Comparing the organization of public research funding in Central and Eastern European Countries

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1   Introduction

It is well-known, that during and after the breakdown of the Communist regimes, research policies and research funding systems in Central and European countries (CEEC) underwent a dramatic process of restructuring (Radosevic and Auriol 1998; Meske 2004). This included the breakdown of the old system of governance of research policy, accompanied by a strong reduction of the investments in the sector especially at the beginning of the '90. Thus, while under the communist regimes CEEC had a higher level of R&D expenditures than expected from their level of economic development., this is not any more true and some countries, like Poland, are actually under this level (Radosevic 2005). Further major changes have taken place in the organisation of research systems at the performer level, with dramatic decreases of industrial research expenditures and, in the public sector, the emergence of higher education institutions (HEI) as a relevant research actors (Sima 2008), as well as a decreasing role or even the transformation of the traditional Academy of Science structures. Finally, we witnessed in most countries the set-up of new governance arrangements and the creation of new funding mechanisms and agencies, including instruments for funding research in higher education and the introduction of project funding instruments and agencies

However, the available qualitative evidence shows that, firstly, this process is far from being complete and many reforms are planned in the next years and, secondly, that there are large differences between individual countries in the pace of the transformation; some of them are fully engaged in the last phase of transformation (as Czech republic and Poland), some clearly lagging behind like Bulgaria and Rumania (Meske 2004). This shows that the simple model where CEEC move from the communist system towards a "western" style organisation of research policy and research funding through different stages might have represented rather well the first phases of transition, where the most evident specificities of communist research policies have been removed, but a more differentiated approach, taking into account also national specificities and trajectories, is now required.

This paper, which is based on a project realised in the last two years in the PRIME Network of Excellence on research and innovation policies, provides an in-depth analysis of public research funding systems in three Central and Eastern European countries, namely Czech Republic, Estonia and Poland, matching qualitative description of funding instruments, their organization and allocation criteria with quantitative data on the share of different instruments and of their beneficiaries; beyond the descriptive work, the main goal is to understand the main structures of the public research funding market, for example the degree of segmentation in different domains (for example between Academy of Sciences and higher education institutions), the level of competition and complementarity between instruments and the role of different institutional levels (the state vs. funding agencies vs. organisations vs. research units). Further, by matching this structural analysis with quantitative data on funding volumes, we aim to understand the evolution of the system, looking also to gradual shifts in addition to radical institutional restructuring.

The topic is of interest for comparative research policy studies, where the issue of convergence and differences between national systems has been highly debated (Lepori et al. 2007; Senker et al. 1999); in this context, CEEC represent an ideal laboratory to study the evolution of research funding, since changes are more rapid and profound than in Western European countries and there is some evidence of large differences between individual countries. Moreover, the topic is also relevant for European and national research policy; namely, data on innovation, economic performance and labour productivity are a source of concern, since it seems that many CEEC are not performing well in this respect as it would be expected from their current level of R&D investment (Stephan 2002); besides other factors, this might also be related to weaknesses in the transfer of research activities towards economic innovation (Radosevic 2005). While of course the organisation of public research funding is just one of the elements to be considered in this respect, a detailed understanding of its organization and dynamics might well provide some useful insights to explain this productivity gap.

The rest of the paper is organised as follows. In the second section, we introduce a framework for the analysis of public research funding and we design an empirical setting for the analysis of CEEC countries. Section three provides a comparative analysis of the main components of the funding system, funding agencies, instruments and allocation modes, as well as performers in Czech Republic, Estonia and Poland.

Section four takes stock of this information to build models of funding systems in the involved countries and of their evolution over time. The last section proposes some general conclusions and reflections.

2   Conceptualising public funding

There is little doubt that the organisation of funding is a central issue in research policy and in the functioning of research systems, since the allocation of financial resources is the main instrument used by public powers to steer the research system according to general goals, while at the same time public research organisations depend almost completely on state support for their operation.

Most studies on the subject have interpreted research funding in terms of delegation and using principal-agent theory as the main conceptual framework (Braun and Guston 2003; Braun 2006); thus the main issue becomes to characterize the different delegation modes adopted by public authorities in the allocation of funding and their implication both for steering of research and control (Braun 2003; Potì and Reale 2007).

The perspective adopted here is slightly different: namely, we will look to the structural features of the whole funding system and what we could call the "coordination interface" between funding agencies from one side, performers to the other side.

Thus, we represent in very general terms research funding as an interface between all kinds of funding agencies from one side – including intermediaries, ministries, international agencies - , and different types of research units and performers to the other side (see Figure 1).
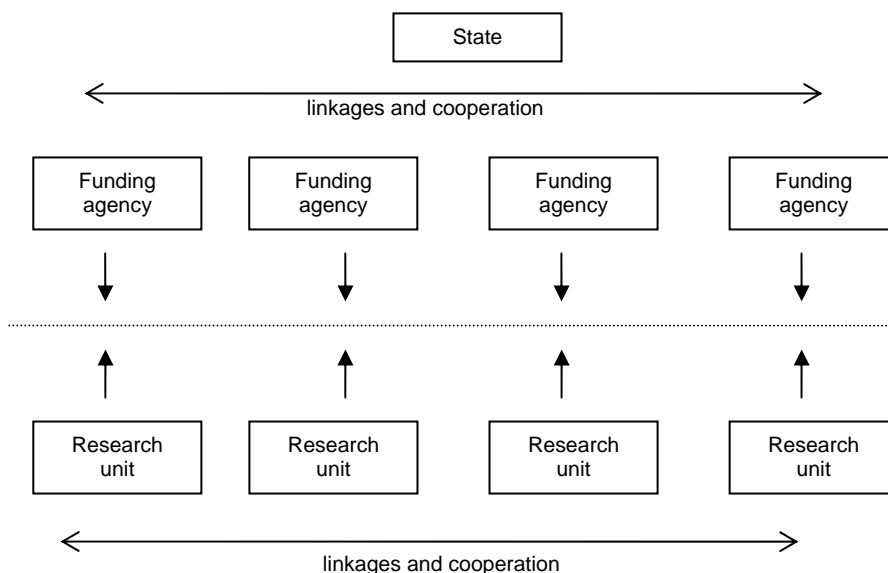

Figure 1. Generic representation of a research funding system

In this framework, we do not advance specific hypotheses on the institutional organization of funding and on the steering of the system, like attributing to the State the principal role, but we let these organization forms emerge from empirical comparative analysis (Morris 2003).

This representation raises a number of issues about *coordination of the funding system,* i.e. the way in which the function and activities of different actors are put together and stabilised through specific institutional arrangements. This includes the issue of horizontal coordination between funding instruments and agencies, which has become more complex in the recent years because of the differentiation and multiplication of funding arrangements (Lepori et al. 2007; Braun 2008): thus, a representation of funding system with the State as unique principal, with its policy goals and adopting a specific delegation modes, should increasingly be replaced by a representation in terms of weakly coordinated agencies, each own with its specific goals and organizational settings, a tendency which is further strengthened by the increasing role of the European Union and other international agencies in research funding (Kuhlmann 2001; Borras and Jacobson 2004).

However, the central issue concerns the coordination between "buyers" and performers in order that demand for research services (with a given level of quality) matches to some extent the offer of research capacities. This is a highly relevant issue since, at least for broader domains, both demand and offer are characterized by some degree of inertia. Thus, public funding policies are defined normally for some years and, once in place, funding agencies and instruments tend to display a high degree of stability (Lepori et al. 2007; Benner and Sandström 2000). To the other side, research activities are based on long-term building of capacity – especially of human resources and competence – and this requires a sufficiently stable availability of funding,

as well as enough predictable expectations on future flows to allow for planning at the performer's side (White 2002). A related issue is who drives the system: since the key resource are highly-qualified people there are good reasons to argue that research funding markets is driven by the performers and by their strategies to hire researchers and then research capacity can be readily sold to funding agencies. However, the relative strength of funding agencies and performers might well different between countries and market segments.

