

Innovation – trends and patterns at Romanian firms

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Abstract. *Innovation is vital for each country's economic growth. This paper comprises an analysis of the main indicators that characterize innovation activity in Romanian firms. Improving our knowledge of firms' activities in aspects associated with their behavior related to innovation is important for monitoring the strengths and weaknesses of the national innovation systems. Our study on Romanian firms is based entirely on the published data by Eurostat (the Commission Innovation Survey – CIS), which centralizes data every two years, the last have been published at the end of 2016 (CIS 9) covering the period 2012-2014. From building and analyzing three main types of general innovation indicators related to firms' innovativeness, including innovation inputs and outputs, our results show that the main weaknesses in business innovation persist over time and they consist of the extremely low share of innovative firms, a low level of business innovation expenditures and a high volatility of innovation performance based on creative effort resulted from R&D activities still concentrated in a few industries.*

Keywords: R&D, innovation, firm, performance, Romania.

JEL Classification: O32.

1. Introduction

Innovation is of crucial importance for the modern economy competitiveness, as well as for a high standard of living and welfare. According to OECD (2005, p. 46), innovation is broadly defined as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations”. Improving our knowledge of firms' activities in aspects associated with their behavior related to innovation is important for monitoring the strengths and weaknesses of the national innovation systems.

The use of innovation indicators developed on the basis of firms' survey has intensified in the last two decades, as they broaden the business analysis framework by taking into account innovation expenditures performed by firms and innovation outputs (with reference, most often, to product innovations expressed using turnover), comprising also the sources of information used by firms, including their collaboration with various partners, as well as business perceptions on obstacles encountered in their activities. Data such as those provided by the Community Innovation Survey (CIS – Eurostat, EBRD etc.) are of crucial utility to identify innovation determinants and innovative firms' characteristics related to the size and structure of innovation expenditures, the collaboration activities and information used in innovation process, innovation output, and allow comparisons over time by firm's size, by industries and cross-countries comparisons. In this framework, simple (general) innovation indicators can be built using the answers given by firms to a single question, or complex indicators can be elaborated following the answers to several questions (OECD, 2011; Huang et al., 2010; Bloch et al., 2008; Arundel, 2007 etc.) being of importance for government policy focused on stimulating innovation.

This paper comprises an analysis of the main innovation indicators that characterize the firms' activity in Romania. Our study is based entirely on the published data by Eurostat (the Commission Innovation Survey – CIS), which centralizes data every two years, the last ones have been published at the end of 2016 (CIS 9) covering the period 2012-2014. Our concern is related to the fact that innovation activities in Romania still lags behind those within most of the EU countries, and the pace of catching up the more advanced economies is very low. These can be reflected in the size of composite innovation indicators such as the Global Competitiveness Index (GCI, reported by the World Economic Forum), the Knowledge Economic Index (measured by the World Bank), the Summary Innovation Index (SII, published by the European Commission) etc.

In this respect, we build and analyze three main general groups of innovativeness indicators. Section 2 comprises a first set of indicators referring to shares of innovative firms broadly defined, performing technological (product and/or process) innovation and non-technological (organizational and/or marketing) innovation, as well as firms that introduced new product innovations. Section 3 contains a descriptive analysis of business innovation inputs building a second set of innovation indicators namely business innovation expenditures, share of innovative firms that performed research and development (R&D) activities and collaborative activities of innovative firms. The next

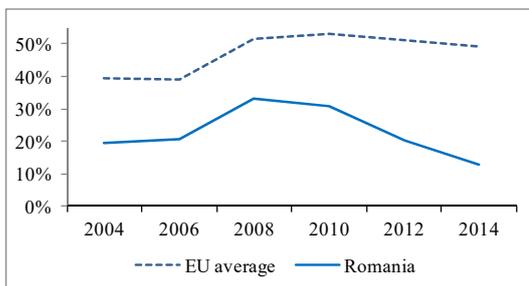
group of indicators measure innovation outputs analyzed in Section 4, the most common comprising the share of turnover from new-to-firm and new-to-market product innovations (as % of turnover) and Section 5 concludes.

