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Measuring the Dynamics of Information Societies: Empowering Stakeholders Amid the Digital Divide

Vesna Dolničar, Katja Prevodnik, and Vasja Vehovar
Faculty of Social Sciences, University of Ljubljana, Ljubljana, Slovenia

Accurate insight into the emergence of information societies is essential not only for understanding the social effects of information and communication technologies, but also for empowering stakeholders to promptly and appropriately respond to the challenges they encounter. One much-discussed challenge that is particularly in need of analytical clarity is the digital divide, which is difficult to empirically elaborate, given its complicated nature. It is prone to superficial interpretations that suit particular agendas. To address this problem, this article proposes a methodology that integrates and upgrades the analysis of absolute change, relative change, and time distance into a general multidimensional approach. With this methodology, target audiences have an intuitively persuasive and methodologically sound instrument that could reinforce trust in digital divide studies. The approach is applied in evaluating the Internet penetration gap between Slovenia and Denmark, which often serves as a benchmark for policymaking in Solvenia.

Keywords digital divide measurement, absolute differences, relative differences, time distance, the diffusion process, statistical literacy, policy assessment

Appropriate interpretations of data are extremely important because such analyses empower stakeholders (researchers, policymakers, investors, the interested public) and enhance their competencies; inadequate interpretations can give rise to incorrect insights into the social reality and lead to suboptimal policy decisions. Moreover, the quality of methodological interpretation is becoming increasingly important because contemporary society has become saturated with information and statistical data. Biggeri and Zuliani (1999) regard the society that emerged at the end of the second millennium as "a cage of statistical information"—an interpretation that may be even more relevant nowadays, when sound interpretations of statistics are crucial.

Effective management of empirical data necessitates distinctions between levels of data quality, basic statistical interpretations, broad methodological interpretations, and contextual interpretations. In theory, the first three aspects are independent of researcher subjectivity, whereas contextual interpretations are not standardized. We focus on extending and standardizing statistical and methodological interpretations, so that contextual and substantive interpretations are more specific and more grounded in empirical evidence. This approach also eliminates the contradictions that sometimes characterize contextual analyses.

One of the most extensively discussed issues is whether the digital divide is expanding, shrinking, or stagnating. Although many methodological challenges have been identified and addressed since the early stage of information and communication technology (ICT) adoption—particularly via longitudinal, cross-country comparative studies—constant and rapid changes in the industry continue to present difficulties in terms of measurement and interpretation. Norris (2001, 26) therefore describes digital divide studies as "blurred snapshots of a moving bullet."

Digital divide studies, and information society research in general, reveal numerous concerns regarding conceptualization, operationalization, measurement, and interpretation of data. These concerns stem largely from differences across various technologies (personal computers [PCs], Internet, mobile technologies), aggregation levels (regional, national, international, global), units of monitoring (individuals, households, companies, etc.), relationships to ICT (access, mode of usage, barriers, attitudes, etc.), nature of studies (cross-country comparisons, support for policymaking, observations of time trends, testing of causal relationships, etc.), and historical differences among countries.

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Address correspondence to Vesna Dolničar, University of Ljubljana, Faculty of Social Sciences, Kardeljeva Ploščad 5, 1000, Ljubljana, Slovenia. E-mail: vesna.dolnicar@fdv.uni-lj.si

According to the early Organization for Economic Co-operation and Development (OECD) definition, the term “digital divide” refers to the “differences between individuals, households, companies, and regions related to the access and usage of ICTs” (2001, 5). This definition constitutes the basic (or so-called “first”) conception of the digital divide. The OECD (2011) recently summarized efforts in this field by collating the definitions of the digital divide for ICT sectors, products, and ICT infrastructures, as well as for electronic commerce and fixed and wireless broadband networks. Subsequently, the OECD and Eurostat collaborated to create standardized questionnaires for ICT use as bases for continuous data acquisition and as standards for comparable data. In the past few years, considerable effort has been directed toward the corresponding standardization of official statistics because “national e-strategies can neither be designed nor evaluated without appropriate indicators” (OECD 2009, 14). Similarly, the International Telecommunication Union (ITU) (2010) also defined key ICT indicators (e.g., number of fixed telephone lines, mobile cellular subscriptions, fixed Internet subscriptions, etc.). The importance of standardized indicators is also highlighted by Vehovar and Dolničar (2004) and Dolničar (2011), who demonstrate that even minor changes in the wording of operational definitions can result in highly different estimates of the proportion of Internet users.

Aside from the already-mentioned standardization efforts, new concepts, approaches, and measures are also being formulated. These additional initiatives are typically related to the increasingly structured and specific aspects of digital inequalities, particularly those arising from multiple dimensions and new typologies (Haddon 2004; Hilbert 2010; Hilbert 2011; van Dijk and Hacker 2003; Tsatsou 2010; Vehovar et al. 2006). Most of these extensions are related to differences in segments of the population, technical specifics of ICTs, and subtle differentiation among users and/or nonusers with respect to subjective experiences, skills, usage patterns, perceptions, interests, and obstacles. A more in-depth discussion of these issues can be found in the literature (DiMaggio et al. 2004; Dolničar et al. 2011; Dutton et al. 2007; Epstein et al. 2011; Fortunati 2010; Hargittai 2003; Hargittai and Hinnant 2008; Hilbert et al. 2010; Mossberger et al. 2003; Selwyn 2004; van Dijk 2005).

Given the broadness and complexity of the subject, we restrict the scope of our discussion to methodological interpretations related to the dynamics of a given information society indicator. In what follows, we do not address issues related to the definitions, construction, and relevance of indicators. Instead, we focus on methodological and statistical interpretations related to the empirical observations of a(ny) given information society indicator across time.

The methodological interpretations of dynamics (e.g., the evaluation of trends in digital inequalities) depend considerably on the selected method for data analysis. Vehovar et al. (2006) present an overview of typical methodological deficiencies: lack of a multivariate approach, omission of control variables, problems with compound measures, and disregard of the time distance perspective. Other studies also addresses specific methodological issues related to the analysis of the evolution of the digital divide. In particular, essential international reports (e.g., OECD [2009] and ITU [2010]) serve as a standard reference for statisticians, analysts, regulators, and policymakers. The two mentioned OECD and ITU reports, which focus on measuring the dynamics of information societies, also include some methodological discussions of the evolution of the digital divide. Specifically, the reports indicate whether the divide is shrinking or expanding, and at what pace this is occurring. Sciadas (2002) also presents valuable methodological discussions, elaborating on the absolute and relative differences in penetration rates for top and bottom income deciles over a lengthy period. In scrutinizing and discussing the interpretations and methodology behind the findings in *A Nation Online: How Americans Are Expanding their Use of the Internet* (U.S. Department of Commerce 2002), Martin (2003)—using odd ratios—questions the results, particularly the claim that the digital divide is rapidly closing.

The works of James (2009; 2011) are particularly relevant because he explicitly focuses on the empirical analyses of two most frequently used statistical measures of dynamics, that is, relative and absolute differences. Dolničar (2007; 2008; 2010) and Vehovar et al. (2006) separately discuss the three statistical measures (i.e., absolute and relative differences, and time distance) that are most often used in digital divide studies and in research related to information society dynamics.

Similar to the aforementioned researchers, we focus on interpretations of dynamics and describe them using absolute difference, relative difference, and time distance. Time distance pertains to the distance (expressed in time units; e.g., number of years) between the points in time at which two units (e.g., countries, regions, or population groups) being compared reached the same level of achievement in relation to a particular indicator (e.g., Internet penetration). As Sicherl (2007) points out, this measure provides additional insight neglected by absolute and relative change because the advantage of standardized units of time is that they are intuitively understandable to a wide audience. The current work extends the efforts of Vehovar et al. (2006) and Dolničar (2007; 2010), who discussed these measures separately. We argue that a single measure is inadequate for accurate methodological interpretation, particularly when it leads to different (or incorrect) conclusions. We propose the simultaneous observation of all the three measures, which we further improve with important methodological extensions.

Theoretical frameworks always govern indicators, but we highlight the conceptual development of a standardized methodological approach for analyzing the dynamics of any given (existing) indicator. This approach is invariant of a specific indicator or theoretical context, similar to standardized statistical concepts (e.g., mean, variance, percentage), in which core statistical interpretations are independent of the context of a specific research object. On the other hand, this conceptual article on methodology does not address specific statistical aspects related to the modeling of the diffusion process. Our goal is simply to expand the standardized methodological interpretations of the three basic measures of dynamics into an approach, thereby generating fewer differences in contextual interpretations. The methodology that we develop minimizes potential ambiguities in substantive interpretations.

