DOCTORAL (PhD) THESIS

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Financing model of agricultural research institutes of state

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1. PRELIMINARIES AND OBJECTIVE OF THE STUDY

As most important precondition, the development of knowledge based economy is defined by the EU within the Lisboan strategy. These objectives are the conditions that could contribute to the competitiveness of the region and to a dynamically developing economy. Within the framework of the strategy the improvement of research and development activity and the necessary material and financial aid and the practical usability of research findings are paid attention.

The timeliness and significance of the research theme is proven by that only those countries can be successful that are able for high level innovation and to launch products representing new intellectual value. Knowledge and innovation play significant role in the modern economy of the 21st century.

For raising the Hungarian economy the key is competitiveness and the social and economic conditions that encourage it. Maintaining the research institutes providing fundamental national values is a task of the state.
In the following years economic growth can be expected only through value added production that is based on research and development and innovation. In order to get it grounded, deliberate financing of the researches and more flexible treasure approach are absolute necessary. Defining the research objectives should be based on practical demands and feedback should be ensured, as well.

The current research primarily has targeted the practical questions of financing agricultural research institutes and the functional effects of public management and control of the operation of these.

The primary objective of the dissertation was to make a proposal for an alternative financing model of research institutes belonging to agricultural higher education by evaluating the current financing of them.

Secondary objective was set to create a rank order of the EU 27 states by cluster analysis according to the indicators R&D ratio to GDP and R&D per capita.

In details, the dissertation deals with only crop research institutes of higher education.

In order to achieve the objectives the following tasks were set:

- Analysis of the indicators R&D ratio to GDP and R&D per capita in the EU27.

- The role of research and development within the Hungarian public finance and abroad

- Introduction and discussion of management problems of R&D institutes of crop production

- Introduction of the public finance law and treasure financing

- Analysis of the public planning and financing practice

- Definition of fundamental principles of base public functions

- **Recommendation for a financing model** for research institutes of agricultural higher education by considering the base public principles and financing components

2. MATERIAL AND METHOD

In the course of the wording, the prescriptions of the Doctoral regulations (Kaposvári Egyetem, 2007) were applied. In order to get more detailed information on the research theme, both secondary and primary researches were conducted. The data processing and analysis was based on suitable indicators that represent the analysed population.

Secondary survey:

It covered the R&D activities of the EU 27 and Hungary, with special regard to the **functions** of crop research institutes of higher education and to their **financial sources**. In the statistical analyses, data supplied by the HCSO and the Eurostat and OECD publications were used.

Primary research:

Both qualitative and quantitative data collection was applied.

Method used in qualitative survey:

In order to better understand the problems analysed qualitative survey was used beside secondary information.

Hungarian experts of crop research institutes were asked personally and in semi-structured interviews.

Method used in quantitative survey:

Statistical relations were sought between the analysed data. Although the publication of the data was not allowed by the institutes, they were used in the development of the alternative financing model.

Chapter results deals with two main parts. Firstly, the EU member states were analysed according to their research and development activities on the basis of two indicators:

- – GDP per capita that indicates the economic development status of the country
- – R&D expenditure to GDP ratio that indicates how deeply a country is committed to create and apply new knowledge.

The relationship between the two indicators was also analysed.

Cluster analysis is basically used to create homogenised groups of the observations on the basis of the involved variables. It is considered successful if the units are similar to their groups but are different from others. Cluster methods can be hierarchic or non-hierarchic (Sajtos-Mitev, 2007). Both methods were used in the clusterisation of the countries involved. In first step, the ideal number, the centres and the outliers of the clusters were defined by hierarchic technique. In second step, the observations were grouped by cluster centre method.

The analyses (cluster analysis) were carried out by Statistical Package for the Social Sciences (SPSS 16.0). The results obtained were demonstrated by GIS software ArcVieW 3.2 and ESRI Europe 200 map.

