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MONITORING IMPLEMENTATION OF THE MILLENNIUM DEVELOPMENT GOALS IN THE TIME DIMENSION

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Monitoring Implementation of the Millennium Development Goals in the Time Dimension

Pavle Sicherl

Summary. The novel generic statistical measure S-time-distance 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. It represents an additional view, relevant to many problems and applications.

Applied to the monitoring of the implementation of the UN Millennium Development Goals the examples for the selected indicators from the four goal domains provide interesting conclusions across the fields of concern and across world regions in simple understandable terms.

A substantial effort by the international and national organisations has been and will be channelled into collecting the necessary data for the related system of indicators. However, quality data is only a necessary but far from sufficient condition for the requirements for policy decisions and broad communication with varied segments of the society and across countries. Time distance measure is one of such measures with clear interpretability that can be helpful in delivering a broader concept to look at data for a better understanding of the situations.

Key words: S-time-distance, monitoring, benchmarking, UN Millennium Development Goals, indicators, time series

1. INTRODUCTION

Millennium Development Goals are a very important global action to provide a common framework for the international development community. The challenges of these goals and targets to decrease poverty, hunger and disease, provide better education and opportunities and care for the environment around the world are very demanding and inspiring. Analysis of their implementation is a necessary step in the process towards these targets.

The road to implementation of the MDG at the world, national and sub-national levels is naturally related to many qualitative issues, but the time distance as a concept and as a novel generic statistical measure can serve as a simple understandable analytical and presentation tool to help in the quantitative phases of evaluation, in planning further policy action and in future target setting.

This paper demonstrates that S-time-distance can as a new easily understandable quantitative measure complement existing measures for monitoring the implementation of the Millennium Development Goals across the domains and indicators at various levels. The numerical examples are meant to demonstrate the generic capability of the S-time-distance to be applied across practically the whole set of 8 goals, most of the targets and the many corresponding indicators for which data are available.

2. METHODOLOGY

2.1 CONCEPT AND DEFINITION OF S-TIME-DISTANCE AS A SPECIAL CATEGORY OF TIME DISTANCE

On the theoretical level it will be shown that the present state-of-the-art does not realize 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. Namely, when comparing in databases two time series for a given variable over time there are two obvious directions of comparison: by time and by level of the variable.

Using the latter approach, statistical measure S-time-distance measures the distance (proximity) in time between the points in time when the two series compared reach a specified level of the variable (indicator) X. The observed distance in time (the number of years, quarters, months, etc.) for given levels of the indicator is used as a 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.

Thus on the theoretical level the time distance approach provides a new view of information: it uses level of the variable(s) as identifiers and time as the focus of comparison and numeraire. Events are dated in time, therefore in time series comparisons, regressions, models, forecasting and monitoring, the notion of time distance was always there as a "hidden" dimension. 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. S-time-distance concept enables additional exploitation of data and visualization for time related databases and indicator systems. 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.

Time has been used in comparisons mainly as information of position, 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, complementing the existing views. If we choose to interchange the roles of the level of the indicator and time, then a given level of the indicator becomes a descriptor or identifier and time becomes a numeraire in which certain distances between the compared units and indicators can be expressed and measured (Sicherl 1997).

In general the time series database can for the case of two units be written as implicit functions

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

The conventional way is to express and compare them as

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

The time distance perspective is expressing them by the level of the variable

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

The database which usually uses time as a descriptor is now turned around (with some possible interpolation and extrapolation) to form a time matrix, where the levels of the variable are used as identifiers and the corresponding times for each unit for given levels of the variable are in the body of the time matrix (see e.g. Sicherl, 2004a, Sicherl 2004c, Sicherl 2007).

From such time matrix two novel statistical measures can be derived: S-time-distance and S-time-step. Both are expressed in standardized units of time understood by everyone, which makes them an excellent presentation and communication tool. **S-time-distance** is derived from the time matrix by subtracting horizontally the respective times for a given level of the variable. Subtracting the respective times in the time matrix for consecutive levels of the variable for each column (each unit) vertically derives the second suggested measure **S-time-step**. These vertical differences can be labeled as time steps and represent an alternative description to the growth rate measure. We shall not use the latter measure in this article.

While the whole approach and the broad range of possible applications are much more complex and general, the S-time-distance application in benchmarking and monitoring of key indicators 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 (Sicherl 1997).

For application for monitoring implementation[1] we shall need to compare only two time series for each unit: actual values and the perceived line to target over time. Thus we can here define the simple case of two units or two states of a selected variable. If we describe static difference and time distance between two units (i) and (j) in terms of operators, then it follows for static difference(s) (Sicherl 2004a):

absolute difference

$$A_{ij}(t) = X_i(t) - X_j(t) \tag{4}$$

ratio

$$R_{ij}(t) = X_i(t)/X_j(t) \tag{5}$$

percentage difference

$$P_{ij}(t) = [X_i(t)/X_j(t) - 1]*100 \tag{6}$$

In case of time distance, for a given level of X_L, $X_L = X_i(t_i) = X_j(_{t_j})$, the S-time-distance, the time interval separating unit (i) and unit (j) for the level X_L,, will be written as

$$S_{ij}(X_L) = \Delta T(X_L) = T_i(X_L) - T_j(X_L) \tag{7}$$

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-time-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 ($T_1, T_2, ..., T_n$).

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)

$$S_{ij}(X_L) = -S_{ji}(X_L) \; . \qquad (8)$$

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 value. This will be the expected case for monitoring implementation in the time dimension for MDGs.

2.2 NEW INSIGHTS FOR BENCHMARKING, GAP ANALYSIS, MONITORING PLANS, BUDGETS, PROJECTIONS AND SCENARIOS

In general time distance approach brings about several persuasive advantages for extensive use. First, since time distance provides an additional (n+1) dimension of description of the state of a multidimensional space of **n** variables, earlier results by other methods are left unchanged but new overall conclusions may be reached due to this new added dimension of analysis.

Second, being expressed in time units, it is intuitively understood by policymakers, professionals, managers, media and the general public, facilitating their subjective perception about their position in this additional dimension. Third, another technical and presentation advantage is that time distance being expressed in standardised units of time is comparable across variables, fields of concern, and units of comparison.

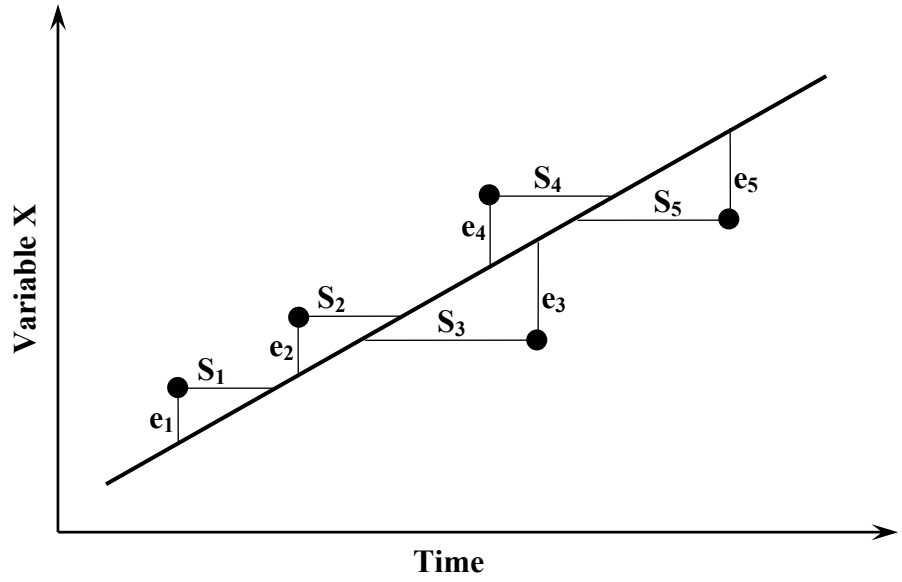
The time distance concept is intuitively understandable and practical. As it is true for any concept and tool, it is the user who makes the final decision which tool is appropriate or not for his/her task, but the field of attaining benefits from application of S-time-distance is wide open for imaginative users. It is not a methodology oriented only towards some specific substantive problem, but *it represents an additional view to many problems and applications*[2].