The rest of the article is organized as follows. We define the concept and key elements of our methodological approach. We then apply the approach in an illustrative example to demonstrate not only how different measures easily produce varied interpretations, but also how to overcome this problem. In the empirical section, we restrict our illustration further to the basic conception of the digital divide, operationalized by differences among individuals in terms of the possibility of Internet access within a domestic environment. We then seek answers to the issue of whether the divide has been shrinking or expanding over time. The principles elaborated on this example can be extended to any other measure designed for the digital divide or for any other information society phenomenon. The conclusions and discussions end the article.

METHODOLOGICAL FRAMEWORK

The Three Basic Measures of Dynamics

The dynamics of social phenomena, including the digital divide, are most often monitored using conventional statistical measures, such as absolute and relative differences (ratio), or time distance. Numerous other complex measures, as well as advanced time-series modeling, are also available. Despite the variety of available measures, a constant requirement is that findings must be expressed in a clear, understandable, and intuitive manner when conveying essential messages to stakeholders. Absolute, relative, and time differences can precisely satisfy this requirement. Beyond these three measures, no other interpretative tools are as simple in elucidating the dynamics of the digital divide to stakeholders.

We use two countries (Denmark and Slovenia) with Internet penetration rates of 40% and 10% as examples. The absolute difference between the two is 30%; the relative difference is 0.25 or a factor of 4; and the time distance may show that the second country lags behind the first by 7 years (i.e., the first country achieved a 10% penetration rate 7 years ago). The formal relationships among the three measures are important. The background methodology for time distance was initially developed by Sicherl (see 1973; 2004) as S-time distance, which is already relatively complex.[1] The three measures provide a specific angle of observation and—all three together for all time points—contain the same amount of information as the raw data. Using some straightforward algebra (see Dolničar et al. 2005) and the corresponding levels of dependent variables (e.g., Internet penetration rates) the data can be expressed (i.e., calculated) from the values of absolute, relative, and time differences. That is, with all these three measures together we can transform the raw data space into a three-dimensional space of differences (absolute, relative, time), which also means that using only one or two measures might not be fully exhaustive, although in a majority of situations such abstraction suffice to present the essential trend. Time distance therefore provides additional information that absolute and relative differences cannot. Nevertheless, because this work is a conceptual article on methodology, we do not go much further into technical details.

Although the three statistical measures are highly informative, the question with regard to the overall magnitude and direction of the digital divide remains unanswered, particularly when these measures show different results. This problem motivates us to study the diffusion process that governs the three measures. In the next section, we argue that absolute and relative differences, as well as time distance, are merely manifestations (or reflections) of an underlying diffusion process, which is characterized by the (1) shape of related diffusion functions; (2) time delay between two observed units in the beginning stage of technology adoption; and (3) final level of specific technology penetration. The parameters of these properties are typically unknown, which is exactly why related uncertainties and hidden assumptions should be acknowledged and elucidated. This approach is the basis for accurate interpretation, in which the findings under scenarios related to the trends of technology adoption are considered.

The Diffusion Process

We build on the conceptual framework of the diffusion of innovations theory (Rogers 1962), which defines diffusion as “the process in which an innovation is communicated through certain channels over time among the members of a social system” (Rogers 2003, 5). Studying the digital divide therefore entails measuring an “innovation’s rate of adoption in a system, usually expressed as the number of members of the system who adopt the innovation

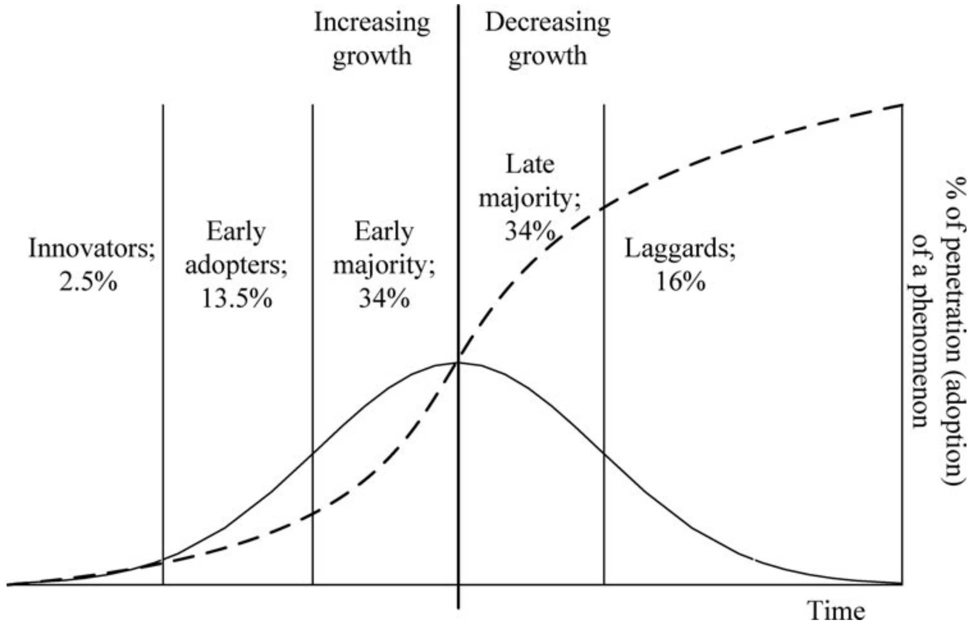

FIG. 1. The diffusion curve (the S-shaped curve, with the percentage scale on the right) and the corresponding probability density (full line) of an innovation (adapted from Rogers 2003).

in a given time period" (Rogers 2003, 20). According to this theory, the adoption of innovation usually follows a normal, bell-shaped curve (Figure 1). In formal statistical terms, this curve is a probability density function, whereas the corresponding integration yields a cumulative distribution function, which expresses the share of users that have adopted innovation by a certain point in time. Of course, when aggregated at annual levels the probability density function becomes a discrete probability distribution, where the annual values represent probability that a unit would adopt the innovation in a specific year. At the same time, these annual values also present an equivalent to the notion of annual growth rates. The annual values of discrete probability distribution are also equal to the differences between the values of the corresponding cumulative distribution function for two consecutive years.

In this article, we also denote the cumulative distribution function as a diffusion function. Under normal distribution (i.e., Gaussian distribution), the corresponding diffusion function is an S-shaped cumulative normal distribution, which is similar (but not identical) to many other S-shaped diffusion curves generated by models, such as the logistic function, Bass diffusion model, or Gompertz model.

If we assume, for example, that the period at which ICT is adopted is distributed normally with a mean time point $T = 2010$ and a standard deviation of 4 years, then 68% of users will have adopted ICT between 2006 and 2014. These users account for 34% of the population, or the early majority, and 34% are the late majority.

Rogers's S-curve is widely used and recognized as a relatively accurate description of the adoption process, including for a new ICT. The categories stated in the graph (Figure 1) are ideal types based on abstractions from empirical investigations (Rogers 2003, 282).

Comparative analysis of two units necessitates consideration of how the characteristics of the diffusion process influence the relationships among the three statistical measures. We argue that these measures should be monitored within the context of the underlying fundamental characteristics of the diffusion process in compared units (e.g., countries):

1. In most cases, the *shape of diffusion functions* that depict ICT adoption suggests some deviations from normal distribution, particularly with respect to kurtosis (peakedness) and skewness (asymmetry). Other diffusion functions (aside from the cumulative normal distribution) can also be detected (e.g., logistic, Bass).
2. The comparison of diffusion functions generally indicates that a certain *time delay* exists between leading and lagging units.
3. The final level of ICT penetration, the *saturation level*, most significantly influences the relationship between the statistical measures and final interpretations. Norris (2001) labels the phenomenon of both units converging to the same level of saturation as a *normalization* model. This model presupposes that differences between groups grow only in

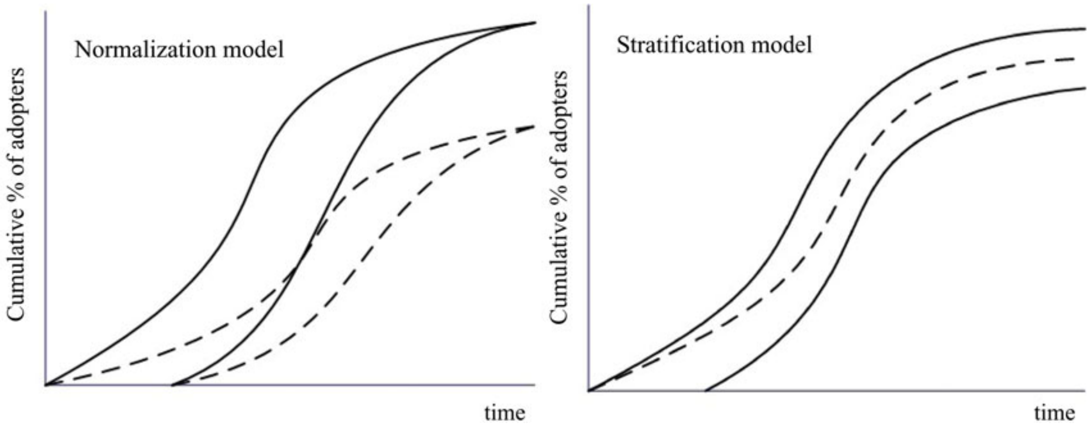

FIG. 2. Normalization and stratification model.