After the clusterisation of the countries, Austria, Hungary and the Czech Republic (former states of the Austrian-Hungarian Monarchy) belonging to different clusters were selected and analysed if the change in R&D expenditure influenced the GDP per capita. Correlation analysis was used to define the strength and direction of the stochastic relationship (Szűcs, 2002). The tendency of the relationship was analysed by regression analysis (Molnár, 2007).

In the second part, the Hungarian R&D expenditure and sources were investigated by sectors; especially from the aspect of crop research institutes belonging to higher education. The changes in expenditure were analysed with static and dynamic ratios.

It was also investigated how the current regulations help or block the financial management of crop research institutes functioning according to the public finance law.

Based on the results of the analysis, an alternative model has been developed, which could contribute to the efficiency of research and development activities.

3. RESULTS

3.1. R&D in the EU-27

Statistical measurability and international comparability of R&D activity are enabled by a method developed by the OECD in the 1960ies.

R&D expenditure is compared to the GDP in practice. The objective set by the European Union to make the EU one of the leader regions of knowledge base can be achieved only if the average R&D expenditure in the EU reaches 3 percent to GDP.

3.1.1. Cluster analysis

The 27 states of the EU were clusterised according to two indicators simultaneously:

– GDP per capita

– R&D expenditure in percentage of GDP.

The analysis covered the years 1995, 2000, 2003 and 2007. Although my intention was not to form one-member groups, Luxembourg stood out of the other countries according to the two indicators. In spite of its ordinary R&D ratio its GDP per capita figure stands out of the other countries.

The results are demonstrated in maps where the clusters are named according to the level of the analysed indicators. Map 1 shows the clusters.

Map 1: The model of GDP per capita and R&D ratio to GDP in the EU27 (2007)
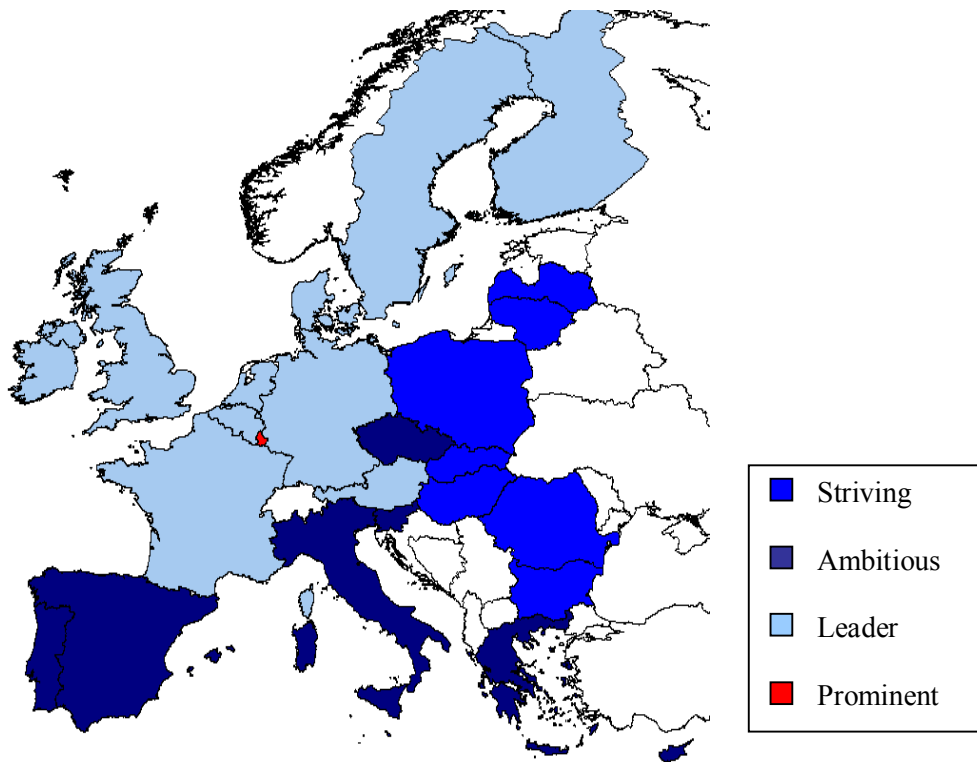
During my analyses, I sought answer on the questions if the EU membership caused changes in the situation of the former socialist countries, and whether any restructuring happened among the developed countries.