In the development field the S-time-distance can be very usefully applied as a complementary measure for benchmarking and gap analysis, on one hand, and for monitoring implementation, on the other. Due to the lack of space we shall only briefly mention the former. For comparisons of countries and regions see e.g. Sicherl (1973, 1993, 2004b), for comparison between EU15 and the USA Sicherl (2005).

The second immediate application is in *monitoring the implementation* of the UN Millennium Development Goals in two dimensions. 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 path to target at a given point in time, and 2 months behind in terms of the achieved level in that year. In other words, the target line (estimate) is 1 per cent higher and 2 months early as compared with the actual implementation. Generally speaking, whenever there are two series with time subscripts, e.g. actual value and estimated (forecast, budgeted, planned, targeted, etc.) values, it is possible to study deviations in two dimensions: deviation in the indicator space (at a given point of time) and deviation in time (for a given level of the indicator).

Figure 1. The generic idea for many other applications of S-time-distance

S-time-distance adds a second dimension to comparing actual value with estimated value, forecast, budget, plan, target, etc. and to evaluating goodness-of-fit in regressions, models, forecasting and monitoring



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 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 and does not need at this point further elaboration. It is especially useful in the cases where the targets are clearly established and/or the monitoring is already a legal or administrative requirement. This can be a standard procedure in numerous other activities of the UN and other international agencies and of the national and local levels like monitoring and evaluation of implementation of development plans and policy targets, as well as for the relevant budgets. *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.*

2.3 A NUMERICAL EXAMPLE FOR EVALUATING PROGRESS TOWARDS IMPLEMENTATION OF THE GOAL TO REDUCE THE UNDER-FIVE MORTALITY USING S-TIME-DISTANCE MEASURE

As shown in the scheme above S-time-distance adds a second dimension to comparing actual value with estimated value, forecast, budget, plan, target, etc. and for evaluating goodness-of-fit in regressions, models, forecasting and monitoring. Usually in monitoring progress static measures like absolute and/or percentage difference between the actual value and estimated value for a given point of time are calculated.

For the case of monitoring progress in reducing under-five mortality rate we are comparing the actual value for the under-five mortality rate in 2004 for Developing Regions as well as for China against the respective average path to Millennium Development Goal (MDG) for the two units. Table 1 shows the preparation of the information needed for calculation of S-time-distances. The calculation of the average path to target is calculated in the following way. It follows Target 5 specification of the MDG to reduce the under-five mortality rate by two-thirds between 1990 and 2015. The 1990 value of 106 for Developing Regions is used to calculate the target 2015 value according to the above specification, i.e. the proposed value is 35 for 2015. The corresponding values for China are 49 in 1990 and 16 for 2015.

The path to target can be projected in several ways. First, it would be possible that each country would specify its own projection from 1990 to 2015. Second, for international action like MDG it is more useful for comparative purposes to specify path to target using the same rule for all countries. The two obvious alternatives for this case are the average absolute rate of decrease/increase (for decreasing/increasing indicators) and the average relative rate of decrease/increase. In this paper we shall use in calculating the path to target the average absolute rate of decrease/increase, which corresponds to a linear path from 1990 to 2015.

The innovation in this monitoring methodology is that the progress towards MDG is measured in at least two dimensions simultaneously. The static absolute difference for Developing Regions A_i (87-66.4) is accompanied by S-time-distance S_i = 7.3 years (2004-1996.7). The corresponding values for China are A_j (31-30.7) and S_j = 0.2 years (2004-2003.8), which show further improvement (see Table 2 and Table 3).

In both cases the actual 2004 values for under-five mortality rate are too high compared to the linear path to target, which means that not enough progress toward reducing child mortality has been achieved until 2004. The actual values showed positive sign of S-time-distance, which means time lag of implementation behind the path to target. The example of China demonstrates that S-time-distance should not be understood as a time needed to reach a target. In 2003 the value for China was 3.8 years, while in 2004 it was only 0.2 years. The value for China in 2004 is practically already on the line to target; in one year the time delay behind the path to target was decreased from 3.8 years to 0.2 years.

There is not enough space to discus the advantages and disadvantages of S-time-distance against the static measures (absolute and/or relative static difference) in monitoring. Best is to utilise both dimensions simultaneously. We shall here use only S-time-distance; the corresponding static measures can be easily added.

One distinct advantage of S-time-distance in understanding the results is that it shows the same sign of time lead or time lag in development for both decreasing and increasing indicators. For static differences this is not so. The positive sign for static measures between actual and estimated values is an indication of better performance for increasing indicators and an indication of worse performance for decreasing indicators. This leads to some difficulties in presenting the results for static measures, while S-time-distance presents the results in a clear way for both types of indicators.

Table 1. ***Numerical example of monitoring progress in reducing under-five mortality (path to target calculated as average absolute rate of decrease)***

	DEVELOPING REGIONS		CHINA	
Year	Actual	Path to target	Actual	Path to target
1990	106.0	106.0	49.0	49.0
1991		103.2		47.7
1992		100.3		46.4
1993		97.5		45.1
1994		94.7		43.8
1995		91.9	46.0	42.5
1996		89.0		41.2
1997		86.2		39.9
1998		83.4		38.5
1999		80.6		37.2
2000		77.7	41.0	35.9
2001		74.9		34.6
2002		72.1		33.3
2003		69.3		32.0
2004	87.0	66.4	31.0	30.7
2005		63.6		29.4
2006		60.8		28.1
2007		57.9		26.8
2008		55.1		25.5
2009		52.3		24.2
2010		49.5		22.9
2011		46.6		21.6
2012		43.8		20.3
2013		41.0		18.9
2014		38.2		17.6
2015	35.3	35.3	16.3	16.3

Source: actual values from UN Millennium Development Goal Indicator Database (accessed February 14, 2007), path to target average absolute rate of decrease assuming the reduction by two-thirds between 1990 and 2015.

3. EMPIRICAL ANALYSIS

3.1 COMPARING IMPLEMENTATION ACROSS SELECTED MDGs FOR ONE UNIT (Developing Regions and China)

The aim of this section is to show how the S-time-distance might be used as one of the measures of the implementation of MDG across a number of relevant indicators. The comparison across many indicators from different fields of concern is a very important topic at the national and sub-national analysis and reports of implementation of the MDG, in addition to the interest of international organisations and aid donors at the world and regional levels.

