Introduction

The idea of this book surfaced in the year 2000 after long deliberations on the future of the research and development (R&D) sector in Hungary. The author had worked on R&D policy issues for a number of years, partly as head of the Hungarian government’s agency on R&D and innovation. It was striking to see that this sector had gradually been losing its financial support, resources and prestige, and seemed to be one of the losers of the transition process. Although a number of political and also policy efforts have been made to reverse this development, only some of them could improve the conditions of R&D and innovation in Hungary.

Some preliminary analysis of the perspectives of the innovation system in Hungary in particular and in the transition economies in general made it clear that without exception, the changes led to the degradation of the science and technology (S&T) sector with serious losses of human and physical resources in the process.

In spite of the permanent waste of time and human effort, Hungarian (and Czech, and Polish, and Russian . . .) R&D could still produce a number of results well received internationally.

The assessment of the sector’s condition and perspectives was in rather sharp contrast with the opinion of the European Commission at the time. This opinion was expressed in the paragraph on S&T of Agenda 2000, the first European Union document assessing the ability of candidate countries to join the EU. This paragraph gave an extremely favourable assessment of the Hungarian S&T sector, ranking it among the top 20 in the world (Agenda 2000, 1997, 38).

The statement was nice as a compliment, but the necessary footnote was missing and no methodological background or ranking lists were provided in order to corroborate it. The EU’s assessment was welcomed with much enthusiasm in the Hungarian S&T community which had not been flooded by good news over the previous ten years or more. However only very few questions were asked as to the relevance of this seemingly very good news. Did it really reflect the truth?

This contradictory picture cries out for analytical evidence and resulted in an ambitious research project on the problem of international comparison of policies and performances in R&D. The project obtained generous support
from the Hungarian government’s National Program for Research and Development launched in 2001.

This book is a product of that research, the scope of which has undergone quite significant changes between the first questions asked and the last answers provided. The focus of the project gradually shifted from a more or less simple assessment of the international position of Hungarian R&D or the S&T sector towards a much more ambitious goal, namely a comparative investigation of the problem of competitiveness in R&D.

It turned out during research that the international literature on the S&T sector lacked, in principle, any competitiveness-oriented analysis of R&D. The fact that the concept of competitiveness is not enjoying generally accepted support in the economics profession could not be disregarded. Still, the evident weaknesses of the concept could not explain why there had been an almost complete lack of analyses of competitiveness in R&D in the literature.

In fact the only attempt at combining different R&D indicators of individual countries and then ranking them based on this synthesis had a quite limited scope and no theoretical ambition (Niwa and Tomizawa, 1995). Several other efforts, subsequently surveyed in this book, were made to assess comparative positions of countries in innovation performance, but innovation does not equal R&D, and many policy tools used to stimulate innovation may not be linked with R&D to the slightest extent and vice versa.

The problem of partial overlaps between the terms ‘R&D’ and ‘innovation’ caused much headache to the authors during their work. The focus of the book is R&D competitiveness, but this topic cannot be discussed without frequently touching upon various problems of innovation. To give the most obvious example, a quite frequently used indicator of R&D output, patent counts, is much more about innovation than R&D even if it reflects the results of R&D quite well in a comparative approach. It is extremely important to note at this point however that science does not mean R&D, just as R&D does not equal innovation. This distinction has to be emphasized due to the fact that these three terms are not always used carefully enough with respect to each other in the press, by politicians or sometimes even in scientific publications.

The basic analytical tool for assessing the structures and performances of national systems of R&D is called NIS (national systems of innovation, or national innovation systems) in the literature. It would have been completely useless to introduce a new term such as for example ‘national systems of R&D’ just to avoid superfluous or redundant references to innovation in our text. As kind of a practical compromise we have tried to refer to ‘R&D and innovation’ if our original focus on R&D could not be observed rigorously. Even this heavy-handed solution proved impossible however in cases when we had to stick to established terms (for example NIS or R&D spending), in spite of the fact that we had narrower or broader definitions of such terms in mind.
The first chapter is devoted to some theoretical and methodological issues of competitiveness analysis, with special emphasis on their applicability for R&D. A key problem to be addressed here is how competitiveness can be used and interpreted for products and markets of R&D. This chapter also gives an overview of the main terms, concepts and models of the systems of R&D (or S&T) and innovation. Since the book is an attempt to analyse the R&D competitiveness of countries, the concept of R&D competitiveness is also presented.

The second chapter deals with the measurement of competitiveness. In the ‘classical’ competitiveness studies the supply- and demand-side measurement is usually not reconciled. High-tech trade and trade in technologies are somewhat related to R&D competitiveness at the country level, yet – besides the fact that each country is a different case study – there are also methodological considerations, which are not easy to resolve. Further, it needs to be considered whether comparison should be made on the basis of usual country indicators regardless of country size, or whether per capita (or other ‘relative’ or ‘efficiency’) data would give a more appropriate picture.

