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A Novel Methodology for Comparisons in Time and Space

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Abstract

In economics, politics, business and statistics time distance concept can provide new insights from existing data. A novel statistical measure S-distance (expressed in time) is generalised to complement conventional static measures in time series comparisons, regressions, models, forecasting and monitoring. The examples focus on disparities in GDP per capita for EU regions and countries, and selected transition countries. The broader analysis in two dimensions leads to a comprehensive definition of convergence, new hypotheses and policy conclusions. For cohesion in the EU it is important also how fast and not only how much faster the less developed units grow.

Keywords
Time distance, S-distance, cohesion in the EU, convergence, disparities in GDP per capita in the EU, proximity in time and proximity in indicator space, overall degree of disparity

JEL-Classifications
C10, N10, O10, O52

Comments

This research was undertaken with support from the European Union's Phare ACE programme 1996, P96-6645-F: "Cohesion in the EU and Accession of Slovenia: A Novel Analytical Framework for Comparison with Selected Smaller EU Countries". The novel methodology for comparisons across time and space is based on a more general approach and is relevant for many fields of application other than comparison between countries and regions, which is the focus of this project. Therefore it was considered advantageous to start in Sections 2.1-2.5 with a more general exposition based on an earlier study by Sicenter (Sicherl, 1997) in order to base the specific application to disparities between countries and regions and to cohesion in a broader theoretical and analytical framework and to enable potential users to consider the application of this methodology to this and other problems.

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1. Introduction

An important issue in the European integration is the effect that the accession of Central and Eastern European (CEE) countries would have on the cohesion in the EU. Cohesion in a community or in a society is first and foremost a question of the state of mind. Yet the perceptions formed and the decisions, behavior and actions undertaken are also influenced by the quantitative indicators and measures used in the semantics of discussing the issue, in setting the targets and in following their implementation.

The understanding of the complexities of real life situation is not increased only by an increase of quantity and/or quality of empirical information. At least equally important are the concepts and tools of analysis which systematise and transform information into perceptions relevant for decision making and influencing human behavior. This study as the first part of the project will describe a novel conceptual and analytical framework that would offer a better integration of comparisons across time and space. The novel methodology offers a new perspective to the problem, an additional statistical measure, and a presentation tool for policy analysis and debate that is readily understood by policy makers, media and general public.

Comparative analysis, over many dimensions and over time, is a complex undertaking, and there are many methods used for cross-country comparisons and comparisons over time that deal in great detail with the conceptual and methodological issues of comparative analysis. The present state of art needs improvement at least in three directions: (1) comparisons over space and over time need to be better integrated, (2) explicit treatment of the time dimension as a universal unit of measurement can contribute new insights to the problem under consideration, and (3) the information content of existing data can be better exploited in a dynamic conceptual and analytical framework.

There are different measures used to express the notion of and the degree of cohesion. One of the main approaches to measuring the degree of cohesion in the EU is that which analyses the degree of regional disparities in selected indicators. Deviation of individual regions from the average value and summary measures of disparities are calculated for different years, and such (mostly static relative) measures are compared over time. This approach is important and indispensable, but lacking in some elements as it is not sufficient to show the complexity of the situation that can be provided by a truly dynamic framework. The methodology used in this study will combine the conventional approach for comparisons of disparities in economic and social indicators between and within countries with the novel concept of time distance and the corresponding statistical measure S-distance.

The better the analytical framework the greater the information content provided to experts, decision makers and general public. Time and money are two topmost units of measurement used to assess and to compare various situations. It is remarkable, however, that the present methods in economics and statistics do not fully utilise the information content with regard to certain aspects of the time dimension embodied in existing data. Since from practically the same information (two vectors of values with time subscripts) an additional theoretically universal and practically relevant measure can be obtained, it is evident that an expanded conceptual and analytical framework is called for.

The conventional analysis of disparity is mainly developed for the evaluation of the degree of disparity at a given point in time. The method used in this study enables two-dimensional analysis of disparity: disparity in the level (for a given point in time) and disparity in time (for a given level of the indicator). In general, time distance measures, for a given level of the indicator, the difference in time that separates the two compared units or situations. From this idea of the multidimensional notion of disparity it follows that the overall degree of disparity is conceived here as a weighted combination of the static and dynamic (temporal) dimensions of disparity (Sicherl, 1992). The degree of disparity between the two compared units can thus be expressed simultaneously in at least two dimensions: ***a static measure*** (e.g. that per capita product in region A was in 1993 50 per cent higher than in region B) ***and the time distance*** (e.g. that the time lag amounted to 10 years, as the current 1993 level of the per capita income of region B was achieved in region A already in 1983). Either cannot in itself describe the complex notion of the overall degree of disparity (Sicherl, 1996c).

Two innovations, one at the analytical and one at the conceptual level, represent an important amendment in methods and techniques of analysis, as well as in their use for policy debate, and for monitoring of progress. At the analytical level, the study will show that new insights for evaluation of policy and business alternatives can be provided from existing data by introducing the time distance concept, since existing methods in economics and statistics do not utilise this information. The farther advantage of this approach is that a new dimension is added while no earlier results are lost or replaced. In addition to a broader theoretical framework a statistical measure S-distance was defined to suggest a possibility how the broader concept and reference framework can be measured in operational terms and integrated with the conventional statistical measures. S-distance is defined in standardised units - time - which means that everybody understands the notion of the time lead or time lag between two compared units for a given level of the indicator. This makes it not only a transparent analytical measure but also an excellent presentation and communication device, which is of great importance for its practical use.

At the conceptual level, the important point is that one needs to start from a broader idea of how to look at and think about various relevant aspects of comparing different situations. The new approach perceives and describes the difference between two compared units (or two compared situations for the same unit) in two dimensions: by the conventional divergence at a given point in time, and by time distance for a given level of the indicator, i.e. the notion of disparity is multidimensional. Time distance thus looks at the proximity in time as one dimension in a multidimensional notion of disparity. As time is one of the most important reference frameworks in a modern society, it is highly unlikely that the time distance concept and the emphasis on the two-dimensional notion of disparity used here would be irrelevant for economic theory and for policy considerations. In normative terms, although the subjective value judgements which people attach to the time dimension of disparity relative to the static dimension is an open question (similar to that how they evaluate the relative importance of various static measures), it is in view of positive time preference embodied in discounting procedures highly unlikely that the weight given to time distance would be zero.

The novel conceptual and analytical approach can thus be broken down into two distinct but interrelated components. The first one is analytical and statistical: a novel statistical measure S-distance (expressed in standardised units - time) is generalised to complement conventional measures in time series comparisons, regressions, models, forecasting and monitoring, and to provide from existing data new insights due to an added dimension of analysis. A new view of the information, using levels of the variable(s) as identifiers and time as the focus of comparison and numeraire, is theoretically universal, intuitively understandable and can be usefully applied as an important analytical and presentation tool to a wide variety of substantive fields. Although there may be certain complications with its estimation in some specific cases, it has in addition to its use as s descriptive statistical measure the potential to provide new understanding of the situation for a variety of situations in economics, politics, business and statistics, asking new questions and formulating new hypotheses.

The second component is normative and theoretical, related to subjective perceptions, policy and welfare issues. Since subjective weights that people assign to static measure(s) of disparity and time distance are not known, no immediate answer is available in the sense that one would be able to make the welfare comparison of the suggested overall degree of disparity. This is a task for an interdisciplinary research over the long run. But new hypotheses about interrelationships between growth and disparities can be formulated, though testing will not be easy. In this theoretical framework a hypothesis can be formulated that, ceteris paribus, increased tensions within some countries may be a result of an increase in overall disparity through increased time distances brought about by lower growth rates. The interrelationships between efficiency, growth, disparity and equity are in this conceptual framework more pronounced than in the conventional analysis (Sicherl, 1992).

It should be emphasised that the first component, use of time distance and S-distance as a statistical measure, is valid on its own merit, whatever the position of the analyst or user is with respect to possible welfare and policy consequences. The first component does not depend on the second component. The latter, however, allows stronger interpretation of the empirical results and/or formulation of additional hypotheses. This viewpoint determined the content and the composition of the study. Sections 2.1-2.5 provide a general description of the approach from an earlier study (Sicherl, 1997), which is considerably broader than the application to the particular problem in the empirical part of this project. Section 3 combines the methodological questions with the empirical analysis of disparities in GDP per capita for EU and CEE countries, and Section 4 with respect to disparities among EU regions, and within Austria in particular. Section 5 presents an illustration that the rankings of indicators by the magnitude of the gap in time distance may be quite different than in terms of static ratios. Section 6 provides some argumentation on subjective evaluation and policy and welfare issues, and Section 7 provides a summary and draws conclusion.

2. Comparing in Two Dimensions: A Broader Concept and a Novel Statistical Measure of the Time Dimension of Disparities

2.1 Time Distance - Concept and Definition

Time distance in general means the difference in time when two events occurred. We define a special category of time distance, which is related to the level of the analysed indicator. The suggested statistical measure **S-distance** measures the distance (proximity) in time between the points in time when the two series compared reach a specified level of the indicator X. The observed distance in time (the number of years, quarters, months, days, minutes, etc.) is used as a dynamic (temporal) measure of disparity between the two series in the same way that the observed difference (absolute or relative) at a given point in time is used as a static measure of disparity.

For a given level of X_L, $X_L = X_i(t_i) = X_j(t_j)$, and the S-distance, the time span separating unit (i) and unit (j) for the level X_L, will be written as

$$S_{ij}(X_L) = \Delta T(X_L) = T_i(X_L) - T_j(X_L) \qquad (1)$$

where T is determined by X_L. In special cases T can be a function of the level of the indicator X_L, while in general it can be expected to take more values when the same level is attained at more points in time, i.e. it is a vector which can in addition to the level X_L be related to time. Three subscripts are needed to indicate the specific value of S-distance: (1 and 2) between which two units is the time distance measured and (3) for which level of the indicator (in the same way as the time subscript is used to identify the static measures). In the general case also the fourth subscript would be necessary to indicate to which point in time it is related $(T_1, T_2, \ldots, T_n)$.

The sign of the time distance comparing two units is important to distinguish whether it is a time lead (-) or time lag (+) (in a statistical sense and not as a functional relationship)[1]

$$S_{ij}(X_L) = -S_{ji}(X_L)\ . \qquad (2)$$

For a given level of the indicator X_L in general there will be two vectors of the values of time when this level of the indicator (or its approximation by interpolation or extrapolation) will be attained by unit i and unit j: $T_i(X_L)$ with $\underline{m}$ values and $T_j(X_L)$ with $\underline{n}$ values. The corresponding matrix of time distances will have $\underline{m}$ times $\underline{n}$ elements. For continuously increasing or decreasing series there will be only one time distance. The strengths and weaknesses of time distance measure and its relationship with the conventional static measures will be discussed in Section 2.3.

[1] The earlier definition of S-distance (see e.g. Sicherl, 1975, 1978 and 1992) used positive sign for time lead and negative sign for time lag. With the generalisation of application of the time distance concept and S-distance measure to short term economic analysis (e.g. deviations in regressions, models, forecasting and monitoring) in Sicherl (1994a and 1994b), for a more clear two-dimensional graphical presentation of deviations between actual and estimated values it was found to be more convenient to assign the negative sign to time lead and positive sign to time lag, as it is done in equations (1) and (2).

Perceiving and measuring differences in two dimensions (in value and in time)

Difference in value at a given point in time

Figure 1a. A schematic presentation of static comparison
Example 1: $R_{12}(t)=1.5$, $r_1=r_2=2\%$

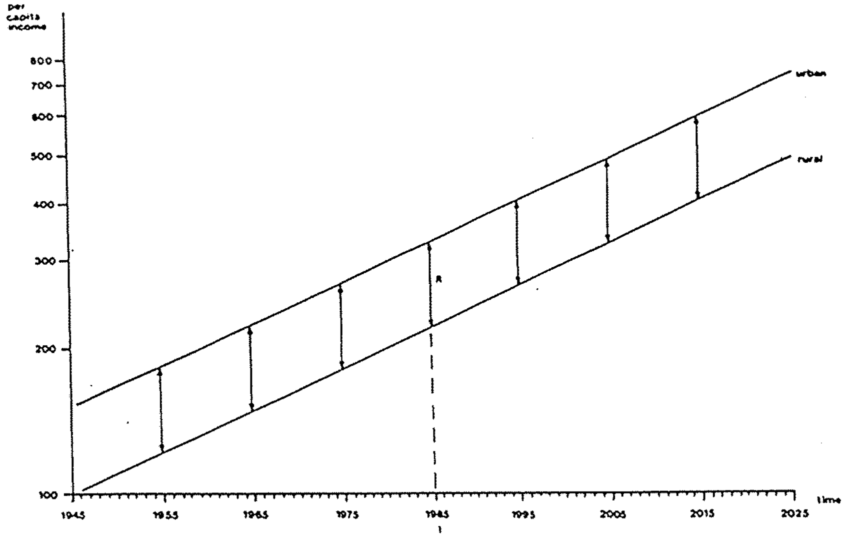
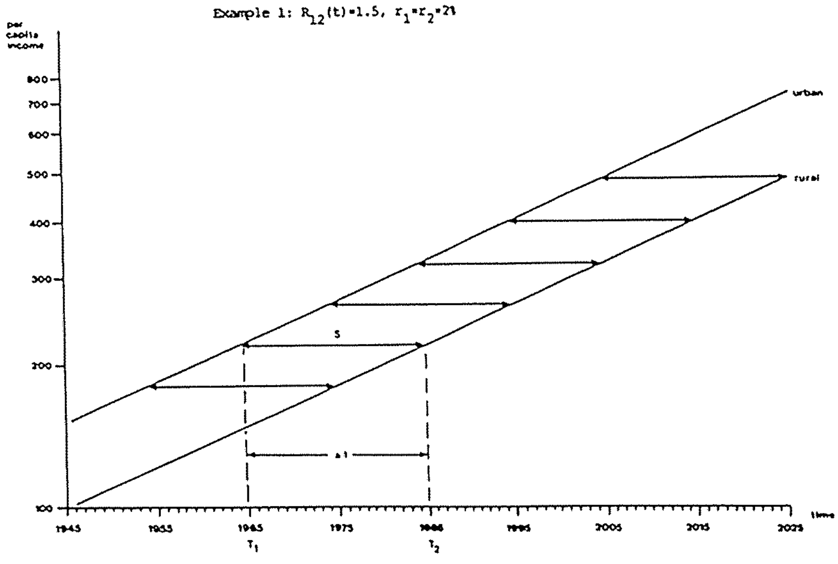


Figure 1b. A schematic presentation of time distance
Example 1: $R_{12}(t)=1.5$, $r_1=r_2=2\%$



Difference in time for a given value

2.2 A New View of the Information: Using Levels of the Variable(s) as Identifiers and Time as the Focus of Comparison and Numeraire

Using the comparison between two units as an example it will be shown that the idea of time distance goes together very naturally with the existing concepts of static disparity at a given point in time and the notion of the growth rate over time. Time has been used in comparisons mainly as locational information, i.e. as a coordinate in a parameter frame forming a coordinate system that is used to organise (or index) a set of variables. In alternative words, it has played a role of a descriptor, subscript or identifier. The intention of this approach is to go further, without replacing the existing views. If we choose to interchange the roles of the level of the indicator and time, a given level of the indicator becomes a descriptor or identifier: time becomes a numeraire in which certain distances between the compared units and indicators can be expressed and measured. While the whole approach and the broad range of possible applications are much more complex and general, the time distance is the priority choice because of its intuitive nature, and of the importance of the time dimension in semantics of describing various situations in real life and forming our perceptions about them.

Table 1 provides a schematic example for such comparisons for a given indicator. Row one is the most frequently used type of comparative analysis, levels of the indicator at a given point in time are compared, we have two points with three elements of information: (i) the respective level of the indicator, (ii) to which unit it belongs, and (iii) at what time it happened. In this case unit as well as time (constant for static comparison) serve as identifiers. Row two compares two levels of the indicator for each unit at two points in time, separately for each unit, which means that one calculation in row two refers to unit 1, and another to unit 2. The simplest example would be growth rate for unit 1 and growth rate for unit 2. Here identifier is the unit, while the numerical values on levels and time are used in the calculation.

These two steps are standard procedures. The first one represents the static type of comparison, the second one measures the dynamic properties of the indicator for each unit separately. By continuing with this process by analogy, one is bound to find that time distance has been the concept and measure missing in conventional approaches. In row three, for the statistical measure S-distance, level is the same, level and unit serve as identifiers, and time is used in the calculation of time distance.

It is remarkable that the notion of time distance, which can be in principle developed from the same information used in steps one and two, has not been developed theoretically and as a standard statistical measure.

Table 1: Points of Comparison for Static Difference, Change over Time and Time Distance (comparing two units)

	TIME	UNIT	LEVEL	Measure
TIME	same	2	2	static difference
UNIT	2	same	2	change over time
LEVEL	2	2	same	time distance

While there may be different problems involved in the calculation of these three types of measures in terms of availability and comparability of data, in principle these three types of measures can be integrated into a formally consistent analytical framework, although at a cost in conceptual purity of these measures. There are alternative ways of doing this, following from the distinction between backward looking (***ex post***) and forward looking (***ex ante***) time distances. They relate to different periods, past and future, the first belongs to the domain of statistical measures based on known facts, the second is important for describing the time distance outcomes of the results of alternative policy scenarios for the future. A very important relationship shows that, ceteris paribus, time distance is a decreasing function of the magnitude of the growth rate of the indicator. Theoretical conclusion (Sicherl, 1992) and present examples show that the S-distance as a dynamic (temporal) measure of proximity offers a perspective which can be quite distinct from that provided by static measures.

The role and importance of the time distance concept and statistical measure S-distance can be in general terms described by reference to a common problem of choice in economic analysis and modelling. Too few variables may not be able to provide the necessary degree of understanding of the problem, too many variables may impose an unrealistic demand on the knowledge of linkages or may result in the loss of understanding of the most important issues. In discovering the important patterns the art of handling and understanding of different views of data is crucial. The time distance approach is useful at least in two domains: (1) it offers a new view of data that is exceptionally easy to understand and communicate, and (2) it may allow for developing and exploring new hypotheses and perspectives that cannot be adequately dealt with without the new concept.