The demonstration is presented at two different levels. Table 2 and Figure 2 show the use of S-time-distance as a measure of monitoring implementation of the MDG in the time dimension for Developing Regions for around 2004. The first example is thus an example for the use at a very highly aggregated level. The second example of China is an example of the use at the national level and can be repeated for more than 100 countries and many more MDG indicators depending on the availability of data and varied interest at different national levels.

There are two ways that the results in Tables 2 for Developing Regions and in Table 3 for China (and the corresponding figures) can be compared. The first perspective is to compare across selected indicators for a given unit. The values of S-time-distance across selected 4 goals and 9 indicators for Developing Regions shows an aggregate summary over many diverse experiences, which can be later studied by regions, countries and sub-national units.

Under the Goal 1 Eradicate extreme poverty and hunger for the aggregate picture there are two diverse conclusions. While the target indicator 'population below the $1 PPP per day' deals with really extreme poverty the calculation that for Developing Regions the actual value for 2004 is more than 3 years ahead of the line to target should be an important indication of the progress in this direction.

The next four indicators show a distinctly different and disturbing situation, all of them show a time delay behind the line to target between 5 to 7 years. All these four indicators are related to children: prevalence of underweight children under-five years of age (Goal 1), net enrolment ratio in primary education (Goal 2), under-five mortality rate and infant mortality rate (Goal 4). From the 9 selected indicators in the paper these domains are those with the largest time delay.

The next four indicators relate to the proportion of population with sustainable access to an improved water source and to improved sanitation, both total and for rural areas. The situation in these fields is much better and still close to the track to reach the targets, with more concern for the improved sanitation in the rural areas.

China is in methodological terms an example of how the S-time-distance method as a complementary method to existing methods for monitoring implementation can be applied to the country level across many countries. In substantive terms China is a country with a very substantial weight influencing also the results for the aggregate Developing Regions discussed above.

The results of the time distance analysis of implementation for China show a very good picture. The 2015 target for indicators 1 and 4 in the Goal 1 domain of eradicating extreme poverty and hunger were already achieved by 2002. This is an exceptional achievement reaching these MDG targets at least 13 years earlier.

China is also very close to the line to target for other selected indicators; only for proportion of population with sustainable access to improved water source in rural areas it is about 4 years behind the schedule. The indicator value for net primary enrolment is not available in the UN MDG database due to the problem of statistical comparability, but China is a country with high enrolment so this should not be a problem at all.

The second possible comparison in this section is to compare Table 2 and Table 3 for the reason mentioned above. For Goal 1 for China the time lead for indicators 1 and 4 against the 2015 targets is exceedingly favourable; for the total for Developing Regions indicator 1 is about 3 years ahead of schedule while the prevalence of underweight children under-five years of age is about 6 years behind the schedule. This means that even very high implementation for this indicator in China was not able to raise enough the results for the total.

Table 2. ***Monitoring implementation of the Millennium Development Goals in the time dimension DEVELOPING REGIONS***

		S-time-distance (years)	Latest indicator value (actual)	Actual year	Year on the path to target
Goal 1. Eradicate extreme poverty and hunger					
Indicator 1	Population below $1 PPP per day	-3.2	19.4	2002	2005.2
Indicator 4	Prevalence of underweight children under-five years of age	6.4	28	2004	1997.6
Goal 2. Achieve universal primary education					
Indicator 6	Net enrolment ratio in primary education	5.1	85.8	2004	1998.9
Goal 4. Reduce child mortality					
Indicator 13	Under-five mortality rate	7.3	87	2004	1996.7
Indicator 14	Infant mortality rate	7.2	59	2004	1996.8
Goal 7. Ensure environmental sustainability					
Indicator 30 t.	Proportion of population with sustainable access to an improved water source, total	-1.5	80	2004	2005.5
Indicator 30 r.	Proportion of population with sustainable access to an improved water source, rural	1.5	70	2004	2002.5
Indicator 31 t.	Proportion of population with access to improved sanitation, total	2.5	50	2004	2001.5
Indicator 31 r.	Proportion of population with access to improved sanitation, rural	4.4	33	2004	1999.6

S-time-distance (years) = Time (actual) - Time (path to target)

S-time-distance (years) = - time lead (progress better than path to target), + time lag (progress worse than path to target)

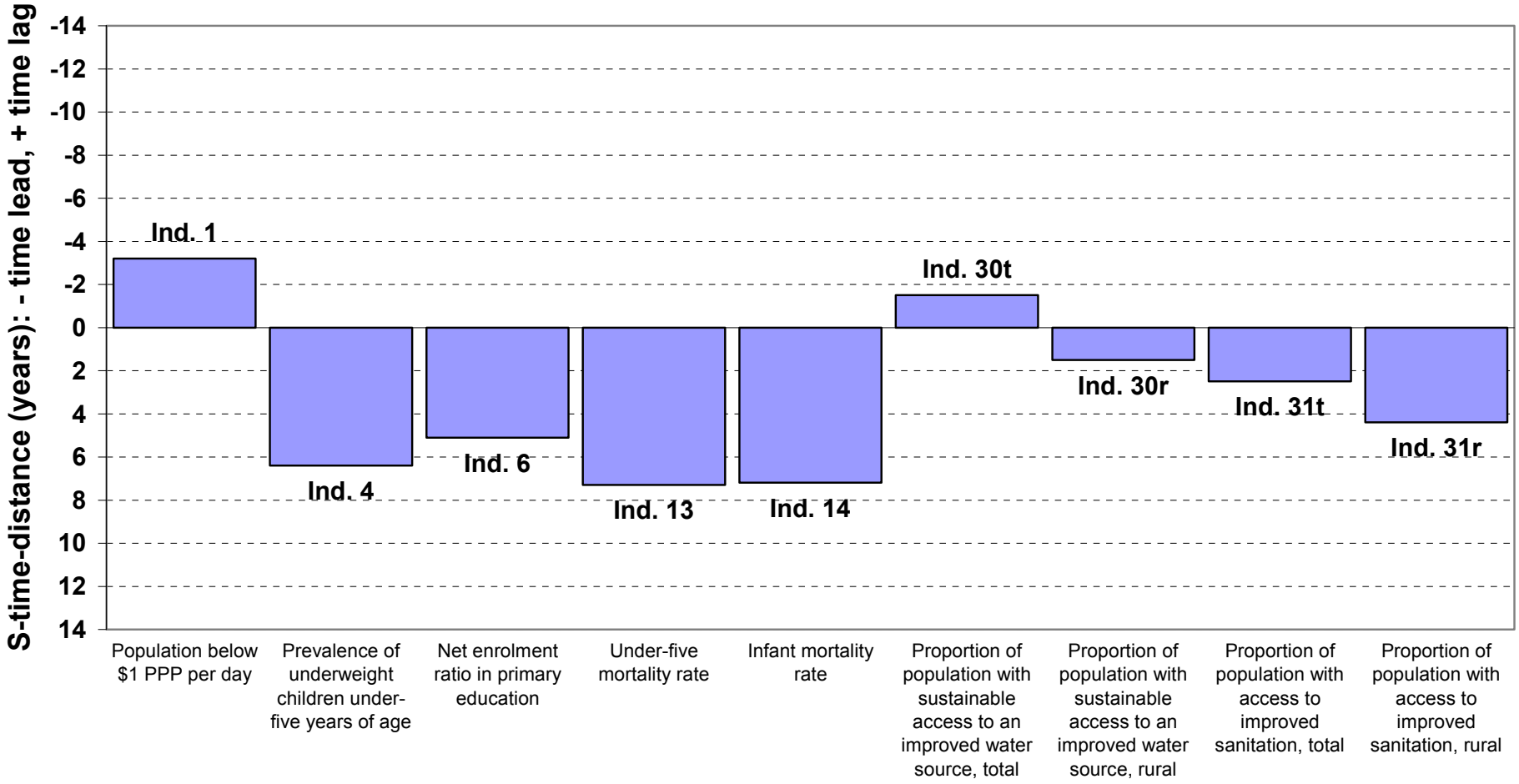


Figure 2. ***Monitoring implementation of the Millennium Development Goals in the time dimension for selected indicators: DEVELOPING REGIONS, about 2004***