2. Indicators of innovativeness

The main indicator of innovativeness is *the share of innovative active firms* defined in the CIS as the proportion of firms having introduced technological (product and/or process) innovations and non-technological (marketing and/or organizational) innovation, including firms with abandoned/suspended innovation activities during the period or still having on-going activities by the end of the period. As we can see in Figure 1, business innovation activity in Romania is based on an extremely low proportion of innovative firms, which is much lower than in the EU average, with an upward trend until 2008, followed by a continued decrease over time.

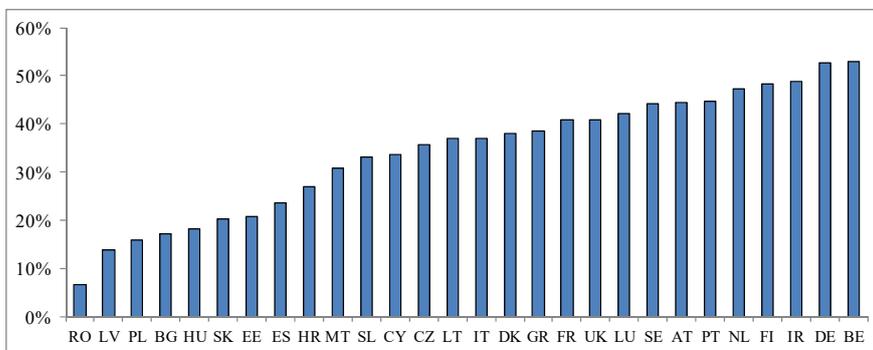
While 49.10% of all firms are innovative active in the EU, on the average, Romania registered 12.8% in 2014. The low proportion of innovative firms is one of the main weaknesses that characterize business innovation and the national innovation system in Romania.

Figure 1. Trends in innovative firms (broadly defined, % of all firms), all core activities



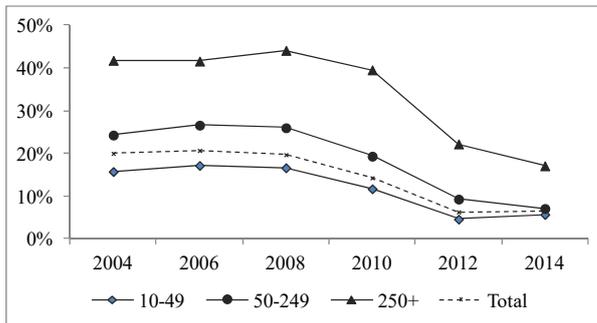
A drastic similar decline was registered in *the share of firms with technological innovation* of all firms in 2014, Romania having also the smallest proportion of technologically active innovative firms in the EU area (6.5%, Figure 2).

Figure 2. Technologically active innovative firms in the EU countries (% of all firms), 2014, all core activities



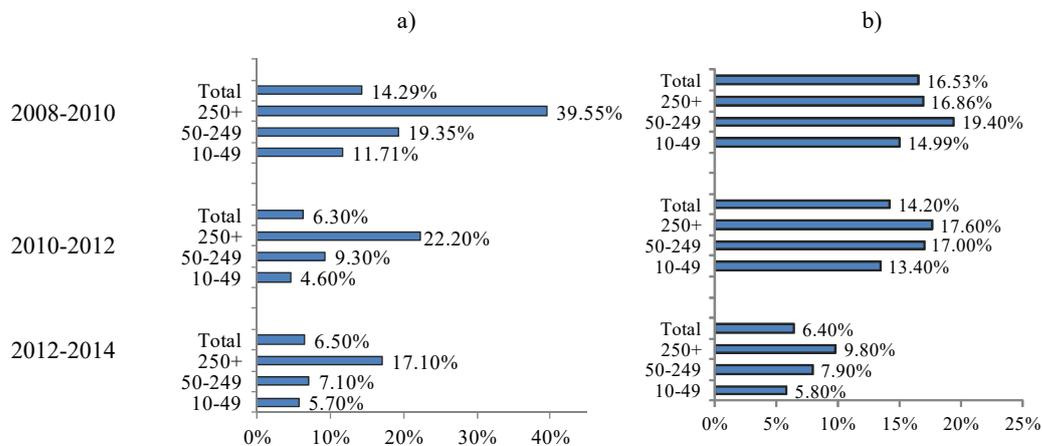
The decline in the proportion of technologically active innovative firms has started in Romania in 2008, when the first signs of the economic crisis showed up, compared with the previous periods, falling from 20.7% in 2006 to 19.7% in 2010, and it was manifested significantly in small and medium-sized enterprises. Since then, a continued reduction in the share of technologically active innovative firms can be observed in Figure 3, that was manifested at the level of all firms' size-groups, and particularly in large firms (with more than 250 employees).