Of course, this does not exclude changes and mismatches between demand and supply, but the general argument is that a well-functioning research funding system requires developing a number of institutional arrangements which allow to provide its coordination and sufficiently stable signals to performers on the level of demand for some kind of research services, the required quality level and the price that might be paid by funding agencies.

Moreover, it is slightly incorrect to speak of a single research funding market, because in fact the system is highly fragmented according to different divides.

A first one is when funding arrangements are specifically designed for some players: the major divide is here between institutional funding – devoted to whole research institutions – and project funding, normally open just to research groups and individuals. Other divides might happen between institutional sectors, for example having some public research organisations funded directly by a sectoral ministry, while universities are funded by the research and higher education ministry. Also in project funding, allocation rules might explicitly target or exclude some categories of performers. This types of divides is stated by norms and explicit rules, in most cases following organizational borders; in order to change them, the explicit renegotiation of the rules system is required, for example through reforms of research policy organisation. They can be rather easily mapped looking to policy documents.

However, another form of segmentation – probably the most interesting for future studies – concerns market structures generated by the interaction between funding agencies and performers, where some performers occupy specific niches – for example on single research subjects or type of research – and develop stable relationships with funding agencies; this is related to the fact – often overlooked in the literature – that typically the interaction between agencies and performers is a repeating one and develops itself over time; thus I suggest that, at least at a small scale level, both sides develop a representation of their expectations and competences – what one could call a representation of the market interface -, which helps to coordinate the market. This is typically done through soft arrangements, like reputation, personal linkages, networking, etc. To characterize this kind of segmentation, one then needs to the actual market functioning, for example looking to the contracts awarded across time, the changing share of different performers, their representations of the interface and of the competitors.

2.1 Coordination modes: some relevant examples

It is useful at this stage to introduce three widespread modes of coordination of research funding, as they emerge from comparative analyses, namely institutional funding, project funding and vertically integrated organizations. As it will be clear in the following, this analysis extends and makes more precise the distinction between project and institutional funding which has been the basis of our previous work on funding systems (Lepori et al. 2007a).

2.1.1 Institutional funding

In this mode, the state allocates research funding to whole research institutions, like universities or large public research organizations, for their normal functioning. Thus, there is some understanding that funding is attributed also to ensure the existence of the organization and, in principle, is not limited in time; also, it is usually left to the steering body of the organization to decide how to allocate internally funds to individual research units (earmarking might be present, but is typically limited to a low share of funding).

This mode consitutes then a nested structure, with the possibility of competition both at the institutional level and at the level of internal units (possibly with different allocation criteria).
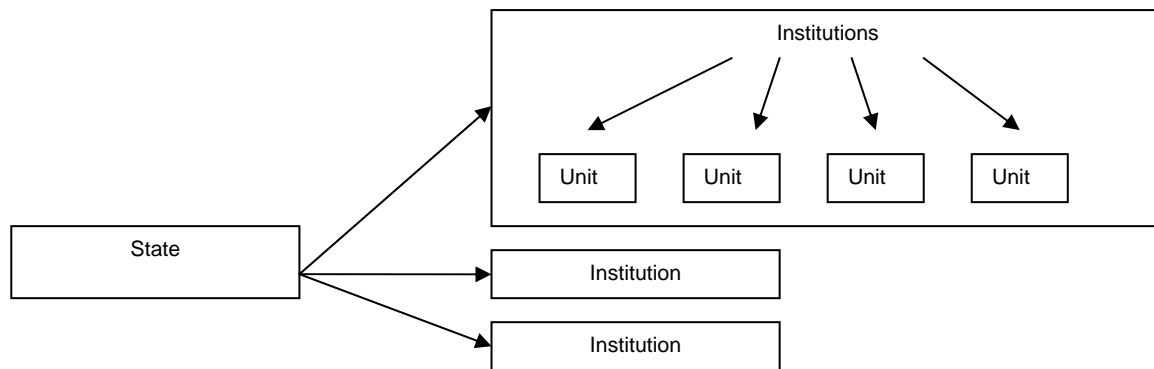
Figure 2. Funding arrangements. Institutional funding

Beyond this general description, this mode of coordination leaves then large room for different arrangements depending on two features. Firstly, one has to look to the adopted allocation criteria to individual organisations, for example choosing between historical allocation, contractual arrangements, indicators-based allocation (see Jongbloed 2008 for a discussion in the case of higher education institutions), to understand the degree of competition and its rules.

Secondly, what matters is also the organization of funding agencies and the number of players. Thus, usually, funding of HEI is assumed by a single ministry at national level and thus, at least in principle, there is some potential competition between institutions, even if the number of institutions in national higher education systems varies strongly from country to country – from some hundreds to the extreme cases of few units in federal countries – and this is likely the influence the behaviour of the actor (for example the likelihood of cooperative agreements between performers). For public research organizations (PRO), the market structure can be very different, if for example all of them are funded by the same agency – for example a research ministry – or sectoral ministries fund directly their own organisation. In the first case, there might be direct competition between PRO for resources, in the second competition will be between policy domains and not necessarily limited to research activities.

2.1.2   Project funding

In this mode, funding is allocated directly to individual research units from a funding agency, while the state basically controls the repartition of funds between agencies and instruments - the definition of the portfolio – and to some extent the allocation criteria, while it has limited control on the selection of beneficiaries (Lepori et al. 2007).
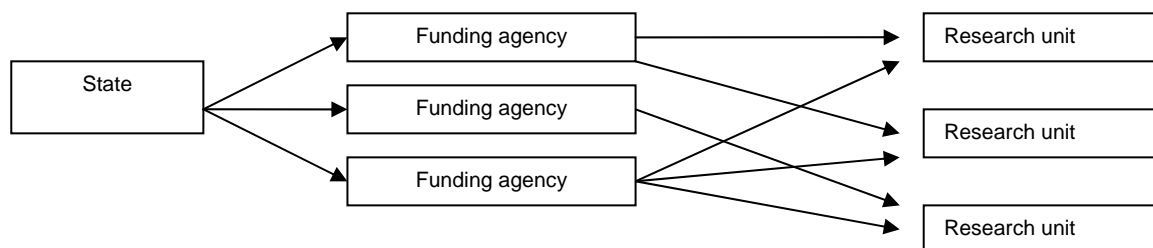

Figure 3. Funding arrangements. Project funding

While there are a large number of studies based on the principal-agent framework on individual funding agencies and their interaction with the state and performers (Braun 1998; van der Meulen 2003), recent work has compared the structure of the whole project funding sector in Western European countries, showing that project funding is in almost all countries highly differentiated with many agencies and instruments covering most of the themes and types of research and with limited coordination (Lepori et al. 2007). It seems that this structure leaves large room for strategic choice of the research units on how to get funded and thus strongly reduces steering capacity from the state.

However, one needs to understand how this market is segmented according to subject domains and type of research; thus, for example, quantitative data show wide differences in the share of funding instruments attributed to different performers categories (Lepori et al. 2007), as well as wide differences in success rates

between stable groups of applicants (Viner 2006). Segmentation according to research subjects – both of available funding and of performer capacities – is a further issue which needs to be addressed.