On the basis of the results it can be stated that the position of the former socialist countries has not changed, with the only exception of the **Czech Republic**. It however **developed faster** and spent more on R&D. **Malta sank back to the group of 'Striving',** while **Italy to the 'Ambitious'.**

The changes seen in the two indicators are different. The rate of growth in the GDP per capita was the highest in the group 'Striving'. Romania tripled it by 2003. The growth rate was lower only in case of Malta than that of Hungary. In the cluster 'Ambitious' the Czech Republic stood out where the GDP per capita doubled. Typically 30 to 40 percent growth rate was seen in

this group, while it was between 10 and 32 percent in the group 'Leaders'. The change in R&D expenditure to GDP ratio showed not only growth but decline, as well, typically in the most developed countries.

3.1.2. Impact of change in R&D expenditure on GDP per capita

The analysis of the relationship between R&D and GDP per capita covered the three countries of the former Austrian-Hungarian Monarchy. (These belong to different clusters.)
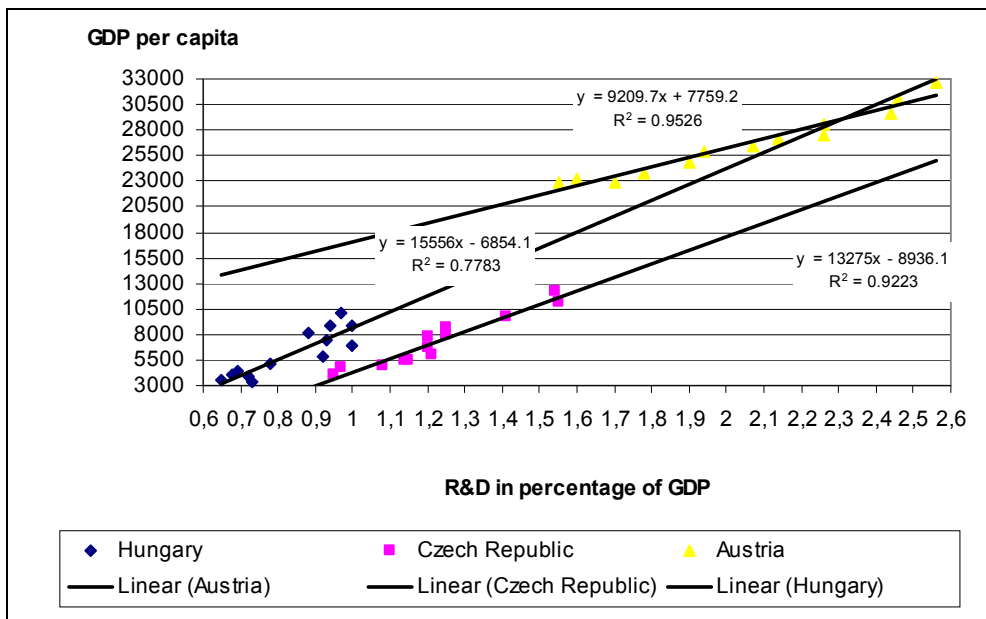

Figure 1: Change in R&D ratio and GDP per capita (1995-2007)

Source: own construction based on Eurostat data

The following was found in the course of the analysis of the relationship between R&D to GDP ratio and GDP per capita:

- Increasing R&D ratio to GDP results in increasing GDP per capita in all of the three countries analysed.

