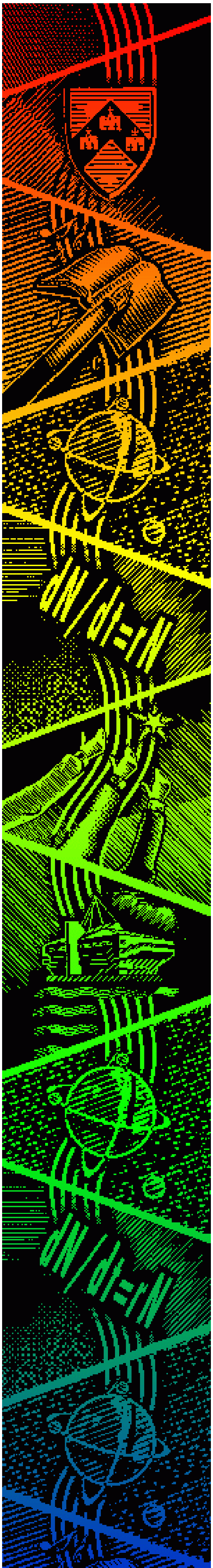

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On the Effects of Industrialization Processes on Growth and Convergence Dynamics: Evidence from Italian Regions

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Abstract

This paper studies the effects of industrialization on growth and convergence dynamics in Italy. We propose a semi-parametric procedure linking growth theory with density-type studies on convergence. Our analysis suggests that absolute convergence processes do not necessarily exclude dynamics of club convergence and vice-versa. Growth and convergence processes should be thought as the composition of contrasting economic influences, in which industrialization matters. Our results suggest that the convergence process between the South and the North of Italy ended due to a slowing down both in the industrialization process in Southern regions and in the steady state convergence process of all regional economies.

Keywords: Industrialization; Growth; Convergence; Distribution Dynamics.

JEL Classification: C14; D30; O14; O41.

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1 Introduction

Despite the importance of the industrialization process for the less-developed economies to catch up with developed countries, its theoretical and empirical role has been largely left aside by papers on growth and especially by the literature on convergence.[1]

The empirical literature employs one-sector versions of the Solow (1956) model or of the "growth accounting" approach (Temple, 1999). In such frameworks, the analysis of the convergence process is conducted by including the initial level of per capita GDP in the regressors set - what has come to be known as β-convergence (Barro and Sala-i-Martin 1991, 1992 and 1996; Barro, 1998).[2]

However, predictions and results on convergence obtained by means of "growth regressions" have been criticized in recent years (Ben-David, 1994; Durlauf and Johnson, 1996; Quah 1996). These criticisms arise from the idea that the Absolute and the Club Convergence Hypotheses (ACH and CCH hereafter) should be intended essentially as empirical questions; for this reason, economic theory should enter the analysis answering the question of why economies converge (or eventually not) only once it has been adequately assessed whether countries are converging (or not). Indeed, Galor (1996) and Durlauf and Quah (1999) note that if, as suggested by the economic theory variables like capital deepening or human capital are included in the regressors set, empirical frameworks study conditional convergence and conditional club convergence processes, rather than testing the ACH versus the CCH.

With the aim of building pure empirical frameworks, many alternative approaches for studying growth and convergence have been recently proposed (see Ben-David, 1994; Bernard and Durlauf, 1995; Quah, 1997 among others). One of these approaches proposes theorizing "directly in terms of the entire distribution, and permitting explicit patterns of cross section interactions [...] to endogenously emerge" (Quah, 1997:121). This procedure makes use of continuous transitional matrices - stochastic kernels - to provide information on whether and to what extent some positions in the

[1] Recent reviews on the so-called new growth empirics and convergence do not even mention industrialization (De la Fuente, 1997 and 1999; Durlauf and Quah, 1999; Islam, 2003). Temple (1999) also notes this point.

[2] There are two main reasons for this choice. On the one hand, empirical models derive directly from reduced-form solutions of a growth model, and empirical results may be interpreted in the light of the economic theory (Temple, 1999). On the other hand, the "old" neoclassical framework seems to encompass, from the empirical viewpoint, models of the so-called new growth theory (Jones, 1995; Parente, 2001).

overall distribution represent the long run basins of attraction for a sample of economies.

This framework overcomes at least two of the main shortcomings of the growth regressions approach. From an empirical perspective, it studies the evolution of the entire distribution of the per capita GDP, rather than its first two moments. More importantly, from a theoretical viewpoint it overcomes the concept of representative economy, allowing for a richer behavior - both cross-country and over time - of each of the economies under examination. Because of these features, this framework is now being used extensively across growth and convergence studies (Quah, 1997; Paap and van Dijk, 1998; Bianchi, 1999; Lamo, 2000; Beaudry, Collard and Green, 2003; Leonida and Montolio, 2001 and 2004).

Quah (1996) suggests that such an approach needs some refinements. We believe that its main shortcomings are due to the necessity of estimating distributions by means of a complete non-parametric technique. As it is known, this estimation framework is free from any theoretical constraint, and this makes it particularly appealing if the analysis is focused on convergence processes. However, the lack of theoretical foundations makes the empirical results difficult to interpret by means of the economic theory: the strength of the non-parametric technique in studying if a sample of economies grows and converges represents its primary weakness when the researcher wants to address why one observes growth, convergence or divergence. In fact, within a completely nonparametric framework it is difficult to provide an answer to questions like "why poor economies do not tend to converge with richer countries? Does capital accumulation explain the differences between growth paths of poor and rich economies? Alternatively, are they explained by human capital accumulation? What are the effects of the industrialization processes on growth and convergence?

To answer these questions we propose a semi-parametric procedure linking growth theory with the stochastic kernel framework. In particular, we use growth theory to remove the effects of some determinants of economic growth from the mobility dynamics of a sample of economies. Our procedure analyzes growth and convergence patterns and the effects of industrialization jointly: we analyze both whether economies converge in their growth processes (addressing the original question of convergence) and whether convergence and growth processes are driven by sectoral unbalances and by processes of resource reallocation between manufacturing and agriculture (combining studies on industrialization and literature on convergence).

We apply our framework to the study of growth and convergence patterns across Italian regions over the period 1960-95. In the analysis of the relationships between industrialization and convergence, Italy appears to be particularly interesting, mainly due to he fact that the analysis involves both developed and less developed regions. All developed regions are geographically close and set in the Centre-North of the country, which exhibits a highly productive industrial sector and it operates close to full employment - see Figure I. On the contrary, the South of Italy represents a case of "missing" industrialization: it experienced a slowing down of industrialization process during the late 60s; therefore, its capacity to create jobs and absorb new employment has been low.

Moreover, the extant distance in term of levels of GDP per capita cannot be imputed to coordination failures among di¤erent institutions, as claimed by Peters (1998): regions share government and all main institutions, and this allows us to draw conclusion about the growth paths of a dualistic economy giving less concern to political issues with respect to, for example, political and economic problems faced by the European Union. Because of these two characteristics, the Italian economy has attracted economists' interest since early stages of its process of development (Lutz, 1960; Eckaus, 1961; Chenery, 1962; Williamson, 1965; Graziani, 1979).

Our analysis provides several interesting results. First, we show that evidence in favour of the ACH does not necessarily exclude the CCH, and vice-versa. Over the period 1960-75, evidence shows that regions both converge and polarize, casting doubts on the common practice of taking these hypotheses as competing in empirical frameworks - see, for example, Quah (1997) or Islam (2003). Second, we show that growth and convergence dynamics should be thought as a composition of competing economic in‡uences. Some of them boost growth and convergence dynamics and some others work against such processes; and their net impact produces the mobility patterns we observe. Uncovering which of these forces are more important in de…ning the growth path of an economy is an essential piece of information for policy makers.

Our results also suggest that in the case of Italy the standard framework of growth accounting is encompassed by models augmented to account for some aspects of the industrialization process which, together with steady state convergence, plays a key role in explaining patterns of growth and convergence. We show that the convergence process between South and North of Italy ended due to a slowing down both in the industrialization process in Southern regions and in the process of convergence of each regional economy to its steady state level. This conclusion is in sharp contrast with the literature on convergence in Italy, which claims that the convergence process among Italian regions ended because of external shocks (namely, the 1973 oil shock).

We believe that our results provide clear insights to Italian policy makers: developing the service sectors - tourism or similar - should be seen as a complementary strategy, rather than a substitute of an effective industrial policy.

The remainder of the paper proceeds as follows. Section 2 provides some preliminary results, which we use to scketch the main lines of the debate on convergence in Italy and to motivate our work. Section 3 defines our research design. Section 4 describes the data sources and variables we use. Section 5 reports our empirical results and section 6 provides some concluding remarks.

2 The Debate on Growth and Convergence in Italy

2.1 Convergence and Growth in Italy: Results from a Density-type approach

Quah (1997) proposes the use of stochastic kernels for providing an estimate of the ex-post probability of having an income per capita of y_{t+s}, conditional to the income level at t, y_t.

More specifically, by making use of Bayes' law, a stochastic kernel is defined as:

$$f(y_{it+s} \mid y_{it}) = \frac{f(y_{it}, y_{it+s})}{f(y_{it})}, \tag{1}$$

where y_{it} is the relative GDP per capita at t, and s is the lenght of the transitional period under examination (Quah, 1997). The estimate in (1) is equivalent to a continuous transition matrix. It allows the researcher to examine whether rich regions at t are still rich at $t+s$ (persistence); whether some poor economies at t become rich at $t+s$ (mobility); and whether some groups of economies, originally grouped in the middle class, have separated because a process of polarization (separability).

Such an estimate can be interpreted as a test of the ACH, by simply studying the position in the space of the estimated mass: "if most of the graph were concentrated along the 45-degree diagonal, then elements in the distribution remain where they began. If, by contrast, most of the mass in the graph were rotated 90 degrees counter-clockwise from that 45-degree diagonal, then substantial overtaking occurs" (Quah, 1997: 134). In Figure II, panel A reports the stochastic kernel estimated for transitions occurred between t and $t+5$, by using the GDP per capita relative to Italian regions between 1960 and 1995.[3]

Panel B shows that persistence of regional disparities is the main feature of the sample; indeed, the estimated mass lies almost entirely along the 45-degree line. Notice also that the middle class tends to vanish; indeed, at the centre of the probability mass we observe a process of local divergence. The estimate also reveals the existence of two positions, close to the 45-degree line, at which the probability mass tends to concentrate. Taken together, these results suggest that Italian regions approach to di¤erent long run equilibria; the …nal position that each region reaches depends on its position within the distribution in t. Indeed, the two modes that the stochastic kernel displays represent the basins of attraction for the regions (Bernard and Durlauf, 1995).

These results are not really surprising: duality is a well known feature of the Italian economic system. However, they are clearly in contrast with the optimistic conclusion of Barro and Sala-i-Martin (1991), according to whom Italian regions are converging at 2% speed per year. They show that Italian regions display a high dispersion in (the logarithm of) GDP per capita; this evidence leads them to claim that "there is nothing surprising in the relative performances of the regions of Northern and Southern Italy. The South of Italy has not yet caught up because it started far behind the North, and the rate of [...] convergence is only about 2% a year" (Barro and Sala-i-Martin, 1991:151).

However, their conclusions have not been supported by recent empirical studies on Italy. Mauro and Podrecca (1994) claim that the results of Barro and Sala-i-Martin (1991) are biased because of a lack of time homogeneity in their data. Their main criticisms concern the implementation of the growth regression framework after a process of homogenization of the data across three di¤erent time spans. They obtain some estimates by applying the growth regression framework to the three di¤erent time periods separately, and show that the coe¢cient associated with the distance between the current and the steady state position of the per capita GDP - from which the so-called rate of β-convergence is recovered - is not statistically signi…cant. Against the ACH they also …nd that the dispersion of per capita income would not decline over time if data were not time homogenized.

Our results show that the probability mass at very low levels of GDP per capita lies upon the 45-degree line; furthermore, the probability mass measured at high levels of GDP lies below the main diagonal: in 1995,

[3] These estimates are obtained by means of a Gaussian Kernel under the hypothesis that data are normally distributed. See Appendix A for more details on these choices.

regions are closer than they were in 1960. Notice that Barro and Sala-i-Martin (1991) analyze the period before 1975, when regions actually show convergence. To see this, Panel A of Figure III reports the contours plot of the stochastic kernel estimated for the period 1960-75. Again, the evidence shows that a convergence process exists. Over this period, this process is not completely offset by the vanishing middle class. In sum, we find evidence of a process that could be named clustering convergence, in the sense that regions both converge and cluster in two distinct groups.

Such evidence raises doubts on the common practice of taking the ACH and CCH as competing hypotheses (Quah, 1997; Bianchi, 1997; Islam 2003). From a theoretical perspective, it is possible that similar economies - or economies with similar initial conditions - converge in groups within a more general process of absolute convergence (Galor, 1996). Hence it is reasonable to hypothesize that the former process, involving similar economies, is faster than the latter, which instead involves economies at different stage of development (Leonida, 2004 discusses this point in greater detail).

Panel B of Figure III shows that in the period 1975-1995, Italian regions experienced divergence and clustering. The mode representing the group of “poor” regions is set below the diagonal; instead, the second mode is set slightly above this line. This evidence represents an established stylized fact: all regions from South are stuck in a sort of underdevelopment trap, and regions from North are growing and diverging from the rest of the country (Graziani, 1978; Giannola and Del Monte, 1979; Faini, 1983; Cellini and Scorcu, 1995; Paci and Saba, 1998; Terrasi 1999).