Table 3. ***Monitoring implementation of the Millennium Development Goals in the time dimension CHINA***

		S-time-distance (years)	Latest indicator value (actual)	Actual year	Year on the path to target
Goal 1. Eradicate extreme poverty and hunger					
Indicator 1	Population below $1 PPP per day	-13.9	16.6	2001	2014.9
Indicator 4	Prevalence of underweight children under-five years of age	-14.0	7.8	2002	achieved
Goal 2. Achieve universal primary education					
Indicator 6	Net enrolment ratio in primary education	N/A	97.4	1991	N/A
Goal 4. Reduce child mortality					
Indicator 13	Under-five mortality rate	0.2	31	2004	2003.8
Indicator 14	Infant mortality rate	2.2	26	2004	2001.8
Goal 7. Ensure environmental sustainability					
Indicator 30 t.	Proportion of population with sustainable access to an improved water source, total	2.3	77	2004	2001.7
Indicator 30 r.	Proportion of population with sustainable access to an improved water source, rural	4.2	67	2004	1999.8
Indicator 31 t.	Proportion of population with access to improved sanitation, total	0.4	44	2004	2003.6
Indicator 31 r.	Proportion of population with access to improved sanitation, rural	2.7	28	2004	2001.3

S-time-distance (years) = Time (actual) - Time (path to target)

S-time-distance (years) = - time lead (progress better than path to target), + time lag (progress worse than path to target)

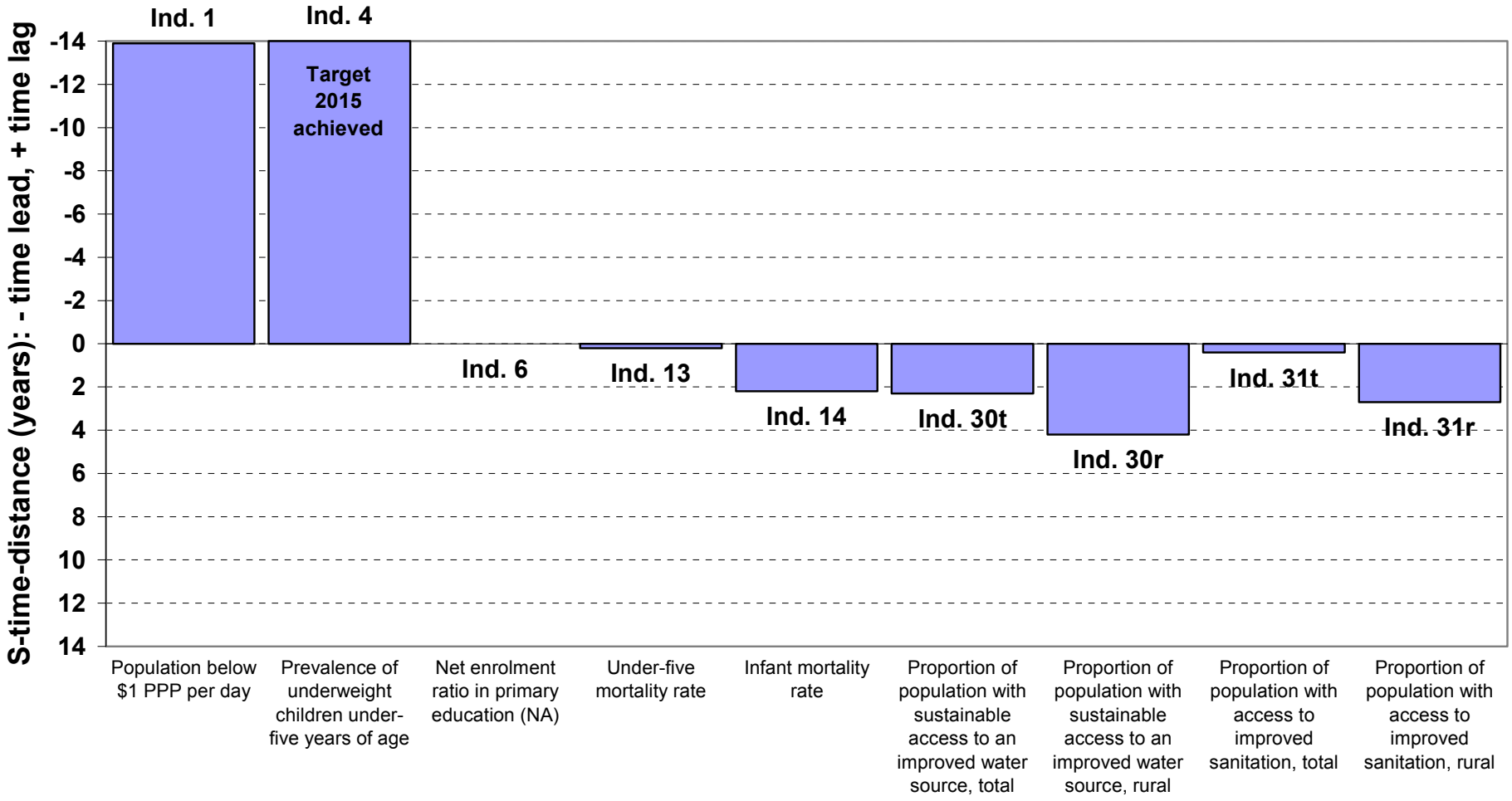


Figure 3. ***Monitoring implementation of the Millennium Development Goals in the time dimension for selected indicators: CHINA, situation around 2004***

In addition to time distance measure as applied to the time deviation of actual implementation from the implied line to target one should also mention and explain the obvious but many times forgotten fact that if two units would show the same measures of implementation towards the MDG targets this by no means indicates that the two units are also on the same absolute level of the indicator.

S-time-distance could be used also for comparing the time distance between two points in time when the compared units would achieve the same level of the analysed indicator[3], which was mentioned in the methodological section as benchmarking. This is a different procedure than the application of S-time-distance for measuring the time dimension of disparity between the actual implementation and path to target, which is the main topic of this paper. Using S-time-distance for comparing the absolute levels of the indicator 1 can be illustrated in comparing the two units for example in the early 1990s. The 1993 actual value for the share of China was 28 which equalled the value for Developing Regions in 1990. This means that for its value in 1993 China was 3 years behind the Developing Regions (S-time-distance = 3 years). By 2001 China substantially lowered the value for indicator 1 below that for Developing Regions, so that now the China is ahead.