the initial phases of adoption (first graph, Figure 2). The leading unit (e.g., educated, younger individuals, a high-achieving country) usually initiates adoption sooner, and soon experiences rapidly increasing growth. However, in the final period when ICT adoption in the leading unit enters the saturation phase, the lagging unit (or units) reaches the same high levels of growth and the differences are eliminated. By contrast (second graph, Figure 2), the *stratification* model (Norris 2001) indicates that the final point of ICT penetration differs among groups. The initial point of adoption typically differs as well (or in some cases, is the same, as the dashed line in Figure 2 suggests); the diffusion functions vary and in the lagging category, saturation occurs at a lower level of ICT penetration.

A closer observation reveals that during the entire diffusion process, the three measures often change signs (i.e., show different digital divide: decreasing, increasing, and constant). As demonstrated by Dolničar (2007), the smallest time fragments of the compared diffusion functions should first be examined, in which each of the three measures is fixed (i.e., does not change). In this manner, we obtain segments of time that can be described with uniform relationships between statistical measures.

We then construct typologies related to the combinations of two diffusion functions, which depend on the variations in the already-mentioned characteristics of the diffusion process (i.e., shape of the diffusion function, initial time delay, and final level of ICT penetration). Deploying key types, the diffusion of ICT in time is described using theoretical, artificially generated values. Such a typology provides a structure to account for the digital divide modifications (regarding the three statistical measures) in the case of combinations of different types of diffusion functions. Concomitantly, it helps to establish how the considered characteristics of ICT diffusion influence the relationships between statistical measures. For example, Dolničar (2008) demonstrates that even in the most rudimentary examples with delayed diffusion processes, in which both diffusion functions are equal and normally distributed, no uniform conclusions can be drawn regarding the measures of digital divide trends because the three measures change during comparison. On the contrary, even in this simplest example we can observe segments with measures that have different directions (e.g., the first segment has fixed absolute difference, increasing relative difference, and decreasing time distance). For more technical details, the readers are referred to Dolničar (2008).

To overcome these inconsistencies, we propose an approach that features the following essential steps:

1. All the three measures (absolute difference, relative difference, and time distance) are first observed and presented.
2. The three essential characteristics of the underlying diffusion processes (diffusion function, initial time delay, and final level of penetration) are deduced or approximated.
3. Assumptions are then identified and formalized to create scenarios of possible future developments.

In the next section, we implement the proposed approach in an empirical example, in which we address the issue of whether the divide is closing: that is, whether the data indicate a normalization or stratification model of ICT adoption.

DIGITAL DIVIDE CASE STUDY: SLOVENIA AND DENMARK

We illustrate our approach with a case study that examines household Internet access, one of the most frequent indicators used in digital divide studies.

The Data

We compare the digital divide in two countries, namely, Slovenia and Denmark. Slovenia is a small and progressive country with a population of 2 million. Slovenia gained its independence in 1991, and in 20 years demonstrated rapid economic growth, became a member of the European Union (EU) and NATO in 2004, and adopted the Euro as its official currency in 2007. Denmark is also a relatively small (population, 5.5 million) but developed EU country, with a gross domestic product (GDP) per capita of 117% in PPP in relation to the EU27 average in 2009 (Slovenia, 87%). Slovenia's strategic goal is to rank as one of the most developed EU countries, where considerable concern for social issues and advanced information societies is prevalent. Scandinavian countries are therefore fitting objects of comparisons. Denmark in particular is a suitable reference country because of its well-developed social and welfare system, as well as its comprehensive general policies, including those on the development of information societies. Within this context, we investigate the digital divide between the two countries because such a divide is an important indicator of whether Slovenia is moving in a direction that accords with its targets.

Data on Slovenia were obtained from the Slovenian General Social Survey, conducted by the Public Opinion and Mass Communication Research Centre at the Faculty of Social Sciences, University of Ljubljana (for 1996–2003), and from the Statistical Office of the Republic of Slovenia (for 2004–2009), which also provides official statistical data on information societies to Eurostat. Data on Denmark were acquired from OECD Statistics (for 1996–2006; OECD Information Technology Outlook 2008) and from recent reports published by Eurostat (for 2007–2009). The units of observation were households. As previously explained, we limit our analysis to the basic conception of the digital divide, which points to the differences between countries in terms of household Internet access (OECD 2001). Although the surveys we used as data sources are different, the questions designed to determine household Internet access are phrased in a similar manner.[2]

The selected indicator assumes that (i) Internet access is available in a household[3]; (ii) any type of connection is considered valid access to the Internet; and (iii) access does not necessarily drive or reflect usage. By using a sufficiently specific indicator, we reduce the problems arising from the changing definition of Internet access. All the data were collected using general social surveys on representative (national) samples.

Basic Analysis

First, we present the data for 1996–2009, corresponding diffusion curves (i.e., cumulative distribution functions), and annual changes in penetration, which are equivalent to a probability density function in a discrete (i.e., annual time) setting. As Table 1 shows, we adjusted real data using a simple regression curve.[4] For the years in which several measurements are available, we calculated the average. The adjusted data were then used as bases for the calculation of the three statistical measures. The annual changes in penetration were adjusted using moving averages (3 years) and were further used as approximations that are based on discrete variables (i.e., annual data) for the corresponding probability density function. The initial Internet penetration delay (in 1997) between the two countries is approximately 1 year. More detailed insight into additional data from the early 1990s indicates that Internet penetration in households symbolically and formally began almost at the same time in both countries,[5] but these are only initial figures and are statistically negligible. In 2009 (according to Eurostat data), the proportions of households with Internet access in Slovenia and Denmark were 64% and 83%, respectively.

The vertical dashed lines in Figure 3, and later in Figures 5, 6, and 7, present temporal periods characterized by a uniform relationship between statistical measures, indicating the three segments in which the relationships

TABLE 1

The actual and adjusted data for the indicator "Access to the Internet in households" (% of households, Slovenia and Denmark, 1996–2009), with data adjusted with regression (third-order polynomial trend lines) and the three calculated statistical measures (TD, time distance; R, ratio; A, absolute difference)

	Real data		Adjusted data		Three basic measures (based on adjusted data)		
Time	SI	DK	SI (b)	DK (c)	TD	R	A
1996	3	5	3.0	5.0		**0.600**	**−2.0**
1997	8	10	7.5	13.0	**0.7**	**0.577**	**−5.5**
1998	13 (a)	22	12.3	24.3	**1.15**	**0.506**	**−12.0**
1999	18	33	17.0	34.5	**1.65**	**0.493**	**−17.5**
2000	21	46	23.0	43.5	**2.2**	0.529	**−20.5**
2001	28	55	28.5	52.0	**2.65**	0.548	**−23.5**
2002	33	59	34.0	59.0	**3.1**	0.576	**−25.0**
2003	41	66	39.5	65.3	**3.45**	0.605	**−25.8**
2004	47	71	44.5	71.0	**3.85**	0.627	**−26.5**
2005	48	73	49.3	75.0	**4.3**	0.657	−25.7
2006	54	80	54.0	78.5	**4.7**	0.688	−24.5
2007	58	78	57.5	80.7	**5.25**	0.713	−23.2
2008	59	82	61.0	82.0	**5.7**	0.744	−21.0
2009	64	83	63.0	83.0	**6.45**	0.759	−20.0

Note. (a) The missing value has been evaluated using moving averages.

(b) $y = -6E\text{-}11x^3 + 3E\text{-}06x^2 + 0.0517x - 29732.9$; $R^2 = 0.9935$.

(c) $y = -4E\text{-}10x^3 + 5E\text{-}05x^2 - 1.778x + 21558$; $R^2 = 0.9964$.

The values in bold represent the increase in the measure.