2.1.3   Vertical integration

In this mode, a large umbrella organisation with a generic research mandate is delegated by the state and attributed a funding envelope which is then allocated to its internal units either as institutional funding or using competitive means. Typical examples were the CNRS in France before the creation of joint laboratories with universities or the Academy of Sciences organisation in many CEEC before the transition (and still in some countries today, like the Czech Republic case we will discuss later).
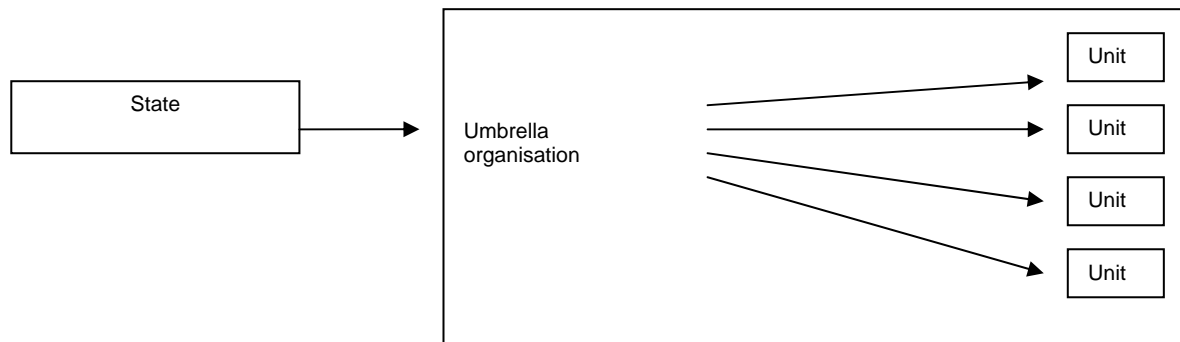

Figure 4. Funding arrangements. Vertical integration

While for some aspects this mode resembles to the institutions funding of HEI, it shows also some distinct features: thus, there is usually no competition in the allocation of funding from the State to the umbrella organization, since this is normally unique; competition is then between this channel and other instruments, like funding of higher education. Moreover, the umbrella organization has normally a larger role than just funding the laboratories, like for example defining strategies, creating and dissolving units and setting rules for employment and internal careers. In fact, this mode tend to create a largely closed internal funding system with limited interaction with the rest of the research system, even if in some cases this has changed in the recent years (see Theves et al. 2007 for the case of the French CNRS). The degree of closeness/openness of these vertically integrated systems becomes thus an empirical issue to be investigated.

2.2   Rebuilding the puzzle: an empirical programme

If looked in a system perspective, these coordination modes not only coexist in a national setting, but are also strongly interacting to determine the whole structure of the funding system. For instance, institutional and project funding are closely linked together at the performer's level, since at the end they benefit to the same research units at laboratory level.

However, existing evidence shows that their relationship can vary quite strongly and thus aggregated indicators – like the share of project funding on total public funding of research (Lepori et al. 2008) – provide only a very rough estimate, since this relationship can be very different according to the performer's sector (for example between universities and PRO's) according to the considered field and at the level of individual laboratories. This raises of course issues concerning the level of concentration of funding streams at the performer's level, but also of complementarities and substitutability between different funding sources. Further, one needs to look to interactions and feedbacks between funding sources, either based on soft mechanisms like reputation or on hard mechanisms, like formula-based allocation of general funds where project funding is used as a component.

Thus, we aim in this paper to go beyond aggregated indicators towards the production of structural charts of funding systems, which map the main divides both related to institutional borderlines and to the actual allocation of funding and market shares of different performers; this includes the analysis of the main organizational forms of funding systems, including the role of funding agencies, mapping the main borders between sectors and measuring quantitatively the importance of the different funding streams. In this analysis of the whole funding system for research, we focus on the main blocks or institutional arrangements at an aggregated level, disregarding the finer market structure (for example related to the type of research or its subject or scientific domain).

To this aim, we will proceed to the analysis for the three involved CEEC countries in two main steps. Firstly, we analyse separately the three main components of a funding system:

- the structure and role of *funding bodies* and the share of public funding managed by them, distinguishing between the research and higher education ministry (usual a central actor in research funding), other ministries, intermediary agencies like research councils and finally international agencies.
- the types of *funding instruments* and their allocation criteria, looking basically to the distinction between institutional and project funding, as well as to possible subcategories.
- finally, the categories of *research performers* and their share in the overall research funding from the state, as well as the share of different instruments in their total funding volume.

In the second step, we use this information to reconstruct for the most recent years (2005 or 2006) the whole structural scheme of funding and we use this for an overall characterization and comparison between funding systems in the three involved countries.

The chosen perimeter includes public research funding, attributed by national states and international agencies and programmes like the European Union. We will include to some extent public funding to private companies, but no complete analysis of private research funding and expenditures is provided. Moreover, for the sake of simplicity, we include here only research funding to higher education institutions, excluding funding for educational activities (with the exception of funding to PhD studies, which is considered as research funding). This has to be considered as a very rough approximation since one should acknowledge that research and education in universities are difficult to separate, even if the situation in CEEC is partially different since at their origin HEI were not supposed to do research.

Information and quantitative data have been collected for each of the three countries by the project participants, using mostly official reports and state budget or directly obtained from the funding agencies. Time coverage is in most cases from the mid-'90 until 2005-6.

While in the following we concentrate on the information required for the comparative discussion, the reader should refer to the three national reports for full description of national funding systems and for details on data sources and availability (Masso and Ukrainski 2008; Jablecka 2008; Sima 2008).

3   Comparing the main components of funding systems

In this section, we compare for the three countries the role of funding agencies, the types of funding instruments and the categories of beneficiaries of public funding and we measure quantitatively their share in public research funding. We include also some preliminary information on the evolution across time as a basis for the analysis of the dynamics in the next section.

Before proceeding to this analysis, it is relevant however to consider that we are confronted here with three quite different countries (see Table 1 for some general data). Thus, Poland is the largest country in Central and Eastern Europe, Czech Republic is a medium-size country with one of the highest levels of economic development, while Estonia is a very small, but rather rapidly increasing country; has one of the highest growth rates of R&D expenditure in the European Union during 2004-2006; has radically reformed its research system. These three countries represent reasonably well the different situation in CEEC, if we except the Balkan countries.

	Czech Republic	Estonia	Poland
Population mio.	10.25	1.34	38.10
GDP (mio. PPS)	189970	21636	470418
GDP per capita (PPS)	18500	16100	12300
GERD (mio. PPS)	2933	246	2614
GERD % GDP	1.54%	1.14%	0.56%
GERD financed by GOV (mio. PPS)	1143	110	1503
GERD financed by GOV as % GDP	0.60%	0.51%	0.32%

Table 1. Basic data on the involved countries and their research system (2006)