2.3 Comparing some Characteristics of Static and Time Distance Measures

As the time distance is in our case defined for a given level of the indicator, it should be emphasised that in principle time distance is independent of the static distance(s) for a given point in time. Two time series (e.g. actual and estimated values of the analysed indicator X) can be analysed independently from two perspectives: for a given point in time one gets static discrepancies, for a given level time distances as discrepancy in timing. If for the moment we look at these two types of comparisons as separate and independent procedures, one can see certain advantages and disadvantages of the two approaches.

The advantage of comparisons at a given point in time lies in the fact that, for the known length of the two time series, all values can be determined as a single value for any given point in time. For comparisons at a given level of the indicator, time distance cannot be determined (without extrapolation or interpolation) for those levels of the indicator which were not reached by both series. Also, it is possible that for the same level of the indicator there are multiple crossings and the analysis of time distances becomes more complex. On the other hand, if the two time series are continuously increasing or decreasing, when defined also for time distances one gets single values only for a given level of the indicator.

In general, while the levels or static differences can be written as a function of time, time intersections and time distances for a given level of the variable have to be expressed as relations. Thus in the computer programme for calculation of time distances one has the options for calculating them on the basis of the first or last intersection, as an average of all time distances or as a minimum distance. As always, it is for the user to decide which is the most useful for the purpose of the inquiry.

The complexity of possible numerous solutions is diminished by the fact that time distance concept is simple and intuitively straightforward, at the same time there is the benefit that the complexity of the situation is underlined. There are also at least two cases where this characteristic can be used for types of analysis which are not available in the static approach. The first is calculation of time distances for various levels of the indicator on the series itself, which makes no sense in static comparison, but can be a useful device to study some characteristics of time series with considerable fluctuations. In such a case the matrix of time distances for a given level of the indicator is a square matrix and the most interesting cases are the elements above (or below) the main diagonal which represent S-distances between the neighbouring intersections in time. Although the application of S-distance analysis to business cycle analysis, for study of residuals and more generally in analysing stationary series is very interesting, it will not be developed further here for lack of space (an empirical example is provided in Sicherl 1996a, Section 5). The second application can be used to study disparity in a dichotomous 0 or 1 case. Let us suppose that a farmer just got a tractor, and his neighbour did not. After 5 or 20 years the situation would look unchanged from the point of view of static disparity, but the neighbour may be having a rather different perception of disparity after 5 and after 20 years. In other words, in such a case time distance analysis can show a much more fine and differentiated picture of 'various shades of grey' as opposed to 'black and white' description of static measures in such cases.

As mentioned above, the analysis of time distances is a new view of data and a novel data reduction method, it can by itself add interesting new information and can be treated independently of static measures of disparity if one tends to look at the situation from the statistical point of view alone. However, we shall try to integrate them despite some problems in doing this, for details see (Sicherl, 1996a). Our aim has been to systematise and formalise this novel approach not only on the analytical but also on the conceptual level (see e.g. Sicherl 1978 and 1992). The concept of the overall degree of disparity (proximity) is based on a simultaneous perception of proximity in space and proximity in time, as both of them matter.

Although the integration of the static and temporal dimensions of disparity into a formally consistent analytical framework can be obtained only as a compromise between the pure concept of comparison at a given point in time and of comparison for a given level of the indicator, we shall use the two-dimensional analysis of disparities across time and space extensively. The advantages of having a broader conceptual framework for a better understanding of the reality far outweighs the disadvantages in dealing with more than one possibility of combining static and temporal distances in a formally consistent analytical framework.

Technically, depending on the particular form of compromise, it is possible to arrive at a two-dimensional presentation of both static and time distances which can enhance the simultaneous analysis of distances in both dimensions. This will be called an SA graph when time distance is presented together with A distance (absolute difference in the indicator) , or an SP graph if static distance is expressed in per cent, or SR graph if static distance is expressed as a ratio. By the position of a particular point in this type of graph it is possible to determine whether on that particular interval of the curve the indicator has been increasing or decreasing. With time distance on the abscissa, and the respective static distance on the ordinate, the points in the four quadrants can be characterised by the various combinations of values as presented in Table 2 (for details and derivation see Sicherl 1996a).

Table 2: Distribution of Time Distances and Static Distances by Quadrants
(x axis = S-distance, y axis = static distance A or ln(R) or percentage P)

II.quadrant	I.quadrant
$S < 0$	$S > 0$
$A > 0$	$A > 0$
$k_T > 0$	$k_T < 0$
III.quadrant	IV. quadrant
$S < 0$	$S > 0$
$A < 0$	$A < 0$
$k_T < 0$	$k_T > 0$

Since k represents the slope of the trends of the values of the indicator for the two units, the second and the fourth quadrant will show the results for increasing functions of time, and the first and the third quadrant for decreasing functions of time (or increasing and decreasing sections of the function). Practical examples are provided in this paper for comparisons over the long run, while examples of application in time series regressions, models, business cycles, forecasting and monotoring are provided e.g. in Sicherl (1997).

2.4 Proximity in Time and Proximity in the Indicator Space (Some Consequences for Analysing Convergence and Divergence)

Convergence can imply a decrease in terms of levels or relative static measures (ratio or percentage) or rates of growth over time. These are different cases and it is not possible to deal with these problems here. One should mention an important conclusion that the decrease in the ratio between two compared units depends only on the difference between their growth rates, while the time distance depends both on the difference between their growth rates and on the absolute value of the growth rates (Sicherl, 1978). This also means that the calculations of how much time is needed for catching up (full equalisation) is not a time distance measure by this definition (or that it may be a very special case of it). Taking into account the notion of proximity in time it is worthwhile to suggest that convergence (divergence) could be discussed in two dimensions: closer (farther) in ratio and closer (farther) in time. Instead of the simple 'yes' or 'no', at least a 2 x 2 classification of cases could be introduced in convergence analysis.

Table 3a: Convergence Viewed in two Dimensions: Proximity in Time and in Space
(2 x 2 classification of cases)

	Distance in indicator space	
Distance in time	Ratio increasing Time distance increasing	Ratio decreasing Time distance increasing
	Ratio increasing Time distance decreasing	Ratio decreasing Time distance decreasing

In the present usage of the term convergence there is only a simple classification of cases into 'yes' and 'no', where the latter case would include also the case of unchanged relationship. Table 3a uses the same classification for the static degree of disparity, but introduces the distance in time as the second dimension, which is again divided only in two classes. Of the four possible cases in the two-dimensional perspective in Table 3a only the last case (when both ratio and time distance are decreasing) shows an unanimous conclusion of convergence (or that the definition of convergence and divergence should become more flexible and discriminating) in the sense that the proximity is increasing both in space and in time. In the opposite case both dimensions also move in the same direction, but this is not the case in the two other situations where static relative disparity and time distance move in different directions. In such cases it is not easy to evaluate what has happened with the overall degree of disparity, one would need to know people's preferences with respect to the weights given to the static and temporal dimension of disparity.

Table 3b: Convergence Viewed in two Dimensions: Proximity in Time and in Space
(3 x 3 classification of cases)

	Distance in indicator space		
Distance in time	1 Ratio ↑ S-distance ↑	4 Ratio = S-distance ↑	7 Ratio ↓ S-distance ↑
	2 Ratio ↑ S-distance =	5 Ratio = S-distance =	8 Ratio ↓ S-distance =
	3 Ratio ↑ S-distance ↓	6 Ratio = S-distance ↓	9 Ratio ↓ S-distance ↓

Even with this limitation, the perception, measurement of and semantics about disparities can be bettered if one takes a broader perspective and discuses the complex situations in a manner which is more comprehensive and understandable. Table 3b shows now nine different combinations of a static measure of disparity and time distance. In this table ratio of the levels of the analysed indicator is used as a possible choice of static measures of disparity. However, other static measures of disparity could be used in this classification in line with the preference of the researcher or policy maker.

In Table 3b one can find on the diagonal the three cases where the static measure and the time distance lead to the same qualitative conclusion as far as the direction of change is concerned. In all other six cases even the conclusion about the direction of change in the two measures is not the same. It will be shown below on concrete examples that the possibility of divergent diagnoses and conclusions, based on relative static measures alone and on the broader conceptual and analytical framework encompassing also the time distance measure, is not only an infrequent theoretical phenomenon but rather a common occurrence of significant theoretical and political importance.

2.5 Three Groups of Possible Applications by Methodological Criteria

Time distance is a generic concept. As such it is capable of universal application across different units and levels of comparison as well as across different indicators. One likely grouping of possible applications include:

1) ***Comparison of economic and social indicators among countries, regions[2], industries, firms, households, etc.,***

2) ***Discrepancy between actual and estimated values in time series regressions and models, business cycle analysis, forecasting and monitoring plans, budgets, projections and scenarios in economic and business applications,***

3) ***Time distances between different values of a given time series, including fields of very fast changes like financial markets.***

The above classification can be to a certain extent paraphrased as application of time distance approach and S-distance measure in economic analysis in the long term, short term and very short term in a specific field. Sicherl (1996a) presented a table referring to a number of examples of empirical application in three categories, dividing application topics by methodological criteria according to the number of units and series which were used in comparisons rather than by the substantive field or time interval of the analysis[3]:

1. ***comparison between series for two units,***
2. ***comparison between two states of a given series like actual and estimated, and***
3. ***calculation of S-distance for a given series on itself.***

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[2] Applications of time distance analysis were first done in development and welfare context of long term analysis. More recent empirical studies dealt with regional comparisons (Sicherl, 1992, 1996c), comparisons across countires (Sicherl, 1990,1992a) and infant mortality as an example of studying social welfare across Europe (Rose, 1992).

[3] In the more detailed general outline (Sicherl, 1997) Section II, IV and VII deal with problems that belong to the first group, including subjective perceptions, policy and welfare issues. Section V and VI relate to the second group, for an example of the third group the reader is referred to Sicherl (1996a, Section 5).

Table 4: Examples of Some Application Topics for the Three Groups

COMPARING TWO OR MORE UNITS	ANALYSING TWO STATES OF AN INDICATOR	ANALYSING ONE SERIES
Two units, one indicator Income disparity by race in the USA *'George Bush should have known it before Los Angeles riots.'*	**Quality of forecasting:** two-dimensional presentation of **errors of consensus forecast** for the inflation rate in the USA	Analysing series in **financial markets** - connection with CBOT * Market Profile
Two units, many indicators Development profile of Korea compared to Brazil for selected economic and social indicators	Two-dimensional presentation of **regression errors** for unemployment rate as a function of capacity utilisation rate, USA	Analysing **cyclical characteristics**
Many units Distance in time between transition economies and the European Union; regional disparities in the EU	**Business cycles** in major OECD countries (USA, Japan, Germany) and dynamic Asian economies (Korea)	**Further developments forthcoming**
Analysing convergence in two dimensions: static measures and time distance (USA and Japan, regional disparities in Austria)	**Management: monitoring implementation** in two dimensions (e.g. actual value versus estimated value - forecast, budgeted, planned, targeted etc.)	

* Chicago Board of Trade

Source: Sicherl (1996a and 1996c).

The focus of this project are disparities within the EU and between the EU countries and Slovenia (possibly some other CEEC). This means that our primary concern are methodological and practical issues related to the first group of application as defined above. They will be further elaborated in Sections 3 and 4 in connection with empirical examples chosen. Before that, a short comment is appropriate with respect to some salient examples of possible application in the second group. For further details the reader is referred to Sicherl (1994b, 1996a and 1997).

First, in time series regression it is possible to obtain a two-dimensional presentation of regression errors: instead of the conventional too high or too low distinction for an individual estimated value, estimated values can show four theoretically possible combinations of static deviations and deviation in timing: too high and too early (quadrant II), too high and too late (quadrant I), too low and too early (quadrant III), and too low and too late (quadrant IV) - see Table 2 in Section 2.3 in this paper. In addition to S-distances between actual and estimated values for individual points in the time series, by analogy with the standard error of the estimate in the indicator space it is in principle possible (for well-behaved series) to calculate a summary measure of the goodness-of-fit with respect to timing - standard error in time (SET) in addition to the conventional standard error of the estimate (SEE). Such a complementary measure would be of interest for each case separately, but also in comparing different cases. For calculation of time distances one needs only two vectors of actual and estimated values with time subscripts. This means that whatever the estimation method for regressions, model simulation or neural network, the result are always (in time series applications) the time series of actual and estimated values on which the calculation of S-distance is based.

Second, a similar additional view of the situation is available for analysing the quality of forecasting or for analysis of business cycles when the estimates are based on expert opinion or similar sources. It has been shown that the application of time distance component changed substantially the picture based on conventional measures in the evaluation of the position of the USA and Japan in business cycle, as well as in the assessment of the goodness-of-fit for Concensus estimates of the USA inflation rate (see Sicherl, 1996a).

Third, the possibilities for application in the business field at the enterprise and sector levels have been left untapped. It is believed that the broader outlook and S-distance as a statistical measure will, after some teething problems, appear useful in practice by providing a new view of the situation and an understandable analytical, presentation and communication device. An obvious example is the comparison of production and financial targets with actual implementation. Targets are usually expressed not only in terms of the indicator values but simultaneously also in time. As processes towards their implementation are related to time, it is very natural and useful to describe e.g. the degree of implementation in two dimensions: 1 per cent below the target at the target date, and 2 months behind in terms of the achieved level. There are alternative ways of expressing these matters, but it is obvious that the interpretation of how to overcome the time delay may be a very relevant additional practical procedure to be routinely applied to a large number of physical and financial indicators before turning to the more complicated programs. By analogy, this approach can be applied to numerous similar problems in business analysis[4].

It is obvious that this new view (dimension) of the situation can be routinely provided to the management and employees if the companies or software providers would integrate the S-distance measure into their information technology. The incorporation of the time distance

[4] Sicherl (1996d) shows one illustration of applying this methodology to the monitoring of discrepancy between projected and actual sales. However, there is a wide open possibility to apply this methodology to numerous business problems at the micro, corporate and sector level.

measure should be straightforward as a S-distance column could be added in the usual table of actual-planned deviation for both values and quantities. More elaborated analysis is available for comparison across more products at a single point in time, monitoring a given product (or physical or financial indicators) over time, for dynamic benchmarking, forecasting, scenarios, etc. Furthermore, competitiveness and benchmarking are two topics that essentially deal with comparisons. Better theoretical and analytical framework means better understanding of the situation and better decisions. Managers, productivity and competitiveness centers, ministries and others should be interested in the benefits and additional insights which this novel and dynamic approach can bring to analysis, understanding, presentation, decision making and monitoring.

Fourth, since this is a novel approach, standard statistical computer packages do not contain the provision for calculating S-distances. Therefore, Sicenter (Ljubljana, Slovenia) has been developing the computer programs for calculation of S-distance: a) for DOS and b) as an Analysis ToolPak Add-in for Excel for Windows, with further developments forthcoming.

2.6 Time Distance, the Rate of Growth and Overall Degree of Disparity

In the analysis of disparities it is important to distinguish the role played by the difference in the growth rates between the compared units ($r_1 - r_2$), and the role that is played by the absolute magnitude of the respective growth rates (r_1, r_2). The conventional analysis based on static relative measures takes into account the effects of the difference in the growth rates, but not the additional effect arising from the absolute magnitude of the growth rate which is the supplementary insight provided by the time distance measure.

To simplify the exposition let us assume that the rate of growth of the analysed indicator is the same for both units ($r_1 = r_2$), but different for three variants (1 per cent, 2 per cent and 4 per cent), while the ratio between the urban and the rural values is 1.5 in all three variants. Conventional relative static measures would describe these three situations as equal degree of disparity (same value of the ratio in this case of two units or same Gini coefficient in the case of many units), but the S-distance would amount to 40 years in the low growth case, 20 years for the 2 per cent growth, and 10 years for the 4 per cent growth rate. In this example (Sicherl, 1992 and 1992a) for the higher growth alternative, looking backward, the rural per capita income in 1985 was equivalent to the urban per capita income in 1975. Assuming no change in the rate of growth, looking forward, the 1985 urban per capita income can expected to be reached by 1995. For the low growth variant, the rural per capita income in 1985 was at the 1945 level of urban per capita income. The level of urban per capita income for 1985 is to be reached only in 2025. It is highly improbable that people would perceive these two situations as equal as far as the degree of disparity is concerned, not to mention the difference in the absolute level.

In the dynamic world of today it is hardly satisfactory to rely only on static measures of disparity which are insensitive to the magnitudes of the growth rates and take into account only differences in the growth rates between the units. In this respect time distance plays in the analysis of disparities an important role, quite distinct from that of static measures. This leads to a very important policy conclusion. In this framework for the analysis of convergence and the degree of cohesion in the EU it will be important ***also how fast and not only how much faster*** will the less developed countries (regions) and the potential member countries grow in the future.

The analytical conclusion that time distance is, ceteris paribus, a decreasing function of the magnitude of the growth rate of the indicator (see equation (3) in Section 3.1) has consequences not only on the value of different measures of disparity, but also on the magnitude and direction of changes in these measures. Let us still assume for simplicity that the growth rate of the indicator is the same for both units, but that the magnitude of the growth rate either increases or decreases for both units as compared with the previous period. The only change in the degree of disparity is a function of the change in the magnitude of the overall growth rate of the indicator. Here we get three completely different results even as far as the direction of change is concerned:

1. relative static difference (ratio and similar measures, like the Lorenz curve, the Gini coefficient of concentration, etc.) is insensitive to it and shows ***no change***;
2. S-distance as a measure of dynamic (temporal) disparity is a ***decreasing*** function of the magnitude of the overall growth rate;
3. absolute static difference is an ***increasing*** function of the growth rate (Sicherl, 1978).