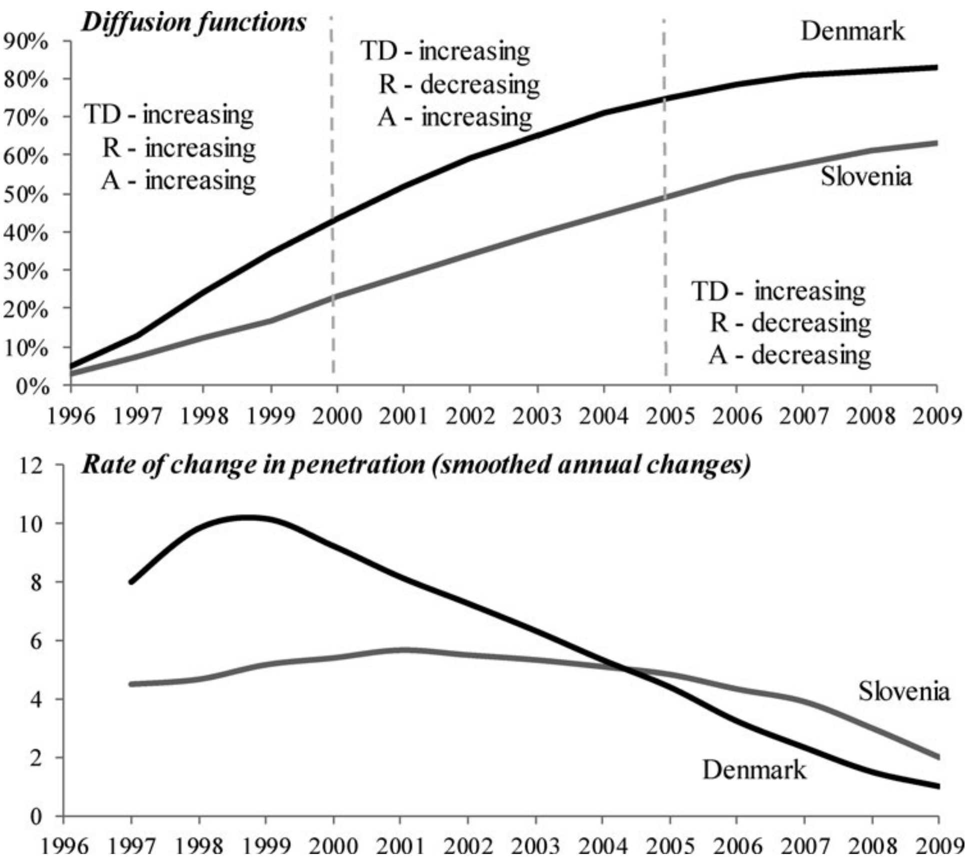

FIG. 3. Comparison of the diffusion functions (i.e., cumulative distribution function) and rate of change in penetration (i.e., probability density function) for the indicator "access to the Internet in households" (% of households, Slovenia and Denmark, 1996–2009); data adjusted with regression (third-order polynomial trend lines).

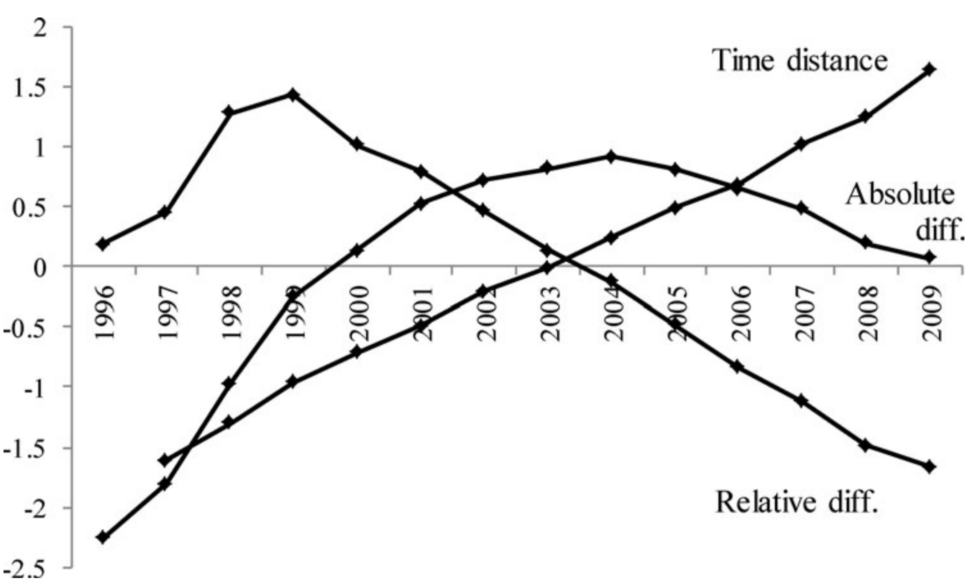

FIG. 4. Schematic trends for the three measures based on standardized data (for practical reasons, standardized data are used and the relative differences are calculated on the basis of percentage differences instead of ratios).

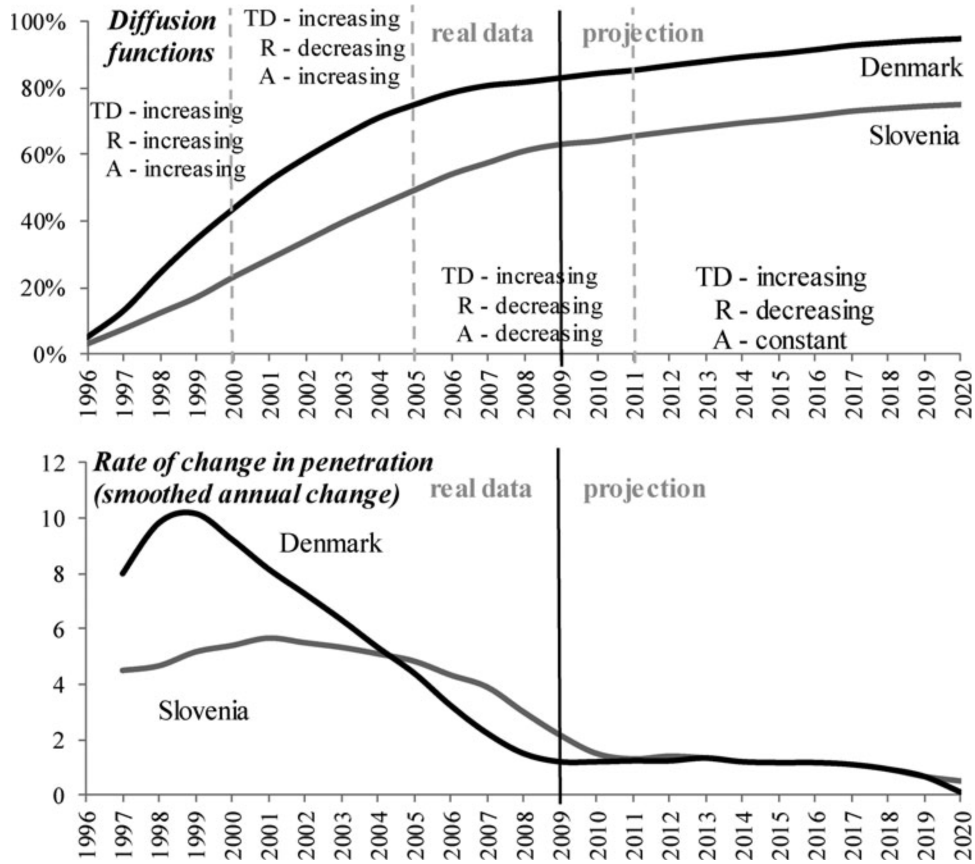

FIG. 5. Scenario A for diffusion of the Internet in households in Slovenia and Denmark (1996–2020); stratification model (95% vs. 75% final Internet penetration level).

between the statistical measures (TD: time distance; A: absolute difference; R: relative difference) are stable.

The comparison of the three statistical measures shows considerable differences between the diffusion processes of the two countries (the data and measures are presented in Figure 3 and Table 1):

1. In the first period, all the three measures showed an increasing digital divide (the absolute and relative differences increase, as do the time distance values for 1996–1999). The level of Internet penetration that has been recorded for Slovenia in 1998 has been achieved in Denmark approximately 1.15 years before, but in just 1 year the time lag increased to 1.65 years.
2. In the second period (2000–2004), the digital divide increased as evidenced by the absolute (from 20.5 to 26.5 percentage points) and time differences (from 2.2 to 3.9 years), but already decreased according to the relative differences. In 2000, Slovenia achieved 53% of the penetration of Denmark, and this proportion increased to 63% in 2004.
3. In the third period (2005–2009), the absolute differences decreased (from 25.7 to 20.0 percentage points) and the relative differences increased (from 66% to 76%). According to time distance values, however, the divide continues to considerably grow (in 2009, the delay between the countries increased to 6.5 years, indicating that within this period alone, the gap expanded by another 2 years).

