

Enhancing Human Capital: Analysis Using an Integrated Model

Barry B. HUGHES

RAND Europe and the University of Denver

Denver, Colorado 80208, USA

Tel: +01 303 4801965; Fax: +01 303 8714566; Email: bhughes@du.edu

Abstract. TERRA2000 combines models and scenario analyses to investigate the sustainability and policy implications of the unfolding global networked knowledge society (GNKS). The TERRA2000 project uses an integrated modelling system called IFs for TERRA2000 in support of its analysis within and across three themes: human capital, growth and equity, and environmental sustainability. Here we identify some of the elements of human capital analysis and explore the leverage that policy makers have with respect to enhancing “the knowledge, skills, competencies and attributes embodied in individuals that [in turn] facilitate the creation of personal, social, and economic well-being.” Specifically, we look at the potential for expanding the knowledge base through R&D expenditures, at increasing basic human skills and competencies through education and health programs, at increasing the supply of human capital through migration, and at increasing the diffusion of knowledge, skills, and competencies through electronic networking. In general, our early exploration suggests that greatest near-term leverage may lie with spreading the benefits of electronic networking throughout the economy, that considerable longer-term leverage lies with education and especially R&D, and that migration has mixed impact in the shorter and longer-term.

1. Introduction

The TERRA2000 project (running from January 2001 through December 2003) will add to the base for European policy deliberations around the emergence of the Global Networked Knowledge Society (GNKS). The project seeks to contribute to the ability of Europe and global society to foster cultural, economic, environmental, and social sustainability in the GNKS. More specifically, the project organizes its approach to these issues of sustainability through three themes: increases in human capital, enhanced growth and equity, and a sustainable human relationship with biological/physical environments.

This paper focuses on the theme of human capital. The OECD [1:18] defines human capital as “the knowledge, skills, competencies, and attributes embodied in individuals that facilitate the creation of personal, social, and economic well-being.” Among the other levers of action that this suggests are: increasing knowledge through Research & Development (R&D); increasing access to knowledge and skills, competencies, and attributes for use of it through education (and perhaps also good health, especially in developing countries); increasing the local supply of humans with knowledge via migration (physical or virtual); and increasing access to knowledge and use of it via electronic (and other) networking. This paper presents a preliminary analysis of these levers.

The TERRA2000 project uses a variety of scenario and modelling tools for investigating the three themes and the integrated emergence of a sustainable GNKS. One of the tools is a modelling system called International Futures for TERRA (IFs for TERRA), and that tool is

used in support of this paper. Although analysis of dominant trends and relationships can provide much insight into the issues of TERRA, the economic, socio-political, and natural systems that underlie success or failure in achieving sustainability are highly integrated and complex. It is impossible to study the reactions of such systems to application of human leverage without looking explicitly and seriously at their interactions (as difficult and complicated as that can be). The IFs for TERRA system is documented elsewhere by Hughes [2]. This report presents information about an emerging “sustainability scenario” developed and explored within IFs for TERRA - although the scenario cuts across all three themes of TERRA, the focus here is on human capital.

2. Increasing Knowledge

Increased expenditures on R&D lead, in general, to increases in knowledge and therefore to increases in human capital. As with other levers, the sustainability scenario introduces this relative to the endogenous calculations of the model in the base case or other scenarios—such expenditures tend to increase in any case with GDP/capita as shown in Figure 1, and the pattern of that figure, as indicated in the regression line, is part of the structure of the IFs model.

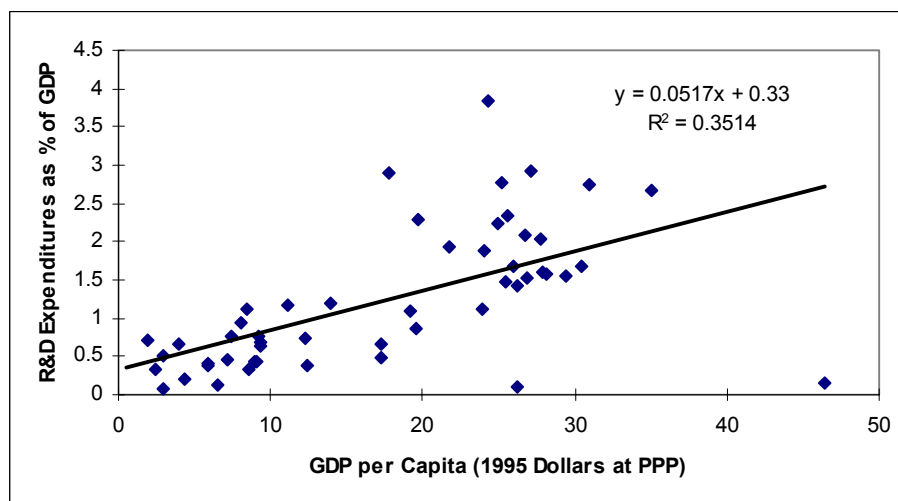


Figure 1: R&D spending as per cent of GDP as a function of GDP per capita (in thousands), most recent year. Data from the IFs for TERRA database, using full set of countries (OECD and non-OECD) for which data are available.