It might be of interest to use this example for illustration of the two different uses of S-time-distance. If one would draw a horizontal line from the point for China for 2001 there could be intersection with the two lines to target for the respective units. The intersection with the path to target for China in 2015 shows the time lead in implementation of the MDG for China itself. This is the type of S-time-distance application for monitoring MDG implementation as the key topic of this paper. The same line also crosses the path to target for Developing Regions at about 2009.5, which is the case of comparison between the two units for the hypothetical case comparing China actual for 2001 with the case if Developing Regions would exactly follow their path to target. In this case one could say that for this level China would be ahead of Developing Regions for 8.5 years. S-time-distance for China in comparison to the absolute value of the indicator 1 would have changed from a time lag of 3 years in 1993 to time lead of -8.5 years (2001-2009.5). The final result of this comparison will depend on actual performance for Developing Regions in the future.

Returning to the monitoring implementation of the MDGs China is also substantially better for the four indicators related to children discussed above for the Developing Regions. It is well ahead for prevalence of underweight children under-five years of age, probably also for net enrolment in primary education. While for under-five mortality rate and infant mortality rate (Goal 4) the actual values for 2004 are about 7 years behind the schedule for Developing Regions, China is for under-five mortality rate on the track and for the infant mortality rate about 2 years behind the schedule.

When compared for the four indicators relating to the proportion of population with sustainable access to an improved water source and to improved sanitation, both total and for rural areas, the situation is different. The implementation for proportion of population with sustainable access to an improved water source is better for Developing Regions, while that for the proportion of population with access to improved sanitation is better in China. In both cases there is a need to foster further effort in these domains, especially in rural areas.

3.2 COMPARING IMPLEMENTATION FOR ONE INDICATOR ACROSS REGIONS AND ACROSS INDICATORS FOR A GIVEN REGION

This section is an illustration of how the S-time-distance methodology can provide an additional perspective to the monitoring implementation of the MDGs across regions for a given indicator as well as numerical estimates for the world regions for around 2004.

Table 4. ***Monitoring implementation of the Millennium Development Goals in the time dimension, across regions for under 5 mortality rate, situation around 2004***

Regions	S-time-distance (years)	Latest indicator value (actual)	Actual year	Year on the path to target
Northern Africa	**-7.7**	37	2004	2011.7
Sub-Saharan Africa	**10.6**	168	2004	1993.4
Latin America and the Caribbean	**-2.0**	31	2004	2006.0
Eastern Asia	**0.7**	31	2004	2003.3
Southern Asia	**3.3**	90	2004	2000.7
South-Eastern Asia	**-2.8**	43	2004	2006.8
Western Asia	**8.0**	58	2004	1996.0
Oceania	**11.0**	80	2004	1993.0

S-time-distance (years) = Time (actual) - Time (path to target)
S-time-distance (years) = - time lead (progress better than path to target), + time lag (progress worse than path to target)

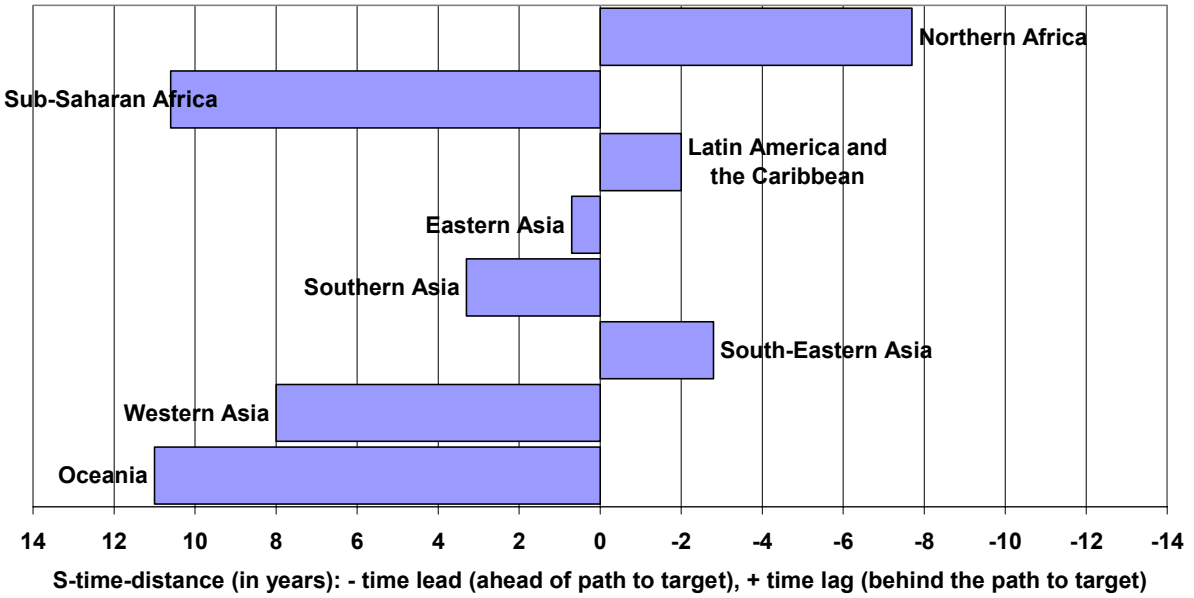


Figure 4. ***Monitoring implementation of the Millennium Development Goal in the time dimension for under five mortality rate: REGIONS, situation in 2004***

Table 5. ***Monitoring implementation of the Millennium Development Goals in the time dimension, by regions and selected indicators, situation around 2004***

		Developing Regions	Northern Africa	Sub-Saharan Africa	Latin America and the Caribbean	Eastern Asia	Southern Asia	South-Eastern Asia
Goal 1. Eradicate extreme poverty and hunger								
Ind. 1	Population below $1 PPP per day	-3.2	Increasing	11.3	1.4	Achieved	1.6	Achieved
Ind. 4	Prevalence of underweight children under-five years of age	6.4	9.0	10.9	-4.2	Achieved	8.3	-0.1
Goal 2. Achieve universal primary education								
Ind. 6	Net enrolment ratio in primary education	5.1	-3.6	7.3	-2.4	N/A	-1.8	11.1
Goal 4. Reduce child mortality								
Ind. 13	Under-five mortality rate	7.3	-7.7	10.6	-2.0	0.7	3.3	-2.8
Ind. 14	Infant mortality rate	7.2	-6.5	10.3	-0.8	2.9	5.0	-0.9
Goal 7. Ensure environmental sustainability								
Ind. 30t	Proportion of population with sustainable access to an improved water source, total	-1.5	4.9	7.1	-9.5	1.9	-9.2	1.5
Ind. 30r	Proportion of population with sustainable access to an improved water source, rural	1.5	2.9	9.3	-2.3	4.2	-8.1	-0.1
Ind. 31t	Proportion of population with access to improved sanitation, total	2.5	-3.1	10.3	-0.1	0.2	2.8	-3.7
Ind. 31r	Proportion of population with access to improved sanitation, rural	4.4	-0.2	11.4	3.8	2.7	3.7	0.7
S-time-distance (years) = Time (actual) - Time (path to target)								
S-time-distance (years) = - time lead (progress better than path to target), + time lag (progress worse than path to target)								
Achieved: Target for 2015 already achieved								
Increasing: Though a favourable low value, the value for North Africa and West Asia for 2004 was higher than in 1990								