This example demonstrates how interpretation can lead to ambiguous conclusions. According to the absolute differences, the divide grew after 2000, whereas the relative differences reflect a shrinking divide. This finding is consistent with the results of the empirical study determining Internet accessibility in households during the 1996–2005 period, where a large data set from representative Slovenian public opinion polls was used to study how the three measures are influenced by the main characteristics of the diffusion process, observing 13 sociodemographic variables: gender, age, education, social stratum, employment status, household income, personal income, marital status, nationality, type of local community, size of community, number of household members, and religiosity (Dolničar

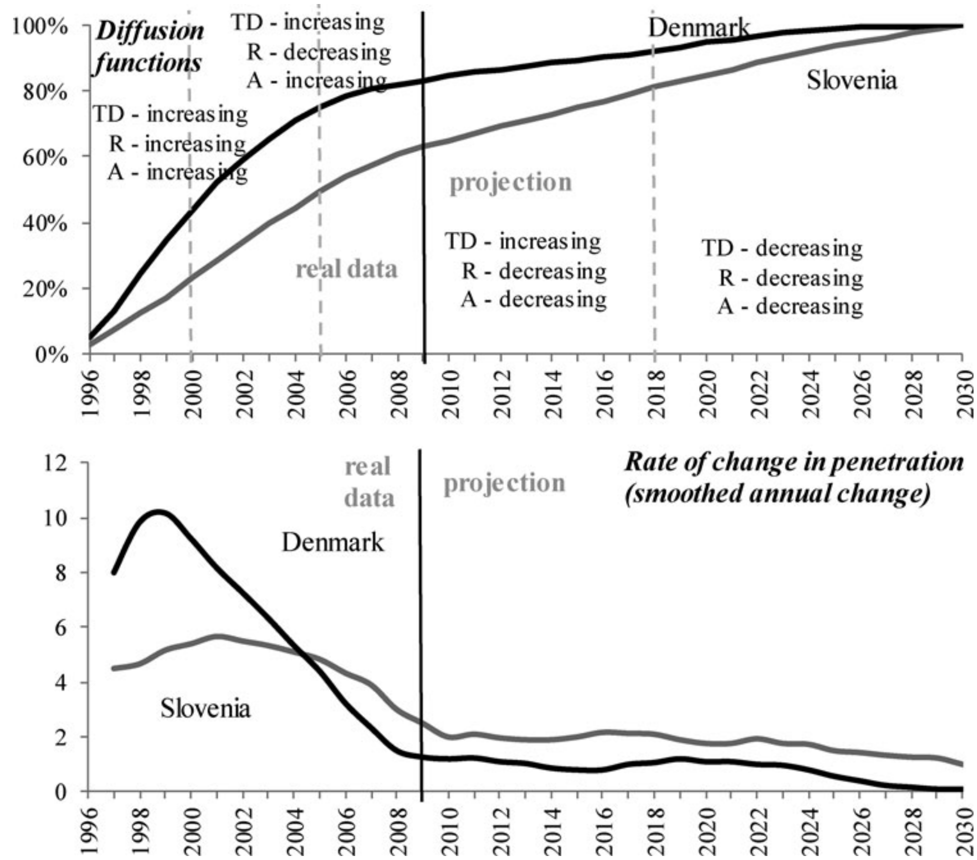

FIG. 6. Scenario B for diffusion of the Internet in households in Slovenia and Denmark (1996–2030); normalization model (100% final Internet penetration level by 2030).

2007). Among other findings, it was concluded that the most frequently occurring relationship between the three statistical measures is the one where according to the absolute differences and time distance the divide is increasing and according to the relative differences the divide is narrowing. Taking the relative differences only into account, one could be tempted to conclude that the digital divide is shrinking with regard to nearly all factors. In his perspective on the growth rate related to the S-curve and the stages of ICT penetration (saturation, plateau, dynamics), Sciadas (2005) asserts that all new technologies are subject to a divide in the early stages of penetration. "Thus, at early stages of diffusion there is strong justification to examine people grouped by characteristic of interest. Only when ICTs approach saturation do their diffusion patterns start to resemble the population at large and the distinction between 'haves' and 'have-nots' fades" (Sciadas 2005, 9). James's (2009) study on the relative and absolute digital divide in developing countries highlights the viewpoint that bridging the relative digital divide is relatively easier to accomplish for "latecomer" countries; according to this interpretation, therefore, closing this gap is "hardly a meaningful goal worth striving for" (James 2009, 1125).

Focusing on the period after 2000, we find that the absolute differences in 2000 and 2008 were approximately the same (20.5% and 20.7%, respectively). However, is the difference between 23% and 43.5% of the same magnitude as the difference between 49.3% and 75%? As James (2011) indicates, a ratio of 10:5 is the same as a ratio of 100:50 or 1,000:500, even though the figures involved reflect large differences. This problem is also visibly demonstrated by the application of the time distance method in the host density (the number of Internet hosts per 10,000 inhabitants) of Slovenia and the EU-15 average in 1995–2004 (Vehovar et al. 2006). Within a 9-year period, the current work generated the same figures for the relative digital divide (40% in 1995 and 2004), but a markedly different interpretation in terms of time distance (1 vs. 4 years). This discrepancy can be explained by the fact that it was much easier to expand growth in 1995 when the annual growth rates in host density were around 100% than in later years when the growth rates were merely around 10% or had stagnated.

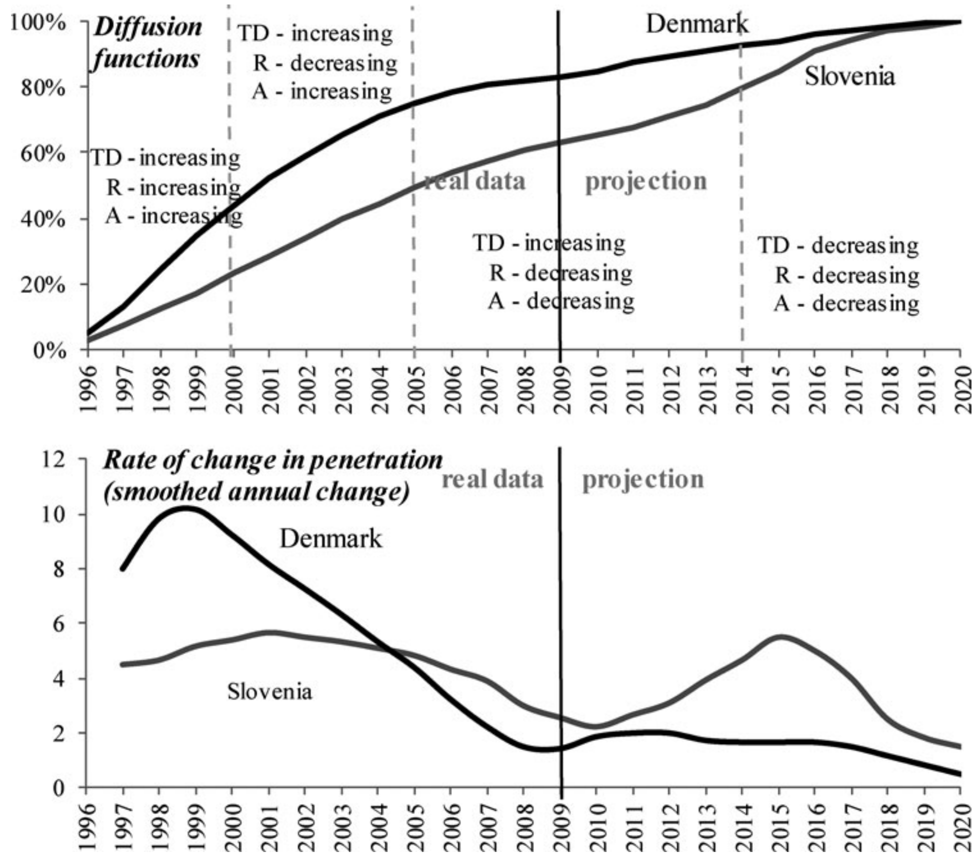

FIG. 7. Projection of the diffusion of the Internet in households in Slovenia and Denmark (1996–2020); normalization model (100% final Internet penetration level by 2020).

We further illustrate the possible (mis)interpretations and (mis)use of available data. The key issue for a stakeholder in an information society is whether the digital divide is shrinking, growing, or stagnating. The interpretations can be easily skewed toward the interests of stakeholders. The values of all the three measures are graphically presented in Figure 4. The relationships between the measures can be clearly observed as their directions change across time.

