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Time Distance in Economics and Statistics

New Insights from Existing Data

edition WISDOM echoraum

Vol. 18
of the Series: Complexity Design Society

Printed with support from the Austrian Ministry of Science and Research, and Blaha Office Furniture Ges.m.b.H.

Layout: Werner Korn
Text edition: Gertrud Hafner
Figures and Graphs: Jaka Hajnšek | Matija Remec | Michael Eigner

Printing: Remaprint Wien

ISBN 978-3-901941-27-6

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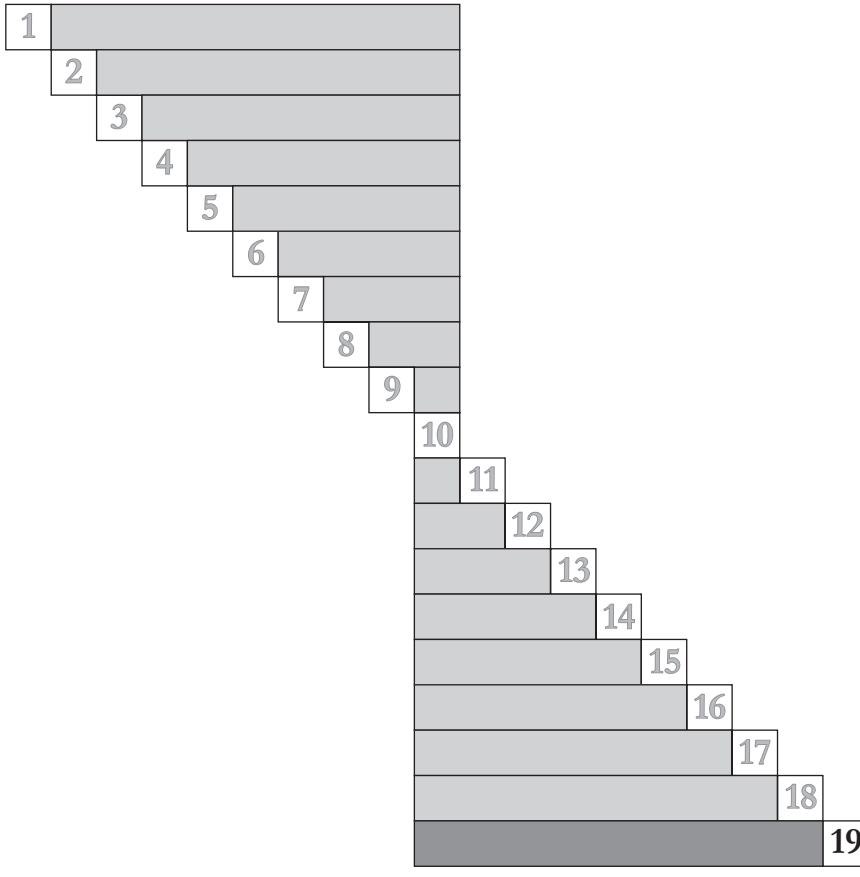

Time distance is an innovative approach for looking at time-series data. The time distance approach offers two improvements in the present state-of-the-art of comparative analysis: it provides an additional view of data that is exceptionally easy to understand and communicate, and it may allow for developing and exploring new hypotheses of forming perceptions about the degree of disparities relevant for policy and management issues.

Time is one of the most important reference frameworks in a modern society. The time perspective, which no doubt exists in human perception when comparing different situations, is systematically introduced in comparative analysis both as a concept and as a quantifiable measure.

The novel conceptual and analytical approach can be broken down into two distinct but interrelated components. The first one is analytical and statistical – two novel statistical measures S-time-distance and S-time-step (expressed in standardised units – time) are 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 second component is normative and theoretical, related to subjective perceptions, policy and welfare issues. Time distance concept can influence the perception and decisions of people when they are assessing their relative position in the society and across countries over time.

S-Time-Distance and S-Time-Step as Two Generic Descriptive Statistical Measures

The first theoretical innovation proposes to study time series in the horizontal direction and that the conventional analysis of disparities should be complemented by the time distance concept and measure to ensure a more comprehensive vision for analysis and policy decisions in a dynamic context. In addition to static comparison there exists in principle a theoretically equally universal measure of difference (distance) in time when a given level of the variable is attained by the two compared time series.

S-time-distance is a special category of time distance defined for the level of the analysed variable. In graphical terms, the usual way to compare time-series is to look at the *vertical* dimension, *i.e.* for a given point in time. The time-distance approach provides an additional perspective, comparing time-series in the *horizontal* dimension, *i.e.* for a given level of the variable. *This innovation opens the possibility for combined simultaneous two-dimensional comparisons of time series data* in two specified dimensions: vertically (standard measures of static difference) as well as horizontally (S-time-distance), providing a new dimension of analysis to a variety of problems.

