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Marking time, and what to do instead

Possible ways ahead of the Hungarian R&D and innovation strategy from a competitiveness point of view

Government programmes and communication often – almost always – refer to the Hungarian R&D sector, and the national innovation system as an area whose rapid development is of key significance from the point of view of the country's convergence. The same has been increasingly often heard from the moment the country's EU accession was agreed, and the EU devised its own convergence programme in 2000, called the Lisbon strategy (Rodrigues, 2003, Kok, 2004).

The programme, setting the target of catching up with the US underlines the creation of a competitive, knowledge based economy in Europe, and sees R&D as a key player in this scenario. The key to improved R&D and innovation output in the EU is, so the programme says, raising the GERD/GDP indicator to 3% of the EU average by 2010[2]. Today it seems that the conditions of achieving an innovation system successful even by American standards on the basis of that objective are in place on the expenditure side only. The situation, however, is by far not as simple as that. We are going to try and scrutinize the Hungarian case from even closer to help the reader understand that even in this sector of the economy just as in all others, it is impossible to find quick and easy solutions for problems piling up for several decades. Especially when proposed solutions have usually been of the routine kind, based on normal distribution principles or governed by the rules of the given institution without digging deeper into the structural deficiencies or the economic background.

Even the present paper is not in a position to bring to light all the underlying reasons of the failures of previous attempted solutions. It is, however, in a position to redirect the debates concerning Hungarian R&D and innovation. It will aim at handling the two areas under one heading as we have rare examples where R&D should not, directly or indirectly, constitute the basis of innovation, or where serious and successful innovation takes place without a significant R&D background.

Our paper will not focus special attention to R&D statistics either in Hungary or abroad, but will make abundant references to publications including such facts. However, statistical facts are widely known e.g. on the EU's GDP ratio spent on R&D (the GERD/GDP index) presently at 1.8%. That is about two thirds of the corresponding US statistic. The corresponding Hungarian figure has in some of the years since the early 90s risen close to 1%, so e.g. in 2004 it was at 0.89%.

Hungarian R&D, however, does not, or not primarily suffer simply from relatively scarce public funding and non-financial resources. In addition to conceptual uncertainties, and an unapparent institution system, and numerous

actors misunderstanding their roles, the reason may be partly that the Hungarian political elite has long failed to properly understand the role of R&D and innovation in economic development. They certainly know the first lesson in the textbook: the main point of these tasks is the creation and launching of new products for later manufacturing and export. But there are other important functions as well, which, however, are truly needed only by an economy that is trying to grow not only in the quantitative, but also in the qualitative sense, and at the same time, wishes to integrate in the world economy.

The benefit of so-called knowledge creation is not only bringing about innovation that may be immediately applied in practice in the economy, but also the operation of research and development capacities that may keep a country's research sector and higher education system as close as possible to the leading edge of the world. And this can only yield tangible economic benefit besides intellectual export, and operating capital import through participation in international research networks, but not before a longer period of development takes place.[3]

The paper will first browse through the literature of the problems of Hungarian R&D and innovation, or more accurately, its core elements. Based on our own research into the competitiveness of the Hungarian R&D and innovation sector, it will attempt a snapshot of the present positions of the sector in international competition. It will devote extra attention to the institution system, and go on to scrutinize the real role of R&D and innovation in the economy. The final part of the paper will provide a list of possible strategic options.

DIAGNOSES OF HUNGARIAN R&D

Numerous diagnoses have been offered on the operation of Hungarian R&D and the national innovation system over the last 10–15 years.[4] These reflect many common features, and reach mostly similar conclusions. The majority of authors attribute the neglected situation of Hungarian R&D along with the scarce interest – financial and intellectual – of most of the economy in innovation to dwindling public funding and missing capital, weak risk-taking potential, and lack of information concerning international matters on the side of the business sector, especially Hungarian owned, and smaller companies.

A number of sources refer to the low efficiency, and the organisational problems of the Hungarian R&D diffusion system (most recently Viszt, 2005), although the theoretical background of investigating the diffusion system is presently subject to debates as the very notion of the diffusion system supposes the linear nature of the innovation system. In the linear model there is a straight line from R&D to innovation sold in the marketplace, the individual actors operate distinctly, and the entire process is made up of research sites following up on each other as discrete points. Recent research, however, regards that approach mere theoretical fiction, and recommends the application of more complex models (circular, random, and three-spiral models) that are also closer to reality (cf. Lundvall, 1992, Nelson, 1993; Leydesdorff, 2000; Török, Borsi and Telcs, 2005).

The earlier (Török, 1996), and later (Viszt, 2005) diagnoses of the Hungarian diffusion system, however, come to identical conclusions. The main point of these concerns the chaotic and fragmented nature of the institution system meant to bring R&D achievements from the research sites to the developing and manufacturing companies. There was hardly any change between the mid 90s and around 2005 in the sense that a significant part of the quasi-diffusion organisations established formerly through public or foreign funding through applications survived, but gave up

managing and mediating technology a long time ago.

The structure left over from before the 1990s creates confusion and unnecessary duplications especially in basic research, where there is no clear division of labour between universities and academic research institutions. Such structures are not unique internationally (similar ones operate e.g. in France, and in most former COMECON countries) with the difference that they usually harmonise their tasks appropriately. The general view in the profession explains duplication in Hungary mainly by the fact that universities in the previous system had the primarily role of teaching, but in many places they included research in their profile after 1990 even though their staff remained below the required quality.

There is no denying that in the 70s and 80s universities had relatively low enrolment levels besides a strict admission system, and since there was little funding to apply for, leading teaching personnel could concentrate on teaching, but further scientific training (today called PhD) was not provided at universities at the time. After 1990 universities were given back their autonomy, and academic institutes also broke free from direct state control. Basic funding was rapidly running out in both areas. In higher education they have been trying to supplement the per capita quota system paid by the state with so-called cost-reimbursement arrangements, while both universities and academic institutions use applications for funding as their primary means of survival.

Mutually competitive applications are a sign of significant duplication between research sites of similar profile, however, really competitive research capacities tend to supplement each other in identical technical areas. One needs to realise also that the ultimate quality control is mostly present in the network of academic institutions, while several higher education institutions were established or upgraded that only have the required relevant intellectual resources on paper. The Hungarian higher education accreditation system finds the formal measurement of researcher status (i.e. the number of scientific grades) much more important than real scientific achievement.