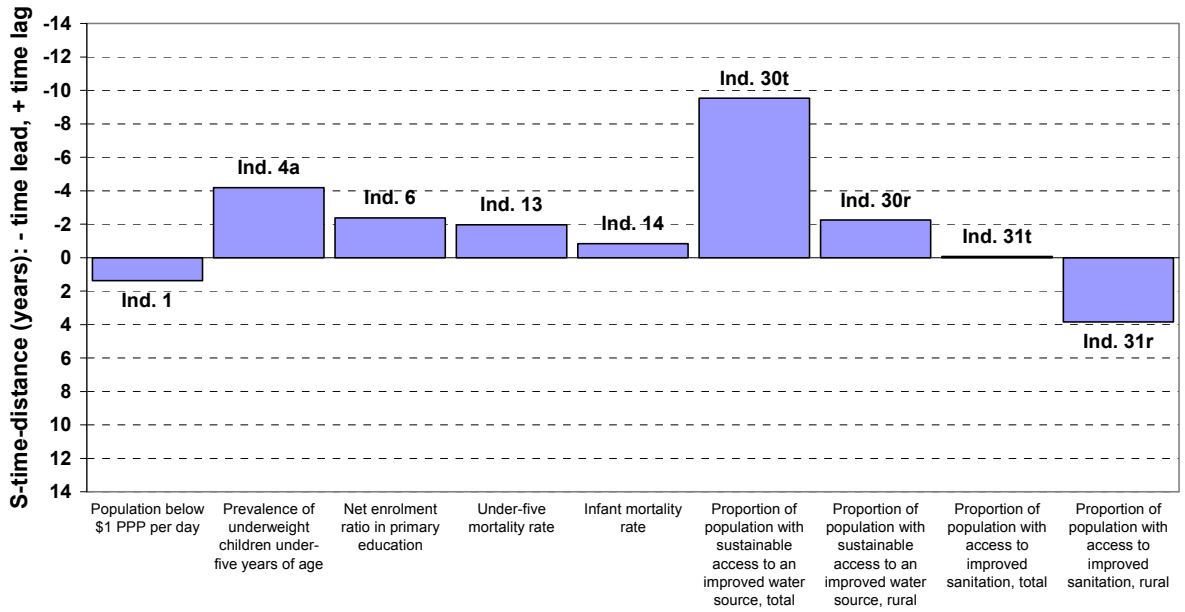


Figure 5. ***Monitoring implementation of the Millennium Development Goal in the time dimension for selected indicators: LATIN AMERICA AND THE CARIBBEAN, around 2004***

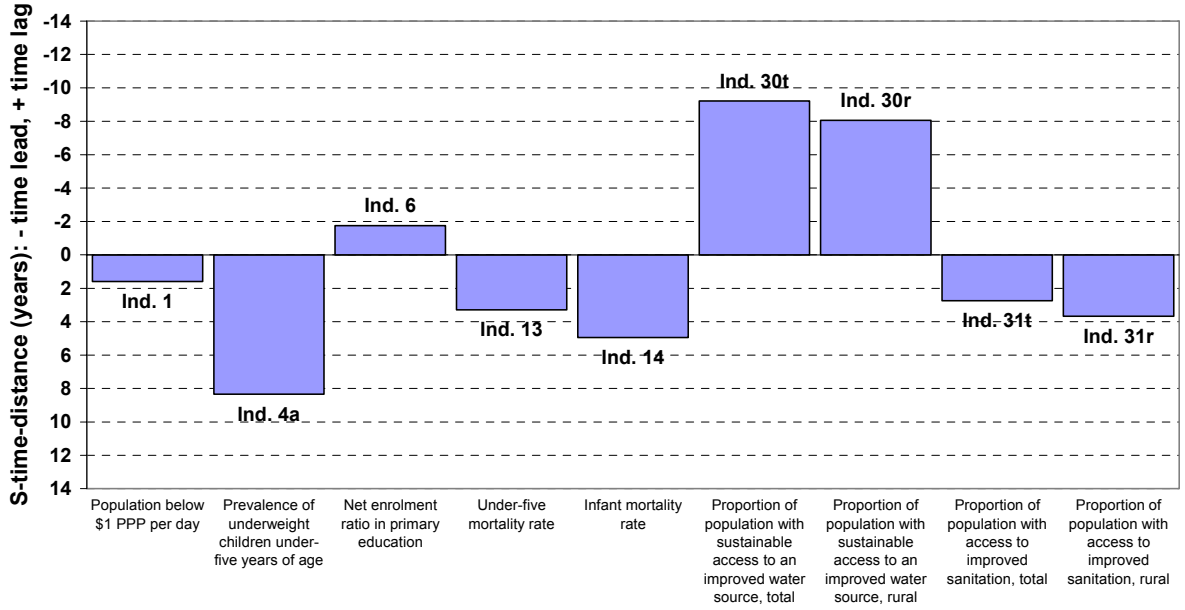


Figure 6. ***Monitoring implementation of the Millennium Development Goal in the time dimension for selected indicators: SOUTHERN ASIA, around 2004***

Table 4 and Figure 4 are an example for the first perspective across regions for a given indicator, in this instance under-five mortality rate for 2004. The figure clearly demonstrates the wide differences in time lead or time delay in implementation for this indicator. However, in addition to S-time-distances from the line to target that is the focus in this paper it is also important to look at the levels of the indicator. One can see that those regions for which the under-five mortality is low have also the best values of S-time-distance deviation from the MDG implementation schedule. Looking at the other side, region with the indicator values over 80 have a great difficulty in following such schedule to decrease the 1990 value by two thirds by 2015.

Analysing implementation of the MDGs like UN (2006a) includes a wide range of targets and indicators for some of which there is a lack of reliable data and the agencies have to deal with these problems in various ways to reach broad conclusions. The colour scale in UN (2006b) uses three colours for indicating the progress. There are two shades of green for the cases where targets had already been met or are close to that as well as for the cases that are expected to be met if the present trends prevail. Yellow indicates cases where targets are not expected to be met if the present trends prevail and red indicates cases with no progress, or a deterioration or reversal. Progress in the chart has been assessed by the responsible agency on the basis of proxy indicators. Similarly World Bank (2006) on its Millennium Development Goals pages compares in colours in the regional charts the progress using for calculations the latest available data point and comparing it to the contemporaneous point on a reference path connecting the 1990 value to the MDG target.

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 of some other agencies on these issues. The existing methods can be complemented for a more narrow selection of indicators with this methodology that could provide a simple understandable additional measure of progress towards implementation of the MDGs various levels[4].

Table 5 shows the estimates for the selected indicators for 6 regions as well as for the aggregate Developing Regions. As this paper is predominantly a methodological paper we shall not engage into more detailed substantive analysis which can be left to domain specialists. The accompanying Table 5 for Latin America and the Caribbean and Table 6 for Southern Asia are provided as illustration of presentation capabilities of the S-time-distance method.