The first statistical measure *S-time-distance* measures the distance (proximity) in time between the points in time when the two compared series (i, j) reach a specified level of the variable X. The second statistical measure *S-time-step* measures the time elapsed between two levels of the variable. It measures the growth characteristics of a series, using the inverse relation to the conventional $\Delta X/\Delta t$ or growth rate metrics and representing a complementary description to the growth rate measure.

The time-distance approach has two obvious advantages: first, the two measures are expressed in time units, which make them easy to understand by policymakers, professionals, managers, media and the general public; second, they can be compared across variables, fields of concern, and units of comparison. Since time distance view provides an additional dimension of temporal disparity between two time series, results by other methods are left unchanged but new conclusions can be reached in the broader framework. S-time-distance values as well as percentage deviations could be processed further by various statistical methods.

The Concept of the 'Overall Degree of Disparity' as a Combination of Static and Time Distance Measures of Disparity

In addition to the use of S-time-distance as a descriptive statistical measure, the broader conceptual framework poses new interesting questions for growth and welfare theory, and the related policy issues. The perceptions of well-being and societal progress are subjective and the resulting decisions, behaviour and actions undertaken are influenced not only by available statistical data and indicators but also by the *measures that are used in the measurement, analysis, presentation and semantics of discussing these issues* as indispensable elements from which the perceptions are formed.

The second theoretical innovations is that the broader conceptual and analytical framework defines the concept of the '*overall degree of disparity*' as a combination of static and time distance measures of disparity. We should recognise that there are multiple aspects or views of disparity and that all of them matter. As the perceptions of well-being and progress are subjective it is thus even more important that we provide to decision makers as well as to general public the information and knowledge in various degrees of complexity with a clear understanding and interpretability so that they can effectively use them as inputs in building their perception and decisions. Time distance measure is one of such measures with clear interpretability that delivers a broader concept to look at situations of individuals, groups and communities and compare them. Again, for a better understanding of the reality one should take into account all these aspects simultaneously. The complex perception of the overall degree of disparity

cannot be based on a single measure, as also the empirical examples showed that the degree of disparities for the analysed economic and social indicators might be very different in static terms and in time.

Time Distance Transformation of Time Series and Descriptive Measures

The correspondence between conventional table format and possible additional complementary tables in the time distance approach was shown; discussing the descriptive characteristics of conventional time series tables and time distance tables. If we interchange in the time series database the roles of the level of the variable and time, a given level of the variable becomes a descriptor or identifier and time becomes a numeraire in which certain distances between the compared units and time series can be expressed and measured. The correspondence between the conventional time series table format and the additional complementary presentation format for the time distance approach can be done for several descriptive presentation formats

- for the indicator data,
- for comparison of dynamics and
- for comparison of levels by static indexes and by time distances.

Thus the original time series table can be transformed into a time matrix; the table of growth rates or indices of dynamics into a table of S-time-steps between the selected levels of the indicator; and the table of index values by years against a benchmark =100 into a table of S-time-distances between the compared units showing the time lead or time lag against the benchmarking unit for selected levels of the indicator.

Time Matrix as a Simple Visualisation Over Many Units and Over Time

Time matrix is the table-graph which provides (with some interpolation) a visual impression of both levels of the indicator and the number of steps of the indicator levels experienced over time. In the time matrix data are arranged by selected levels of indicators showing in which year these levels of the indicators were achieved by given country. The identifiers in level-time matrix are units and selected levels of indicator while the corresponding times are in the main body of the table. Calculating these times by interpolations may pose a small problem of the degree of accuracy compared to original data but it gains additional understanding about time dimension of disparities and a good summary overview.

This is an additional way of easily understandable presentation across many units and many years which enable numerous comparisons between countries

and over time. Such level-time matrix is understood by everybody and one can immediately observe several stories. The shaded fields in the time matrix indicate the range of values of life expectancy achieved by each country over the period shown and of how many steps over the levels of indicators a given country has achieved (which is an additional indication of the dynamics of the indicator in the country). This allows for an immediate comparison of the situation across countries and of the improvements that each country has achieved. The years in bold refer to the latest available observation available for each country to quickly observe whether there was a noticeable decrease in the observed period.

Chapter 9 '50 years of OECD countries' showed how the same data from the OECD Factbook 2010 can be arranged in time matrices to visualise 5 decades of development for 10 indicators over 34 countries. It is also an empirical example how from the time matrix two descriptive statistical measures: S-time-distance and S-time-step can be derived providing additional numerical information beyond the visualisation characteristic of the time matrix. The same methodology can be used also when analysing in more detail regions, sectors, socio-economic groups, etc. for a variety of indicators.