Specifically, the sustainability scenario includes an increase in R&D expenditures for OECD countries of 50 per cent relative to the endogenous calculation, phased in over 15 years, and an increase for non-OECD countries of 100 per cent, phased in over 15 years. Both of these are aggressive assumptions, based on the special importance that knowledge growth has in TERRA2000’s investigation of the global networked knowledge society. The reasons for emphasizing growth in non-OECD countries are that (1) many policy prescriptions such as those by the United Nations Development Program [3] and the Commission on Macroeconomics and Health [4] call for global partnerships in order to rapidly increase R&D in less developed countries and (2) electronic and other networking should, in fact, facilitate more rapid advance in R&D in such countries than was historically possible, often targeted at special needs of those countries.

The IFs for TERRA version of IFs represents the world in terms of more than 60 countries and regions (with a database covering 162 countries). The scenario analysis presented in this paper focuses, however, on OECD and non-OECD groupings (or on the EU in particular) both for scenario drivers and for presentation of results.

Figure 2 shows the impact of the integrated sustainability scenario on R&D expenditures, as a rough proxy for possible impact on knowledge growth. Although the scenario input specification was a 50 per cent increase in spending of OECD countries and a 100 per cent increase for non-OECD countries, the resultant global increase is decidedly above 100 per cent. The greater overall growth rate of non-OECD countries and the powerful positive feedback dynamic connecting R&D and total economic growth account for this result. There is inadequate space in this paper to explore the wide range of impacts of such R&D on economic performance, equity, and environmental sustainability, but that is, of course, the broader purpose of the project.

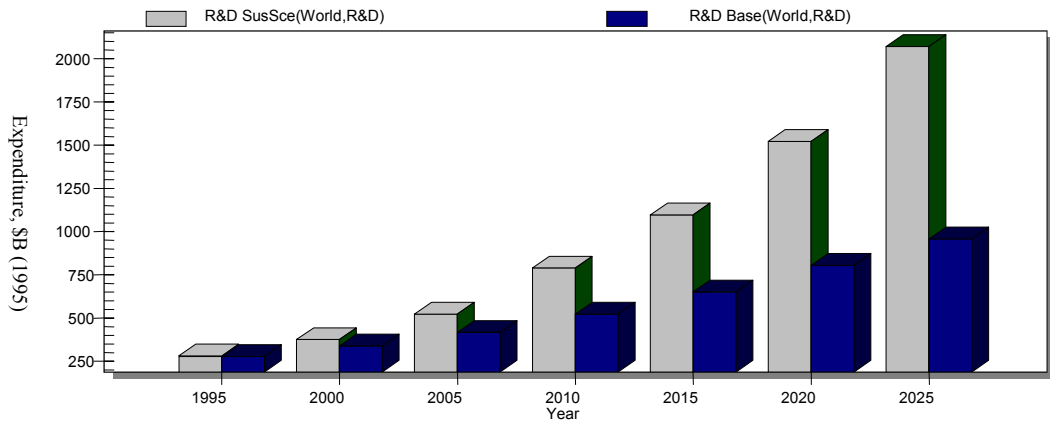


Figure 2: Global R&D Spending (Billion 1995 Dollars)

3. Skills, Competencies, and Attributes

One of the most direct ways of enhancing skills, competencies, and attributes is greater spending on formal education. Specifically, the sustainability scenario now includes an assumption of 50 per cent increase in spending relatively to endogenous base calculations over 15 years for non-OECD countries and 20 per cent increase for OECD countries. This is also an aggressive scenario component—it may be too aggressive (see the basic cross-sectional patterns in Figure 3).