The literature on convergence in Italy uncovers the existence of a clear pattern of divergence from the mid-seventies up to today across Italian regions (Paci and Saba, 1998; Terrasi, 1999). More specifically, Paci and Saba (1998), on the basis of an homogeneous series, claim that the convergence process ends in 1975. The estimate of the coefficient associated with the gap variable is negative and statistically significant, and this result seems to be driven by a strong catching-up process only for the period 1960-75.

Actually, most of the studies find conditional convergence: Italian regions tend to converge to their own steady state positions (Mauro and Podrecca, 1994; Cellini and Scorcu, 1995; Di Liberto and Symons, 1998). In a growth regression framework, however, it is difficult to distinguish conditional convergence processes from club convergence dynamics (Islam, 2003). Other researchers employ more sophisticated econometric tools. For example, an analysis based on the estimation of the Theil index for the period 1953-1993 confirms that the reversal in the convergence path took place in 1975 (Terrasi, 1999). However, as in a time series framework (Cellini and

Scorcu, 1995), this approach needs some *a priori* grouping criteria - usually, the geographical provenance of each observation - and it has been shown that the analysis of the club convergence processes depends crucially on such splitting criteria (Ben-David, 1994).

Our results show that a club convergence process has unambiguously occurred over time and across Italian regions. Such a process is more evident over the period 1975-95 (Figure III, panel B): the evidence confirms the finding that Italian regions did not show convergence during the 80s or the 90s. However, we also note that even the period 1960-75 shows a similar process; it is difficult to uncover it without referring to the shape of the entire distribution because it is overshadowed by a strong reduction in the dispersion.

To highlight the finding according to which the North and the South of Italy converge until 1975, the second column of Table I reports their relative GDP per capita averaged across seven intervals of five years each - Italy is set equal to unity. This column shows that in fact the distance between the North and the South of the country decreases until 1975, and increases thereafter.

The reversal in the convergence process occurring in the early 70s manifests even if the analysis focuses on labour productivity (Paci and Saba, 1998). The same table reports some other simple economic indicators. These figures show that both the North and the South of Italy experienced a decline in the fraction of the value added produced by the agricultural sector; moreover, the two sets of regions show an increase in the value added produced by the manufacturing until 1970-1975. It is evident that these fractions decline in subsequent periods. However, Southern regions experienced a stronger decline with respect to the rest of the country. It is suggested that this decline is at the root of the cause of the reversal in the convergence pattern, and it is caused by the oil shock occurred in 1973 (Paci and Saba, 1998; Terrasi, 1999).

2.2 Motivation

Table I reports other information highlighting how different the North and the South of Italy are: in the first period we consider, the value added produced in agriculture in the South was twice as large as that produced in the North. This proportion remains essentially constant over all periods. On the other hand, Northern regions produced almost 50 percent more than Southern ones in the manufacturing sector, and this proportion tends to increase over time.

Also, note that the process of resource reallocation from agriculture to manufacturing begins in 1960 for the Northern regions: their investment in agriculture is always lower with respect to the Southern ones. Moreover, this fraction tends to decline over time, while investment in manufacturing increases. Conversely, across the Southern regions investment in agriculture tends to decrease substantially after the second part of the 80s only. Southern investment in the industrial sector is always lower than across Northern regions; moreover, excluding the early 70s - where a peak manifests, essentially because of large investments in industry made by the central government - the fraction of manufacturing investment tends to decrease throughout.

The differences in the process of resource reallocation are also evident in the composition of employment and its evolution. Manufacturing employment in Northern regions is always higher than across Southern economies. Across the former some of the workers leaving the agricultural sector were absorbed by the manufacturing sector, especially during the first four intervals of time. Employment in agriculture across Southern regions is always much higher than in Northern ones. Moreover, the Southern manufacturing sector appears to be much less able to absorb people leaving agriculture.

In summary, there is evidence of different growth processes across regions, and especially over time. A process of unbalanced growth seems to manifest especially across the period 1960-75, when Italy was at an early stage of development and regional economies were converging. More specifically, Northern regions seem to have experienced a strong industrialization process; Southern regions also grew, but the salient structural features of the two groups of regions were different.

Williamson (1965) looks optimistically at this imbalance. He suggests, by looking at the sectoral and geographical imbalances as growth-boosting devices, that Southern regions would catch up in a second stage of the Italian development process. As noted by Terrasi (1999), he explicitly links the level of the national development and the process of absolute convergence across regional economies, introducing the hypothesis that the lower the degree of development of a nation, the faster some of the regions within the country will grow and diverge from other regional economies. The laggands would catch up in a second stage, by taking advantage of the progress of the fast-growing regions: "the evidence on Italian regional dualism suggest optimistic projections regarding the future size of the North-South problem as Italy passes into mature stages of growth and rapidly ascends into high-income classes" (Williamson, 1965:28).

This has not been the case. Nowadays, Italy must clearly be regarded as a developed country; however, over recent decades, Southern regions have not caught up with Northern ones, and it seems unrealistic to hypothesize that a convergence process will manifest in the near future. Giannola and Del Monte (1997) suggest that the Williamson (1965) model may also provide theoretical ground for a dualistic economy to induce divergence across regions. The authors suggest that, if some non-linearities exist in the function describing the accumulation of capital (non-decreasing returns to scale) or if production functions di¤er across regional economies (so returns to capital may be higher in the developed parts of the country) economic activities may concentrate instead of spreading across regions. This, in turn, may lead to the observed divergence pattern between the North and the South of Italy.

The observation that economic systems of the regions located in South of Italy are unbalanced towards the agricultural sector is a well known stylized fact of the Italian economic dualism. However, even thought it is acknowledged "virtually every country that experienced rapid growth of productivity and living standards over the last 200 years has done so by industrializing" (Murphy, Shleifer and Vishny, 1989:1003), to our knowledge there are no studies that quantify the e¤ects of such imbalances on the subsequent convergence paths of Italian regions by means of a non-parametric framework.[4]

3 Research Design

3.1 From Unconditional to Counterfactual Transitions

As discussed earlier, the distributional approach is attractive because it makes use of all moments of the distribution of GDP per capita. When we deal with samples where the level of development di¤ers, the growth processes may also di¤er; for this reason, an analysis based on the e¤ects of growth determinants on the mean of the growth rates may not be su¢ cient. Indeed, we have shown that the distribution-based approach allows the researcher to model economies as a set, and each of them is allowed to display a di¤erent temporal behavior; in this sense, the analysis is no more focussed on a representative economy. Second, in a growth regression framework no information is given in the case of rejection of the null hypothesis of absolute

[4] Dall'Aglio (2003) is an interesting exception. He uses a regression tree approach to study the convergence process among Italian regions for a period going from 1963 to 1996. His results suggest that the extent of the industrial sector in‡uence the ability of a region to growth. However, he is not recovering his conditioning parameters from a theoretical model; and this raises doubts on the consistency of the estimated coe¢ cients (Islam 2003).

convergence. Instead, by using the procedure proposed by Quah (1997), if the ACH is rejected we can directly study whether economies are converging in clubs or diverging.

Eq (1) represents a pure non-parametric estimator, and only in this case it represents a continuous transition matrix. This estimation procedure is free from any constraints coming from the economic theory, and exactly this feature turns out to be important when the analysis is focused on whether economies are converging.

However, such lack of theoretical foundations represents its primary weakness once one tries to study why economies grow and converge (or eventually why they do not). This issue is of great importance. If it is difficult to relate empirical results to growth theory, it is consequently difficult to state which theoretical model - if any - explains the observed dynamics. It is also difficult to analyze the effects of variables such as physical and human capital stocks on growth and convergence dynamics.

We define a link between the non-parametric approach and growth theory in order to provide an answer to these questions. Such effort usually requires a semi-parametric procedure (see Di Nardo, Fortin and Lemieux, 1996; Beaudry, Collard and Green, 2003 for applications in univariate contexts). We identify this link by noting that in estimating the stochastic kernels, the positions of each observation in the income distribution at $t+s$ is entirely defined by three elements: its position at t, the growth rate it experienced between t and $t+s$, and the length of the transitional period, s. Indeed, by definition:

$$y_{it+s} = y_{it} e^{s(g_i - \bar{g})}, \tag{2}$$

where, for the ith observation, $y_{i,t}$ and $y_{i,t+s}$ are relative incomes per capita at t and $t+s$ respectively, g_i represents the average growth rate experienced between t and $t+s$, with s being the distance between the two points of time. Finally, $\bar{g}$ represents the average growth rate experienced by the sample between t and $t+s$.

Substituting (2) in (1) yields:

$$f\left(y_{it+s} \mid y_{it}\right) = \frac{f\left(y_{it}, y_{it} e^{s(g_i - \bar{g})}\right)}{f\left(y_{it}\right)}, \tag{3}$$

The formulation in (3) allows us to address a number of interesting questions.

On the one hand we may estimate:

$$f^{\cdot s}\left(y_{it+s} \mid y_{it}\right) = \frac{f\left(y_{it}, y_{it} e^{\cdot s(g_i - \bar{g})}\right)}{f\left(y_{it}\right)}, \tag{4}$$

for positive and increasing Δs. Eq. (4) allows us to assess the importance of the initial conditions in defining the convergence paths of the entire sample of economies, under the hypothesis that growth rate of each region stays constant over time.

On the other hand, let s be the transitional period under analysis, we may estimate the effect of a vector of variables x on g:

$$E(g \mid \mathrm{x}) = h(\mathrm{x}) \qquad (5)$$

As long as the impact of the variable $x_l \in \mathrm{x}$ - where $l = 1, ..., L$ - on g is consistently estimated (say $\hat{\beta}_l$), we may use results from the auxiliary regression in (5) to estimate:

$$f^{x_l}(y_{it+s} \mid y_{it}) = \frac{f\left(y_{it}, y_{it} e^{s[(g_i - \bar{g}) - \hat{\beta}_l (x_{li} - \bar{x}_l)]}\right)}{f(y_{it})}, \qquad (6)$$

which represents the stochastic kernel defining the path of convergence of the entire sample of economies from which the effects of the variable x_l is subtracted.

The difference between the estimate provided by eq. (1) and the one given by eq. (6) shows the effect of the variable x_l on the dynamics of the entire distribution. Under the hypothesis that $\hat{\beta}_{li} = \hat{\beta}_l \ \forall i$[5], the term $\hat{\beta}_l(x_{li} - \bar{x}_l)$ removes the effects of the variable x_l from the growth rate relative to each observation, since it is obtained by multiplying the constant parameter $(\hat{\beta}_l)$ by the vector $\mathrm{x}_{li} - \bar{\mathrm{x}}_l$.

Notice that eq. (5) can be derived from a standard growth model. Durlauf and Quah (1999), indeed, suggest that a growth regression may be used to recover the structural parameters of the production function. By using these parameters jointly with eq. (6), we may answer questions such as "which parts of the observed convergence process are explained by the steady state convergence and which parts depend on factor accumulation instead?" and "what is the effect of sectoral imbalances on growth and convergence patterns?" by simply choosing the appropriate economic model.[6]

[5] This hypothesis should be tested, rather than imposed at the outset, by means of tests for structural stability of the parameters. Since the interest of the Italian literature lies in the reversal of the convergence path occurred in 1975, we prefer to study stability of parameters over time, rather than across observations, which is left for future reasearch.

[6] In particular, we employ two models to estimate our conditioning parameters. We first use the standard neoclassical model for growth accounting - i.e. the production function approach. In the second stage, we extend such framework by proposing a two-sector formulation, which allows us to analyze the effects of sectoral imbalances on the growth rate. This model will be explicitly designed to conduct an encompassing analysis with the standard production function approach.

Notice also that eq. (5) can be estimated by means of several estimators, ranging from the OLS framework to the GMM panel estimator proposed by Arellano and Bond (1991).

Islam (2003) cautions against using the OLS estimator, since the constant term is supposed to be the same across economies and uncorrelated with other regressors. Notice that the constant term captures the so-called "Solow residual" - that is, the proportion of the growth rate not explained by the accumulation of production factors. However, since differences in terms of technological levels are not observable, they are captured by the constant terms. In this sense, we are making the hypothesis that all economies share the same technology, without studying whether this hypothesis pass the empirical test. If these differences are significant, we are likely to commit omitted variable bias. For this reason, it seems reasonable to switch to a panel data framework, and test whether the differences in the constant terms are statistically significant. Indeed, panel data are explicitly designed to overcome issues arising from the correlation between the unobservable effects and the error term.

This option is not without its own limitations. Barro (1997) argues that such a procedure tends to lose the cross-section variation of the data, since it relies on the within variation only. Hence, the within dimension of the data will be flawed because of its short frequency. However, since theoretical models suggest that each economy converges to its own steady state - rather than to one another - growth regressions should in fact rely on the within dimension of the data alone (Durlauf and Quah 1999). Moreover, to deal with the issue of short frequency, we may rely on five-year intervals to obtain the panel structure. Clearly, such approach gives shorter time spans with respect to the twenty year framework used in the cross-sectional framework; however, it is considerably longer than the frequency used in the time series approach to convergence, for example. In any case, issues arising from the use of a panel data estimator look less problematic than the omitted variable bias the OLS framework is likely to induce.