In an overview one can say that Latin America and the Caribbean is the best region in terms of an overall implementation with respect to the domains analysed by the selected indicators. The two only indicators behind the schedule are share of the population below $1 PPP per day and proportion of the rural population with access to improved sanitation. Eastern and South-Eastern Asia have already achieved the 2015 target for the share of the population below $1 PPP per day, the former also for prevalence of underweight children under-five years of age. Northern Africa shows the fastest progress in child and infant mortality. Sub-Saharan Africa is very much delayed in implementing their targets. A separate question is whether the targets for the least developed countries in general might have been too ambitious. Namely, the setting of the MDGs targets in relative terms was a good approach as any country as well as regions is to follow their own targets related to their starting values. However, it may have been that such comparable relative targets have really implied very high requirements for absolute changes in these fields. This is to be analysed further also as an input in the process of designing future targets in similar actions.

3.3 ONE INDICATOR – MANY COUNTRIES

This section demonstrates the possibility that the S-time-distance methodology is applied at the country level and that it can enable also the comparison of implementation of the Millennium Development Goal across countries for a given indicator. The usual problem is the availability of reliable data, but the method is generally applicable across most of the indicators for any number of countries.

Infant mortality rate was chosen for this example of a MDG indicator for two reasons. First it is an important indicator for Goal 4: reducing child mortality. Second, the estimates in the UN Millennium Development Goal Indicator Database for infant mortality rate provide estimates for 1990 and 2004 for over 130 countries.

There are a number of countries which in the period 1990-2004 did not show reduction in the infant mortality rate. For some of them the values of the indicator were approximately constant, for some of them the infant mortality rate even increased. These countries are listed at the end of the country tables below in alphabetical order. For 113 countries for this indicator it was possible to construct the path to target from their 1990 value to 2015 under the condition that its value would be reduced by two-thirds over that period.

For each of the countries S-time-distance was calculated by comparing the actual value of the infant mortality rate in 2004 with the year on the path to target for that country when the actual 2004 value of the indicator was expected to be achieved. When the value of S-time-distance is negative, this means that the actual progress is ahead of the assumed progress indicated on the path to target. In other words, the actual implementation was better than required by the calculated average path to target. For instance, the value of infant mortality rate for Singapore was 7 in 1990; the implied target for 2015 is 2.3. In 2004 the actual value was 3; this value was on the path to target foreseen to be achieved in 2011. Since it was achieved already in 2004, the S-time-distance of -7 years indicates that this progress was attained 7 years earlier (2004-2011) than calculated on the average path to target.

The results presented in Table 6 show that for 46 countries the progress in reducing infant mortality rate in the period 1990-2004 was better than required by the assumed average absolute rate of decrease as calculated by the path to target. For the other 67 countries the implementation in 2004 measured by S-time-distance shows smaller or larger delay as compared to the assumed average absolute rate of decrease.

It is important to emphasize that S-time-distance measure values in Table 6 show the lead or delay measured against the calculated path to target until 2004. It should not be taken to imply that many of the countries may not by 2015 achieve their targets. This will depend also on their performance in the next decade.

The most severe problem in implementation is related to the 23 countries at the end of the Table 6 which did not show reduction in the infant mortality rate between 1990 and 2004. This implies that their time delay is at least 14 years. It is of interest to observe that the countries with high levels of the infant mortality rate are in many cases those countries which have not shown good progress toward the MDG. No country with the value of infant mortality rate in 2004 of over 70 showed the (-) sign of S-time-distance, which would indicate that it is already on the track of achieving their goal with respect to this indicator. In other words, all these countries showed smaller or very large delays in implementation.

Table 6. ***Monitoring implementation of the Millennium Development Goal in the time dimension BY COUNTRIES (results for 113 countries), infant mortality rate, situation in 2004***

Country	2004 value	S-time-distance (years)		Country	2004 value	S-time-distance (years)
Egypt	26	**-10.7**		Korea, Republic of	5	**-0.1**
Oman	10	**-8.5**		Malaysia	10	**-0.1**
Peru	24	**-8.5**		Samoa	25	**-0.1**
Bahamas	10	**-7.9**		Bhutan	67	**0.0**
Turkey	28	**-7.8**		Philippines	26	**0.3**
Singapore	3	**-7.4**		Paraguay	21	**0.4**
Syrian Arab Republic	15	**-7.4**		Brazil	32	**0.5**
Maldives	35	**-6.9**		Fiji	16	**0.5**
Viet Nam	17	**-6.7**		Trinidad and Tobago	18	**0.6**
Sri Lanka	12	**-6.2**		Occupied Palestinian Territory	22	**0.8**
Chile	8	**-5.9**		Algeria	35	**0.8**
Timor-Leste	64	**-5.0**		Saint Lucia	13	**0.9**
Cyprus	5	**-4.8**		Mozambique	104	**1.2**
Indonesia	30	**-4.8**		Mauritius	14	**1.5**
Israel	5	**-4.8**		Vanuatu	32	**1.5**
El Salvador	24	**-4.4**		Venezuela	16	**1.5**
Tunisia	21	**-4.3**		China	26	**2.2**
Libyan Arab Jamahiriya	18	**-4.2**		Costa Rica	11	**2.3**
Mongolia	41	**-3.8**		Cook Islands	18	**2.5**
Ecuador	23	**-3.4**		Guinea	101	**2.6**
Dominican Republic	27	**-3.3**		Jordan	23	**2.6**
Lao People's Democratic Rep.	65	**-3.2**		Panama	19	**2.9**
Cuba	6	**-3.1**		Honduras	31	**2.9**
Guatemala	33	**-2.9**		Seychelles	12	**3.0**
Morocco	38	**-2.9**		Barbados	10	**3.3**
Bangladesh	56	**-2.5**		Kuwait	10	**3.3**
Thailand	18	**-1.7**		Haiti	74	**3.7**
United Arab Emirates	7	**-1.6**		Lesotho	61	**3.7**
Nepal	59	**-1.4**		Micronesia, Federated States of	19	**3.9**
Comoros	52	**-1.3**		Madagascar	76	**4.2**
Eritrea	52	**-1.3**		India	62	**4.2**
Iran (Islamic Republic of)	32	**-1.3**		Guyana	48	**4.6**
Nicaragua	31	**-1.1**		Uruguay	15	**4.6**
Bahrain	9	**-1.0**		Malawi	110	**4.8**
Cape Verde	27	**-1.0**		Kiribati	49	**4.8**
Colombia	18	**-1.0**		United Republic of Tanzania	78	**5.2**
Grenada	18	**-1.0**		Tonga	20	**5.4**
Saint Kitts and Nevis	18	**-1.0**		Namibia	47	**5.9**
Saudi Arabia	21	**-1.0**		Palau	22	**6.0**
Bolivia	54	**-0.8**		Niger	152	**6.3**
Argentina	16	**-0.4**		Brunei Darussalam	8	**6.5**
Mexico	23	**-0.2**		Pakistan	80	**6.5**
S-time-distance (years) = Time (actual) – Time (path to target)						
S-time-distance (years) = - time lead (progress better than path to target), + time lag (progress worse than path to target)						