Sources: Eurostat database

The level of economic development and of public investment in R&D are also rather different; with a GDP per capita of about 80% of the European (EU-27) average Estonia and Czech Republic have the highest levels among CEEC countries, exceeding also the level of Portugal, while Poland reaches only half of the European level and has the lowest level just before Bulgaria. The level of public investment in R&D and its evolution in last then years differ also remarkably; thus, in Estonia and in the Czech Republic the level of public R&D expenditures has strongly grown in the last ten years – both in absolute values and as a percentage of GDP – and now in fact is near to the EU average (0.61% of GDP; Figure 5), while Poland witnessed a stagnation in real terms, respectively a decrease in % of GDP, has now one of the lowest levels of public R&D expenditures in the whole EU (see Figure 5).
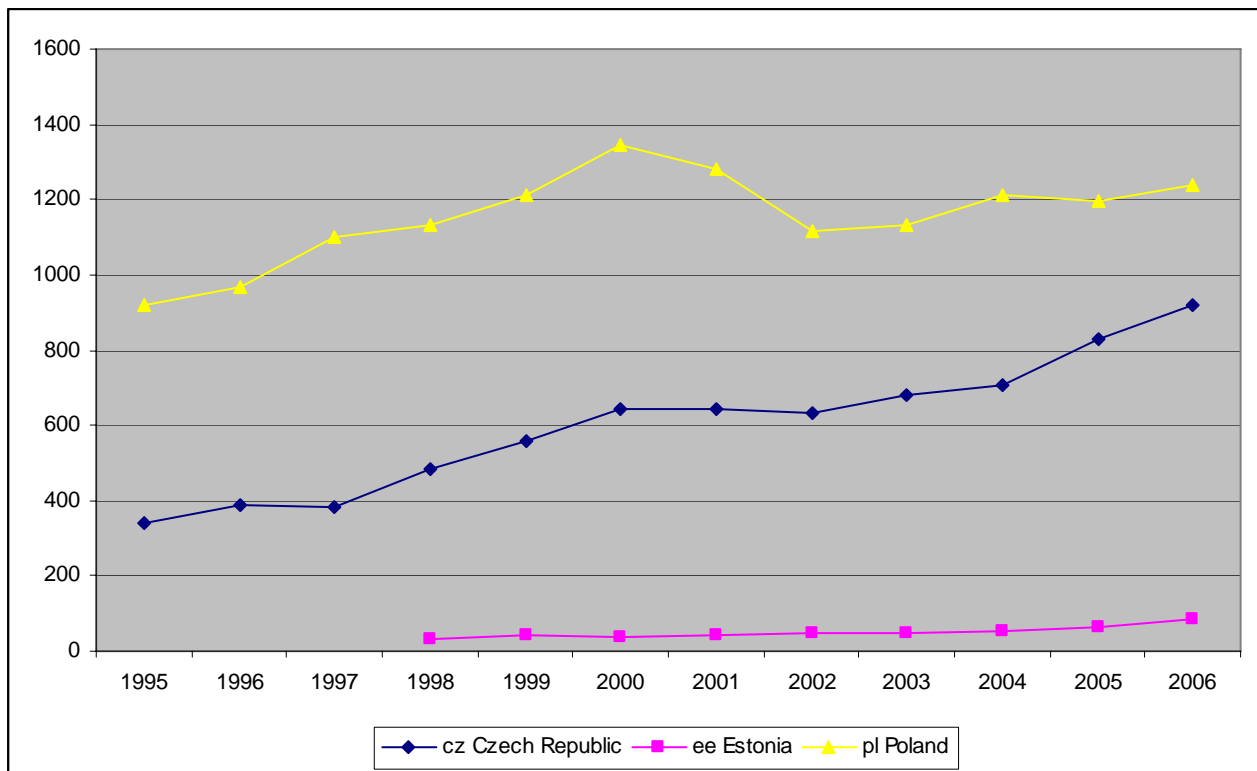
Figure 5. Evolution of GERD financed by the state in PPS at prices of 1995

3.1   Funding agencies

An analysis of the role of agencies in public funding is interesting to look to two issues: the level of delegation from the national state to more or less autonomous organizations from one side, the level of centralization or differentiation of public funding bodies. Simple division leads to distinguish between following classes:

- the research and/or education ministry, being usually the main body in charge of research policy; thus a strong role in funding of the ministry should be probably understood as the lowest level of delegation.
- the other state ministries, being still part of the state organisation, but with looser connection to research policy design and objectives.
- all kind of intermediary agencies: we include in this category the research councils, but also other agencies with large autonomy from the state at least in operational terms.
- international funding agencies, including some international organizations and the EU framework programs (EU structural funds are included in national funding, since they are usually attributed by a national agency).
- finally, we consider separately the Academy of sciences because of its very specific organizational setting and role in the research system.

Using these categories, the picture for the three considered countries looks as in Figure 6.
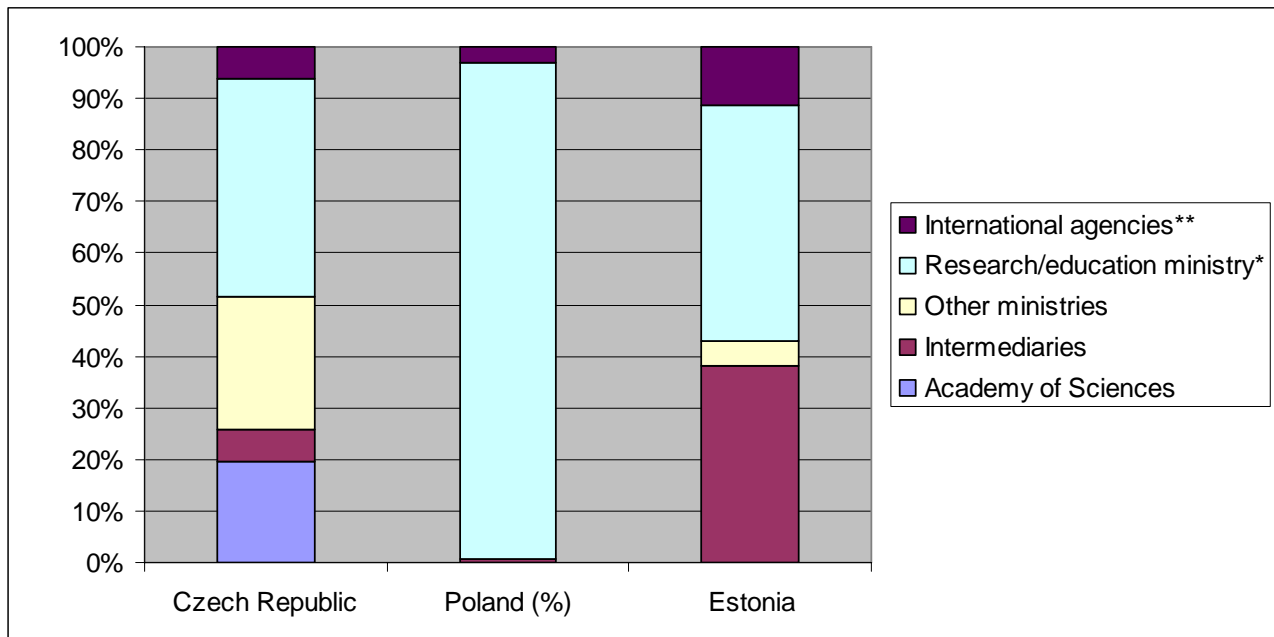
Figure 6. Role of different funding agencies 2006 (% of total public funding)

Intermediaries: Czech Science Foundation, Polish Foundation for Science, Estonian Science Foundation, Enterprise Estonia and Environmental Investments Centre.
Estonia: data for 20005

We are thus facing three completely different models. In Poland, since 1991 almost the whole budget is concentrated at the research and higher education ministry, meaning a very low level of delegation from the State, Estonia has a mixed structure with a strong education ministry, as well as two largely independent agencies (the Estonian Science Foundation and Enterprise Estonia), corresponding to the two main ministries in charge of research funding (ministry of research and ministry of economy). Finally, the Czech Republic has a very differentiated structure with the Academy of Sciences keeping a significant role and a strong role of resort ministries for funding research in their domains.

While in Poland centralisation has been very stable in the last 15 years, more significant changes have taken place in the two other countries. In Estonia, the ESF has a dominant role in the first half of the '90, but progressively lost importance with the strengthening of the programs directly managed by the education ministry, as well as the transfer of some ESF programs to the ministry, and by the economics ministry through Enterprise Estonia. The funding system made thus the evolution from a model centralized in the research council towards a more differentiated system. The Czech Republic witnessed a gradual change with the educational ministry increasing its role and the other ministries and the Academy of Sciences loosing progressively ground.

Figure 7. Role of different funding agencies in the Czech Republic (% of total public funding).

3.2   Allocation modes

When looking to allocation modes, we basically adopt the distinction between project funding and institutional funding discussed in section 2, as well as the corresponding definitions (Lepori et al. 2007). However, we elaborate on this introducing two further categories: institutional project funding, meaning funding provided to whole research institutions (for example universities) for their normal operation, but allocated on the basis of competitive proposals, and centres and networks of excellence, meaning funds provided to support the establishment of new research centres of networks, thus usually on a large scale and longer duration than "usual" project funding. Thus, this classifications look to structural features of the allocation, rather than to issues like the type of research funded or the specific research themes. Table 2 presents the main definitions and the corresponding instruments in three considered countries.