Statistical offices of international organisations (like OECD, Eurostat, UN, ITU, UNDP, UNICEF, WHO, etc.) as well as national statistical offices could also use the time matrix presentation to complement their usual time-series data tables covering many years and units. By itself (*i.e.* even without calculating the two statistical measures S-time-distance and S-time-step) such matrices can be used in publications, web pages and other software as a first-level visualisation tool to 'turn statistics into knowledge'. The time matrix is a very useful starting tool to select what issues and hypothesis could be best suited for analysis and for presentation through other visualisation tools such as OECD eXplorer, Google Public Data Explorer and Gapminder.

As illustrated in the OECD case for the share of elderly population with values covering both historical data and projections to 2050, the time matrix, spanning a period of 100 years, condenses such information in much smaller number of entries, which is a great advantage for presentation. It can convey in a very parsimonious way the same amount of information provided by time-series tabulation with 3400 entries, *i.e.* 34 countries across 100 years.

However, if one calculates time distances for scenarios and projection it is important to keep in mind the distinction between backward looking (ex post) and forward looking (ex ante) S-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 derived by other methods. The time distance approach described is not meant to be a forecasting

tool but provides a very useful means of presentation of complex data sets that have universal appeal and are intuitively understandable.

Additional Understanding and Insights from Existing Time Series Data

The present state-of-the-art does not realise that, in addition to static comparison, there exists in principle a theoretically equally universal measure of difference (distance) in time when a given level of the variable is attained by the two compared time series. Empirically, in benchmarking the disparity among compared units the degree of disparity may be very different in static terms and in time distance, which leads to new information, conclusions and semantics important for policy and business issues. S-time-distance thus produces new knowledge in comparative analysis.
The empirical analysis showed numerous examples of such diverse conclusions, in some cases the conclusion whether the degree of disparity is small or large depends very much on which of the two measures one uses.

1. The perception whether the gender difference in life expectancy is large or small depends on the measure used: static percentage difference was only 7 percent, while S-time-distance was 25 years for EU15; very similar is the situation for the OECD average.
2. When comparing across many countries and across indicators from very different domains a typology was suggested that indicators can be initially classified into three types in this respect: Type I (low static disparity and large time distances), Type III (large static disparities and small time distances), and Type II indicators in between. These types were confirmed in analysing world disparities for a very large number of countries.
3. In Chapter 5 in the example comparing over time different views of the gap between North America (NAM) and W. Europe/Scandinavia (WES) for Internet Users per capita the five measures analysed showed very different results describing the same situation: the level of the indicator was higher in NAM than in WES, the rate of growth was higher in WES than in NAM; absolute difference of the gap between NAM and WES was constant, relative difference was decreasing and time distance increasing.
4. Different conclusions about convergence based on static relative disparity and time distance were reached in comparing 4 European countries and the USA in the period of a significantly higher growth rate of GDP until 1973 and after that. Similar conclusions were reached in Chapter 12 analysing the relationship between static relative measure and S-time-distance comparing Slovenia and Yugoslavia in the period of high growth rate before 1964 and in the period 1964–1989.

5. If one uses in analysing regional disparity in two countries in Chapter 6 the static measure of disparity alone it indicates the conclusion that the degree of regional disparity for GDP per capita is larger in China than in the USA. On the other hand, if one uses the time distance measure of disparity alone then the regional disparity is much larger in the USA than in China.
6. It is shown in Chapter 15 that in complementing conventional static measures for analysing digital divide time distances provide sometimes strikingly different conclusions. ICT indicators showed very high growth rates, high degree of disparity in static relative terms and small time distances. There was also the striking difference in the world median S-time-distance behind the benchmark Sweden of 74 years for GDP per capita and about 8 years for fixed broadband Internet subscribers per 100 inhabitants.

Thus even at the descriptive level the time distance dimension showed in many cases very different results and provided a new view of the situation. The theoretical hypothesis that the two measures may show a different degree of disparity has been confirmed in many situations above and many more can be mentioned.

Goodness-of-Fit: S-Time-Distance Adds a Second Dimension to Evaluation of Goodness-of-Fit in Regressions, Models and Forecasting

The above examples showed benchmarking applications comparing two or more units in the two dimensions. A further direction of the generalisation of the time distance approach in Chapter 4 includes the extension and application to the measurement of discrepancy between the estimated and actual values in time series regressions and models, forecasting and monitoring. The change from the earlier case is the choice of what we wish to describe, analyse and compare: here the comparison is between two different states (positions) of the same unit for the analysed indicator, *i.e.* between the actual value and the estimated (forecast, budgeted, planned, targeted, etc.) value. In general it means that whatever the estimation method for regressions, model simulation or neural network, the results can be (in time series applications) presented as two time series of actual and of estimated values on which then the calculations of S-time-distance are based.
For estimating procedures in regressions, models and forecasting the two-dimensional analysis of deviations of estimated values from the corresponding actual values can be showing all four theoretically possible combinations of deviation in timing and static deviations: estimates are too high and too early, too high and too late, too low and too early, and too low and too late.