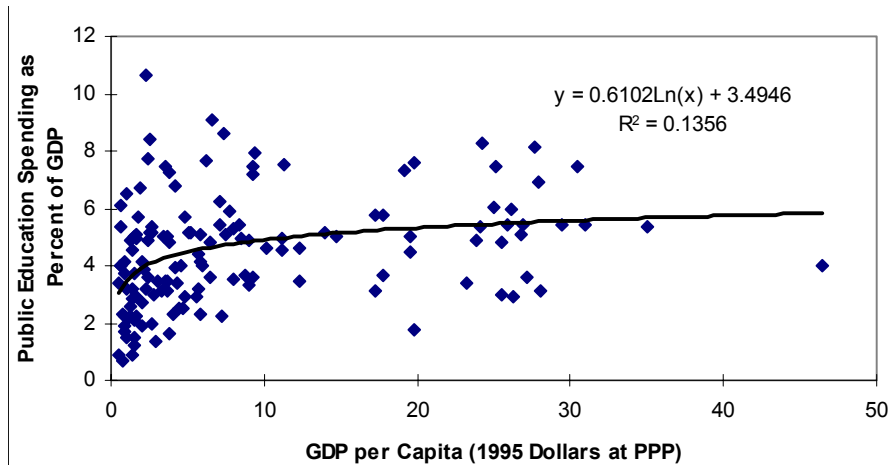


Figure 3: Total education spending as per cent of GDP as a function of GDP per capita (in thousands), most recent year. Data from the IFs for TERRA database.

What might be the effect of such an increase? Figure 4 reports specifically on the European Union and it is clear that effect is broadly positive, but not terribly large within this time horizon. Why is the leverage less substantial than one might expect (adding about .15 per cent to annual economic growth)? Again, only a short answer is possible here: formal educational spending is already significant in OECD countries and although further education has clear benefits, it also can simply generate credential inflation in employment markets. IFs for TERRA will add more representation of the interactions among education, labour markets, and income distributions as exploration of this issue continues.

European Union Economy with 20% Increase in Education Spending

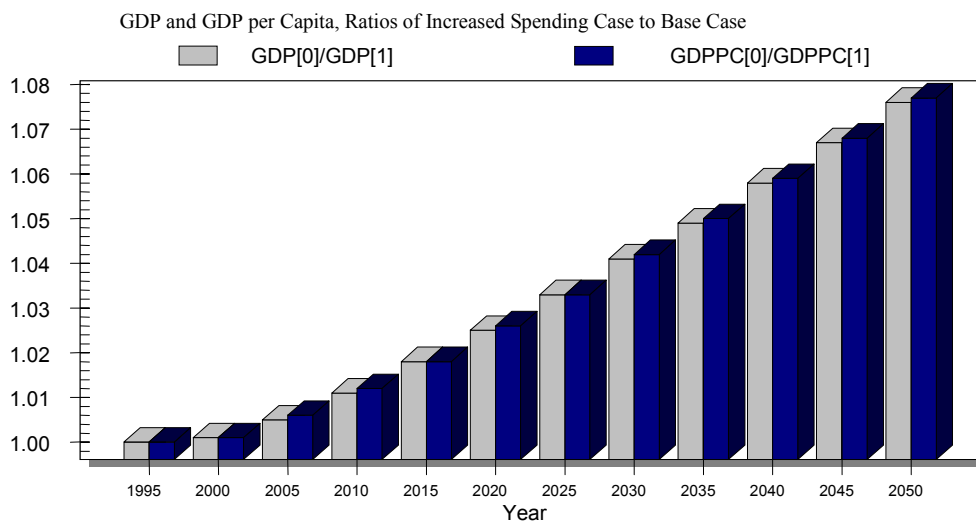


Figure 4: The impact of increased educational spending on the economy of the EU.

A second direct approach to human capital is greater spending on health care. Specifically, the sustainability scenario includes an assumption of 50 per cent increase in spending relatively to endogenous base calculations over 15 years for non-OECD countries and 20 per cent increase for OECD countries. For LDCs this is actually a little conservative relative to the proposals in the CMH white paper for an increase of health spending in LDCs by 1 per cent of GDP by 2007 and 2 per cent of GDP by 2015. (This paper does not present investigation of the consequences of that intervention.)

4. Importing Human Capital

In addition to creating human capital within a country, it is possible to import it in at least two ways. The first is more rapid immigration from labour “rich” countries to labour “poor” ones. It is not always clear that such immigration enhances global sustainability rather than simply meeting economic needs in importing regions (sometimes at the cost of social disruption). IFs includes recent migration data and forecasts from the UN. Figure 5 shows the impact of doubling immigration relative to UN forecasts in the sustainability scenario. It focuses on the EU, where demographic change will lead to greatly increased ratios of dependent populations in coming decades. Although the impact on GDP is substantial and positive, the impact on GDP per capita is actually negative. A simplified explanation is that immigration brings a wide range of consequences, including the social costs of dependents of those who immigration with human capital.

