Harnessing innovation in Romania – A comparative analysis

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Abstract: In order for national economies to ensure a high degree of competitiveness in the area of research, development and innovation, the former need to secure and develop a commercial coordinate so as to support the demand side for innovative goods and services. Measures taken in this direction can be revealed by a series of indicators such as the contribution of medium/high technology products to the trade balance or external revenues derived from patents and licenses. This paper aims to investigate, through a comparative analysis, the results recorded by Romania in terms of capitalizing on intellectual output, as well as the prerequisites of the relevant system's competitiveness.

Keywords: statistical indicators, comercialization, intellectual output, innovation

JEL Classification: K11, L24

Introduction

Innovation is globally recognized as representing an important driver for growth and a fundamental source for competitiveness (OECD, 2010). This conclusion is supported by ample evidence, both theoretical (e.g. Romer, 1986) and empirical (e.g. Mani, 2004). The primary motivation for governments to measure innovation is the need to develop policies in this area and to implement actions to support innovative activities. Behind governmental decisions to intervene in this field is the idea that many innovative process elements are public in nature (e.g. education or infrastructure) or have a political nature (e.g. legislation). Thus, like other specific areas of governance, innovation policies require measurement

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tools in order to assist policy-makers with both the development as well as the evaluation of specific interventions (Gault, 2005).

Nowadays, the innovation indicators and subsequent policies focus on *two innovative activity coordinates*: a) *creation of new knowledge* and b) *exploitation of innovation*. These coordinates adapt the linear innovation model that assumes a uni-directional connection between the various *components/ input factors* (inputs), such as spending on research – development and *results* (outputs) within the innovation process. Thus, measurement of innovation has attached little importance to what happens between the two components. As noted by Landry and Amara (2012), decision makers focus on implementing innovation policies based heavily on one or two components, such as investments in patents and R&D. Also, the literature notes that much of the traditional innovation indicators, such as those focused on scientific or technological activities, do not support the measurement of innovation in developing countries and cannot capture the complex factors that contribute to the ability of different states to innovate (Archibugi, Coco, 2004).

The analytical framework used in this paper is based on *an input-output approach*, where innovation indicators, as provided by the Innovation Union Scoreboard (IUS) are assigned to one category or another (i.e., input and outputs). The methodological entries used are as follows:

A. Input indicators: i) R&D expenditure in the public sector, ii) R&D expenditure in the business sector, iii) Venture capital, iv) Non R&D innovation expenditure, v) PCT patent applications, vi) Community trademarks, vii) Community designs, viii) Employment in knowledge intensive activities, ix) SMEs introducing marketing or organisational innovations and x) SMEs introducing product or process innovations.

B. Output indicators: i) Contribution of medium and high-tech products exports to the trade balance, ii) Knowledge-intensive services exports, iii) Sales of new-to-market and new-to-firm innovations, iv) License and patent revenues from abroad.

Output indicator assessment

The first stage of the analysis envisages a comparison of the input indicators in the case of Romania to the European average recorded for each such indicator, while emphasizing the highest performance level. The data were originally collected for each indicator on the three coordinates mentioned above (i.e.,

Romania, the EU average and best performance), while they constitute the elements of a comparative analysis.

Following such analysis, one can note that Romania ranks constantly below the EU average with respect to those inidicators that constitute the premises of innovation commercialization. The only exception appears to be the *non R&D innovation expenditure* indicator where, in 2010 and 2011, the results place Romania above the aforementioned average. However, given the constant position that emerges out of the other nine indicators, we consider that the relevance of this "deviation" is a marginal one, especially for the purposes of this analysis.

Therefore, based on the methodological aspects discussed, the results at the level of input indicators are necessary prerequisites for achieving performance in the area of intellectual output/innovation commericialization. In this context, Romania achieves negative results along the whole spectrum.

Notably, several indicators stand out. Thus, *R&D expenditure in the public sector* recorded a slight increase during the 2013-2014 period, in contrast to *R&D expenditure in the business sector* which seems to have decreased in the same period, compared to the situation recorded in 2010 and 2011. Also, the performance level of *PCT patent applications*, *Community trademarks* and *designs* reflect a reality that seems to predict the results of our analysis with regard to innovation commercialization in Romania. This is because patents, trademarks and designs are true key elements that constitute the basis of the formation and development of a "stock" of intellectual assets, wich will be the object of future transactions and negotiations on the specific markets for intellectual output or markets for ideas, in more general terms. A low level of performance in this regard is likely to translate, at least in theory, into low possibilities to compete on the markets for knowledge transfer/technology/know-how, etc., not taking into account the issues relating to intellectual asset quality or the latter's marketing propensity (two aspects that can influence, by themselves, independently, the concrete possibilities to benefit commercially from research & innovation). The relevance of the comparison with the EU average and the best performance emerges from how the IUS measures the indicators concerned, i.e. the number of applications (patent/trademark/design) to GDP purchasing power parity.

