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Toward a Demographic Theory of Societal Change with Predictive Power

Wolfgang Lutz[1]

> **Basic idea:** Societies change in important and measurable dimensions as a consequence of the changing composition of people characterized by certain properties which are often persistent along cohort lines. The degree of persistence of these properties (in terms of proportions of a cohort that maintain the property as they age) can be empirically assessed by the means of age-period-cohort (APC) analysis. This can provide the basis for making assumptions about future persistence versus transitions to other properties (states) using the tools of multi-state population dynamics. Based on these projections, future societal change in terms of a changing composition of the population by relevant properties can be predicted, tested and potentially falsified, which makes it qualify as a theory.

<u>**Preamble 1**</u>: The Explanandum

This paper proposes a demographic theory of social change which implies that the inspiration and approach of the paper is demographic but its goal is not. The goal of this theory is to predict social change in its wider sense. In the same way that an economic theory of fertility tries to explain fertility changes using the tools of economics, this theory tries to explain social change using the tools of demography. But there should be no relativism with respect to the chosen approach. The demographic approach chosen here stands in open competition with all other possible approaches. There is a clear objective criterion for which is the better approach: it is the ability to better predict the phenomenon under consideration.

<u>**Preamble 2**</u>: Predictive Power, Karl Popper and the Effect of Viennese Potato Goulash

Every theory is to be judged by its explanatory and predictive power. While the assessment of its explanatory power greatly depends on subjective criteria (When do we accept a specific explanation to be good enough?), the assessment of its predictive power has more objective criteria: We can empirically assess whether or not a prediction based on the theory under consideration can accurately predict the event it tries to explain. In the natural sciences this can be usually done by carrying out experiments. In social sciences, where large scale experiments are difficult or impossible to conduct (although there are some "natural

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[1] Leader of the World Population Program at the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria; Director of the Vienna Institute of Demography (VID) of the Austrian Academy of Sciences; Professor of Social and Economic Statistics at the Vienna University of Economics and Business (WU); and Professorial Research Fellow at Oxford University.

experiments"), predictions of the evolution of social phenomena over time are the best way to test the predictive power.

Wikipedia (as of Sept 29, 2009) defines predictive power as follows: "The **predictive power** of a scientific theory refers to its ability to generate testable predictions. Theories with strong predictive power are highly valued, because the predictions can often encourage the falsification of the theory. The concept of predictive power differs from explanatory and descriptive power (where phenomena that are already known are retrospectively explained by a given theory) in that it allows a prospective test of theoretical understanding. Scientific ideas that do not confer any predictive power are considered at best 'conjectures', or at worst 'pseudoscience'. Because they cannot be tested or falsified in any way, there is no way to determine whether they are true or false, and so they do not gain the status of 'scientific theory'."

The above-mentioned criterion of falsifiability is usually associated with Karl Popper, who introduced it as a defining element of theories. In his understanding the predictive power of a theory is a prerequisite of its falsifiability and hence of its status as a theory. To my knowledge, Karl Popper has never explicitly written about demographic theories, but thanks to his desire to eat his favorite dish (Wiener Erdäpfelgulasch = Viennese potato goulash), I had the opportunity to have a lengthy discussion with him about this topic in 1984, when I stayed in London for an internship with the World Fertility Survey and his private doctor in Vienna asked me to take his favorite dish to him. In return for this service, he talked to me at his private residence, patiently answering the questions of an eager young demographer with an interest in philosophy of science. In essence, what he told me about the role of theories in demography was: With respect to the validity of theories, demography is not different from all the other sciences. Through its quantitative nature it should be actually easier than in many other social sciences to define hypotheses and theories that are specific enough so that they can be tested, i.e. potentially falsified. He also asked what would be the most important theories with predictive power in demography. After some hard thinking I could only come up with the theory of demographic transition (the real one, not the so-called "second demographic transition" which has no predictive power) which predicts that all societies starting from pre-modern conditions will experience a fertility decline following the mortality decline. Despite its lack of precision about the time lags involved and the precise course of fertility decline, this theory has predictive power and as a consequence underlies all the population projections for developing countries where further fertility declines to at least replacement levels are being assumed. After listening to my explanations with interest, he then asked whether demographic models could be applied to forecast other social trends as well. Since I had never thought about it in this way, he encouraged me to do so. And it took me 25 years to take up the challenge.

I remember well his last words as we waited for the taxi outside his house which would bring me back to the train: "As scientists we have to be like bats, sending out signals to an unknown world and based on the echoes we receive, build an image (theory) which is the basis for predictions where we can safely fly. And as we fly, we have to listen very carefully to be able to update our predictions". Looking back, I remember that he had particularly big ears.