Most diagnostic reports fail to give details on the direction and the manner in which and the structure by which the Hungarian R&D and innovation system should develop if regularly reiterated political promises were ever complied with, and funding levels in the entire sector were to rise in accordance with requirements, perhaps to a point where it would come close the EU average. The overwhelming majority of diagnoses fail to engage in serious comparisons of Hungary to European countries of comparable level of development such as Greece, Portugal, Poland, the Czech Republic, Slovakia, or Slovenia.

Those comparisons, if ever conducted would highlight GERD/GDP ratios and economic development rates (Török, 2005) indicating that in most economies of the world there is a strong correlation between the per capita GDP, and the GERD/GDP index, and that in the majority of countries with levels of development similar to Hungary (except the Czech Republic, and Slovenia), the GERD/GDP index actually remains below 1%. That strong relationship could, of course be interpreted suggesting that larger R&D expenses promote the country's economic development. That correlation, however, only holds on a longer term. On a shorter term, the opposite seems much more true: more developed countries can spend more on objectives such as R&D and innovation, which have favourable financial return, but it takes some time before the investment returns.

That is because in richer countries the distribution of the GDP is less dependent on – long unmet – welfare and development requirements than in countries with lower levels of development. At the same time, there is anoth-

er strong correlation at work, namely the one between economic development and the GERD/GDP index on the one hand, and its components on the other. The BERD/GDP index (i.e. the GDP ratio of the R&D expenditure of the business sector) also increases in direct proportion to economic development (Török, 2005). It would seem simple to account for that by saying 'in a developed country even the enterprises are more developed', and truth is not far from that – apparently tautological – statement.

It would take further analysis to corroborate the probably justified hypothesis whereby more developed countries' companies have better endowment with capital, more powerful protection of intellectual property, a wider network of international relations, greater risk bearing capacity, and more significant market standing, while the internal and the international innovation networks of developed countries are also multi-layered, and are composed of several elements. And these bring about network effects (cf. Pyka-Küppers, 2002; Barabási, 2003) that powerfully increase the effectiveness of R&D expenditures.

All these point in the same direction: it seems that rendering the R&D sector and the innovation system in Hungary more successful requires the delivery of many tasks in the entire economy, that is, even outside the encouragement and funding of R&D and innovation. We could even expect a scenario whereby a steadily growing economy frees up increasing amounts of public and corporate resources in order to reinforce the growth-accelerating role of R&D and innovation. This is how a classic self-induction and feed-back activated R&D and innovation-oriented development process could unfold.

However, the Hungarian case can still not be properly described in the context of a sterile growth model because strategy creation here is increasingly affected by institutions' interests, and these institutions are in open conflict of a type apparently unique in Europe. Such conflict is partly between institutions, and partly between *policy* priorities.

The fact remains that the Lisbon strategy of the European Union advocates the need for successful innovation built upon effective R&D more openly than any EU document before (Rodrigues, 2003), meaning that it sees increasing R&D expenditure a deficient instrument to meeting convergence criteria unless it results in significantly more successful innovation projects. In the European Union R&D belongs under the Research Directorate General and Innovation under the Enterprise DG, and that separation sometimes amounts to serious difficulties of coordination. However, open confrontation between R&D and innovation is unprecedented even there.

In Hungary, the Hungarian Academy of Sciences (hereinafter MTA) is statutorily empowered to be responsible for R&D policy otherwise in line with professional traditions, and innovation policy is based on the same authority under the National Agency for Research and Technology (hereinafter the NKTH, the organisation assuming the functions of the former OMFB [National Committee for Technological Development] after four years of non-operation), thus the two profiles are truly separated from each other. The two institutions represent markedly different views concerning Hungarian R&D and innovation policy[5], and the NKTH, a government backer along with the Ministry of Economic Affairs sometimes voice their views openly in public.[6]

The MTA acknowledges the mutual dependence of basic research and applied research on the one hand, and innovation on the other, while the NKTH tends to advocate the concept of exclusion. It fails to accept the claim of basic research for significant public funding, and primarily intends to use more corporate resources

in R&D. The MTA's ideal scenario would be distributing one third of the funding to basic research, applied research, and experimental development each, while the NKTH is of the view that only those research projects deserve public funding that directly promote innovation and increased competitiveness in the business sector.

According to one interpretation of the 'European paradox' R&D in the European Union develops chiefly in the area of basic research, and so providing extra funding to R&D does not improve the conditions of innovation and competitiveness as expected (Papanek, 2003). The author quoted considers that the Hungarian system of R&D and innovation suffers from the same paradoxical problem at a lower level. It is likely that the recent popularity of the 'European paradox' in technical literature helped form the truly sharp views of the NKTH referred to above. In all diagnoses of the Hungarian R&D and innovation system (cf. e.g. Báger–Goldperger–Varga, 2005. 11–12) the effect of the 'European paradox' is increasingly strongly felt[7], and so several authors regard that problem the major weakness of R&D in Hungary.

The mere fact of the 'paradox' (i.e. the results of European R&D are seen increasingly in publications, and less and less in patents) is statistically unquestionable, while a clear statistical picture is conducive to excessive simplification. That statement is justified because *another* possible interpretation would be that in the European Union there is too much basic research, and too little R&D really directly serving corporate needs.

The reducing number of registered patents, however, is not necessarily indicative of slackening innovation, but is equally the result of the threat whereby patenting is too costly compared to the decreasing levels of legal protection (against e.g. counterfeiting in the Far-East) that it provides.[8] To be quite accurate, legal protection gradually loses its status as the most effective instrument of protecting intellectual property. Innovation may perhaps remain better hidden within a company if unpatented prior to marketing, thus fending off malicious interest.

The unwelcome effect of statistical 'paradox' is that it creates an unfavourable mood for basic research among the public, and even among some policy makers suggesting that such research is unnecessary, and is only the livelihood of an unproductive group of researchers. Another fact, namely that the internationally recognised achievements of Hungarian R&D in natural sciences are primarily in basic research in mathematics, life sciences, and chemistry helps bring about a situation similar to the 'European paradox' in Hungary.

