Fondazione Eni Enrico Mattei

How to Measure the Unobservable: A Panel Technique for the Analysis of TFP Convergence

Adriana Di Liberto, Roberto Mura
and Francesco Pigliaru

NOTA DI LAVORO 16.2005

JANUARY 2005

KTHC - Knowledge, Technology, Human Capital

Adriana Di Liberto, *UCL London, UK, Università di Cagliari and CRENoS*
Roberto Mura, *University of York and Università di Cagliari and CRENoS*
Francesco Pigliaru, *Università di Cagliari and CRENoS*

How to Measure the Unobservable: A Panel Technique for the Analysis of TFP Convergence

Summary

This paper proposes a fixed-effect panel methodology that enables us to simultaneously take into account both TFP convergence and the traditional neoclassical-type of convergence. We analyse a sample of Italian regions between 1963 and 1993 and find strong evidence that both mechanisms were at work during the process of aggregate regional convergence observed in Italy up to the mid-seventies. Finally, we find that our TFP estimates are highly positively correlated with standard human capital measures, where the latter is not statistically significant in growth regressions. This evidence confirms one of the hypotheses of the Nelson and Phelps approach, namely that human capital is the main determinant of technological catch-up. Our results are robust to the use of different estimation procedures such as simple LSDV, Kiviet-corrected LSDV, and GMM *à la* Arellano and Bond.

Keywords: TFP, Panel data, Regional convergence

JEL Classification: O47, O33, O18, C23

We gratefully acknowledge financial support from MIUR Cofin "I fattori che influenzano i processi di crescita economica e di convergenza tra le regioni europee". We would like to thank Pasquale Scaramozzino, Mark Rogers, Paul Cheshire, Anna Soci, Bernard Fingleton, Wendy Carlin and the participants at the ERSA Conference (Jyvaskila, 2003) and EEFS Conference (Bologna, 2003) for their helpful comments and suggestions.

Address for correspondence

Adriana Di Liberto
Dipartimento di Ricerche Economiche e Sociali
Universita' di Cagliari
Viale S. Ignazio, 78
09123 Cagliari
Italy
Phone: +39070 6753765
Fax: +39070 6753760
E-mail: diliberto@unica.it

1. Introduction

In early studies on growth differentials across countries, technology was regarded as a pure public good, freely available to all, with heterogeneity in technological levels ruled out by assumption. More recent papers show how misleading such an assumption can be: indeed, differences in total factor productivity (TFP) levels are often estimated as a major component of the observed large cross-country differences in per capita income.[1] Typically, these studies show that a large part of cross-country per capita income differences is left unexplained after taking account of differences in physical or human capital. Remarkable differences in TFP have also been detected in highly integrated areas or across regions of a single country[2] and, nowadays, few economists would dispute these findings[3].

More controversial is the question of whether such differences in TFP are constant or not – that is, whether TFP convergence is taking place, at what speed and under what conditions. In fact, observed convergence may be the result of three different mechanisms: convergence due to capital accumulation, convergence due to technology transfer (catch up), and convergence due to both. Indeed, as Bernard and Jones (1996) put it, we often do not know "how much of the convergence that we observe is due to convergence in technology versus convergence in capital-labour ratios" [4]. Both theoretically and empirically, the problem is therefore to find a methodology able to discriminate between these three hypotheses.

Recently, things have improved on both the analytical and on the empirical side. On the

---

[1] Among the most influential, see Klenow and Rodriguez Clare (1997) and Hall and Jones (1999). The role of TFP heterogeneity in cross-country analysis is also stressed in Parente and Prescott (2000), Easterly and Levine (2001), and Lucas (2000), among many others.

[2] Using a sample of 101 EU regions Boldrin and Canova (2001) find that per capita GDP is much more correlated with their measure of TFP than with capital-labour ratios. See also Aiello and Scoppa (2000), and Marrocu, Paci and Pala (2001) for the Italian regions, and De la Fuente (2002) for the Spanish regions.

[3] For a different viewpoint on the role of TFP, see Young [(1994) and (1995)] and, more recently, Baier, Dwyer and Tamura (2002).Using growth accounting techniques in a sample of 145 countries Baier *et al.* (2002) find that TFP growth is an unimportant part of average output growth (about 8%).

[4] This problem remains unsolved in another stream of research in a non neoclassical tradition, where technology diffusion is regarded as the crucial source of convergence [for instance, Dowrick and Nguyen (1989) and Fagerberg

analytical side, simple models in which technology-driven TFP convergence and capital-deepening can be studied within a common framework are now available. In these models, transitional dynamics is simple enough to be useful for empirical analysis.[5] On the empirical side, exisisting literature has identified a number of different methodologies to measure TFP at different points in time. In general, in this case difficulties arise since measuring TFP levels is not an easy task, and measuring it at different points in time is even more difficult, given the current availability of data in most of the existing cross-country and cross-region datasets. Within the available empirical literature it is possible to identify three different approaches. The first approach introduces per capita (or per worker) GDP levels in a standard growth-convergence regression, or a combination of GDP and other variables, as a proxy for technology. In this case the estimated coefficient on this variable is interpreted as a technological convergence coefficient. This methodology was used in two pioneering works on this subject, Dowrick and Nguyen (1989) and Benhabib and Spiegel (1994). However, early studies have been criticised[6] owing to the fact that the coefficient on this variable may capture the effect of diminishing returns as well as that of technological diffusion, so that distinguishing between them is something beyond the reach of this technique. This approach has been recently further developed by Dowrick and Rogers (2002): the use of data on capital per worker enables these authors to control for possible observational equivalence problems. A second approach computes technology levels as a residual once the contribution of factors of production to per capita GDP has been taken into account[7]. Here technology is measured indirectly, as the residual component of GDP growth that cannot be explained by the growth of the assumed inputs of production. Growth (or level) accounting techniques have been criticised since they require the imposition of too many assumptions such as cross-country parameter homogeneity and the absence of externalities, and may easily attribute to capital accumulation something that should be attributed

---

and Verspagen (1996)]. Here the whole observed convergence is typically assigned to the catch-up mechanism, and other mechanisms (such as capital-deepening) are neglected on a priori grounds, rather than tested.

[5] See for instance, De la Fuente (1997) and (2002), and Pigliaru (2003).

[6] See De la Fuente (1995).

[7] See Klenow and Rodriguez-Clare (1997), Hall and Jones (1999) and Aiyar and Feyrer (2002).

to technological progress and *vice-versa* [8]. In particular, by assuming the absence of externalities this methodology tends to ascribe too much of the observed income variation to differences in productivity.

In this paper we build upon a third methodology based on Islam (2000) in which the presence of TFP heterogeneity in cross-country convergence analysis is tested by using an appropriate fixed-effects panel estimator. Originally, this methodology was designed to measure cross-country convergence in capital-labour ratios while controlling for TFP (or technology) heterogeneity[9]. In particular, we show that the same methodology can be extended to analyse cases in which TFP differences in levels are *not* constants, and therefore might be converging.[10] The methodology we use is as follows. First, we use data on GDP per worker to estimate the standard convergence equation with a fixed effects estimator over two sub-periods. Second, we use the values of the individual intercepts to compute our regional TFP levels. The robustness of our results is assessed by comparing the estimates obtained using different estimators – namely, a Least Square with Dummy Variable (LSDV) estimator, a biased-corrected LSDV estimator and a GMM (Arellano-Bond) estimator. Third, we analyse the two TFP series to test whether the observed pattern over time is consistent either with the technological catch-up hypothesis or with the hypothesis that the current degree of TFP heterogeneity is at its stationary value.

Finally, note that direct estimates of TFP enable us to test for one of the main hypothesis in catching-up literature and, in particular, of the Nelson and Phelps (1966) approach. In these models TFP growth is determined by the technological distance from the leader and by the level of human capital, where the latter influences the capacity for both discovering new technologies and adopting innovations from abroad. In other words, human capital levels determine the capacity of adopting new technologies from abroad and, thus, the possibility of a catch up process among countries. As a

[8] This is certainly true if capital is endogenous and responds to technological progress or if improvements in educational attainment have indirect effects on output through changes in labour force participation or R&D and growth of TFP.On this, see in particular Barro and Sala-i-Martin (2004) pp.457-60, Temple (2001) and Islam (2000) for a direct comparison between growth accounting and panel methodologies.

[9] See Islam (1995) and Caselli et al. (1996), among others.

consequence, we should expect estimated TFP levels to be positively correlated with human capital stocks.

Our case-study is Italy and its persistent regional divide. Thus, we follow the Klenow and Rodriguez-Clare (1997) suggestion of using within country data bearing on the process of technology diffusion[11] and use a panel dataset of Italian regions, 1963-93. Note that, from a methodological point of view, the use of regional data has two main advantages. First, various unobservable components are supposed to be far more homogeneous across regions than across countries. This feature makes the interpretation of fixed-effects as technology (or more broadly TFP) in panel regressions far easier, since a number of components such as culture and institutions are necessarily more homogeneous across regions than across countries. Second, data comparability is also easier. Consider human capital, a crucial variable for convergence analysis. One of the main criticism with cross-country datasets is that direct comparison of the data is not viable due to divergent quality in schooling institutions. The use of a regional dataset allows us to limit this type of problem. At the same time, unlike in many other regional samples, Italian data usually reveals a remarkable degree of regional heterogeneity in variables such as per capita income levels and human capital stocks,[12] and we have access to fairly long time series data. These characteristics render our sample best suited for this type of empirical analysis.

The remaining part of the paper is organized as follows. In section 2 we briefly review the literature on Italian regional inequalities. In section 3 we discuss how a panel data technique can be used to test for both the presence of TFP heterogeneity and convergence. In section 4 we discuss how to select the estimator that suits our case better. Section 5 presents our evidence on the degree of cross-region TFP heterogeneity, while section 6 shows how much TFP convergence can be detected in our dataset. Finally, in section 7 we test if our regional TFP estimates are positively correlated with the observed regional human capital endowments. Conclusions are in section 8.

---

[10] See also Islam (2000).

[11] "…we think the insights gleaned from cross-country regressions have run into sharply diminishing returns. We would like to see more detailed country analysis a la Young (1995)…." Klenow and Rodriguez-Clare (1997) p.614.

2. Regional inequality in Italy: a brief outline

Although the Italian case is one of the best known and most analysed cases of a regional divide, the existing papers have usually introduced the standard "classical approach[13]" to convergence analysis[14], while studies that focus on the role of TFP[15] do not examine how the cross-region TFP distribution evolves over time. In other words, our paper provides the first explicit analysis of TFP convergence across Italian regions.

We start with a brief summary of the main stylised facts about regional inequality and convergence in Italy. The degree of regional inequality in Italy is among the highest across all the EU countries.[16] Such high inequality reflects the old and persistent North-South divide within the country. Stylised facts show that the per capita income distances between top and bottom regions during the 1960s were remarkable. Valle d'Aosta, was 42% (and Lombardia 38%) wealthier than in the average Italian region. On the other hand, the poorest regions, Calabria and Basilicata, had a 38% disadvantage with respect to the Italian average. This is a very large regional gap by any European standard. This gap has diminished during the last three decades but the decrease was neither persistent nor uniform, and came to a halt in the mid-1970s. Relevant literature has put forward various explanations for this. There was a decrease in migration from the South to the North following a more uniform national wage rate imposed by law in 1969. Moreover, there were radical changes in the policies aimed at fostering the development of the more backward regions. In particular, the Italian Government's efforts to boost industrial investment in the South during the 60s and part of the 70s is well documented[17]. After that period, there was a shift in policy from investments to income maintenance in the form of direct transfers and by means of a significant

---

[12] Paci and Pigliaru (1995), Di Liberto (2001), Boltho, Carlin and Scaramozzino (1999), among several others.
[13] See Sala-i-Martin (1996).
[14] See Mauro and Podrecca (1994), Di Liberto (1994), Boltho, Carlin and Scaramozzino (1999), Paci and Pigliaru (1995) among others.
[15] See Aiello and Scoppa (2000), and Marrocu, Paci and Pala (2001).
[16] See Barro and Sala-i-Martin (2004).
[17] On this issue see Graziani (1978).

expansion of the Public Sector. Finally, the rapid increase of oil prices in 1973-74 is thought to have influenced investment patterns, technology and additional factors that may have affected the convergence process internationally. [18] Whatever the reason, the pre- and post-1970 pattern is strongly confirmed by numerous studies.