Antecedents: Karl Mannheim and the "Problem of Generations"

The proposer of any new theory needs to be aware of what has already been proposed in the field. When searching through the social science literature, the one strain of writing that

seems to come closest to the projection along cohort lines proposed here, is on the succession of generations which was prominent in the late 19th and early 20th centuries in history (and even history of art) for explaining the sequence of different historical epochs which, under this view, was driven by the replacement of old generations by new ones with new views of the world, new priorities and new styles. A comprehensive synthesis of this approach was offered by the sociologist, Karl Mannheim, in his 1927 essay on "The Problem of Generations". Karl Mannheim was of Hungarian origin and in 1930 became Professor of Sociology in Frankfurt before he left (like Karl Popper and many other intellectuals) for England, where he taught at London University. His writings are partly in German and partly in English.

In his essay on generations, Mannheim starts out by contrasting two opposite views on generations: One that he calls "positivist" and which is focused on measurement and studying the average periods of time taken for the older generation to be superseded by the new in public life (p. 278). He calls this approach as having a biological perspective which we could safely translate in terms of meaning demographic. The opposite approach, which he calls "romantic-historical", is distinctly non-quantitative and associated with the writings of the German historian, Dilthey. Here the central notion is that of "entelechy" which is meant to be the expression of the "inner aim" or its "inborn way of experiencing life and the world" of one generation. Although Mannheim seems clearly more amenable to the first view, he also criticizes the positivists (whom he calls the French school going back to Compte) as being too narrow in their purely biological approach.

In developing his own view, Mannheim starts out with the statement that the issue of generations is "one of the indispensible guides to an understanding of the structure of social and intellectual movements" (p. 286). And he sees it as the "task of *Formal Sociology* to work out the simplest, but at the same time the most fundamental facts relating to the phenomenon of generations" (p. 287). And he urges formal sociology to move from its dominating static approach to capturing social dynamism (p. 288). This all reads like a nice introduction to the focus on population dynamics which the approach presented here is trying to advance. The only difference is that Mannheim, as well as the others he discusses, is only looking backwards, trying to understand the forces driving history, rather than looking into the future.

Mannheim defines a generation as being determined by its "social location" (soziale Lagerung), something that the members of a generation all share. He compares it to the way one is a member of a specific social class, viewed not cross-sectionally but over time: both generation and class "endow the individuals sharing in them with a common location in the social and historical process, and thereby limit them to a specific range of potential experience, predisposing them for a certain characteristic mode of thought and experience, and a characteristic type of historically relevant action". (p. 291). He goes on to discuss what produces generation units and under what conditions a new group of people growing up is sufficiently different from the previous one in order to be called a new generation. This is where Mannheim's sociological approach, which is still to some extent trying to capture the qualitative inner spirit of a generation, is quite different from the more formal cohort approach proposed below, where inner values (entelechy) may be a consequence but not a defining criterion for membership in a generation.

At the end Mannheim comes to the conclusion that "it must be admitted that biological data constitute the most basic stratum of factors determining generation phenomena; ... but we cannot observe the effect of biological factors directly; we must, instead, see how they are

reflected through the medium of social and cultural forces." (p. 311). This conclusion is fully in line with the starting point of the demographic approach presented in the following. Membership in a demographic (biological) cohort is only a statistical place holder (dummy variable) for the changing social and cultural aspects that shall be analyzed and – unlike Mannheim – forecast. There is one other decisive difference in the proposed new approach to that of Mannheim: Members of a generation (cohort in our case) are not all required to have the same social location, i.e., be similar in key aspects. Quite the opposite, we will consider cohorts as being composed of groups of people with clearly distinguishable properties (social locations) such as speaking different languages, having different levels of educational attainment or different national/European identities, just to mention the examples that will be given below. Hence, the basic idea is not that generations are homogeneous but rather the opposite, that they are heterogeneous in measureable ways, but that their properties are sticky (persistent) along cohort lines and the composition of the properties in the entire population changes as a consequence of the changing proportions of cohorts who are carriers of the relevant properties.

Main Elements and Definitions of the Theory

1. The starting point for this proposed comprehensive framework for studying and projecting all kinds of social change is that cultures, values, behavioral norms and even institutional arrangements do not exist independently of people. It is the **people** who **are the carriers of all views** of life, all norms, all reflection and all knowledge relevant for action (except for the one in books and computers). Without individuals (and their individual brains) interacting, none of the above exist. Much of sociological theory focuses on these interactions among people, but it is important to see that these **interactions** cannot have a life of their own. They **do not exist without the people that carry them out**. In the extreme, if all the people involved die, there is no culture, no institution and no interaction left.

2. In terms of terminology, in the following I will call all these views that people hold and things they do and everything that characterizes a person **individual properties**. Some of these properties never change over life (such as skin color); others tend to change over each individual life course (such as physical strength as a function of age); and other characteristics change as a consequence of interaction with other people (such as certain preferences and behavioral norms). It is a key element of this demographic theory of social change that these individual properties can be grouped into disjunctive categories and the rates of individual **transitions from one category to another** can be quantitatively described.