To keep the basic research base in operation is important for at least three reasons in a country otherwise prepared to do such research, and these three reasons are regularly left out of consideration by professional or political statements made against basic research[9]. The three reasons are as follows:

❶ It is a particularly difficult task from a technical and organisational point of view to separate strictly basic and applied research as even with areas of research apparently remote from everyday reality it becomes clear that they have major practical utility;[10]

❷ With basic research one may easily experience the fare dodger problem if several countries decide they would only engage in applied research, and experimental development, and take the results of basic research from other countries. As basic research results are more rarely under industrial patent than R&D stages closer to marketing, most of them may be easily taken over at low cost from technical literature. So the public property developed by basic research countries land in the possession of fare dodgers, thus ultimately undermining the interest of countries that still fund basic research. But

even the fare dodgers do not necessarily get a free ride as they will have less and less say in basic research, and will have to adjust their applied research to already existing basic research results;

❸ Higher education of countries aiming to build their own top standard R&D may not be steadily excellent if it takes over basic research results playing a key role in education and scientific further training from abroad in the absence of domestic basic research. That may result in the deterioration of the overall standards of the teaching staff because teachers of basic subjects may hardly deliver the research results required for their professional progress without the appropriate basic research conditions in place.

Opposing basic research to applied research is, unfortunately, not surprising in a country where actors in the R&D and innovation system are in the habit of fighting each other to lay hands on the scarce resources. The fight is practically a zero sum game i.e. extra resources may only be obtained to the detriment of each other. Basic research teams of no apparent economic benefit, lacking any financial support of or relations with the business sector and thus also unable to represent their political interest have too little power. In their present position they have great difficulty competing against applied research and development lobby groups intent on monopolising the argument of economic rationality who often have the backing of large corporations, and thus represent significant lobbying potential.

Opposing the two types of research to each other is artificial, and professionally unjustified, exactly because the two can only progress relying on each other. The arbitrary interpretation of the 'European paradox' may offer a seemingly tempting solution to the long-awaited reform of the Hungarian innovation system. The elimination of basic research from the Hungarian national innovation system may, however, eradicate the professional roots of applied research in Hungary without any serious guarantees that the surplus resources thus left over will be used to the benefit of applied research to improve its competitiveness.

The bad funding, and the structural disturbances, or numerous operational problems of the Hungarian R&D and innovation system are not denied by a single source of technical literature. The system did not undergo dramatic deterioration in the 90s by international standards, although some slow lowering of its profile took place unquestionably. However, such relative setback also characterised most EU countries when some countries, for decades on the periphery of international R&D shot ahead suddenly. Mostly countries of large areas and populations belong here such as China, India, Brazil, South African Republic, but some others e.g. Vietnam, Thailand, and the Philippines are also increasingly good examples.

Hungary is still positioned right behind the vanguard of international R&D and innovation. That of course should not lead to complacency: maintaining our 2003–2004 international positions would be a major achievement in itself in the light of the anti-competitive effect of the funding, operational, and organisational problems discussed above.

HUNGARIAN R&D IN THE INTERNATIONAL RACE

The performance and competitiveness of Hungarian R&D assessed by international standards have been the subject of several studies. These surveys using different methodologies yielded similar results in spite of the fact that the individual surveys usually had a different background of terminology and theory. Another shared feature is that their strategic conclusions go no further than making recommendations concerning increasing certain indicators, even though individual indicators alone can only describe the performance and the

competitiveness of the entire R&D and innovation system at a very low rate of efficiency (Török, Borsi and Telcs, 2005).

Török (2002, 2002) was the first to introduce the notion of competitiveness in international R&D comparisons. His analyses use two input indicators (GERD+GDP, and R&D-employment rate), and two output indicators (international publication ratios without a breakdown to field of science, and stake in patents registered in the US) in trying to verify the statement made in the EU document called Agenda 2000 concerning whether Hungary belongs among the first 20 countries of the world based on its scientific performance.[11]

Tamás Balogh (2002, 2004) comes to similar conclusions discussing not so much the theoretical background of the issue than indicators suitable for characterising Hungarian R&D in an international context. In an article written in 2004 he based his work on the EU Innovation Scoreboard. However, he did not regard his task either the interpretation of R&D competitiveness nor an attempt at construing an integrated indicator to identify the international position of the competitiveness of Hungarian R&D. His results corroborate that Hungary in the international R&D competition comes in the top middle field (i.e. the group right after leading industrial nations), but with deficient funding, and the weak operating efficiency of the national innovation system there is a real threat of lagging further and further behind.

Ferenc Hohl, Márton Holczer and *Attila Pái* (2004) used more recent data, and more indicators than the indices referred to so far, and applied the technique of *benchmarking* also expressly recommended by the European Union[12]. Their study is based on surveys by the OECD, and the EU, and include indicators of R&D funding, and employment rates well known for the reader.

At the same time, the authors rarely refer to the methodological problems of the frequently used indicators. Thus they regard the number of references in a paper as a quality indicator without any serious reservation. Meanwhile they, too, mention criticism in technical literature concerning the limitations of applying the indicator (Papp, 2004). Similarly, they recognise patent indicators as the measure of technological developments (Hohl, Holczer and Pái, 2004. 1017), and remark only later that companies can protect their intellectual property created through R&D not exclusively by patenting.

The group of authors list among the measures of international R&D performance the success rate in applications for funding that are equally open for countries listed in the comparison (such application systems include e.g. the framework programmes of the EU, and the European Research Region if it is about R&D comparison among European countries). The study provides a list of 32 indicators regarded partly quality indicators without any reference to similar attempts at systemisation (first of all Godin, 2003). The summary conclusions of the researchers concern less the Hungarian positions than deficient statistics rendering comparison of R&D performance within the European Research Region difficult.

Balázs Borsi, and András Telcs prepared analyses between 2001 and 2004 within the framework of the National Research and Development Programme attempting a quantitative presentation based on several indicators of the international competitive position of Hungarian R&D.[13]

Borsi and Telcs (2004) take the major methodological problems of international R&D comparisons one by one. Using their phrasing – as accurate as it could be – the absolute country-comparisons represent the individual players on the R&D world map as 'weighted points', while the specific (per capita) indicators are used to represent efficiency. Thus the two R&D comparisons made using two different approaches result in markedly different pictures, but in

really high standard analyses the two methods are worthwhile integrating.