Figure 3. Trends in technologically active innovative firms in Romania (% of all firms), all core activities



Similar trends of reducing in the percentage of *firms with non-technological innovations* can be shown over time in Romania, in all firms' size-groups. Both the gap between two periods and the variations resulting from comparisons with the EU average are lower (12.9% in 2012 according to CIS 8 and 10.4% in 2014 according with CIS 9) than registered in technological innovation (Figures 4a and 4b). Large firms were also more involved in non-technological innovation. There seems to be a pattern, that the countries with low total share of innovative firms have low shares of innovative active firms in the smaller size-class. We can note this as being an another major weakness that characterizes business innovation in Romania, taking into account the fact that small and medium-sized enterprises form the largest proportion of firms in the economy.

Figure 4. Technological (a) and non-technological (b) innovative firms in Romania by firms' size (% of all firms), all core activities



In fact, technological and non-technological innovations are highly interconnected and many firms engage in both types of innovation. As Arundel (2007) notes, non-technological innovation plays also a critical role in the creation of economic value and the firms' competitiveness, and should be viewed as an important innovation input of similar importance. For instance, the diffusion of product innovations often requires the development of new marketing methods. Similarly, a new production technique can increase productivity when is supported by changes in organization.

According to the CIS data, innovation activity in manufacturing is more intense than in services, and also the innovation activity increases with the firms' size. Services are more engaged in non-technological innovation. In general, innovation in services is more heterogeneous, firms opting more for introducing advanced communications technology and non-technological innovations. The organizational aspects of innovation are particularly important to services innovative firms that are, in principle, more involved in working with customers and suppliers than to perform in-house R&D activities.

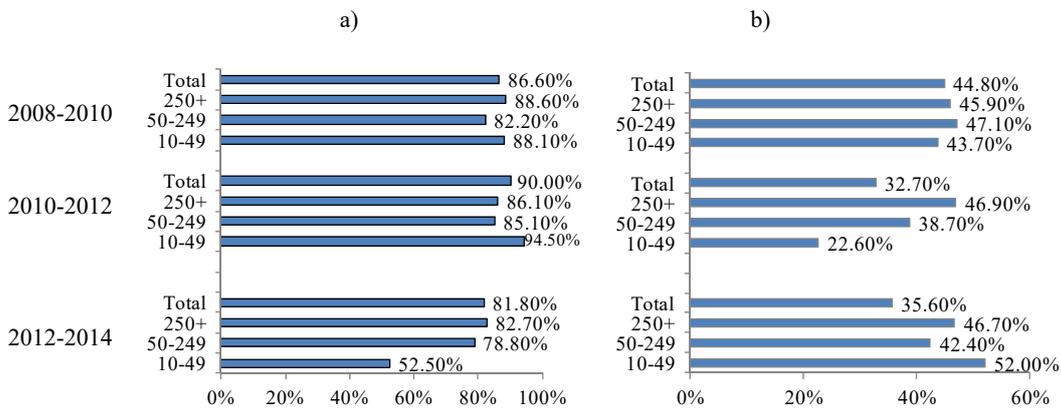
Firms are often involved in both types of technological (i.e. product and process) innovations, with intensities resulting from their strategies adopted. Product innovation (pursuing technological competitiveness) requires more research and development efforts (Vaona and Pianta, 2008), as well as production activities to increase the market share. Our calculations based on the CIS 9 data show that the share of firms that introduced only product innovations of technological innovative firms was the lowest in small firms (17.41%, growing slowly as firms' size rise), large firms being most active in this respect. Process innovation is primarily performed to increase efficiency in production. It creates prerequisites for product innovations and price competitiveness is pursued. According to our calculus based on the CIS 9 data, small and medium-sized firms are involved more in process innovation.