3. If these two assertions are accepted, then any change in the number and composition of people who carry different properties changes the societies they form. This social change is more easily predictable if the characteristics are stable. For example, assume there are two groups with different mother tongues and different levels of fertility in one society. If there is little intermarriage or transition, then the laws of population dynamics can describe quite well how the linguistic balance will shift in favor of the higher fertility group. More generally, multi-dimensional population dynamics can model the changing spread of all kinds of individual properties and the associated behavioral patterns in society. This can also be done in a non-linear fashion with feedbacks and tipping points which may trigger a change in the dominating culture/pattern and in the extreme case even lead to the extinction of a culture or language group or group of carriers of any other relevant property, if the carriers of this culture disappear through death, lack of reproduction or transition to other properties.

4. The more stable the properties are in which one is interested, the more reliable this demographic approach is in terms of forecasting. It has so far been empirically applied to the changing composition of the population with respect to religious affiliation and to the educational attainment distribution of the population. It has also proven to be applicable for anticipating future trends in "softer" characteristics such as the spread of a European identity in addition to a national one. The approach has less predictive power if the properties studied are very volatile. It only becomes useless in the hypothetical extreme case of zero stability of characteristics over the life course combined with the absence of any clear age patterns of transition. It is hard to find an example of such complete volatility; even properties greatly influenced by fashions such as preference for a specific kind of music tend to show some age profiles combined with a certain degree of persistence along cohort lines.

5. Over the past decades demography has developed two potentially very powerful analytical tools which (for various reasons) have not yet been used to their full potentials: Age-Period-Cohort (short APC) analysis and multi-state demography (short MSD). These two tools for analyzing, modeling and projecting changes in the composition of the population for people distinguished by certain well-specified properties become particularly powerful when they are combined. To my knowledge this has not yet been done in a more general form. This hybrid, which I call APC-MSD, provides a very powerful analytical handle to empirically quantify the forces along age, period and cohort dimensions that change the composition of the population and model the dynamics of the changing composition of the population considering different rates of attrition (deaths), reproduction/replacement (births) and transitions (migration) to another state with other properties. Unlike most other sociological theories and theories of social change, this approach has the potential to forecast social change on the basis of certain explicit assumptions. This makes it empirically testable.

6. APC (Age-Period-Cohort) analysis is the analytical tool to empirically assess the relative strengths of variations over age, across cohorts and over time (period) in explaining any change in the distribution of certain properties in a population. One needs at least two age profiles for the same population at two different points in time in order to be able to disentangle these effects. A cohort effect is something formed at some point (typically rather early) in life which then stays constant with this group who experience it throughout the rest of their lives (e.g., the people graduating from college in a certain year). An age effect is defined as some change in a property that affects all people (of different cohorts and at different periods) as they age (e.g., all women going through the sequence from menarche to menopause). A period effect, finally, is some force that affects all people of all ages and cohorts at a specific point in time (e.g., a war or a major political or cultural event that leaves its mark). Since mathematically each of these three effects can be expressed as the interaction of the other two (e.g., the combination of age and period defines cohort membership), much work has been done to deal with this problem of over-identification and satisfactory solutions for the empirical estimation exist.

7. MS (Multi-State) population dynamics is a generalization of the simple cohort-component model, the standard tool for doing population projections (taking birth cohorts and letting them become one year older every calendar year while exposing them to assumed levels of age-specific fertility, mortality and migration rates). In the multi-dimensional generalization the population is sub-divided into distinct groups (according to characteristics such as place of residence, marital status, religion, education, etc.) and differential fertility, mortality and migration schedules are applied to the groups in addition to considering the transition rates from one state to the others (e.g., moving from province A to B or from the single to the

married state). This multi-dimensional projection method is the tool for modeling and forecasting changes in the composition of the population based on certain assumed fertility, mortality, migration and transition rates.

8. One may of course argue that this concept is not a behavioral theory which tells us why people are doing certain things. It does not attempt to be a theory of individual behavior but rather, it focuses at societal-level change. It tells us about the forces that shape the composition of societies and therefore their nature. Age and period effects are, in a way, place holders for many kinds of forces that cause individuals to change over their life course or refer to the sum of external environmental events and influences at one particular point in time. But this lack of specificity with respect to the concrete forces that are shaping our individual life course patterns or shaping the course of external events from year to year can be seen as an advantage rather than a shortcoming. It makes the theory more flexible to very different kinds of applications. Also, we can apply the theory to forecasting without having to wait until we have a full understanding about all the substantive forces that shape changing individual behavior. Actually there is reason to assume that we might never be in the position to fully explain human behavior in its extreme complexity because one can infinitely regress to deeper and deeper levels of causation. Limiting the analysis to the level of capturing age, period and cohort changes and making transparent assumptions about their possible future courses is a clean and defendable approach and it does not prevent the analyst from conducting deeper levels of causal and behavioral analysis. New behavioral insights, should they come up, can then be readily integrated into this model.

Empirical Examples:

The changing educational composition of the population: Here the property under consideration (highest educational attainment) is invariant along cohort lines after a certain age. (The following is Lutz et al. 2008.)

ECONOMICS

The Demography of Educational Attainment and Economic Growth

Complementing primary education with secondary education in broad segments of the population is likely to give a strong boost to economic growth.