The authors sought the solution to the problem of matching up the different indicators of R&D performance and competitiveness through two methods, i.e. principal component analysis, and genetic algorithm[14]. The two researchers illustrate this by the spectacular fact that in the individual rankings of different absolute indicators Hungary's positions spread around the 24th–43rd place, while in the specific rankings we are between the 6th and the 40th place.[15]

Analyses conducted with absolute indicators rank Hungary 35–36th, and specific analyses 27–28th in the international R&D race (based on 2000 statistics), which suggests an efficiency rate for the Hungarian innovation system somewhat higher than the international average[16]. That, however, is no more than a suggestion as the relatively small dimensions of the country are a disadvantage in themselves in absolute comparison, and the rankings of specific indicators reflect a significant spread.

Based on the difference of the two places and the rankings established by the Borsi–Telcs author team we may, somewhat inaccurately, arrive at the conclusion that in the international R&D race Hungary[17] is the immediate competitor of the following countries:

- from among developed countries: countries with a population 2–3 times smaller than Hungary (Ireland, New-Zealand, and perhaps Norway), but Denmark, Finland, and Switzerland are not among the examples;
- from among medium developed countries: Poland, Czech Republic, and, from among older EU member countries of similar populations Greece, and Portugal;
- from among developing countries: much larger countries, rapidly industrialising countries such as Brazil, Argentina, Mexico and Turkey, but most of these are working off their lag against the new Central European member countries.[18]

The international comparisons referred to above highlight some structural anomalies in the operation of the Hungarian R&D sector and the national innovation system. One of these is the relatively high funding rate, and good output indicators of basic research besides applied research and experimental development are off the limelight (see in particular Hohl, Holczer, and Pái, 2004, 986), which is a characteristic incarnation of the 'European paradox'. The other is the surprisingly favourable standing of output indicators vis-a-vis meagre financial and labour investment. The third is the little weight of corporate R&D expenses (BERD) within GERD, which is a traditional problem of the Hungarian R&D and innovation system (touched upon earlier in the present paper).

From a competitiveness point of view, all this means that the Hungarian R&D sector, and the innovation system operate under an ever greater international pressure of competitiveness while its results continue to attract little market interest, its resources continue to shrink in a relative sense (compared to the major competitors), and it is increasingly forced to fight for its resources and the sale of its achievements in an international competition. Even though in accordance with the computations referred to above we see deteriorating competitiveness, too, in fact it is primarily the deterioration of the competitiveness factors that are the main cause for concern. The question now is whether in the Hungarian R&D policy (or indeed economic policy) there is a strategic answer to this challenge.

Does Hungary have an R&D and innovation strategy of its own?

The comprehensive government strategy of the Hungarian R&D sector and innovation system does not have a dedicated document. There was an innovation strategy prepared in late 1999,

however, it was taken off the agenda due to the government reshuffle undertaken at the time prior to the final debate (so-called public administration discussion), and even references could not be made to it later.

In early 2006 we have no knowledge of any similar document. Strategic concepts transpiring from the regular reports by the Hungarian Academy of Sciences presented to Parliament, as well as the Academy's science policy concept published in 2005 refer to the development of Hungarian science as a whole, which does not overlap with the R&D sector, and even less with the national innovation system. The strategic aim of the concepts phrased in the different versions of the National Development Plan are unambiguous, but that strategy serves to provide a basis to Hungary's resource requirements within the EU rather than to restructure the individual sectors, or to render these sectors more competitive by a better use of domestic resources. Meanwhile the 2005 programme document by the NKTH titled Knowledge, creation, value is specifically aimed at improving the conditions of innovation through an exclusive approach referred to above.

The Lisbon Strategy of the European Union – and the Spring Report investigating its rate of implementation (European Commission, 2004), and then the Kok report (Kok et al., 2004) attributes a key role at a theoretical level to R&D, and innovation in helping the EU catch up internationally, but attaches an unjustified level of significance to funding to accelerate growth in the sector. That mentality has been reflected by Hungarian political standpoints concerning R&D – not necessarily at EU inspiration – over the last 10 years or more, i.e. since at least 1995. The cornerstone of political promises and objectives was the raising of the GERD/GDP indicator: in Hungary to 1%, and then to 1.5% already on a short term, and in the EU to 3% on a medium term on average from the 1.8% value measured in the early 2000s (Rodrigues, 2003).

We cannot consider an R&D strategy as either any pressure upward to raise the GERD/GDP indicator or any promises given downward. Not even if – just as in Hungary in 2005 – doubtlessly and obviously the sector is critically underfunded. The main part of the government' role in developing the R&D sector and the national innovation system is of course funding, especially in the countries in which the BERD/GERD ratio is low, i.e. the government has to take a larger share of funding R&D and innovation than the business sector.

DIFFERENT LEVELS OF R&D STRATEGCAL THINKING

The GERD issue is the uppermost, politically quite spectacular, easily understandable level of R&D strategy, whose content, however, is of low standards. The GERD issue refers to the ratio of the GDP that must or may be spent on R&D, but it does not contain performance criteria of any accuracy. The second, already less visual level is the contribution of the business sector to funding and to R&D, called the BERD issue, although is has more than just statistical content and significance. The third, and lowest level is the one where the detailed knowledge of the R&D sector, and the national innovation system and its players are required to understand strategic options. That is sometimes referred to as the diffusion problem.

The GERD issue: This is where R&D and innovation strategy primarily touch the world of political deals. When the BERD issue is unresolved, i.e. the R&D sector requires more funding, but the business sector is unwilling to grant it, then universities, academies of science, and further actors of the supply side of the national innovation system usually ask the government for further raising the GERD. And

when they do, they must at any rate join in the game of political relationships and communication to some extent.

Hungarian experience has, ever since the early nineties supplied copious examples for what may happen in such situations. The interest representative power of the R&D sector is apparently strong, i.e. Hungarian scientific life can usually achieve a promise from the government at the time to increase R&D support. R&D institutions, and scientific life, however, lack the power to ensure effective delivery of these promises, thus these promises will either not materialise, or government only delivers on them seemingly. Over no more than the 5 years since 1999 there were three different examples for techniques when government, while apparently keeping its promise of raising the GERD/GDP ratio above 1% gave in fact nothing or much less than promised to the R&D sector, and also failed at achieving a more serious raising of corporate R&D expenses.

