FORESIGHT AND TIME DISTANCE METHODOLOGY A NEW PERSPECTIVE RELATED TO TIME

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I. THE NEW GENERIC TIME DISTANCE METHOD

The art of handling different views of data is crucial for discovering the relevant patterns and for providing a broader framework for policy analysis. The new generic time distance approach (with associated novel statistical measure S-distance) offers a new view of data that is exceptionally easy to understand and communicate, and it allows for developing and exploring new hypotheses and perspectives. Within the structure of the FTA workshop the new approach is related foremost to session 6 (imported ideas that could be adopted from other fields). It can also make important contribution to exploiting information resources in new ways and to visualisation of findings, and it is well placed to be used jointly with other methods.

The new view of 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 at macro and micro levels.

This innovation opens the possibility for simultaneous two-dimensional comparisons of time series data in two specified dimensions: vertically (standard measures of static difference) as well as horizontally (Sicherl time distance), providing a new dimension of analysis to a variety of problems.

II. RELEVANCE FOR THE SEMINAR AND FOR THE SESSION

1. Possible benefits for FTA from importing time distance method

- A novel generic statistical measure S-distance with clear interpretability
- A presentation and communication tool to influence policy making and public opinion
- Exploiting information resources and visualisation of findings in new ways
- A new specific time dimension view of data providing additional insights from existing time related databases for gap analysis, goodness-of-fit, scenarios and monitoring
- A broader concept to compare situations for policy analysis and debate in two dimensions allowing for developing and exploring new hypotheses and perspectives
- It is a new complementary view of the information adding additional dimension(s) to analysis and policy debate when used jointly with other methods

2. The European value added component

The European value added component of time distance methodology is not restricted to its generic characteristics for statistics and econometrics. It is related also to the mainstream of the European development model in the Lisbon Strategy. The nexus between growth and inequality is in the European development paradigm again at the forefront of economic and social policy considerations.

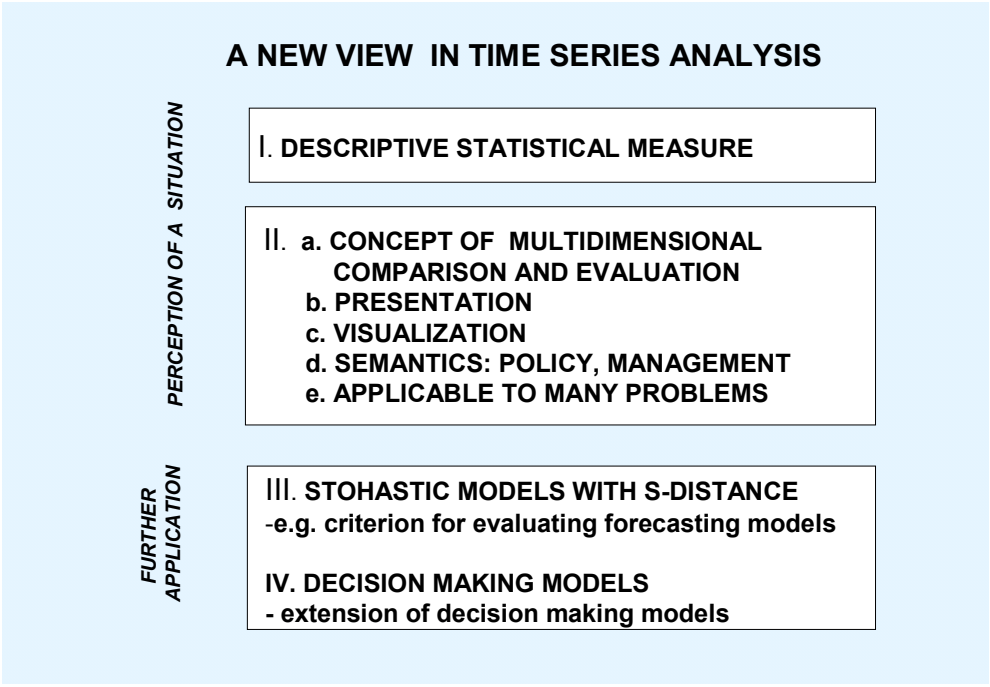
This approach can help that the conceptual and the statistical framework for dealing with the problems of interrelationships between growth, efficiency, inequality, social exclusion, convergence and benchmarking can reach beyond the conventional predominately static approach and thus provide a broader dynamic framework for policy analysis and debate.

3. A broad range of possible applications

S-distance represents an additional view, relevant to many problems and applications in economics, management, research and statistics, asking new questions, formulating new hypotheses, establishing new semantics and reaching new conclusions.