The government institution responsible for ICT adoption in Slovenia may be inclined to emphasize the decreasing gap (compared to Denmark benchmark target) based on the relative differences, while critics may focus on the growing time distances. In principle, anybody can choose the measure most convenient for his or her purposes within partial approaches, and actual trends may remain unelucidated because thus far, no criteria, hierarchies, or priority standards exist; why would a certain measure be better than another? We believe that even the simultaneous observation (e.g., Figure 4) of the three measures cannot fully clarify whether the gap is closing, although this approach is considerably more informative than using only a single measure.

In the second step, we go beyond the three measures, which are only the manifestations of the underlying regularities of distribution functions. The explanation as to the actual trend of the digital divide basically depends on an *unknown* assumption about the form of the diffusion curves, as well as on an assumption related to the level of the final stages of Internet penetration. Aside from the initial one-year lag, a very flat distribution curve is observed for Slovenia and high skewness for Denmark (Figure 3).[6] These characteristics alone already—in considerable part—explain the value of the three indicators. The third essential characteristic of the diffusion process is related to saturation level, which is unknown. To address this issue, we can employ simple extrapolations or more sophisticated statistical models, as well as expert scenario construction. We opted for the last one because statistical modeling can conceptually add relatively little (i.e., only a certain sharpening in the scenario selection process) to the basic philosophy of our approach.

Scenarios of Future Developments

Similar to Chermack, Lynham, and Ruona (2001), we define scenario construction as a qualitative technique for forecasting and as a narrative description of possible future events. In applying the scenario method, we skeptically approach the deterministic assumptions of the diffusion of innovations theory—hence the introduction of the two key diffusion models (normalization and stratification) and the focus on the various shapes of diffusion functions. Following Bouwman and van der Duin (2003), we assume that the only adequate way to present scenarios is to clearly outline and present several alternative future possibilities.

We look at the time series of real (empirical) data and at the projections based on some theoretical assumptions and assumed diffusion functions (for an elaboration on the two concepts, see Sicherl [2004]). After reviewing the three basic characteristics of the diffusion process based on real data, we summarize the conclusions and starting points of the scenarios as follows:

1. The identification of the diffusion functions in the three Internet diffusion scenarios is relatively unproblematic because we are already in the decreasing growth phase for both units.
2. The initial time delay is assessed to be approximately 1 year; thus, its influence is minor and its implications will not be explained in detail.
3. The primary characteristic of the diffusion process that we focus on is the final level of Internet penetration, which determines the components of the normalization and stratification models.

In what follows, we present the three key scenarios for Internet diffusion: one with the normalization model and two with variations of the stratification model. The details of the corresponding measures (A, R, TD) for all the three scenarios are presented in the appendix.

Scenario A: Stratification Model by 2020

In Scenario A (Figure 5), the level of Internet access in Slovenia and Denmark will not reach the same level by 2020, nor will it be saturated at 100% penetration. This outcome appears to be the most likely because of the decline in the growth rate of Internet penetration in both countries. The increase in household Internet access is expected to proceed at a slower pace because the drivers are largely younger generations instead of older ones, who are unlikely to adopt Internet technology, at least without extensive external incentives. Given that the shift to "digital natives" will primarily be a generational shift, the share of population born in a year is assumed to be around $R = 1\%$. With some simplifications we further assume that the process of declining household Internet use is predominant in households whose members are older than 65 years. For example, we can estimate the 2009 Internet penetration in this segment to be $I^{Si,\,65+} = 20\%$ in Slovenia and $I^{Dk,\,65+} = 40\%$ in Denmark. We further assume that for these cohorts (i.e., 65+ in 2009) the penetration rate will remain the same in future years, while the share of these cohorts in the total population will slowly diminish. On the other end, young households would enter—replacing old ones—with an Internet penetration rate of 100%. Of course, a much more sophisticated model could be used here, but the preceding suffices for a conceptual illustration.

We smoothed this annual growth model using a third-order polynomial.[7] In accordance with this annual growth model, 2020 reflects final penetration levels of 75% and 95% in Slovenia and Denmark, respectively. The black vertical line in Figure 5 at time point 2009 differentiates real, measured data from anticipated potential values. This scenario indicates that after 2011, the digital divide slightly decreases as indicated by the relative difference; is almost constant (a slight decrease can also be expected) as reflected by the absolute difference; and increases according to the time distance. These attributes are typical of the stratification model. In this scenario, the three measures (each one by itself is objective, straightforward, and easy to understand) imply three different conclusions or interpretations (i.e., the divide is growing, stagnating, or closing), which can be confusing and likely easy to manipulate.

The essence of these comparisons should therefore be conveyed to stakeholders in alternative terms (i.e., not in terms of selected statistical measure A, R, or TD), which are related to the characteristics of the diffusion process:

1. The shapes of adoption curves differ: The adoption rates were much lower for Slovenia, and the inflection point (the point at which the growth rate is maximized and the cumulative curve shifts from increasing to decreasing growth) in Denmark already occurred in 1998 at 24.2% Internet penetration (adjusted data). In Slovenia, Internet adoption reached its maximum growth rate in 2002 at a level of 34% (adjusted data). In both countries, the increasing growth trend shifted to a decreasing one relatively early (close to 30% Internet penetration). After the inflection point adoption curve for Denmark remained steep, however, the adoption rates for Slovenia were relatively low with different peaks.
2. Slovenia initially adopted the Internet with a 1-year delay.
3. This (generation replacement) scenario reflects (in a 2020 prospective) a stratification model, indicating

that the differences in the final penetration rates will still be considerable: 95% versus 75%.

Figure 5 shows the diminishing relative differences between the two segments (starting in 2000), which results from the transition from increasing to decreasing growth. Considering the anticipated scenario, the absolute differences are expected to begin decreasing in 2005, during which Slovenia has a growth rate higher than that of Denmark; this situation indicates progression far into the phase of decreasing growth. If Internet adoption in Slovenia and Denmark follows this scenario, the absolute differences in the final period (2011–2020) would be approximately constant. Identical absolute differences (along with the prevalence of the digital divide) occur when both countries evolve at the same pace, but with varying levels of Internet penetration. However, this situation bears no significance on the time distance values, which are constantly increasing (even in the final period) under the stratification model. With regard to the size and dynamics of the digital divide, a substantial gap (according to all the three measures) will remain in 2020 and 2030 (a simulation of the evolution of this scenario until 2040 shows that in 2030, the absolute difference is still about 10%; the ratio is approximately 0.92; and the time distance increases to about 15 years[8]), but will gradually become negligible around 2040.

Such findings are the basic message of scenarios, and reporting the trends of the specific measures is secondary in importance. However, if we want to demonstrate the disparities in statistical measures, all the three (most commonly used) measures should be presented to describe the gap as stable and gradually declining (i.e., 20% absolute difference), gradually declining (i.e., 80% relative difference), or gradually growing (i.e., 6-year time difference). If only the trends of the measures are discussed in this scenario, we can expect government stakeholders to choose the relative difference measure, given that it reflects progress; other stakeholders (the opposition, media, nongovernmental organizations [NGOs]) would argue that the position of Slovenia compared with that of Denmark shows no improvement or is improving too slowly. The discussion of the trends of a single selected measure is exactly what we want to avoid. Instead, potential discussions should be directed toward future adoption segments, saturation levels, potential changes in the parameters of the "generation replacement" scenario, sharper statistical modeling (particularly of the experience with similar diffusion patterns in other countries and/or other technologies), and new ICT issues (e.g., changing role of mobile and TV devices). The key message of this (very likely) scenario is that, unless some external stimuli occur, Slovenia will continue to follow the lagging stratification scenario at least for the next 10 years.

Scenario B: Normalization Model by 2030

The second projection (Figure 6) is an illustration of a possible long-term normalization scenario, assuming a 100% penetration in household Internet access, where Slovenia increases the penetration rate faster than in Scenario A. Scenarios that provide long-term insight (20 years in this case) are difficult to establish and justify because several issues regarding their validity arise.[9] Especially in an information society (because of rapid development and new innovations), we cannot foretell what the Internet will be like, what its status will be, and whether it will be as important as it is today in 2030. Internet household access may no longer be a relevant measure because mobile devices and TV Internet access can become mainstream. Van Dijk (2005) similarly questions Rogers's premise regarding the S-curve that characterizes the adoption of innovations, and emphasizes that the path is considerably more complex and differentiated among population groups (or countries). Nevertheless, we illustrate this (otherwise most commonly used) normalization model, as well as studying the adoption curve and the relationships between the statistical measures. Each distribution function[10] is characterized by increasing growth followed by decreasing growth. Both countries are characterized by higher growth rates[11] than those depicted in the stratification model (Scenario A). Both annual changes in penetration curves are asymmetrical, but a new distinctive wave of growth is unnecessary, as the third and even more optimistic scenario implies (Figure 7).