The results of the statistical analysis data mentioned also confirm the conclusions of the Innovation Union Scoreboard report in recent years. Thus, Romania's position as a constant modest innovator strengthens and, to some extent,

subsumes the poor results with respect to the selected input indicators. Strictly related to the discussion on innovation performance, an interesting analysis, and useful as well, for understanding the phenomenon, checks the situation of innovation leaders (as they are classified by IUS) with respect to the input indicators used in our analysis. We would thus test, at an empirical level, a functional link between the overall performance in the area of innovation and relevant details relating to individual (input) indicators used in the analysis at this stage. The data were collected for each of the following individual EU Member States, i.e. Denmark, Finland, Sweden and Germany, which summarizes performance data for every indicator. For comparison, the data are related to the results achieved by Romania, the Union's average and the best peformance in the respective area.

With respect to most of the indicators used, the EU innovation leaders perform above the EU average. Exceptions are rare and their relevance is debateable, e.g. Germany is below average when it comes to *venture capital* throughout the period investigated (i.e. years 2010, 2011, 2013, 2014) and Finland is also below average in the area of *Community designs* in 2013, as well as *SMEs introducing marketing and organizational innovations* throughout the period considered. However, we note that the best performance for certain indicators overlaps with the results of some of these innovation "champions". Such is the case of Finland for *R&D expenditure in the public and the business sectors* (partly Sweden for the latter, for years 2011 and 2013), Finland, Sweden and Germany in the area of *Community patent applications* and Germany, absolute champion with respect to *SMEs introducing marketing and organizational innovations*, throughout the period analyzed.

In conclusion, after analyzing the results of the selected input indicators, one can notice, on the one hand, that Romania's performances are well below the EU average, constantly falling in the category of modest innovators statistics as reported by IUS, also because of their poor performance with respect to the analyzed indicators (under-funding of research and development is a defining element). On the other hand, the European Union innovation leaders achieve, in general, great results over the entire area of the selected indicators.

Output indicators analysis

Following the methodological path described in the beginning of this paper, we intend to analyze the situation of the outcome indicators in the case of Romania in order to check the marketing/capitalization performance of knowledge/ innovation. Also, in order to follow the approach used for the input indicators we

shall analyze the status of the output indicators for Romania, so as to verify the level of related performance. In addition, in order to use the similar approach mentioned above we shall add for comparison purposes the European Union's average as well as the best performance. Mention needs to be made at this point of the fact that the indicators chosen under this exercise are merely intended to provide an overview of the commercialization environment at state level; consequently such analysis is not to be interpreted as being a diagnosis.

Data collected correspond to the years 2010, 2011, 2013 and 2014 for the four output indicators selected. The results are at least surprising. Thus, with respect to the first three indicators, Romania is ranked around the EU average, exceeding it at times. Regarding the results of the *license and patent revenues from abroad* indicator, it is quite close to the average, although slightly below. In this context we must mention that, according to IUS, in 2011 Romania recorded the highest increase in the aformenetioned indicator (21.5 % with an EU average of 3%), the situation being similar at the 2013 level (23.4 % with an EU average of 6.1%). Therefore, these results raise potential questions, taking into account the premises drawn from the analysis of the relevant input indicators and Romania's performance in this field.

The results are also surprising, in line with those identified earlier in the case of Romania. Thus, with regard ro the first indicator, in the case of two innovation leaders, Finland and Sweden, the *contribution of medium/high technology products to the trade balance* is similar to Romania, while Denmark`s results were below the EU average. Obviously, the results of this indicator show the role technology plays in relation to manufacturing industries' performance as a whole and, in this context, it is surprising how Romania joins the leaders of innovation which start from completely different premises than those of our country, i.e. favorable to the development of a sustainable innovation environment.

Regarding the *export of technology-intensive services*, again surprisingly, Romania is close to the EU average, exceeding Finland and Sweden, two countries known for their outstanding performance in the field.