Name	Definition	Czech Republic	Estonia	Poland
Institutional funding	Funding attributed to whole research organizations for the institutional mission and their long-term existence.	Research Plans of Academy of Sciences Institutes. Research plans of governmental institutes. Specific research funding of HEI.	MER Base financing and infrastructure costs, PhD grants programme.	Statutory funding and in-house research funding of HEI. Investments.
Competitive institutional funding	Institutional funding, however attributed through competitive submission of proposals and with some possibility of non-renewal of the grant.	Research Plans of Higher Education Institutions	None	None
Project funding (national)	Funding attributed for research activities of limited scope and duration to individual research units or researchers.	National Research Programmes. Departmental programmes. Czech Science Foundation Grants. Ministry of Industry and Trade programs (in fact departmental programmes)	MER targeted financing. ESF grants Enterprise Estonia programmes, others.	Research projects (bottom-up) and goal-oriented projects.
Project funding (international)	Project funding attributed by international agencies and organizations, including European Union.	EU framework programmes	EU framework programmes	EU framework programmes
Networks and centres of excellence	Funds devoted to establish new competences centres and cooperation networks, however limited in time and based on proposal submission.	Research centres (cooperation networks). Centres for basic research.	Centres of excellence programme.	COE, Technology platforms, Centres of Competence, research networks-as new organizational forms but funded through traditional instruments

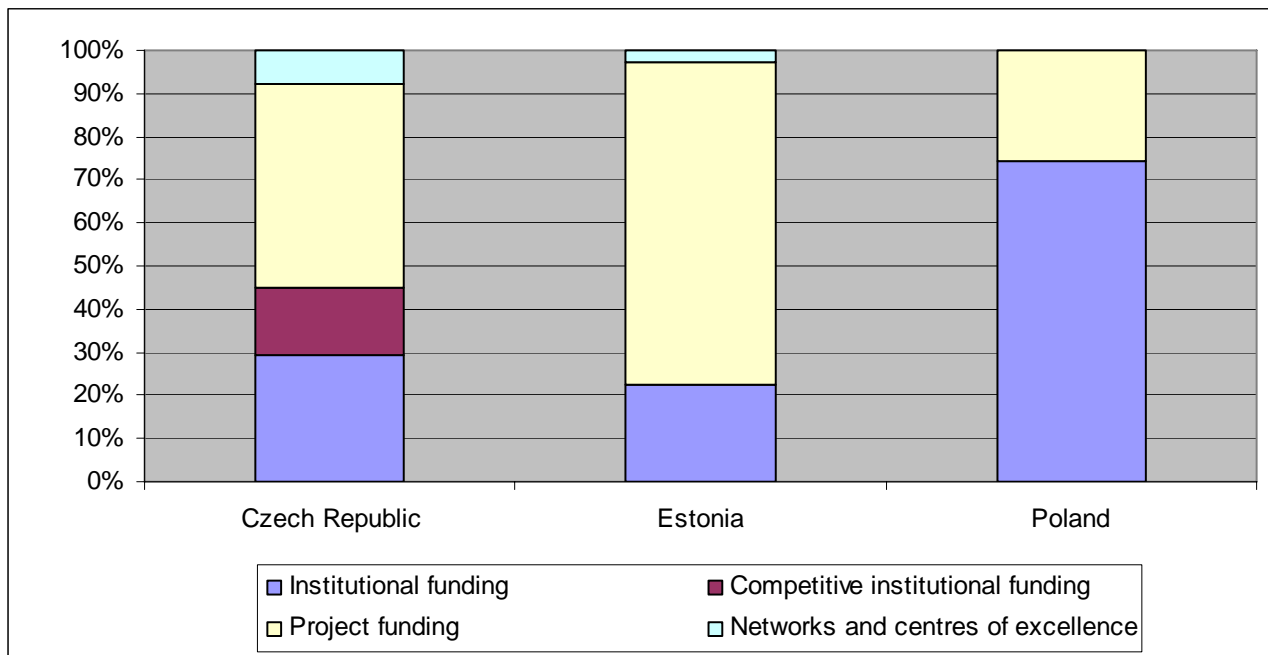**Table 2. Allocation modes and instruments per country (2006).**

Figure 8. Shares of different allocation modes per country (2006)

The data show three different situations. In Estonia, project funding covers about ¾ of the total funding volume, while there are very few instruments for institutional funding: three instruments directed to universities and managed by the research ministry, as well as some limited infrastructure funding from the Ministry of Agriculture and the Ministry of Culture. Project funding is much more differentiated among agencies including the research ministry, Estonian Science Foundation, Enterprise Estonia and the European Union. Historically, the system switched around 1997-1998 from institutional to project funding with the end of the base-line funding from the Estonian Science Foundation; from 2005 some new instruments for institutional funding of universities have been introduced, but at the same project funding from European sources has also increased.

Poland displays a share of 2/3 for institutional funding and 1/3 for project funding which is typical of many Western European countries (Lepori et al. 2007); change in this respect from 2000 has been limited, except some increase in the share of project funding due to the European framework programs. Almost all national funding is managed by the research ministry, while European framework programs have a significant role in project funding.

Finally, the Czech Republic displays the most complex situation. Namely, while funding to governmental institutes and academy of sciences institutes is allocated through so-called research plans which can be considered as institutional funding, research plans of higher education institutions are attributed through the competitive submission of proposal and, in the most recent round, some HEI got their plan refused and thus did not receive any institutional funding. This mechanisms represents thus a truly intermediate between institutional and project funding. To the other side, project funding is rather highly differentiated among ministries managing department programmes on their specific area of competence. Project funding accounted in 2006 for nearly half of the total public funding and competitive institutional funding (HEI research plans) for a further 16%, while traditional institutional funding (academy of sciences and public research organizations) for about 30%. Since the year 2000, there has been a continuous increase in the share project funding, with a parallel decrease of the share of research plans of research institutes.

3.3   Structure of performers

If we look to the performers at a very aggregated level, we can distinguish between four main sectors, namely higher education, the research institutes of the academy of sciences, the remaining institutes in the public sector and, finally, private companies. We are thus interested in looking to their shares in public funding and its changes across time, but also through which agencies and instruments are funded the different performers groups.
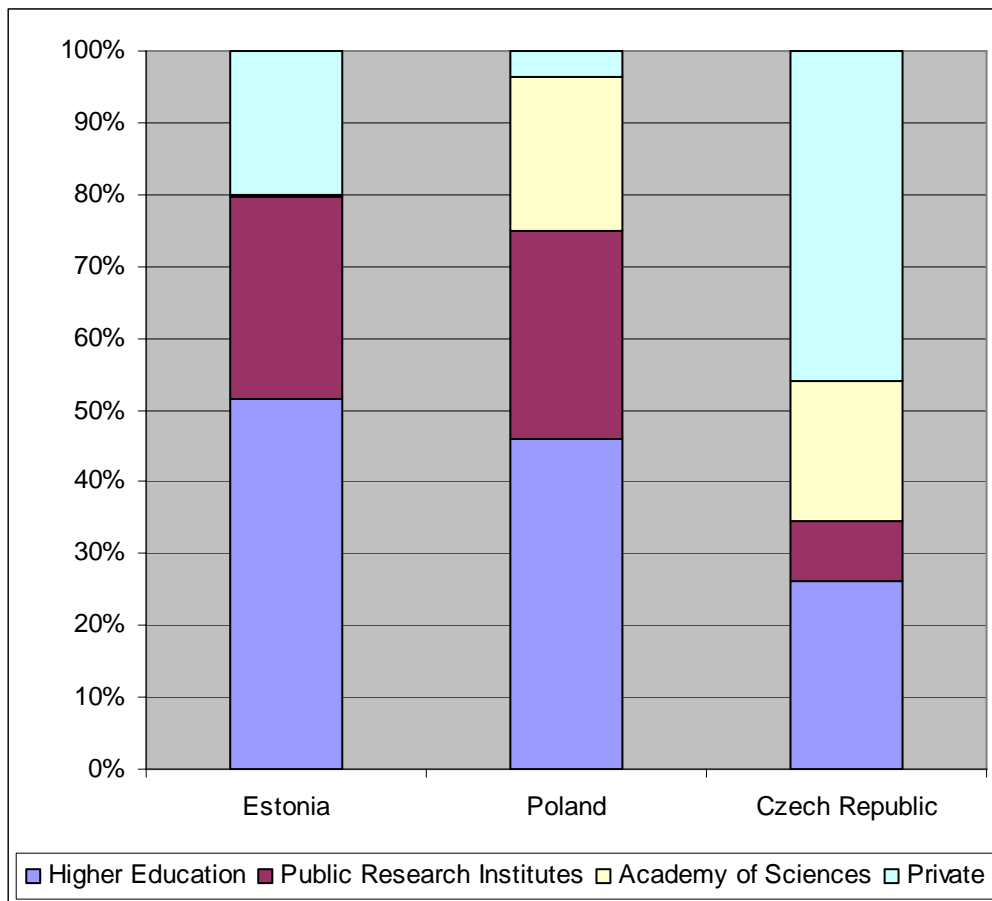
Figure 9. Share of different performers in public research funding (2005)