3. A Panel Data approach to estimate TFP convergence

Our aim is to test for the presence of TFP heterogeneity and convergence in cross-country convergence analysis by using an appropriate fixed-effect panel estimator. As said above, TFP levels are measured by means of two main methodologies, namely the level accounting approach and the GDP-proxy approach. Another approach to control for possible cross-country differences in technology is to test for the presence of technology heterogeneity in cross-country convergence analysis by using an appropriate fixed-effect panel estimator[19]. Islam (1995) was among the first to suggest this econometric solution to the problem of estimating TFP levels. In particular, he extends the standard Mankiw Romer and Weil (1992) structural approach (hereafter MRW) by allowing TFP levels to vary across individual economies, together with saving rates and population growth rates. The convergence equation is given by:

$$\ln Y_{it2} = (1-\beta)\frac{\alpha}{1-\alpha}\ln(s_{it1}) - (1-\beta)\frac{\alpha}{1-\alpha}\ln(n_{it1}+g+\delta) + \beta\ln Y_{it1} + (1-\beta)\ln A_{i0} + g(t_2-\beta t_1) \qquad (1)$$

where Y_{it_1} is per capita GDP in economy *i* at time t_1 (initial period, while t_2 is the final one), and s , n, δ and g are, respectively the saving rate, the population growth rate, the depreciation rate, and exogenous technological change; the latter is assumed to be invariant across individual economies. Moreover, α is the usual capital share of a standard Cobb-Douglas production function.

[18] Indeed, stops and goes in regional convergence have been detected in several other countries. See de la Fuente (1997) for Spanish regions and Sala-i-Martin (1996) for examples from other OECD countries.
[19] See Islam (1995) and (2000) and Caselli Esquivel and Lefort (1996) among others.

Finally, $\beta \equiv e^{-\lambda\tau}$, where $\lambda = (1-\alpha)(n+g+\delta)$ represents the convergence parameter and $\tau \equiv t_2 - t_1$, is the time span considered.

Unlike in the MRW approach, Islam introduces the idea that the unobservable differences in TFP are correlated with other regressors[20], and uses suitable panel techniques to estimate:

$$y_{it} = \beta y_{it-1} + \sum_{j=1}^{2} \gamma_j x_{j,it} + \eta_t + \mu_i + v_{it}\,, \qquad j=1,2 \qquad (2)$$

where the dependent variable is the logarithm of per capita GDP (measured in terms of population working age), v_{it} is the transitory term that varies across countries, and the remaining terms are:

$$x_{it}^1 = \ln(s_{it}) \qquad (3)$$

$$x_{it}^2 = \ln(n_{it} + g + \delta) \qquad (4)$$

$$\gamma = (1-\beta)\frac{\alpha}{1-\alpha} \qquad (5)$$

$$\mu_i = (1-\beta)\ln A(0)_i \qquad (6)$$

$$\eta_t = g(t_2 - \beta t_1) \qquad (7)$$

In this specification, technology is represented by two terms. The first is the time trend component that captures the growth rate of the technology frontier assumed constant across individuals. The second term, μ_i, a time-invariant component that varies across economies, should control for various unobservable factors like institutions or climate, and – crucially to our study – technology. Since technology is likely to be correlated with other regressors, a fixed effect estimator

[20] In their study MRW's assume $\ln A_{i0} = \ln A_0 + \varepsilon_i$, with $\ln A_0$ constant across individuals, and ε_i representing a random shock, uncorrelated with the other explanatory variables. Notice that, if instead technology is correlated with the explanatory variables, MRW's OLS results are not consistent.

is appropriate.[21]

Once we have the estimated individual intercepts, we can easily compute a proxy of TFP by:

$$A(0)_i = \exp\left(\frac{\mu_i}{1-\beta}\right) \tag{8}$$

In other words, this methodology can be used to obtain a measure of the degree of cross-country technology heterogeneity.[22]

The main problem with this methodology is that, while it was designed to control for the presence of cross-country TFP heterogeneity, it rules out technology convergence by assumption and completely ignores possible problems of observational equivalence between technological catch up and capital deepening. More precisely, as shown by equations (6) and (7), equation (2) is obtained by log-linearizing the Solow model around the steady-state under the assumption of a *constant* degree of TFP heterogeneity. In other words, all economies are assumed to grow at the same technological rate according to the process $\ln A_{it} = \ln A_{i0} + gt$, whatever their level of technological knowledge.

This is clearly in sharp contrast with the technological catching-up hypothesis. The latter may be described by a process where the growth rate of technology is proportional to the current gap between the world technology frontier and the technology level currently adopted in an economy. Typically, during the transition towards the steady-state in which all economies share the common long-run technological growth *g*, the presence of technological catch-up enables the technology levels in the lagging economies to grow faster than *g*. As a consequence, during the transition, the technology gap between the leader and a follower should decrease. On the contrary, if

[21] For more on this see Baltagi (2003).

[22] One of the main criticisms of this approach is that the estimated individual intercepts do not simply control for technology but include also the effect of other possible unobservable factors such as institutions or geography. As explained in the following section, one way to control for this problem is to apply this methodology to samples that are relatively homogeneous with respect to other factors such as institutions.

no systematic process of technology diffusion is at work, this gap should stay constant over time, since all economies grow at a common rate of technology growth. Note that, since productivity is certainly correlated with technology, equation (2) is plagued by problems of observational equivalence, as the β coefficient may still capture the effect of both neoclassical convergence and catch-up.

Hence, how can we use equation (2) to test for the presence/absence of technological convergence? First, notice that, the longer the time dimension of the panel, the higher the risk that differences in TFP levels are not constant within the sample period, since technological diffusion is more likely to be at work. As a consequence, in the presence of technological convergence equation (2) should be regarded as an approximation of the real process – an approximation that deteriorates as the length of the period under analysis increases.

Second, and consequently, the presence of technological convergence should be detected by comparing the TFP values obtained by estimating (8) over different periods. This type of comparison should reveal whether the observed pattern of TFP values is consistent either with the catching-up hypothesis or with the alternative hypothesis that the current degree of technology heterogeneity is at its stationary value (or constant). Indeed, in this case we are estimating the initial level of TFP at two different points in time. By doing this, we are able both to detect if the pattern over time of these TFP levels is consistent with the presence/absence of catch up and to control for observational equivalence problems.

The technique we use follows several, simple steps. First, we estimate equation (2) over different sub-periods, in order to obtain a sequence of estimated values of individual intercepts. Second, the latter values are used to compute the individual values of $\ln A_i$. Third, we analyse the evolution over time of the distribution of $\ln A_i$ in order to test for the presence of technological convergence. Indeed, while technology convergence implies a variance of $\ln A_i$ that decreases over time while approaching its stationary value, the alternative hypothesis implies that the variance of

$\ln A_i$ is at its stationary value, and thus no significant trend in its value should be detected. A similar approach has been previously introduced by Islam (2000), where the author compares the distribution of the estimated fixed effects over two points in time. However, in his paper the possibility that technology convergence lies behind the observed changes in the distribution is neither discussed nor tested.

4. Comparing the available estimation procedures

We use Italian data on regional GDP per worker 1963-1993[23] to estimate the following equation:

$$\tilde{y}_{it} = \beta \tilde{y}_{it-\tau} + \sum_{j=1}^{3} \gamma_j \tilde{x}_{jit-\tau} + \mu_i + u_{it} \qquad (9)$$

$$\tilde{y}_{it} = y_{it} - \bar{y}_t, \qquad \tilde{x}_{it} = x_{it} - \bar{x}_t \qquad (10)$$

where $\bar{y}_t$, and $\bar{x}_t$ are the Italian average in period t: data are taken in difference from the Italian mean, in order to control for the presence of a time trend component η_t and of a likely common stochastic trend (the common component of technology) across regions. We use a suitable time span in order to control for business cycle fluctuations and serial correlation, which are likely to affect the data in the short run. Moreover, $x_{1i,t}$ is the lagged saving rate proxied by the ratio of regional investment to GDP, and x_{3it} represents a measure of human capital stock, namely average years of schooling. Both these variables are taken at their $t-\tau$ level, while $x_{2i,t}$ represents the sum of *n*, population growth, δ the depreciation rate and *g* the exogenous technology growth rate and is taken as an average over the five years preceding *t*.[24] As standard in this literature, $(g+\delta)$ is assumed equal to 0.05. Note that equation (9) simply augments equation (2) to include a measure of the stock of human capital since, in order to identify TFP differences, it is essential to control for one of its

[23] The length of the dataset is constrained by the human capital variable. We use census data and more recent observations are not available yet.

[24] In fact, regional series may be characterised by high volatility and this was the case for $x^2_{i,t}$.

most likely determinants.[25] Finally, as shown in the previous section, the coefficient on the lagged dependent variable yields a measure of the speed of the conditional convergence (or *within* convergence), while individual effects reflect the degree of TFP heterogeneity.

The first problem we face when we estimate a dynamic panel data model such as the one represented by equation (9) is which estimator suits our case better. The answer is not simple. It is still true today what Kiviet wrote a few years ago: “As yet, no technique is available that has shown uniform superiority in finite samples over a wide range of relevant situations as far as the true parameter values and the further properties of the DGP are concerned.”[26] Indeed, the LSDV estimator, while consistent for large T,[27] is characterised by small sample problems and, in particular, it is known to produce downward biased estimates in small samples. Conversely, the Arellano and Bond (1991) estimator (GMM-AB from now on) is becoming increasingly popular since it has both the advantage of producing consistent estimates in a dynamic panel regression with both (i) endogenous right hand side variables, and (ii) the presence of measurement error. Moreover, it is more efficient than other standard IV estimators such as the Anderson-Hsiao estimator. However, it has recently been shown[28] that, when T is small, and either the autoregressive parameter is close to one (highly persistent series), or the variance of the individual effect is high relative to the variance of the transient shock, then even the GMM-AB estimator is biased and, in particular, downward biased. Note that the presence of a relatively small number of time periods and persistent time series are typical features of macro-growth datasets like ours.

To control for this problem, Kiviet (1995) put forward a more direct approach to the problem of the LSDV finite sample bias by estimating a small sample correction to the LSDV estimator. Monte Carlo analysis[29] finds that for small T (such as the one we usually find in

[25] For details on how this variable is constructed see Di Liberto (2001).
[26] See Kiviet (1995) page 72.
[27] See Amemyia (1967).
[28] See Blundell and Bond (1998) and Bond-Hoeffler-Temple (2001). We do not consider the system-GMM suggested in these studies here since this methodology requires that first-difference Δy_{it} are not correlated with μ_i, thus implying the absence of technological catching-up.
[29] See Kiviet (1995) and Judson and Owen (1996).

convergence literature) LSDV estimates corrected for the bias (KIVIET from now on) seem more attractive than GMM. In particular, these Monte Carlo studies explicitly analyse typical macro dynamic panels and find that for $T \leq 20$ and $N \leq 50$, as in our case, the KIVIET and Anderson-Hsiao estimators consistently outperform GMM-AB. Moreover, despite having a higher average bias, KIVIET turns out to be more efficient than Anderson-Hsiao. Overall, these Monte Carlo analyses suggest that a reasonable strategy would be to use the KIVIET estimator for smaller panels ($T \leq 10$), while Anderson-Hsiao should be preferred for larger panels, as the efficiency of the latter improves with T (Anderson-Hsiao has the additional advantage of being computationally simpler than the former).

Let us now turn to our specific case. Our Italian regional panel includes the period 1963-93 for 19 regions.[30] Using the five-year time span (or $\tau = 5$) implies that we are left with T=7 observations for each of the N=19 regions, corresponding to 1963, 1968, 1973, 1978, 1983, 1988, and 1993. Given the dimension of our panel and the above discussion, the Kiviet-corrected LSDV estimator should be preferred[31]. However, since there is still a lot of debate on which technique shows a clear superiority in finite samples, in the following analysis we will use several estimators and will compare their results in order to assess their robustness.