Expressed in time units, time distance is comparable across variables, fields of concern, and units of comparison, and as such easily understood by policy makers, managers, media and general public, influencing how experts and the general public form their perception about a given situation, and thus public opinion. Combined with other methods, earlier results are left unchanged, but new conclusions may be reached due to an added dimension of analysis.

4. Elements of the new perspective in time series analysis



III. METHODOLOGICAL APPROACH

- A special family of time distance measures (S-distance) is a new generic measure extracting additional information in time series analysis left unexplored by the present state-of-the-art
- In graphical terms, the usual way is to compare the time series in the vertical dimension, i.e. for a given point in time.
- This novel generic level defined time distance approach uses an additional perspective; it compares the respective time series in the horizontal dimension, i.e. for a given level of the variable (see e.g. Sicherl, 1973, 2004a, 2004b).
- It transforms the time series database by using levels of the variable as identifiers and time as the focus of comparison and numeraire.

To summarise, time series for two units (i) and (j) as implicit functions are

$$F_i (X, t) = 0 \text{ and } F_j (X, t) = 0 \qquad (1)$$

The present state-of-the-art solves these functions by one of the arguments

$$X = X_i (t) \text{ and } X = X_j (t) \qquad (2)$$

However, additional theoretically universal and practically relevant measures can be obtained by solving them using the inverse relations

$$t = t_i (X) \text{ and } t = t_j (X) \qquad (3)$$

Time matrix from the inverse relations: time when a specified level of the variable was achieved in each compared unit

Level	**Time $t_i (X_L)$**	**Time $t_j (X_L)$**
X_{L1}		$t_j (X_{L1})$
X_{L2}	$t_i (X_{L2})$	$t_j (X_{L2})$
X_{L3}	$t_i (X_{L3})$	$t_j (X_{L3})$
…	…	…
X_{Ln}	$t_i (X_{Ln})$	

The resulting time matrix provides new information from which new generic measures can be derived. Two operators applied to this time matrix lead to the derivation of two novel statistical measures, expressed in standardized units of time.

The first suggested statistical measure **S-distance** measures the distance (proximity) in time between the points in time when the two compared series reach a specified level of

the variable X. It compares two series by subtracting horizontally the respective times for a given level X_L in the time matrix[1]:

$$S_{ij}(X_L) = \Delta t(X_L) = t_i(X_L) - t_j(X_L) \qquad (4)$$

Subtracting the respective times in the time matrix for consecutive levels of the variable for each column vertically derives the second suggested measure **S-step:**

$$S_i(\Delta X_L) = (t_{XL+\Delta X} - t_{XL}) / \Delta X \qquad (5)$$

The concept of S-step measures the growth characteristics of a series, using the inverse relation to the conventional $\Delta X/\Delta t$ or growth rate metrics. In this paper we shall not deal further with the S-step measure.

IV. RESULTS

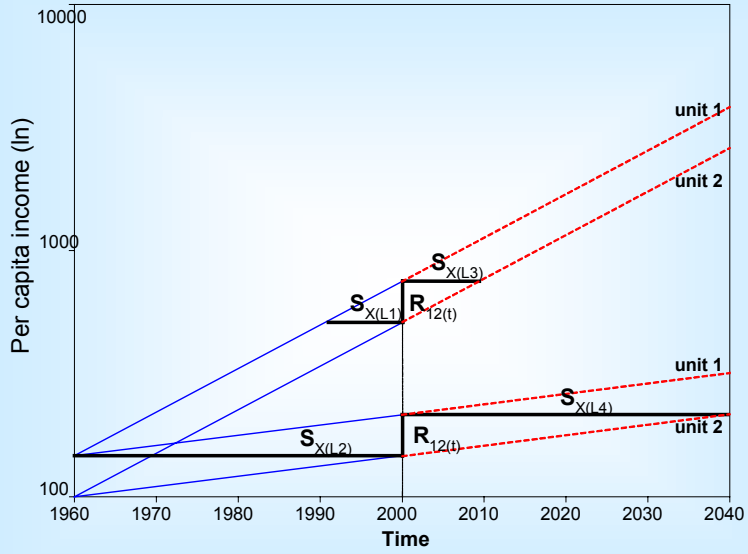
- As events are dated in time, the notion of this special category of time distance is a rather natural perspective in time series analysis such as comparisons, gap analysis, regressions, models, forecasting, scenarios and monitoring
- Statistically, from available time related database one can get two new statistical measures (variables) with clear interpretability: level defined Sicherl time distance (S-distance) and change in level defined Sicherl time step (S-step). Both of these variables can be further analysed and processed with standard statistical, mathematical and visualisation tolls (e.g. means, trends, confidence limits, interrelations with other variables, etc.).
- Empirically, degree of disparities may be very different in static terms and in time distance, which provides new insights from existing data. The present state-of-the-art neglects this additional information that has been always available in time series databases as "a hidden dimension" and thus leads to an information loss that has no justification.
- Theoretically, 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 in comparative analysis. This leads to a notion of the two-dimensional analysis of disparities: disparity (proximity) in the indicator space and disparity (proximity) in time.
- In practical applications there is an important 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. S-distance as a new view of data and a novel data reduction method gives us the information about the magnitude of lead (lag) in time between the two compared