This question is usually not asked in ‘mainstream’ competitiveness analysis, since most of such attempts are rooted in classical and neoclassical trade theory in which countries have no spatial dimension and country size does not matter. It is however interesting to see how the per capita approach modifies the international competitiveness picture in R&D and innovation, and the extent to which smaller countries can cope with the lack of economies of scale in this field.

If there is more than one indicator used, another problem emerges and it is related to how different ranking lists using different indicators can be combined into one. The most important ranking methods used so far in the literature are presented briefly.

The most important question as regards the measurement of R&D competitiveness at the country level is ‘Which indicators shall we use?’ The data based upon which ‘absolute’ and ‘relative’ indicator measurements can take place are thoroughly discussed at the end of the second chapter. Despite methodological problems, we have found that in general the number of researchers and GERD (gross domestic expenditure on R&D) as input indicators and the number of publications and patents as output indicators are sufficient enough to describe the R&D competitiveness positions of countries. Nonetheless a word of caution must also be included here. The impact of R&D on a society is difficult to measure, and even if it is done with success, the result of any cross-country comparability will remain questionable because of the different socio-economic contexts of the different countries. To this end, a very important constituent of the national systems of innovation, education, is not discussed in this book. The business and social impacts of R&D (including innovation
effects such as spillovers) also had to be kept out of the set of indicators that can be used for cross-country analysis.

The third chapter presents the quantitative measurement of R&D competitiveness. It is the work of Balázs Borsi and András Telcs, who have also contributed to finalizing the manuscript. The chapter is experimental in its approach. Based on all the previous methodological deliberations on the theoretical and policy background, and also the useability of the various important R&D indicators, it uses a quantitative analysis. The investigation involves the selected indicators, carefully chosen methods and interpretations in a rather understated style. It presents different ways to construct composite ranking lists of countries including different indicators. In a sense it shows the progress of our research, going from the first, intuitive attempt at creating an international ranking list towards methodologically more demanding ones. Among these, we have used principal component analysis, a genetic algorithm and Data Envelopment Analysis (DEA). We have produced several results based on the different methods and, quite interestingly, kind of a ‘meta-result’: the different ranking lists overlap to a significant extent and together they seem to colour the general picture in a coherent way. Nonetheless the verification of the selection of the indicators, methods and approach used should come from the communities linked to R&D in one way or another when the results are being confronted and compared to other findings. Repetition of the measurement and investigation of longer time series would be desirable as well. Finally, the macro-level study cries for detailed case studies as to how R&D activity becomes embedded in the economy and society.

The quantitative picture calls for urgent policy action in Europe and also in the transition countries. As far as international competition in R&D is concerned, the European Union is losing ground vis-à-vis North America and the Far East. At the same time, the competitiveness positions of the countries of Central and Eastern Europe are increasingly challenged by the newly industrialized countries (NICs) of Asia and Latin America.

Policy conclusions are presented along with institutional aspects of R&D competitiveness in the two subsequent chapters. The fourth chapter is devoted to the analysis of such participants of international R&D competition which represent more or less atypical cases of national innovation systems (NIS), and where policy answers have to be found to the challenge of increasing competitiveness in R&D. Special attention is given here to two groups of countries. The case of transition economies is explained in more detail because some of these countries are already members of the OECD and also of the European Union, but their NISs still have a number of characteristics not found elsewhere in the developed world. Third World countries are included owing to the fact that some of them have shown spectacular improvements of R&D competitiveness and are approaching the best in the world, while others are at
best marginal players in international R&D. It is beyond doubt that Third World countries are a very heterogeneous group regarding R&D (which they are not with respect to problems of economic development, export competitiveness or policy choices), but it is still an open question whether their NISs show any particular aspects related to the Third World.

Both the case of transition economies and that of so-called developing economies have interesting theoretical implications with respect to a quite new and very stimulating approach to the role of R&D and innovation in economic development – the one offered by evolutionary economics (for an in-depth survey of its fundamental literature see Nelson, 1995). The main focus of the book is narrower and slightly more technical than the usually quite comprehensive approach used by evolutionary economics.

We shall however try to interprete our special country cases of national innovation system development from an evolutionary economics point of view as well. Some issues to be tackled here, but also in further comparative NIS research, include the patterns and directions of the evolution of innovation systems undergoing transition, the problem of innovation as an endogenous factor of growth on both the firm level and the national economy level, and the patterns of institutional development. The problem of path dependency often encountered in evolutionary economics literature may have a special meaning in such transition economies where systemic evolution through transition is accompanied by a shrinking of the NIS and a decomposition of its institutional framework.

The fifth chapter presents the conclusions, with special emphasis on a global picture of competitiveness in R&D. The focus of the research turns to the developed world here, with a brief assessment of the R&D aspects of the EU’s Lisbon Strategy.

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