The larger share of firms performed both types of technological innovation, particularly large firms (52.26%), that reflects the fact that they aim at increasing efficiency in production by reducing costs and streamlining production processes, as well as increasing production (driven by lowering prices of new products). This indicates the fact that the resources available for the acquisition (adoption) of new machinery and equipment are essential. The share of firms that introduced product or process innovation did not register significant variations. For example, according to our calculations made for previous years using CIS 4 - CIS 7 data, similar conclusions we draw in terms of the more intense involvement of small and medium-sized firms in process innovation. Also, large firms performed both types of technological innovation (Diaconu, 2013).

Highlighting the share of firms that introduced “new-to-firm” or “new-to-market” product innovations can provide some insights regarding *products novelty* and developers, market leaders (major innovators), or technology adopters and adopters can be identified. At the same time, assessments of the innovation modes can be formulated analyzing the proportions of firms involved in the creation of new knowledge or in the use of the existing knowledge. Figures 5a and 5b show the evolution of the two indicators in Romania by firm's size over the period 2008-2014. The total share of firms that developed “new-to-firm” products (81.80%) exceeded the proportion of firms that

performed “new-to-market” products (35.6%) at the end of 2014 in all core activities. This is a common feature of all EU countries as well. Generally, Romanian small enterprises have been more focused on performing “new-to-firm” innovations, registering the highest proportion of process innovative firms as percentage of firms with technological innovations in all core activities.

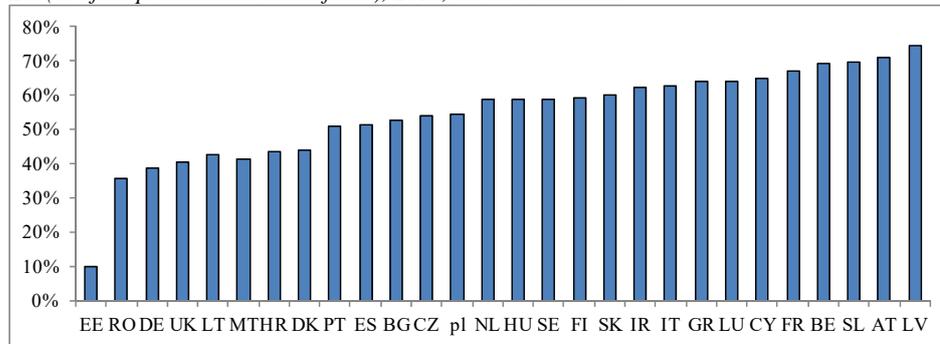
Figure 5. Firms that introduced new or significantly improved products that were only new to the firm (a) and new to the market (b) in Romania, % of all product innovative firms, all core activities



Admitting that “new-to-market” products are resulted from more creative activities than “new-to-firm” products, we can consider, from this point of view that most modifiers and adopters of technologies that promote defensive innovation strategies can be found among small firms. As the novelty of products rises, the investment risk grows, and it can be assumed easier by large firms adopting offensive innovation strategies. For a more appropriate assessment of these phenomena using simple innovation indicators, analyzing other dimensions using the available data can be necessary. For example, we identify that the modifiers and adopters of technologies are found to have a higher proportion in small firms (14.5%), compared to medium-sized (9.5%) and large firms (9.3%), when we analyze “enterprises that developed product and/or process innovations by adapting or modifying goods, services and processes originally developed by other enterprises or institutions/non-R&D performers” (which can be calculated under the reference “product and process innovative enterprises”, CIS 9). On the other hand, it can be noted that large firms were more involved in R&D, having the highest proportion of R&D innovators. This can be observed analyzing the “enterprises that developed product and/or process innovations by itself/R&D performers” (including in collaboration with other organizations). Large firms show a higher share (42.3%) of technological innovators, and the percentage decreases to 27.9% in medium sized-firms and 24.8% in small firms according to the CIS 9 data.