The Estonian system is dominated by a small number of universities, with the University of Tartu, the University of Tallin and the Estonian University of Life Sciences receiveing 54% of the whole public funding (including also the private sector), while the rest of the system is composed by a large number of small-size research institutes. This tendency, to be expected in a small country, has been further reinforced with the integration of most of the former Academy of Sciences institutes in the universities (Masso and Ukrainski 2008).

Poland, displays a much larger system with three distinct sectors, namely higher education, research institutes, academy of sciences. However, the significance of these divisions is lessened by the fact that allocation of institutional funding is centralized to the ministry using the same rules for the three sectors and that most institutional funding is provided to research units directly (departments in HEI). Time series display a reinforcement of the HEI sector at the expenses of the two other sector in the '90, but substantial stability since then.

Among the three considered countries, the Czech Republic is the only one showing a distinct academy of sciences system with its own funding channels, including an internal project funding agency, alongside a large higher education sector. The share of these two sectors has been rather stable since the year 2001, while public research institutes continuously decreased since then. The high share of the private sector is largely explained by private research institutes that were reorganised ("privatised") from state research organisation in first half of 90s (both departmental and as part of state industrial companies).These research labs (now mainly registered as limited companies or corporations) are still partly oriented towards public research funding and they are relatively successful in competition for projects of applied research and in cooperative projects as research centres.

3.4   A summary comparison

Table 3 provides an overview of the main features of public funding in the three considered countries.

Country	Funding Agencies	Allocation modes	Structure of performers
Czech Republic	The system is highly differentiated, with an important role of the Ministry of Education, Youth and Sport and of the sectoral ministries; Academy of Sciences still manages a significant proportion of funding, while intermediaries are negligible.	About half of the total funding volume is composed by project funding, half by institutional funding. Institutional funding of HEI is attributed through a competitive procedure. A significant proportion of public project funding benefits to private companies	A large HEI sector alongside a large Academy of Sciences sectors; the shares have been quite stable since 2001.
Estonia	The dominant funding agency is the Ministry of Education and Research, alongside the Ministry of Economy through Estonian Enterprise. In the '90 the Estonian Science Foundation had a dominant role, which has strongly decreased afterwards.	Mostly project funding instruments with a rather large number of funding agencies, only a few institutional funding instruments.	HEI play the dominant role and research capacity is strongly concentrated in just three universities; a large number of smaller research institutes.
Poland	Since 1991, the funding is completely centralised in the Ministry of Science and Higher Education which manages almost all funding (both as general and project funding).	2/3 institutional funding and 1/3 project funding; institutional funding is allocated to institutional units (departments in HEI), rather than to whole research organizations. Substantial stability since 2001.	The HEi sector is the largest, but substantial share of research institutes and academy of sciences institutes; strong increase of the role of HEI in the '90, but stability since then.

Table 3. Summary table. Components of the funding system

4   Understanding CEEC funding systems and their coordination mode

In this section, we apply the concepts developed in the previous section to understand the organisation and dynamics of the funding system in three countries considered, namely Czech Republic, Estonia and Poland.

4.1   Poland: a system centred on the research ministry

Poland displays the model of a system where, not only a single player – the ministry of education and research – manages almost all public funding, but where also a single funding instrument – primary statutory funding – is the dominant funding source for all performers in the public sector (see Figure 10).
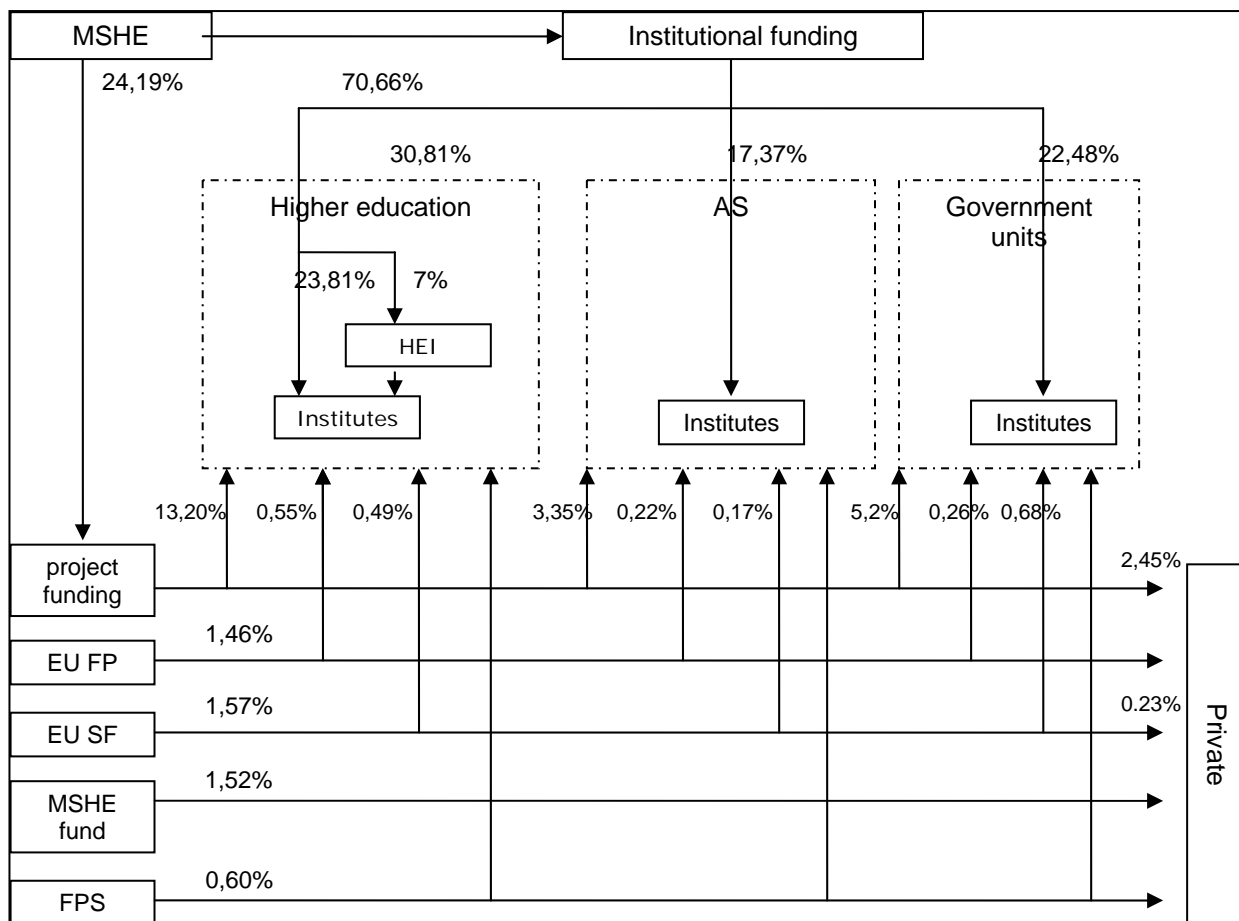
Figure 10. Poland. Structure of the public funding system (2006)

For MSHE fund and Foundation for Polish Science there are no data on beneficiaries.