The same phenomenon is significant in analysing the degree of disparity between two compared units over many indicators. The ranking of the indicators by the degree of disparity based on static measures may be quite different from the ranking based on time distances. This point will be illustrated in Section 5. It is clearly much easier not to think in terms of dynamic characteristics like dynamic (temporal) measures of disparity and the growth rate effects, but this will not make the reality less complex.

Economic analysis is frequently used as a tool for policy makers to assess the degree of cohesion in a community. The above examples pose a serious question whether the professionals in the social sciences, which for this type of analysis are using mainly conventional static measures of disparity like coefficient of variation, standard deviation, or Gini coefficient, should not look for a broader dynamic conceptual and analytical framework suggested in this study. This is not a question of a greater precision in empirical analysis, it is first and foremost a question of the perception of disparities and the policy consequences which arise from using an analytical framework which is farther away or closer to the way in which people perceive disparities and react to them (Sicherl, 1996c).

3. Disparities in GDP per Capita for EU and CEE Countries

3.1 Backward looking and forward looking time distances

Backward looking (***ex post***) and forward looking (***ex ante***) time distances relate to different periods, past and future. This is an important distinction. Backward looking time distance belongs to the domain of statistical measures based on known facts, and there is no need to relate it to any static measure or growth rate. The second, the forward looking time distance, is important for describing the time distance outcomes of alternative assumptions about future developments or of alternative policy scenarios for the future.

There are at least four ways in which one can read off or estimate the values of S-distance for the past. The first one simply compares data in a table, then for a given value (level of the indicator) finds the two time values indicating when such indicator value was achieved in the two compared units, and subtracts the time values to arrive at the value of S-distance. This is simply a statistical fact and one does not need to bring into the picture any assumption about the respective rates of growth or catching-up hypothesis. It is an additional way of looking at the situation, which in no way discards or replaces other measures. The second method is similar, one can from a figure of trends of the compared series select a given level of the indicator, read off from the figure the respective times and calculate the corresponding time distances.

The third method is more interesting and leads even at this simple manner of exposition to important conclusions. Let us imagine an usual two-dimensions scatter diagram of time series relationship between variables X and Y for two countries (a detailed example for relationship between GDP per capita and life expectancy for the USA and Japan is provided in Sicherl, 1997). Each point in the scatter diagram has four elements of information: values of X and Y, unit to which it belongs and the time subscript (see Table 1 in Section 2.1). Time distances become visible in a scatter diagram when one applies the generic idea that the time subscripts can be used not only as identifiers but also as values in the implicit time framework in the third dimension beyond the XY dimensions explicit in such scatter diagram. For any selected level of an indicator (X or Y in our simple example) one can only subtract the time subscripts for the two countries to obtain the time distance for that level of the chosen indicator. In this approach the information on time is in a n-dimensional space of indicators used as the (n+1) dimension to calculate time distances, while the customary regression analysis does not extract this information from time subscripts.

In all three methods of estimating time distance mentioned, S-distance is calculated from original data (with some possible interpolation and extrapolation) without referring to any other information than levels of the indicator and time subscripts. This is a confirmation of the statement that one deals with the (n+1) dimension in a multidimensional space of n variables, which was always there but left unexplored.

The fourth possible method of estimating the value of S-distance is, as distinct from the other three mentioned above, based on possible integration of static and intertemporal comparisons, relating all three measures presented in Table 1 in Section 2.1 When they relate to the appropriate period and levels, the relationship is the obvious

$$S_{ij}(X_L) = \ln R_{ij}(t) / r_{i,} \tag{3}$$

where r represents the corresponding average rate of growth. This method is particularly useful for calculation of forward looking time distances, although it can be used also as an approximation in calculating backward looking time distances.

In practical analysis an important choice is the selection of the level of the indicator(s) for which S-distances will be calculated and analysed. In the general case the level of a given variable for which time distances are calculated is specified without reference to time or specific unit. This more general specification is not paying much attention to relate S-distance to static measures of difference and to particular compromises that are necessary for such interrelationship. It has the advantage of being further developed along the lines explained in Section 2.1. One possible extension is to variables other than time, the other one is related to the notion of how much time was needed to pass through certain steps in growth of the variable (provisionally labelled as 'time step' and being incorporated into this dynamic analytical framework in another study). Details are available in Sicherl (1997).

As mentioned in Section 2.3, time distance has some advantages and some disadvantages when compared with static measures. One disadvantage e.g. lies in the fact that at a given point in time the below-the-average units have not yet reached the average level of the indicator and the time distance has to be approximated. This can be done in principle with backward looking or forward looking time distances.

To use forward looking time distance would mean that one could assume a certain rate of growth for the below-the-average unit and calculate the number of years needed to reach the 1993 level of the EC. This method is useful for scenarios, but not as a measure of statistical facts. In analysing the disparities between the EU countries for 1993 (see Table 5 in Section 3.2) the choice was made to look for an approximation based on backward looking time distance. Thus for below-the-average units the S-distance was estimated for the level of their GDP per capita in 1993, although this level is not the same for all. Therefore, in practical terms the base level of GDP per capita for which the time distance between a given unit (country, region) and the EU average has been calculated is different for above-the-average and for below-the-average units.

For above-the-average units the base level is the average level for EU, S-distance is negative indicating time lead for these units. For below-the-average units the base level for calculating time distance is their own level of GDP per capita, time distances have a positive sign indicating how many years they are lagging behind the average for the EU (e.g. the level of GDP per capita for Ireland for 1993 was the same as that for EU average in 1982.4, indicating a time distance of about 10 years). The column 'last' indicates the calculated time when the EU level was last achieved by the compared unit. For above-the-average units this is the time when they have achieved the EU 1993 level, for below-the-average units this is the time when the EC average was the same as their present (1993) level of GDP per capita.

An example of calculation of forward looking S-distance will be used in Section 3.3, analysing the position of CEE countries with respect to EU average. Both methods have their advantages and disadvantages, and care has to be taken that the interpretation is in line with the assumptions used in the calculation. The calculation of time distances may in some cases be more complex than the calculation of static measures and some approximations have to be used. It is felt, however, that from the point of view of better decision-making it is more important to have a broader picture and be vaguely right rather than to be precise but one-sided.

3.2 Disparities in GDP per Capita within the EU

This is an example of comparison between many units for one indicator. The range of values of the variable is quite large so that the dilemma of how to combine static and time distance measures in the most practical way is an issue. Data set for EU countries and regions for GDP per capita at purchasing power parity for 1993 is based on Eurostat estimates in Eurostat (1996). The comparable estimates for the 10 analysed CEE countries for 1993 are from UN/ECE (1996). We shall demonstrate the methodology first using the values for 1993, which are not expected to be changed, and later compare them with results for 1994 based on provisional figures.

Table 5 and Figure 2 show the results of the disparities in GDP per capita at purchasing power parity between EU member countries in 1993. These results are showing both the static relative and absolute differences as well as time distances from the average GDP per capita for EUR 15 for 1993 (15845 ECU in purchasing power parity), which will in further calculations correspond to 100.

In Table 5 the first three columns relate to time distance analysis, next three columns describe various relative static measures of disparity, followed by absolute static difference. The last three columns are used to calculate the elements of summary measures of disparity and can be helpful as an indication of contribution by each region to the summary measures of disparity. The most frequently used measures in current debates are those related to relative static disparity. The first one is the ratio R_i where the base is the EU average. The relative static disparity is also expressed in percentage terms P_i and in natural logarithms $\ln(R_i)$. Absolute statistic difference A_i is in this case the same as P_i since the base equals to 100.

As explained in Section 3.1, the procedure for calculating time distances depends on the position of country's GDP per capita in relation to the EU average. The base level of GDP per capita for which the time distance between a given country (or region later) and the EU average has been calculated is different for above-the-average and for below-the-average units. For above-the-average countries (regions) the base level is the average level for the EU and the time distances S_i in Table 5 have a negative sign indicating time lead for these countries. For below-the-average countries (regions) the base level for calculating time distance is their own level of GDP per capita, time distances have a positive sign indicating how many years they are lagging behind the EU average (e.g. the level of GDP per capita for Greece in 1993 was the same as that for EU average in 1970.4, indicating a time distance of about 23 years).

One conventional way by which the Commission of the European Communities measures disparity between regions and countries is by the weighted standard deviation of regional values for GDP in purchasing power standards (Commission of the European Communities, 1991), the weights being the size of the population in each region (or each Member State as appropriate). This measure corresponds to the third summary measure below the Table 5, so that for 1993 the weighted standard deviation as percentage of the average amounts to 12.8. The last column in Table 5 shows the contribution of each region to the sum of weighted squared deviations which form the basis for calculation of the discussed measure.

A similar summary measure with very convenient possibilities for substantive interpretation is relative mean deviation. Both relative mean deviation and Gini's coefficient of concentration as relative measures of dispersion depend only on static relative differences which do not change if the growth rate of the indicator is the same for all units and are also insensitive to changes in the overall growth rate (Sicherl, 1978). This deficiency of relative static measures can be remedied by adding the analysis of time distances, which take into the account also the dynamic characteristics of the situation. Before paying more attention to the integration of static and temporal measures of disparity it is useful to discuss the relative mean deviation as a summary measure on its own (and the weighted contribution of individual countries $P_i^* w_i$ to this summary measure in the second to the last column in Table 5).

For 1993 the value of relative mean deviation for GDP per capita for 15 countries in the EU 15 amounted to 9.3 percent. Since it is calculated as the weighted deviation from the mean regardless of the sign, it can be said that if 4.6 percent of GDP from the above-the-average units would be transferred to the corresponding below-the-average units all countries would hypothetically enjoy equal per capita income. Similarly, the individual elements $P_i^* w_i$ of the summary measure indicate the relative impact of a particular country on the average value of

Table 5

Relative differences and S-distances from EC average (1993)

No.	Countries	Inters.	last	Si	Ri	Pi [%]	Ln (Ri)	Ai	Si × wi	Pi × wi	PPi × wi
1	LUX	0	1974.2	-18.8	1.6	60	0.47	60	-0.02	0.06	3.87
2	BEL	0	1988.2	-4.8	1.13	13	0.12	13	-0.13	0.35	4.6
3	DAN	0	1988.6	-4.4	1.12	12	0.11	12	-0.06	0.17	2.02
4	AUT	0	1988.6	-4.4	1.12	12	0.11	12	-0.09	0.26	3.11
5	FRA	0	1989.0	-4.0	1.1	10	0.1	10	-0.62	1.55	15.48
6	DEU	0	1989.8	-3.2	1.08	8	0.08	8	-0.7	1.75	14.03
7	NED	0	1991.8	-1.2	1.03	3	0.03	3	-0.05	0.12	0.37
8	ITA	0	1992.2	-0.8	1.02	2	0.02	2	-0.13	0.31	0.63
9	UK	1	1990.3	2.8	0.99	-1	-0.01	-1	0.43	-0.16	0.16
10	SVE	1	1989.7	3.3	0.98	-2	-0.02	-2	0.08	-0.05	0.09
11	FIN	1	1987.3	5.7	0.91	-9	-0.09	-9	0.08	-0.12	1.11
12	IRL	1	1982.4	10.6	0.81	-19	-0.21	-19	0.1	-0.18	3.47
13	ESP	1	1978.4	14.6	0.78	-22	-0.25	-22	1.55	-2.33	51.15
14	PRT	1	1972.8	20.3	0.69	-31	-0.37	-31	0.54	-0.83	25.63
15	GRE	1	1970.4	22.6	0.63	-37	-0.46	-37	0.63	-1.04	38.31
16	EC	2	1993.0	0.0	1	0	0	0	0	0	0

Summary:

$\sum_i |S_i| \bullet w_i = 5.21$ $\sum_i |P_i| \bullet w_i = 9.28$ $\sqrt{\sum_i P_i^2 \bullet w_i} = 12.81$

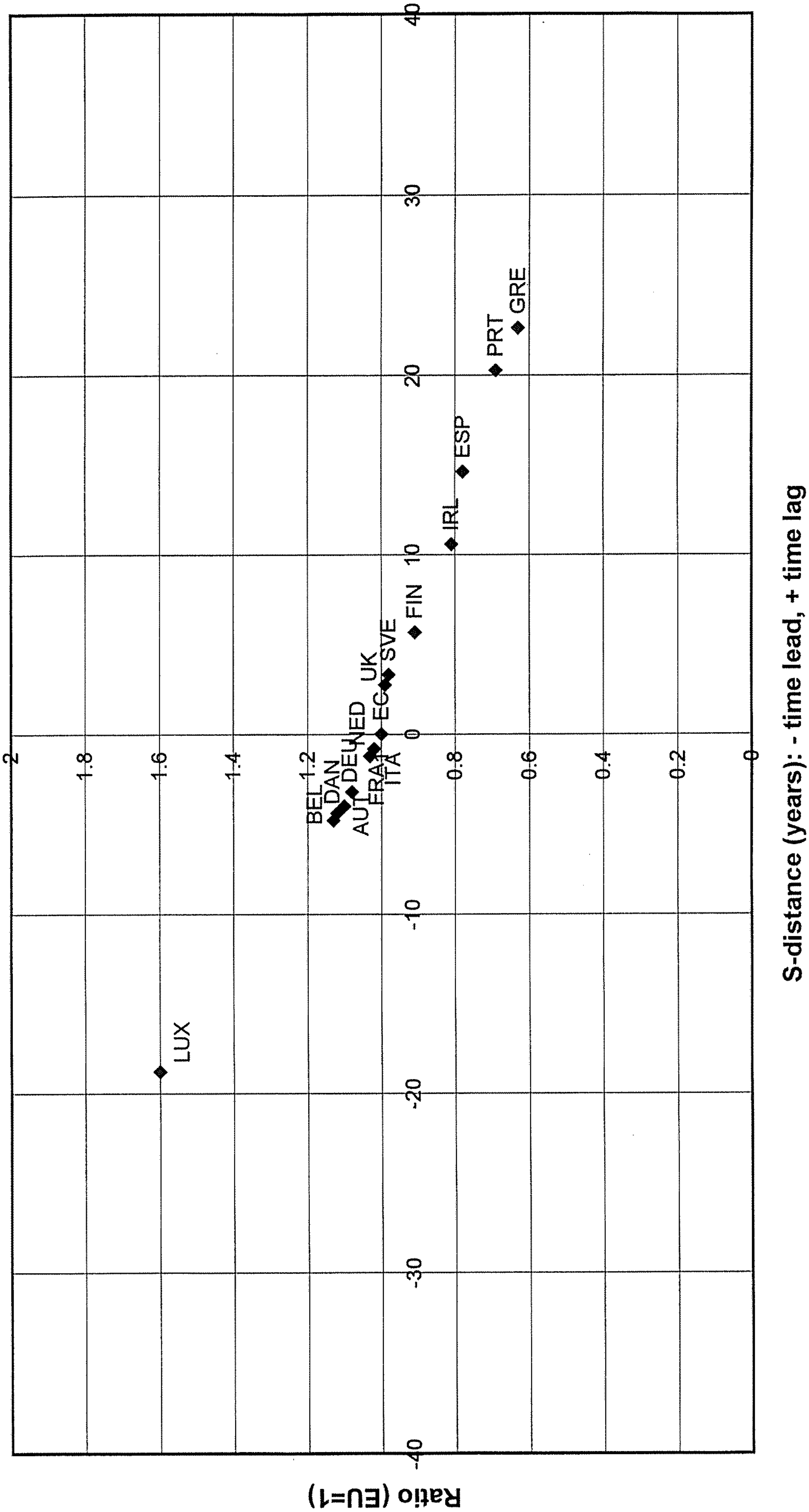
GDP per capita (which is a combination of percentage deviation from the mean and population weight). For instance, GDP per capita for France is 10 percent and for Luxembourg is 60 percent above the EU average, but the impact of the former country on the mean value for the EU is 1.55 percent and of the latter only 0.06 percent. The greatest positive influence on the average value of GDP per capita is that of Germany (1.75 percent) and of France (1.55 percent), and the greatest negative influence by Spain (-2.3 percent) and Greece (1.04 percent).

The analysis on the basis of relative static disparities can be enriched by integrating comparisons across time and space. The relative static measure of disparity, percentage deviation from the mean in 1993, is combined with the estimate of time lag in GDP per capita for below-the-average countries comparing the time when their values in 1993 were observed for the EU average. These are historical backward looking time distances and their positive values indicate the factual situation in the past based on known facts. For the above-the-average countries the data source used (Eurostat, 1996) does not provide the past history of GDP per capita for these units. A 2.5 percent rate of growth of GDP per capita was assumed for all these countries (or regions later) in the past. The corresponding times and time distances in Table 5 are thus an approximation of their lead in time ahead of the EU average. This should suffice for an illustration of existing cohesion in time and space in the EU. The necessary data for above-the-average countries (regions) could be supplied from historical databases.

In addition to time distance measure of proximity in time (time lead or time lag) for individual countries from the mean value for the EU, it is also possible to calculate summary measures of time distance for the whole set of the analysed countries (regions). The theoretical approach was developed in Sicherl (1978), where mean S-deviation as a summary measure for time distance was defined. The mean value of weighted time distances presented under the Table 5 is somewhat different from the definition of mean S-deviation mentioned above, as in this study the level for which time distances are calculated is different for above-the-average and below-the-average units for practical purposes, and should be considered as an illustration.

Figure 2 is a convenient visual presentation of an integration of comparisons across time and space, based on the corresponding values S_i and R_i from Table 5. It does not leave out the information about the conventionally used relative static disparity, by complementing and combining the information on disparities at a given point in time with the additional dimension of proximity in time a broader and more realistic picture of the existing overall degree of disparity is provided.

Figure 2. GDP per capita (ppp): static difference and time distance for EU countries from EU average for 1993



When one looks at the disparity between EU countries and the EU average in time with the approximations used, Luxembourg was about 19 years ahead in time, and Greece was behind for about 23 years, as presented in Figure 2. Disregarding Luxembourg, the discrepancy within the group of countries grouped around the mean was small. Belgium, Denmark, and Austria were about 5 years ahead, and Finland about 5 years behind the EU average. Only four countries showed backward looking time distances greater than 10 years: Ireland and Spain between 11 and 15 years, and Portugal and Greece between 20 and 23 years.