Choosing among the available panel data estimators is not straightforward, because there are different ways to deal with the so-called country fixed effects (Islam, 2003). It is suggested that GLS and MLE methods, to the extent that the unobservable term is likely to be correlated with other regressors, might not be the appropriate choices. However, the problem still exists, since most of the remaining estimators display similar asymptotic properties.

Note also that, as common across the growth literature, we use contemporaneous values of explanatory variables and output growth. To the extent that some of the regressors (for example, the growth rate of the physical capital stock) are likely to be jointly determined with the output growth rate, an endogenity bias may arise. However, given the poor small sample performance of the IV and GMM estimators in estimating growth regressions, it is not clear whether the use of these frameworks is worthwhile: the reduction in the endogenity bias may well be outweighed by the introduction of a small sample bias (Islam, 2000). The issue of endogenity of regressors in estimating growth regressions is not yet comprehensively addressed (Temple, 1999; Islam, 2003). Since our panel structure has a small cross section (20 observations) and a relatively large time dimension (1960-95), the LSDV estimator looks to be the safest empirical framework - even if it is biased for n ! 1, it is consistent for T ! 1 (Amemiya, 1971). To deal with the issue of endogeneity we perform a test for exogenity of regressors suspected to be correlated with the error term - namely, the Hausman speci…cation test. This speci…cation will also be tested again the OLS pooled model and a Random E¤ects Two-Ways Model.

3.2 Modelling Factors Accumulation and Steady State Convergence

The …rst model we employ to recover our conditioning parameters is a well-known framework for growth accounting (Temple, 1999).

As is known, this framework provides a breakdown of observed output growth into components associated with factor accumulation and technological progress. Production follows

$$Y_{it} = F_i(t) K_{it}^{\alpha} H_{it}^{\beta} L_{it}^{\gamma} \tag{7}$$

where Y_{it}, K_{it}, H_{it} and L_{it} are the aggregate output, the physical capital stock, the human capital stock and employment at time t in region i; α, β and γ are the elasticities of output to factors, and the term $F_i(t)$ represents the technological level of the ith region.

We extend a formulation due to Bairam and McRae (1999) to include human capital in the analysis.[7] Dividing both sides of (7) by employment

[7] The role of the human capital accumulation in growth models is emphasized especially by Lucas (1988): human capital, in the form of education, can lead to spillover e¤ects throughout the whole economy. Furthermore, in a generalization of Arrow's (1962) learning-by-doing model Romer (1986) focuses upon a model where e¢ ciency in production rises with cumulated experience. The standard Solow (1956) model has also been extended by Mankiw, Romer and Weil (1992) to account for the e¤ects of education on growth.

size, and differentiating with respect to time yields:

$$g_{(Y/L)_{it}} = g_{F_{it}} + \alpha g_{(K/L)_{it}} + \beta g_{(H/L)_{it}} + \delta g_{L_{it}} \tag{8}$$

where the gs represent the growth rate of the variables indicated by the subscripts, and $\delta = \alpha + \beta + \gamma - 1$.

Also, we obtain an expression for the per capita output, rather than an expression for the labour productivity:

$$\left(\frac{Y}{N}\right)_{it} \equiv \left(\frac{Y}{L}\right)_{it}\left(\frac{L}{N}\right)_{it} \tag{9}$$

Taking logs of (9) and differentiating it with respect to time, yields

$$g_{(Y/N)_{it}} = g_{(Y/L)_{it}} + g_{(L/N)_{it}} \tag{10}$$

Substituting (8) in (10) and rearranging yields:

$$g_{(Y/N)_{it}} = g_{F_{it}} + \alpha g_{(K/L)_{it}} + \beta g_{(H/L)_{it}} + \varphi g_{(L/N)_{it}} + \delta g_{N_{it}} \tag{11}$$

where $\varphi = \delta - 1$.

In the light of the debate on convergence, "the simplest neoclassical models, based on the assumption of decreasing returns to capital and free access by all countries to a common stationary technology, predict that growth cannot be sustained permanently but have optimistic implication from the point of view of convergence" (De la Fuente 1997:30-31). In the Solow's (1956) paper, the growth rate of the income per worker is inversely related to its initial level, provided that the estimates are controlled for the steady state determinants. A variety of authors have shown that once factor accumulation contributions have been taken into account, countries in fact tend to converge to their own steady state, and the convergence speed is positively related to the distance from the economy equilibrium position.

However, the debate on returns to scale casts some doubts on neoclassical conditional convergence (Barro and Sala-i-Martin, 1996). If increasing returns hold, richer countries - with a higher initial level of per worker capital stock - may exploit scale economies and grow faster than poorer countries, this in turn leads to divergence paths in per capita incomes. Hence, in eq. (11) φ is a crucial parameter; it provides an estimate of the returns-to-scale regime: $\varphi < >$ or equal to 1 implies decreasing, increasing or constant returns to scale respectively. By regressing the growth rate of output per capita on the growth rates of all inputs we can explicitly test for the returns to scale regime.[8]

Following Bairam and McRae (1999), we assume non linear convergence of economies to their own steady state positions:

$$g_{F_{it}} = \theta + \theta_1 (Y/N)_{it_0} + \theta_2 (Y/N)^2_{it_0} \tag{12}$$

where $(Y/N)_{t_0}$ represents the per capita GDP level at $t = 0$ in country i. Eq. (12) assumes that the growth rate di¤ers across countries because of their technological gap. This framework is normally designed to test for conditional convergence (or divergence, depending upon the signs of θ_1 and θ_2).

Notice that the exogenous rate of technological change is captured by the constant term. Following Islam (1995), we allow such term to di¤er across economies by using a panel data framework, which represents our third improvement with respect to the Bairam and McRae (1999) formulation. Substituting (12) in (11), and shifting to a panel data formulation of the model yields

$$\begin{aligned} g_{(Y/N)_{it}} &= \theta_1 (Y/N)_{it_0} + \theta_2 (Y/N)^2_{it_0} + \alpha g_{(K/L)_{it}} + \beta g_{(H/L)_{it}} + \\ &\quad \varphi g_{(L/N)_{it}} + \delta g_{N_{it}} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{13}$$

where μ_i is the sum of θ and the individual e¤ects, λ_t are time dummies and ε_{it} is a random error term.

3.3 Modelling Structural Changes and Spillover E¤ects

We test the empirical speci…cation just presented against a model capturing some of the e¤ects of the industrialization process on growth rates.

It is di¢cult to account for all possible e¤ects that the industrialization process may exert on economic growth. In fact, there is no de…nition of this process that is …rmly agreed upon. Following Dowrick and Gemmell (1991), we focus on technological spillover, inter-sectoral disequilibrium, sectoral di¤erences in technical progress and factor accumulations - as in the previous section, and we extend the original formulation to account for the e¤ects of human capital on growth.

The …rst aspect of interest is the e¤ect of the process of resources reallocation. Attempts to quantify the impact of this process across sectors

[8] The growth accounting framework allows the term φ to di¤er from unity (Bairam and McRae, 1999). Notice that the parameter φ appears twice in eq. (11); for this reason, we test the null hypothesis that $\varphi = 1$ and $\delta = 0$ jointly.

have been relatively few. Feder (1986) proposes a growth model based on productivity differentials between industry and agriculture. In his setting, economies moving resources quicker from agriculture to industry are predicted to grow faster. We build an empirical specification that allows us to test the hypothesis that "if agricultural productivity growth lags that of the other sectors, the countries with largest agricultural sectors will tend to exhibit the slowest aggregate growth" (Dowrick and Gemmel, 1991:265). Suppose economy has two sectors, industry (I) and agriculture (A), each producing according to:[9]

$$Y_{jit} = F_{ji}(t) K_{jit}^{\alpha_j} H_{jit}^{\beta_j} L_{jit}^{\gamma_j} \qquad (14)$$

where $j = A, I$.[10] The total output is the sum of production in both sectors:

$$Y_{it} = Y_{Ait} + Y_{Iit} \qquad (15)$$

Taking logs of eq. (15), and differentiating it with respect to time yields:

$$g_{Y_{it}} = \left(\frac{Y_A}{Y} \right)_{it} g_{Ait} + \left(\frac{Y_I}{Y} \right)_{it} g_{Iit} \qquad (16)$$

where g_{Yit} is the growth rate of total output, and g_{Ait} and g_{Iit} are the growth rates of the fractions of output produced in agriculture and industry respectively at time t in region i.

From (14), the sectoral growth rate is:

$$g_{jit} = g_{F_{jit}} + \alpha_j g_{(K/L)_{jit}} + \beta_j g_{(H/L)_{jit}} + \varphi_j g_{L_{jit}} \qquad (17)$$

with $j = A, I$.

Substituting eq. (17) in eq. (16), using eq. (15) and subtracting $g_{L_{it}}$ from both sides of (17), yields

[9] Admittedly, there are even differences inside each sector. In other words, we could decompose the industrial sector much more than we did. However, the far this decomposition goes, the more difficult comparisons with the standard growth accounting framework, which is one of our aims in this paper.

[10] In a preliminary analysis we studied the effects of the sector of services on growth rates, and all the variables we used to proxy for its extent were insignificant - this finding is consistent with previuos studies (Acconcia, 1997). To avoid further complications in the algebraic formulation of the model, we switch to a simpler two sectors specification.

$$
\begin{aligned}
g_{(Y/L)_{it}} = \; & (g_{F_{Iit}} - g_{F_{Ait}}) \left(\frac{Y_I}{Y}\right)_{it} + \alpha_A \left(\frac{Y_A}{Y}\right)_{it} g_{(K/L)_{Ait}} + \\
& \alpha_I \left(\frac{Y_I}{Y}\right)_{it} g_{(K/L)_{Iit}} + \beta_A \left(\frac{Y_A}{Y}\right)_{it} g_{(H/L)_{Ait}} + \\
& \beta_I \left(\frac{Y_I}{Y}\right)_{it} g_{(H/L)_{Iit}} + \varphi_A \left(\frac{Y_A}{Y}\right)_{it} g_{(L_A/L)_{it}} + \\
& \varphi_I \left(\frac{Y_I}{Y}\right)_{it} g_{(L_I/L)_{it}} + (\varphi - 1) g_{L_{it}} \qquad (18)
\end{aligned}
$$

Notice that the last term of eq. (18) measures returns to scale at the aggregate level.[11]

Because of data availability, we impose some hypotheses on this model. First, we assume that intra-regional mobility equalizes marginal return to schooling across sectors:[12]

$$\beta_A g_{(H/L)_{Ait}} = \beta_I g_{(H/L)_{Iit}} = \beta g_{(H/L)_{it}} \qquad (19)$$

We make the same assumption for marginal productivity of private capital:

$$\alpha_A g_{(K/L)_{Ait}} = \alpha_I g_{(K/L)_{Iit}} = \alpha g_{(K/L)_{it}} \qquad (20)$$

This assumption holds as long as the shift of resources from agriculture to industry increases productivity of both sectors - as claimed by Dowrick and

[11] More specifically, we assume that returns to scale at the aggregate level are a weighted average of returns to scale in each sector:

$$\varphi_A \left(\frac{Y_A}{Y}\right)_{it} + \varphi_I \left(\frac{Y_I}{Y}\right)_{it} = \varphi$$

Admittedly, this is not necessarily the case: the "whole" economy is not necessarily the sum of each part. See Eicher and Turnowsky (1999) for an analogous aggregation problem, and Martin and Mitra (2003) for a justification of this hypothesis.

[12] This hypothesis is reasonable as long as human capital is measured as the percentage of people in secondary schools and universities, rather than as the percentage of workers having a degree and/or a diploma and working in agriculture or industry. Unfortunately, these information are unavailable at the regional level for the period of time we are referring to. However, we have used the following variables to test the hypothesis that human capital affects industry and agriculture differently:

$$(\beta_A - \beta_I) \left(\frac{Y_A}{Y}\right)_{it} g_{(H/L)_{it}} \text{ and } (\beta_I - \beta_A) \left(\frac{Y_I}{Y}\right)_{it} g_{(H/L)_{it}}.$$

These variables result to be statistically insignificant.

Gemmel (1989), who reject the hypothesis that marginal returns to physical capital systematically differ across sectors.[13]

With these hypotheses, eq. (18) reduces to:

$$\begin{aligned} g_{(Y/L)_{it}} = {} & (g_{F_{Iit}} - g_{F_{Ait}}) \left(\frac{Y_I}{Y}\right)_{it} + \alpha g_{(K/L)_{it}} + \beta g_{(H/L)_{it}} + (\varphi - 1) g_{L_{it}} + \\ & \varphi_A \left(\frac{Y_A}{Y}\right)_{it} g_{(L_A/L)_{it}} + \varphi_I \left(\frac{Y_I}{Y}\right)_{it} g_{(L_I/L)} \end{aligned} \qquad (21)$$

Eq. (21) allows us to test for the hypothesis that the sectoral employment, interacted with the level of development of each sector, drives the growth rate of the economy, as well as factors accumulation. More specifically, we test the hypothesis that barriers to the transfer of labour between sectors and regions drive a wedge between the marginal sectoral products of labour. The process of inter-sectoral labour transfer is likely to increase productivity and to stimulate growth, whereas the shift of employment from agricultural to industrial sector is seen as a primary source of growth across the development literature (Lewis, 1954).