- The stereotype that more intensive growth can be expected from lower level is proven by that one unit change of a lower R&D ratio results in

greater change in the GDP per capita in the comparison of the Czech Republic and Austria. This was proven at 95 % confidence level by the regression statistics.

3.2. R&D activity in Hungary

The Hungarian R&D expenditure rose from 0.68 to 1.01% in the GDP between 1999 and 2002. This tendency broke in 2003 and 2004, while a new and slighter growth can be seen from 2005. In 2007 it dropped again to 0.97%.

In 2007, 245.7 billion HUF was spent on research and development, which represent 0.97% of the GDP, exceeding hardly the half of the EU average (1.83%). This meant 3.3% increase lagging behind the 14.5% of increase experienced in the previous years.

3.2.1. R&D expenditure in crop production

The research institutes have gone through significant changes in the recent years. The number of research institutes operating as profit oriented businesses increased due to partly the outsourcing of government institutes and partly to separating business functions.
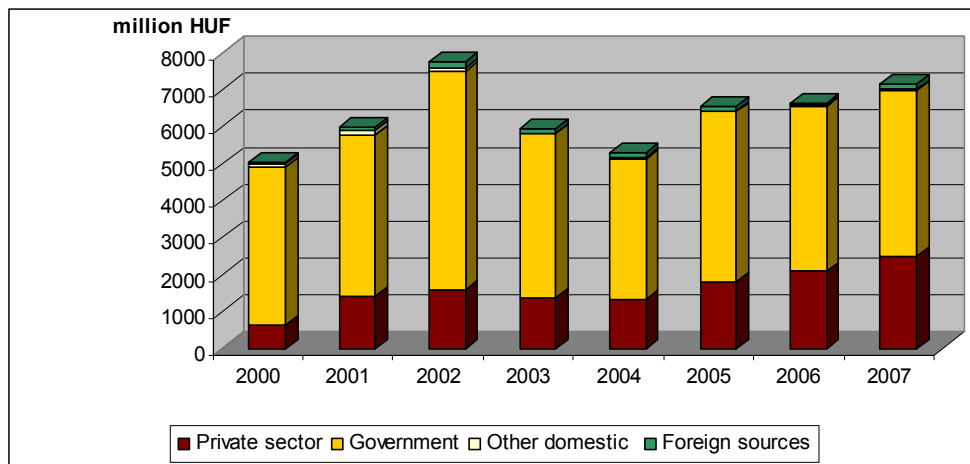
Figure 2: R&D expenditure by types of financing sources
Source: own construction based on HCSO data

3.3. General problems in research institutes

In order to analyse the operation of research institutes belonging to agricultural higher education, it is necessary to reveal the problems. Both the answers given by research institutes and the plight analysis of research institutes integrated to higher education (Fehér et. al, 1999) were used.

The following problems occur that the management of Hungarian crop research institutes faces:

– Both the number of scientific researchers and total employees dropped significantly.

– The researcher supply has become critical; they are lack of mid-aged or younger researchers.

– Huge under-financing of the institutes is typical.

– The allocation of government financial funds is time-based, it does not consider that research expenditure arise impulsively or periodically.

– Greater part of the funds depends on unsecure market factors (own revenue).

- The extremely low ratio of public fund within financing results in defencelessness and operational problems.
- The usability stage of the equipment is rather low.

The analysis of the institutes showed that financing should be based on new fundaments by introducing a new financing system that is objectively calculable and based on defined functions and physical-financial norms.

The starting point should be the base functions of the institutes that support real public demands. Base functions need to be tailored to demand: if the government needs the given function in deed. The base functions defined in the memorandum of association of the institutes need to be financed by the government.

In the course of the definition of functions, base and complementary functions shall be differentiated (Figure 3). It is reasonable to provide opportunity for complementary functions in order to make it possible that the institutes use their material and intellectual capital according to the peculiarities of the institutes; in a form that is clearly separated from the base functions.