[1] For details see Sicherl (2002), also on possible multiple time intersections. In general, while the levels or static differences can be written as a function of time, time intersections and S-distance(s) for a given level of the variable have to be expressed as relations.

units for a given level of the indicator, for the past it is a statistical fact reflecting one of the possible perspectives on the magnitude development gap.

- Policy wise, the novel S-distance dynamic framework shows important new interrelationship between growth and inequality in general, and also for discussion of implementation of the Lisbon strategy in particular. The graph below presents a simple, but not simplistic case of comparing two countries or regions or social groups for a given indicator, assuming two scenarios: scenario A assumes growth rate of 4%, and scenario B growth rate of 1%, for simplicity reasons both units are growing at the same rate of growth, respectively. In the two compared units, the value of the indicator for region 1 is 50% higher than that of region 2 in both scenarios. If one uses for the evaluation of the magnitude of the gap between the two regions the conventional statistical measures like ratio, percentage, Gini coefficient, Theil index, they show the same values for scenario A and scenario B over time. While the present state-of-the-art distinguishes the two situations by the different growth rates, it does not recognize that the difference in the growth rates results also in an important effect on the overall degree of disparity via S-distance.
- Now let us take a broader view of the situation. The concept of S-distance as one of the dimensions of disparity leads to a different conclusion about the degree of disparity in the two scenarios. If people would be asked to compare two scenarios, one with 50% static disparity and 10 years of time distance, and the other with 50% static disparity and 40 years of time distance, it is highly unlikely that people would perceive such situations as equal degrees of disparity, as it is concluded by the above mentioned relative static measures of disparity[2].

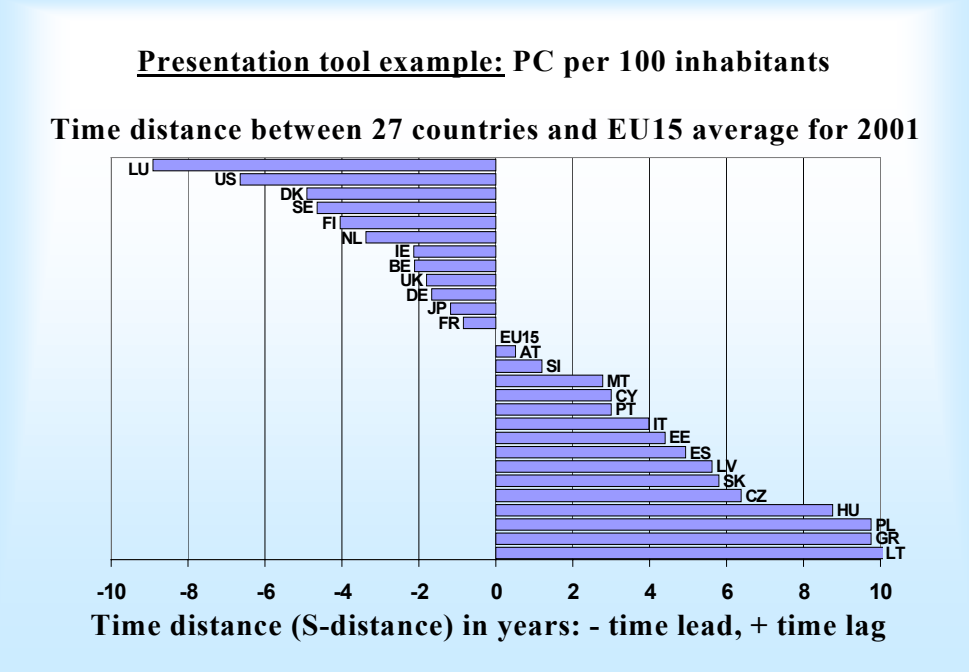
Concept of overall degree of disparity: simultaneously perceiving and measuring differences in two dimensions (in value and in time)