Overall, the share of firms that introduced new or significantly improved products that were only new to the firm decreased over time (Figure 5a) and the share of firms that introduced new to the market products slightly improved (Figure 5b). However, the share of firms with new to the market innovations remains in Romania one of the lowest in EU countries, as we depict in Figure 6.

Figure 6. Firms that introduced new or significantly improved products that were new to the market in the EU (% of all product innovative firms), 2014, all core activities



Obviously, the products' novelty performed in firms could be appropriately highlighted knowing firms' sales market or the proportion of turnover obtained from sales of the newest products. From this last perspective, since 2012, the CIS data have been improved to the extent that the surveyed firms have been able to specify their sales of new products introduced on the world markets, the indicator measuring the proportion of firms for which the percent of the total turnover from world first product innovation falls within a certain interval (ranging from 0-1%, 1-5%, 5-10%, 10-25% and more than 25%). Unfortunately, the values are extremely low in Romania (due to the low number of innovative firms) and others data for building such indicators are not available yet.

3. Indicators of innovation input

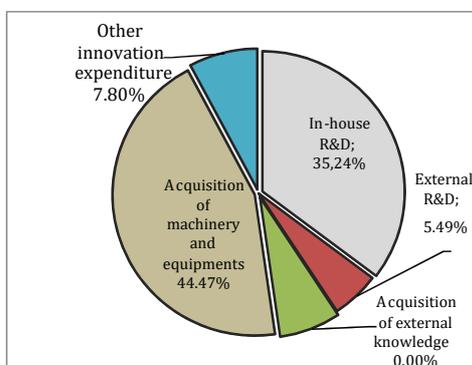
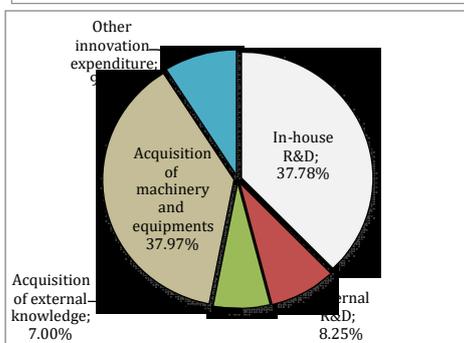
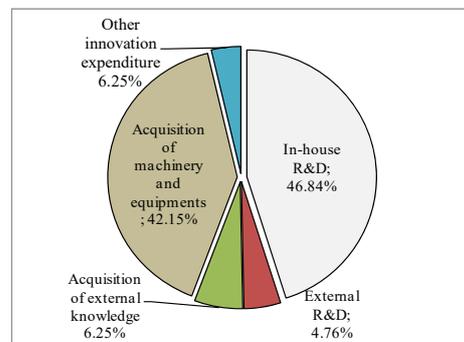
The analysis of *innovation expenditure* performed in firms, particularly by structure, can reveal the activities in which efforts are predominantly focused in innovation processes, respectively to in-house R&D (creative work undertaken within the organization, in order to achieve new or improved products and/or processes), in external R&D (acquired by firms from other companies or research institutes), the purchase of machinery, equipment and software (to obtain new or significantly improved products or processes), the acquisition of other external knowledge (patents, drawings, models, know-how and other types of knowledge) and performing other innovation expenditures (including design, training, marketing, and other relevant activities).

Figure 7 displays the structure of innovation expenditure by firms' size that was adopted in technological innovative firms in Romania, according our calculus based on the CIS 9 data. Purchasing of machinery, equipments and software (not incorporated in R&D) accounted for the largest share of innovation expenditure, registering more than 37% of innovation expenditures in each firms' size groups. Also, the percentage of expenditures on acquisition of machinery and equipments rises as the firm's size increases.

In general, the internal R&D activities are lower represented than the acquisition of equipments, having a downward trend as the firms' size grows. The categories related to other innovation expenditure and, in particular, those associated with external R&D and acquisition of external knowledge show the lowest share of total innovation expenditure performed in firms with technological innovation in 2014.