5. Testing for TFP heterogeneity

Before moving into the estimate of the presence of TFP convergence, we firstly test for the presence of regional TFP heterogeneity using the whole sample 1963-93. We suggest using this strategy because the presence of TFP heterogeneity may be considered as a necessary but not sufficient condition for TFP convergence. Moreover, note that the analysis of TFP convergence requires a further reduction in our sample and, as we have seen above, all these estimators perform poorly in small samples. Thus, we only continue our analysis further if we find evidence in favour

[30] There are 20 Italian regions . We have excluded Valle d'Aosta because it represents an outlier. Nevertheless, results do not change if we include this region.

[31] To implement the Kiviet's small-sample correction we use the STATA routine proposed by Adam (1998).

of TFP heterogeneity.

In Table 1 we compare the results obtained by using four different estimators, namely, a standard pooling OLS, LSDV, KIVIET and GMM-AB. For each regression we include the estimates obtained and the implied $\hat{\lambda}$, i.e. the speed of the convergence parameter.[32]

TABLE 1

Let us start by the results obtained using the (uncorrected) LSDV estimator. When equation (9) is estimated with LSDV (Model 2) we find an AR(1) coefficient of 0.51 and a correspondingly relatively high speed of convergence of 13%. Among the regressors, only the coefficients on the lagged dependent variable and on population growth are significant, while both the coefficient on the investment share and on human capital are not significant. These results will be confirmed when other estimation procedures are introduced. The use of the Kiviet correction procedure increases the LSDV parameter from 0.51 to 0.67 (model 3), with a decline in the corresponding speed of convergence coefficient from 13% to 8%[33]. Note that KIVIET only corrects the bias in the LSDV estimated parameters but does not produce alternative or corrected standard errors. This is why they are not shown among the results.

Let us now extend our comparison to the other available estimators. The GMM-AB estimates are shown together with the p-value of the AB-2 statistic and the Sargan test as in Arellano and Bond (1991)[34]. The GMM-AB estimator may be performed under very different assumptions on the endogeneity of included regressors. In this study we specify two different

[32] From $\beta = e^{-\lambda t}$

[33] To compute the estimated bias the methodology requires the use of a consistent estimator, such as Anderson-Hsiao or GMM, and the routine used to calculate KIVIET cannot handle missing observations. See Adam (1998).

[34] The first statistic tests for the presence of serial correlation. In particular, since the final regression equation is in first differences, it tests for second order serial correlation in the error term. The latter must be absent for the assumption of no serial correlation in the model in levels to be accepted. The presence of second-order serial correlation would imply that the estimates are inconsistent. The second statistic tests the validity of overidentifying restrictions. The consistency of this estimation procedure crucially depends on the identifying assumption that lagged values of both income and other explanatory variables are valid instruments in these growth regressions.

hypotheses on the additional regressors $x's$. First, Model 4 (or model GMM-AB1) in Table 1 assumes that all regressors are predetermined, that is $E\left[x_{it}u_{is}\right] \neq 0$ for $s < t$, and zero otherwise. Second, Model 5 (or model GMM-AB2) assumes instead that all $x's$ are strictly exogenous, that is, $E\left[x_{it}u_{is}\right] = 0$ for all t and s[35].

The results in Table 1 show that both specifications are valid: the p-values of the AB-2 and Sargan tests say that it is not possible to reject the null hypothesis of absence of second-order autocorrelation and that the over-identifying restrictions are valid. Thus, the choice between these two specifications is not obvious, even if the increase of the p-value of the Sargan test in GMM-AB1 indicates that treating the included regressors as predetermined makes it more difficult to reject the null and, thus, that Model 4 should be preferred to Model 5. However, these estimates may be biased. To detect a possible bias in our GMM-AB models we follow the procedure suggested by Bond, Hoeffler and Temple (2001). Given that it is well known that OLS is biased upwards in dynamic panels and LSDV is biased downwards, these authors suggest that a consistent estimate should therefore lie between the two. As expected, when we introduce the pooling-OLS estimator (Model 1), the coefficient on the lagged dependent variable is high compared with other individual effects estimators, with a corresponding speed of convergence of 4%. All regressors are in this case significant and with the expected sign. Since we presume that the true parameter values lie somewhere between $\hat{\beta}_{ols}$ and $\hat{\beta}_{LSDV}$, in this specific case we expect its value to be between 0.80 and 0.51. The estimated AR(1) coefficient on GMM-AB2 is higher than that obtained with OLS, where the latter should be characterized by upward bias. Consequently, we exclude GMM-AB2 from the following analysis, while we accept GMM-AB1 since its estimated AR(1) coefficient is 0.696, very similar to that obtained in KIVIET, 0.669. With a value ranging between $\hat{\beta}_{ols}$ and $\hat{\beta}_{LSDV}$, this estimate does not suggest any obvious presence of bias.

With these estimates in hand we now move on to compute our regional TFP measures. In

[35] See Baltagi (2003).

our LSDV estimates the regional dummy coefficients, $\hat{\mu}_i$, are almost invariably statistically significant. As for the GMM-AB1 estimator, note that it controls for fixed effects by transforming data in first difference, so the individual effects are therefore not directly estimated. Following Caselli, Esquivel and Lefort (1996), we obtain estimates of μ_i and, through equation (8), $\hat{A}(0)_i$, by:

$$\left(\hat{\mu}_i + \hat{u}_{it}\right) = \tilde{y}_{it} - \hat{b}\tilde{y}_{it-1} - \sum_{j=1}^{2} \hat{\gamma}_j \tilde{x}_{jit-1} - \hat{\xi}\tilde{h}_{it-1} \qquad (11)$$

$$\hat{\hat{\mu}}_i = \frac{1}{T}\sum\left(\hat{\mu}_i + \hat{u}_{it}\right) \qquad (12)$$

The same procedure has been used to obtain $\hat{\mu}_i$ using KIVIET. In all cases, the regional TFP estimates $\hat{A}(0)_i$ are then used to compute the ratio $\hat{A}(0)_i / \hat{A}(0)_{Lom}$, with $\hat{A}(0)_{Lom}$ being the estimated TFP value for Lombardia, currently the richest, most industrialised and arguably the most technologically advanced Italian region.

Table 2a includes the estimates of the relative (to Lombardia) levels of regional TFP obtained by applying each different estimator. To make the interpretation of results easier, Table 2b shows the ranking of each region obtained with the different methodologies.

TABLE 2A & TABLE 2B

Overall, these results suggest that different econometric methodologies produce similar TFP estimates. This conclusion is confirmed by the analysis of the Spearman rank order coefficient (see Table 3).

TABLE 3.

In particular, as expected, the estimates of the regional relative TFP levels obtained by LSDV and

KIVIET are almost identical, with a correlation coefficient equal to 0.98. A lower but still very high ranking correspondence is found between the LSDV, KIVIET and GMM-AB1 estimates. Thus, the close correspondence found in this section among the TFP estimates obtained with different estimation procedures support the conclusion that our results can be safely regarded as robust.

Moreover, the overall picture emerging from our estimates is an interesting one. In particular, it strongly confirms that TFP differences can be significantly large even across regions, and that an important part of the Italian economic divide seems to be due to such differences. We also find confirmation that the northern and richer regions are the most technologically advanced areas in the country, and that at the bottom end are the southern, less developed areas.

To sum up, the pattern and the magnitude of TFP heterogeneity as measured by our estimates suggest that a potential for technological catch-up does exist for the lagging regions. In turn, this implies that any analysis of aggregate convergence across Italian regions should take this potential source of convergence into account. This is what we will do in the next section.

6. Detecting technological convergence: Empirical results

To investigate whether the observed degree of hereogeneity is either constant or is the source of a process of TFP convergence we follow Islam (2003). He suggests testing for the presence of TFP convergence generating TFP-level indices for several consecutive time periods, so that the TFP dynamics can be directly analysed. The indices produced by panel methods may be used to this end as "…they contain ordinal as well as cardinal information, which can both be helpful in answering questions regarding TFP-convergence".[36] The main difficulty with this procedure is that, in order to generate different TFP-level indices for consecutive time periods we need to further reduce the time dimension of the estimated samples, thus worsening the problems associated with small sample bias discussed above. The KIVIET estimator should certainly be preferred with very small samples. However, note that using a time span equal to 5 implies that we are left with T=7 observations, which in turn implies T=5 with Kiviet since it uses the Anderson-Hsiao estimates to calculate the bias.[37]

With such a dataset, the implementation of the KIVIET correction procedure to these short sub-samples becomes unfeasible. A possible alternative is to gain degrees of freedom by using a shorter time span. For example, a time span equal to three ($\tau = 3$) yields T=11 (i.e., T=10 with LSDV and T=9 with KIVIET). Clearly, using a shorter time span has the obvious disadvantage that it increases the problems related to short term disturbances and serial correlation of the error term.[38] Given these problems, we firstly estimate TFP levels KIVIET to a sample with $\tau = 3$. Moreover, to control if the results obtained are robust, we apply the same procedure using LSDV since this estimator may be applied with a standard time span $\tau = 5$ [39].

When we apply KIVIET to the data with the non-standard time span of three years we obtain two sub-samples, each including 5 observations with one overlapping year. The first sub-sample includes 1969, 1972, 1975 1978, 1981, the second 1981, 1984, 1987, 1990, 1993. As before, we estimate equation (9) and save the two different series of $\hat{\mu}_i$. Results are shown in Table 4.

TABLE 4

Models 1 and 2 in Table 4 suggest that the convergence coefficient is significant in both sub-periods. In the first subsample analysed, the other variables included are never significant, while in the second both $\ln(s)$ and $\ln(n+\delta+g)$ are negative and significant. Human capital is never significant. Moreover, $\hat{\mu}_i$, are almost invariably significant. Again, we use equation (6) to obtain $\hat{A}(0)_i$, and transform the data as $\hat{A}(0)_i / \hat{A}(0)_{Lom}$, with $\hat{A}(0)_{Lom}$ being the estimated fixed effect of

[36] See Islam (2003), p.349.
[37] Where data are taken in first difference and levels of the dependent variable (lagged twice and further) are introduced as instruments. For more details see Baltagi (2003).
[38] In this case we need to assume that measurement error is not three-order serially correlated. Moreover, it has been argued that short time spans may not be appropriate for studying growth convergence. See Islam (1995) p. 1140 and Caselli Esquivel and Lefort (1996) among others.

Lombardia. This procedure yields two different estimates of regional effects, the first corresponding mainly to the 1970s and the second mainly to the 1980s. Table 5 shows the relative TFP values for the two sub-periods. A well-defined dynamic pattern emerges as relative TFP values increase for most southern laggard regions in the second period, while they decrease for most northern regions. Moreover, regional TFP dispersion decreases: the variance of (relative) TFPs is higher in the first period (with a value of 0.020) than in the second (0.011).

These results are strongly consistent with the hypothesis that a process of *technological convergence* does exist and represents an important component of the aggregate convergence observed across these two sub-periods[40]. This conclusion finds clear confirmation in Figure 1, which shows the relationship existing between the TFP estimated for the first sub-sample and the subsequent one.

FIGURE 1

The dotted 45 degree line shows the locus where the relative TFP level in each region would be unchanged between the two periods. Most southern regions are clearly above the 45 degree line[41] as they performed consistently better in terms of relative TFP growth, while six (mostly northern) regions are below the 45 degree line. This pattern is consistent with the hypothesis of TFP convergence.

The same data may be rearranged to analyse this result in terms of a typical *growth-initial level* convergence relationship. In Figure 2 the Y-axis represents the rate of growth of relative TFP, while the X-axis represents the initial relative TFP level. Convergence implies a negative correlation between the initial level of TFP and its subsequent growth rate. This is exactly what our

---

[39] We do not lose one observation due to a first-difference transformation as with KIVIET.