Beside S-time-distances between estimated and actual values for individual points in the time series, by analogy with the conventional standard error of the estimate (SEE) 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). The time dimension can lead to new procedures for testing goodness-of-fit; *e.g.* an alternative criterion could be to minimise the sum of squared time deviations of time distances, or to use a combination of the two approaches. The principle and the procedures for operational use are clear but the software has to be developed by users or it may be done in future centrally. The much simpler version of the method for two-dimensional estimation and evaluation of deviations for implementation of various targets is discussed below under monitoring.

S-Time-Step as an Additional Measure of the Dynamics and Other Application of Time Distance Analysis to Single Time Series

S-time-step as one measure of dynamics of the time series measures the time that was needed in the past for the step from one level to the next selected level of the variable (*e.g.* in the time matrix). In the OECD example S-time-step showed how many years were needed to reach the next level of life expectancy; for the OECD average 4.2 years were needed on the average over the analysed period to increase the life expectancy by one year. This approximate measure of dynamics is at least as easy if not easier to understand than to say that the average rate of growth of life expectancy was about 0.3 percent per year or that the coefficient of dynamics per year was 1.003. The S-time-step measure can be applied to many time series.

In benchmarking one possible weaknesses of the time distance method may be, that for a given level of the variable, the two time-series considered may not both reach the selected level of the variable, or they may intersect the selected level more than once in case of time-series that change directions: in these situations, one has to decide which intersection to consider (the first, the last, etc). A subset of such cases is the use of time distance comparison to assess the severity of the fall in a crisis (*e.g.* Eurostat forecast for 2012 shows that the share of gross fixed investment in GDP would fall back to the level of 1997 for EU27 and to the level of 1995 for the USA; thus falling back to the levels 15 and 17 years ago, respectively).

In business cycle analysis and more generally in analysing stationary series with considerable fluctuations, for the same chosen level of the indicator there could be multiple crossings with the time series and the analysis of time distance for the selected level of the indicator becomes more complex. Such S-time-distance applications relate to the analysing variable for a single time series that can be a useful device to study also some characteristics of time series with considerable fluctuations.

Further Development of the Method

The generic nature of the time distance approach to study time series in the horizontal direction can be further developed and applied beyond simple use for benchmarking and monitoring done in this book.
It can be further developed as analytical and presentation tool to more complex cases in a wide variety of substantive fields at macro and micro levels. Extensions to measuring deviations between estimated and actual values in regressions and models, forecasting, error in timing and causality, monitoring, and business cycle analysis are indicated; also the extension to variables other than time is mentioned in Chapter 3. There is also a potential for extension of decision making models with S-time-distance. It may be hopefully possible to motivate researchers in other fields beyond social sciences to test, apply, and further develop time distance methodology applications as well as to develop software which can facilitate its use. On the scientific side, the fact that the Nobel Prize winner C. Granger extended the S-time-distance measure to econometric forecasting is an evidence of the *generic capability of the idea*.

Monitoring: S-Time-Distance Adds a Second Dimension to Comparing Actual Values with Estimated Values, Forecast, Budget, Plan, Target etc.

The application to monitoring is simple, operational and broadly applicable to policy and management issues, from macro to individual levels. Monitoring and evaluation of the degree of implementation of policy or business targets are very important as a feedback to continuous decision making and improvements. Continuous monitoring and communication of the situation at the world, regional, national, sub-national levels or business levels is needed.
The time distance information seems to be at least as helpful in providing a proper perception of the progress in implementation or the lack of it as is the percentage difference. The story-telling and the interpretation of the deviation of actual development from the line to target with S-time-distance measure is straightforward and intuitively understandable; for each unit it deals with lead or lag of actual development against the line to their own target for the selected indicator. It is like tracking the actual arrivals in comparison with the train or bus timetable, the difference being that the concept of geographical space is in our application replaced with the indicator space.
The additional advantage of this approach is that the results and conclusions based on the two-dimensional analysis add new information while none of earlier results are lost or replaced. This holds also for applications in business. The illustration in Chapter 4 compares sales targets with actual implementation. The use of the

additional measure of deviation of the actual implementation from the plan, budget, target or forecasts at a project or activity level is straightforward. There are alternative ways of expressing these matters, but it is obvious that the interpretation for 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.

The Two-Dimensional Notion of the Overall Degree of Disparity – New Insight from Existing Data

A major innovation needed in comparative analysis is an application of a *simple dynamic descriptive framework that would offer a better integration of comparisons across time and space*. In a rapidly changing world existing measures relying mainly on the difference between the compared units at a given point in time, though important and indispensable, are simply not enough to show the complexity of the situation in a dynamic context. Such a situation requires not only new measures to describe, monitor and analyse various aspects of the change, one needs to start from a broader idea of how to look at and think about various relevant aspects of comparing different situations.