As regards *sales of new innovations to market and firm*, only Germany recorded over the entire period analyzed (2010, 2011, 2013 and 2014) results significantly superior to those of Romania. Thus, Finland appears to be close to Romania's results, while in the years 2010 and 2011, Denmark is below the EU average, being implicitly superseded by our country. In turn, Sweden pinpoints a totally unexpected position, if we refer back to its input indicators and the constant position as European innovation leader.

When it comes to the *license and patent revenues from abroad* indicator, the results of the innovation champions constantly lie above the EU average, except for Germany which, in the years 2011, 2013, and 2014 was ranked below this average and close to the Romania's results. As mentioned above, although Romania does not have the same surprising results in this field, the reported growth of this indicator from year to year show considerable performance in the years 2011, 2013 and 2014.

Consequently, given the above, it is time for a series of conclusions, at least at an interim level, in order to clarify the data obtained from analyzing the output indicators.

First, we must return to the subject matter of this paper. Thus, our aim is to determine, based on the indicators prepared by the Innovation Union Scoreboard, Romania's performance and its relative position in the competitive landscape of innovative results commercialization, generally referred to herein as intellectual output.

Following the first stage of our analysis, when we "lined up" the input indicators for relevant comparisons, one could conclude without significant reserves that Romania does not fulfill the necessary prerequisites for developing and supporting a competitive innovation environment leading, in turn, to outstanding results in the area of marketing the related results. This personal conclusion resulting from the methodological context proposed under this research is supported and confirmed by the Innovation Union Scoreboard global rankings as well as other expert reports (for example *Science, Technology and Innovation in Europe*, which ranks Romania last by R&D intensity).

In a second stage, after analyzing the selected output indicators, we notice a paradox: although the relevant essential conditions are missing, Romania seems to perform in an unexpected way, constantly ranking at the EU average level and, in some cases, above it. This "Romanian paradox", beyond its exotic appearance, necessarily requires further investigation as well as a satisfactory explanation.

Thus, below we will try to investigate more closely the aforementioned surprising results, distancing us from the analytical framework provided by IUS and focusing on collecting and interpreting data relevant to the Romanian R&D landscape. In this regard, we start with an analysis of the funding directions of the research, development and innovation sector in Romania, as well as the results of this sector.

An analysis of the RDI financing structure and its relevant results

The most important input indicator used in this analysis is the one concerning the financing of research, development and innovation represented, in fact, by two IUS indicators, namely R&D expenditure in the public sector on the one hand, and the private sector, on the other hand. As presented in the previous section, Romania seems to be characterized by a chronic under – financing of the R&D sector, and in the following we will focus on the public side. This is because our analysis takes into consideration and intends to examine the functioning of the public policies and strategies in this area, as well as their results over time.

Thus, despite the poor results mentioned above and, of course, considering the paradoxical performance concerning the exploitation of intellectual output, it is possible that the latter may have occurred due to an efficient public fund allocation, such funding being channeled to economic sectors prolific in terms of development and enhancement of innovative results. In this context, we intend to explore the destination of the funds allocated to R&D (million RON in current prices) over a period of time long enough to provide highly relevant results. In this regard, we took into consideration the years 2007-2013 and the related data are those presented under the official communications of the National Institute of Statistics. The sectors included in the analysis are identical to those presented by the OECD expert reports, namely the business sector, government, higher education and private non-profit sector.

In this context, mention should be made of the fact that, at OECD countries level, most of the R&D funding comes from the business sector (e.g. 70 % in 2007). In Romania's case, the situation is quite the opposite, with most of the financing coming from the public sector. To support these findings we present Table 1 below, based on data published by Eurostat which covers only the business, government and education sectors.

Table 1 – R&D spending by source of funding (billion Euro)

Year	2007	2008	2009	2010	2011	2012	2013
Total	30.9	39.2	27.2	28.2	32.5	32.1	27.9
Business sector	8.3 (26.8%)	9.1 (23.2%)	9.5 (34.9%)	9.1 (32.5%)	12.2 (37.5%)	11 (34.2%)	8.6 (30.8%)
Government sector	20.7 (66.9%)	27.5 (70.1%)	14.9 (54.7%)	15.4 (54.6%)	16 (49.2%)	16 (49.8%)	14.6 (52.3%)
Higher education	0.4 (1,2%)	1 (2.5%)	0.5 (1,8%)	0.6 (2,1%)	0.4 (1,2%)	0.3 (0,9%)	0.3 (1%)

Source: EUROSTAT (http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do).