[40] These results are qualitatively in line with those obtained by Maffezzoli (2004) for the 1980-2000 period using the Data Envelope Analysis approach

data reveal.

FIGURE 2

Note that, since our TFP measures are interpreted as initial period TFP levels, our evidence shows that technology convergence took place *between* the two sub-periods of our analysis (1963 and 1981), while nothing can be inferred on what has happened, in terms of technology diffusion, *within* the second sub-period. Thus, during the period of observed per capita GDP convergence we find evidence that both neoclassical and TFP convergence forces were at work while nothing can be inferred for the second period. Indeed, as shown by Table 5, in spite of this clear convergence pattern during the first sub-period, the distance between northern and southern regions in terms of relative TFP remains significant in the second sub-period. So, one possibility is that the halt of aggregate convergence observed in this sub-period is due to a halt of technology diffusion.

Let us now go back to Table 4, columns 3 and 4, in order to assess the robustness of our previous result by applying the LSDV estimator using the standard time-span. Our LSDV estimates in columns 1 and 2 are based on two sub-samples of 4 observations each, with one overlapping year: the first sub-sample includes 1963, 1968, 1973 1978, and the second 1978, 1983, 1988, 1993. In this case, the convergence coefficient is significant only in the first subsample, 1963-78, while we see no evidence of convergence during 1978-93. Apart from this, our previous results based on the LSDV estimator are confirmed. Other explanatory variables are never significant while the regional dummies coefficients, $\hat{\mu}_i$, are almost invariably significant. Again, regional TFP dispersion decreases since the variance of (relative) TFPs is higher in the first period (with a value of 0.027)

[41] These are Molise, Basilicata, Calabria, Puglia, Sicilia and Campania.

than in the second (0.010)[42]. In sum, our previous result pointing to the presence of a clear pattern of TFP convergence appears to be robust to the use of LSDV with a different time-span.

7. Technology convergence and the role of human capital

Finally, our measures of regional levels of TFP may also be used to test one of the main hypotheses of literature on catching-up . Nelson and Phelps (1966) and Benhabib and Spiegel (1994) show how TFP growth can be determined by the technological distance from the leader and by the level of human capital, where the latter influences the capacity for both discovering new technologies and adopting innovations from abroad. In other words, human capital levels determine the capacity of adopting new technologies from abroad and, thus, the possibility of a catch up process among countries. As a consequence, we should expect TFP levels to depend on human capital stocks, while the role of human capital on GDP growth is only indirect. This is exactly what our results seem to suggest. The correlation coefficient between the regional human capital level in 1969 and TFP levels estimated using KIVIET ($\tau = 5$) is equal to 0.93, while that calculated between the level of human capital in 1978 and the subsequent TFP levels is 0.89[43]. The same relationship may be observed in Figures 3 and 4, where we include regional relative TFP estimates in the Y-axis and the initial level of human capital in the X-axis. In general, this evidence, together with the absence of significance of the human capital variable in our regressions, corroborate the hypothesis of a relationship between human capital and TFP as described by the Nelson and Phelps approach.

FIGURES 3 AND 4

8. Conclusion

[42] Using these new TFP estimates we would obtain the same pattern shown by Figures 1 and 2. The only difference is observed for a group of three regions, Abruzzo, Umbria and Sardegna: these regions are among the (relative) losers in Figure 1 while in this case they would be among the (relative) winners.

[43] When we use LSDV, the results are almost identical (0.93, 0.87).

The aim of this paper was to assess the existence of technology convergence across the Italian regions between 1963 and 1993. Different methodologies have been proposed to measure TFP heterogeneity across countries, but only a few of them try to capture the presence of technology convergence as a separate component from the standard (capital-deepening) source of convergence. To distinguish between these two components of convergence, we have proposed and applied a fixed-effect panel methodology.

Our results show, first of all, the presence of TFP heterogeneity across Italian regions. This result is robust to the use of different estimation procedures such as simple LSDV, Kiviet-corrected LSDV, and GMM *à la* Arellano and Bond (1991). Second, we find strong evidence to support the hypothesis that a significant process of TFP convergence has been a key factor in the observed aggregate regional convergence that took place in Italy up to the mid-seventies.

Moreover, our results show that a period of significant convergence in TFP has not generated a significant, persistent decrease in the degree of cross-region inequality in per capita income. The solution to this puzzle may be a simple one. Our evidence shows that technology convergence took place *between* the two sub-periods of our analysis (1963-78 and 1978-93), while nothing can be inferred on what has happened, in terms of technology diffusion, *within* the second sub-period. So, one possibility is that the halt of aggregate convergence in this sub-period is due to a halt of technology diffusion. More data and research are needed to test this additional hypothesis.

Finally, our human capital measures have been found to be highly positively correlated with TFP levels. This result confirms one of the hypothesis of the Nelson and Phelps approach, namely that human capital is the main determinant of technological catch-up. This latter result suggests an explanation for the existence of persistent differences in regional GDP per worker which might be due to the fact that the backward regions never caught-up with the the northern and richest ones in terms of their human capital endowments.

References

Adam, C. S. (1998), "Implementing Small-Sample Bias Corrections in Dynamic Panel Data Estimators Using Stata." Mimeo, University of Oxford.

Aiello and Scoppa (2000), Uneven Regional Development in Italy: Explaining Differences in Productivity Levels, *Giornale Degli Economisti e Annali di Economia*, 59, 270-98

Aiyar and Feyrer (2002), "A contribution to the empirics of TFP", *mimeo*.

Amemiya, T. (1967), "A Note on the Estimation of Balestra-Nerlove Models." Institute for Mathematical Studies in Social Sciences Technical Report No. 4. Stanford University, Stanford.

Arellano M., and Bond S. (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies* 58, 277-97

Baltagi, B. H. (2003). *Econometric Analysis of Panel Data*. Chichester: John Wiley and Sons.

Barro R. and Sala-i-Martin X. (2004), *Economic growth*, MIT Press.

Barro, R.J., and Sala-i-Martin, X. (1991), "Convergence Across States and Regions." *Brookings Paper of Economic Activity* 0, 107-182.

Baier S. L., Dwyer G. P. and Tamura R. (2002) "How Important are Capital and Total Factor Productivity for Economic Growth?", Working Paper, Federal Reserve Bank of Atlanta.

Benhabib, J., and Spiegel, M.M. (1994), "The role of human capital in economic development. Evidence from aggregate cross-country data." *Journal of Monetary Economics* 34, 143-173.

Bernard A.B. and Jones C.I. (1996), Technology and convergence, *Economic Journal*, 106, 1037-44.

Boldrin and Canova (2001), Inequality and convergence: reconsidering European regional policies, *Economic Policy*, n. 32, 205-245

Boltho A., Carlin W. And Scaramozzino P. (1999), Will East Germany become a new Mezzogiorno?, in: J. Adams and F. Pigliaru, editors, *Economic Growth and Change. National and Regional Patterns of Convergence and Divergence*, Cheltenham: Edward Elgar.

Blundell R. and Bond S. (1998), "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics*, 87, 115-143.

Bond, S., Hoeffler , A. and Temple, J. (2001), "GMM Estimation of Empirical Growth Models." Mimeo.

Caselli, F., Esquivel, G., and Lefort, F. (1996), "Reopening the Convergence Debate: a New Look at Cross Country Growth Empirics." *Journal of Economic Growth* 1, 363-89.

De la Fuente, A. (1995). "The Empirics of Growth and Convergence: a Selective Review." CEPR Discussion Paper No. 1275. London.

De la Fuente A. (1997), The empirics of growth and convergence, *Journal of Economic Dynamics and Control*, 21, 23-77

De la Fuente A. (2002), On the source of convergence: a closer look at the Spanish regions, *European Economic Review,* 46, 569-599.

Di Liberto A. (1994), “Convergence Across Italian regions.” Nota di Lavoro Fondazione ENI Enrico Mattei No. 68/94. Milano.

Di Liberto (2001) "Stock di Capitale Umano e Crescita delle Regioni Italiane: un Approccio Panel", *Politica Economica*, 17: 159-184.

Dowrick S. and Nguyen D. (1989), OECD comparative economic growth 1950-85: catch-up and convergence, *American Economic Review*, 79, 1010-30.

Dowrick and Rogers M. (2002), Classical and technological convergence: beyond the Solow-Swan growth model, *Oxford Economic Papers*, 54, 369-385.

Easterly W. and Levine R. (2001), . It's Not Factor Accumulation: Stylized Facts and Growth Models, *World Bank Economic Review*, 15, 177-219.

Fagerberg J. and Verspagen B. (1996), Heading for divergence. Regional growth in Europe riconsidered, *Journal of Common Market Studies*, 34, 431-48.

Graziani A. (1978), “The Mezzogiorno in the Italian Economy.” *Cambridge Journal of Economics* 2, 355-72.

Judson, R. and Owen, A. (1996), “Estimating DPD models: a Practical Guide for Macroeconomists.” Federal Reserve Board of Governors mimeo.

Hall R.E. and Jones C.I. (1999), Why do some countries produce so much more output per worker than others?, *Quartely Journal of Economics*, 114, 83-116.

Islam N. (1995), Growth empirics: a panel data approach, *Quarterly Journal of Economics*, 110, 1127-1170.

Islam N. (2000), Productivity dynamics in a large sample of countries: a panel study, Emory University, mimeo.

Islam, N. (2003), “What Have we Learnt from the Convergence Debate?.” *Journal of Economic Survey* 17, 309-62.

Kiviet, J. (1995), “On Bias, Inconsistency, and Efficiency of Various Estimators in Dynamicc Panel Data Models.” Journal of Econometrics, 68, pp. 53-78.

Klenow P.J. and Rodriguez-Clare A. (1997), Economic Growth: A Review Essay, *Journal of Monetary Economics*, 40, 597-617.

Lucas R. E. (2000), Some macroeconomics for the 21st century, *Journal of Economic Perspectives*, 14, 159-168.

Maffezzoli M. (2004), Convergence across Italian Regions and the Role of Technological Catch-up, mimeo, Università Bocconi, Milano.

Mankiw N.G., Romer D. and Weil D. (1992), A contribution to the empirics of economic growth, *Quarterly Journal of Economics*, 107, 407-37.

Marrocu E., Paci R. and Pala R. (2001), Estimation of Total Factor Productivity for Regions and Sectors in Italy: A Panel Cointegration Approach, *Rivista Internazionale di Scienze Economiche e Commerciali*, 48, 533-558.

Mauro, L., and Podrecca, E. (1994), “The case of Italian Regions: Convergence or Dualism?” *Economic Notes* 24, 447-472.

Nelson, R. R., and Phelps, E. S. (1966), “Investments in Humans, Technological Diffusion, and Economic Growth.” *American Economic Review* 56, 69-75.

Paci R. and Pigliaru F. (1995), Differenziali di crescita nelle regioni italiane: un'analisi *cross-section*, *Rivista di Politica Economica*, LXXXV, pp. 3-34.

Paci R. and Pigliaru F. (2002), Technological diffusion, spatial spillovers and regional convergence in Europe, in: J.R. Cuadrado-Roura and M. Parellada (eds), *Regional convergence in the European Union*, Berlin: Springer, 273-292.

Parente S.L. and Prescott E.C. (2000), *Barriers to the Riches*, Boston: MIT Press.

Pigliaru F. (2003), Detecting technological catch-up in economic convergence, *Metroeconomica*, 54, 161-178

Sala-i-Martin X. (1996), "The Classical Approach to Convergence Analysis." *The Economic Journal* 106, 1019-1036.

Temple J. (2001), "Growth Effects of Education and Social Capital in the OECD Countries." Mimeo, University of Bristol.

Young, A. (1994), "Lessons from the East Asian NIC's. A Contrarian View." *European Economic Reviw* 38, 964-73.

Young, A. (1995), "Confronting the Statistical Realities of the East Asian Growth Experience." *Quarterly Journal of Economics* 110, 641-80.