- Changing the internal proportions of university financing. The Hungarian government used that method in 1999 when it raised the per capita research quota in higher education to the debit of the education quota. In simple terms, universities and colleges were given the same amount of public funding as before (of course including the increasing nominal subsidy meant to offset inflation), but spent nominally more of this on R&D than before. But that did not mean a real raising of the GERD.
- Raising the value added tax on R&D. The Hungarian government raised the value added tax of R&D services twice, first in 2003, then in 2004, first from 0% to the lowered rate, then to the normal level of 25%. The Hungarian national innovation system, and the main actors of the R&D sector, universities, and the academic research institutions, however, are statutorily prohibited from reclaiming VAT, thus by raising the VAT government reduced R&D funding to the same extent. Meanwhile in governmental communication the public was only informed of higher levels of R&D funding – a misstatement only politically justifiable – without the fact of the VAT increase (i.e. VAT reclassification of R&D). What is more is that increasing the VAT only reduces Hungarian GERD in terms of substance, but not statistically. This way pre- and post-2002 Hungarian GERD statistics are no longer comparable.
- The Hungarian government introduced an innovation contribution in early 2004 payable by each company exceeding a certain size, and could only be lowered by the same company placing R&D orders with public research units, or spending on R&D internally. That amount appears to be part of the BERD on the liability side, while regarding its essence it does not increase the GERD on the basis of corporate decisions. True, its GERD-increasing effect is double, because government – in accordance with its promise, but only from 2007 as we know in early 2006 – is going to raise R&D funding to be allocated through application by the amount of the contribution coming in from companies.[19]

The politically motivated promises, and communicational rather than strategic objectives of raising the GERD have been met in Hungary only partially since the mid 90s.[20] It never became integrated in public thinking (and apparently never surfaced in governmental strategic thinking either) that the GERD/GDP index cannot be regarded the comprehensive and reliable status indicator of R&D and the innovation system. The improvement of that indicator may only mean the improvement of the conditions of R&D from a single (even if important) point of view.

A chronically underfinanced system may catch its breath, and its processes of deterioration or disintegration may slow down if there are more financial resources available. That, however, does not necessarily mean that the system's efficiency or performance potential

will immediately improve, as that would require change in its internal structure, and its players would have to be rendered more interested in achieving results. That improvement, however, does not happen overnight, and this is not only due to the internal inertia and resistance of the system. One of the real reasons is that the performance criteria of R&D are not obvious even in international technical literature (see Török, Borsi and Telcs, 2005). They are of especially little use if the strategic objective itself is not the improvement of the R&D performance, but a significant unfolding of the innovation process.

The popular slogan of increasing the GERD is not missing from among the main objectives of the Lisbon Strategy. But that slogan will only be filled with real content beyond the similarly important aspect of domestic scientific capacities, and values as soon as it is complemented by an increasing rate of R&D funding by the business sector, and it becomes clear how much the rise of the GERD/GDP ratio can strengthen the competitiveness-increasing potential of the economy. So increasing the GERD may have as one of its important effects that it eventually creates closer linkages between the competitiveness of R&D (whose measurement may be done by several methods), and the competitiveness of the economy (the measurement of which is likewise possible by different methods).

The *BERD issue:* in most countries in the world the ratio of corporate R&D expenditures within GERD is in direct relationship with the development rate of the economy, and it is likewise true in general that in countries of higher BERD/GERD ratios there is a higher rate of R&D competitiveness. There are, however, no internationally comparable statistics available concerning the R&D intensity of the corporate sector. Thus we lack information for most countries on how R&D intensive or how innovative the activity of their companies is on average. The technology intensiveness of a country's exports and the technological balance of payment are usually interpreted as relevant indicators, but these indicators cannot distinguish between innovation and technologies created within and outside the national economy. Thus in many countries, including Hungary one sees a technology intensive foreign trade structure where otherwise the willingness of domestic enterprises to finance R&D is very low.

The word *willingness*, however, is not accurate here as it is suggestive of the appearance that most companies have a choice between an R&D intensive strategy, and one without R&D. Several corporate surveys[21] indicate that there are at best a few thousand companies with a real R&D profile in the Hungarian economy, and companies qualifying for the word innovative remain below 20% of all companies.[22]

Hungarian enterprises, and especially the majority of small enterprises perform such service type activities or simple ones of traditional technology that do not require R&D or innovation. Therefore one must interpret the issue of raising R&D expenditure in a wider structural policy framework, and the solution, i.e. the major increase of R&D expenditure and so the BERD/GERD ratio may not be expected from better or stronger incentives.

The structural policy interpretation of the BERD/GERD ratio must not be based on the traditionally interpreted sector structure of the economy. It emerged in conjunction with several foreign owned major, apparently technology intensive plants in Hungary – with some of them only after their closure – that all they did was assemble a part in some state-of-the-art product, requiring no more than routine skilled work. The conclusion is that even in apparently top technology sectors or branches of industry there is not always a high rate of value added. Although sector statistics may accurately reflect the high manufacturing or export ratio of industries considered high-tech, it does not necessarily mean the presence of a proportion-

ate weight of R&D intensive activities in the entire economy.

When implementing concepts of raising the BERD/GERD ratio (i.e. the increased contribution of the corporate sector to R&D) it would be important to take note of the size of the workforce in the Hungarian R&D sector and national innovation system available for modern R&D work. That information is necessary as we currently lack any results of surveys reflecting the rate of higher level research skills.[23]

Statistics on scientific grades fail to reflect a realistic picture of research skills. One reason is that a significant part of researchers wit higher qualifications belong to the elderly generation.[24] The statistical size of the research staff, however, includes many experts with irrelevant experience, obsolete education or workplaces with deficient infrastructure rendering them less than capable of conducting research of international standards.