3.3 Disparities in GDP per Capita between EU and CEE Countries

Table 6 adds to earlier results for 1993 for EU 15 countries the results for the ten analysed CEEC (data source UN/ECE 1996). The time distances in this table are calculated as historical backward looking time distances. The historical time series for GDP per capita for EC used is from OECD (1994) and goes back to 1960 (at the price levels and exchange rates of 1990). Therefore backward looking time distances can be directly estimated only if they are less than 33 years. Only Slovenia and Czech Republic fall into this category, time distances for other CEEC are thus approximated[5].

According to this calculation backward looking time distance from EU mean is 26 years for Slovenia and 29 years for Czech Republic, for Hungary, Slovakia and Poland from 36 to 40 years, for Bulgaria, Estonia, Romania and Lithuania from 41 to 44 years, and for Latvia 46 years. Another way of looking at the analysed proximity in time is the time lag in GDP per capita between CEEC and Austria. In the European Comparison Project of UN/ECE and Eurostat for estimation of GDP at purchasing power parity Austria is used as a country with which CEEC are compared and connected to other countries. On the basis of bilateral comparisons Oesterreichisches Statistisches Zentralamt internally calculated also the time lag of CEEC behind Austria from their estimates for 1993. The 1993 level of GDP per capita for Slovenia was achieved in Austria in 1966, for Czech Republic in 1964, for Hungary in 1956, for Slovakia in 1955, for Poland in 1953, for Bulgaria 1952 and for Romania in 1950.

By comparing Figures 2 and 3, first for the present 15 Member States, and then together with the 10 potential Member States from CEE, the situation can be evaluated visually for 1993 as the starting point of such analysis. Slovenia and the Czech Republic are close to Portugal and Greece, Slovenia was about 4 years behind Greece and 6 years behind Portugal.

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[5] Obviously the results depend on the quality and comparability of the data on GDP per capita at purchasing power parity. One should not be surprised if there will be sudden changes in the position of certain countries or regions in future estimates. For instance, Eurostat estimates for Portugal and especially Greece have increased substantially from their values published by the same source earlier due to 'methodological reasons'. According to 1990 estimates Slovenia was ahead of Portugal and Greece, after this revision of data it has been placed behind them. Havlik (1997) reports that the Czech Republic and Poland are in the process of revision of their GDP estimates.

Table 6

Relative differences and S-distances from EC average (1993)

No.	Countries	Name	Inters.	last	Si	Ri	Pi [%]	Ln (Ri)	Ai	Si × wi	Pi × wi	PPi × wi
1	LUX	LUXEMBOURG	0	1974.2	-18.8	1.6	60	0.47	60	-0.02	0.06	3.87
2	BEL	BELGIQUE-BELGIE	0	1988.2	-4.8	1.13	13	0.12	13	-0.13	0.35	4.6
3	DAN	DANMARK	0	1988.6	-4.4	1.12	12	0.11	12	-0.06	0.17	2.02
4	AUT	OESTERREICH	0	1988.6	-4.4	1.12	12	0.11	12	-0.09	0.26	3.11
5	FRA	FRANCE	0	1989.0	-4.0	1.1	10	0.1	10	-0.62	1.55	15.48
6	DEU	BR DEUTSCHLAND	0	1989.8	-3.2	1.08	8	0.08	8	-0.7	1.75	14.03
7	NED	NEDERLAND	0	1991.8	-1.2	1.03	3	0.03	3	-0.05	0.12	0.37
8	ITA	ITALIA	0	1992.2	-0.8	1.02	2	0.02	2	-0.13	0.31	0.63
9	UK	UNITED KINGDOM	1	1990.3	2.8	0.99	-1	-0.01	-1	0.43	-0.16	0.16
10	SVE	SVERIGE	1	1989.7	3.3	0.98	-2	-0.02	-2	0.08	-0.05	0.09
11	FIN	SUOMI/FINLAND	1	1987.3	5.7	0.91	-9	-0.09	-9	0.08	-0.12	1.11
12	IRL	IRELAND	1	1982.4	10.6	0.81	-19	-0.21	-19	0.1	-0.18	3.47
13	ESP	ESPANA	1	1978.4	14.6	0.78	-22	-0.25	-22	1.55	-2.33	51.15
14	PRT	PORTUGAL	1	1972.8	20.3	0.69	-31	-0.37	-31	0.54	-0.83	25.63
15	GRE	ELLADA	1	1970.4	22.6	0.63	-37	-0.46	-37	0.63	-1.04	38.31
16	EC	EUR 15	2	1993.0	0.0	1	0	0	0	0	0	0
17	SLO	SLOVENIA	1	1966.7	26.3	0.54	-46	-0.62	-46	0.14	-0.25	11.38
18	CZE	CZECH REPUBLIC	1	1963.7	29.3	0.49	-51	-0.71	-51	0.82	-1.42	72.56
19	HUN	HUNGARY	0	1957.2	35.8	0.35	-65	-1.05	-65	1	-1.81	117.44
20	SVK	SLOVAKIA	0	1956.7	36.3	0.34	-66	-1.08	-66	0.52	-0.95	62.63
21	POL	POLAND	0	1953.2	39.8	0.27	-73	-1.31	-73	4.14	-7.58	553.42
22	BG	BULGARIA	0	1952.0	41.0	0.25	-75	-1.39	-75	0.94	-1.72	128.68
23	EST	ESTONIA	0	1950.0	43.0	0.22	-78	-1.51	-78	0.17	-0.32	24.74
24	ROM	ROMANIA	0	1949.3	43.7	0.21	-79	-1.56	-79	2.69	-4.85	383.46
25	LIT	LITHUANIA	0	1949.3	43.7	0.21	-79	-1.56	-79	0.44	-0.79	62.76
26	LAT	LATVIA	0	1946.9	46.1	0.18	-82	-1.71	-82	0.32	-0.57	46.59

Figure 3. GDP per capita (ppp): static difference and time distance for EU15 and CEEC from EU average for 1993

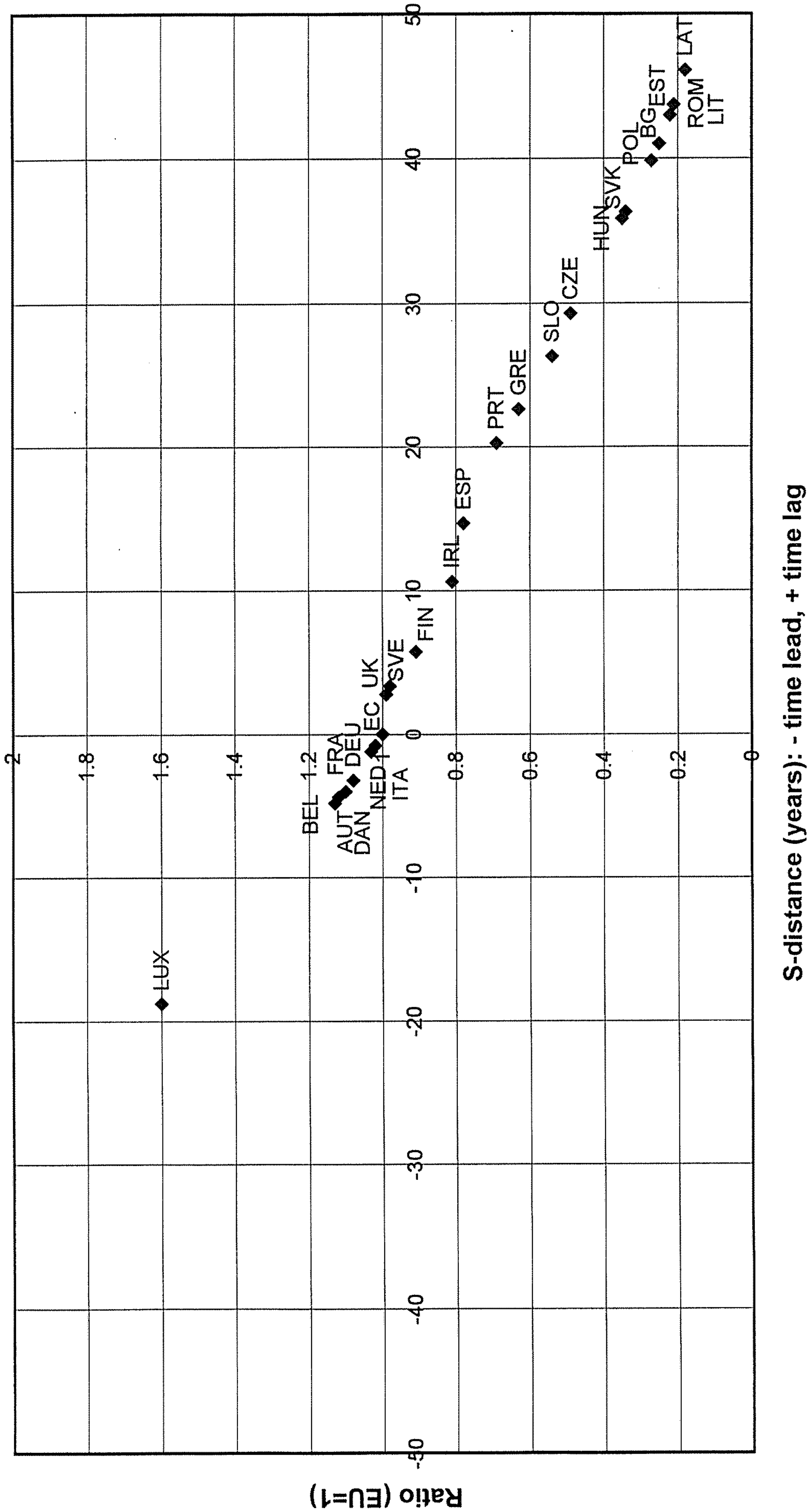


Figure 4. Distances in time (projected) at the level of EC average for 1993
Scenario: growth rate 2.5% EU and 4.5% CEEC

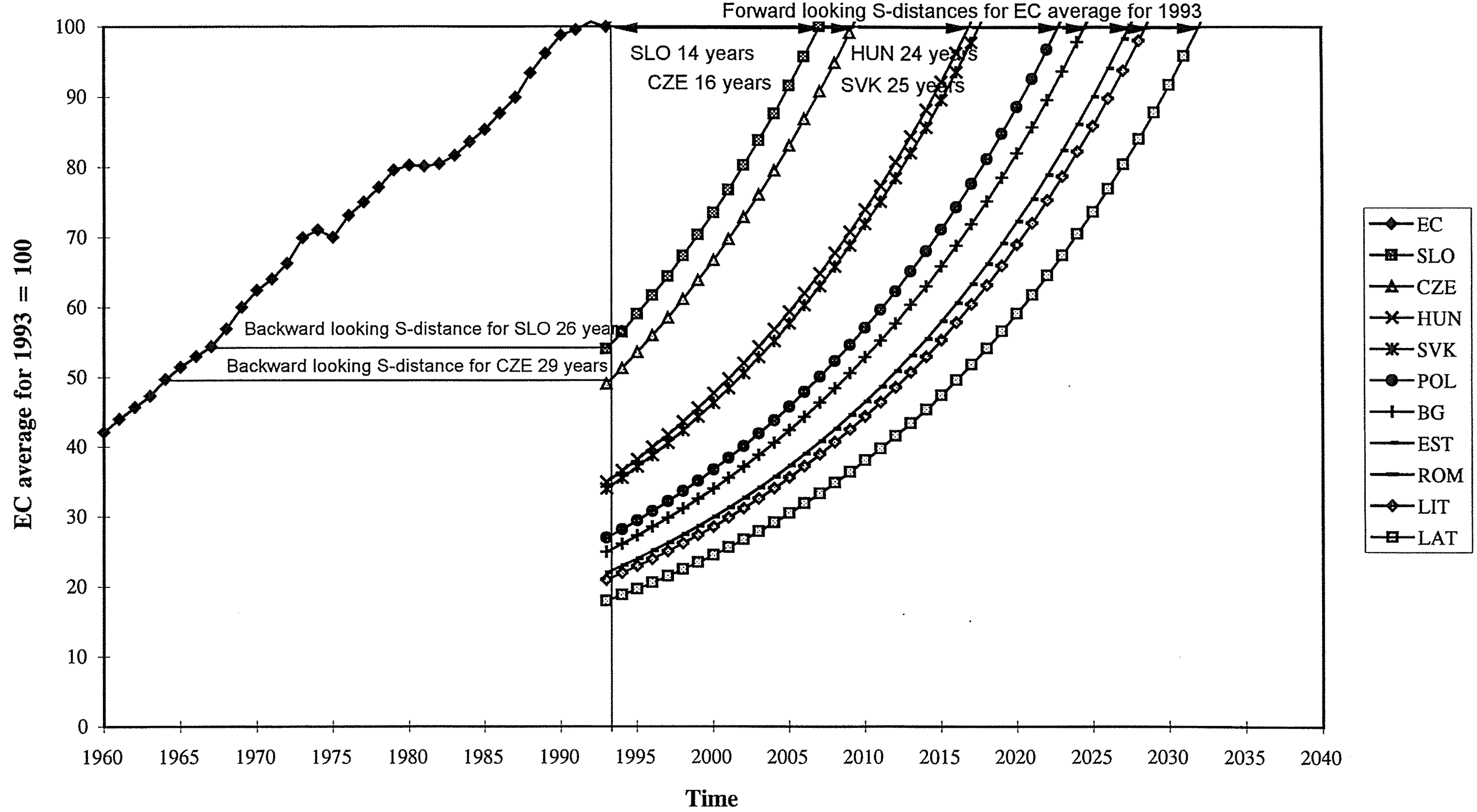


Table 7: Forward Looking S-distances for the Level of EC Average for 1993

No.	Country	Scenario EU 2.5%, CEEC 4.5%		
		year	S_i (years)	R_i (EC=1)
1	LUX	1974	-19	1.6
2	BEL	1988	-5	1.13
3	DAN	1989	-4	1.12
4	AUT	1989	-4	1.12
5	FRA	1989	-4	1.1
6	DEU	1990	-3	1.08
7	NED	1992	-1	1.03
8	ITA	1992	-1	1.02
9	UK	1993	0	0.99
10	SVE	1994	1	0.98
11	FIN	1997	4	0.91
12	IRL	2002	9	0.81
13	ESP	2003	10	0.78
14	PRT	2008	15	0.69
15	GRE	2012	19	0.63
16	EC	1993	0	1
17	SLO	2007	14	0.71
18	CZE	2009	16	0.67
19	HUN	2017	24	0.56
20	SVK	2018	25	0.55
21	POL	2023	30	0.48
22	BG	2024	31	0.46
23	EST	2027	34	0.42
24	ROM	2028	35	0.41
25	LIT	2028	35	0.41
26	LAT	2032	39	0.38

Therefore, in1993 in terms of GDP per capita all CEEC show lower values than the present Member States in the EU, though the most developed of them are very close to the least developed countries in the EU. In terms of regions, the most developed regions in the CEEC are higher than the group of the least developed regions in the EU. Since the accession of potential Member States will be relevant only after a certain time span, one can look at some possible scenarios of future developments.

There are several examples of such work (see e.g. Havlik, 1997). In the methodological part of the study there is no need to engage in substantive analysis and in predicting the future.

Using an illustrative example we shall show how forward looking time distance could be used in connection with describing a possible situation when CEE countries are expected in a given scenario to reach a fixed target of the 1993 level of GDP per capita for the EU. Let us assume that EU countries will grow at 2.5 per cent, and CEE countries at 4.5 per cent per annum. The calculations are presented in Table 7 and Figure 4.

Forward looking S-distances in Table 7 are showing the years needed for the analysed countries to reach the absolute level of EU average in 1993 at assumed growth rates. The values for above-the-average EU countries are presented only as an indication of their position in the past, and the values for below-the-average EU countries are not at all an assessment of their individual potential. Three measures are presented: the number of years needed to reach the EU average for 1993, the year in which this would hypothetically take place, and the projected ratio to the EU average at that year. This scenario would significantly shorten the forward looking time distances for CEE countries as compared to the backward looking time distances in Table 6 and Figure 3. This is an example of time needed for a given country to attain a fixed target (in this case the EU average of GDP per capita in 1993). Assuming that CEEC would grow at the rate of 4.5 percent per annum until they reach this fixed target, the time lag would be considerably shorter than in the case of backward looking time distances which is taking into account the historical growth of the EU average over more decades. For Slovenia the forward looking time distance is about 14 years.

However, one should be aware that in this type of calculations these countries would have to grow at such optimistic rate for a long period of time and that the time to which the results for the individual countries are related is not the same. The more understandable information is the year in which it is expected that under this scenario the level of 1993 EU average would be attained: for Slovenia in 2007, for Czech Republic 2009, for Hungary and Slovakia around be 2017, for Poland in 2023, etc.

4. Disparities in GDP per Capita - for EU Regions

4.1 Regional Comparisons for GDP per Capita in Austria

Regional disparities in GDP per capita in Austria for the period 1961-1992 will be used as an empirical example to show how the conclusions about the regional disparities over time based on the dynamic conceptual and analytical framework described above can differ substantially from those based only on conventional static relative measures of disparity. The time series data on GDP per capita for nine Austrian regions were provided from the WIFO database and have been expressed in constant prices. The methodological distinction between the analysis of disparities between countries and regions in the EU and this analysis for Austrian regions is that the former has been done for one indicator, many units, for a given year (EU average 1993 or 1994), and the latter for many units for a whole time series for over 30 years.

Table 8 shows the relative static disparity in GDP per capita expressed as a ratio to the average level in a given year (Austria=1). In general one can conclude that in the observed period of about three decades there have been no substantial changes in relative position of the analysed regions. A closer examination may find that there has been some decrease in relative static disparity until mid 1970's and some increase after that, but the overall relative static disparity was very similar in 1962 and 1992. Hofer and Woergoetter (1993) also state that a convergence pattern - if any - would take place with a very slow pace. Thus the conventional approach shows essentially unchanged regional disparities.