Another aspect of interest are the effects on the overall growth rate of catching up processes among sectors belonging to different regions, and between sectors belonging to the same region. Following Dowrick and Gemmell (1991), we model these effects by splitting the exogenous components of the growth rates in eq. (21) in a sector-driven and a sector-independent component:

$$g_{F_{jit}} = \psi_{it} + b_{jit} \qquad (22)$$

The sector independent component, ψ_{it}, is modelled as depending on the initial level of per capita GDP and on net imports to total output:

$$\psi_{it} = \theta + \theta_1 (Y/N)_{it_0} + \theta_2 (Y/N)^2_{it_0} + \theta_3 (NET/Y)_{it} \qquad (23)$$

[13] We believe believe that this hypothesis should be tested, rather than imposed on the estimating model. As in case of the human capital accumulation, we have used the following variables:

$$(\alpha_A - \alpha_I) \left(\frac{Y_A}{Y}\right)_{it} g_{(K/L)_{it}} \text{ and } (\alpha_I - \alpha_A) \left(\frac{Y_I}{Y}\right)_{it} g_{(K/L)_{it}}$$

to test the hypothesis that productivity of capital in agriculture differs from productivity of capital in industry. These variables reveal to be statistically insignificant giving support to the hypothesis we impose to the model. However, this result may depend on the fact that we are using growth rate at the aggregate level, rather than at the sectoral one. There are many issues to deal with, if capital stock has to be constructed at the sectoral level (which depreciation rate should be used in the permanent inventory model? Is it equal in both sectors? Would results be comparable with other studies?), well beyond of the scope of this paper.

where NET are net exports. Eq. (23) allows us to test the hypothesis that regions are converging at a decreasing rate to their own steady state position (Bairam and McRae, 1999; Durlauf and Quah, 1999), and that growth rate depends on the export capacity of the ith region, as suggested by Graziani (1978).

The sector-linked component of the growth rate is given by:

$$b_{jit} = \begin{cases} b_{Ait} = \omega_{1A} + \omega_{2A} \ln(g_{(Y/L)_{Ait}}/g_{(Y/L)_{Iit}}) \\ b_{Iit} = \omega_{1I} + \omega_{2I} \ln(g_{(Y/L)_{Iit}}/g^{*}_{(Y/L)_{Iit}}) \end{cases} \qquad (24)$$

where $g^{*}_{(Y/L)_{Iit}}$ represents the productivity growth rate in a reference leading region, and $g_{(Y/L)_{Ait}}$ and $g_{(Y/L)_{Iit}}$ are the labour productivity growth rates in agriculture and manufacturing, respectively.

Eq. (24) tests the hypothesis that the rate of technological progress in agriculture - b_{Ait} - differs from that in industry - b_{Iit}. It is suggested that there may be a convergence process across industrial sectors; in this case, the larger the difference between growth rate of industrial sectors belonging to different regions, the higher the growth rate.[14] We also test the hypothesis that a catch up process exists between sectors inside economies. In this case, the higher the distance between productivity growth in agriculture and in industry, the higher the growth rate. "If this internal catch up operates, countries with lower agricultural (labour) productivity relative to that in industry should experience faster growth, industrial development acting as a magnet, pulling up agricultural productivity" (Dowrick and Gemmel, 1991:265).

Substituting this set of hypotheses in (21), using (10) and rearranging yields:

$$\begin{aligned} g_{(Y/N)_{it}} = {} & \theta_1(Y/N)_{it_0} + \theta_2(Y/N)^2_{it_0} + \alpha g_{(K/L)_{it}} + \beta g_{(H/L)_{it}} + \\ & \varphi g_{(L/N)_{it}} + \theta_3(NET/Y)_{it} + \varphi_A(Y_A/Y)_{it} g_{(L_A/L)_{it}} + \\ & \varphi_I(Y_I/Y)_{it} g_{(L_I/L)_{it}} + \omega_{2I}(Y_I/Y)_{it} \ln(g_{YL_I}/g^{*}_{YL_I})_{it} + \\ & \omega_{2A}(Y_A/Y)_{it} \ln(g_{YL_A}/g_{YL_I})_{it} + (\omega_{1I} - \omega_{1A})(Y_I/Y)_{it} + \\ & + \delta g_{N_{it}} + \chi_i + \phi_t + \eta_{it} \end{aligned} \qquad (25)$$

where χ_i and ϕ_t are individual and time dummies respectively, and η_{it} is a random error term.

[14] We tested the same hypothesis for the agricultural sector by using $\ln(g_{(Y/L)_{Ait}}/g^{*}_{(Y/L)_{Ait}})$ - this hypothesis was rejected. Our opinion is that catch up processes across agricultural sectors of different regions is more difficult than in industry because production in the former sector depends heavily on local factors.

Two features make the empirical specification in (25) appealing. First, a rich set of questions may be addressed, especially if compared to the simple growth accounting equation in (13): θ_1 and θ_2 represent the conditional convergence parameters; θ_3 measures the impact of net imports on growth; α and β are factor elasticities; $\omega_{1I} - \omega_{1A}$ measures the effects of the size of the manufacturing sector; φ_I and φ_A measure the importance of shifting workers from agriculture to industry, ω_{2A} and ω_{2I} measure respectively the existence of catching up processes between sectors in the same region, and across manufacturing sectors belonging to different regions.

Second, (25) is an augmented counterpart of (13); this makes predictions coming from the two models easily comparable. Indeed, we may test the joint significance of parameters associated with additional regressors and see whether they add explanatory power to the simple growth accounting framework.

4 Data and Sources

We use data for regional per capita GDP from 1960 to 1995. This series is composed of two sub-series. Data from 1970 to 1995 are from Istituto Nazionale di Statistica (ISTAT).[15] More specifically, series of per capita GDP for each region from 1970 to 1980 (at constant price 1970) is available from Conti Economici Regionali by ISTAT. This institute also provides the series for the period 1980-1995; in this case the series is expressed at constant prices 1990. The two series have been recently revisited by Istituto per lo Sviluppo del Mezzogiorno (SVIMEZ), who corrected the series beginning in 1970 making it comparable with data from the second period.

A second series for the period 1960-1993 is provided by Centre for North-South Economic Research (CRENoS), using mainly data from Istituto Tagliacarne, SVIMEZ and UNIONCAMERE. This series is expressed at constant prices 1985. We use it to extend the series provided by SVIMEZ, by shifting its base-year. The resulting series is expressed at constant prices 1990 and it is based on imperfectly homogeneous parts; however, they do not show breaks in 1970 (Figure IV).

All variables used in our conditioning exercises come from the same sources - CRENoS and ISTAT. The capital stock is built by using a perma-

[15] We do not extend our analysis up to 2002 because ISTAT measured variables from 1995 to 2002 following SEC95, rather than SEC79 as before. The Institute has recently published data for the period 1980-2002 following the new accounting system. However, because we focus on the effect of industrialization on growth and convergence, we cannot exclude the 60s and the 70s.

nent inventory model.[16] All variables are measured at constant 1990 prices. Net imports are taken as a fraction of total output. We measure human capital as the fraction of the population in the working age enrolled in secondary schools and universities - primary schooling is compulsory and it is excluded from the analysis.

Figure IV graphs the path of the GDP per capita for each region over the period we consider. The same picture reports the GDP per capita for Italy, North and South obtained averaging across regions. The North of Italy consists of 12 regions - namely Piemonte, Valle D'Aosta, Lombardia, Trentino Alto-Adige, Friuli Venezia-Giulia, Veneto, Emilia Romagna, Liguria, Toscana, Umbria, Marche and Lazio; the South is obtained by averaging per capita GDPs across the remaining eight regions - Abruzzi, Molise, Campania, Puglia, Basilicata, Sicilia, Sardegna and Calabria. The picture shows that regional GDP per capita tends to spread over time across regions. In 1960, Umbria and Abruzzi belong to the South of Italy; over time, they tend to converge with the richer regions. All other Southern regions have GDPs per capita considerably smaller than the richer ones; none of them, moreover, displays a tendency to take off.

This is more evident when studying relative positions (see Figure V). Such a transformation highlights two features of the Italian growth process. First, in 1995 regions are less dispersed than they were in 1960. Regions experienced a strong convergence process until the early 70s; after this period, the convergence process ends and the difference between the GDP per capita of the South and the North increases. However, the convergence process occurring in the first part of the 70s has not been completely offset by the divergence dynamics observed in the following period.

Second, even if regions converge from 1960 to the early 70s, they tend to cluster in two distinct groups - this process is especially evident for the period from 1965 to 1970: the polarization process begins some years before the end of the convergence process, rather than following it. Although less formal, these results confirm results coming from the stochastic kernel analysis presented in section 2.

[16] In the dynamic equation we use, we apply the depreciation rate that ISTAT provides for Italy; the sum of the capital stocks of all regions does not substantially differ from the one provided by ISTAT.

5 Empirical results

5.1 Variations in the Transitional Period

Figure VI reports results describing the regional dynamics as the transitional period, s, grows. More specifically, Panel A is obtained by fixing the growth rate of each region and $s = 10$; instead, panel B is estimated for $s = 20$ (to save space, we report only the contours plot of the estimates).

As in Figure II, persistency seems to be the main message of this second set of estimates: in both estimates, the largest part of the probability mass appears close to the 45-degree line. However, the exercise makes it more evident that Italian regions are experiencing a process of increasing divergence. In panel A, the mode representing the Southern cluster appears located slightly below the 45 degree line; moreover, the mode representing the Northern group of economies lies above it. This feature is even more evident in the 20 years framework. As time passes, the long run positions of the regions diverge, and to the extent that they represent the basins of attraction for each group of economies (Quah, 1997), the divergence and polarization processes are predicted to continue.

Estimates display a second feature. The evidence according to which both modes are "flatter" compared to the 45-degree line suggests that there exists a process of local convergence: regions are clustering in two distinct groups. Again, this is more evident when longer transitional periods are considered.

A final and maybe obvious point is that the impact of initial conditions reduces when longer transitional periods are studied. All the features we find are still present in the estimates relating to the 20 year framework; however observations look more dispersed around their modes, and the valley deepens with respect to both the 5 years and the 10 years setups.[17]

5.2 Regression Results

Table II reports results from our regression analysis. Column A reports results for the standard growth accounting framework, and column B reports results for the model augmented for variables capturing some of the effects of the industrialization process on growth rates.

[17] This point leads to the long debated issue on how long the "long" run should be. We obviously cannot give an answer to this question. However, we believe that it is reasonable to define as persistent differences in the per capita GDP lasting 20 years or more. An interesting issue remains unsolved still, is there an optimal choice for s? This issue is left for future research.

Table III reports a series of diagnostic statistics for the models we have estimated. The adjusted R^2 ranges from 88% to 89%. In all cases the tests for the presence of first order serial correlation are satisfied. Moreover, our results are robust to heterosckedasticity and autocorrelation - consistent t-statistics are reported in square brackets in Table II (Arellano and Bond, 1991).

Time dummies are highly significant in all models, as well as individual dummies. Moreover, the LM test of poolability always rejects the null hypothesis of an equal intercept. The panel data structure we impose encompasses the OLS pooled model, and this conclusion is in line with previous studies on growth regressions (Islam, 1995).

As expected, the Hausman test is in favour of the fixed effects model. We also perform the Hausman specification test for endogeneity of the regressors suspected to be jointly determined with the per capita GDP growth rate - namely, physical and capital accumulation, and employment growth.[18] The null hypothesis of exogenity of the regressors is never rejected.[19] The LSDV model with time dummies is the preferred model.

The test for the degree of returns to scale is performed by testing the null hypothesis that φ = 1 and δ = 0 jointly, which is rejected at the 5% level - this is especially the case for the augmented version of the model. Hence, we re-estimate all models excluding the growth rate of the population - this variable is always insignificant. Results in Table II refer to models (13) and (25), where the variable g_N is removed.

The growth rate of per worker physical capital and employment displays a positive and statistically robust impact on growth rate of per capita GDP. In all models the estimated elasticities for marginal productivity of capital are lower than the parameters usually found across empirical literature on growth, even in the case of Italy (Bairam and McRae, 1999; Mauro and Podrecca, 1997). This result is consistent with Islam (1995): the panel data

[18] We use three alternative sets of instruments. The first set of instruments includes the physical capital stock (K), human capital stock (H) and employment size (L); the second set includes the population size (N), population growth rate (g_N) and the ratio of agricultural to manufactoring employment (L_A/L_I). Finally, the third set includes human capital stock (H), population size (N) and employment (L).

[19] The procedure involves the estimates of three regressions, where the variables suspected to be correlated with the error term are taken as dependent variables and all exogenous variables and instruments as regressors. We, then, recover residuals from these auxiliary regressions and test for their joint significance in models A, B and C, re-estimated by including these residuals. Results from this testing procedure should be taken with caution, because they heavily depend on the set of instruments one chooses, the validity of which cannot be statistically verified.

estimator corrects the upward bias arising in the OLS framework because of the omitted variables issue. As in previous studies, human capital growth appears to be much less signi...cantly correlated with growth (De la Fuente, 1997). Returns to human capital range between 12% and 9%; these results are consistent both with studies for other countries (Mankiw, D. Romer and Weil, 1992) and, especially, with studies for Italy (Aiello and Scoppa, 1999; Di Liberto and Symons, 1998).