Wolfgang Lutz,[1]* Jesus Crespo Cuaresma,[2] Warren Sanderson[3]

When the world leaders convened in New York in 2000 and solemnly announced the United Nations (U.N.) Millennium Development Goals (MDGs), the goal of universal primary education by 2015 figured prominently, second only to the reduction of extreme poverty and hunger. Although the diminution of poverty and hunger is a self-evident end in itself, putting all children into school is a goal primarily because it is believed to be the vehicle through which the level of adult human capital is improved, in turn enhancing individual well-being, health, and economic growth. The empirical basis for assuming an important positive effect of education on economic growth is, however, surprisingly weak. Although it is well established that, at the individual level, more years of schooling lead to higher income, at the macroeconomic level, the empirical evidence, so far, relating changes in education measures to economic growth has been ambiguous.

The MDG's focus on universal primary education has to be seen in the context of the evolution of international concerns about eradicating illiteracy with a series of well-intended but "demographically illiterate" and therefore unrealistic goals, which ultimately failed. In 1990 at a historical conference in Jomtien (Thailand), 155 governments and 150 organizations issued a World Declaration on Education for All that included the prominent goal of reducing the adult illiteracy rate to one-half of its 1990 level by the year 2000. From a demographic perspective, it is clear that this goal is impossible to achieve in poorly educated countries if education is primarily concentrated in young people, because it would take many decades for the better-educated youngsters to replace the illiterate adult population. Ten years later in Dakar, the international community, confronted with the failure of the

previous goals, chose to use an even more unfortunate formulation of their goal, namely, "increase the literacy rate by 50%," which, for countries that already had more than 66.7% literacy, implied a goal of more than 100%. To correct this evident political innumeracy, the U.N. Educational, Scientific, and Cultural Organization (UNESCO) later modified the goal to imply a goal of 100% for countries that already had 66.7% literacy or more. Leaving aside the fact that 100% literacy may be impossible to reach for any society, even this revised goal focuses on the stock of adult literacy without considering the cohorts involved.

The MDG's focus on enrollment in formal primary education is related but somewhat different from the earlier focus on literacy: Literacy is a skill that, in principle, can also be acquired outside the regular education system and that can be lost again (secondary illiteracy). In contrast, once a certain level of educational attainment is reached, it cannot be lost again throughout the rest of our lives. We will be able to keep our doctorates even if our skills seriously degrade; this property actually makes educational attainment distributions easier to model because movements can only go in one direction, toward higher education.

Using the demographic method of multistate back projection, a group of researchers at the International Institute for Applied Systems Analysis (IIASA) and the Vienna Institute of Demography (VID) has recently completed a full reconstruction of educational attainment distributions by age and sex for 120 countries for the years 1970–2000 (1). This improvement in human capi-

tal is illustrated (see figure, below) along cohort lines in the case of South Korea. The advantages of this data set relative to others (2–4) are its detail (four educational categories for 5-year age groups of men and women), its consideration of differential mortality, and its strict consistency of the definition of educational categories over time. The age and education composition detail in our new data allow us to perform more detailed statistical analyses of the relation between education and economic growth than can be performed using preexisting data.

Previous cross-country economic growth regressions tended to show that changes in educational attainment are largely unrelated to economic growth [for example, (5, 6)], which contradicts theory and microeconometric evidence. Most of the literature in this field attributes the existence of this puzzle to
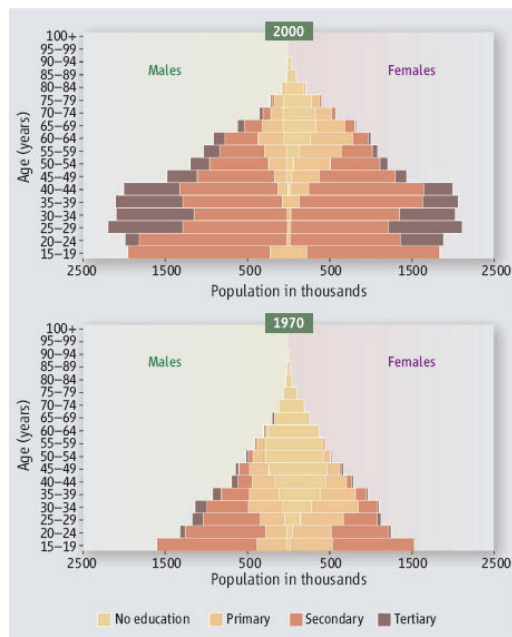
Reconstructing educational attainment. (Top) Age pyramid of South Korea in 2000 with colors indicating different educational attainment categories. (Bottom) Reconstructed age pyramid of South Korea in 1970 with colors indicating different educational attainment categories.

[1]Vienna Institute of Demography (Austrian Academy of Sciences), A-1040 Vienna, and World Population Program, International Institute for Applied Systems Analysis (IIASA), Schlossplatz 1, A-2361 Laxenburg, Austria. [2]University of Innsbruck, A-6020 Innsbruck, and World Population Program, IIASA. [3]Stony Brook University, Stony Brook, NY 11794, USA, and World Population Program, IIASA.