The Hungarian network of researchers consists not only of internationally renowned Centres of Excellence, but also of smaller research units (e.g. non-metropolitan colleges) lacking technology worth the name, and maybe even the capacities of the available research staff remain below international standards. And all that sets the limits of strategic endeavours, not yet even fully crystallised, aiming at increasing the BERD.

Thus the BERD issue is in close relationship with the GERD issue, and raises the fundamental issue of how much capital the R&D sector is in fact capable of absorbing, i.e. what limitations of researcher-developer capacities could arise in the course of more intensive funding, and especially funding of enterprises that require tangible results turned out rapidly.

The diffusion issue: it is a repeatedly confirmed experience in the Hungarian R&D sector and innovation system[25] that Hungarian research and development results take a long time to become established innovation in the market. The traditional explanation is the weakness of the Hungarian diffusion system, but the review of the BERD issue has shown that even the demand side of the innovation system is underdeveloped. Thus the issue is not only that R&D results created in Hungary undergo a tedious process to reach the users, but also that there are few serious users to reach.

However, the diffusion issue is broader than the problem of the diffusion system as such. It also includes the issue of the relationships among all players of the national innovation system. The Hungarian R&D or innovation strategy should set the objective of reviewing these relationships, and rendering them transparent.

An analysis should be prepared on what players of the Hungarian innovation system have proved to be successful domestic and international applicants in the 90s and the last few years, and what role their relationships with the users had in that success. At the same time, regularly unsuccessful applicants' failure may be ascribable to their deficient skills of writing applications (including the low quality applications) same as the isolation of such applicants within the international innovation system, and their missing relationships with users. There may be, however, occasionally successful applicants who are granted funding not because of a good track record or doing something that is in great demand, but because their institutional funding cannot be resolved in any other way, and because that particular R&D organisation must be kept afloat not for its R&D merits, but for some other (e.g. regional) interest.

So from a strategic point of view, the diffusion issue primarily means that the players of the Hungarian national innovation system are only nominally known; how competitive they are, and how interesting R&D potential they offer for the users is only known about only

some of them. A significant part of players known, and so far proved successful, participate in diffusion themselves, and have a wide network of relationships, too. A number of other players, however, fail to relate to the diffusion system in any way, and it is not known for the time being how much they could become competitive players of a modern national innovation system.

Handling the diffusion issue must not miss from the Hungarian R&D and innovation strategy, because upon reviewing funding issues one cannot plan on the fiction of a homogenous, and well planned national innovation system. It is possible (but needs still to be corroborated by detailed organisational analyses) that in the Hungarian innovation system in the developed countries there is an unusual coexistence of internationally competitive high standard capacities, and those only kept alive 'artificially', which, however, do not deserve that a formally homogenous set of support regulations containing also some discretional elements be maintained exclusively for them. It would be certainly simple to concentrate support on capacities proven to be competitive, but that would render regional equalisation, an objective also set in the Lisbon Strategy more difficult in the area of R&D.

THE ELEMENTS OF HUNGARIAN R&D AND INNOVATION STRATEGY IMPROVING COMPETITIVENESS

We can still consider the international competitiveness of Hungarian R&D relatively good, and favourable compared to the country's economic development rate. In accordance with per capita GDP adjusted by purchasing power parity Hungary belongs only to the first 50 countries of the world. The 2004 international competitiveness list of the IMD (not containing a number of less developed countries, but containing some west European regions separately) ranks Hungary as 42nd (which would be 38th without the regions in the individual countries), while on the basis of the different interpretations and indicators of R&D competitiveness we are definitely among the first 35. However, we have begun to slide down the international rank scale, and so the elaboration of the Hungarian R&D and innovation strategy must be undertaken without delay if that strategic branch is to be saved.

The Hungarian R&D and innovation system requires adjustments at several points, many of which may be implemented through changes in regulation that need no or hardly any additional financial resources. The domestic performance standards of Hungarian R&D do not fully correspond to the internationally accepted standards. Using those 'distorted incentives' results in a picture of Hungarian R&D performance and competitiveness less favourable than what it could show up even with its current financial status.

THE RESEARCH FUNCTION OF UNIVERSITIES

The role of universities is still unclear and dysfunctional in the organisational context of the Hungarian national innovation system[26]. Modern American and European universities have research functions established in their statutes, and research is usually of equal rank with their educational function. Such stipulations exist also in the statutes of Hungarian universities, however, the quota (per capita funding) system of state universities gives priority to educational performance measured on an exclusively quantitative basis rather than relying on quality considerations.

A fact in conflict with the above is that the promotion of university teachers depends greatly on their scientific grading, a system

which is disadvantageous for university staff with a good teaching record but tabling weaker research performance. The category of 'research university' recognised also by higher levels of funding still awaits introduction in Hungary. That notion implies the assumption that other universities do not do research.

Education and R&D policy makers should finally agree on the exact role of universities in the Hungarian R&D strategy, and the full recognition of research careers within a university is also a duty still undelivered. It is established practice in several Hungarian universities that professors of high scientific grade, with outstanding research results teach large numbers of students early in their studies, frequently forced to teach rudimentary knowledge that the students should have been taught back at grammar school. That greatly weakens the utilisation efficiency of universities' research capacities.

RESEARCH CAREERS AND NETWORKING

International research performance standards are clear even if some of their weaknesses (e.g. disproportionately high appreciation of co-authorship) are not likely to be eliminated. Careers of development specialists relate less to the kind of performance one expects on the basis of scientometric indicators. Such careers are pursued much more characteristically by promotion within a company, thus remaining unseen for the public. Such promotion is partly due to the growth of the company's intellectual property, i.e. the larger number of patents, even though corporate patents are usually not regarded as individual development achievements.

The difference between the two standards of success is not clear in Hungary, and government fails to grant any support to research and development careers other than the general funding of R&D. Such support would be necessary, though, because standing the race of international R&D, i.e. improving the indices of publication, quotations, and individual patents also require specific forms of support. It would be necessary for instance to launch an easily operated application system to support the top standard English translations of articles authored in Hungarian as in lack of such some otherwise competitive results do not reach the international publication market on time.