Moreover, most of the institutional funding from the Ministry of Science and Higher Education (MSHE) is directly allocated to institutional units, departments in HEI and research institutes in the Academy of Sciences and in the Government sector. Project funding plays a significant role as a funding source, but at least in the aggregate, its share is likely to be too low to be a major force for the structural evolution of the research system at the aggregate level (given the low level of competitiveness of institutional funding).

As a whole, the funding system is characterized by low levels of delegation and by no sectoral divisions, since the basic funding mechanism is the same for all units. At least concerning funding, all intermediary structures between the ministry and the institutes level have lost most of their role, including both intermediary funding agencies, umbrella organizations like the academy of sciences, but also the directions of the universities. The concentration of the power in the ministry appears however to overburden its role in respect to the available capacity and information and thus *de facto* reduces the overall steering and strategic capacity at system level, as it is indicated by the substantial stability in the share of different funding channels in the recent years.

While in principle this model could lead to a strong competition between a large number of units, at the same time it requires a very high level of competence and monitoring at the ministry level; in fact, the main example of competitive allocation of institutional funding is the UK Research Assessment Exercise, with its highly demanding information and review process (Barker 2007). In the context of the Polish system, this has led however to two well-known phenomena: firstly, *de facto* delegation of the evaluation to representatives of the academic community (through the Council for Science) and, secondly, an allocation practice essentially based on historical criteria and internal negotiation between the actors. In fact, the most centralised system is also the one among the three countries examined displaying the highest degree of stability, but at the same time the lowest ability to mobilize public resources for the research system.

4.2   Estonia: limited competition between few players

The Estonian system displays a completely different structure, characterized by the variety of funding agencies and sources from one side, by the limited number of relevant performers to the other side (see Figure 11).

MER		Targeted financing, other project funding of MER	ESF	EU FP	Enterprise Estonia
	28%				

MER → 22% → Institutional funding

Targeted financing: 28% ESF: 10% EU FP: 16% Enterprise Estonia: 23%

1%   2%   1%   5%   12%

6%   1%   1%   2%   6%

	Tartu		Tallin		Other HE		Public institutes		Private
11%	18%	5%	8%	3%	4%	2%	6%	1%	1%

Figure 11. Estonia. Structure of the public funding system (2005)

Note. Only the main funding instruments have been considered that in 2005 accounted for 90.2% of the total research funding. The numbers at beneficiaries need not to add up to 100% because of rounding. For some of the Enterprise Estonia funding (about 2% of research funding) the sums were indivisible across beneficiaries.

Namely, differentiation in the funding agencies took progressively place from the '90 – where the Estonian Science Foundation had a dominant role in the funding system – with the strengthening of the role of the Ministry of Education and Research, the creation of Enterprise Estonia and the emergence of European Union framework programs as a major funding source.

At the same time, at the performer's level the research system underwent a concentration process with the integration of the research institutes of the Academy of Sciences in the universities; this concentration process is probably also related to the small size of the research system (public research funding amounted to 65 mio. euros only in 2005, including EU funds).

Our data display that the three largest players in the public research system – University of Tartu, Tallin University of Technology and the Estonian University of Life Science – account for over 70% of the total funding for the most important national instruments, and all funding for the centres of excellence programme. This pattern is not only consistent across instruments – with similar shares of the main players for most instruments -, but increases also with time (Masso and Ukrainski 2008).

In a sense, we find here the opposite situation as in the Polish case: there is strong delegation and, accordingly, limited coordination at the level of the funding agencies, but at the same time three performers just dominate the research system and consistently get similar shares from each funding agency. In this case, one could assume that the performers largely drive through their decisions on developing research fields and capacity the allocation decisions of the funding agencies, even if more in-depth empirical studies would be needed to confirm this hypothesis (Masso and Ukrainski 2008).

4.3   Czech Republic

The Czech Republic displays the most complex system in the three considered countries, where sectoral division between Academy of Science, departmental research centres and higher education institutions are quite visible in the organization of funding (Figure 12).
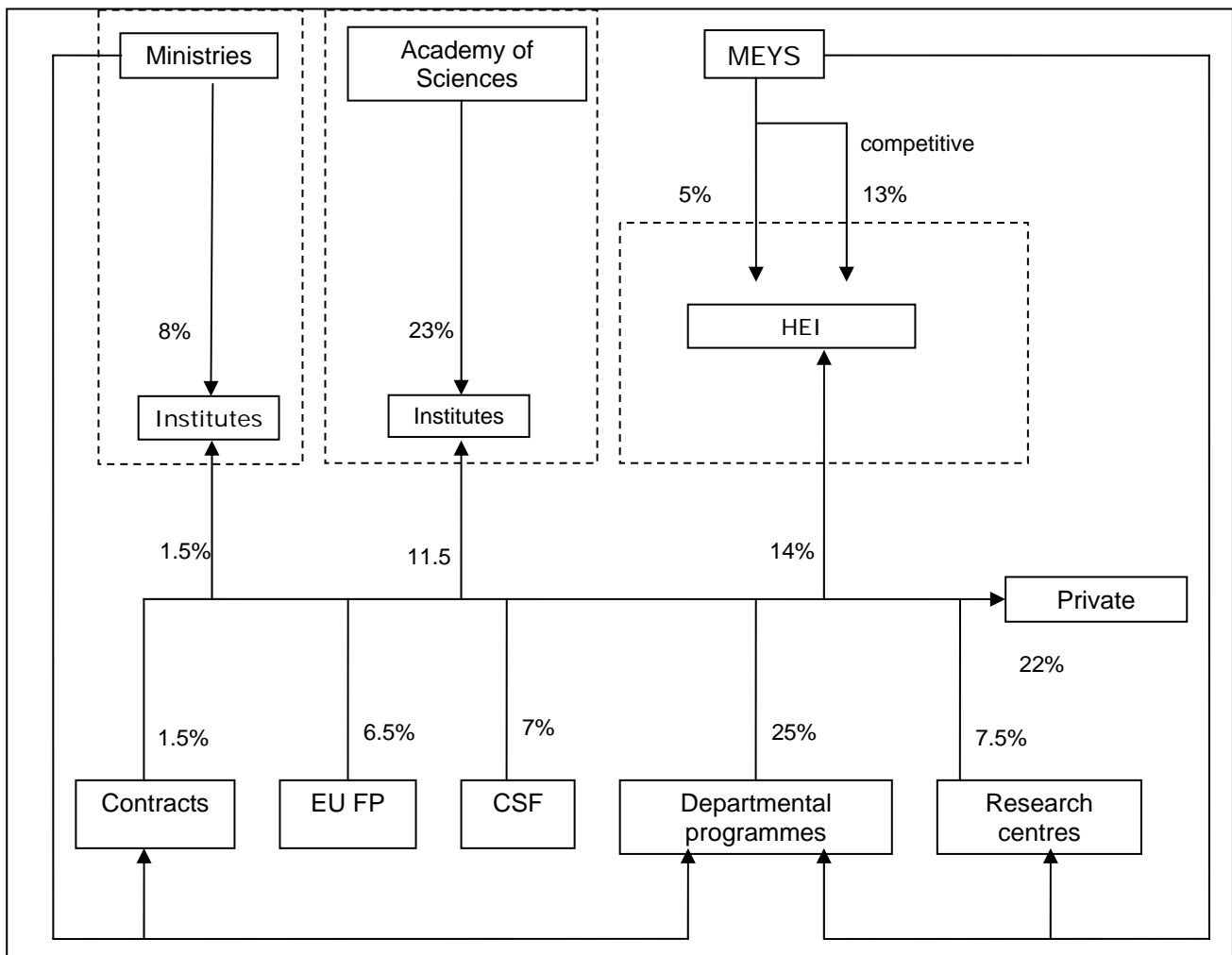

Figure 12. Czech Republic. Structure of the public funding system (2005)

The Czech system displays a clear division in three sectors with rather distinct funding structures. Thus, the Academy of Science sector is characterized by its specific institutional funding mechanism, but at the same time is able to get a significant share of general project funding. At the contrary, other public research institutes are financed through their responsible ministry, while get about 1/3 of their resources from project funding. Finally, higher education institutions get 85% of their research funding by competitive allocation mechanisms both quasi-institutional and project. Thus, the differences between the sector in the allocation criteria are very large, even if officially the instruments bear the same name.

