0,389
	(0,005)	(0,006)	(0,6E-05)	(0,0005)	
	-47,65	-56,65	6,85	19,74	

[a] The transformation of equation (15) in the first differences eliminates both the constant terms and the national dummies.

Table 4: Estimates of the static model: EU-15 objective 1 and accessioning states regions

Specification	a (SE) t	β (SE) t	φ (SE) t	ξ (SE) t	λ
WITHIN ESTIMATES[a]					
Unconditional convergence	([a])	-15,49 (2,213) -7,00			-
Treatment as dummy D=0,1	([a])	-15,54 (2,216) -7,01	-2,479 (3,973) -0,62		-
Treatment as expenditure level (T = M)	([a])	-15,66 (2,208) -7,09	0,002 (0,8E-03) 1,94		-
Treatment (T = M) and agricultural employment share	([a])	-20,36 (2,635) -7,73	0,002 (0,8E-03) 2,01	0,242 (0,139) 1,74	-
FGLS ESTIMATES[b]					
Unconditional convergence	3,212 (5,763) 0,56	0,198 (0,625) 0,32			-0,020
Treatment as dummy D=0,1	10,58 (7,53) 1,40	-0,662 (0,844) -0,78	1,081 (0,710) 1,52		1,085
Treatment as expenditure level (T = M)	5,327 (5,867) 0,91	-0,051 (0,639) -0,08	0,9E-03 (0,5E-03) 1,88		0,052
Treatment as expenditure level (T = M) and national dummies[c]	5,888 (9,212) 0,64	-0,073 (0,994) -0,07	0,9E-03 (0,5E-03) 1,71		0,076
Treatment (T = M), national dummies and agricultural employment share	17,17 (11,67) 1,47	-1,588 (1,258) -1,26	0,8E-03 (0,5E-03) 1,53	-0,040 (0,063) -0,63	-

[a] The WITHIN estimator does not admit the national dummies due to data singularity. Since fixed effects are assumed, the *a* parameter is estimated for any region. The list of these estimates are available upon request.
[b] The estimates of the region-specific random effects are available upon request.
[c] The coefficient estimates of the national dummies are available upon request.

Table 5: GMM estimates of the dynamic model: EU-15 objective 1 and accessioning states regions

Specification[a]	ρ (SE) t	β (SE) t	φ (SE) t	ξ (SE) t	λ
Unconditional convergence	-0,106 (0,095) -1,11	3,049 (7,299) 0,42			-1,398
Treatment as dummy D=0,1	0,050 (0,186) 0,27	30,86 (23,37) 1,32	4,830 (2,922) 1,65		-3,461
Treatment as expenditure level (T = M)	0,305 (0,261) 1,17	22,81 (17,08) 1,34	0,025 (0,017) 1,45		-3,170
Treatment (T = M) and agricultural employment share	-0,980 (3,047) -3,21	92,58 (346,5) 0,27	-7,426 (40,76) -0,18	16,60 (31,65) 0,53	-4,539

[a] The transformation of equation (15) in the first differences eliminates both the constant terms and the national dummies.

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