European Union GDP and GDP/Capita with Doubled Immigration

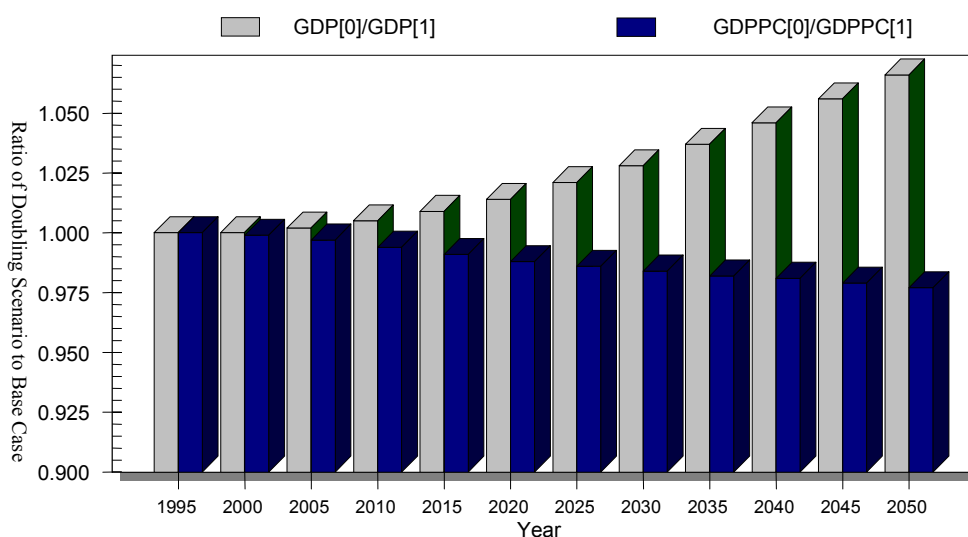


Figure 5: The impact of increased immigration on European economic performance.

A second way of importing human capital is virtual, namely the use of telecommuting. This is not yet in the sustainability scenario, but is a priority for future consideration.

5. Diffusion of Human Capital

Another approach to enhanced human capital is increased speeds of diffusion of electronic networking and therefore of existing knowledge through population and economies. The special attention in TERRA2000 to electronic networking is a result of the impetus provided by TERRA2000 network economy modelling experts Pol Descamps and Thomas Tesch and the Network Effects Model (NEMO) of the TERRA2000 project. That model has now become the basis for the broader Insight model.

Specifically, the sustainability scenario includes an assumption of 50 per cent faster growth in the expansion of connections than in the base case (phased in over 15 years) for non-OECD

countries. Because usage rates are growing so rapidly already in OECD countries, we have left those rates at endogenous levels. In IFs such growth rates do, of course, saturate as penetration levels increase.