There are two further characteristics of the Czech system that has to be mentioned. Firstly, the role of independent intermediary bodies is negligible. Apart of very low share of CSF, majority of project funding is managed by ministries (ministry of education and ministry of industry being the most important). The academy of sciences has highly autonomous position (organisational and financial), but its role as an intermediary body is questionable. Its internal science foundation should function as a second agency for funding of basic research in the whole system, but in fact these funds go almost completely to the institutes of academy of sciences and represent just a small share of the total funding volume.

Second characteristics is the significant role of private research labs in Czech public research funding system. This sector consists partly of former state research institutes and research departments of state owned industrial companies that were restructured in first half of 90s. These research establishments have in many cases history dating back to pre-WWII period and retain a significant role in applied research funded by both public and private sources.

The role of state in coordination of Czech funding system is important, but highly decentralised. Both academy of sciences and HE sectors are greatly independent and the steering capacity of the state is here very low. The rest of the allocation mechanisms are very much fragmented among ministries.

5   Conclusions

There are a number of interesting conclusions emerging from this analysis. Firstly, the three countries considered display completely different structures of research funding; not only they don't show a convergence towards a western-European model – as characterized by 2/3 of general funding, mostly to universities, and 1/3 of project funding (Lepori et al. 2007) -, but differences between countries are large and do not seem to diminish during the analysed period. In a nutshell, the experiment of breaking down the communist system has been a major source of divergence, since early choices in the restructuring of the research system have pushed each country on a distinct and stable path.

Secondly, a common feature in all three countries is the weakness of steering from the State, even if though different mechanisms: fragmentation in distinct subfields in the Czech Case, oligopoly of few performers and diversification of funding agencies in Estonia and too strong centralisation, without any intermediary structure mediating steering in the Polish case. The latter example points to the fact that formally centralised arrangements do not necessarily imply strong central steering if the required competences and information infrastructure is not available.

The degree of competition for funding can be judged also as rather low, at least in the aggregate level. This is pretty clear in the Polish case, with its prevailing institutional funding with low degree of competition. More surprisingly, it emerges also in Estonian case because of the small number of potential competitors. We notice that in both cases looking to formal arrangements would have provided a misleading picture; thus, the Estonian system is formally very open and competitive, but the fact that the main performers get very similar shares of different funding instruments casts some doubts on the effective degree of competition.

The final remark lies thus in the interest of the approach proposed here to look to the overall structure of the funding market and on the interaction between funding agencies and performers, by combining qualitative descriptions with quantitative data. An approach that could be pushed further looking to more deep market structures at the level of individual units and funding programmes.

6   References

Barker K. (2007), The UK Research Assessment Exercise: the Evolution of a National Research Evaluation System, Research Evaluation 16 (1), 3-12.

Benner M., Sandström U. (2000), Institutionalizing the triple helix: research funding and norms in the academic system, Research Policy 29 (2), 291-301.

Borras S., Jacobson K. (2004), The Open Method of Coordination and the New Governance Patterns in the EU, Journal of European Public Policy, 11 (2), 185-208.

Braun D. (1998), The role of funding agencies in the cognitive development of science, Research Policy, vol.27 no 8. 807-821

Braun D. (2003): Lasting tensions in research policy making- a delegation problem, Science and Public Policy, vol. 32 no 5. 302-308

Braun D. (2006), Delegation in the distributive policy arena: the case of research policy, in Braun D., Gilardi F. (2006), Delegation in Contemporary Democracies, Routledge, London, 146-170.

Braun D. (2008), Organising the machinery of Government in Knowledge and Innovation Policy, Science and Public Policy, forthcoming.

Braun D., Guston D. (2003), Principal-Agent Theory and the Research Policy – An Introduction, Science and Public Policy 30 (5), 302-308.

Jablecka (2008), Poland country report. Research funding systems in Central and Eastern European Countries, PRIME-CEEC report.

Jongbloed B. (2008), Creating public-private dynamics in higher education funding: a discussion of three options, in Enders J., Jongbloed B. (2007), Public-Private Dynamics in Higher Education, Transcript, Bielefeld.

Kuhlmann, S. (2001): Governance of Innovation Policy in Europe – Three Scenarios, Research Policy, 30 (6), 953-976.

Lepori B., van den Besselaar P., Dinges M., van der Meulen B., Potì B., Reale E., Slipersaeter S., Theves J. (2007), Comparing the evolution of national research policies: what pattern of change? Science and Public Policy vol. 34 no 6, July. 372-388

Lepori B., van den Besselaar P., Dinges M., van der Meulen B., Potì B., Reale E., Slipersaeter S., Theves J., (2007a), Indicators for Comparative Analysis of Public Project Funding. Concepts, Implementation and Evaluation, Research Evaluation, 16(4), 243-256.

Masso and Ukrainski (2008), Estonia country report. Research funding systems in Central and Eastern European Countries, PRIME-CEEC report.

Masso J., Ukrainski K. (2008a), Competition in Estonian research funding, paper to be presented at the ENID-PRIME Indicators Conference, Oslo, May 2008.

Meske, Werner(Ed.) (2004), From System Transformation to European Integration - Science and technology in Central and Eastern at the beginning of the 21st century, Reihe: Soziologie: Forschung und Wissenschaft, Bd. 7, 2004, 496 S.

Morris N. (2003), Academic researchers as "agents" of science policy, Science and Public Policy 30 (5), 359-370.

Potì B., Reale E. 2007: Changing allocation models for public research funding: an empirical exploration based on funding data, Science and Public Policy, vol. 34 no 6 July.

Radosevic S. (2005), Are systems of innovation in Central and Eastern Europe inefficient?, Paper presented at the DRUID tenth anniversary conference, Copenhagen, June 2005.

Radosevic, S and Auriol (1998): 'Patterns of Restructuring in Research, Development and Innovation Activities in Central and Eastern European Countries: Analysis Based on S&T Indicators', *Research Policy*, Vol 28 No 4, 1999, 351-376.

Senker J. (1999), European Comparison of Public Sector Research Systems, Brighton.

Sima (2008a), Czech Republic country report. Research funding systems in Central and Eastern European Countries, PRIME-CEEC report.

Sima K. et. al (2008), Different strategies of transforming HE sector towards research. Czech Republic, Poland, Estonia, paper to be presented at the ENID-PRIME Indicators Conference, Oslo, May 2008.

Stephan, J. (2002), The Productivity Gap between East and West Europe: What Role for Sectoral Structures during Integration?, Acta Oeconomica, 52, 289-305.

Theves J., (2007), Comparing national research policies and their evolution over time. An empirical study on public project funding, Science and Public Policy, 34 (6), 372-388.

van der Meulen B. (2003), New role and strategies of a research council: intermediation of of the principal-agent relationship, *Science and Public Policy*, 30 (5), pp. 323-336.

Viner N. (2006), Segmenting academics: resource targeting of research grants, Science and Public Policy, 33 (3), 166-178.

White H. (2002), Markets from Networks. Socioeconomic models of production, Princeton University Press.