In a dynamic conceptual and analytical framework the overall evaluation of the situation looks quite different. Obviously, the conclusion about the static dimension of regional disparities is telling one part of the story. Time distance analysis describes another dimension of perceiving and measuring regional disparities which is strongly influenced by the differences in the growth rates of GDP in Austria in different subperiods of the analysed three decades. As before, for above-the-average regions the base level is the average level for Austria and the time distances in Table 9 have a negative sign indicating time lead for these regions. For below-the-average regions the base level for calculating time distance is their own level of GDP per capita, time distances have a positive sign indicating how many years these regions are lagging behind the average (e.g. the level of GDP per capita for Burgenland in 1975 was achieved in Austria as a whole in 1962, indicating a time distance of 13 years).

Table 9 shows the respective time distances between regions and average for Austria for the analysed indicator GDP per capita. It shows that substantial changes have taken place during the period and that the time distances have increased substantially between 1974 and 1992. For instance, Burgenland was in 1974 lagging behind the average for about 12 years, in 1992 the lag was about 20 years. Similarly, in 1974 Vienna was in GDP per capita about 7 years ahead of the average for Austria, in 1992 the lead was more than 15 years (the average GDP per capita for Austria for 1992 was attained in Vienna already in 1976). Figures 5 and 6 give a visual presentation of results in Table 9. After 1973 when the period of rapid growth has ended time distances between regions in Austria have been increasing in general. While there have been only minor changes in the static relative position of Austrian regions, in terms of time they have become more and more apart.

Table 8

Relative static disparity from Austrian average

Ratio (AUT=1)

No.	*YEAR*	*BUR*	*CAR*	*LOA*	*UPA*	*SAL*	*STY*	*TYR*	*VOR*	*VIE*	*AUT*	*RMD*
1	1961	0.57	0.81	0.89	0.95	1.01	0.85	0.93	1.06	1.37	1	0.18
2	1962	0.58	0.81	0.87	0.96	1.02	0.82	0.94	1.08	1.40	1	0.19
3	1963	0.58	0.79	0.87	0.95	1.03	0.81	0.95	1.11	1.40	1	0.19
4	1964	0.58	0.8	0.89	0.96	1.05	0.80	0.95	1.11	1.39	1	0.19
5	1965	0.55	0.82	0.87	0.95	1.07	0.81	0.99	1.10	1.40	1	0.19
6	1966	0.56	0.82	0.87	0.95	1.07	0.79	1.01	1.10	1.40	1	0.19
7	1967	0.59	0.82	0.87	0.94	1.07	0.79	1.00	1.08	1.41	1	0.19
8	1968	0.57	0.82	0.86	0.93	1.07	0.79	1.01	1.07	1.42	1	0.20
9	1969	0.58	0.83	0.84	0.94	1.08	0.79	1.00	1.05	1.43	1	0.20
10	1970	0.58	0.84	0.84	0.95	1.08	0.79	0.99	1.05	1.43	1	0.20
11	1971	0.57	0.82	0.85	0.97	1.12	0.79	1.02	1.07	1.39	1	0.19
12	1972	0.59	0.82	0.87	0.97	1.15	0.79	1.02	1.08	1.37	1	0.19
13	1973	0.58	0.85	0.86	0.96	1.16	0.83	1.00	1.07	1.34	1	0.17
14	1974	0.59	0.85	0.88	0.99	1.11	0.84	0.99	1.03	1.32	1	0.15
15	1975	0.6	0.83	0.88	0.98	1.09	0.82	1.01	1.04	1.35	1	0.16
16	1976	0.62	0.82	0.89	0.97	1.08	0.82	0.98	1.05	1.37	1	0.17
17	1977	0.61	0.81	0.86	0.98	1.11	0.81	0.98	1.07	1.37	1	0.17
18	1978	0.64	0.81	0.87	1.00	1.10	0.80	0.98	1.09	1.36	1	0.17
19	1979	0.61	0.83	0.87	1.01	1.10	0.81	1.00	1.08	1.35	1	0.16
20	1980	0.61	0.83	0.86	0.98	1.10	0.82	1.01	1.09	1.37	1	0.17
21	1981	0.63	0.83	0.85	0.98	1.10	0.81	1.01	1.10	1.37	1	0.17
22	1982	0.63	0.83	0.86	0.98	1.11	0.80	1.01	1.08	1.37	1	0.17
23	1983	0.61	0.82	0.86	0.99	1.12	0.80	1.00	1.06	1.39	1	0.18
24	1984	0.61	0.83	0.86	0.97	1.11	0.80	1.01	1.05	1.41	1	0.18
25	1985	0.6	0.81	0.84	1.00	1.09	0.80	1.00	1.04	1.42	1	0.18
26	1986	0.62	0.81	0.86	0.96	1.11	0.79	1.00	1.06	1.43	1	0.19
27	1987	0.62	0.79	0.86	0.97	1.10	0.77	1.01	1.06	1.45	1	0.19
28	1988	0.63	0.79	0.86	0.98	1.10	0.78	0.99	1.04	1.44	1	0.19
29	1989	0.62	0.81	0.85	0.97	1.11	0.78	0.99	1.04	1.44	1	0.19
30	1990	0.63	0.8	0.85	0.96	1.09	0.79	1.00	1.02	1.44	1	0.19
31	1991	0.63	0.81	0.85	0.96	1.10	0.78	1.00	1.03	1.44	1	0.19
32	1992	0.63	0.79	0.85	0.95	1.12	0.78	1.01	1.02	1.44	1	0.19

RMD = Relative mean deviation

BUR=Burgenland CAR=Carinthia LOA=Lower-Austria UPA=Upper-Austria
SAL=Salzburg STY=Styria TYR=Tyrol VOR=Vorarlberg
VIE=Vienna AUT=Austria

Table 9

Time distances for GDP per capita from the Austrian average

S-distance (in years: - time lead, + time lag)

No.	YEAR	BUR	CAR	LOA	UPA	SAL	STY	TYR	VOR	VIE	AUT	Mean S-deviation
1	1961	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A
2	1962	#N/A	#N/A	#N/A	#N/A	-0.7	#N/A	#N/A	#N/A	#N/A	0	#N/A
3	1963	#N/A	#N/A	#N/A	1.9	-0.7	#N/A	#N/A	#N/A	#N/A	0	#N/A
4	1964	#N/A	#N/A	#N/A	0.9	-0.7	#N/A	1.1	-1.9	#N/A	0	#N/A
5	1965	#N/A	#N/A	#N/A	1.5	-1.4	#N/A	0.7	-2.6	#N/A	0	#N/A
6	1966	#N/A	#N/A	3.5	1.2	-1.5	#N/A	-0.1	-2.7	#N/A	0	#N/A
7	1967	#N/A	#N/A	3.9	1.8	-2.1	#N/A	0.0	-3.3	#N/A	0	#N/A
8	1968	#N/A	5.7	4.5	2.2	-2.2	6.8	-0.2	-2.7	#N/A	0	#N/A
9	1969	#N/A	5.0	4.2	1.1	-1.2	5.9	-0.1	-1.3	#N/A	0	#N/A
10	1970	#N/A	3.7	3.6	0.7	-1.2	5.1	0.1	-0.8	-8.0	0.0	#N/A
11	1971	#N/A	3.8	2.9	0.6	-1.6	5.1	-0.3	-1.1	-7.7	0.0	#N/A
12	1972	#N/A	3.5	2.7	0.7	-1.8	4.5	-0.4	-1.2	-7.2	0.0	#N/A
13	1973	#N/A	3.3	3.1	0.9	-2.2	3.7	-0.2	-1.5	-7.2	0.0	#N/A
14	1974	12.3	3.7	3.0	0.2	-2.7	3.8	0.3	-1.9	-7.0	0.0	3.6
15	1975	13.0	5.1	3.9	1.7	-3.7	5.4	-0.4	-3.0	-8.0	0.0	4.8
16	1976	11.9	5.3	3.9	0.7	-4.2	5.5	0.5	-0.9	-8.1	0.0	4.6
17	1977	11.8	5.7	4.5	0.4	-4.5	5.7	0.5	-1.1	-8.4	0.0	4.7
18	1978	11.9	6.8	5.3	1.0	-3.0	7.0	1.4	-2.1	-9.4	0.0	5.5
19	1979	12.3	6.2	5.2	-0.1	-2.8	6.8	0.0	-2.3	-9.6	0.0	5.2
20	1980	12.5	6.6	4.7	0.7	-3.4	7.0	-0.3	-2.5	-10.1	0.0	5.4
21	1981	13.1	7.5	7.2	1.8	-4.5	8.2	-1.4	-3.7	-11.2	0.0	6.7
22	1982	13.8	8.3	6.5	2.6	-5.4	9.3	-2.2	-4.3	-12.1	0.0	7.3
23	1983	15.0	9.2	7.2	0.5	-4.8	10.0	-0.4	-4.5	-12.1	0.0	7.1
24	1984	15.7	8.5	7.7	1.7	-5.6	10.6	-0.5	-5.2	-12.7	0.0	7.7
25	1985	16.6	9.7	8.8	0.1	-6.1	9.8	-0.2	-5.6	-13.1	0.0	7.7
26	1986	16.9	10.3	8.2	2.4	-6.8	10.9	-0.4	-6.3	-13.7	0.0	8.4
27	1987	17.7	11.4	8.7	2.4	-7.3	12.0	-0.3	-2.9	-14.0	0.0	8.7
28	1988	17.7	11.7	8.8	0.6	-5.3	12.1	0.3	-2.0	-13.3	0.0	8.2
29	1989	18.3	10.6	7.0	0.9	-3.6	12.1	0.3	-1.3	-13.6	0.0	7.7
30	1990	18.4	11.2	6.7	1.3	-2.8	11.3	0.1	-1.3	-14.0	0.0	7.6
31	1991	19.1	9.7	6.9	1.8	-3.4	12.3	-0.1	-1.1	-14.6	0.0	8
32	1992	19.9	12.7	7.4	3.1	-4.2	13.1	-0.7	-1.9	-15.5	0.0	8.9

BUR=Burgenland CAR=Carinthia LOA=Lower-Austria UPA=Upper-Austria
SAL=Salzburg STY=Styria TYR=Tyrol VOR=Vorarlberg
VIE=Vienna AUT=Austria

Figure 5. Distance for Burgenland, Carinthia and Vienna in time and percent from average for Austria: GDP per capita, constant prices

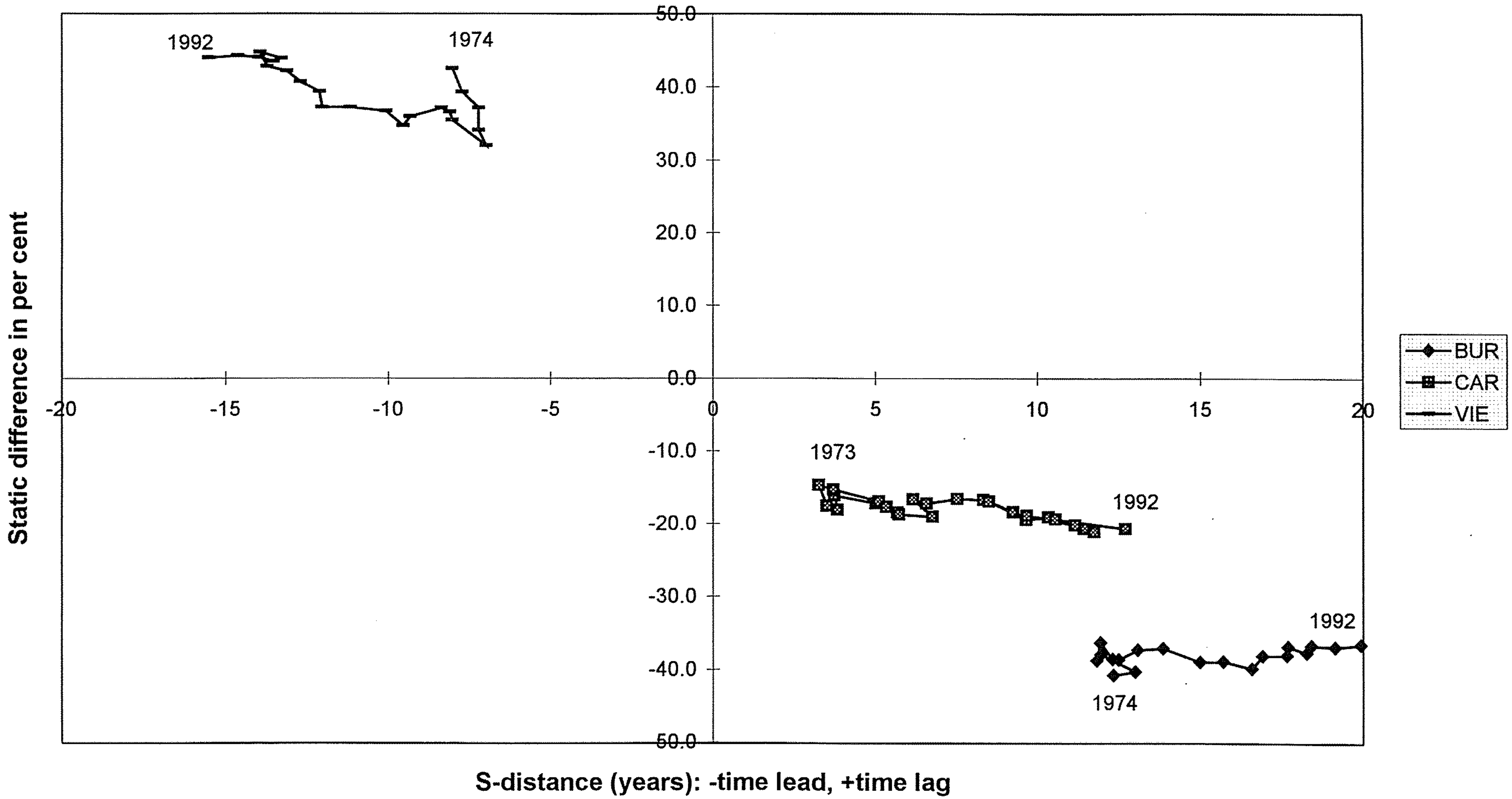
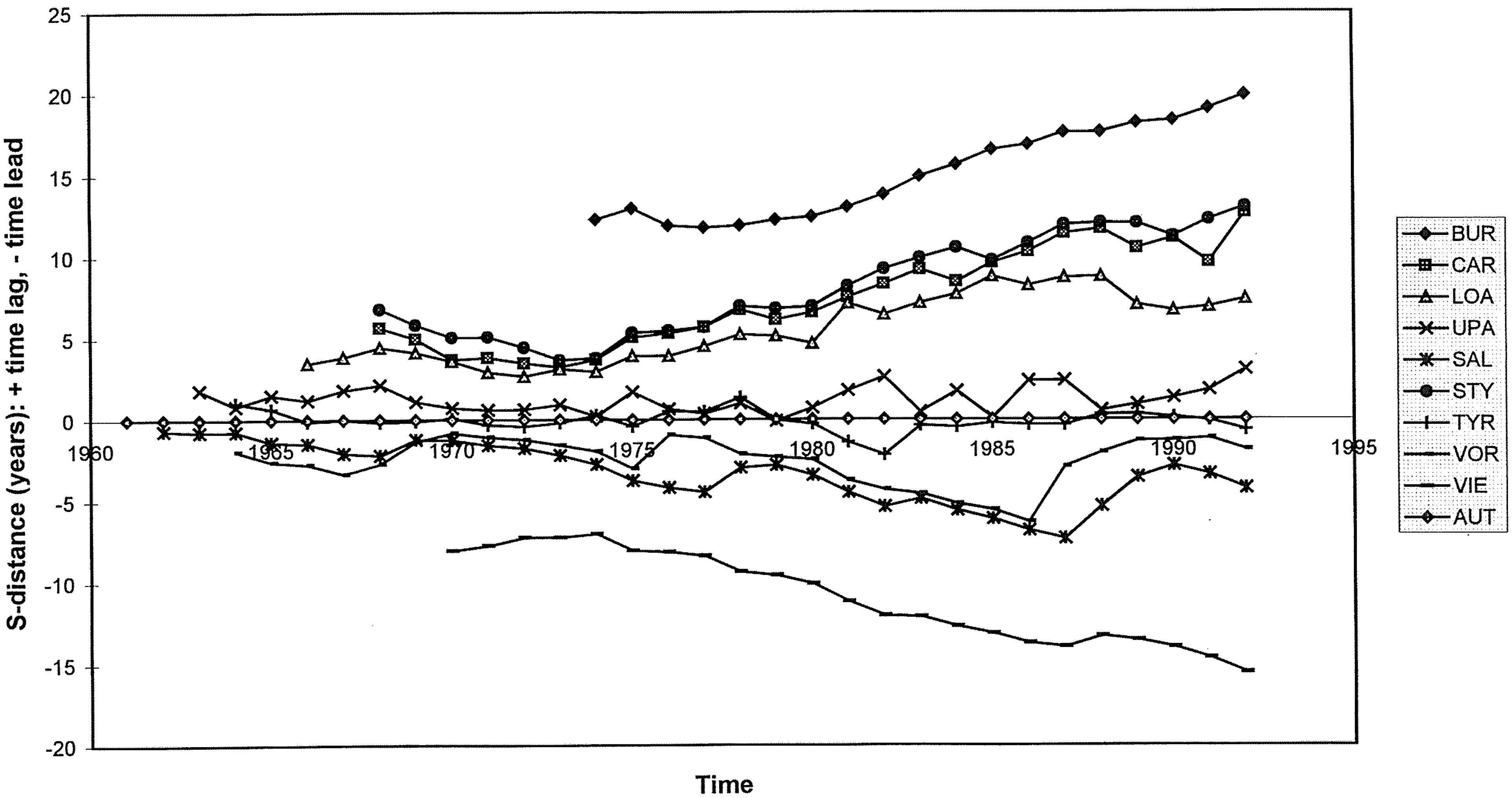


Figure 6. Time distance for GDP per capita for 10 regions from the average value for Austria (1960-1992)



In this type of graph used in Figure 5 time distance is on the horizontal axis, and static difference in percent on the vertical axis (see Section 2.3). It is possible to use other static measures of disparity on the vertical axis, like absolute differences, ratios or logarithms of static differences. While an optimal ratio of scales for the two axes can be determined only by knowing the subjective relative importance which people assign to the time dimension and to the static dimension of disparity, it is plausible to assume that a situation with the same static degree of static disparity and a smaller time distance would be preferable to the same degree of static disparity and larger time distance. Broadly speaking, the farther away a point in the graph is from 0,0 (the point of full equality), the greater the overall degree of disparity, which is a weighted combination of the static and the temporal dimension.