Beyond the better description of the situation discussed above the second theoretical innovations is that the broader conceptual and analytical framework defines the concept of the '*overall degree of disparity*' as a combination of static and time distance measures of disparity. People understand time and feel time. Thus perceiving and measuring differences in the two dimensions (proximity in indicator space and proximity in time) broadens the horizon of accepted wisdom. If people take into account also time distance as one element of their subjective evaluation of the (overall) degree of disparity, a new set of hypotheses with important economic, social and political consequences follows; some new hypothesis about the interrelationship between efficiency, growth and disparity can be formulated.

This is a question of the perception of disparities and the welfare and political consequences which arise from using an analytical framework which is closer to the dynamic reality and the way in which people perceive disparities and react to them.

A very important policy conclusion arising from this broader conceptual and analytical framework for the analysis of the degree of cohesion and convergence is that the degree of disparity and thus cohesion will depend *also on how fast, and not only how much faster than e.g. the average*, will the compared units grow in the future. In the conventional theory the trade-off between growth and inequality is emphasised. In this framework 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. 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; inefficiency has important negative economic and political consequences as far as disparities are concerned. The present crisis in many countries might increase differences between socio-economic groups and regions in static terms but it has no doubt increased the time distances between these groups because of lower growth rates and expectations about the future. Thus the time distance dimension of the overall degree of disparity provides an important component of understanding of the current economic and social circumstances. *Lower growth rates should signal to politicians that an increase in the degree of disparity may be felt and that social tension may be increasing and cohesion decreasing*.

Broader Semantics

Time distance and time step measures bring new semantics to policy debate and management decisions. Since S-time-distance and S-time-step are expressed in time units everyone can understand the concept and use these descriptive measures in official and everyday life. The concept of the time dimension of disparity is by no means an unfamiliar notion in everyday business and political discussions or in sports.
Using these expressions in social, business and technical contexts time distance approach can be very useful as an excellent presentation and communication tool for describing the situations, challenges and scenarios, for proactive discussion and presentation of policy and business alternatives to decision makers, media, civil society, the general public and mobilizing those participating in or being affected by the programs. It is a question how people perceive disparities and react to them. This framework also offers improved semantics for analysis and policy debate.
If one does not use explicitly the broader framework outlined here, with both static and time distance dimensions, there is a possibility that in political debate and policy formulation *various interest groups would intentionally look only at the measure which will suit their particular interest*. Obviously, for a better understanding of the reality one should take into account all these aspects simultaneously. In the book we have shown numerous examples how the additional semantics can improve broader perception of the situation: description, multidimensional comparison and evaluation, presentation, visualisation and semantics for policy and management.

EMPIRICAL APPLICATIONS

Socio-Economic Development: An Overview of Time Distance Disparities in the World

Comparing across many indicators and fields of concern is the essence of quantitative work in forming perceptions assessing the overall "position" and "progress". It has been shown that comparing across indicators S-time-distance in many cases produces different and sometimes very surprising new qualitative conclusions.
Disparities in average living standards across countries in the world are typically described through static measures of absolute or relative disparities, such as the Gini coefficient or the Theil index. A complementary perspective on world inequalities across many countries, fields of concern, and units of comparison can be gained through the time distance method. Chapter 8 provided an overview of time-distance comparison for GDP per capita, life expectancy at birth, and penetration of mobile phones for between 160 and 200 countries. Sweden was chosen as benchmark because of the availability of long time-series for this country in a wide range of fields.
GDP per capita describes the story for 2008 through the time distance lens: *One half of the countries (80 countries) were lagging Sweden by more than 74 years (26 countries even for more than 150 years)*. A conventional statistic measure of world disparity Gini coefficient would be around 0.53. Both are valid, yet the time distance picture tells a more understandable perspective of the situation.
Time matrix for infant mortality shows the situation for the period 1961–2005 against the history of benchmark Sweden from 1792 and was in more detail presented in Chapter 18. Very substantial progress has been achieved. For example, the group of least developed countries (LDC) decreased the infant mortality from 170 in 1961 to 100 in 2002, a decrease of 70 in 41 years.
Also when comparing across different indicators from different fields of concern time distance view presents again sometimes very surprising new qualitative conclusions. Median value of S-time-distance was between 74 years for GDP per capita and 56 years for life expectancy, while for mobile telephones penetration rate it is only 7.5 years (this is about ten times less than for GDP per capita). Static indices could not lead to such important conclusion; they show a very different picture. Indices for the aggregate of Developing countries (Sweden=100) for 2008 amounted to 83 for life expectancy, 95 for infant survival rate, 45 for mobile phones, 20 for Internet users and 11 for fixed broadband. Also, the ranking by the degree of development gaps for 6 indicators is significantly different by S-time-distance and by static index. Thus conventional static measures are not able to convey the message that the speed of diffusion of ICT sector indicates its much