Supporting researchers of outstanding performance with the appropriate intellectual infrastructure could also repay for Hungarian R&D through helping it move faster up the rank scale. It is long-standing practice with many leading American researchers that a number of assistants work for them, and so they themself will not have to spend time on finalising or even technically editing their articles, or preparing the excerpts of their conference presentations. The work contract of such leading researchers includes not only their salaries, their IT and travel budgets, but also the sum with which they can pay research assistants or younger researchers to work with them. Supporting leading researchers repays for their employers when they see a better publication output, which in turn works a beneficial effect on application success rates, and the ranking of universities as well.

In certain universities leading researchers are supported by employing PhD students to help them, which brings about great staff turnover, and may even result in problems of compatibility. Only very few members of the secretarial staff of Hungarian universities, and academic research institutes are capable of acting as research assistants, and they mostly lack the necessary time, too.

Participation in international research networks always yields a complex set of benefits, and that benefit is immediately reflected in researchers' publication output as well. Regularly published American R&D analyses

(e.g. NSF 2002; 2004) include the indicators characterising the network relationships of individual countries, e.g. the frequency of co-authored articles. It seems obvious that R&D performance and competitiveness indicators are better in institutions where researchers participate more intensively in international R&D networks. A main reason of that relationship is probably that members of research networks publish a relatively large number of co-authored articles (and thereby improve their publication output more than their research efforts), which is in fact a statistical proof of the existence of the given network.

So a Hungarian R&D strategy would need tools/methods that help researchers improve not only their actual, but also their apparent performance. For example supporting international networking would probably spectacularly improve the international scientometric indicators of Hungarian researchers besides identical research efforts. Similarly, enabling the provision of administrative/clerical support to leading researchers, or researchers generally capable of good performance would result in the better utilisation of their research capacities.

SCIENCE AND R&D IN HUNGARIAN SOCIETY

Science enjoys great prestige in Hungarian society, and the Hungarian Academy of Sciences has similar prestige among our institutions. A representative survey conducted in 2003–2004 suggested that scientists are the second most recognised (after doctors) among all branches of occupations, and among the institutions of society the Academy takes the first place with over 80% popularity (Fábri, 2004. 1257–1259).

That suggests that a special public, namely Hungarian society has a very favourable impression of the competitiveness of Hungarian science, so partly also of R&D. One can only properly appreciate that impression knowing that several occupations[27], and several political, and social institutions are victims of a massive crisis of confidence in Hungarian society in the last few years. This is why the favourable assessment of science, and the Hungarian Academy of Sciences has been deserved not only by the latter's professional output, but also by its integrity, and its distance from daily politics.

However, the favourable judgement of Hungarian science and scientific life by society does not necessarily translate into a strong bargaining position of representatives of science, and leading officials of scientific life vis-a-vis the government, or politics in general. The changes of GERD, and the public funding of R&D since 1990 indicates that the GERD/GDP ratio declined until 1997, and from 2003 onward it went steadily down again, while the 1% GERD/GDP ratio was only approached or reached in few of these years despite promises, and apparent even enthusiasm by several governments.

Even though that ratio is similar to south European and central European countries with an economy comparable to Hungary's in their rate of development, it in itself is not enough for a breakout or even a little improvement in our positions. Besides such funding ratio the social support of Hungarian science and R&D may be great, it does not surface in the political behaviour vis-a-vis the sector, and that funding rate fails to reflect the heavily quoted strategic status of the sector. Even the business sector's behaviour does not reflect the apparently significant social acceptance rate of Hungarian science as suggested by the BERD/GERD index, steadily very low even in international comparison.

Society may like and be supportive of Hungarian science, however the survey referred to does not say what tax rise Hungarian society would find tolerable to offset the increased public approval to R&D. It is quite likely that the same acceptance rate without any possible

financial consequence would be much greater than in an acceptance survey where respondents are also asked if they are prepared to contribute financially.

The result of investigations concerning the international competitiveness of Hungarian R&D may of course be used by government and politics to judge how justified the sector's support requirements are. One has to see, though, that performance and competitiveness in a given year or during a shorter period is always the result of expenditure in earlier years. It is sufficient to consider the fact that a research project, or an innovation process usually takes several years, while the time until any article is published in a leading scientific paper takes 1, but could take up to 2–3 years. For example, if Hungarian R&D is to come into full swing in 2007 or 2008, its foundations should have been laid as early as 2004 and 2005.

The rate of the GERD, and the GERD/GDP index may only be a limited measure of the resource supply and performance potential of R&D. There is no denying, nevertheless that with a low GERD/GDP ratio the strategic sector status of R&D and innovation remain a promise, and increasing competitiveness in such a position is ab ovo impossible. One experiences the interesting situation in Hungary whereby the popularity and acceptance of science and R&D, and the Hungarian Academy of Sciences go back to historical reasons, namely their traditional independence from politics in addition to their achievements. And their status as a national branch, or institution is more apparent and easier to prove than their role in the development of the economy, and in the improvement of competitiveness.

Meanwhile it is quite hard to prove for government its economic (and thus the political) utility, so the sector's (the Academy, higher education, and the research-development funds) situation at the budget negotiations is somewhat similar to its social assessment. Government, and politics in general verbally regularly acknowledge the importance of the R&D sector, but when it comes to funding negotiations with a great deal at stake, only the maintenance of previous positions is possible.

The strategic importance of the R&D and innovation sector should be established also in higher level legislation. It would not be sufficient, naturally, if only the preamble of a law contained such a commitment. It would provide emphasis to such a statement if tangible and lasting government commitment would appear in the background.

Such commitment could come in the form of legislation guaranteeing for every year the minimum value of the GERD/GDP index, and the same legislation could also provide the required annual increase of the planned funding. Such a statutory provision could also create an indirect incentive for the government to aim at a more extensive involvement of the private sector in funding R&D and innovation, because a BERD increasing in accordance with the proposed legislation would automatically reduce the R&D funding share to be contributed by the central budget.

The GDP of the given year and the expected value of the GERD cannot be predicted accurately, but both problems are easily resolvable technical issues. Similarly, the value of the BERD can only be ascertained after the end of the year in question, and yet even a forecast is never attempted. One could, however, rely on the GDP forecast of the Central Statistical Office, and reserve the option of later adjustment, and in the budget appropriation one could approach the expected value of the BERD by the average of the last 5 years' BERD. With a constantly rising BERD that would somewhat increase the government's R&D funding responsibilities, but that extra budget expenditure would be indirectly compensated by the continuous lowering of the BERD/GERD ratio.