Figure 5 also indicates that for all three regions presented time distances have increased substantially in the last two decades (for other regions see also Figure 6). For Burgenland, Carinthia and Styria time lag increased between 1974 and 1992 for 8 - 9 years, and time lead for Vienna for the same magnitude. Also the summary measure of time distances weighted by population weights, mean S-deviation (for definition and elaboration see Sicherl, 1978), increased from 3.6 years in 1974 to 8.9 years in 1992. These results show that the possibility of divergent diagnoses and conclusions, based on relative static measures alone and on the broader conceptual and analytical framework encompassing also the time distance measure, is not an infrequent theoretical phenomenon but rather a common occurrence of significant theoretical and political importance.

For instance, for the NUTS 1 regions in Italy the static relative mean deviation was practically the same in 1980 and 1993, while the mean S-deviation with constant population weights was 6.4 years in 1980 and 12.1 years in 1993. Similarly, while gross material product per capita was in 1974 in the less developed republics and autonomous provinces in the former Yugoslavia lagging behind the more developed regions for about 12 years (Sicherl, 1975), in 1989 after stagnation in 1980s the backward looking time distance amounted to about 30 years. Since we know that in most European countries the growth rates of GDP per capita have been higher in the post-war period until 1973, it can be expected that, ceteris paribus, lower growth rates would result in increased time distances. Rather than an exception, under these circumstances similar problems can be facing policy makers in many countries. The deterioration of economic conditions resulting in a lower rate of growth would probably lead to a feeling of increased overall degree of disparity and an increased degree of social tensions. The conventional relative static measures would in these cases not lead to such a conclusion as the degree of relative static disparity was in these cases largely unchanged (Sicherl, 1996b).

4.2 Proximity in Time and Space for EU Regions in 1993 and 1994

Table 10 presents the situation in 1993, based on Eurostat estimates in Eurostat (1996). These results for 76 regions are showing both the static relative and absolute differences as well as time distances from the average GDP per capita for EUR 15 for 1993 in the same manner as it was done earlier for the EU countries. As before, the base level of GDP per capita for which the time distance between a given region and the EU average has been calculated is different for above-the-average and for below-the-average units. In Table 10 where the regions are sorted in descending order by relative static disparity R_{it} the time T_i for the below-the-average regions is printed in italics thus indicating that such a value shows the time when the GDP per capita for the EU average equalled that of a below-the-average region in 1993 (e.g. the level of GDP per capita for Campania in Italy for 1993 was the same as that for EU average in 1972.8, indicating a time distance of about 20 years).

Similarly as measuring the degree of disparity between countries, standard deviation weighted by population is shown as the third summary measure below the Table 10, and for 1993 it is 25.3. The last column in Table 10 shows the contribution of each region to the sum of weighted squared deviations which form the basis for calculation of the discussed measure. For 1993 the value of relative mean deviation for regional GDP per capita for 76 regions in the EU 15 amounted to 19.2 percent. Since it is calculated as the weighted deviation from the mean regardless of the sign, it can be said that if 9.6 percent of GDP from the above-the-average units would be transferred to the corresponding below-the-average units all regions would hypothetically enjoy equal per capita income. Similarly, the individual elements Pi^*w_i indicate the relative impact of a particular region on the average value of GDP per capita (which is a combination of percentage deviation from the mean and population weight). The greatest impact from below-the-average regions is observed for Continente in Portugal (-0.76 percent) and Sachsen in Germany (-0.59 percent).

The whole range of dispersion from the EU average for 1993 is now provided in two dimensions (see also Figure 7): Hamburg (DEU6) is 90 percent above the mean with a time lead of about 26 years, GDP per capita for Acores (PRT2) amounts to 42 percent of the mean with a time lag of about 33 years. Taking into account the approximations used in this study, the time span between the highest and the lowest regional value of GDP per capita was in 1993 about 60 years (Sicherl, 1996c). These are historical backward looking time distances. For the above-the-average regions the data source used (Eurostat, 1996) does not provide the past history of GDP per capita for these regions. A 2.5 percent rate of growth of GDP per capita was assumed for all these regions in the past. The corresponding times and time distances in Table 10 are thus an approximation of their lead in time ahead of the EU average.

Table 10

Relative differences and S-distances from EC average (1993)

No.	Regions	Name	Inters.	last	SI	RI	PI [%]	Ln (RI)	AI	SI × wI	PI × wI	PPI × wI
1	DEU6	HAMBURG	0	1967.4	-25.6	1.9	90	0.64	90	-0.12	0.41	37.14
2	BEL1	BRUXELLES-BRUSSEL	0	1969.0	-24.0	1.82	82	0.6	82	-0.06	0.21	17.32
3	FRA1	ILE DE FRANCE	0	1972.6	-20.4	1.66	66	0.51	66	-0.6	1.93	127.52
4	LUX	LUXEMBOURG	0	1974.2	-18.8	1.6	60	0.47	60	-0.02	0.06	3.86
5	DEU5	BREMEN	0	1975.8	-17.2	1.54	54	0.43	54	-0.03	0.1	5.38
6	DEU7	HESSEN	0	1977.0	-16.0	1.49	49	0.4	49	-0.26	0.79	38.51
7	ITA2	LOMBARDIA	0	1982.2	-10.8	1.31	31	0.27	31	-0.26	0.76	23.48
8	DEU1	BADEN-WURTTEMBERG	0	1983.0	-10.0	1.28	28	0.25	28	-0.28	0.77	21.57
9	ITA4	EMILIA-ROMAGNA	0	1983.8	-9.2	1.26	26	0.23	26	-0.1	0.28	7.29
10	FIN2	AHVENANMAA / ALAND	0	1983.8	-9.2	1.26	26	0.23	26	0	0	0.05
11	DEU2	BAYERN	0	1984.2	-8.8	1.25	25	0.22	25	-0.28	0.8	19.92
12	AUT1	OSTOESTERREICH	0	1984.2	-8.8	1.24	24	0.22	24	-0.08	0.22	5.23
13	ITA6	LAZIO	0	1985.8	-7.2	1.2	20	0.18	20	-0.1	0.28	5.68
14	ITA1	NORD OVEST	0	1986.6	-6.4	1.17	17	0.16	17	-0.11	0.28	4.84
15	ITA3	NORD EST	0	1986.6	-6.4	1.17	17	0.16	17	-0.11	0.3	5.16
16	UK5	SOUTH EAST (UK)	0	1987.0	-6.0	1.16	16	0.15	16	-0.29	0.77	12.24
17	BEL2	VLAAMS GEWEST	0	1987.8	-5.2	1.14	14	0.13	14	-0.08	0.22	3.08
18	DAN	DANMARK	0	1988.6	-4.4	1.12	12	0.11	12	-0.06	0.17	2.02
19	DEU10	NORDRHEIN-WESTFALEN	0	1988.6	-4.4	1.12	12	0.11	12	-0.21	0.57	6.88
20	AUT3	WESTOESTERREICH	0	1988.6	-4.4	1.12	12	0.11	12	-0.03	0.09	1.11
21	NED3	WEST-NEDERLAND	0	1989.0	-4.0	1.11	11	0.1	11	-0.08	0.21	2.34
22	DEU12	SAARLAND	0	1990.2	-2.8	1.07	7	0.07	7	-0.01	0.02	0.14
23	ITA5	CENTRO (I)	0	1990.6	-2.4	1.06	6	0.06	6	-0.04	0.1	0.57
24	FRA7	CENTRE-EST	0	1991.0	-2.0	1.05	5	0.05	5	-0.04	0.09	0.46
25	DEU9	NIEDERSACHSEN	0	1991.8	-1.2	1.03	3	0.03	3	-0.02	0.06	0.18
26	DEU15	SCHLESWIG-HOLSTEIN	0	1991.8	-1.2	1.03	3	0.03	3	-0.01	0.02	0.07
27	NED1	NOORD-NEDERLAND	0	1992.2	-0.8	1.02	2	0.02	2	0	0.01	0.02
28	FRA4	EST	0	1992.6	-0.4	1.01	1	0.01	1	-0.01	0.01	0.01
29	UK4	EAST ANGLIA	0	1992.6	-0.4	1.01	1	0.01	1	0	0.01	0.01
30	DEU11	RHEINLAND-PFALZ	2	1993.0	0.0	1	0	0	0	0	0	0
31	FRA2	BASSIN PARISIEN	2	1993.0	0.0	1	0	0	0	0	0	0
32	EC	EUR 15	2	1993.0	0.0	1	0	0	0	0	0	0
33	DEU3	BERLIN	1	1990.2	2.8	0.99	-1	-0.01	-1	0.03	-0.01	0.01
34	NED4	ZUID-NEDERLAND	1	1989.7	3.3	0.98	-2	-0.02	-2	0.03	-0.02	0.04
35	SVE	SVERIGE	1	1989.7	3.3	0.98	-2	-0.02	-2	0.08	-0.05	0.09
36	ESP3	MADRID	1	1989.3	3.7	0.97	-3	-0.03	-3	0.05	-0.04	0.12
37	UK10	SCOTLAND	1	1989.3	3.7	0.97	-3	-0.03	-3	0.05	-0.04	0.12
38	FRA6	SUD-OUEST	1	1988.6	4.4	0.95	-5	-0.05	-5	0.07	-0.08	0.41
39	UK6	SOUTH WEST (UK)	1	1988.2	4.8	0.94	-6	-0.06	-6	0.06	-0.08	0.46
40	FRA8	MEDITERRANEE	1	1987.9	5.1	0.93	-7	-0.07	-7	0.09	-0.13	0.9
41	UK3	EAST MIDLANDS	1	1987.9	5.1	0.93	-7	-0.07	-7	0.06	-0.08	0.54
42	FRA5	OUEST	1	1987.6	5.4	0.92	-8	-0.08	-8	0.11	-0.16	1.3
43	BEL3	REGION WALLONNE	1	1987.3	5.7	0.91	-9	-0.09	-9	0.05	-0.08	0.72
44	ESP2	NORESTE	1	1987.3	5.7	0.91	-9	-0.09	-9	0.06	-0.1	0.89
45	FIN1	MANNER-SUOMI	1	1987.3	5.7	0.91	-9	-0.09	-9	0.08	-0.12	1.1
46	UK2	YORKSHIRE AND HUMBERSIDE	1	1987.3	5.7	0.91	-9	-0.09	-9	0.08	-0.12	1.09
47	UK7	WEST MIDLANDS	1	1987.3	5.7	0.91	-9	-0.09	-9	0.08	-0.13	1.15
48	NED2	OOST-NEDERLAND	1	1987.0	6.0	0.9	-10	-0.11	-10	0.05	-0.08	0.84
49	UK8	NORTH WEST (UK)	1	1987.0	6.0	0.9	-10	-0.11	-10	0.1	-0.17	1.73
50	UK1	NORTH	1	1986.6	6.4	0.89	-11	-0.12	-11	0.05	-0.09	1.01
51	ESP5	ESTE	1	1986.1	6.9	0.88	-12	-0.13	-12	0.2	-0.35	4.17
52	FRA3	NORD-PAS-DE-CALAIS	1	1986.1	6.9	0.88	-12	-0.13	-12	0.07	-0.13	1.54
53	AUT2	SUEDOESTERREICH	1	1986.1	6.9	0.88	-12	-0.13	-12	0.03	-0.06	0.69
54	ITA7	AMBRUZZI-MOLISE	1	1985.7	7.3	0.87	-13	-0.14	-13	0.03	-0.06	0.74
55	UK9	WALES	1	1984.2	8.8	0.84	-16	-0.17	-16	0.07	-0.13	2
56	IRL	IRELAND	1	1982.4	10.6	0.81	-19	-0.21	-19	0.1	-0.18	3.47
57	UK11	NORTHERN IRELAND	1	1978.8	14.2	0.79	-21	-0.24	-21	0.06	-0.09	1.94
58	ITA11	SARDEGNA	1	1978.0	15.1	0.77	-23	-0.26	-23	0.07	-0.1	2.4
59	ESP7	CANARIAS	1	1977.5	15.5	0.76	-24	-0.27	-24	0.06	-0.1	2.37
60	GRE3	ATTIKI	1	1975.7	17.4	0.72	-28	-0.33	-28	0.16	-0.26	7.39
61	ITA10	SICILIA	2	1975.3	17.7	0.71	-29	-0.34	-29	0.24	-0.4	11.56
62	PRT1	CONTINENTE	2	1975.0	18.0	0.7	-30	-0.36	-30	0.46	-0.76	22.78
63	ITA8	CAMPANIA	1	1972.8	20.3	0.69	-31	-0.37	-31	0.32	-0.48	14.98
64	ITA9	SUD	1	1972.8	20.3	0.69	-31	-0.37	-31	0.38	-0.57	17.81
65	ESP4	CENTRO (E)	1	1972.5	20.5	0.68	-32	-0.39	-32	0.29	-0.45	14.46
66	ESP1	NOROESTE	1	1971.9	21.1	0.66	-34	-0.42	-34	0.25	-0.4	13.55
67	GRE1	VOREIA ELLADA	1	1969.0	24.0	0.6	-40	-0.51	-40	0.22	-0.36	14.42
68	ESP6	SUR	1	1969.0	24.0	0.6	-40	-0.51	-40	0.53	-0.89	35.5
69	GRE2	KENTRIKI ELLADA	1	1968.7	24.3	0.59	-41	-0.53	-41	0.17	-0.28	11.48
70	DEU4	BRANDENBURG	1	1968.0	25.0	0.57	-43	-0.56	-43	0.17	-0.29	12.67
71	GRE4	NISIA AIGAIOU, KRITI	1	1967.6	25.4	0.56	-44	-0.58	-44	0.07	-0.12	5.2
72	DEU14	SACHSEN-ANHALT	1	1966.7	26.3	0.54	-46	-0.62	-46	0.2	-0.35	15.92
73	DEU13	SACHSEN	1	1966.0	27.0	0.53	-47	-0.63	-47	0.34	-0.59	27.55
74	DEU8	MECKLENBURG-VORPOMMERN	1	1965.4	27.6	0.52	-48	-0.65	-48	0.14	-0.24	11.51
75	DEU16	THURINGEN	1	1965.4	27.6	0.52	-48	-0.65	-48	0.19	-0.33	15.77
76	PRT3	MADEIRA	1	1961.6	31.4	0.45	-55	-0.8	-55	0.02	-0.04	2.08
77	PRT2	ACORES	0	1959.9	33.1	0.42	-58	-0.87	-58	0.02	-0.04	2.17

Summary:

$\sum_i |S_i| \bullet w_i = 9.33$ $\sum_i |P_i| \bullet w_i = 19.17$ $\sqrt{\sum_i P_i^2 \bullet w_i} = 25.31$

Figure 7. GDP per capita(ppp): static difference and time distance for NUTS1 regions from EU average for 1993