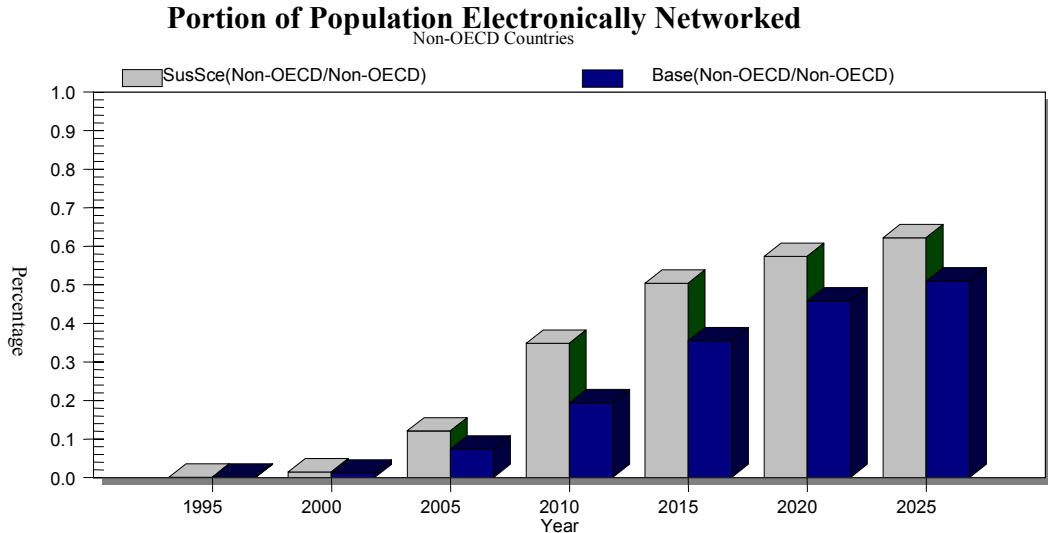


Figure 6: Electronically Networked Population

The key to the impact of such networking is the diffusion of the benefits of the ICT sector (and more generally of R&D and networking) beyond the ICT sector itself to the rest of the economy. Except for Gordon and a few other analysts, there is a wide presumption that it will ultimately be the broader economy that benefits most from these trends rather than just the ICT sector (see, for example, Castells [5]). Figure 7 shows that it makes a huge difference whether the diffusion effects are narrow or broad. Even more, Figure 7 shows that the impact of broad diffusion appears to dwarf that of educational enhancement and of migration, and rivals that of R&D.

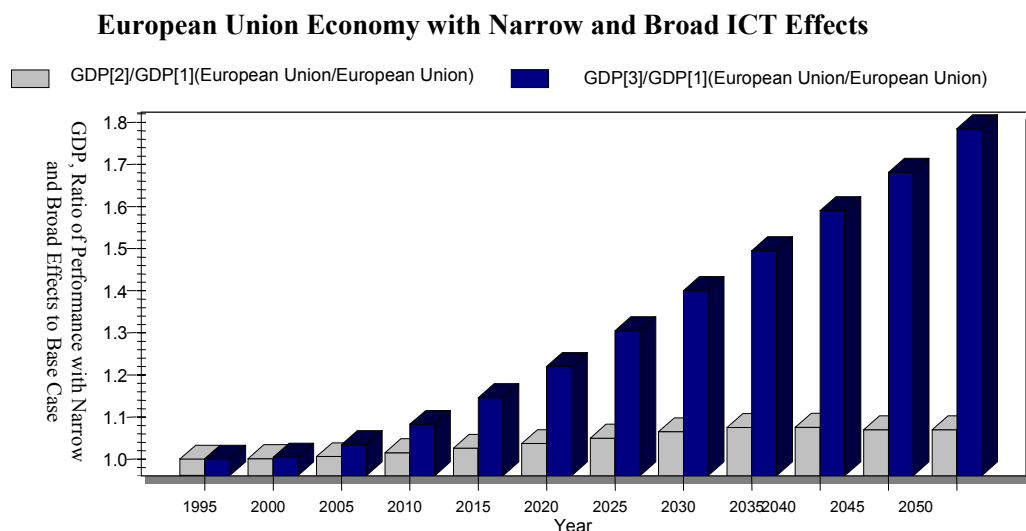


Figure 7: The differential impact of broad and narrow diffusion effects.

6. Conclusions

What can one say about the various levers that policy makers have to enhance human capital and about the broader economic, social, and environmental implications of those levers? In general, this early exploration suggests that greatest short-term and very great long-term leverage lies with electronic networking and the diffusion of it throughout the society and economy. In the longer-term, however, very considerable leverage also lies with both education and especially with greater R&D. Migration has mixed and more complicated impact in the shorter and longer-term. This is, however, an early report on human capital, and TERRA2000 will be exploring these issues in considerably more detail over the coming year.

Preliminary results are already available from project staff, and will be made more widely available over the coming year. Ultimately, a wide range of products will be published by the project. This will include elaborated analyses, scenarios, models and data taking account of and integrating the human capital theme together with the other two TERRA2000 themes (Equity & Growth and Information Age Sustainability). The scenarios will be used to support a range of position papers and reports that will be circulated to policy makers and used as the basis for targeted policy analysis. The results should support enhanced debate around policy issues and a greater facility for evidence-based policy making and implementation.

References

- [1] Organization for Economic Cooperation and Development (OECD), 2001. *The Well-Being of Nations: The Role of Human and Social Capital*. Paris: OECD.
- [2] Hughes, Barry B., *International Futures: Choices in the Face of Uncertainty*, 3rd edition. ISBN 0-8133-6841-3. Westview Press, Boulder, CO, 1999. See the Help System of IFs for updated documentation and Deliverable 7.1 for adaptations in the TERRA2000 project.
- [3] United Nations Development Programme (UNDP), 2001. *Human Development Report 2001. Making New Technologies Work for Human Development*. New York: Oxford University Press.
- [4] Commission on Macroeconomics and Health (CMH), 2001 (December). *Macroeconomics and Health: Investing in Health for Economic Development*, presented to Gro Harlem Brundtland, Director-General of the World Health Organization.
- [5] Castells, Manuel, 1996 and 2000. *The Rise of the Network Society (Volume 1 of a Trilogy on The Information Age: Economy, Society, and Culture)*. Oxford: Blackwell Publishers.