Several changes developed over time in the structure of innovation expenditures. For instance, R&D expenditures in small firms totaled 15.70% of innovation expenditures performed at their level, 17.48% in medium-sized firms, and respectively 12.33% in large firms in 2008. The percentage of expenditures on R&D increased significantly in the period 2010-2012 and, at the same time, decreasing the acquisitions of technologies more than 70% to the levels showed in Figure 7. The significant decrease in the percentage of expenditures on equipments can be partially explained by firms' anticipations regarding reducing the market demand for the existing products in the future, becoming more interested in improving their products or processes and manifesting less interest in increasing the production capacities.

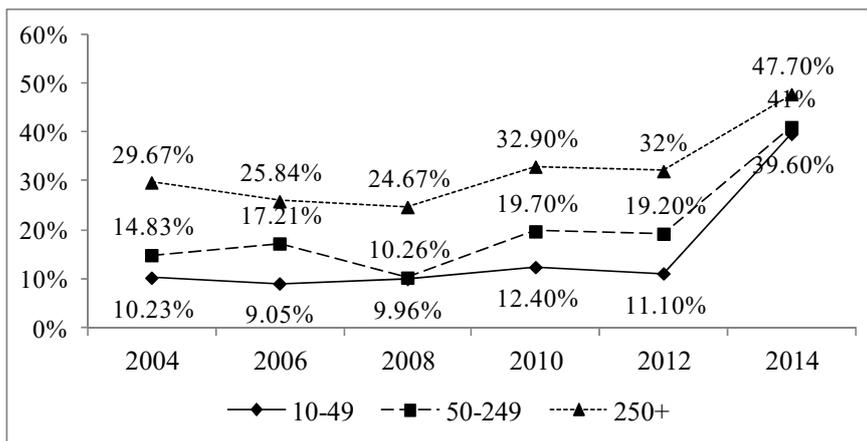
Figure 7. The structure of innovation expenditures in Romanian firms by size: a) small, b) medium-sized, c) large firms (% of innovation expenditures performed by technologically innovative firms), 2014, all core activities



Non-R&D innovation activities remain widespread in many other EU states as well. Adopting advanced technologies explains in some OECD countries (Ireland, Australia etc.) why there are no strong correlations and direct relationships between R&D investments and higher average (per capita) income. However, investments in research show an upward trend in the majority of EU countries, and the frequency of firms that continuously developed creative activities often exceeds the percentage of firms performing discontinuous R&D.

Although the number of technologically innovative firms with R&D activities remains in Romania one of the lowest in the EU, as well as total business R&D expenditures (Diaconu, 2016), the share of firms engaged in R&D increases over time (Figure 8), surpassing even the levels registered in the period 2006-2008 regarding firms engaged occasionally in R&D (Diaconu, 2013).

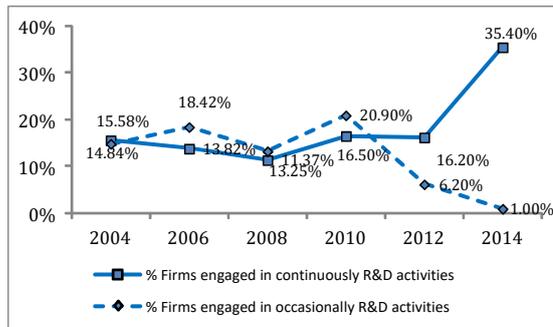
Figure 8. Trends in firms with continuous R&D activities in Romania (% of technologically innovative firms), all core activities



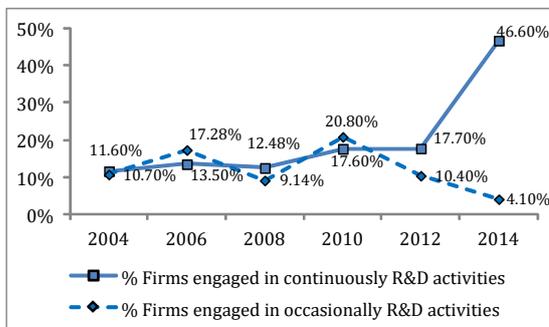
Particularly large firms perform continuously R&D activities of all technologically innovative firms, where the frequency was often twice higher than in small and medium-sized firms.