Table 6. ***continued***

Country	2004 value	S-time-distance (years)		Country	2004 value	S-time-distance (years)
Benin	90	**6.9**		Countries for which infant mortality rate was constant or even increasing over time		
Saint Vincent and the Grenadines	18	**7.2**				
Belize	32	**7.3**		Angola	154	
Guinea-Bissau	126	**7.4**		Botswana	84	
Marshall Islands	52	**7.5**		Burundi	114	
Djibouti	101	**7.6**		Cambodia	97	
Myanmar	76	**7.8**		Cameroon	87	
Yemen	82	**7.9**		Central African Republic	115	
Ethiopia	110	**8.0**		Chad	117	
Nigeria	101	**8.1**		Cote d'Ivoire	117	
Lebanon	27	**8.1**		Democratic Rep. of the Congo	129	
Sudan	63	**8.4**		Equatorial Guinea	122	
Qatar	18	**8.6**		Gabon	60	
Suriname	30	**8.6**		Iraq	102	
Burkina Faso	97	**8.7**		Jamaica	17	
Uganda	80	**8.8**		Kenya	79	
Gambia	89	**8.9**		Korea, Dem. People's Rep. of	42	
Mali	121	**8.9**		Liberia	157	
Dominica	13	**9.0**		Rwanda	118	
Senegal	78	**9.0**		Sao Tome and Principe	75	
Togo	78	**9.7**		Somalia	133	
Solomon Islands	34	**10.1**		South Africa	54	
Tuvalu	36	**10.3**		Swaziland	108	
Ghana	68	**10.5**		Zambia	102	
Mauritania	78	**10.9**		Zimbabwe	79	
Papua New Guinea	68	**11.0**				
Sierra Leone	165	**11.9**				
Congo	81	**13.1**				
Afghanistan	165	**13.3**				
S-time-distance (years) = Time (actual) – Time (path to target)						
S-time-distance (years) = - time lead (progress better than path to target), + time lag (progress worse than path to target)						

4. CONCLUSIONS

The first conclusion is methodological. On the general level in the analysis of time series S-time-distance measure represents a generic concept like static difference and the growth rate over time. 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 specific 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. 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.

This has important technical and policy implications. Expressed in time units it is an excellent presentation and communication tool easily understood by policy makers, managers, media and general public and can support decision-making and influence public opinion. In an information age a new view of the existing databases should be evaluated as an important contribution towards a more efficient utilization of the available information complementing, rather than substituting, the existing methods in extracting the relevant information content and new insights from available data.

Earlier results are left unchanged, but new conclusions may be reached due to an added dimension of analysis. Empirically, the degree of disparity may be very different in static terms and in time distance, which leads to new conclusions and semantics important for policy considerations. There are many possible aplication of S-time-distance approach, here we use one of the formally least demanding application.

The application of S-time-distance in this paper for monitoring implementation of the MGDs is practical, straightforward and easy to understand. It measures the time dimension of deviation between the actual implementation and the implied path to target in 2015 for a given target. It is very much like comparing actual arrivals with the train or bus time table; the difference being that the geographical space is here replaced with the indicator space.

As it is expressed in standardised time units, S-time-distance is comparable across variables, fields of concern, and units of comparison. In this respect it is even easier to compare across these aspects than the absolute or relative static deviations of actual from the implied lines to target as there are both increasing and decreasing directions for MDGs. Thus there was no problem (except for possible lack of data) to demonstrate the results for monitoring implementation of the MDGs across different indicators for a given region or across regions for a given indicator; as well as for 113 countries for the selected indicator infant mortality rate. The example of China was used to show this also for country level.

The main purpose of this paper is to present a novel methodology that can be used as one of the measures of the implementation of MDG across a number of relevant indicators by various users. The comparison across many indicators from different fields of concern is a very important topic at the national and sub-national analysis and reports of implementation of the MDG, in addition to the interest of international organisations and aid donors at the world and regional levels. 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 of some other agencies on these issues.

As this paper is predominantly a methodological paper detailed substantive analysis is left to domain specialists. An overview for Developing Regions showed that for the indicator ‘population below the $1 PPP per day’ the actual value for 2004 was more than 3 years ahead of the line to target and should be an important indication of the progress in this direction. The next four indicators showed a distinctly different and disturbing situation, all of them show a time delay behind the line to target between 5 to 7 years. All these four indicators are related to children: prevalence of underweight children under-five years of age (Goal 1), net enrolment ratio in primary education (Goal 2), under-five mortality rate and infant mortality rate (Goal 4). From the 9 selected indicators in the paper these domains are those with the largest time delay.

Another set of indicators relates to the proportion of population with sustainable access to an improved water source and to improved sanitation, both total and for rural areas. The situation in these fields is much better and still close to the track to reach the targets, with more concern for the improved sanitation in the rural areas.

The results provided for six world regions showed a mixed picture and can be a source for further analysis. At the country level China showed an extraordinary progress in eradicating extreme poverty and hunger. This methodology can be used a standard procedure in numerous other activities of the UN and other international agencies and at the national and local levels, like monitoring and evaluation of implementation of development plans and policy targets, as well as for the relevant budgets. *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.*

In summary, a substantial effort by the international and national organisations has been and will be channelled into collecting the necessary data for the related system of indicators. Yet we need also concepts and tools of analysis that systematise and transform information into perceptions relevant to different levels of decision makers and interest groups for describing the situations, challenges and scenarios, for proactive discussion and presentation of policy alternatives to policy makers, media, the general public and mobilizing those participating in or being affected by the programs. Time distance measure is one of such measures with clear interpretability that can be helpful in delivering a broader concept to look at data for a better understanding of the situations and for improved semantics in communication.

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NOTES

[1] The application of the S-time-distance methodology for monitoring implementation in the time dimension is one of the simplest applications of this methodology. In the development field it is more frequently used in comparisons between different units (countries, regions, socio-economic groups, etc.) for given indicators as a complementary dimension for analysing development and inequality gaps. However, the field of possible more complex applications of this generic methodology is much broader than that. For 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, 1997), to variables other than time Sicherl (1999). Granger and Jeon (1997, 2003a) extended it to comparisons of leading and lagging indicators and used the time distance as a criterion for evaluating forecasting models.

[2] Time distance concept and S-time-distance measure are directly connected to the pillar 3 of the proclamation of the OECD initiative on key indicators and the proposed project to measure and assess the overall "position" and "progress" (OECD, 2005, p. 9): 'research work to develop innovative approaches to make statistical information accessible and usable to the public at large: to compare existing tools and develop new approaches to statistical data dissemination and presentation to various sectors of society (public decision makers, citizens, younger generations, media, businesses, etc.)'.

[3] There is a more general question about which measures should be applied for the analysis of disparity in various fields. In the 2004 General Conference of the International Association for Research in Income and Wealth in Cork two papers in the plenary sessions on measuring and interpreting global inequality and poverty raised the same problem of the unsatisfactory situation that at the empirical level the acceptance of the relative criterion is almost unconditional. In both papers there was a common objection to the one-sided reliance on relative measures and the recommendation that they should be complemented by other dimensions. Atkinson and Brandolini (2004) put the emphasis on a broader choice of static measures, while Sicherl (2004c) discussed the role of time distance in measuring the temporal aspect of disparity. The arguments for extension in several directions to a broader framework in theory and especially in empirical and policy work are well established; it has to happen sooner or later.

[4] It was stated that the purpose of the OECD World Forum is to convene and promote research and information sharing among countries, allowing them to compare strategies intended to measure and assess the overall "position" and "progress" of a certain political entity (country, region, etc.) vis-à-vis other similar entities (Giovannini, 2005). The time distance methodology could be useful in this context in various ways, the monitoring aspect was discussed in this paper.