Results suggest that regions are converging to their own steady state positions - the coe¢cient associated with the initial level of per capita GDP is negatively correlated with growth. Moreover, the evidence suggests that the speed of convergence to the equilibrium position depends on the initial position of the region. This evidence is in favour of non-linear conditional convergence: regions tend to converge to their steady state at a decreasing rate - a non-linear conditional convergence process is also provided by Bairam and McRae (1999) for a sample of countries.

The set of regressors we use to obtain the augmented version of the model increases the explanatory power of the standard growth accounting framework. The χ^2 statistic rejects the standard growth accounting framework when tested against its augmented speci...cation. This ...nding is robust to the speci...cation we use - column C reports the results we obtain by removing all insigni...cant variables from the model reported in column B.

It is noticeable that the χ^2 statistic dramatically reduces when statistically insigni...cant variables are removed from the set of regressors. This may be due to collinearity among some variables, that leads to large standard errors. The obvious candidates are the terms $(Y_I/Y)g_{(L_I/L)}$ and $(Y_A/Y)g_{(L_A/L)}$, that are likely to be correlated with the term $g_{(L/N)}$. We use the χ^2 statistic to test the hypothesis that these variables may be jointly excluded from the model - the results are reported in the last three rows of Table III. The test rejects the hypothesis that these variables are jointly insigni...cant - especially when we examine the joint signi...cance of $(Y_I/Y)g_{(L_I/L)}$ and $g_{(L/N)}$. Conversely, the test for the joint signi...cance of $(Y_A/Y)g_{(L_A/L)}$ and $g_{(L/N)}$ is only marginally satis...ed.

In sum, the evidence supports a positive e¤ect of industrialization on the growth rate: the higher the shift of workers from agricultural to industrial sector, the higher the growth rate. The parameter associated with the gap across manufacturing sectors is highly signi...cant with a negative sign. It appears therefore that the greater the distance from a leading region, the lower the growth rate: this is evidence against the hypothesis that industrialization of poor regions necessarily follows from technological progress in rich regions. Also, there is no evidence of spillovers across sectors belonging to the same regions.

Consistent with the model based on sectoral imbalances, the higher the level of industrialization of a region and the higher its ability to shift resources to the manufacturing sector, the higher the growth rate. Moreover, the parameter associated with the dimension of the industrial sector displays a robust and highly positive impact on growth rate. In sum, industrialization and sectoral imbalances matter: growth across the Italian sample of economies is explained not only by factors accumulation. Finally, in accordance with Graziani (1978), results reveal that export capacity influences the regional growth processes: the lower the ability of a region to export, the lower the growth rate.

We also analyze whether the growth process differs between the two periods the literature refers to. In particular, we estimate model (25) by splitting the 1960-95 period into two sub-periods: 1960-75 and 1975-95.

Estimation results are reported in Table IV. The period from 1960 to 1975 is characterized by strong positive effects of sectoral imbalances and industrialization when compared with the second sub-period. The variable associated with sectoral imbalances presents a statistically robust and positive impact on the growth rate, and this impact seems to be much higher between 1960 and 1975 than the effect estimated for the whole period. The same holds both for the variable proxying the shift of workers from other sectors to manufacturing, and for the parameter estimated for the dimension of the manufacturing sector.

The evidence suggests that over this period regions experienced a strong conditional convergence process. The parameter associated with the distance between the actual and the steady state position is twice as large as the coefficient estimated for the whole period. All these variables seem to be much more important in explaining the growth process when compared with the accumulation of factors, which display low marginal returns and are statistically insignificant.

In the period 1975-95, the estimates reveal that the growth processes have changed. Sectoral imbalance turns out to be statistically insignificant. Results are in favour of a negative effect of resource shifting both in agriculture and in industry - even if the latter is statistically insignificant. There is evidence of spillover effects between sectors belonging to the same region.

In these years, growth appears to be primarily driven by factor accumulation and not by the industrialization process. Finally, the conditional convergence process slows down, possibly because regions are closer to their steady state position than they were in the previous period.

5.3 Sectoral Imbalances, Steady State Dynamics and Convergence

Figure VII reports results from our ﬁrst conditioning exercise. Panel A reports the stochastic kernel estimated under the condition that the dynamics experienced by each region in tending to its own steady state positions is set to zero. In the univariate context, Di Nardo, Fortin and Lemieux (1996) refer to such an estimate as a counterfactual density.[20] In the same fashion, our estimate represents a counterfactual mobility dynamics.

The example we give in Figure VII addresses the following question: what would the realized dynamics be if regional economies did not tend to their own steady state position? The diﬀerence between the realized or actual mobility and the counterfactual one may be regarded as a measure of the eﬀect of the variable that has been removed from the stochastic kernel.

In performing this ﬁrst exercise, we use parameters estimated by means of the standard growth accounting framework. Panel B reports the contours plot of the estimated stochastic kernel; to facilitate comparisons, we superimpose on the picture the actual dynamics - dotted lines. The results suggest that for the counterfactual dynamics, the modes appear more distant than they actually are. In particular, almost all the mass distributed around the mode representing the group of rich regions moves above the 45-degree line. Furthermore, the valley between the two clusters tends to deepen. Due to the diﬀerence between the two estimates, the process of conditional convergence is found to fuel the absolute convergence process.

The results coming from the conditioning exercise are more evident when we use the parameters associated with the gap variable estimated by using the augmented version of the model - results are reported in Figure VIII (panel A). In this case, the estimated stochastic kernel not only shows that the cluster composed by rich regions is above the 45-degree line, but also that a large fraction of the probability mass representing the observations located at low levels of per capita GDP move to below the diagonal. Both results suggest that, if regions did not tend to their own steady state, we would have observed a stronger process of divergence between the North and the South of Italy with respect the observed one.

[20] More speciﬁcally, they deﬁne a procedure to remove the eﬀects of institutional variables from the distribution of wages - for example, the eﬀect on household incomes of the presence of a minimum wage in the labour market. This procedure produces such counterfactual densities in an univariate context. For an application of this framework in a growth context with univariate densities, see Beaudry, Collard and Green (2003) and Leonida and Montolio (2004).

Panel B reports the dynamics estimated under the hypothesis that no variables proxying for sectoral imbalances had e¤ects on regional growth rates - again, we report the actual dynamics to facilitate comparisons. If this hypothesis held, the mode representing the lower cluster would be set above the main diagonal. Moreover, the mode representing the richer group of regions would almost disappear, so would the valley. This evidence suggest that the club convergence process is explained by the process of industrialization that the northern regions experienced over time.

5.4 Absolute Convergence and Club Convergence Patterns as Syntheses of Economic In‡uences

Results in the previous section suggest that processes of absolute and club convergence may be viewed as the outcome of the e¤ects of a number of variables. Some forces, such as the tendency of each economy to its steady state position, are found to facilitate the catching up process; some others, are instead found to work against the absolute convergence process. In the case of Italy, among the latter is the economic structure of each region.

By studying how the relative power of these in‡uences varies over time, one may uncover some of the reasons why Italian regions display convergence until early 70s and tend to diverge afterwards. Figure IX reports the results obtained using our conditioning device on the period 1960-1975; we use parameters in Table IV to perform this exercise.[21]

Panel A reports the e¤ects of all the variables we use to proxy for the structure of the economy and the process of resource shifting on the realized dynamics. Results suggest that the industrialization process displays a strong e¤ect on convergence processes. In particular, there exists evidence of these e¤ects both in rich and poor regions. Northern regions would not take o¤ without industrialization and would not separate from the rest of the country. Notice that the two clusters emerge over this period because of the industrialization e¤ect.

However, the club convergence dynamics is o¤set by a strong conditional convergence process (panel B). Convergence to the steady state results in a strong absolute convergence process. If convergence to equilibrium was absent, regions from North of Italy would appear completely separated from other regions. Taken together, results regarding the 1960-75 period suggest the existence of a club convergence process almost completely hidden by the

[21] Results do not qualitatively di¤er if we use parameters estimated for the whole period. However, because the latter are smaller than the ones we use, the e¤ects are less evident compared to the ones we report.

absolute one. However, over this period the two groups of economies became more di¤erentiated, in the sense that North of Italy took advantage of the industrialization process to grow.

Figure X reports results regarding the period 1975-1995. The di¤erent structure of the economy still enables the Northern regions to grow and diverge; the Southern regions look stuck in a sort of underdevelopment trap (panel A). However, the conditional convergence process, even if still in action, slows down considerably in comparison with the previous period. The combination of the two contrasting forces produces the divergence path the two clusters experienced until 1995.

6 Conclusions

In this paper we study growth and convergence patterns of the per capita GDP across a sample of Italian regions over the period 1960-95. Our study contributes to the extant literature in many respects.

1. We propose a semiparametric procedure which links growth theory, industrialization and density-type studies on growth and convergence.
2. Our results con…rm that Italian regions converged until early 70s and diverged afterwards. Our results suggest, also, that two basins of attraction manifest in the period from 1960-75.
3. The club convergence process begins before the appearance of the divergence process, and during the period in which regions converge. Over the period 1960-75, evidence shows that regions both converge and polarize even if the club convergence pattern is hidden by the absolute convergence process. This means that the ACH does not necessarily exclude the CCH and vice versa, casting doubts on the common practise of taking these hypotheses as competing in empirical frameworks.
4. We test a standard growth accounting framework against an augmented version capturing the e¤ects of resources reallocation between manufacturing and agriculture on growth rates. At least in the Italian case, the former is encompassed by the latter. The industrialization process is found to play a key role in explaining patterns of growth and convergence in Italy.

5. Growth and convergence dynamics should be thought as a combination of contrasting economic influences. Some of them boost growth and convergence dynamics, and some others work against such processes. More specifically, over the period 1960-75 the process of convergence to the steady state leads regions to converge to each other, hiding that industrialization makes regions to converge in clubs. Conversely, in the period 1975-95, the steady state convergence process slows down, and differences in the level of industrialization lead to a path of polarization and divergence.

6. The evidence suggests that the reversal in the convergence process does not depend on external shocks only, as claimed by the literature on convergence in Italy (namely, it refers the 1973 oil shock). Rather, its sources may be endogenous with respect to the Italian growth process. The two clusters manifest in the period 1960-75 and their appearance depends on industrialization, which creates a two-velocity economic system. Of course, external shocks may have reinforced such process, since economic systems with different growth potential may answer differently to the same external shock.

It is worth mentioning that our approach, even if accounts for a large fraction of the growth and convergence processes shown by Italian regions, does not explain all of them. This is for a number of reasons. Firstly, public sector is left out from the analysis, even if Italian governments tried to contribute to the development of Southern regions by means of public investments in the industrial sector and, more recently, through investment in infrastructure (Giannola and Del Monte, 1997). We also do not analyze the effects on growth of improvements in the banking sector, the development of which seems to be highly correlated to the growth process (Levine, 1997). Finally, historical events may have affected both the growth process and the accumulation of private and human capital.

All these questions are left for future research.

7 Appendix A

Eq. (1) may be estimated by means of the following non-parametric estimator:

$$\hat{f}(y_{it+s} \mid y_{it}) = \frac{\hat{f}(y_{it}, y_{it+s})}{\hat{f}(y_{it})} = \frac{\frac{1}{Nh^2} \sum_{i=1} K\left(\frac{y_{it} - y_{it}^o}{h}\right) K\left(\frac{y_{it+s} - y_{it+s}^o}{h}\right)}{\frac{1}{Nh} \sum_{i=1} K\left(\frac{y_{it} - y_{it}^o}{h}\right)} \tag{26}$$

The joint distribution at the fixed point $z_i^o = (y_{it}^o, y_{it+s}^o)$ in the numerator of eq. (26) is estimated by using N cross-sectional and time series realizations of per capita GDP given the length of the transition period, s. For example, vector t and $t + s$ for $s = 5$ consists of $620 = 20 \times (35 - 4)$ observations - 20 regions from 1960 to 1995.

$K(.)$ is a weighting function, the kernel, which is defined as follows:

$$\int_{x \to -\infty}^{x \to \infty} K(u)du = 1, \tag{27}$$

the height of which, evaluated at $(y_{it} - y_{it}^o)$, gives the weight attached to the i_{th} observation. If a Gaussian kernel is used to perform the estimate in eq.(26), the height is given by the standard normal density function. All positive functions that integrate to unity could play this role. The kernel function is particularly appealing because it has monotonicity of features - peaks and valleys - with respect to the magnitude of the bandwidth (Silverman, 1981). Because of this property, it is the kernel that we use in this paper.

Finally, $h > 0$ is the bandwidth, which determines "which observation we are looking at" (Kennedy, 1996). The bandwidth choice is the crucial parameter in eq. (26): If h is chosen "too small", the kernel assigns non-negligible weight only to the observation very close to z_i^o. In such a case, the estimated density function is under-smoothed and uninformative. On the other hand, if h is chosen "too large", the kernel assigns a non-negligible weight to observation very far from z_i^o, over-smoothing the estimate and possibly losing crucial information about the "true" shape of the distribution. Notice that, in order to compare distributions over time a common bandwidth has been used to estimate the stochastic kernel (Marron and Schmitz, 1992). Alternative smoothing parameters may be chosen for h (Silverman, 1986). We opt for the safest choice, and use the average of the bandwidths as data were normally distributed.

Finally, to obtain the conditional distribution, one should divide the joint distribution by the marginal one, as shown in eq. (26).