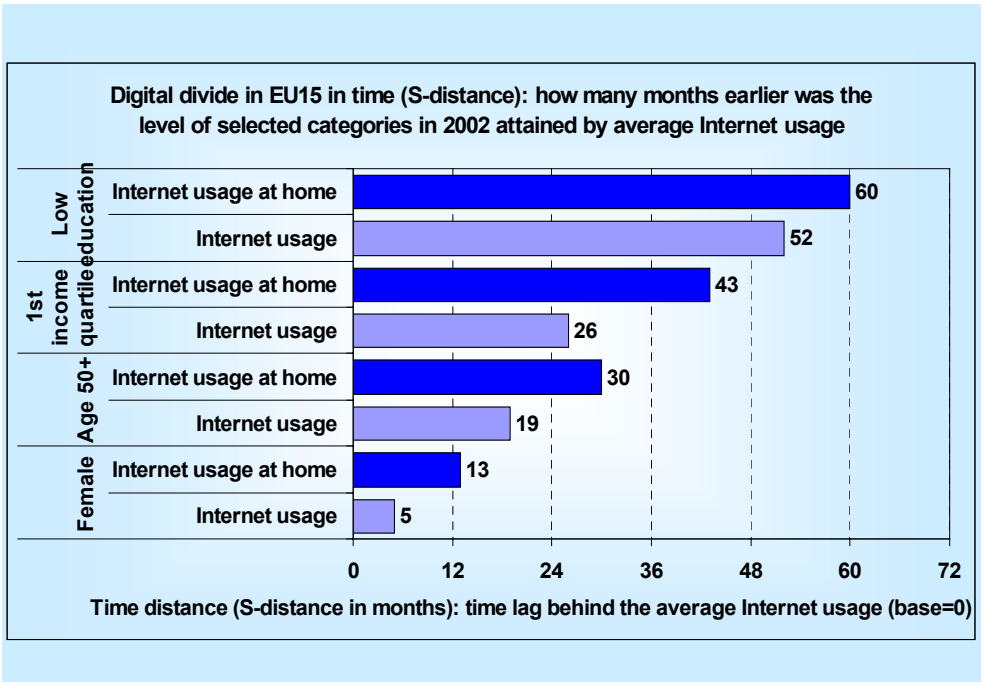


Static relative disparity and time distance:
higher (4%) growth example R=1.5, S=10 years;
lower (1%) growth example R=1.5, S=40 years.

[2] Testing such a hypothesis is not easy since we do not know what relative weight people assign to the static disparity and time distance in their perception of the overall degree of disparity. But in view of the positive time preference it is unlikely that a zero weight would be given to the time distance dimension. Conventional welfare theory would need to explain why it would not be possible to incorporate such broader way of thinking and semantics into the present state-of-the-art.

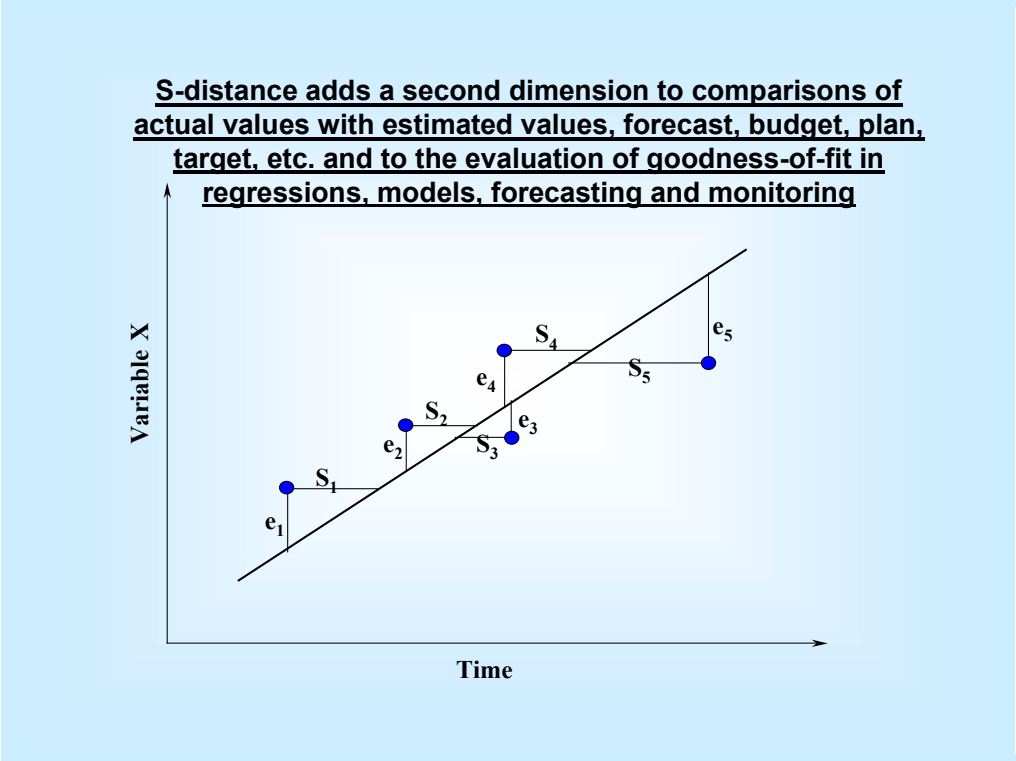
- If people take into account also S-distance as one element of their subjective evaluation of the (overall) degree of disparity, a new set of hypotheses with important economic, social and political consequences follows. In a dynamic world it is hardly satisfactory to rely only on static measures of 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 S-distance plays in the analysis of disparities an important role, quite distinct from that of static measures. This is not a question of a greater precision in empirical analysis; it is first and foremost a question of the more complex perception of disparities and the policy consequences, which arise from using a broader dynamic analytical framework.
- One of them is the relationship between efficiency, growth and overall degree of disparity. Factors that influence the magnitude of overall and sector growth rates also influence the overall degree of disparity via S-distance, if at the same time appropriate distributional policies are being followed in the general strategic orientation for growth and equity. 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. 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 (Sicherl, 1992).
- Due to lack of space, there are only two graphs of schematic examples of presentation of some empirical results of S-distance analysis.