In order to develop a new financing model it is necessary to define both the finance principles and the finance components.

3.4. Finance principles and components

The preconditions of base financing are the contract on function-based financing and executing it. The supervising authority makes the decision on accepting the professional plan and financial plan of function-financing contract.

The decision shall cover the sources and amount of public funds given for the functions defined in the research plan. In the contract, the functions of the research institute shall be defined for complementary sources. It shall

Figure 3: Functions of research institutes for crop production
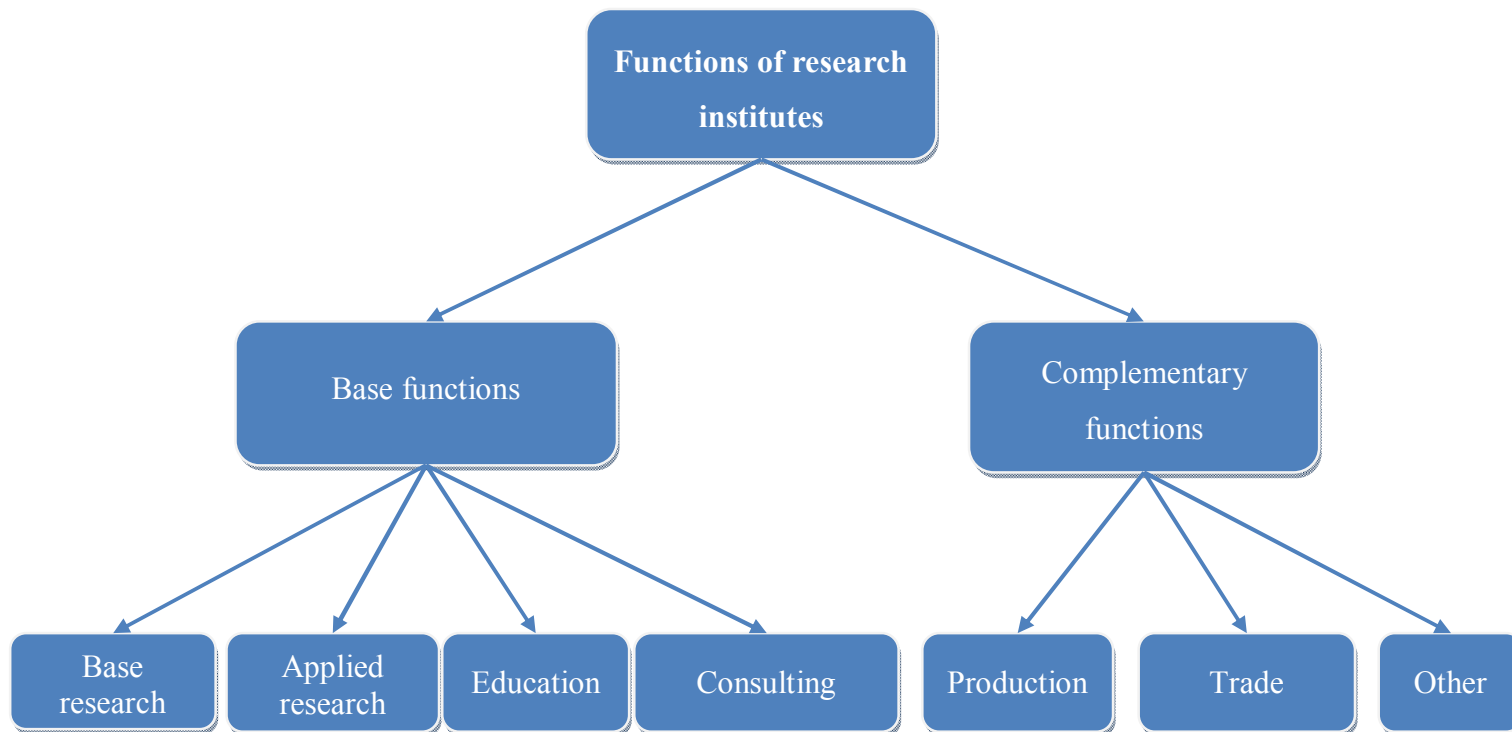
state the ratio of own revenue to government sources. The list of alternative financial sources shows that the base functions of the institute and those R&D, educational, scientific education and consulting functions that are not possible to sell directly on the market are necessary to be financed by the government. Finance components are shown in Figure 4.