greater potential for catching up and becoming an important instrument to reduce world disparities.
The analysis of Human Development Index (HDI) between world regions, levels of human development and China was an example of dynamic analysis of a composite indicator with again very different perception of the disparities in HDI in the two dimensions. Both absolute and relative static disparities in HDI appeared small while time distances in HDI gave an impression of large degree of disparity and difficulty in decreasing the degree of disparity in HDI. This also raises the question how to treat and interpret intertemporal changes in composite indicators? Using only one group of measures might lead to biased conclusions.

50 Years of OECD Countries at a Glance

Chapter 9 was used to demonstrate the capability of the time matrices to provide a simple visualisation of the situation in 34 OECD countries over several decades. There is a wealth of information and of possible comparisons in these tables, which cannot be covered in a single chapter. Using 10 selected indicators it shows the methodological point that time matrices are means of presentation of complex data sets that have universal appeal, are intuitively understandable and can be usefully applied to a wide variety of substantive fields.
For the majority of the selected indicators it is obvious at a glance that the differences between OECD countries are large (for some indicators values for the best countries are 4 to 5 times higher than for the lowest countries). All OECD countries have enjoyed important progress in domains like life expectancy and GDP per capita, less in road fatalities and tertiary attainment. For some structural indicators (like total employment rate, gross domestic expenditures in R&D, current account balance) there was very little change for OECD average, but there were substantial changes within countries.

Central and South Eastern Europe

This group of EU countries includes about 246 millions people, *i.e.* about one half of the EU27 population. It is of interest to see that this the group still shows substantial disparities among these countries though smaller than among the larger number of countries in the OECD and especially among the up to 200 countries in the world studied in Chapter 8. One of interesting indicators is the share of elderly population in total population from the OECD Factbook projections. Compared with other groups the aging of EU27 is broadly foreseen as being 12 years ahead of the OECD total and about 47 years ahead of the world average.

The highest S-time-distances among these EU10 countries are for GDP per capita. The values of the time lag behind Austria in 2010 are less than 20 years for Germany (9 years) and Italy (16 years), between 20 and 30 years for Slovenia (21 years) and Czech Republic (23 years), up to Bulgaria (45 years) and Romania (50 years) showing the largest delays. Time distance socio-economic profiles of countries for four indicators against benchmark Austria are examined. It is obvious that policies have to be adjusted and differentiated to wide differences in the circumstances.

Time Distance View of Regional Disparities in Austria

Chapter 11 is the first of two chapters dealing with regional disparities. The largest regional disparities in Austria from the selected 10 indicators were those for GDP per capita. The largest gap was between Vienna and Burgenland, the former was 18 years ahead and the latter 20 years behind the Austrian average; time distances for other regions from the average were not large. Disparities in labour productivity were less, between 13 years of time lead for Vienna and 14 years of time lag for Burgenland.
One important factor was the structure of employment, *i.e.* the share of selected sectors in total employment. The special role of Vienna in the process of modernisation together with the advantage in education and qualifications of the labour force put Vienna well ahead. For the sectoral structure of employment Vienna was so much ahead of the respective average values that the time lead of Vienna in the share of Knowledge sector was outstanding; the shares of the Tertiary 1 and public administration sectors were also at least 13 years ahead of the average Austrian levels. Time distance approach has underlined these differences in a dynamic framework within the background of the general trend of modernisation.

Efficiency and Regional Development Distances: Lessons from the Former Yugoslavia

The example of analysing regional disparities in the two dimensions in the former Yugoslavia is an example with much larger disparities than in Austria and with very great changes over time. This is an extraordinary example of decreasing efficiency leading to lower growth rates and stagnation and consequently increasing the time distances between regions and thus increasing the overall degree of regional disparities with important economic, social and political consequences.
The period of high growth of product and employment [1953–1964] was followed by a period of lower growth and fall of efficiency [1965–1979], and a period of

stagnation [1980–1989]. The rates of growth within a given sub-period were very similar for all republics. Thus the greatest change in their relative position was not coming from the change in their static relative position, but rather from the changes in the overall performance of the whole country which then showed in the deterioration of their relative dynamic position as measured by time distance. The trend of large increases in the time distance for GMP per capita between Slovenia and Yugoslavia, which increased from 7 years in 1960 to 21 years in 1989, has been very similar comparing more developed regions (MDR) and less developed regions (LDR). Here the increase in the time distance was even greater, from 7 years in 1959 to 25 years in 1989.