P. Sicherl in SIBIS (2003)

- The generic idea for a number of additional applications of S-distance



V. LESSONS LEARNED

- The theoretical proposition is that the degree of disparities may be very different in static terms and in time
- This has been confirmed in many practical applications (economic, social and information society indicators between countries, regions, and socioeconomic groups)
- The new measures offer new insights, broader outlook and semantics as well as new presentation tools
- This leads to different perceptions, assessment and policy conclusions

- Time distance approach has two practical advantages for wide use.
- First, expressed in time units, time distance is comparable across variables, fields of concern, and units of comparison.
- Second, earlier results are left unchanged, but new conclusions may be reached due to an added dimension of analysis.

- The analytical conclusion that higher magnitudes of growth rates lead, ceteris paribus, to smaller time distances, and vice versa, is important in explaining past developments and in preparing policy recommendations. In comparative analyses a better integration of comparisons across time and space is needed.[3]

- For ideas and examples of extensions to measuring deviations between estimated and actual values in regressions and models, forecasting, error in timing and causality, monitoring, business cycle analysis see Sicherl (1994, 1996,1997), for variables other than time Sicherl (1999).
- Granger and Jeon (1997, 2003) further elaborated S-distance for the use as a criterion for evaluating forecasting models of leading and lagging indicators.

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[3] Among other problems, the static statistical measures of disparities like ratios or percentage differences (or Gini coefficient, Theil index or coefficient or variation for the case of many units) are insensitive to the changes in the absolute magnitude of growth rates of the indicator (or differences in growth rates among different indicators) and take into account only differences in growth rates between the units. They have to be supplemented by Sicherl distance to incorporate the temporal relative position of a given unit against the benchmark as an essential element of analysis (SIBIS 2003, p. 211).

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VII. CONCLUSIONS, NEXT STEPS

- The level defined time distance concept and statistical measure S-distance are:
  - theoretically universal
  - intuitively understandable
  - immanently practical
- The novel time distance methodology offers improvements in the present state-of-the-art at both conceptual and application levels**.**
- 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 in statistical and comparative analysis.
- A new set of information with clear interpretability, hidden in the available data, is now provided due to an added dimension of measurement and analysis. The present state-of-the-art neglects this additional information available in time series databases and thus leads to an information loss that has no justification.

- This is not only a question of statistics, econometrics and database analysis. It profoundly affects also the analytical and decision-making level by providing new insights for a better evaluation of policy and business alternatives.
- Expressed in time units it is an excellent presentation tool easily understood by policy makers, managers, media and general public and can have an influence on public opinion.
- S-distance approach is well placed to complement, rather that to replace, conventional measures and thus provide a broader concept to look at the data and to compare situations, improve visualisation, describe scenarios and monitor progress in a truly dynamic conceptual and analytical framework.
- In a dynamic world 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. It is time for asking new questions and exploring new perspectives in a dynamic context.
- A new dimension is added while no earlier results are lost or replaced. As time distance is a generic concept, it is not a methodology oriented towards some specific substantive problem, it presents an additional view to many problems and applications.