The amount of base financing can be calculated in relevance to two aspects: part of it in its *ratio to expenditure*, another part in its *ratio to performance*.

In case of expenditure based supports it is necessary to consider the realistically necessary expenditure on real value.

Performance based support could be allocated by the university according to the real performance from the national research fund of universities.

Performance based support necessitates performance indicators. The support pretences are shown in Figure 5.

By considering the above principles, the professional committee of the university and the institute defines the annual amount of support.

Figure 4: Alternative financial sources for research institutes of crop production

Components of government support	External sources of funds (own revenue)

Base financing depending on expenditure

- Fund supplied by supervisor institution

- Grants of targeted proposals called by government
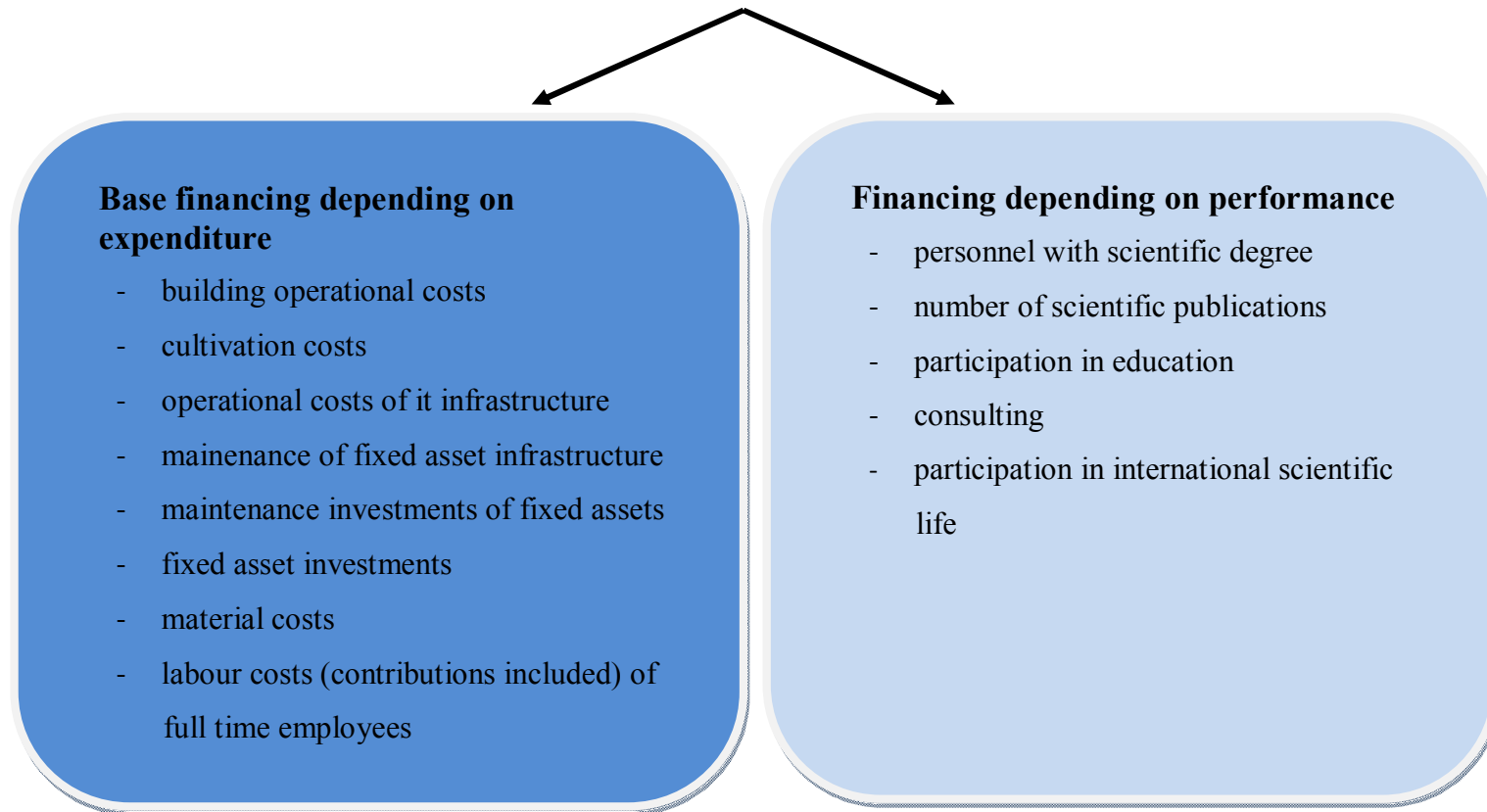
Financing depending on performance
- personnel with scientific degree