With regard to the relationships between the statistical measures of the digital divide, the absolute differences constantly decrease after 2005, which alone can indicate a normalization model (as illustrated in the stratification model in Scenario A, the absolute differences become constant in 2011). An even more revealing measure is the time distance, which according to Scenario B starts decreasing after 2018 (clearly indicating that the normalization model is more probable; as shown in the previous scenario, the stratification model shows a growing divide, according to the time distance).

The policy implications of this scenario are straightforward, given that the diffusion process progresses almost automatically. This automatic nature aligns with the "trickle-down" principle, which assumes (in our opinion, a highly questionable assumption, which makes this scenario less likely than Scenario A) that the digital divide will shrink by itself. Additional measures as to the potential of speeding up the adoption process can be discussed because 2030 may be too remote as the considered time frame. A stronger justification as to why the diffusion process will evolve on its own by 2030 in this scenario but not in the stratification scenario (at which the difference in 2030 will persist at about a 10% absolute difference, 0.92 ratio, and 15-year time distance) is also necessary.

Scenario C: Normalization Model by 2020

Scenario C (Figure 7) is an optimistic 2020 projection of a normalization model.[12] This scenario requires a bimodal annual change in penetration curves for Slovenia, which would require another intensive wave of Internet diffusion between 2010 and 2020 at very high growth rates (an average of 4.3% and 1.7% for Slovenia and Denmark, respectively). Incorporating another diffusion wave would necessitate the inclusion of comprehensive and radical government incentives (e.g., free broadband infrastructure, minimal access and usage costs, education and promotion among specific segments, promotion of some "revolutionary applications"), along with an extensive digital literacy policy, especially targeted toward digitally excluded groups (e.g., the elderly and lower educated groups).

The relationships among the statistical measures correspond to those in the normalization model up to 2030 (Scenario B), but according to all the three measures, the divide begins shrinking much sooner—in 2014. This example confirms the importance of applying an adequately comprehensive approach because if we examine only the diffusion functions, then the normalization would appear reasonable. However, considering only the (annual) rates of change (i.e., net adoptions, after deducting discontinuations from new user additions) alters interpretations because achieving bimodality would require substantial activities. For Denmark, we assume a slightly increased growth rate, but this rate can be modified further in accordance with the assumption of the model. One of the benefits of this analysis is that it enables the identification of the parts of the population in which certain phenomena are doubted, as well as the definition of adjusted policies and incentives directed toward these groups.

DISCUSSION AND CONCLUSION

Every communication space where persuasive arguments are needed to drive decision making on certain controversies is prone to the misuse or abuse of statistical data. Discussions about public issues in general and those from the political arena in particular are no exception. Within this context, Van Dijk and Hacker (2003) argue that statistics are often purposely selected and exploited in accordance with political interests or subjective perspectives.[13] Possible misuse and abuse of statistical data by groups of various interests are also described in many popular readings (e.g., Best 2001; Blastland and Dilnot 2008; Huff 1993). Many of the instances of misuse may be unintentional, but they rather originate from lack of knowledge. It is also true that once statistical data are distorted or manipulated, these become uncontrollable, spreading a wrong picture of a problem. Trust in data and the empowerment of stakeholders involved in important societal issues, such as the digital divide, should take precedence in methodological analyses.

Contribution

In this work, we outlined an approach for the integrated elucidation of the dynamics of the digital divide, thereby facilitating the improved understanding of societal issues. We initially focused on three basic measures (absolute, relative, and time differences) that are typically used to convey research findings to stakeholders. In practice, however, only one of these measures is often employed in interpreting digital divide dynamics. A single measure provides only partial insight and may be easily manipulated to serve the interests of a specific group.

To prevent such situations and fully empower stakeholders, we proposed an alternative three-step methodological approach, which involves (1) calculating all the three measures (for entire time series), (2) estimating the underlying characteristics of distribution curves (shape, lag, saturation level), and (3) creating scenarios to elucidate hidden assumptions.

Generally, the essential added value of this approach is a comprehensive perspective of situations and the simultaneous use of more statistical measures, together with a critical evaluation of the deterministic implicit assumptions related to the diffusion of innovations theory, particularly with respect to final ICT penetration levels.

These three steps may not be necessary in cases where the comparisons are visibly observable or inconsequential. However, we believe that a more comprehensive discussion of the digital divide should include all of the three proposed steps. We can already observe this trend in contemporary practice, given that an increasing number of studies are shifting from presenting (and discussing) only one measure to applying more complex treatments. Increasingly, absolute and relative differences are not the only measures discussed; studies have extended arguments to include time distance, as in the case of a recent OECD Statistics Working Paper (Sicherl 2011) and the ITU report *Measuring the Information Society* (ITU 2010). We firmly believe that a knowledgeable stakeholder is one who is fully aware of the actual picture.

We illustrated our approach in the empirical section, using the divide in Internet household penetration in Slovenia and Denmark. We first showed that each measure might convey different—even contradictory—substantive interpretations of digital divide trends. The simultaneous observation of all the three measures sheds more light on this issue, but we propose that instead of observing and interpreting these measures, the characteristics of the diffusion process should be analyzed. To this end, we discussed a few scenarios, which enabled interpretation to revolve around final penetration levels and not around the trends of the three statistical measures. We showed that the most likely scenario for 2020 (Scenario A—generation replacement) is a continued and considerable digital divide (75% versus 95%) between the two countries. Further contextual interpretation should then focus on the evaluation of such a gap, its consequences on national policy, corresponding assumptions, and alternative scenarios.

With respect to the practical implementation of our approach, it is sequential in nature, given that even discontinuing the process after the first or second steps is also beneficial. The full implementation of the first step alone, that is, presenting all the three measures, already promotes considerable progress compared with using only one or two measures. The second step—the discussion of potential characteristics (together with potential statistical modeling of diffusion functions)—can also be a standalone procedure with an added value that is not necessarily associated with the third step (scenario building and explicit discussion of assumptions).

The proposed approach is applicable to any measure of the digital divide. The approach can also be extended to other information society indicators and interpretations of the dynamics of general societal phenomena. We believe that our approach extends the scope of standardized methodological interpretations in this area and expands possibilities for standardization, so that ambiguous substantive analyses that usually pertain to subjective contextual interpretations are effectively clarified.

Limitations

Being methodological in nature, our approach does not question complex conceptual and theoretical issues related to the definition of the digital divide and its variable quality. Nevertheless, the approach can be applied to any empirically measured concept of digital divide dynamics. It is also applicable to more structured analyses of the digital divide within certain sociodemographic groups because it is a method that is equally suitable for any subgroup.

At the same time, because this work looks at methodology at a conceptual level, we did not focus on technical issues related to statistical modeling and time series. Advanced statistical techniques may facilitate a more precise identification of distribution functions, particularly for projections and forecasts. We also acknowledge the importance of such techniques in an advanced examination of important digital inequalities. Using advanced statistical time series (e.g., ARIMA) or modeling specific diffusion functions (e.g., normal, logistic, Gompertz's model of internal influence or Bass's model of mixed influence) can substantially enhance the quality of results, especially that of the formulation of appropriate scenarios. In some instances, the power of a statistical forecasting model may even reveal definitive information on future diffusion trends. Nevertheless, such techniques are not a fundamental component of our methodological approach, which can be used (as demonstrated in our example) without advanced statistical modeling. This work is not concerned with specific statistical issues; thus, a more technical elaboration will not bring added value to the study. Incorporating these issues would also exceed the scope of the article.

The same holds true for more elaborate scenarios. We limited our scope to illustrative examples and did not discuss issues related to subgroups or additional assumptions associated with specific factors that influence projected trends of diffusion functions. Practical applications should be heavily based on past experience and examples of diffusion functions, be they from other related environments (e.g., countries) or similar ICT phenomena. The patterns from related diffusion functions can provide valuable insight into deciding on future scenario options.

Finally, in practice, the time series are frequently very short. Interpretations may inevitably rely on even larger number of implicit and hidden assumptions (which cannot be properly treated and explicated), providing numerous opportunities for subjective understanding.

Another issue that is difficult to manage in reality is the fact that ICT phenomena are not clearly delineated and fixed in scope and definition (particularly in the long run). They are characterized by substantial overlap and are often interwoven. Their essence and nature (the definition of Internet access is perhaps the most typical example) dynamically change, thereby bringing forth additional complexity. In discussing the absolute and relative changes in a certain indicator, the recommendations in the outlined methodology should nonetheless be considered.