APPENDIX

Table 1: Estimation of the augmented Solow model

Sample: Italian regions (1963-93)

Dependent Variable

	1 **OLS**	2 **LSDV**	3 **KIVIET**	4 **GMM-AB1**	5 **GMM-AB2**
Observations	*95*	*95*	*95*	*95*	*95*
$ln(y_{i,t-1})$	.800	.514	.669	.696	.834
	(.051)	(.090)		(.097)	(.135)
$ln(s_{i,t-1})$	-.063	-.019	-.022	-.047	-.044
	(.020)	(.030)		(.043)	(.037)
$ln(n_{i,t-1}+g+d)$	-.108	-.074	-.089	-.125	-.108
	(.025)	(.028)		(.031)	(.028)
human capital	.024	-.010	0.00	.001	-.028
	(.011)	(.019)		(.021)	(.022)
λ	0.04	0.13	0.08	0.07	0.04
Sargan test (p-value)				0.79	0.35
AB-2 test (p-value)				0.31	0.20

Notes:

19 Italian regions included (Val d'Aosta excluded)
Standard errors in parentheses.
LSDV is the Least Squares with Dummy variables estimator.
GMM-AB1 is the Arellano-Bond estimator under the assumption that x's are predetermined
GMM-AB2 is the Arellano-Bond estimator under the assumption x's strictly exogenous
KIVIET is the LSDV estimator with the Kiviet (1995) correction. KIVIET only corrects the bias in the LSDV estimated parameters, but does not produce alternative or corrected standard errors. This is why they are not shown among results.
The figures reported for the Sargan test are the p-values for the null hypothesis, valid specification.
The figures reported for the AB-2 test are the p-values of the Arellano-Bond test that average aucovariance in residuals of order 2 is 0.
Lambda is the corresponding convergence coefficient

Table 2a: Regional relative TFP levels by different estimation procedures

ln(y) 1968		**LSDV**		**GMM-AB1**		**KIVIET**	
Lazio	3.69	*Lombardia*	1.00	*Lombardia*	1.00	*Lombardia*	1.00
Liguria	3.67	*Lazio*	0.97	*Lazio*	0.99	*Lazio*	0.98
Lombardia	3.61	*Liguria*	0.95	*Friuli*	0.94	*Emilia Romagna*	0.95
Toscana	3.55	*Emilia Romagna*	0.94	*Emilia Romagna*	0.94	*Friuli*	0.95
Trentino	3.54	*Friuli*	0.92	*Veneto*	0.94	*Liguria*	0.95
Emilia Romagna	3.51	*Veneto*	0.90	*Liguria*	0.93	*Veneto*	0.92
Veneto	3.49	*Piemonte*	0.89	*Trentino*	0.89	*Piemonte*	0.90
Piemonte	3.47	*Toscana*	0.86	*Sardegna*	0.89	*Trentino*	0.88
Sardegna	3.45	*Trentino*	0.86	*Piemonte*	0.87	*Toscana*	0.86
Friuli	3.40	*Marche*	0.82	*Toscana*	0.86	*Abruzzo*	0.85
Campania	3.39	*Sardegna*	0.81	*Abruzzo*	0.85	*Marche*	0.85
Sicilia	3.38	*Abruzzo*	0.81	*Marche*	0.85	*Umbria*	0.84
Marche	3.36	*Umbria*	0.81	*Umbria*	0.84	*Sardegna*	0.83
Umbria	3.35	*Sicilia*	0.76	*Sicilia*	0.81	*Puglia*	0.78
Abruzzo	3.24	*Puglia*	0.75	*Puglia*	0.79	*Sicilia*	0.78
Puglia	3.23	*Campania*	0.73	*Campania*	0.77	*Campania*	0.75
Calabria	3.21	*Molise*	0.68	*Basilicata*	0.72	*Molise*	0.73
Basilicata	3.17	*Calabria*	0.65	*Molise*	0.70	*Calabria*	0.68
Molise	3.06	*Basilicata*	0.64	*Calabria*	0.68	*Basilicata*	0.67

Notes:

ln(y) 1968 is the logarithm of GDP per worker in 1968

LSDV includes the regional individual effects estimated using the LSDV estimator (95 observations)

GMM-AB1 includes the regional individual effects calculated using the GMM-AB1 estimator

KIVIET includes the regional individual effects calculated using the LSDV estimator with the KIVIET correction

Table 2b: Regional TFP ranking

Regions	LSDV	GMM-AB1	KIVIET
Abruzzo	12	11	10
Basilicata	19	17	19
Calabria	18	19	18
Campania	16	16	16
Emilia Romagna	4	4	3
Friuli	5	3	4
Lazio	2	2	2
Liguria	3	6	5
Lombardia	1	1	1
Marche	10	12	11
Molise	17	18	17
Piemonte	7	9	7
Puglia	15	15	14
Sardegna	11	8	13
Sicilia	14	14	15
Toscana	8	10	9
Trentino	9	7	8
Umbria	13	13	12
Veneto	6	5	6

Notes:
LSDV includes the rank of regional individual effects estimated using the LSDV estimator.
GMM-AB1 includes the rank of regional individual effects calculated using the GMM-AB1 estimator.
KIVIET includes the rank of regional individual effects calculated using the LSDV estimator with the KIVIET correction.

Table 3: Spearman rank order correlation coefficient			
	LSDV	GMM-AB1	KIVIET
LSDV	1		
GMM-AB1	0.94	1	
KIVIET	0.98	0.96	1

Table 4: Estimation of the augmented Solow model (two subsamples)

Sample: Italian regions 1963-978 and 1978-93

Dependent Variable ***ln(y $_{i,t}$)***

	1 *time span=3* 1963-1981 KIVIET	2 *time span=3* 1981-1993 KIVIET	3 *time span=5* 1963-1978 LSDV	4 *time span=5* 1978-1993 LSDV
Observations	*95*	*95*	*57*	*57*
ln(y $_{i,t-1}$)	.760	.386	.480	.015
			(.141)	(.124)
ln(s $_{i,t-1}$)	-.068	-.061	.055	-.051
			(.049)	(.036)
ln(n $_{i,t-1}$ +g+d)	-.047	-.062	-.061	-.069
			(.052)	(.027)
human capital	-.30	.013	-.051	.006
			(.052)	(.044)
λ	0.09	0.32	0.15	0.84

Notes:
19 Italian regions included (Val d'Aosta excluded)
Standard errors in parentheses.
LSDV is the Least Squares with Dummy variables estimator.
KIVIET is the LSDV estimator with the Kiviet (1995) correction and only corrects the bias in the estimated parameters.
It does not produce alternative or corrected standard errors. This is why they are not shown among results.
Lambda is the corresponding convergence coefficient

Table 5: Estimated Relative regional TFP levels

Regions	Relative TFP levels: initial period	Relative TFP levels: subsequent period
Piemonte	0.86	0.88
Lombardia	1.00	1.00
Trentino Alto Adige	0.85	0.85
Veneto	0.89	0.89
Friuli Venezia Giulia	1.00	0.91
Liguria	1.07	0.96
Emilia Romagna	0.88	0.93
Toscana	0.83	0.85
Umbria	0.87	0.80
Marche	0.74	0.78
Lazio	1.01	0.98
Abruzzo	0.84	0.80
Molise	0.60	0.71
Campania	0.70	0.72
Puglia	0.66	0.74
Basilicata	0.63	0.64
Calabria	0.61	0.66
Sicilia	0.75	0.75
Sardegna	0.87	0.79
Variance	0.020	0.011

Notes:
Initial TFP level correspond to the TFP estimated using the sample 1969-1981;
Subsequent TFP level correspond to the TFP estimated using the sample 1981-1993.

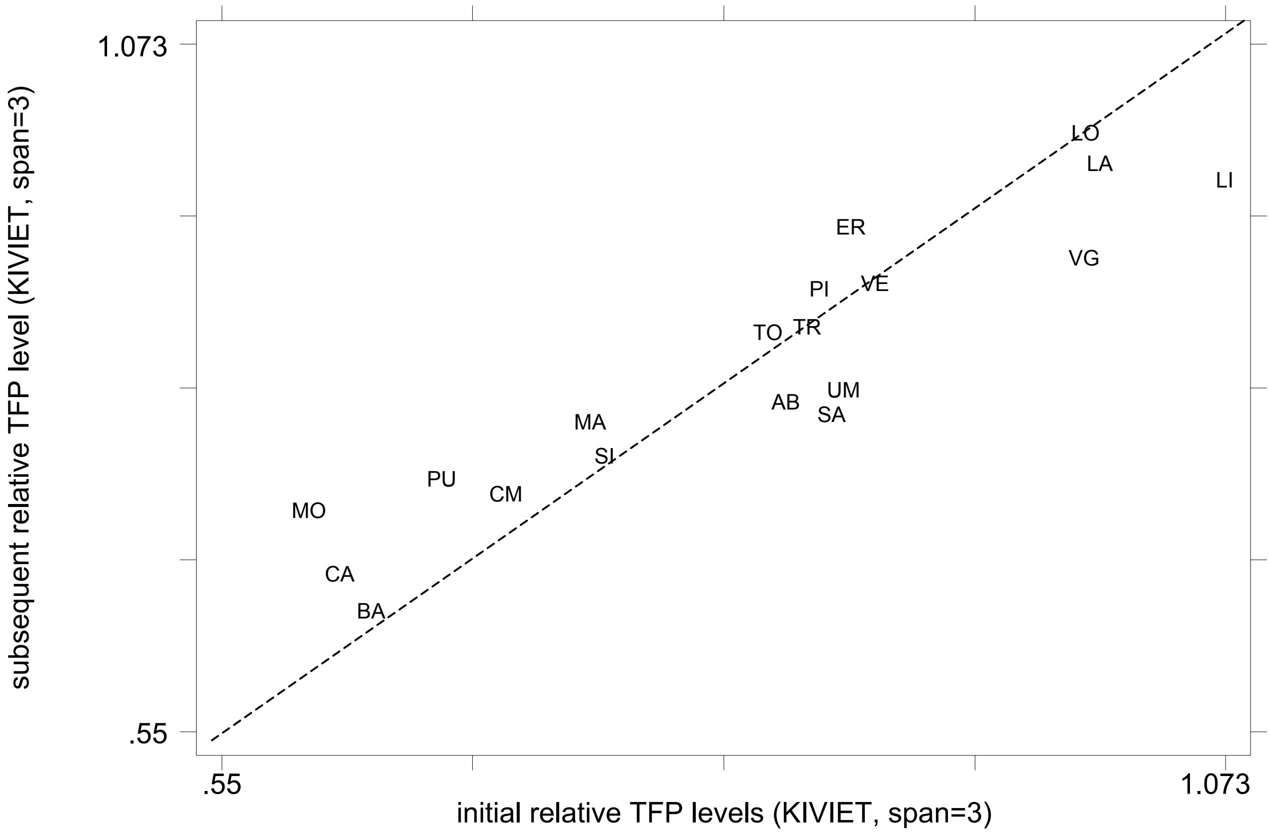

Figure 1: Productivity dynamics (KIVIET)