- number of scientific publications

- participation in education

- consulting

- participation in international scientific life

- Revenue from conrtacted R&D work for economic organisations

- Revenue from realisation of intellectual products

- Grants of open competitions awarded by researchers and their teams

- Revenue from scientific consultancy

- Business revenues

Figure 5: Government budget funds for research institutes of crop production
Components of public financing

Base financing depending on expenditure

- building operational costs
- cultivation costs
- operational costs of it infrastructure
- mainenance of fixed asset infrastructure
- maintenance investments of fixed assets
- fixed asset investments
- material costs
- labour costs (contributions included) of full time employees

Financing depending on performance

- personnel with scientific degree
- number of scientific publications
- participation in education
- consulting
- participation in international scientific life

4. Conclusions

The objective of the EU to become one of the leader region of knowledge base by 2010 was set in March 2002 Barcelona in the idea of the Lisbon Round (March 2000). In order to achieve this objective, the average R&D expenditure needs to reach 3% to the GDP in the EU27. The cluster analysis of the member states resulted in four clusters according to two macro-economic indicators. It was found that the analysed countries' position hardly altered during the period. The former socialist countries belong to the least developed cluster with the exception of the Czech Republic and Slovenia.

The analysis of the Hungarian R&D expenditure showed that the proportion of private research increased in advantage on the public researches. Government and business sector represent similar share within the financing structure of R&D activities, although with slightly weakening role of the government.

Hungary has not have yet a single agricultural research concept, which would determine how many institutes of state financing is necessary, and what highlighted central functions they should supply. It worsens the efficiency of research that crop research institutes belong various supervising authorities.

Huge under-financing is typical for the institutes. Financial and liquidity problems occur due to that the level of current asset is not adequate in the research institutes.

In order to increase the amount of expenditure on research, it is necessary to rise the amount of own revenue. Greater part of the financial sources depend on unsecure market conditions (majority of own revenue).

Due to their situation, research institutes are forced to a more marketing oriented way of thinking. Those institutes will survive in long term that are able to build their strategy on realisable market demands.

5. NEW AND PROSPECTIVE SCIENTIFIC RESULTS

1. On the basis of the analysis of two selected macro-economical indicators

   - GDP per capita

   - R&D in the percentage of the GDP

   I have developed a model; according to that four clusters have been defined for the 27 states of the EU: "Striving", "Ambitious", "Leader" and „Prominent".

   In the model defined, the former socialist countries and within them Hungary belong to the cluster "striving", with the exception of Slovenia and the Czech Republic; showing no change in their position during the analysed period.