The conclusion of increased overall regional distances and especially of increased time distances among regions fits much better into the explanation of growing disintegrating forces in economic and social fields which have in addition to the dominant political factors contributed to the disintegration of the former Yugoslavia. Static relative measures which do not take into account changes in the overall rates of growth are incapable of explaining such perceptions and providing the right policy conclusions.

Transition Economies in Historical Perspective

The depths of the transition depression, of the Great Depression and that after WW II in the developed countries are compared with several measures. A given time series of GDP is compared with its own movements in the past and one possible way of presenting the degree of decline from earlier values is to calculate the observed distance in time (number of years, months, etc.) between the present time and the time when this level of the indicator was already achieved earlier. This specific S-time-distance application compares the time path of real GDP for each country with its own past development (and not with another country as it was done in the some earlier benchmarking applications).

We cover in the analysis 11 countries for the period of observation 1989–2008 so that all countries analysed already recovered to its pre-depression levels. Historical experience in depression and recovery in developed countries and in post socialist transition countries was analysed in several ways; the fall in index from the peak and S-time-distance measure of the fall to earlier trends for every year, and by the total time elapsed to return to the level in benchmark year. There are many interesting details in following those developments like visual comparison between the USA in the Great Depression and Hungary after 1989 and WW II experience in Germany with the transition period in Russia.

The ambition of this chapter is to present some statistical findings, to initiate questions and provoke deliberations rather than to provide competent answers to

this historical task. The total time elapsed from the starting benchmark levels to the return to these levels was in the transition depression in most cases longer than for the developed countries in the Great Depression and after the WW II. For three countries (Poland, Slovenia, and Slovakia) the total elapsed time was less than in the USA, for Czech Republic and Hungary slightly more than that. The fall in the other 6 transition economies was much more similar to the severity of the fall in the depression of Germany and Japan after WW II. This was for Germany and Japan after WW II about 10 years; for the 6 transition economies between 13 and 18 years. The performance in transition was also below expectations. The lack of social consensus needed to carry out specific reforms might have been one of the greatest obstacles for successful recovery of these countries and for their integration into global economic processes.

ICT and Digital Divide Measured by Time Distance

The analysis of ICT indicators in general exhibited the characteristics of Type III indicators with very high growth rates, high degree of disparity in static relative terms and small time distances. The examples of visual presentation of the dynamic framework deal first with the analysis of digital divide. On the digital divide on the world level the time distance analysis was used in the International Telecommunication Union study 'Measuring the Information Society 2010'. In Chapter 15 the visualisation of the digital divide for around 190 countries shows that the time distance lag for the aggregate of Developing Countries behind benchmark Sweden was for three ICT indicators between 8 to 12 years, which is sharp contrast with the time lag for life expectancy and infant survival rate. For development strategy it is not enough to analyse digital divide across various aspects by itself; it has to be also analysed together with other development attributes.

Despite large static disparities the trends of mobile phones showed great progress and mobile phones have improved significantly the quality of life in developing countries in several domains though they were used mostly for undemanding applications. It is obvious that the technological progress and cost-cutting makes it much easier to shorten time dimension of digital divide than in some more difficult areas of development. The findings that Internet users were among the best performers of MDG indicators are discussed below in conclusions on monitoring. The potential of technological progress can with additional help of the world community create the opportunity for the ICT sector to become an important tool of development and in the catching-up process to diminish world disparities.

The digital divide was analysed also for the region of South Eastern Europe, followed by the visualisation of 20 e-Government services in EU27 and of an

example of comparisons for socio-economic groups: gender, age, income and education to indicate the additional stories that can lead to new conclusions and semantics by applying the time distance approach.
The overall perception of disparity is different if we include also the time distance dimension; the time delay for fixed broadband for Serbia behind Slovenia is 4.9 years, which gives a very different impression than the 400% of static index dividing the penetration levels of Slovenia with that of Serbia in 2009. S-time-distance dimension can be also an important motivational factor for the SEE countries to continue to speed up the ICT applications.
In the EU27 the e-government availability has within this decade increased the levels of availability very fast in all countries. Yet the time matrices show at a glance that the usage by individuals and the number of steps passed have been much less, *e.g.* for EU15 has gone only through 2 steps. The usage by enterprises is considerably higher. Chapter 14 adds methodology example to present sectoral time distances in adoption of e-commerce activities, online buying and online selling.
These examples show how one can develop further in much more detail the time distance methodology for study of digital divide by individual indicators, sectors, regions, socio-economic groups, etc. The high rate of technical progress and diffusion of ICT technology and services makes this sector especially attractive for application of the time distance aspect of analysis, monitoring and decision making.