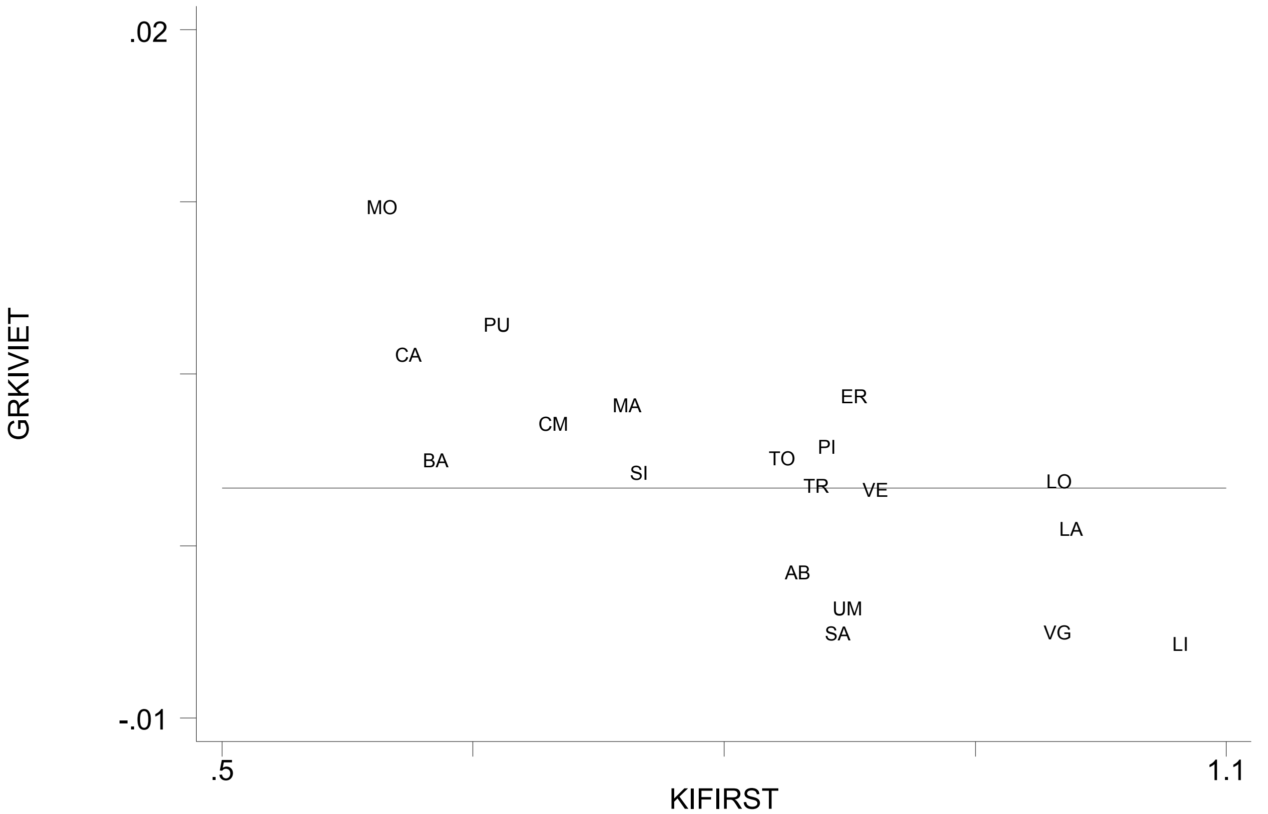

Figure 2: Productivity dynamics (KIVIET), growth-initial level relationship

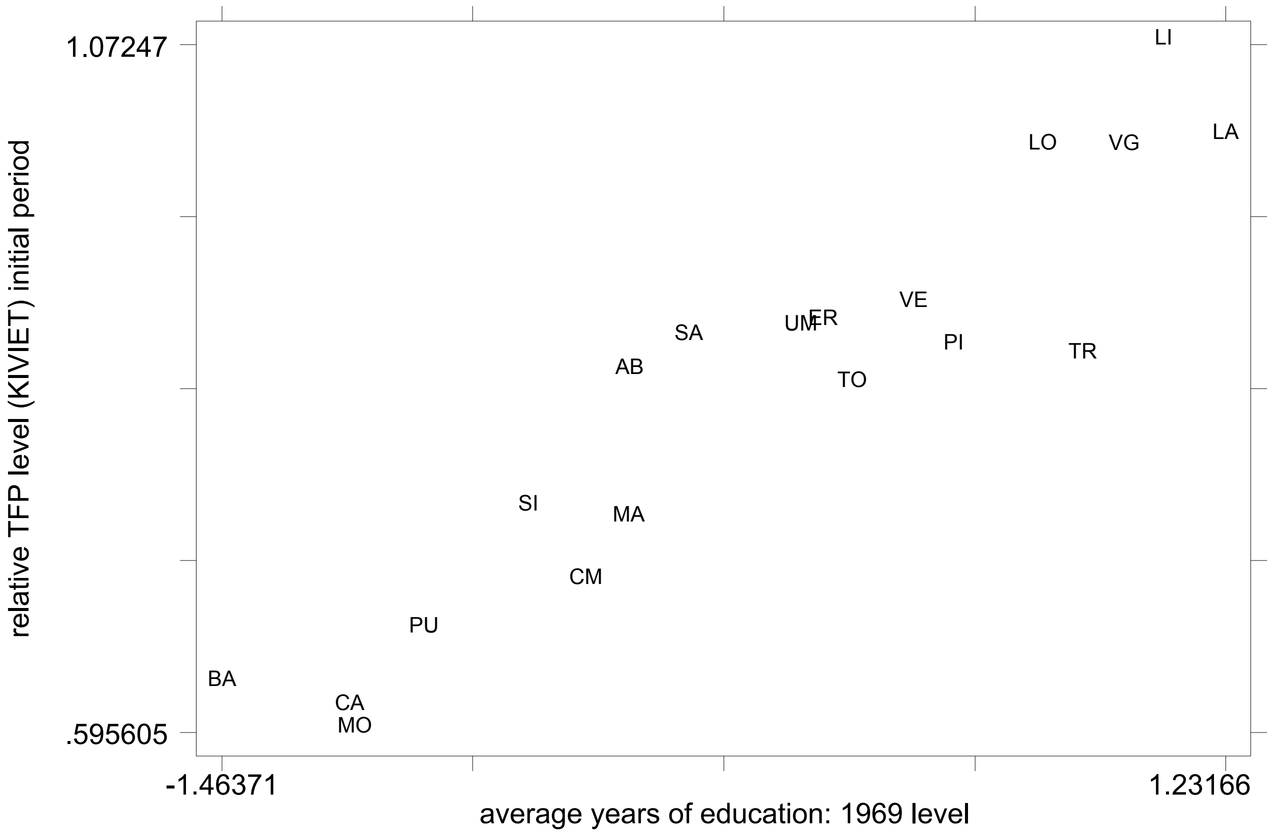

Figure 3: human capital and TFP, initial period

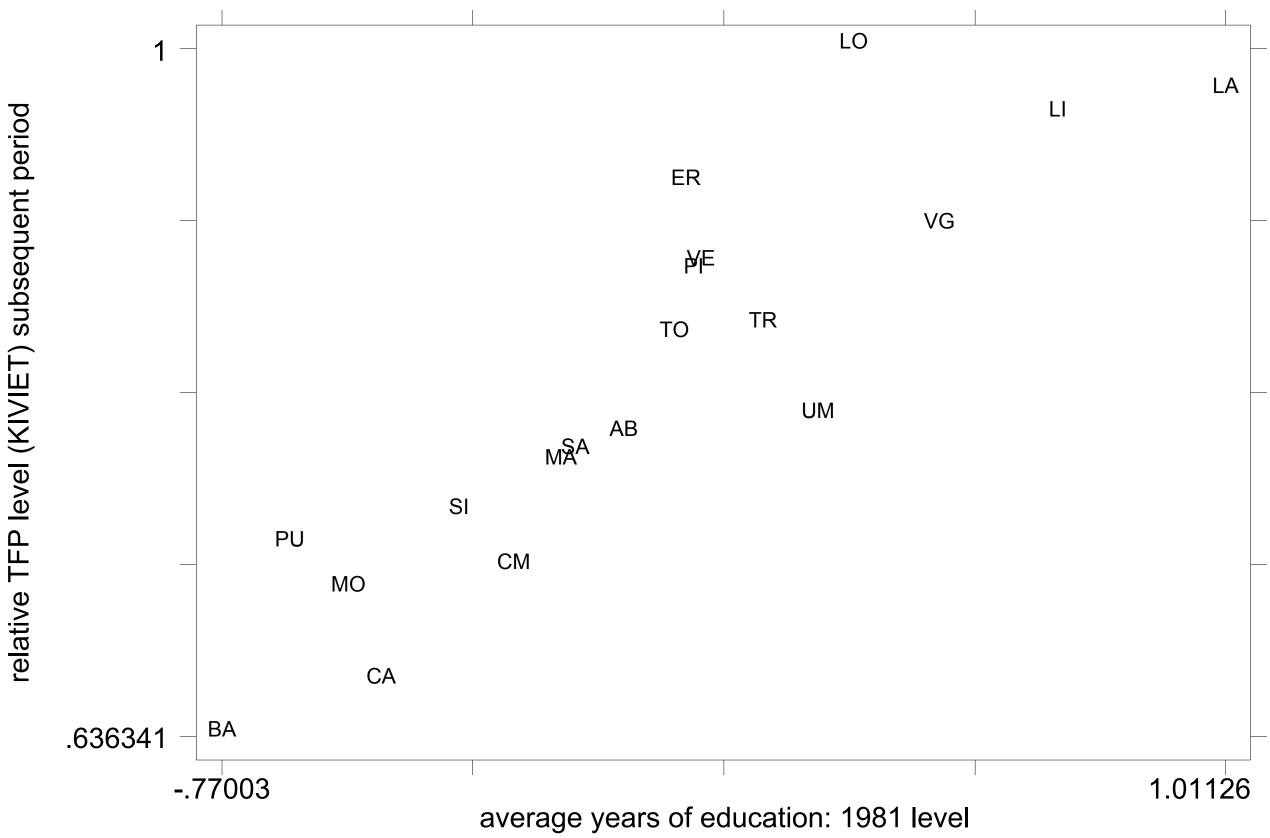

Figure 4: human capital and TFP, subsequent period

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:

http://www.feem.it/Feem/Pub/Publications/WPapers/default.html

http://www.ssrn.com/link/feem.html

NOTE DI LAVORO PUBLISHED IN 2004

IEM	1.2004	*Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB*: Empirical Analysis of National Income and So2 Emissions in Selected European Countries
ETA	2.2004	*Masahisa FUJITA and Shlomo WEBER:* Strategic Immigration Policies and Welfare in Heterogeneous Countries
PRA	3.2004	*Adolfo DI CARLUCCIO, Giovanni FERRI, Cecilia FRALE and Ottavio RICCHI:* Do Privatizations Boost Household Shareholding? Evidence from Italy
ETA	4.2004	*Victor GINSBURGH and Shlomo WEBER:* Languages Disenfranchisement in the European Union
ETA	5.2004	*Romano PIRAS:* Growth, Congestion of Public Goods, and Second-Best Optimal Policy
CCMP	6.2004	*Herman R.J. VOLLEBERGH:* Lessons from the Polder: Is Dutch CO2-Taxation Optimal
PRA	7.2004	*Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN* (lxv): Merger Mechanisms
PRA	8.2004	*Wolfgang AUSSENEGG, Pegaret PICHLER and Alex STOMPER* (lxv): IPO Pricing with Bookbuilding, and a When-Issued Market
PRA	9.2004	*Pegaret PICHLER and Alex STOMPER* (lxv): Primary Market Design: Direct Mechanisms and Markets
PRA	10.2004	*Florian ENGLMAIER, Pablo GUILLEN, Loreto LLORENTE, Sander ONDERSTAL and Rupert SAUSGRUBER* (lxv): The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions
PRA	11.2004	*Bjarne BRENDSTRUP and Harry J. PAARSCH* (lxv): Nonparametric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders
PRA	12.2004	*Ohad KADAN* (lxv): Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values
PRA	13.2004	*Maarten C.W. JANSSEN* (lxv): Auctions as Coordination Devices
PRA	14.2004	*Gadi FIBICH, Arieh GAVIOUS and Aner SELA* (lxv): All-Pay Auctions with Weakly Risk-Averse Buyers
PRA	15.2004	*Orly SADE, Charles SCHNITZLEIN and Jaime F. ZENDER* (lxv): Competition and Cooperation in Divisible Good Auctions: An Experimental Examination
PRA	16.2004	*Marta STRYSZOWSKA* (lxv): Late and Multiple Bidding in Competing Second Price Internet Auctions
CCMP	17.2004	*Slim Ben YOUSSEF:* R&D in Cleaner Technology and International Trade
NRM	18.2004	*Angelo ANTOCI, Simone BORGHESI and Paolo RUSSU* (lxvi): Biodiversity and Economic Growth: Stabilization Versus Preservation of the Ecological Dynamics
SIEV	19.2004	*Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA:* Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice
NRM	20.2004	*Guido CANDELA and Roberto CELLINI* (lxvii): Investment in Tourism Market: A Dynamic Model of Differentiated Oligopoly
NRM	21.2004	*Jacqueline M. HAMILTON* (lxvii): Climate and the Destination Choice of German Tourists
NRM	22.2004	*Javier Rey-MAQUIEIRA PALMER, Javier LOZANO IBÁÑEZ and Carlos Mario GÓMEZ GÓMEZ* (lxvii): Land, Environmental Externalities and Tourism Development
NRM	23.2004	*Pius ODUNGA and Henk FOLMER* (lxvii): Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya
NRM	24.2004	*Jean-Jacques NOWAK, Mondher SAHLI and Pasquale M. SGRO* (lxvii):Tourism, Trade and Domestic Welfare
NRM	25.2004	*Riaz SHAREEF* (lxvii): Country Risk Ratings of Small Island Tourism Economies
NRM	26.2004	*Juan Luis EUGENIO-MARTÍN, Noelia MARTÍN MORALES and Riccardo SCARPA* (lxvii): Tourism and Economic Growth in Latin American Countries: A Panel Data Approach
NRM	27.2004	*Raúl Hernández MARTÍN* (lxvii): Impact of Tourism Consumption on GDP. The Role of Imports
CSRM	28.2004	*Nicoletta FERRO:* Cross-Country Ethical Dilemmas in Business: A Descriptive Framework
NRM	29.2004	*Marian WEBER* (lxvi): Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada's Boreal Mixedwood Forest
NRM	30.2004	*Trond BJORNDAL, Phoebe KOUNDOURI and Sean PASCOE* (lxvi): Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting
CCMP	31.2004	*Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part I: Sectoral Analysis of Climate Impacts in Italy
CCMP	32.2004	*Marzio GALEOTTI, Alessandra GORIA ,Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part II: Individual Perception of Climate Extremes in Italy
CTN	33.2004	*Wilson PEREZ:* Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution
KTHC	34.2004	*Gianmarco I.P. OTTAVIANO and Giovanni PERI* (lxviii): The Economic Value of Cultural Diversity: Evidence from US Cities
KTHC	35.2004	*Linda CHAIB* (lxviii): Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison