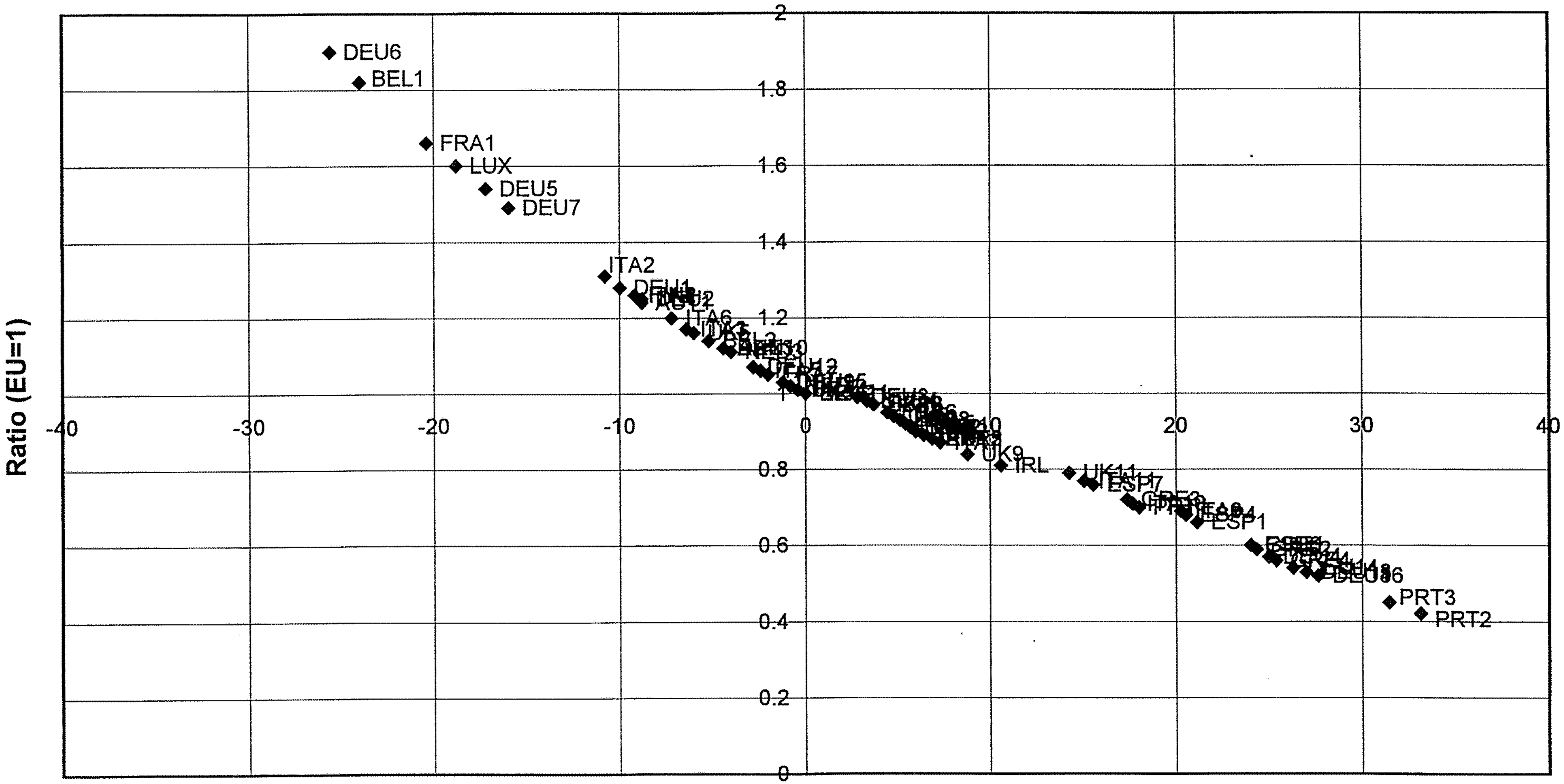


Table 11

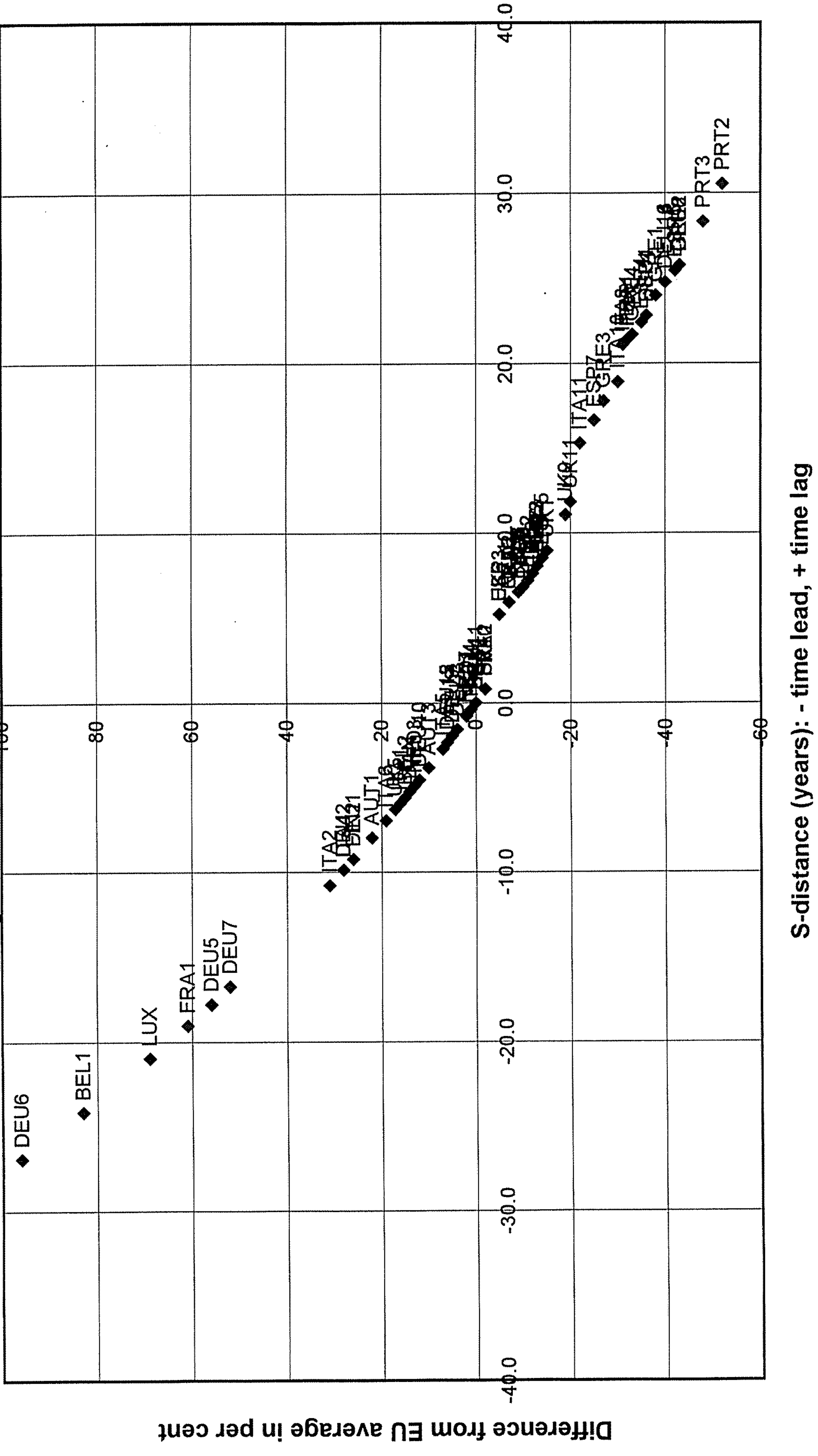
Relative differences and S-distances from EUR 15 average for GDP per capita (1994)

No.	Region	SI [year]	PI	AI	last	Inters.	SI × wi	PI × wi	PPI × wi	SI93	PI93	SI94-SI93	PI94-PI93	Region
1	BEL1	-24.2	83	83	1969.8	0	0.06	0.21	17.6	-24.0	82	-0.2	1	BEL1
2	BEL2	-5.6	15	15	1988.4	0	0.09	0.24	3.5	-5.2	14	-0.4	1	BEL2
3	BEL3	6.5	-9	-9	1987.5	1	0.06	0.08	0.7	5.7	-9	0.9	0	BEL3
4	DAN	-5.2	14	14	1988.8	0	0.07	0.2	2.7	-4.4	12	-0.8	2	DAN
5	DEU1	-9.2	26	26	1984.8	0	0.25	0.72	18.6	-10.0	28	0.8	-2	DEU1
6	DEU2	-9.9	28	28	1984.1	0	0.32	0.89	25.1	-8.8	25	-1.1	3	DEU2
7	DEU3	-1.6	4	4	1992.4	0	0.01	0.04	0.2	2.8	-1	-4.4	5	DEU3
8	DEU4	22.8	-36	-36	1971.2	1	0.16	0.25	8.8	25.0	-43	-2.2	7	DEU4
9	DEU5	-17.8	56	56	1976.2	0	0.03	0.1	5.7	-17.2	54	-0.6	2	DEU5
10	DEU6	-26.9	96	96	1967.1	0	0.12	0.44	42.2	-25.6	90	-1.3	6	DEU6
11	DEU7	-16.8	52	52	1977.3	0	0.27	0.83	43.4	-16.0	49	-0.8	3	DEU7
12	DEU8	25.8	-43	-43	1968.2	1	0.13	0.21	9.1	27.6	-48	-1.8	5	DEU8
13	DEU9	-2.0	5	5	1992.1	0	0.04	0.1	0.5	-1.2	3	-0.8	2	DEU9
14	DEU10	-4.5	12	12	1989.5	0	0.22	0.57	6.9	-4.4	12	-0.1	0	DEU10
15	DEU11	0.0	0	0	1994.0	1	0	0	0.0	0.0	0	0.0	0	DEU11
16	DEU12	-2.3	6	6	1991.7	0	0.01	0.02	0.1	-2.8	7	0.5	-1	DEU12
17	DEU13	24.8	-40	-40	1969.2	1	0.31	0.49	19.8	27.0	-47	-2.2	7	DEU13
18	DEU14	24.8	-40	-40	1969.2	1	0.18	0.3	11.9	26.3	-46	-1.5	6	DEU14
19	DEU15	-2.3	6	6	1991.7	0	0.02	0.04	0.3	-1.2	3	-1.1	3	DEU15
20	DEU16	24.8	-40	-40	1969.2	1	0.17	0.27	10.9	27.6	-48	-2.9	8	DEU16
21	GRE1	24.0	-38	-38	1970.0	1	0.22	0.34	13.1	24.0	-40	0.0	2	GRE1
22	GRE2	25.8	-43	-43	1968.2	1	0.18	0.3	12.8	24.3	-41	1.5	-2	GRE2
23	GRE3	17.8	-27	-27	1976.2	1	0.17	0.25	6.8	17.4	-28	0.4	1	GRE3
24	GRE4	21.7	-33	-33	1972.3	1	0.06	0.09	2.9	25.4	-44	-3.7	11	GRE4
25	ESP1	22.8	-36	-36	1971.2	1	0.27	0.42	15.1	21.1	-34	1.7	-2	ESP1
26	ESP2	7.2	-11	-11	1986.8	1	0.08	0.12	1.3	5.7	-9	1.5	-2	ESP2
27	ESP3	5.2	-5	-5	1988.8	1	0.07	0.07	0.3	3.7	-3	1.5	-2	ESP3
28	ESP4	22.4	-35	-35	1971.6	1	0.32	0.49	17.3	20.5	-32	1.9	-3	ESP4
29	ESP5	8.5	-14	-14	1985.5	1	0.25	0.4	5.7	6.9	-12	1.7	-2	ESP5
30	ESP6	25.5	-42	-42	1968.5	1	0.56	0.93	39.0	24.0	-40	1.5	-2	ESP6
31	ESP7	16.6	-25	-25	1977.4	1	0.07	0.1	2.6	15.5	-24	1.1	-1	ESP7
32	FRA1	-19.1	61	61	1975.0	0	0.56	1.8	109.9	-20.4	66	1.4	-5	FRA1
33	FRA2	0.8	-2	-2	1993.2	3	0.02	0.06	0.1	0.0	0	0.8	-2	FRA2
34	FRA3	8.1	-13	-13	1985.9	1	0.09	0.14	1.8	6.9	-12	1.2	-1	FRA3
35	FRA4	0.0	0	0	1994.0	1	0	0	0.0	-0.4	1	0.4	-1	FRA4
36	FRA5	6.5	-9	-9	1987.5	1	0.13	0.18	1.7	5.4	-8	1.1	-1	FRA5
37	FRA6	5.9	-7	-7	1988.1	1	0.1	0.11	0.8	4.4	-5	1.5	-2	FRA6
38	FRA7	-0.8	2	2	1993.2	0	0.01	0.04	0.1	-2.0	5	1.2	-3	FRA7
39	FRA8	6.5	-9	-9	1987.5	1	0.12	0.17	1.5	5.1	-7	1.4	-2	FRA8
40	IRL	7.6	-12	-12	1986.4	1	0.07	0.12	1.4	10.6	-19	-2.9	7	IRL
41	ITA1	-5.9	16	16	1988.1	0	0.1	0.27	4.3	-6.4	17	0.5	-1	ITA1
42	ITA2	-10.8	31	31	1983.2	0	0.26	0.76	23.4	-10.8	31	0.0	0	ITA2
43	ITA3	-7.0	19	19	1987.0	0	0.12	0.34	6.4	-6.4	17	-0.6	2	ITA3
44	ITA4	-9.9	28	28	1984.1	0	0.11	0.3	8.4	-9.2	26	-0.7	2	ITA4
45	ITA5	-2.7	7	7	1991.3	0	0.04	0.11	0.8	-2.4	6	-0.3	1	ITA5
46	ITA6	-7.0	19	19	1987.0	0	0.1	0.27	5.1	-7.2	20	0.2	-1	ITA6
47	ITA7	8.1	-13	-13	1985.9	1	0.04	0.06	0.7	7.3	-13	0.8	0	ITA7
48	ITA8	21.1	-31	-31	1972.9	1	0.33	0.49	15.1	20.3	-31	0.9	0	ITA8
49	ITA9	21.4	-32	-32	1972.6	1	0.4	0.59	18.9	20.3	-31	1.2	-1	ITA9
50	ITA10	18.9	-30	-30	1975.1	3	0.26	0.42	12.5	17.7	-29	1.2	-1	ITA10
51	ITA11	15.3	-22	-22	1978.7	1	0.07	0.1	2.2	15.1	-23	0.2	1	ITA11
52	LUX	-21.0	69	69	1973.0	0	0.02	0.07	5.2	-18.8	60	-2.2	9	LUX
53	NED1	-0.8	2	2	1993.2	0	0	0.01	0.0	-0.8	2	0.0	0	NED1
54	NED2	5.9	-7	-7	1988.1	1	0.05	0.06	0.4	6.0	-10	0.0	3	NED2
55	NED3	-4.9	13	13	1989.1	0	0.09	0.25	3.3	-4.0	11	-0.9	2	NED3
56	NED4	-0.4	1	1	1993.6	0	0	0.01	0.0	3.3	-2	-3.7	3	NED4
57	AUT1	-8.0	22	22	1986.1	0	0.07	0.2	4.4	-8.8	24	0.9	-2	AUT1
58	AUT2	8.1	-13	-13	1985.9	1	0.04	0.06	0.8	6.9	-12	1.2	-1	AUT2
59	AUT3	-3.8	10	10	1990.2	0	0.03	0.08	0.8	-4.4	12	0.6	-2	AUT3
60	PRT1	21.4	-32	-32	1972.6	1	0.54	0.81	25.9	18.0	-30	3.4	-2	PRT1
61	PRT2	30.5	-52	-52	1963.5	1	0.02	0.03	1.7	33.1	-58	-2.6	6	PRT2
62	PRT3	28.4	-48	-48	1965.7	1	0.02	0.03	1.6	31.4	-55	-3.1	7	PRT3
63	FIN1	6.5	-9	-9	1987.5	1	0.09	0.12	1.1	5.7	-9	0.9	0	FIN1
64	FIN2	-9.2	26	26	1984.8	0	0	0	0.1	-9.2	26	0.0	0	FIN2
65	SVE	0.8	-2	-2	1993.2	3	0.02	0.05	0.1	3.3	-2	-2.5	0	SVE
66	UK1	9.0	-15	-15	1985.0	1	0.08	0.13	1.9	6.4	-11	2.6	-4	UK1
67	UK2	8.1	-13	-13	1985.9	1	0.11	0.18	2.3	5.7	-9	2.4	-4	UK2
68	UK3	5.9	-7	-7	1988.1	1	0.07	0.08	0.5	5.1	-7	0.8	0	UK3
69	UK4	0.0	0	0	1994.0	1	0	0	0.0	-0.4	1	0.4	-1	UK4
70	UK5	-6.3	17	17	1987.7	0	0.3	0.81	13.9	-6.0	16	-0.3	1	UK5
71	UK6	5.2	-5	-5	1988.8	1	0.07	0.06	0.3	4.8	-6	0.4	1	UK6
72	UK7	6.8	-10	-10	1987.2	1	0.1	0.14	1.4	5.7	-9	1.2	-1	UK7
73	UK8	7.6	-12	-12	1986.4	1	0.13	0.21	2.5	6.0	-10	1.7	-2	UK8
74	UK9	11.1	-19	-19	1982.9	1	0.09	0.15	2.8	8.8	-16	2.3	-3	UK9
75	UK10	0.8	-2	-2	1993.2	3	0.01	0.03	0.1	3.7	-3	-2.9	1	UK10
76	UK11	11.9	-20	-20	1982.2	1	0.05	0.09	1.8	14.2	-21	-2.4	1	UK11
77	EC	0.0	0	0	1994.0	1	0	0	0.0	0.0	0	0.0	0	EC

Summary:

$\sum_i |S_i| \bullet w_i = 9.68$ $\sum_i |P_i| \bullet w_i = 19.50$ $\sqrt{\sum_i P_i^2 \bullet w_i} = 25.16$

Figure 8. GDP per capita(ppp): per cent difference and time distance for NUTS1 regions from EU average for 1994



Broadly speaking, three groups of regions can be observed in Picture 7. The group of the most developed regions consists of six regions for which GDP per capita at purchasing power parity is more than 50 percent higher than the mean and their lead in time is between 16 and 26 years. These are three German regions (Hamburg, Bremen and Hessen), Ile de France, Brussels and Luxembourg. The second group is the largest in numbers, about 50 regions, that are grouped around the mean with time distances up to 10 years in both directions. This group is led by Lombardia, which is about 11 years ahead of the EU average, and ends with Ireland, which lags the average for the same number of years. The third group of regions, about 20 of them, starts with Northern Ireland with time distance of 14 years and finishes with Acores with time distance of 33 years. In the third group of regions mentioned above, two subgroups can be observed. In the first subgroup regions achieve from 66 to 77 percent of mean income and have a time lag between 15 and 21 years. The second subgroup consists of the least developed regions of Greece, Spain, earlier East German regions and two Portuguese regions. They do no exceed 60 percent of the mean income and their time lags are not less than 24 years. (Sicherl, 1996c).

Recently data for GDP per capita at purchasing power parity became available for EU regions for 1994 (Eurostat, 1997). The results of calculations for 1994 are presented in Table 11 and Figure 8. As far as summary measures of disparity at the regional level are concerned, there has been little overall change. The weighted standard deviation decreased slightly from 25.31 in 1993 to 25.16 in 1994. Relative mean deviation shows a slight change in the other direction: it increased from 19.2 in 1993 to 19.5 per cent in 1994. Also the weighted summary measure of S-distance increased between 1993 in 1994, though because of various approximations this value should be given less importance than the change in relative mean deviation, which is derived from exactly the same information than the weighted standard deviation, only the formulae are different. For individual regions the changes in one year appear substantial, in a few cases the underlying data could be in question. In Table 11 the corresponding values of S-distance and percentage deviation from EU average for 1993 are added for comparison, and the corresponding changes between 1993 and 1994 are calculated. There are 10 regions which gained 6 or more percentage point in one year (see also comment in Eurostat, 1997). Without going into details in this methodological exposition, it is of interest to see that according to the Eurostat data all Spanish, French and Austrian regions have faired worse in percentage terms in relation to the EU average in 1994 than in 1993.