2. Based on the results obtained I have found that, according to the shown growth rate, the average R&D ratio to GDP will not reach the 3% goal set in the EU27 by 2010.

3. Regarding the research institutes of higher education I have
   - defined financing principles, according to which the research functions assigned on the basis of users' demand should be defined in the function-based financing contract
   - elaborated the components of financial sources in reference with public funds and private revenues;

   and I have developed an alternative financing model based on these two.

The model may help in developing a financial framework for research, which is separable from the financial sources of education in agricultural higher education institutes.

4. In the course of my research I have found that Hungary does not have a single national agricultural development concept; therefore it is not possible to define
   – the base functions expected by the government and created according to users' demand,
   – the financing,
   – and the necessary number of research institutes.

   Due to the uncertainty the Hungarian research and development can hardly follow international trends; which results in disadvantageous position in the international competition and market defencelessness.

6. RECOMMENDATIONS

On the basis of the results obtained in the curse of the analyses of research and development expenditure and of the management of research institutions of Hungarian higher education, the following can be recommended.

For Hungary it is a **key issue** to improve its research and development status, hence this is the only way to keep up with countries with knowledge based economy. Preconditions of it are to increase the research and development expenditure and the **harmonisation of private and public researches** with forming a suitable ratio of these two.

It is important that the financial sources of university research institutes shall be ensured according to **objective norms** and **separately** from the base financing of the university providing the organisational framework in such a way that it corresponds the expenditure necessities and it is based on partly **functional quotas** and partly on its **performance**. Preconditions of the improvement of research efficiency and of base financing are the contract on **function-based financing** and executing it.

Liquidity and financial problems occur due to the extreme under-financing of the institutions. It could be a solution if the research institutions were given **single capital allowance**.

Due to the time-based allocation of government financial funds, the public finance law and treasure financing block the operation of the institutes, because the research expenditures arise periodically or suddenly. Solutions could be given by:

- Government support allocated according to the cycles of research expenditure emergence typical for the crop production.
- Opportunities given for short term loans in order to reduce the transitional liquidity problems.

The return demand of research expenditure raises the necessity of intervention in the current land based subsidising system. It is necessary to **specify the use of quality seed as stipulation** on national top up grants. The use of quality seeds increase the revenue of research institutes as the utilisation fee of varieties to be contributes to the return of research and development expenditure.

International competitiveness is ensured by the use of equipment that meets the highest requirements of our time. The usability of the equipment of Hungarian institutes is rather low. The way to catch up is the following:
- Government support for investments in equipment elementary for fulfilling base functions.
- Defining depreciation as cost arising at government institutions would increase the accumulated funds, which contribute to the replacement of equipment.
- Credit facilities for investment and development in order to complement the available sources.

On the basis of detailed analyses I have found that the amount of targeted fund defined by the government budget does not correspond with real requirements. On the basis of the functions written in the articles of association, the whole research process should be appointed and the estimation of costs should be based on **real observations** and **empirical facts** and **on real value**.

7. LIST OF PUBLICATIONS RELATED TO THE PHD RESEARCH

REFEREED PAPERS PUBLISHED IN SCIENTIFIC JOURNALS IN FOREIGN LANGUAGE

Wickert I.–Geszti Sz. - Balogh L. .- Lehőcz G.: Das Wirtschaften von haushaltsfinanzierten Institutionen. Europaische Fahhochschule), Brhül, 2008 June 2-5.

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Dr. Horváth Gyula (editor): **Wickert I**.: Az államháztartási törvény és kincstári finanszírozás hatása a költségvetési rendszerben működő növénytermesztési kutatóintézetek gazdálkodására. In: „Az alternatív mezőgazdaság tőkeszükséglete", KE, GTK Kaposvár, 2006; 57-61. o.

Wickert I.: Felsőoktatási kutatóhelyek finanszírozása, II. Kaposvári Gazdaságtudományi Konferencia 2009. (recieved)