*Author for correspondence. E-mail: lutz@iiasa.ac.at

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deficiencies in the series of education data (3, 4, 7). Also, averaging education attainment data over longer horizons has led to more consistent patterns (8), which highlights the importance of measurement problems in the previous data.

Using our new educational attainment data by age groups, we estimated simple growth regressions based on 5-year periods for a panel of 101 countries for which all the necessary economic and education data exist over the period 1970–2000. It has a fair representation of all continents (9). These new data allow us to use the education levels of different age groups as potential determinants of economic growth. The results show consistently positive, statistically significant education effects on economic growth for some age and education groups (9) and, hence, make the puzzle disappear.

In our model, human capital by broad age groups enters production both as differentiated labor force inputs and through the absorption rate of new technologies, which, in turn, depends on the interaction between human capital and distance to the technological frontier [see (5) for a similar approach]. The effect of education on labor force participation is assumed to be specific to each age and education group and constant over time. The model is described, related to the literature, and justified in detail (9).

The implications of the results and the value added by the new data set are illustrated by simulating four scenarios based on estimated coefficients (see figure below, table S1, and the discussion in the supporting online text). These four roughly resemble alternative hypothetical education policy strategies for a poor African country. In these simulations, we focus on the fact that economic growth is determined by the adoption of new technologies, and that the size of the effect depends on the income level of the country under study, because countries that are further away from the technology frontier are able to profit more [in terms of Gross Domestic Product (GDP) growth] from this channel of the education-growth link.

The figure above presents the average annual GDP growth rates corresponding to different education level distributions. Scenario 1 presents the reference case of a country with a young age structure (70% of the population in the 15- to 40-year-old group and 30% in the 40- to 65-year-old group), a low starting level of income and investment rate and the following educational structure: half of the population without any formal schooling, 40% with some primary and 10% with at least completed junior secondary
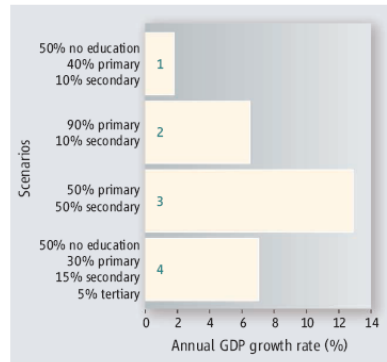
Annual GDP growth rates according to the four alternative educational attainment distributions (see text).

school (but no tertiary education). The education groups used in the analysis (no education, primary, secondary, and tertiary) are nonoverlapping. This roughly fits the demographic structure of some Latin American and African countries in our sample, e.g., Guatemala, Honduras, Kenya, Rwanda or Uganda. On the basis of the estimated model, such a country would have rather slow economic growth. Scenario 2 considers the otherwise identical country under the hypothetical assumptions that it has for long met MDG goal 2 and that the previously uneducated half of the adult population now has primary education. This case would lead to somewhat higher average growth of GDP. Scenario 3 considers a possible new MDG effort that adds widespread secondary education (we assume here 50% of the population achieving at least some secondary schooling) to universal primary. The model simulations indicate that this additional investment in secondary education provides a huge boost to economic growth, over five times the level of the baseline scenario and also much more than in the scenario of universal primary education alone.

Scenario 4 finally presents another possible direction of improvement from the baseline (which somewhat resembles the case of India), in which half of the population remains without education although 5% have tertiary education, 15% secondary, and 30% primary. This case of elitist education in a context with half of the population being without any schooling does clearly better than the baseline and even better than the universal primary education (combined with 10% secondary and no tertiary), but falls far short of the economic growth implied by universal primary combined with 50% secondary and no tertiary education.

We compared these results with an

age-aggregated version of the IIASA-VID data and the widely used Barro-Lee (2) data set, which has no age detail (see table S2). The comparison with the full age-structured model gives evidence of differences across age groups in the effects of education on GDP growth (table S1). These results point to the importance of the demographic structure of human capital when assessing the effect of education on economic growth. The IIASA-VID data set is, as of today, the only comprehensive data set offering such demographic detail in education figures.

These new findings have political consequences for the next round of defining international education goals (10): The current MDG's focus on universal primary education is important but insufficient. It needs to be complemented with the goal of giving broad segments of the population at least a completed junior secondary education. Only this is likely to give initially poor countries the human capital boost that is necessary to bring large segments of the population out of poverty. For more industrialized countries, tertiary education of younger adults also is an important determinant of economic growth.

In conclusion, better education does not only lead to higher individual income but also is a necessary (although not always sufficient) precondition for long-term economic growth. The fruits of investments in education need a long time to ripen, to translate the education of children into better human capital of the adult labor force. Education is a long-term investment associated with near-term costs, but, in the long run, it is one of the best investments societies can make in their futures.