References

[1] Acconcia, A., 1997. La Convergenza Regionale: Un'Analisi Cross-Sezionale, in: Del Monte, A., Giannola, A. (Eds), Istituzioni Economiche e Mezzogiorno. NIS, Bologna, 107–118.

[2] Aiello, F., Scoppa, F., 2000. Uneven Regional Development in Italy: Explaining Di¤erences in Productivity Levels. Giornale degli Economisti ed Annali di Economia 60, 1–30.

[3] Amemiya, T., 1971. The Estimation of the Variance in a Variance-Component Model. International Economic Review 12, 1–13.

[4] Arellano, M., Bond, S., 1991. Some Tests of Speci…cation for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Review of Economic Studies 58, 277–297.

[5] Arrow, K.J., 1962. The Economic Implications of Learning by Doing. Review of Economic Studies 29, 155–173.

[6] Bairam, E.I., McRae, S.D., 1999. Testing the Convergence Hypothesis: a New Approach. Economic Letters 64, 351–355.

[7] Barro, R.J., 1997. Determinants of Economic Growth, Cambridge, MIT Press.

[8] Barro, R.J., 1999. Notes on Growth Accounting. Journal of Economic Growth 24, 119–137.

[9] Barro, R.J., Sala-i-Martin, X., 1991. Convergence across States and Regions. Brookings Paper on Economics Activity 1, 1107–182.

[10] Barro, R.J., Sala-i-Martin, X., 1992. Convergence. Journal of Political Economy 100, 223–51.

[11] Barro, R.J., Sala-i-Martin, X., 1995. Economic Growth. McGraw-Hill, New York.

[12] Beaudry, P., Collard, F., Green, D.A., 2003. Changes in the World Distribution of Output-per-Worker 1960-98: How a Standard Decomposition Tells an Unorthodox Story. University of British Columbia Working Paper Series, September.

[13] Ben-David, D., 1994. Converging Club and Diverging Economies. CEPR Discussion Papers 922.

[14] Bernard, A., Durlauf, S.N., 1995. Convergence in International Output. Journal of Applied Econometrics 10, 97–108.

[15] Bernard, A., Durlauf, S.N., 1996. Interpreting Tests of the Convergence Hypothesis. Journal of Econometrics 71, 161–173.

[16] Bianchi, M., 1997. Testing for Convergence: Evidence from Non-Parametric Multimodality Test. Journal of Applied Econometrics 12, 393–409.

[17] Cellini, R., Scorcu, A., 1997. How Many Italies? What Data Show about Growth and Convergence across Italian Regions: 1970-91. Rassegna dei Lavori dell'ISCO 14, 93–124.

[18] Chenery, H.B., 1962. Development Policy for Southern Italy. Quarterly Journal of Economics 76, 515–547.

[19] Dall'Aglio, V., (2003). La Dinamica del reddito regionale italiano: un'analisi non-parametrica. Rivista Italiana degli Economisti, a. VIII, n. 3, Dicembre.

[20] De la Fuente, A., 1997. The Empirics of Growth and Convergence: A Selective Review. Journal of Economic Dynamic and Control 21, 23–73.

[21] De la Fuente, A., 2000. Convergence Across Countries and Regions: Theory and Empirics. EIB Papers 2, 25–43.

[22] Del Monte, A. Giannola, A., 1997. Istituzioni Economiche e Mezzogiorno. NIS, Bologna.

[23] Di Liberto, A., Symons, J., 2001. Education and Italian Regional Development. CEP Discussion papers 0496, Centre for Economic Performance, London School of Economics, London.

[24] Dowrick, S., Gemmell, N., 1991. Industrialisation, Cathing Up and Economic Growth: A Comparative Study Across the World's Capitalist Economies. The Economic Journal 101, 263–275.

[25] Di Nardo, J., Fortin, N.M., Lemiex, T., 1996. Labour Market Institutions and the Distribution of Wages 1973-1992: A Semiparametric Approach. Econometrica 64, 1001–1044.

[26] Durlauf, S.N., Johnson, P.A., 1995. Multiple Regimes and Cross-Country Growth Behavior. Journal of Applied Econometrics 10, 365–384.

[27] Durlauf, S.N., Quah, D.T., 1999. The New Empirics of Economic Growth, in : Taylor, J., Woodford, M. (Eds.), Handbook of Macroeconomics, Vol. 1A. North-Holland, Amsterdam.

[28] Eicher, S.T., Turnovskj, S.J., 1999. Convergence in a Two-Sector Non-Scale Growth Model. University of Washington Discussion Papers, July.

[29] Eckaus, R.S., 1961. The North-South Di¤erential in Italian Economic Developement. Journal of Economic Hystory 20, 311–318.

[30] Feder, G., 1986. Growth in Semi-Industrial Countries, in Chenery, H.B., Robinsons, S., Syrquin, M., (Eds.), Industrialization and Economic Growth. Oxford University Press for the World Bank, New York.

[31] Galor, O., 1996. Convergence? Inference from Theoretical Models. Economic Journal 106, 1056–1069.

[32] Graziani, A., 1979. Il Mezzogiorno nel Quadro dell'Economia Italiana, in: Graziani, A., Pugliese, E., (Eds.) Investimenti e Disoccupazione nel Mezzogiorno. Il Mulino, Bologna.

[33] Islam, N., 1995. Growth Empirics: a Panel Data Approach. Quarterly Journal of Economics 110, 1127–1170.

[34] Islam, N., 2000. Small Sample Performance of Dynamic Panel Data Estimators in Estimating the Growth-Convergence Equation: A Monte Carlo Study. Advances in Econometrics 15, 317–339.

[35] Islam, N., 2003. What Have We Learnt from the Convergence Debate? Journal of Economic Surveys 17, 309–362.

[36] Jones, C.I., 1995. Time Series Tests of Endogenous Growth Models. Quarterly Journal of Economics 110, 495–525.

[37] Lamo, A., 2000. On Convergence Empirics: Some Evidence for Spanish Regions. Investigaciones Economicas 24, 681–707.

[38] Leonida, L., 2004. h-Convergence. Department of Economics and Statistics Discussion Papers, Università degli Studi della Calabria.

[39] Leonida, L., Montolio, D., 2001. Inter-Distributional and Intra-Clusters Dynamics, and Territorial Distribution of Growth among Spanish Provinces. Estudios sobre la Economia Espagnola, FEDEA, Working Paper EEE-109.

[40] Leonida, L., Montolio, D., 2004. On the Determinants of Convergence and Divergence Processes in Spain. Investigaciones Economicas 28, 123–140.

[41] Levine, R., 1999. Financial Development and Economic Growth: Views and Agenda. Journal of Economic Literature 35, 688–726.

[42] Lewis, W.A., 1954. Economic Development with Unlimited Supply of Labour. Manchester School 47, 139–191.

[43] Lucas, R.E., 1988. On the Mechanics of Economic Development. Journal of Monetary Economics 22, 3–42.

[44] Lutz, V., 1960. Italy as a Study in Development. LLoyds Bank Review 58.

[45] Martin, W., Mitra, D., 2003. Productivity Growth and Convergence in Agriculture and Manufacturing. World Bank Discussion Papers, June.

[46] Mauro, L., Podrecca, E., 1994. The Case of Italian Regions: Convergence or Dualism. Economic Notes 3, 447–472.

[47] Mankiw, N.G., Romer, D., Weil, D., 1992. A Contribution to the Empirics of Economic Growth. Quarterly Journal of Economics 107, 407–437.

[48] Murphy, K., Shleifer, A., Vishny, R., 1989. Industrialization and the Big Push. Journal of Political Economy 97, 1003–1026.

[49] Paci, R., Saba, A., 1998. The Empirics of Regional Economic Growth in Italy, 1951-1993. Rivista Internazionale di Scienze Economiche e Commerciali 5, 513–542.

[50] Parente, S., 2001. The Failure of Endogenous Growth. Knowledge, Technology, and Policy 13, 49–58.

[51] Paap, R., Van Dijk, H.K., 1998. Distribution and Mobility of Wealth of Nations. European Economic Review 42, 135–165.

[52] Peters, B.G., 2004. Managing Horizontal Goverment. The Politics of Coordination. Canadian Centre for Management Development, Research Papers 21.

[53] Quah, D., 1996. Convergence Empirics Across Economies with (Some) Capital Mobility. Journal of Economic Growth 1, 95–124.

[54] Quah, D., 1997. Empirics for Growth and Distribution: Stratification, Polarization and Convergence Clubs. Journal of Economic Growth 2, 27–59.

[55] Romer, P.,1986. Increasing Returns and Long-Run Growth. Journal of Political Economy 94, 1002–1036.

[56] Solow, R.M., 1956. A Contribution to the Theory of Economic Growth. Quarterly Journal of Economics 70, 65–94.

[57] Temple, J., 1999. The New Growth Evidence. Journal of Economic Literature 37, 112–156.

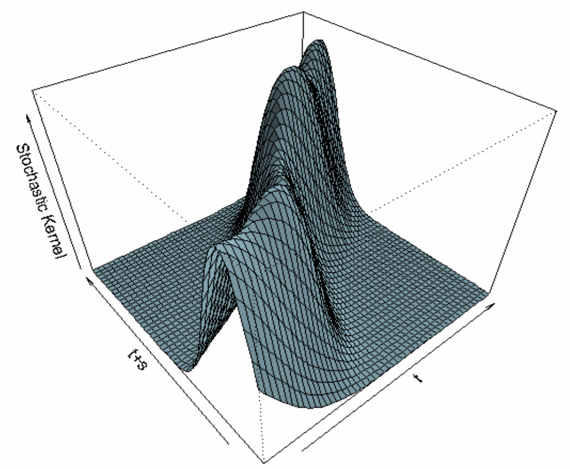
[58] Terrasi, M., 1999. Convergence and Divergence Across Italian Regions. The Annals of Regional Science 33, 491–510.

[59] Williamson, J.G., 1965. Regional Inequality and the Process of National Development: A Description of the Patterns. Economic Development and Cultural Change 13, 3–84.

Figure I
Stochastic Kernel Analysis (1960-95)

Panel A reports the stochastic kernel estimated for transitions of five years (i.e. s=5) between 1960 and 1995 for Italian regions. Vectors t an $t+s$ consist of 620 observations of relative per capita GDP (20 regions for 31 years). The estimate is performed by means of the Gaussian Kernel under the hypothesis that the data are normally distributed. Panel B reports the contours plot of the estimate for fixed levels of probability.

Panel A



Panel B

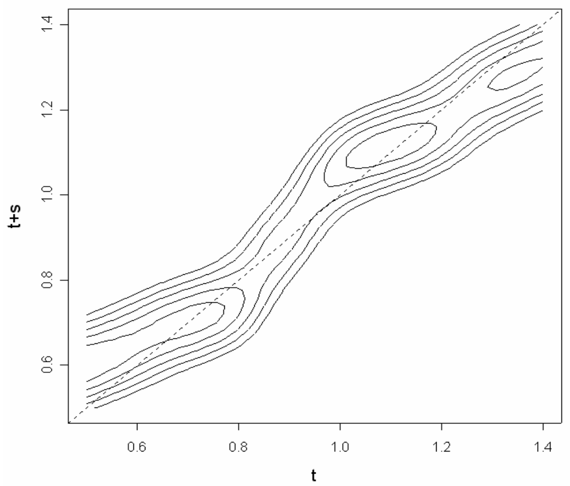
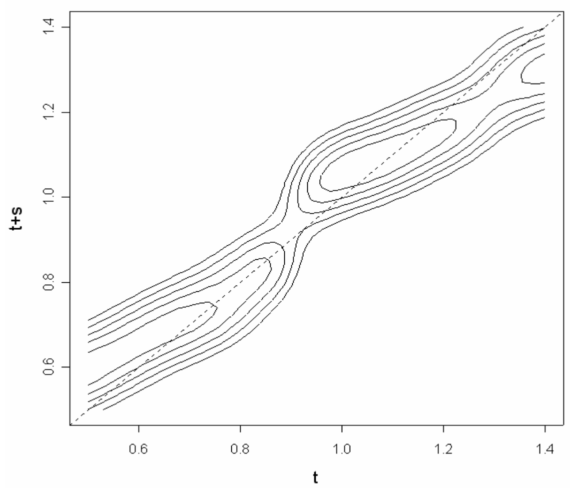


Figure II
Stochastic Kernel Analysis for Sub-Periods

Panel A and panel B reports the contours plot of the stochastic kernel for transitions of five years (i.e. s=5) between 1960 and 1975 and between 1975 and 1995 respectively. Vector dimensions consist of 240 and 340 observations respectively.

Panel A



Panel B

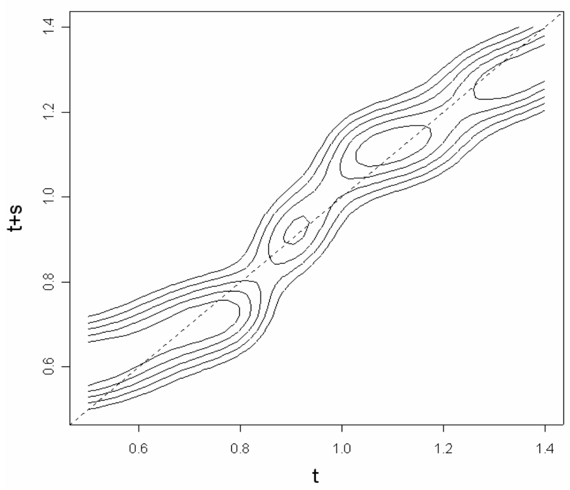


Table I
Sectoral Unbalances in Italy (1960-1995)

Rel. Y/N is the relative per capita GDP (Italy=1); VA_A/VA and VA_I/VA are the fractions of Value Added in agriculture and in manufacturing respectively; I_A/I and I_I/I are the fractions of investments in produced agriculture and manufactoring respectively. All variables are measured at constant prices 1990. L_A/L and L_I/L represent the fractions of employment in agriculture and manufacturing respectively.