KTHC	36.2004	*Franca ECKERT COEN and Claudio ROSSI* (lxviii): Foreigners, Immigrants, Host Cities: The Policies of Multi-Ethnicity in Rome. Reading Governance in a Local Context
KTHC	37.2004	*Kristine CRANE* (lxviii): Governing Migration: Immigrant Groups' Strategies in Three Italian Cities – Rome, Naples and Bari
KTHC	38.2004	*Kiflemariam HAMDE* (lxviii): Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm
ETA	39.2004	*Alberto CAVALIERE:* Price Competition with Information Disparities in a Vertically Differentiated Duopoly
PRA	40.2004	*Andrea BIGANO and Stef PROOST:* The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?
CCMP	41.2004	*Micheal FINUS* (lxix): International Cooperation to Resolve International Pollution Problems
KTHC	42.2004	*Francesco CRESPI:* Notes on the Determinants of Innovation: A Multi-Perspective Analysis
CTN	43.2004	*Sergio CURRARINI and Marco MARINI:* Coalition Formation in Games without Synergies
CTN	44.2004	*Marc ESCRIHUELA-VILLAR:* Cartel Sustainability and Cartel Stability
NRM	45.2004	*Sebastian BERVOETS and Nicolas GRAVEL* (lxvi): Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach
NRM	46.2004	*Signe ANTHON and Bo JELLESMARK THORSEN* (lxvi): Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits
NRM	47.2004	*John MBURU* (lxvi)*:* Wildlife Conservation and Management in Kenya: Towards a Co-management Approach
NRM	48.2004	*Ekin BIROL, Ágnes GYOVAI and Melinda SMALE* (lxvi)*:* Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transition al Economy
CCMP	49.2004	*Gernot KLEPPER and Sonja PETERSON:* The EU Emissions Trading Scheme. Allowance Prices, Trade Flows, Competitiveness Effects
GG	50.2004	*Scott BARRETT and Michael HOEL:* Optimal Disease Eradication
CTN	51.2004	*Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG:* Simple Priorities and Core Stability in Hedonic Games
SIEV	52.2004	*Francesco RICCI*: Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory
SIEV	53.2004	*Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON:* Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?
NRM	54.2004	*Ingo BRÄUER and Rainer MARGGRAF* (lxvi): Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams
NRM	55.2004	*Timo GOESCHL and Tun LIN* (lxvi): Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices
NRM	56.2004	*Tom DEDEURWAERDERE* (lxvi): Bioprospection: From the Economics of Contracts to Reflexive Governance
CCMP	57.2004	*Katrin REHDANZ and David MADDISON:* The Amenity Value of Climate to German Households
CCMP	58.2004	*Koen SMEKENS and Bob VAN DER ZWAAN:* Environmental Externalities of Geological Carbon Sequestration Effects on Energy Scenarios
NRM	59.2004	*Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA* (lxvii): Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management
NRM	60.2004	*Timo GOESCHL and Danilo CAMARGO IGLIORI* (lxvi):Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon
CCMP	61.2004	*Barbara BUCHNER and Carlo CARRARO*: Economic and Environmental Effectiveness of a Technology-based Climate Protocol
NRM	62.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Resource-Abundance and Economic Growth in the U.S.
NRM	63.2004	*Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ* (lxvi): Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis
NRM	64.2004	*E.C.M. RUIJGROK and E.E.M. NILLESEN* (lxvi): The Socio-Economic Value of Natural Riverbanks in the Netherlands
NRM	65.2004	*E.C.M. RUIJGROK* (lxvi): Reducing Acidification: The Benefits of Increased Nature Quality. Investigating the Possibilities of the Contingent Valuation Method
ETA	66.2004	*Giannis VARDAS and Anastasios XEPAPADEAS*: Uncertainty Aversion, Robust Control and Asset Holdings
GG	67.2004	*Anastasios XEPAPADEAS and Constadina PASSA*: Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach
GG	68.2004	*Michael FINUS*: Modesty Pays: Sometimes!
NRM	69.2004	*Trond BJØRNDAL and Ana BRASÃO*: The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications
CTN	70.2004	*Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZDAÏT*: On Coalition Formation with Heterogeneous Agents
IEM	71.2004	*Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA*: Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants
IEM	72.2004	*Alessandro LANZA, Matteo MANERA and Michael MCALEER*: Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns
SIEV	73.2004	*Margarita GENIUS and Elisabetta STRAZZERA*: The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests

CCMP	74.2004	*Rob DELLINK and Ekko van IERLAND*: Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment
ETA	75.2004	*Rosella LEVAGGI and Michele MORETTO*: Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach
CTN	76.2004	*Salvador BARBERÀ and Matthew O. JACKSON* (lxx): On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union
CTN	77.2004	*Àlex ARENAS, Antonio CABRALES, Albert DÍAZ-GUILERA, Roger GUIMERÀ and Fernando VEGA-REDONDO* (lxx): Optimal Information Transmission in Organizations: Search and Congestion
CTN	78.2004	*Francis BLOCH and Armando GOMES* (lxx): Contracting with Externalities and Outside Options
CTN	79.2004	*Rabah AMIR, Effrosyni DIAMANTOUDI and Licun XUE* (lxx): Merger Performance under Uncertain Efficiency Gains
CTN	80.2004	*Francis BLOCH and Matthew O. JACKSON* (lxx): The Formation of Networks with Transfers among Players
CTN	81.2004	*Daniel DIERMEIER, Hülya ERASLAN and Antonio MERLO* (lxx): Bicameralism and Government Formation
CTN	82.2004	*Rod GARRATT, James E. PARCO, Cheng-ZHONG QIN and Amnon RAPOPORT* (lxx): Potential Maximization and Coalition Government Formation
CTN	83.2004	*Kfir ELIAZ, Debraj RAY and Ronny RAZIN* (lxx): Group Decision-Making in the Shadow of Disagreement
CTN	84.2004	*Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ* (lxx): Economics: An Emerging Small World?
CTN	85.2004	*Edward CARTWRIGHT* (lxx): Learning to Play Approximate Nash Equilibria in Games with Many Players
IEM	86.2004	*Finn R. FØRSUND and Michael HOEL*: Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power
KTHC	87.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources, Investment and Long-Term Income
CCMP	88.2004	*Marzio GALEOTTI and Claudia KEMFERT*: Interactions between Climate and Trade Policies: A Survey
IEM	89.2004	*A. MARKANDYA, S. PEDROSO and D. STREIMIKIENE*: Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?
GG	90.2004	*Rolf GOLOMBEK and Michael HOEL* : Climate Agreements and Technology Policy
PRA	91.2004	*Sergei IZMALKOV* (lxv): Multi-Unit Open Ascending Price Efficient Auction
KTHC	92.2004	*Gianmarco I.P. OTTAVIANO and Giovanni PERI*: Cities and Cultures
KTHC	93.2004	*Massimo DEL GATTO*: Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution
CCMP	94.2004	*Pierre-André JOUVET, Philippe MICHEL and Gilles ROTILLON*: Equilibrium with a Market of Permits
CCMP	95.2004	*Bob van der ZWAAN and Reyer GERLAGH*: Climate Uncertainty and the Necessity to Transform Global Energy Supply
CCMP	96.2004	*Francesco BOSELLO, Marco LAZZARIN, Roberto ROSON and Richard S.J. TOL*: Economy-Wide Estimates of the Implications of Climate Change: Sea Level Rise
CTN	97.2004	*Gustavo BERGANTIÑOS and Juan J. VIDAL-PUGA*: Defining Rules in Cost Spanning Tree Problems Through the Canonical Form
CTN	98.2004	*Siddhartha BANDYOPADHYAY and Mandar OAK*: Party Formation and Coalitional Bargaining in a Model of Proportional Representation
GG	99.2004	*Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA*: The Impact of Surplus Sharing on the Stability of International Climate Agreements
SIEV	100.2004	*Chiara M. TRAVISI and Peter NIJKAMP*: Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents
SIEV	101.2004	*Chiara M. TRAVISI, Raymond J. G. M. FLORAX and Peter NIJKAMP*: A Meta-Analysis of the Willingness to Pay for Reductions in Pesticide Risk Exposure
NRM	102.2004	*Valentina BOSETTI and David TOMBERLIN:* Real Options Analysis of Fishing Fleet Dynamics: A Test
CCMP	103.2004	*Alessandra GORIA e Gretel GAMBARELLI:* Economic Evaluation of Climate Change Impacts and Adaptability in Italy
PRA	104.2004	*Massimo FLORIO and Mara GRASSENI*: The Missing Shock: The Macroeconomic Impact of British Privatisation
PRA	105.2004	*John BENNETT, Saul ESTRIN, James MAW and Giovanni URGA*: Privatisation Methods and Economic Growth in Transition Economies
PRA	106.2004	*Kira BÖRNER*: The Political Economy of Privatization: Why Do Governments Want Reforms?
PRA	107.2004	*Pehr-Johan NORBÄCK and Lars PERSSON*: Privatization and Restructuring in Concentrated Markets
SIEV	108.2004	*Angela GRANZOTTO, Fabio PRANOVI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo MAINARDI*: Comparison between Artisanal Fishery and Manila Clam Harvesting in the Venice Lagoon by Using Ecosystem Indicators: An Ecological Economics Perspective
CTN	109.2004	*Somdeb LAHIRI*: The Cooperative Theory of Two Sided Matching Problems: A Re-examination of Some Results
NRM	110.2004	*Giuseppe DI VITA*: Natural Resources Dynamics: Another Look
SIEV	111.2004	*Anna ALBERINI, Alistair HUNT and Anil MARKANDYA*: Willingness to Pay to Reduce Mortality Risks: Evidence from a Three-Country Contingent Valuation Study
KTHC	112.2004	*Valeria PAPPONETTI and Dino PINELLI*: Scientific Advice to Public Policy-Making
SIEV	113.2004	*Paulo A.L.D. NUNES and Laura ONOFRI*: The Economics of Warm Glow: A Note on Consumer's Behavior and Public Policy Implications
IEM	114.2004	*Patrick CAYRADE*: Investments in Gas Pipelines and Liquefied Natural Gas Infrastructure What is the Impact on the Security of Supply?
IEM	115.2004	*Valeria COSTANTINI and Francesco GRACCEVA:* Oil Security. Short- and Long-Term Policies