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The changing prevalence of European identity: Here the property under consideration is observed to vary across ages, periods and cohorts. Hence, in order to assess the cohort effect, one needs to apply empirical APC analysis. (The following is Lutz et al. 2006.)

Reprint from *Science*

POPULATION

The Demography of Growing European Identity

Younger Europeans are more likely than older groups to consider themselves to have a European identity in addition to their national one.

Wolfgang Lutz[1,2]*, Sylvia Kritzinger[3], Vegard Skirbekk[1]

The process of European integration appears to be in disarray. After rejection of the new European constitution by referenda in France and the Netherlands and serious quarrels over the future budget of the European Union (EU), observers have warned that the EU is entering a period of stagnation or even disintegration (*1, 2*). But observers should not be overly impressed by short term events and need to study the important underlying forces. One such force is the slowly evolving feeling of identity in the national and European context. Here we study the trends in identity and project them into the future.

Easton (*3*) has suggested that the development of identity is crucial for the legitimacy of a political system. Eurobarometer surveys (EB) provide a consistent series of accessible individual level data with answers to the following question: "In the near future, do you see yourself as [Nationality] only, as [Nationality] and European, as European and [Nationality] or European only?" We combined the three categories that have at least some European element, and called this category "multiple identities" (*4*).

In the EB survey of 2004, 42% of the population above age 18 said that they felt themselves to be solely nationals of their own country, whereas 58% gave an answer that reflected at least some European identification. This implies that 130 million adult citizens of the EU-15 consider themselves only as nationals and 177 million as having multiple identities. But there are differences by country of residence (see table) and by age (see figure). The

PREVALENCE OF MULTIPLE IDENTITY

Country	Percent*
Luxemburg	78
Italy	72
France	68
Spain	64
Belgium	59
Netherlands	59
Germany	56
Denmark	54
Ireland	53
Austria	51
Portugal	50
Greece	46
Sweden	45
Finland	43
UK	40

*Average of 1996–2004

EU-15 POPULATION WITH MULTIPLE IDENTITIES

older the respondents, the higher is the chance that they feel only a national identity.

Do these data allow us to make projections? No, because this empirical pattern at only one point in time could be due to (i) a cohort effect, i.e., the current younger generations having been socialized in such a way that they will maintain their multiple identities throughout their lives, or (ii) an age effect, which would assume that peoples' identities change over their life course. Age profiles at different points in time (which the EB data provide) allow us to distinguish between these possibilities.

When the data for 1996 (the first year after the EU expanded to 15 member states) are compared to those for 2004, the proportion with multiple identities was lower at each age in 1996, although the general shape of the curve was maintained. This upward shift of the profile from 1996 to 2004 indicates that the pattern is not primarily due to an age effect, but rather is dominated by cohort effects. Visual analysis also shows that the curve is not merely shifted upwards, but that the humps and valleys are also shifted to the right, i.e., along cohort lines.

This visual pattern was confirmed analytically by a demographic age-period-cohort model (*5*). The model shows a strong and highly significant positive cohort effect. The coefficient we calculated of 0.48 means that for cohorts born 1 year later, the proportion with some European identity is on average half a percentage point higher. An age effect

also mattered, but only to a secondary degree, with the tendency to multiple identities reaching a peak around age 50 to 60 and then starting to decline around an age that seems to coincide roughly with retirement age.

This quantification allows us to forecast future trends under the assumption that the estimated effects will continue to prevail over the coming 25 years. In 2030, under the stated assumptions, there will be only 104 million adult EU-15 citizens who have strictly national identities and 226 million with multiple identities. Age-specific proportions with multiple identities in 2030 show a marked upward shift. In the age group 30 to 44, those who have some identity as Europeans will outnumber those with strictly national identities by more than three to one.

To test the sensitivity of our results to political events at the European level, we ran an alternative model that included dummy variables for 3 years, reflecting the negotiations of the Amsterdam and Nice Treaties, as well as the introduction of the Euro (*6*). This did not change the results. Multivariate models, including education, urban versus rural place of residence, and occupation, showed that those segments of the population that are likely to increase in size have more multiple identities (*6*). In addition, changing socialization processes such as expanding European-level media impact, increasing mobility of students and tourists, as well as labor migration within the EU, may also enhance the prevalence of European identity.

Our conclusion is that as older, more nationally oriented cohorts die, there are likely to be significant changes in the pattern of European identity. Although the politics of European integration remain volatile and unpredictable, these long-term tectonic shifts in identity are likely to have major and enduring consequences for the future of Europe.

References and Notes

1. L. Cohen-Tanugi, *Foreign Affairs* **84**, 6 (2005).
2. "Crisis, what crisis?," *Economist*, 8 September, 2005), p. 37
3. D. Easton, *A Systems Analysis of Political Life* (Wiley, New York, 1965).
4. This question does not cover subnational identities.
5. R. V. Robinson, E. F. Jackson, *Soc. Sci. Res.* **30**, 117 (2001).
6. For detailed information and analyses see supplemental online material.