Recommendations for Future Work

Future research can focus on important issues related to human perceptions of the statistical measures (e.g., the understanding of absolute or relative difference). This approach is partially emphasized by Sicherl (2004) and by neuropsychological research related to the perception of numbers (e.g., Dehaene 2011) or graphs and tables (e.g., Friel et al. 2001). Further elaboration on theoretical and empirical work (e.g., Nardo at al. 2008) related to the potential construction of a single integrated synthetic measure for digital inequality is also a worthwhile research direction; this approach depicts situations in a simple manner (in contrast to the complex multi-indicator strategy in our approach). Researchers can also seek solutions for prioritizing statistical measures, depending on which is the most applicable at a certain stage of diffusion.

NOTES

1. For more information, see also http://www.gaptimer.eu/overview_of_the_methodology.html

2. OECD questionnaire (OECD 2009): "Does any member of this household/do you have access to the Internet at home regardless of whether it is used?«; GSS questionnaire (translated): "Does your household have access to the Internet at home?"; Eurostat (SORS): "Do you or anyone in your household have access to the Internet at home, regardless of whether it is used?"

3. Statistics Denmark also provides information on information societies but its unit of observation is the family. The interesting effect is that it reports higher penetration rates than does Eurostat (e.g., for 2009, Statistics Denmark 86% and Eurostat 83% of households with access to the Internet).

4. Third-order polynomial trend lines; $R^2{}_{\mathrm{DK}} = 0.9935$ and $R^2{}_{\mathrm{SI}} = 0.9964$.

5. The bases for this conclusion for Slovenia are the data provided by RIS (a national project on the use of the Internet in Slovenia, http://www.ris.org) and for Denmark are the data from the Denmark Statistical Yearbook 2010 (http://www.dst.dk/HomeUK/Statistics/ofs/Publications/Yearbook/2010.aspx).

6. Both distribution curves and corresponding annual changes in penetration are approximated with simple third-order polynomial functions (as mentioned in notes 4 and 8 and in Table 1). These calculations can be further modeled with general time series (e.g., ARIMA) or more specific diffusion models.

7. Denmark: $\mathrm{y} = 0.0127\mathrm{x}^3 - 0.7269\mathrm{x}^2 + 14.51\mathrm{x} - 11.556$; $\mathrm{R}^2 = 0.998$; Slovenia: $\mathrm{y} = 0.0009\mathrm{x}^3 - 0.1864\mathrm{x}^2 + 7.3053\mathrm{x} - 7.0426$; $\mathrm{R}^2 = 0.9959$.

8. An increase in the time distance in the last phase of Internet adoption is expected because of the asymptotic narrowing of the difference between the two functions.

9. Very different time horizons are used in forecasting, usually classified as short-term, mid-term, and long-term forecasts. For this scenario, a time frame of 21 years is taken (2009–2030). Considering other classifications of forecasts' time horizons (see Albright 2002; Weingand 1995), this time frame fits in long-term predictions. However, the »real« time horizon is long (13 years), which may lead to more accurate forecasts.

10. The corresponding polynomial equations are: Denmark: $\mathrm{y} = 0.0068\mathrm{x}^3 - 0.4914\mathrm{x}^2 + 11.985\mathrm{x} - 5.6095$; $\mathrm{R}^2 = 0.9912$; Slovenia: $\mathrm{y} = 0.0025\mathrm{x}^3 - 0.2071\mathrm{x}^2 + 7.3111\mathrm{x} - 6.8056$; $\mathrm{R}^2 = 0.9981$.

11. In Scenario A, the growth rates from 2010 forward are on average 1.18 (a 10-year average) in Denmark and 1.61 in Slovenia. In Scenario B, the 20-year averages for Slovenia and Denmark are 2.23 and 0.89, respectively (due to very low growth rates in the last 10 years for almost absolute penetration). The 10-year average growth rates for Slovenia and Denmark are 2.76 and 1.21, respectively.

12. The corresponding polynomial equations are: Denmark: $\mathrm{y} = 0.0122\mathrm{x}^3 - 0.6889\mathrm{x}^2 + 14.094\mathrm{x} - 10.695$; $\mathrm{R}^2 = 0.9978$; and Slovenia: $\mathrm{y} = 0.0032\mathrm{x}^3 - 0.1787\mathrm{x}^2 + 6.7697\mathrm{x} - 5.4631$; $\mathrm{R}^2 = 0.9961$.

13. Of course, we should differentiate between purposeful one-sided reporting of results based on only one statistical measure that shows findings in line with the reporter's interests on one hand, and goal-oriented use of statistics that implies a well-thought choice of particular statistical measure or method on the other hand. If the choice of the measure or method can be methodologically justified and if the purpose and potential impact of the study are appropriately taken under consideration, the usage of that particular measure or method should not be considered as negative (for more details, see Hilbert 2011).

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APPENDIX: THE BASIC THREE STATISTICAL MEASURES FOR THE PRESENTED SCENARIOS

	Scenario A, Stratification model by 2020			Scenario B, Normalization model by 2030			Scenario C, Normalization model by 2020		
Time	TD	R	A	TD	R	A	TD	R	A
1996		0.600	−2.0		0.500	−3.0		0.600	−2.0
1997	0.70	**0.577**	**−5.5**	0.60	**0.577**	**−5.5**	0.60	**0.577**	**−5.5**
1998	**1.15**	**0.506**	**−12.0**	**1.15**	**0.506**	**−12.0**	**1.15**	**0.506**	**−12.0**
1999	**1.65**	**0.493**	**−17.5**	**1.75**	**0.493**	**−17.5**	**1.75**	**0.493**	**−17.5**
2000	**2.20**	0.529	**−20.5**	**2.20**	0.529	**−20.5**	**2.20**	0.529	**−20.5**
2001	**2.65**	0.548	**−23.5**	**2.60**	0.548	**−23.5**	**2.60**	0.548	**−23.5**
2002	**3.10**	0.576	**−25.0**	**3.10**	0.576	**−25.0**	**3.10**	0.576	**−25.0**
2003	**3.45**	0.605	**−25.8**	**3.45**	0.605	**−25.8**	**3.45**	0.605	**−25.8**
2004	**3.85**	0.627	**−26.5**	**3.90**	0.627	**−26.5**	**3.90**	0.627	**−26.5**
2005	**4.30**	0.657	−25.7	**4.35**	0.657	−25.7	**4.35**	0.657	−25.7
2006	**4.70**	0.688	−24.5	**4.70**	0.688	−24.5	**4.70**	0.688	−24.5
2007	**5.25**	0.713	−23.2	**5.30**	0.713	−23.2	**5.30**	0.713	−23.2
2008	**5.70**	0.747	−20.7	**5.70**	0.747	−20.7	**5.70**	0.747	−20.7
2009	**6.45**	0.759	−20.0	**6.40**	0.759	−20.0	**6.40**	0.759	−20.5
2010	**7.30**	0.759	−20.3	**7.15**	0.769	−19.5	**7.10**	0.760	−20.2
2011	**8.10**	0.768	−19.8	**7.70**	0.783	−18.6	**7.65**	0.771	−20.0
2012	**8.90**	0.776	−19.3	**8.40**	0.799	−17.4	**8.00**	0.798	−18.0
2013	**9.80**	0.782	−19.0	**9.00**	0.808	−16.9	**8.20**	0.819	−16.5
2014	**10.50**	0.790	−18.5	**9.60**	0.820	−16.0	7.70	0.859	−13.0
2015	**11.25**	0.795	−18.2	**10.00**	0.840	−14.3	5.30	0.904	−9.0
2016	**11.90**	0.806	−17.3	**10.50**	0.853	−13.3	3.00	0.948	−5.0
2017	**12.60**	0.817	−16.4	**10.80**	0.869	−11.9	2.80	0.969	−3.0
2018	**13.10**	0.823	−15.9	10.40	0.882	−10.9	1.40	0.985	−1.5
2019	**13.80**	0.829	−15.4	10.00	0.891	−10.2	1.00	0.990	−1.0
2020	**14.60**	0.833	−15.0	9.80	0.897	−9.8	0.00	1.000	0.0
2021				9.00	0.907	−8.9			
2022				8.55	0.915	−8.2			
2023				6.50	0.928	−7.0			
2024				6.30	0.934	−6.5			
2025				5.70	0.946	−5.4			
2026				5.50	0.958	−4.2			
2027				5.30	0.966	−3.4			
2028				5.00	0.979	−2.1			
2029				4.40	0.991	−0.9			
2030				0.00	1.000	0.0			

Note. The numbers in bold represent the increase in the divide according to the measure.