Period	Rel. Y/N	$VA_A/$ VA	$VA_I/$ VA	I_A/I	I_I/I	L_A/L	L_I/L
			North-Centre				
1960-1965	1.461	0.079	0.391	0.082	0.291	0.221	0.306
1965-1970	1.425	0.063	0.394	0.075	0.257	0.166	0.326
1970-1975	1.410	0.048	0.409	0.063	0.276	0.119	0.339
1975-1980	1.415	0.044	0.402	0.073	0.311	0.101	0.334
1980-1985	1.416	0.041	0.391	0.068	0.317	0.092	0.301
1985-1990	1.422	0.039	0.389	0.061	0.308	0.078	0.273
1990-1995	1.429	0.037	0.391	0.052	0.295	0.064	0.278
			South				
1960-1965	0.539	0.153	0.269	0.098	0.228	0.419	0.128
1965-1970	0.575	0.134	0.281	0.080	0.200	0.360	0.135
1970-1975	0.590	0.111	0.294	0.082	0.286	0.302	0.146
1975-1980	0.585	0.094	0.278	0.106	0.253	0.253	0.154
1980-1985	0.584	0.089	0.267	0.100	0.238	0.200	0.144
1985-1990	0.578	0.079	0.265	0.084	0.228	0.170	0.128
1990-1995	0.571	0.075	0.260	0.069	0.261	0.149	0.155
			Italy				
1960-1965	1.000	0.098	0.361	0.086	0.274	0.282	0.251
1965-1970	1.000	0.081	0.365	0.076	0.240	0.225	0.268
1970-1975	1.000	0.064	0.379	0.069	0.279	0.173	0.282
1975-1980	1.000	0.057	0.370	0.083	0.293	0.146	0.281
1980-1985	1.000	0.053	0.360	0.077	0.294	0.124	0.255
1985-1990	1.000	0.049	0.358	0.068	0.285	0.106	0.229
1990-1995	1.000	0.047	0.358	0.056	0.287	0.089	0.241

Figure III

Per capita GDP across Italian Regions (1960-95)

The series are expressed at constant prices 1990. The dashed line is calculated as an average across southern regions (Abruzzi, Molise, Puglia, Campania, Basilicata, Calabria, Sicilia and Sardegna). The dotted line is calculated as an average across northern regions (Piemonte, Valle D Aosta, Lombardia, Trentino Alto-Adige, Veneto, Friuli Venezia-Giulia, Emilia Romagna, Toscana, Umbria, Marche and Lazio). ITA is calculated as the average across the sample.

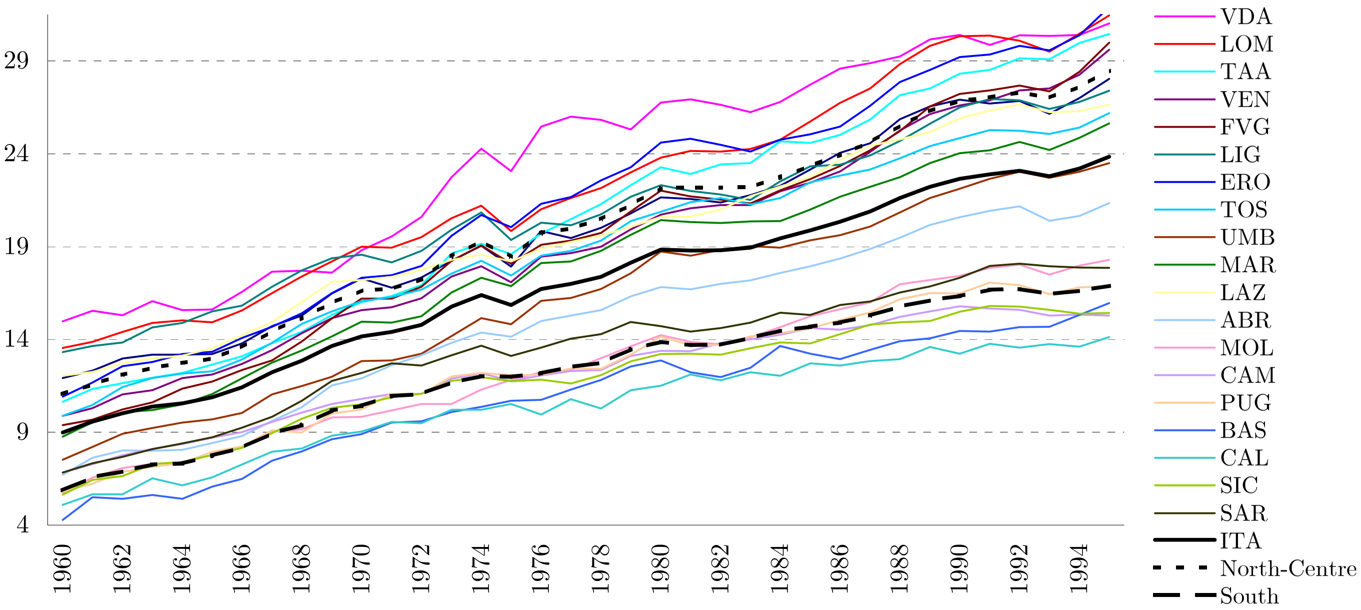


Figure IV

Relative per capita GDP across Italian Regions (1960-95)

Series are expressed at constant 1990 prices. The dashed line is calculated as average across southern regions (Abruzzi, Molise, Puglia, Campania, Basilicata, Calabria, Sicilia and Sardegna). The dotted line is calculated as average across northern regions (Piemonte, Valle D Aosta, Lombardia, Trentino Alto-Adige, Veneto, Friuli Venezia-Giulia, Emilia Romagna, Toscana, Umbria, Marche and Lazio). Italy is set equal to unity.

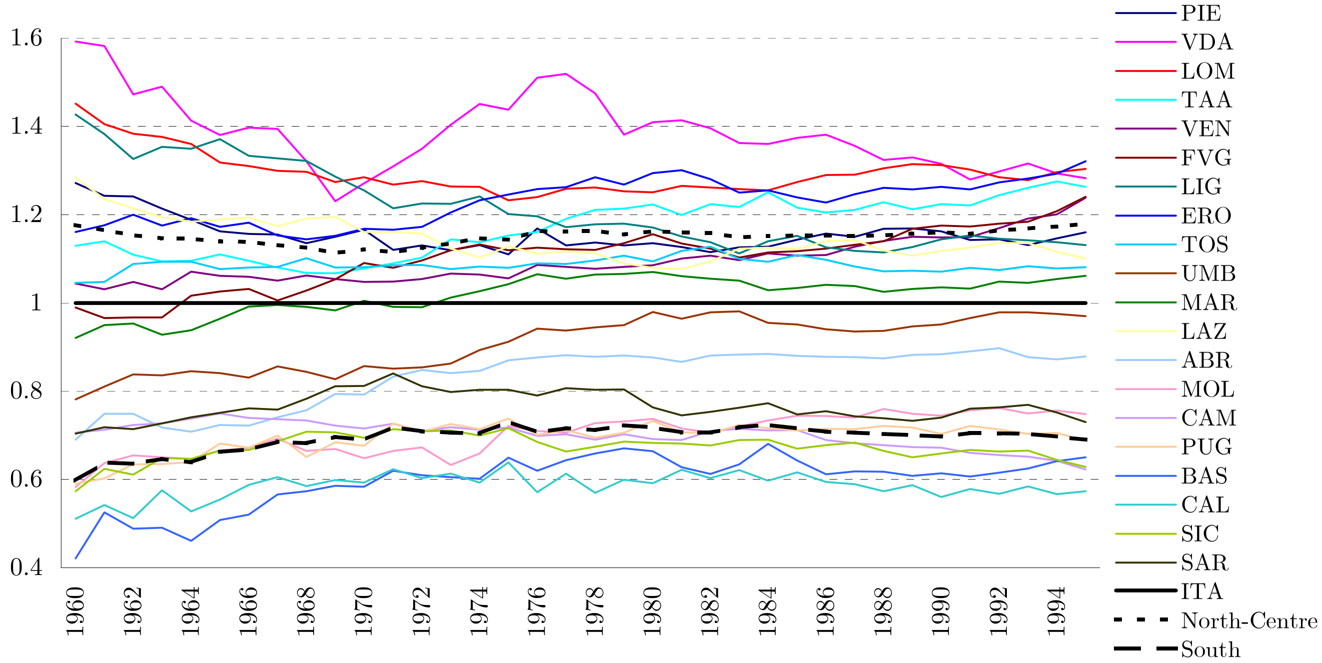
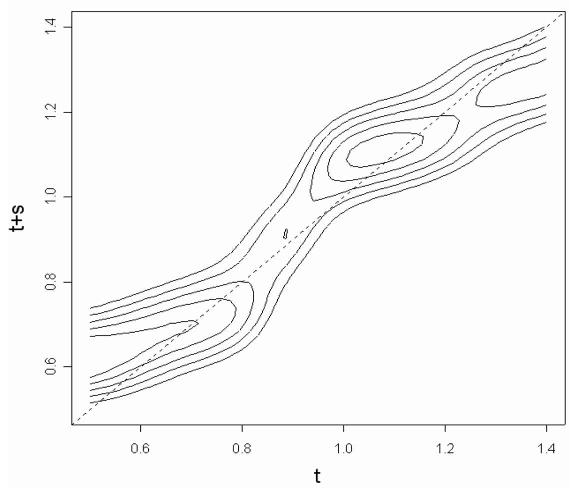


Figure V
Alternative Transitional Periods

Panel A reports the contours plot of the stochastic kernel for transitions of 10 years (i.e. s=10) between 1960 and 1995. Panel B reports the contours plot of the stochastic kernel for transitions of 20 years (i.e. s=20) between 1960 and 1995. Vector dimensions consist of 520 and 340 observations respectively.

Panel A



Panel B

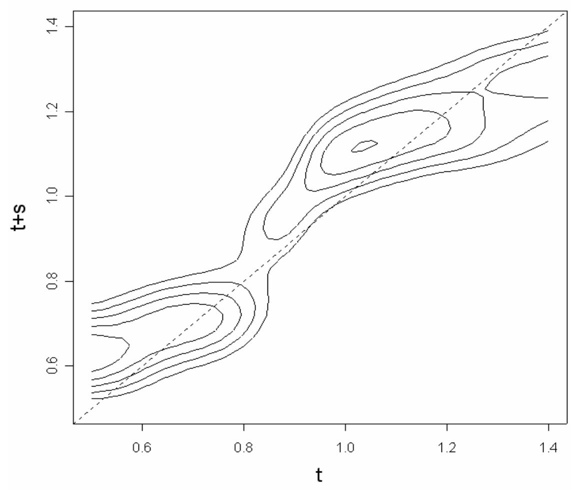


Table II

Growth Regressions across Italian Regions

The dependent variable is the growth rate of per capita GDP - g_{YN}. Growth rates are calculated across non-overlapping intervals of five years. Level variables are calculated as means across the 5 year periods composing each panel and are indicated with capital letters. Initial levels of per capita GDP refer to the first year of each panel. The starred variable indicates that Lombardia is taken as the reference region. All models are estimated by LSDV including time and individual dummies. t-statistics are reported in round brackets; heterosckedasticity consistent t-statistics are reported in square brackets. *** (**) [*] denotes that the null hypothesis of statistical insignificance is rejected at the 1% (5%) [10%] significance level.