Supporting Online Material
www.sciencemag.org/cgi/content/full/VOL/ISSUE/PAGE/DC1

[1]World Population Program, International Institute for Applied Systems Analysis (IIASA), Laxenburg, A-2361, Austria. [2]Vienna Institute of Demography (Austrian Academy of Sciences), Vienna, Austria. [3]Institute for Advanced Studies, Vienna, Austria.

*Author for correspondence. E-mail: lutz@iiasa.ac.at

Selected Additional Material from the Supporting Online Material to the *Science* Policy Forum*

This specific piece of analysis does not attempt to explain recent political events within the EU nor does it refer to the trust in and support of specific European institutions or the participation rates in European level elections. Instead of this actual (utilitarian) support for EU membership and policies, we focus on the deeper level of attitudes, namely, the identity of considering oneself as a member of a certain group of people including associated sets of norms and values, which in our case can either be a national population or the population of Europe. Contrary to common belief, the development of a European identity does not have to be accompanied by the decline of a national identity. Rather, European integration has established a new context that people can identify with and hence, opens up the possibility of multiple identities.

Our research question is structured accordingly: How does European identity differ by age, sex and by country of residence? How did it change over time and to what extent does this happen along cohort lines? And what do these patterns imply for the likely future trends in the prevalence of European identity over the coming decades? Our statistical analysis—using Eurobarometer (EB) data—starts with the expansion of the EU to 15 states in 1995 and does not consider the 10 new member countries that recently joined. We are fully aware of the fact that this EB question covers only one specific dimension of identity, which for instance does not cover the possibility of sub-national identities. However, this is the only feasible way of trying to quantitatively project an indicator of identity into the future, something that in political science has not been done so far and that could significantly enrich our discussions about the future.

Theoretical Background
In the political science literature, identity with a political system is often regarded as a necessary precondition for its stability and legitimacy. The identification of a citizen leads to the acceptance of a government's decisions and authority (1) and creates a 'common good' that leads a citizen to act as a community member (2). Identity reflects the emotional attachment that a citizen develops and possesses towards a political system. This emotional attachment is the outcome of a process of trust, a socialization process in which norms and values are communicated (3). Clearly distinct from this emotional attachment is a utilitarian support, which focuses on short-term outputs and trends and on benefits obtained from the political system. From this point of view, the development of the concept of a European identity amongst European citizens re-emerges as an important stepping stone in the ongoing integration process as it is not based on short-term outputs, developments and discussions. It could rather become a force that helps to 'uphold' the European integration process also in moments of crisis induced by referenda outcome, decisions taken, national interests, etc. The legitimacy of the European project through its citizens might thus be achieved (4, 5, 6).

Contrary to common belief, the development of a European identity does not have to be accompanied by the decline of a national identity. Rather, European integration has established a new context that people can identify with and hence, opens up the possibility of multiple identities. Depending on the context and the purpose, citizens have different feelings of belonging and they delegate power to different political units to make decisions. This context is the crucial factor for attributing political actions and decisions. European identity, hence, complements but does not displace national and regional identities (7). In this way, "national identity is a springboard, not the gravedigger, of European identity, with national identity providing a model of what it is to belong to a remote political community" (8). The socialization process and trust development —fostering multiple identities, and European identity in particular—could be enhanced by the expanding media impact coming from and reporting about the European level (9), the increasing free movement of people across European borders either for tourism or work, the increasing number of students in university exchange programs as well as the fast-growing day-to-day communication across borders.

Data and Analysis
For further methodological issues on Eurobarometer-data, including sampling procedures, etc., please visit http://ec.europa.eu/public_opinion/index_en.htm as well as the documentation of the individual Eurobarometer-surveys.

Demographers developed the well-established methodology of age-period-cohort (APC) analysis decades ago (11, 12, 13) to try to understand the relative importance of three different possible forces in shaping the changing patterns of sets of age-specific rates over time. Particularly the distinction between period and cohort effects is important for analysis as well as forecasting because they can have very different determinants. A period effect is something affecting all ages and cohorts simultaneously such as wars, epidemics or specific political events, while cohort effects only affect groups of people born in the same year and typically relates to factors that are associated with childhood experiences or socialization.

Our main model includes linear period and cohort variables and a set of dummy variables representing 5-year age groups. The dependent variable is the proportion with multiple identities in each age group and at the period of each survey. The model is run over all 12 surveys and thus for 12,780 cells (12 periods × 15 countries × 71 age groups) based on 185,568 interviews. In addition to the APC variables, the model also estimates country effects that are invariant over time.

Table A2 gives the results of our model confirming our initial expectation that the change towards more multiple identities in the European Union largely happens along cohort lines, i.e., cohorts born later in time are socialized in such a way that they adopt fewer solely national identities, and more multiple identities. They then largely maintain these identities throughout their lives. Regarding national fixed effects interesting country differences can be spotted. While Luxemburg, Italy and France have the strongest effects in increasing the probability of having a multiple identity, the United Kingdom, Finland and Sweden have the weakest effect in that direction. The high proportion with a European identity in France is interesting in light of the recent negative referendum on the European constitution, giving support to the view that the result has mostly to do with a protest against government and current conditions in France rather than a decline in European identity.