IEM	116.2004	*Valeria COSTANTINI and Francesco GRACCEVA:* Social Costs of Energy Disruptions
IEM	117.2004	*Christian EGENHOFER, Kyriakos GIALOGLOU, Giacomo LUCIANI, Maroeska BOOTS, Martin SCHEEPERS, Valeria COSTANTINI, Francesco GRACCEVA, Anil MARKANDYA and Giorgio VICINI*: Market-Based Options for Security of Energy Supply
IEM	118.2004	*David FISK*: Transport Energy Security. The Unseen Risk?
IEM	119.2004	*Giacomo LUCIANI*: Security of Supply for Natural Gas Markets. What is it and What is it not?
IEM	120.2004	*L.J. de VRIES and R.A. HAKVOORT*: The Question of Generation Adequacy in Liberalised Electricity Markets
KTHC	121.2004	*Alberto PETRUCCI*: Asset Accumulation, Fertility Choice and Nondegenerate Dynamics in a Small Open Economy
NRM	122.2004	*Carlo GIUPPONI, Jaroslaw MYSIAK and Anita FASSIO*: An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application
NRM	123.2004	*Margaretha BREIL, Anita FASSIO, Carlo GIUPPONI and Paolo ROSATO*: Evaluation of Urban Improvement on the Islands of the Venice Lagoon: A Spatially-Distributed Hedonic-Hierarchical Approach
ETA	124.2004	*Paul MENSINK*: Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited
NRM	125.2004	*Mauro FABIANO, Gabriella CAMARSA, Rosanna DURSI, Roberta IVALDI, Valentina MARIN and Francesca PALMISANI*: Integrated Environmental Study for Beach Management:A Methodological Approach
PRA	126.2004	*Irena GROSFELD and Iraj HASHI*: The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic
CCMP	127.2004	*Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL*: A General Equilibrium Analysis of Climate Change Impacts on Tourism
CCMP	128.2004	*Reyer GERLAGH*: A Climate-Change Policy Induced Shift from Innovations in Energy Production to Energy Savings
NRM	129.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources, Innovation, and Growth
PRA	130.2004	*Bernardo BORTOLOTTI and Mara FACCIO*: Reluctant Privatization
SIEV	131.2004	*Riccardo SCARPA and Mara THIENE*: Destination Choice Models for Rock Climbing in the Northeast Alps: A Latent-Class Approach Based on Intensity of Participation
SIEV	132.2004	*Riccardo SCARPA Kenneth G. WILLIS and Melinda ACUTT*: Comparing Individual-Specific Benefit Estimates for Public Goods: Finite Versus Continuous Mixing in Logit Models
IEM	133.2004	*Santiago J. RUBIO*: On Capturing Oil Rents with a National Excise Tax Revisited
ETA	134.2004	*Ascensión ANDINA DÍAZ*: Political Competition when Media Create Candidates' Charisma
SIEV	135.2004	*Anna ALBERINI*: Robustness of VSL Values from Contingent Valuation Surveys
CCMP	136.2004	*Gernot KLEPPER and Sonja PETERSON*: Marginal Abatement Cost Curves in General Equilibrium: The Influence of World Energy Prices
ETA	137.2004	*Herbert DAWID, Christophe DEISSENBERG and Pavel ŠEVČIK*: Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game
CCMP	138.2004	*ZhongXiang ZHANG*: The World Bank's Prototype Carbon Fund and China
CCMP	139.2004	*Reyer GERLAGH and Marjan W. HOFKES*: Time Profile of Climate Change Stabilization Policy
NRM	140.2004	*Chiara D'ALPAOS and Michele MORETTO*: The Value of Flexibility in the Italian Water Service Sector: A Real Option Analysis
PRA	141.2004	*Patrick BAJARI, Stephanie HOUGHTON and Steven TADELIS* (lxxi): Bidding for Incompete Contracts
PRA	142.2004	*Susan ATHEY, Jonathan LEVIN and Enrique SEIRA* (lxxi): Comparing Open and Sealed Bid Auctions: Theory and Evidence from Timber Auctions
PRA	143.2004	*David GOLDREICH* (lxxi): Behavioral Biases of Dealers in U.S. Treasury Auctions
PRA	144.2004	*Roberto BURGUET* (lxxi): Optimal Procurement Auction for a Buyer with Downward Sloping Demand: More Simple Economics
PRA	145.2004	*Ali HORTACSU and Samita SAREEN* (lxxi): Order Flow and the Formation of Dealer Bids: An Analysis of Information and Strategic Behavior in the Government of Canada Securities Auctions
PRA	146.2004	*Victor GINSBURGH, Patrick LEGROS and Nicolas SAHUGUET* (lxxi): How to Win Twice at an Auction. On the Incidence of Commissions in Auction Markets
PRA	147.2004	*Claudio MEZZETTI, Aleksandar PEKEČ and Ilia TSETLIN* (lxxi): Sequential vs. Single-Round Uniform-Price Auctions
PRA	148.2004	*John ASKER and Estelle CANTILLON* (lxxi): Equilibrium of Scoring Auctions
PRA	149.2004	*Philip A. HAILE, Han HONG and Matthew SHUM* (lxxi): Nonparametric Tests for Common Values in First-Price Sealed-Bid Auctions
PRA	150.2004	*François DEGEORGE, François DERRIEN and Kent L. WOMACK* (lxxi): Quid Pro Quo in IPOs: Why Bookbuilding is Dominating Auctions
CCMP	151.2004	*Barbara BUCHNER and Silvia DALL'OLIO*: Russia: The Long Road to Ratification. Internal Institution and Pressure Groups in the Kyoto Protocol's Adoption Process
CCMP	152.2004	*Carlo CARRARO and Marzio GALEOTTI*: Does Endogenous Technical Change Make a Difference in Climate Policy Analysis? A Robustness Exercise with the FEEM-RICE Model
PRA	153.2004	*Alejandro M. MANELLI and Daniel R. VINCENT* (lxxi): Multidimensional Mechanism Design: Revenue Maximization and the Multiple-Good Monopoly
ETA	154.2004	*Nicola ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS*: Is there any Scope for Corporatism in Stabilization Policies?
CTN	155.2004	*Johan EYCKMANS and Michael FINUS*: An Almost Ideal Sharing Scheme for Coalition Games with Externalities
CCMP	156.2004	*Cesare DOSI and Michele MORETTO*: Environmental Innovation, War of Attrition and Investment Grants

CCMP	157.2004	*Valentina BOSETTI, Marzio GALEOTTI and Alessandro LANZA*: How Consistent are Alternative Short-Term Climate Policies with Long-Term Goals?
ETA	158.2004	*Y. Hossein FARZIN and Ken-Ichi AKAO*: Non-pecuniary Value of Employment and Individual Labor Supply
ETA	159.2004	*William BROCK and Anastasios XEPAPADEAS*: Spatial Analysis: Development of Descriptive and Normative Methods with Applications to Economic-Ecological Modelling
KTHC	160.2004	*Alberto PETRUCCI*: On the Incidence of a Tax on PureRent with Infinite Horizons
IEM	161.2004	*Xavier LABANDEIRA, José M. LABEAGA and Miguel RODRÍGUEZ*: Microsimulating the Effects of Household Energy Price Changes in Spain

NOTE DI LAVORO PUBLISHED IN 2005

CCMP	1.2005	*Stéphane HALLEGATTE*: Accounting for Extreme Events in the Economic Assessment of Climate Change
CCMP	2.2005	*Qiang WU and Paulo Augusto NUNES*: Application of Technological Control Measures on Vehicle Pollution: A Cost-Benefit Analysis in China
CCMP	3.2005	*Andrea BIGANO, Jacqueline M. HAMILTON, Maren LAU, Richard S.J. TOL and Yuan ZHOU*: A Global Database of Domestic and International Tourist Numbers at National and Subnational Level
CCMP	4.2005	*Andrea BIGANO, Jacqueline M. HAMILTON and Richard S.J. TOL*: The Impact of Climate on Holiday Destination Choice
ETA	5.2005	*Hubert KEMPF*: Is Inequality Harmful for the Environment in a Growing Economy?
CCMP	6.2005	*Valentina BOSETTI, Carlo CARRARO and Marzio GALEOTTI*: The Dynamics of Carbon and Energy Intensity in a Model of Endogenous Technical Change
IEM	7.2005	*David CALEF and Robert GOBLE*: The Allure of Technology: How France and California Promoted Electric Vehicles to Reduce Urban Air Pollution
ETA	8.2005	*Lorenzo PELLEGRINI and Reyer GERLAGH*: An Empirical Contribution to the Debate on Corruption Democracy and Environmental Policy
CCMP	9.2005	*Angelo ANTOCI*: Environmental Resources Depletion and Interplay Between Negative and Positive Externalities in a Growth Model
CTN	10.2005	*Frédéric DEROIAN*: Cost-Reducing Alliances and Local Spillovers
NRM	11.2005	*Francesco SINDICO*: The GMO Dispute before the WTO: Legal Implications for the Trade and Environment Debate
KTHC	12.2005	*Carla MASSIDDA*: Estimating the New Keynesian Phillips Curve for Italian Manufacturing Sectors
KTHC	13.2005	*Michele MORETTO and Gianpaolo ROSSINI*: Start-up Entry Strategies: Employer vs. Nonemployer firms
PRCG	14.2005	*Clara GRAZIANO and Annalisa LUPORINI*: Ownership Concentration, Monitoring and Optimal Board Structure
CSRM	15.2005	*Parashar KULKARNI*: Use of Ecolabels in Promoting Exports from Developing Countries to Developed Countries: Lessons from the Indian LeatherFootwear Industry
KTHC	16.2005	*Adriana DI LIBERTO, Roberto MURA and Francesco PIGLIARU*: How to Measure the Unobservable: A Panel Technique for the Analysis of TFP Convergence

(lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003

(lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL) , Venice, August 28-29, 2003

(lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003

(lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003

(lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003

(lxx) This paper was presented at the 9^{th} Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004

(lxxi) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by Fondazione Eni Enrico Mattei and Consip and sponsored by the EU, Rome, September 23-25, 2004

2004 SERIES	
CCMP	*Climate Change Modelling and Policy* (Editor: Marzio Galeotti)
GG	*Global Governance* (Editor: Carlo Carraro*)*
SIEV	*Sustainability Indicators and Environmental Valuation* (Editor: Anna Alberini)
NRM	*Natural Resources Management* (Editor: Carlo Giupponi)
KTHC	*Knowledge, Technology, Human Capital* (Editor: Gianmarco Ottaviano)
IEM	*International Energy Markets* (Editor: Anil Markandya)
CSRM	*Corporate Social Responsibility and Sustainable Management* (Editor: Sabina Ratti)
PRA	*Privatisation, Regulation, Antitrust* (Editor: Bernardo Bortolotti)
ETA	*Economic Theory and Applications* (Editor: Carlo Carraro)
CTN	*Coalition Theory Network*

2005 SERIES	
CCMP	*Climate Change Modelling and Policy* (Editor: Marzio Galeotti)
SIEV	*Sustainability Indicators and Environmental Valuation* (Editor: Anna Alberini)
NRM	*Natural Resources Management* (Editor: Carlo Giupponi)
KTHC	*Knowledge, Technology, Human Capital* (Editor: Gianmarco Ottaviano)
IEM	*International Energy Markets* (Editor: Anil Markandya)
CSRM	*Corporate Social Responsibility and Sustainable Management* (Editor: Sabina Ratti)
PRCG	*Privatisation Regulation Corporate Governance* (Editor: Bernardo Bortolotti)
ETA	*Economic Theory and Applications* (Editor: Carlo Carraro)
CTN	*Coalition Theory Network*