Variable	A	B	C
	Coefficient (t-ratio) [het. c. t-ratio]	Coefficient (t-ratio) [het. c. t-ratio]	Coefficient (t-ratio) [het. c. t-ratio]
Physical capital growth rate - g_{KL}	0.2351	0.2830	0.2832
	(3.23)***	(3.69)***	(4.01)***
	[2.09]**	[2.53]**	[2.72]***
Human capital growth rate - g_{HL}	0.1266	0.0910	0.0960
	(2.53)**	(1.77)*	(2.04)**
	[3.04]***	[1.76]*	[1.86]*
Employment growth rate - g_{LN}	0.6129	0.6351	0.6785
	(4.50)***	(4.53)***	(5.20)***
	[4.70]***	[5.06]***	[6.57]***
Per capita GDP at t_o - Y_{to}	-0.0073	-0.0116	-0.0119
	(-3.54)***	(-4.38)***	(-4.73)***
	[-6.21]***	[-6.05]***	[-6.07]***

Table II - continued

Squared per capita GDP at t_o - ${Y_{to}}^2$	0.0001	0.0002	0.0002
	(3.83)***	(4.26)***	(4.89)***
	[4.760]***	[4.81]***	[5.17]***
Net imports quote - NIMP/Y		-0.0398	-0.0376
		(-3.17)***	(-3.12)***
		[-4.36]***	[-3.59]***
Industrial employment growth rate - $(Y_I/Y)g_{LI}$		0.0903	
		(0.82)	
		[0.84]	
Agricultural employment growth rate - $(Y_A/Y)g_{LA}$		0.1692	
		(0.36)	
		[0.59]	
Industrial sector dimension - Y_I/Y		0.1749	0.1584
		(3.32)***	(3.53)***
		[3.69]***	[3.59]***
Intra-sectorial unbalance - $(Y_I/Y)\ln(g_{YLI}/g^*_{YLI})$		-0.0668	-0.0608
		(-4.04)***	(-4.53)***
		[-3.67]***	[-3.40]***
Inter-sectorial unbalance - $(Y_A/Y)\ln(g_{YLA}/g_{YLI})$		-0.0197	
		(-0.57)	
		[-0.85]	

Table III
Diagnostic Analysis and Encompassing Procedure

Columns A and B report diagnostic tests for the standard growth accounting model and for the augmented specification. F-test (1) and (2) test the joint statistical significance of variables representing sectoral imbalances - i.e. H_o: the standard growth accounting model is the right model. In column B, F-test(1) tests the alternative hypothesis that the model augmented with NIMP/Y, $(Y_I/Y)g_{LI}$, $(Y_A/Y)g_{LA}$, Y_I/Y, $(Y_I/Y)\ln(g_{YLI}/g^*_{YLI})$ and $(Y_A/Y)\ln(g_{YLA}/g_{YLI})$ is the correct one; F-test (2) tests the alternative hypothesis that the model augmented with $(Y_I/Y)g_{LI}$, $(Y_A/Y)g_{LA}$, Y_I/Y, $(Y_I/Y)\ln(g_{YLI}$ $(Y_A/Y)\ln(g_{YLA}/g_{YLI})$ is the correct one. In column C, F-test (1) tests the alternative hypothesis that the model augmented with Y_I $(Y_I/Y)\ln(g_{YLI}/g^*_{YLI})$, and NIMP/Y is the correct one; F-test (2) tests the alternative hypothesis that the model augmented with Y_I/Y and $(Y_I/Y)\ln(g_{YLI}/g^*_{YLI})$ is the correct one.

Statistic	A	B	C
Adjusted R^2	0.890	0.880	0.882
Wald test (time dummies)	188	347	330
Two-ways vs one-way model			
Chi Sq. statistic	439.21	92.10	98.28
Wald test (individual dummies)	9358	7593	8375
Lagrange multiplier test (pooled vs panel model)			
Two ways model	13.21	42.13	73.34
Hausman test (fixed vs random model)			
Two ways model	23.31	29.24	27.02
Model test	49.93	28.45	31.55
Test for first-order serial correlation	-1.56	-1.47	-1.96
F-test (1)		50.41	18.08
F-test (2)		44.58	12.91
Test for returns to scale regime:			
Chi Sq. for H_o: $\psi=1$ and $\delta=0$	7.78	5.67	6.78
Test for joint excl. of g_{LN}, $(Y_I/Y)g_{LI}$, $(Y_A/Y)g_{LA}$		158.72	
Test for joint excl. of g_{LN} and $(Y_I/Y)g_{LI}$		157.28	
Test for joinf excl. of g_{LN} and $(Y_A/Y)g_{LA}$		8.33	

Table IV
Growth Regressions for Italian Regions across Periods

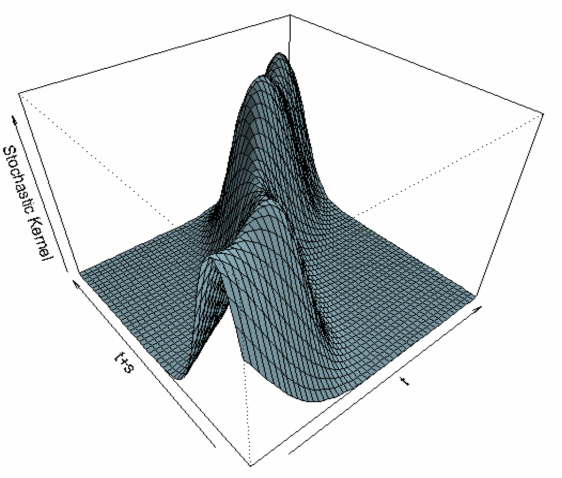
The dependent variable is the growth rate of per capita GDP - g_{YN}. See table II for variables definitions. All models are estimated by LSDV including time and individual dummies. Column A reports results for the period going from 1960 to 1975; panel B reports results for the period going from 1975 to 1995. Heterosckedasticity consistent t-statistics are reported in square brackets. *** (**) [*] denotes that the null hypothesis is rejected at 1% (5%) [10%] significance level.

Variable	A Coefficient [het. c. t]	B Coefficient [het. c. t]
g_{KL}	0.1640 [0.92]	0.4890 [3.72]***
g_{HL}	-0.1308 [-1.45]	0.0450 [0.456]
g_{LN}	0.2015 [0.91]	0.8794 [3.50]***
Y_{to}	-0.0201 [-3.48]***	-0.0111 [-3.82]***
Y_{to}^{2}	0.0004 [2.73]**	0.0002 [3.12]***
NIMP/Y	-0.0547 [-4.36]***	-0.0718 [-2.68]***
$(Y_I/Y)g_{LI}$	0.5152 [2.40]**	-0.0166 [-0.228]
$(Y_A/Y)g_{LA}$	0.5297 [0.45]	-0.8062 [-2.19]**
Y_I/Y	0.4321 [4.70]***	-0.0143 [-0.205]
$(Y_I/Y)\ln(g_{YLI}/g^{*}_{YLI})$	-0.1651 [-4.27]***	-0.0019 [-0.08]
$(Y_A/Y)\ln(g_{YLA}/g_{YLI})$	-0.1428 [-1.82]*	0.1445 [3.60]***
Test for joint ecxl. of g_{LN}, $(Y_I/Y)g_{LI}$, $(Y_A/Y)g_{LA}$	12.42	46.89
Test for joint ecxl. of g_{LN} and $(Y_I/Y)g_{LI}$	9.52	13.92
Test for joint ecxl. of g_{LN} and $(Y_A/Y)g_{LA}$	1.33	26.07

Figure VI
Conditioning Dynamics Using the Simple Growth Accounting Framework

Panel A reports the stochastic kernel estimated for transitions of five years (i.e. s=5) between 1960 and 1995 for Italian regions where the effect of the steady state convergence process has been removed. Panel B reports the contours plot of the estimate for fixed levels of probability. The dotted lines represent the actual dynamics.

Panel A



Panel B

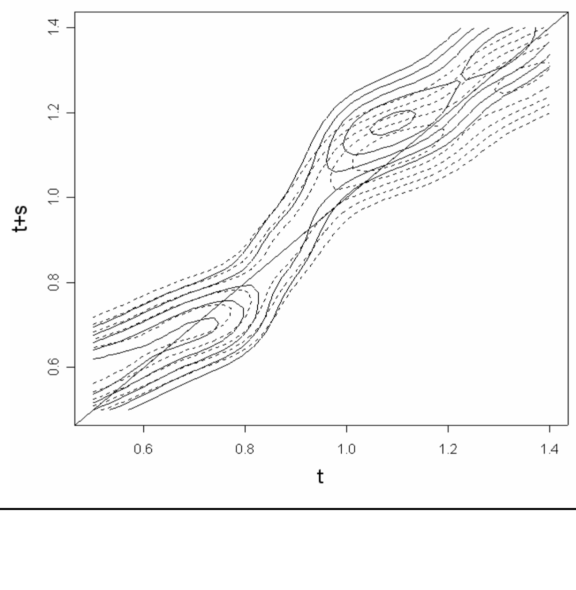
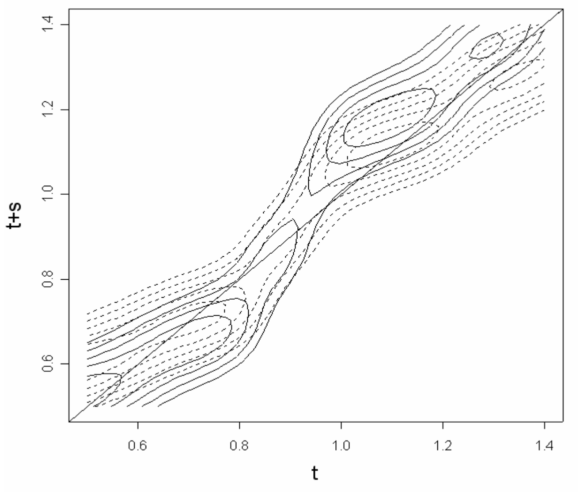


Figure VII

The Effects of Sectoral Imbalances and Conditional Convergence Dynamics on Mobility

Panel A reports the contours plot of the stochastic kernel estimated for transitions of five years between 1960 and 1990 after conditioning regional growth rates using the effects of sectoral imbalances. In Panel B only steady state convergence is removed from transitional paths. In both panels the dotted lines represent the actual dynamics.

Panel A



Panel B

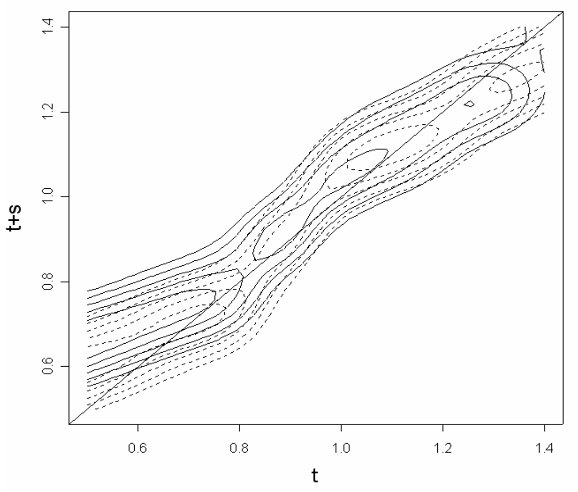
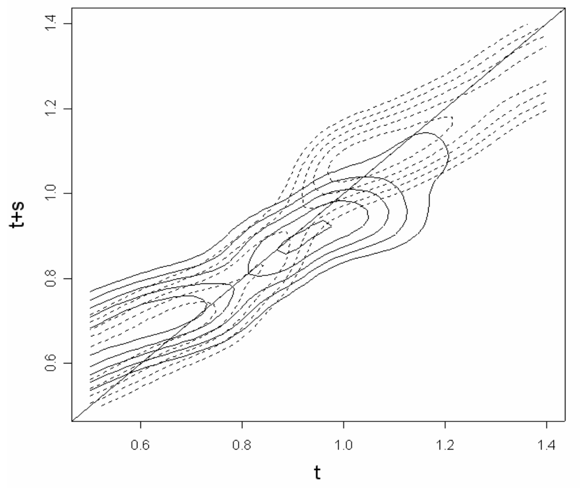


Figure VIII
Conditional Dynamics (1960-75)

Panel A reports the contours plot of the stochastic kernel estimated for transitions of five years between 1960 and 1975 after conditioning the regional growth rates using the effects of sectoral imbalances only. In Panel B the estimates are obtained removing the effect of the steady state convergence from transition paths. In both panels the dotted lines represent the actual dynamics.

Panel A



Panel B

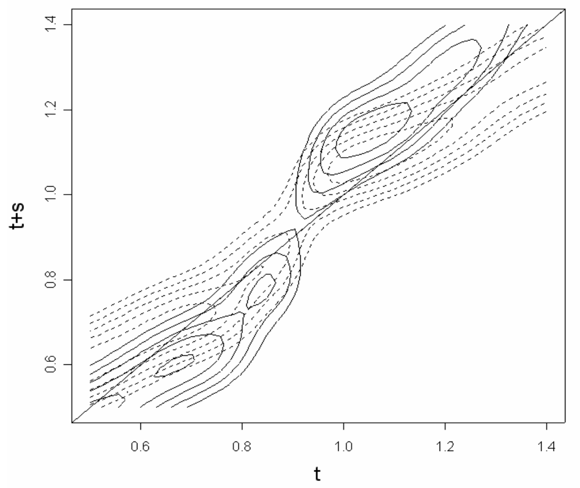
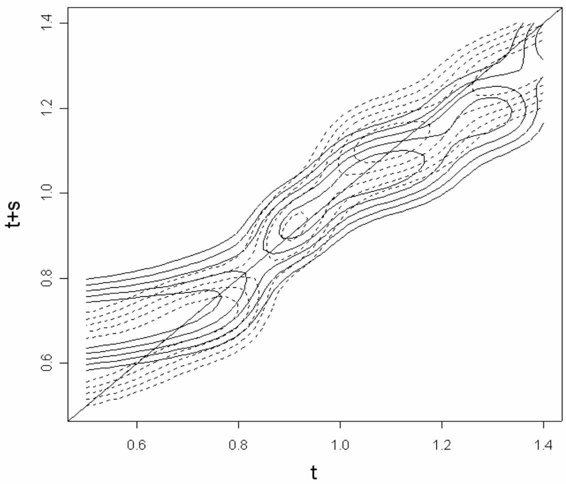


Figure IX
Conditional Dynamics (1975-95)

Panel A reports the contours plot of the stochastic kernel estimated for transitions of five years between 1975 and 1995 after conditioning regional growth rates using the effects of sectoral imbalances only. In Panel B the estimates are obtained removing the effect of the stady state convergence from transition paths. In both panels the dotted lines represent the actual dynamics.

Panel A



Panel B