Table A3 (not shown here) gives the results of an alternative model which allows specific historical events at the European level to influence the model estimates. This was done through the introduction of period dummy variables for the calendar years 1997, 2001 and 2003 to reflect the following events: In 1997, the newly negotiated Amsterdam Treaty brought major changes, inter alia in the field of justice and home affairs, and in expanding the qualified majority voting. In 2001 the Nice Treaty was negotiated and major institutional reforms were introduced in order to prepare the EU and its institutional working procedures for the enlargement. Finally, we selected 2003 as the year when the impact of the introduction of the EURO in 2002 was clearly visible and tangible to European citizens. The

parameters for all three years turn out to be negative, which means that these events were associated with lower levels of multiple identities in the EB surveys of the respective years. The inclusion of these period dummies does not affect the estimated cohort effect, which is the key for our projections into the future.

Table A4 gives a rather different model that does not include the estimate of age-period-cohort effects but rather presents a multi-variate analysis of some key, non-demographic factors included in the Eurobarometer. Being interested in the most recent patterns, we analyze the data from the Eurobarometer survey from October/November 2004, which is the only available dataset that includes all variables of interest.

The findings clearly indicate that socio-economic categories that are likely to become larger in the future, such as the more highly educated, people living in urban areas and people whose parents have migrated from one EU country to another, all have significantly higher degrees of multiple identities. As expected, farmers, low-skilled workers and those who do not work have multiple identities to a lesser degree. This analysis of broader socio-economic variables supports the view that we can expect more people with multiple identities in the future because the social groups that show higher multiple identities are expected to grow in the future. But since we cannot produce quantitative forecasts for these factors, and their changes over time are already implicit in the estimated cohort effects, our forecasts are based only on those cohort effects.

These analyses do not yet include the 10 new EU member countries joining the Union in 2004. For these countries only one EB with a comparable identity question exists for 2004. From this survey it is interesting to find that level and age pattern of all 10 countries taken together are almost identical to the curve of the EU-15 in 1996 (see graph on page 6), but only above age 40. For cohorts below the age of 40 the level of multiple identities (65-70 percent) is even somewhat higher than for young adults in the EU-15 in 2004. This shows an interesting discontinuity toward more European identity for cohorts under age 40 in the new EU member countries. ∎

Table A2: Results of the multivariate age-period-cohort model with fixed country effects. Dependent variable: Proportion with multiple identity (MI).

	Coefficient	Significance
Period	-0.13	n.s.
Cohort	0.48	***
Age	Dummies for 5-year age groups	***
Country	Dummies for individual countries	***
Luxemburg	26.3	***
Italy	21.0	***
France	16.7	***
Spain	12.2	***
Belgium	8.9	***
Netherlands	7.6	***
Germany	5.7	**
Denmark	3.2	***
Ireland	(Ref. Cat.)	
Austria	-0.3	
Portugal	-1.2	***
Greece	-6.0	***
Sweden	-6.2	***
Finland	-9.3	***
UK	-10.1	***
Constant	-528.51	***
Number of observations (cells)	12741	
Number of countries	15	
R² (adjusted)	0.3781	

** = Significant at the 5 percent level.
*** = Significant at the 1 percent level.

Table A4: Results of the multi-variate model considering the impact of selected individual characteristics on European identity. Country-specific effects have been taken into account. Data: EB 62 (2004). Dependent variable: Proportion with multiple identity (MI).

	Coefficient	Std. Err.	
Female respondent	-0.05	0.01	***
Education level			
Primary (finished school at 15 at the latest)	(Ref. Cat.)		
Secondary (finished school at 19 at the latest)	0.12	0.01	***
Tertiary (at least 20 when finishing school)	0.22	0.01	***
Urbanization			
Rural area	(Ref. Cat.)		
Town	0.03	0.01	***
City	0.06	0.01	***
Parents' country of origin			
Both parents born in same country as respondent	(Ref. Cat.)		
One parent born in a different EU country than respondent	0.09	0.02	***
Both parents born in different EU countries than respondent	0.21	0.02	***
At least one parent born outside the EU	0.06	0.02	***
Occupation			
Self-employed professional	(Ref. Cat.)		
Responsible for household	-0.13	0.03	***
Farmer	-0.13	0.04	***
Fisher	0.04	0.33	
Student	0.03	0.03	
Unemployed	-0.12	0.03	***
Retired or disabled	-0.08	0.03	***
Shop owner	-0.05	0.03	
High skilled employee	0.00	0.03	
Low skilled employee	-0.09	0.03	***
Age	Dummies for 5-year age groups		***
Constant	0.28	0.04	***
R² (adjusted)		0.11	
Number of countries		15	
Number of observations (cells)		14972	

*** = Significant at the 1 percent level.

The changing prevalence of English as a second language in Europe: (still to be done)

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