In this context it becomes even more necessary to investigate the areas that benefit from government funding. Following data collection and processing for the years analyzed we focused on a number of relevant aspects.

The first we noted was that along the whole time spectrum, 2007-2013, the public sector, represented by government and higher education, benefited from most of the budgetary funding. Thus, approximately two-thirds of the funds allocated to research and development went to public entities. For example, according to NSI, in the years 2008 and 2013, 70 % and 69 %, respectively, of the total funding were granted to the public sector. In the years 2007 and 2009 the lowest level was recorded, i.e. 40 % and 42 %, respectively of the total budget.

Therefore, it is quite obvious that the public sector benefits from most of the funds allocated to these activities. In this context, taking into account the approach that we have proposed in this section of the paper, the focus is now on analysing those elements that capture best results of R&D activities with potential marketing/commercial value. The main available items, given the relevant statistical data, are *patents*. In this case we have two indicators available, namely, the *number of patent applications* and *number of granted patents* by the State Office for Inventions and Trademarks in Romania.

In order to benchmark the results with those describing the destination of public funds, the data regarding the two indicators above will be spread over different categories of Romanian applicants thus: individuals, companies, research institutes and others. The statistics used are those provided by the State Office for Inventions and Trademarks in its annual reports, during the same period, 2007-2013.

Following the data collection and analysis relevant for patent applications, the results are also surprising, given that we sought to identify a causal link between the destination of the investment and the materialization of innovation results. Thus, one may easily note that the public sector performance (the biggest beneficiary of budgetary funds for research and development activities) with regard to patent applications accounts for 25% and 47% of the total.

However, the really surprising aspect is that most applications have been submitted by individuals. Therefore, the leaders of the area under consideration are not public sector entities and, moreover, they pertain to a group which, at least at a global level, did not benefit from any government funding. Consequently and paradoxically, the “champions” of this indicator come from an area which is not influenced in any way by state intervention in order to perform.

Of course, the situation assessed with regard to the patent applications represents only part of the picture that we intend to investigate, one that we intend to round off by analysing the number of patents actually issued by the State Office for Inventions and Trademarks during 2007-2013. If we spread the results across the same categories (i.e. individuals, companies, research institutes and others) one may note that, with regard to the actual patents granted by the State Office for Inventions and Trademarks, public sector entities do not stand out as leaders, although the percentages are considerably improved. In this context, the category formed by individuals is the one with the highest number of patented inventions in the years 2007, 2008, 2009 and about at the same level as the public sector in 2010. In the years 2011, 2012 and 2013 the share held by these categories increased but not in a spectacular way, the individuals representing between one-third and one-quarter of all recipients of patents granted.

Also, there is a difference between individuals and the public sector with regard to applications actually turning into patents, in the sense that the public sector's results are superior. This may benefit from a relatively obvious explanation. Thus, unlike the entrepreneurial activity, the strict specialization of research institutes and education entities is a distinct advantage in the formulation and channelling of R&D projects, which can lead to superior performance in terms of achieving patentable results.

Conclusions

At least two conclusions can be drawn from the results analyzed with regard to the two indicators. First, given the results expressed by the number of patent applications and patents granted effectively, one can note that between the research and development public sector spending and the results/ performance there is no a close connection or, at least, a causal relationship cannot be proven. Consequently, while the performance of the individuals category is superior to that achieved by the public sector, the two categories starting from totally unequal premises (i.e. the latter benefiting from government funding, the others, at least based on the data analyzed, having no such advantage) one cannot even establish a direct link between the government R&D funding for public entities and their related performance, i.e. the latter may be coincidental or related to other stimulating factors. Therefore, the first conclusion to be drawn is that there is a relative inefficiency of the way government financing is channeled.

Second and intrinsically linked to the above, another conclusion can be drawn. Thus, given the area that fosters the analyzed performance, one can raise the question whether the policy of public money being invested in research and

development is properly planned in terms of economic efficiency. We raise this issue in a context where, although without significant support, the entrepreneurial segment seems to support innovation performance, at least statistically, as it is provided by the two indicators. Therefore, based on this reality we can issue a second conclusion, namely, that the funding of research and development in Romania must be decided and implemented on the basis of carefully selected performance indicators, so as to incentivize those categories of recipients that prove, through their results, the ability to produce real added value and, at the same time, to support the entrepreneurial innovation potential at individual level.

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