From the methodological point of view, two comments are in order. First, Figure 8 is combining S-distance with the percentage deviation from the EU average as the static measure of disparity (SP graph as described in Section 2.3), while Figure 7 uses as the static measure of disparity the ratio of the value for the region in relation to the EU average (SR type of graph). It is for the user to decide which version is more useful for the presentation in his/her case. Second, backward looking time distances mean that the benchmark of performance in time is the dynamics of the EU average. Because of the poor growth performance of the EU at the beginning of 1990's, it is possible that improvements in time distance were the result of the decline in the EU average rather than of better performance of some regions. This problem can be easily avoided if necessary, as one can take as the benchmark a smoothed series of the EU average (or whatever is the comparator series in a given analysis). Nevertheless, the addition of the time dimension has added a useful view of the problem of regional disparities.

5. Comparison in Two Dimensions Over More Indicators

The multidimensional nature of development and welfare demands that any serious analysis of disparities or comparative analysis of development looks into a number of dimensions of the problem to cover at least the most important aspects of the issue. The apparent neatness and comprehensiveness as the advantages of a single indicator approach are far outweighed by its disadvantages with respect to the formulation of policy direction and measures in various fields.

The need to analyse a number of economic and social indicators, or policy and welfare attributes, opens up also new methodological issues. Development is not a process of proportional improvement in all attributes at the same time, and different indicators could grow at very different rates of growth for various reasons. In Section 2.6 it was established that in a dynamic framework the magnitude of the growth rate is important for the time dimension of disparity, and that in a case of a given indicator a change in the magnitude of its growth rate (and not only the difference between the growth rates for the compared units) may result in a very different evaluation of the corresponding change in the degree of disparity if measured by static measures or S-distance. For comparative analysis of more indicators, a similar growth rate effect can be observed when one attempts to rank a number of development and welfare indicators with respect to the magnitude of disparity. In other words, the ranking of more indicators by the degree of disparity may be very different if they would be ordered by a static measure or by time distance.

Technically, the larger are the differences in the magnitudes of the growth rates for different indicators, the higher the probability that the assessment of the degree of disparity in these indicators based on static measures will be different from the results based on time distance as a dynamic (temporal) measure of disparity. Depending on the magnitudes of the growth rate, indicators that show a high degree of disparity in static comparison may at the same time show a rather small distance in time, and vice versa. Sicherl (1992) shows the conditions under which this would happen, i.e. that comparing two units a static measure would show a greater degree of disparity for indicator A than for indicator B, while the S-distance would be smaller for indicator A than for indicator B.

Such conflicts between results based on static measures and time distance are not so rare that they would be of interest only as a theoretical curiosity. On the contrary, large differences in the growth rates of various economic and social indicators are a rule rather than an exception in real life. Table 12 presents an empirical example comparing a set of indicators for Slovenia and the average for the former Yugoslavia, methodologically this is a comparison of a region against the average, as e.g. EU regions were compared with the EU average. For two years, 1964 and 1985 the analysed indicators were ranked separately by the ratio of the value for Slovenia against the average value, on the one hand, and by the corresponding S-distance showing the lag in time for Yugoslavia, on the other.

Table 12: Disparity Across Selected Indicators by Static Ratio and S-distance Slovenia and Yugoslavia

Indicator	Around 1964				Around 1985			
	Ratio(t)	Rank	S (years)	Rank	Ratio(t)	Rank	S (years)	Rank
GMP* per capita	1.85	3	7.4	5	2.03	2	17.5	3
Employed per working pop.	1.67	5	10.7	3	1.55	4	24.8	1
GMP per worker	1.22	7	4.0	8	1.38	6	16.7	4
Fixed assets per worker	1.17	8	2.2	9	1.32	7	6.9	10
Cars per 1000 pop.	3.52	1	4.8	7	2.06	1	12.7	5
Telephones per 1000 pop.	1.76	4	7.8	4	1.65	3	7.3	8
TV sets per 1000 pop.	2.19	2	1.2	10	1.38	5	11.7	7
Doctors per 1000 pop.	1.29	6	5.6	6	1.12	8	7.1	9
Infant survival rate	1.05	10	12.5	1	1.02	10	21.1	2
Life expectancy (female)	1.08	9	10.9	2	1.03	9	12.2	6

* Gross material product
Source: Sicherl (1992)

The ranking of indicators by the static measure and time distance is very different. The values of Spearman's rank correlation coefficient show that there is no significant correlation between the rankings of the indicators by the static measure and S-distance, the values being -0.45 for 1964 and 0.14 for 1985 (Sicherl, 1992).

Comparing individual indicators from this empirical example shows that if one would assess the degree of disparity only by the relative static degree of disparity, the problem of employment possibilities (indicator 2) and availability of telephones (indicator 6) would in 1985 indicate a very similar degree of disparity in the two fields. However, time distance shows another dimension of the situation, the values of backward looking S-distance are 25 years as against 7 years, respectively. The overall degree of disparity in employment opportunities is thus a more severe problem and the substantially greater time distance is an indication that it would be much more difficult to overcome (ibid).

Furthermore, this example may be used to illustrate the exposition with respect to nine possible combinations of convergence or divergence in time and indicator space in Table 3b. Analysing changes over time from about 1964 to about 1985, the static ratio between Slovenia and Yugoslavia decreased for seven indicators and increased for three indicators. The changes in S-distance show a different picture, it increased for 9 out of 10 indicators, for six of them even more than doubled. The simple 'yes' or 'no' answer about convergence based only on the static ratio would obviously miss the point and present a very one-sided and misleading picture.

The salient features of the analysis of changes in regional disparities in the former Yugoslavia are not to be found in the detailed analysis of the static ratios, but in the dynamic elements. The increased inefficiency over time in the former Yugoslavia as a whole led to lower growth rates or stagnation in all regions and thus to increased time distances between them. Such a view seems to offer a better explanation of the factors that have, in the addition to the prevailing political factors, contributed to the disintegration of the former Yugoslavia. Static relative measures alone were not capable to provide the right policy conclusions (for details see Sicherl, 1992).

6. Subjective Perceptions, Policy and Welfare Issues

As mentioned in the introduction, it is possible for many purposes to use the time distance concept and S-distance in its role as a descriptive statistical measure, where no normative judgements are associated. It would indeed not be wise not to use the advantages of getting an additional view of the situation without having to sacrifice any other results. It has been shown that in many cases the additional conclusions were quite distinct from those arrived at by conventional static measures and have complemented them in a very important way.

Beyond that, one should distinguish that in decision-making and policy oriented research three types of issues are involved: (1) estimation of statistical measures of disparities as 'objective' measures of the multidimensional notion of distances in time and space for many indicators, (2) value judgments associated with them, which assign subjective weights to the 'objective' measures across various dimensions and fields of concern, (3) analysis of reactions of people, how the subjective evaluation influences decisions, behaviour and action (Sicherl, 1992).

Time distance has a special role to play in this regard. Time is besides money the most common unit of measurement used to assess and compare various situations. Time distance measuring one dimension of disparity makes a complicated matter understandable to all, from board members to workers, from politicians to general public, facilitating their subjective perception. This means that time distance as a statistical measure, presentation and communication tool will have an important influence on people's opinion.

When people assess their position in the society, they do so over many dimensions and over time, they have memories of the past and expectation about the future. While static measures of disparity are necessary and important, they are not enough. Sicherl (1978) argues that a framework is needed which deals with both the static and dynamic aspects of disparities. Without going into details here, the overall degree of disparity (proximity) is defined as a weighted combination of static measure and time distance. Although the subjective value judgements which people attach to the time dimension of disparity relative to the static dimension is an open question, similar to that how they evaluate the relative importance of various static measures, it is in view of positive time preference embodied in discounting procedures highly unlikely that the weight given to time distance would be zero. In other words, both of them matter and should be used together for a better description and evaluation of reality.

An example was mentioned that static measures of disparity would describe three situations as equal, if in all three cases the ratio of the value of the more developed unit to the less developed unit would be 1.5, though the time distances would be 10, 20 or 40 years, respectively, depending on the growth rate of the indicator. It is highly unlikely that people would perceive such situations as equal degrees of disparity. There are no immediate answers with regard to the normative consequences of the suggested notion of the overall degree of disparity combining static measures and time distance, since subjective weights that people assign to the two components are not known. Conventional welfare theory would need to explain how could it be possible or why it would not be possible to incorporate this way of thinking and the changed semantics into its domain. Because of the complexity of the matter and since unpleasant questions are not a great incentive to undertake such response, these normative issues are not expected to be clarified soon.

However, if this theory is right in suggesting that people take into account also time distance as one element of their subjective evaluation of the (overall) degree of disparity, a whole new set of hypotheses with important economic, social and political consequences follows. An analytical conclusion that higher magnitudes of growth rates lead, ceteris paribus, to smaller time distances, and vice versa, can lead to interesting new hypotheses and to additional factors that can be used in explaining past developments and in preparing policy recommendations.

A change in the overall degree of disparity can be expected if there is a substantial change in the magnitude of the growth rates of the most important indicators. In this theoretical framework a hypothesis can be formulated that, ceteris paribus, lower growth rates in the past and current decades have increased the overall degree of disparity in many countries though increased time distances which they caused. If this theory is right, it should be a warning to politicians that the feeling of inequality has increased and that an increased degree of social tension may be expected. The conventional relative static measures would in many cases not convey such conclusions (Sicherl,1992 and 1996b).

Similar situation has occurred in the field of regional disparities: the relative static disparity in the last two decades has been in Austria and Italy practically unchanged, while time distances have increased noticeably. Since we know that in most European countries the growth rates of GDP per capita have been higher in the post-war period until 1973, it can be expected that, ceteris paribus, lower growth rates would result in increased time distances. Rather than an exception, under these circumstances similar problems may be facing policy makers in many countries (Sicherl, 1996b).

A further important hypothesis about the interrelationship between efficiency, growth and disparity can be formulated within this framework. In the conventional theory the trade-off between growth and inequality is emphasised. Here a high growth rate (with appropriate distribution policy) is not only a means for reaching higher levels of satisfaction of needs faster, but can be also a means of reducing disparities, at least in the time dimension. Furthermore, inefficiency has important negative economic and political consequences as far as disparities are concerned (Sicherl, 1992). Increased efficiency leads to higher growth from the same resources, this leads to smaller time distances that in turn could mean greater social cohesion, enabling a more conducive environment for timely adjustment to changes supporting increased efficiency and effectiveness, and the 'virtuous' circle can continue. The 'vicious' circle would work in the other direction. In addition to the insights brought up in its use as a descriptive statistical measure, the broader framework outlined here can pose some interesting questions for growth and welfare theory, and the related policy issues (Sicherl, 1997).

7. Summary and Conclusions

The contribution of this novel dynamic conceptual and analytical approach to the analysis of the cohesion in the present EU and of the impact of EU enlargement on the cohesion is twofold. First, a broader viewpoint to the problem is introduced. This is not a question of a greater precision in empirical analysis, it is first and foremost a question of the perception of disparities and the policy consequences which arise from using a dynamic analytical framework that is closer to the way in which people perceive disparities and react to them. Second, the methodology presented combines the conventional approach to comparisons of disparities in economic and social indicators with the novel concept of time distance and the associated statistical measure S-distance. This will permit perceiving and measuring disparities also in time and an integration of static and intertemporal comparisons to deliver better understanding of the situation to policy makers and general public.

People compare their position in a community over many dimensions and over time. Cohesion of a society is principally a question of the state of mind. However, economic analysis can be helpful and is frequently used as a tool for policy makers to assess the degree of cohesion in a community. There are different measures used to express the notion of and the degree of cohesion. At present for this type of analysis mainly static measures of disparity like coefficient of variation, standard deviation, or Gini coefficient are being used. Such measures, though important and indispensable, are not sufficient to show the complexity of the situation in a dynamic context, and a framework that deals with both static and dynamic aspects of disparities is needed.

The generic nature of the time distance concept and the S-distance measure leads to the conclusion that this theoretical approach and statistical measure can be usefully applied in a wide variety of substantive fields. A novel statistical measure S-distance (expressed in standardised units - time) is generalised to complement conventional measures in time series comparisons, regressions, models, forecasting and monitoring, and to provide from existing data new insights due to an added dimension of analysis. The examples mentioned indicate the potential of this methodology to provide new understanding of the situation for a variety of situations in economics, politics, business and statistics, asking new questions and formulating new hypotheses.

The time perspective, which no doubt exists in human perception when comparing different situations, is systematically introduced both as a concept and as a quantifiable measure. A theoretical background is provided for placing time distance concept in line with the conventional concepts of static difference between two compared units and the notion of the rate of growth over time. In time series analysis in addition to the disparity (difference, distance) in the indicator space at a given point in time, in principle there exist a theoretically equally universal disparity (difference, distance) in time when a certain level of the indicator is attained by the two compared units. By reversing their roles, the level of the variable becomes the identifier for calculation of the novel statistical measure S-distance, and time is used as numeraire and focus of comparison. This implies some need for a more flexible and varied semantics in discussing convergence and divergence, it should be discussed in two dimensions: closer (or more apart) in static measure(s) and closer (or more apart) in time.

After this general background of the new approach based on an earlier study the exposition is focused on the conceptual and methodological problems of comparing economic and social indicators between countries and regions, as required for the analysis of the degree of cohesion in the EU. The importance of the magnitude of the growth rates of the indicators is emphasised. In the dynamic world of today it is hardly satisfactory to rely only on static measures of disparity which are insensitive to the magnitudes of the growth rates and take into account only differences in the growth rates between the units. In this respect time distance plays in the analysis of disparities an important role, quite distinct from that of static measures. This leads to a very important policy conclusion. In this framework for the analysis of convergence and the degree of cohesion in the EU it will be important ***also how fast and not only how much faster*** will the less developed countries (regions) and the potential member countries grow in the future.

In Sections 3 and 4 methodological issues are discussed in combination with an exploratory analysis of the disparities in GDP per capita at purchasing power parities between 15 EU countries, as well as 10 CEE countries for 1993, for 76 EU regions for 1993 and 1994, and for Austrian regions for the period 1961-1992. In this way also practical problems of applying this methodology are exposed and discussed.

Analysing first countries rather than regions, the dispersion between the 15 EU countries was not large when compared to regional disparities. Excluding Luxembourg, four countries, Belgium, Denmark, Austria and France were in 1993 about 5 years ahead, and Finland about 5 years behind the EU average, and only four countries have time lag greater than 10 years: Ireland and Spain between 11 and 15 years, and Portugal and Greece between 20 and 23 years. Observing the existing range of disparities for the indicator GDP per capita at purchasing power parity among the regions and Member States of the EU 15 in 1993, there are only two CEE countries (Slovenia and the Czech Republic) which in addition to Cyprus and Malta fall within this range .

The presentation is followed by an empirical application to regional disparities in Austria for the time series of GDP per capita for the period 1961-1992. It showed that while there have been only minor changes in the static relative position of Austrian regions, in terms of time they have become more and more apart. For instance, Burgenland was in 1974 lagging behind the average for about 12 years, in 1992 the time lag was about 20 years, even though in percentage terms it improved from 59 percent in 1974 to 63 percent in 1992. Since these two measures showed different directions of change, this example confirms the proposition that the process of convergence has to be analysed and monitored in at least two dimensions: catching up in the static dimension and catching up in the time dimension of disparity. Similar divergence of results based on conventional static measure and S-distance have been observed in the example of disparity between Slovenia and the former Yugoslavia for 10 indicators. Between 1964 and 1985 there was decrease in static ratios for 7 and increase in 3 indicators, while time distances increased for 9 out of 10 indicators. It was the increased inefficiency over time in the former Yugoslavia as a whole, rather than interregional exploitation as suggested by some, that was driving the regions apart in time and increasing the perception of greater disparities. Static relative measures were not capable of providing the right policy conclusion in these cases.

For the 76 EU regions the whole range of dispersion from the EU average for 1993 is now provided in two dimensions: Hamburg is 90 percent above the mean with a time lead of about 26 years, GDP per capita for Acores amounts to 42 percent of the mean with a time lag of about 33 years. Taking into account the approximations used in this study, the time span between the highest and the lowest regional value of GDP per capita was in 1993 about 60 years. Three groups of regions can be observed: the group of 6 most developed regions being ahead the EU average between 16 and 26 years, the second one of about 50 regions grouped around the average within time distance of about 10 years in both directions, and the third group of about 20 regions lagging behind the average between 14 and 33 years. The results for 1994 are very similar as the summary measures of cohesion are concerned, though there were changes in the position of individual regions.

The fact that high growth rates reduce, ceteris paribus, the time dimension of disparity unveils a set of new hypotheses about possible relationships to be explored between growth and inequality. A high growth rate is not only a means for reaching higher levels of satisfaction of needs faster but also an instrument for reducing disparities at least in the time distance dimension. Efficiency without adverse distribution effects is in this framework important also for the degree of cohesion, and inefficiency has negative economic and political consequences also in this respect. Lower growth rates should signal to politicians that an increase in the degree of disparity may be felt and that social tensions may be increasing and cohesion decreasing.

This and other hypotheses outlined have important welfare and policy consequences. As time is one of the most important reference frameworks in a modern society, it is highly unlikely that the time distance concept and the emphasis on two dimensional notion of disparity presented here would be irrelevant for economic theory and policy considerations. Both as a descriptive statistical measure in an exploratory analysis as well as a concept for looking at policy issues from a new perspective, S-distance can be important for empirical analysis of cohesion within and among present EU members and regions for many indicators, for analysis of comparative positions of potential member countries and competitors in the world, as well as for analysis of discrepancies between actual and planned (budgeted, estimated, targeted) values and for monitoring of implementation. In the second part of the work on this project the empirical analysis will concentrate on comparison of Slovenia with its neighbour Austria and selected other smaller countries of the EU for a set of about 10 economic and social indicators, as these countries are the most relevant comparators for Slovenia in approaching full membership in the EU.

It can be concluded that in the applied policy context the novel methodology used offers a new perspective to the problem, and a presentation and communication tool for policy analysis and debate that is readily understood by policy makers, media and general public.

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