NOTES

[1] An associate member of the Hungarian Academy of Sciences (MTA), professor at the Budapest University of Technical Sciences, and leader of the MTA-BDF (Berzsenyi Dániel College) Regional Developmental and Microintegration Research Team. The research enjoyed the financial support of the NKFP 5/089/2004 programme (Theoretical problems and economic policy instruments of the dual convergence process).

[2] The Kok report, however, has recently been stressing the requirement that the raising of the GERD/GDP ratio should be accompanied by the raising of the BERD/GERD ratio as well (Kok, 2004).

[3] The same construction/development process is exemplified by post-war Finnish economic policy. Cf. Steinbock, 1998

[4] Comprehensive ones include Papanek et al., 1999; Biegelbauer, 2000; Balogh, 2002, 2004; Báger, Goldperger and Varga, 2005; On similar R&D problems of EU countries and Hungary Papanek, 2003; Papanek and Török, 2004; On the deficiencies of the diffusion system see Török, 1996; On the weaknesses of the R&D and innovation system of the new EU member states, similar in many ways see Gorzelak et al., 2001; Aide a la Décision Économique, 2001

[5] For the concise summary of the two concepts see: Fábri, 2006

[6] One of the proof readers required an assessment or at least a superficial description of the role and the performance of the NKTH since early 2004. We will, however, decline the request as even the narrowest circles of the profession are greatly divided over that issue, and detailed and authoritative information needed for such an objective and proficient assessment e.g. information regarding the transparency of the application system, the departure of a great part of the technical staff, and the use of the funds handled by the NKHT was kept by the Hungarian Government until February 2006.

[7] At the same time, the authors referred to also criticise the arguments for the existence of the 'European paradox' as most recent research suggests the Europe is losing ground even in the global arena of basic research (Báger-Goldperger-Varga, 2005. 12).

[8] To understand this one needs to know that the infringement of patent rights has to be stated with legal effect by a court of justice. However, giving effect to a judgement by the courts may be a lengthy and complex process today in the enlarged EU. And outside Europe it is even much more difficult.

[9] For a theoretical analysis of the raison d'etre of basic research see Pavitt, 1991

[10] The same happened e.g. in number theory. Nearly all of the research achievements there were considered never to have any practical benefit. In the early 80s, however, demand for mathematicians experienced in number theory ('number theoreticians') suddenly rose as it was recognized that number theory may play a major role in cryptography with long and complex IT applications (Devlin, 1990. 21–22).

[11] The measurement was made difficult by the fact that, when making the statement, the EU gave no index or definition. The investigation suggested that several indicators place Hungary among the 25-30th place internationally. Thus the analysis concludes by saying that based on 1996-1997 statistics, Hungary used to belong to the 30 leading competitors of the international R&D race, but seems unable to maintain its positions even on a short term due to the rapid emergence of industrialized developing countries.

[12] For the application of the method for measuring the competitiveness of converging countries see Zinner, Eilat and Sachs, 2001

[13] The results of the first stage of their research (Borsi-Telcs, 2004) is included in the present article, and the further elaboration of these results is found in chapter 4 of the book (Török, Borsi és Telcs, 2005).

[14] In the relevant chapter of their book they already applied the DEA (data envelopment analysis) method (Borsi-Telcs, 2005). However, the results of this did not, unlike the article (Borsi-Telcs, 2004) serve specifically the identification of the Hungarian position.

[15] One can see that spread is much larger in the specific ranking. An analysis of scientometric data, however, shows that specific international 'championship tables' sometimes rank in very high posi-

tions some international R&D players that are simply a country with hardly a handful of outstanding researchers probably working abroad, but without an operational national innovation system, (Török, Borsi és Telcs, 2005).

[16] The authors make no reference to this.

[17] As a country, which is only indirectly linked to the competitive chances of the individual Hungarian research sites in winning applications and seeking partners.

[18] The Data Envelopment Analysis by Borsi and Telcs indicate that in the second part of the 90s all new Central European EU member countries lost positions in the R&D race (Borsi-Telcs, 2005).

[19] That, however, is a sort of forced measure that will not increase companies' interest in supporting R&D, and may create the impression for them that they have to make increasing contributions to the survival of Hungarian R&D that generates little direct profit to them. Recoursing to that method, the Hungarian government must be very cautious to avoid a political effect contrary to the objectives of the Lisbon Strategy as the EU convergence programme sets as an objective the mutual approach of R&D and the business sector rather then creating strategic opposition between them.

[20] Most recent CSO statistics indicate that the Hungarian GERD/GDP ratio declined between 2002 and 2004, approaching 0.8% of the GDP (CSO, 2005a, 5).

[21] See e.g. OMFB (National Committee for Technological Development), 1999; Papanek-Török, 2004; at the same time the competitiveness survey by Chikán et al. indicates that the majority of the companies surveyed are aware of the lag they have in spending on R&D, but the same majority fail to express any intention of changing that situation in the upcoming years (Chikán, Czakó and Zoltayné, 2004, 20.).

[22] Source: CSO, 2005b. 8. In accordance with the representative survey the ratio of innovative enterprises was 21.4% in industry, and 15.8% in services. Actual ratios were probably lower, however, because only those companies responded to the representative survey that considered themselves innovative. And there are no objective criteria to whether an enterprise that finds itself innovative has actually introduced products to the market that the market, too, found innovative.

[23] All we know is that the ratio of the Hungarian R&D workforce is definitely low among the entire workforce. In 2002 that constituted 10.2 per mill of the average of the 15-member EU. In the Hungarian context it was 6.1 per mill, i.e. one of the lowest among the European countries surveyed (CSO, 2005a. 65).

[24] 60% of those with a scientific qualification are in excess of 60 years of age, and the ratio of the 49+ age group is 87.8% (CSO, 2005a. 50)

[25] See: Török, 1996; Inzelt, 1998, 71; OMFB (National Committee for Technological Development), 1999

[26] For formal reasons one should list colleges as well, but their research capacities and performance usually remain far below those of universities except for some larger colleges operating in larger cities with several faculties.

[27] The survey in question refers to judges, prosecutors, and journalists in particular.

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