Monitoring Implementation of UN Millennium Development Goals, Lisbon Strategy and Sustainable Development Targets in the EU and the Free Time Distance Monitoring Tool

S-time-distance is complementing rather than replacing existing statistical measures for monitoring implementation of targets (or plans, budgets, forecasts) and can be used as one of the measures of the implementation across a number of relevant indicators by many users at many levels. Chapters 16, 17, 18 and the Annex are in addition to the methodological discussion in Chapter 4 dealing with this very interesting and practical application of the time distance methodology.
The time distance view shows that MDG implementation for selected indicators is far from satisfactory for the aggregate of developing regions. Only for two indicators the implementation of the MDGs targets was ahead of the line to target; for the other eight indicators the delays behind the lines to the respective MDGs targets vary between 4.6 years for Official Development Aid (ODA) and 12.9 years for maternity mortality rate. Notwithstanding the above conclusions a clear distinction must be made between the progress made in the world in the analysed period and the considerable delays in the implementation of the

MDGs. It was discussed that the percentage rule for determining the MDGs target understates the progress made in Africa and puts a much more demanding target in terms of feasibility to regions and countries with more difficult starting positions.

It was also shown in Chapter 15 that the indicator Internet users is among the best performers of MDG indicators. The widely predominant share of population (88% of world population) is ahead of the line to target 25% penetration rate in 2015; about 26% already reached the 2015 target in 2008. These results are in sharp contrast with time delays for the child mortality rate or with the Official Development Aid from the same MDG Goal 8 domain. These examples can show the potential of the time distance monitoring method for ICT indicators in the framework of MDG and World Summit on the Information Society (WSIS) targets in policy and operational applications.

The WSIS targets relate to very heterogeneous units, from inhabitants, villages, various centers, to local and central governments, etc. S-time-distance can help us to form a new perception of the magnitude of the gap between the implementation and proclaimed targets for a given indicator as well as across more indicators. Thus it is an operationally transparent measure for the evaluation of the degree of the implementation of the ongoing situation that would give a clear political message both to policy makers at the international, national and local levels as well as to the general public that can help to bring about continuous adjustments in policy and actions.

In Chapter 17 the same methodology was applied to the EU targets for Lisbon 1 strategy and for EU15 across 6 themes of sustainable development. The implementation of both sets of targets has in general been very disappointing. Seemingly the Commission did not use signals from the monitoring process to improve coordination and efficiency. Time distance deviations from the line to the 2010 targets showed already in 2004 significant delays; by 2008 these time delays further increased, while the current financial crisis increased them dramatically.

The additional time distance supervision can be a standard procedure also in numerous other activities of the Commission and of the national and local levels like monitoring and evaluation of implementation of structural funds policy and of development plans, as well as for the relevant budgets. Similarly, it should be reasonably easy to incorporate the S-time-distance methodology for monitoring implementation of the MDGs in the work of the UN, the World Bank and other agencies on these issues. This methodology can be used as a standard complementary procedure in numerous other activities of the UN and other international agencies as well as at the national and local levels, like monitoring and evaluation of implementation of development plans, policy targets and operational projects as well as for monitoring budgets.

To facilitate the understanding and use of this method SICENTER has developed a FREE WEB TOOL to monitor implementation of targets with the S-time-distance measure.

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Time Distance in Economics and Statistics elaborates time distance as an innovative concept of looking at time series data to provide new additional understanding and insights from existing data. The time distance approach compares time series in the horizontal dimension, *i.e.* for a given level of the variable. In the field of statistical measures it provides two generic statistical measures S-time-distance and S-time-step with interesting potential for further developments. Expressed in time units they are intuitively understandable and as such could serve as excellent analytical, presentation and communication tools complementing existing methods.

In the empirical part of this book we apply the time distance approach toward the more narrow range of examples of indicators for international comparisons across world regions, selected countries, regions within countries, socio-economic groups, economic, social and ICT indicators, etc. In this domain S-time-distance and S-time-step play a role of a generic concept like static measures of disparity or growth rate. The time matrix format is a very useful tool to summarise information over many units and years and to provide a first-level visualisation tool. The concentration is on benchmarking and monitoring, further potential developments are discussed in the theoretical chapters. In general it can be usefully applied to benchmarking, target setting and monitoring of progress for a large number of indicators in many areas of concern, either for long-term, medium-term or short-term analysis.

Beyond the statistical field in the narrow sense time distance framework may allow for developing and exploring new hypotheses of forming perceptions about the degree of disparities relevant for policy and management issues. The concept of the overall degree of disparity (proximity) is defined that is based on a simultaneous perception of proximity in indicator space and proximity in time. The time distance concept can influence the perception and decisions of people when they are assessing their relative position in their surroundings, in the society and across countries over time. Seeing with new eyes the broader conceptual framework can bring new understanding in economics, management, research and statistics, asking new questions, formulating new hypotheses, establishing new semantics and reaching new conclusions. In the information age this additional view of the existing databases should be evaluated as an important contribution to the more efficient utilisation of the available information in many fields.