An increase of firms' orientation towards R&D activities, mainly continuous R&D can be observed over time. The share of firms with intramural R&D and those that conduct R&D on a continuous basis are indicators that provide measures of the prevalence of firms involved in creative innovation activities. R&D plays a more central role among firms that conduct R&D on a continuous basis. Figure 9 shows this trend of technologically innovative firms operating in manufacturing (a) and services (b). Romanian firms in services are, to a certain extent, more involved in continuously R&D than manufacturing firms since 2008 and that impacts innovation performance indicators.

Figure 9. Trends in firms engaged in R&D activities in Romania: a) manufacturing; b) services (% of technologically innovative firms).



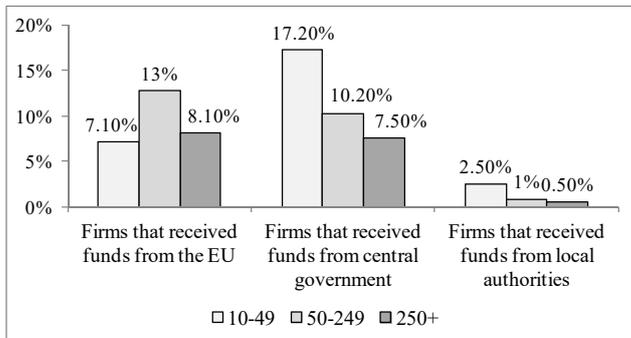
a)



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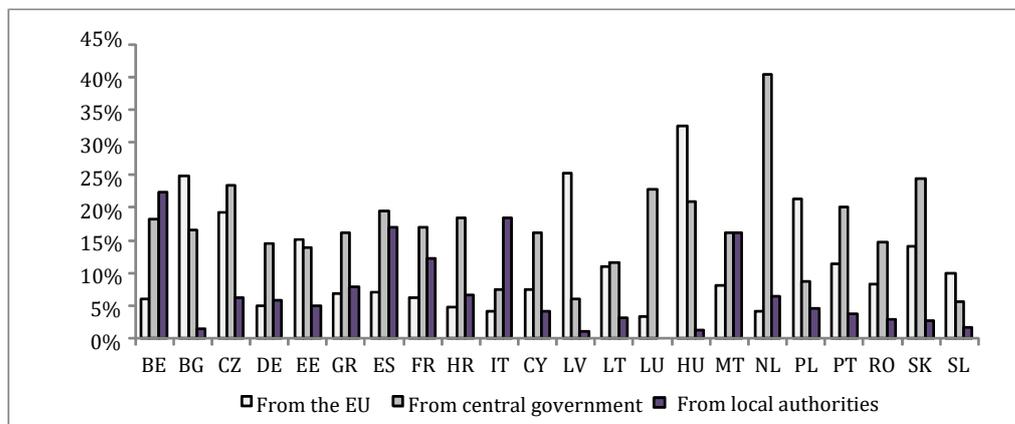
Research and development has a positive impact on firms' productivity. The benefits of supporting private R&D investments are well documented, but with constrained public spending the available funds have to be targeted effectively. R&D is a high-risk activity for firms, impacting in particular the risk of small firms – it entails significant investment, uncertain outcomes and knowledge spillover to other organizations. Since firms will not be able to capture all the benefits of their own investment, they will perform less R&D than what would be socially optimal – justifying government incentives for private R&D. However, large firms were usually the first *beneficiaries of public financial resources* in Romania since 2002 (according to Eurostat available data). That can be shown by their higher percentage of all firms with technological innovation supported from the public funds, as such this can explain their greater involvement in continuous R&D activities. The central budget was not always the main source of supporting of innovative firms from public funds, financial resources from the EU also played an important role in business R&D financing. Figure 10 shows the low percentage of Romanian innovative firms supported with funds from the EU and an increased proportion of small innovative firms encouraged by the central authorities.

Figure 10. Firms supported from public financial resources in Romania, by size class (% of technologically innovative firms), 2014, all core activities



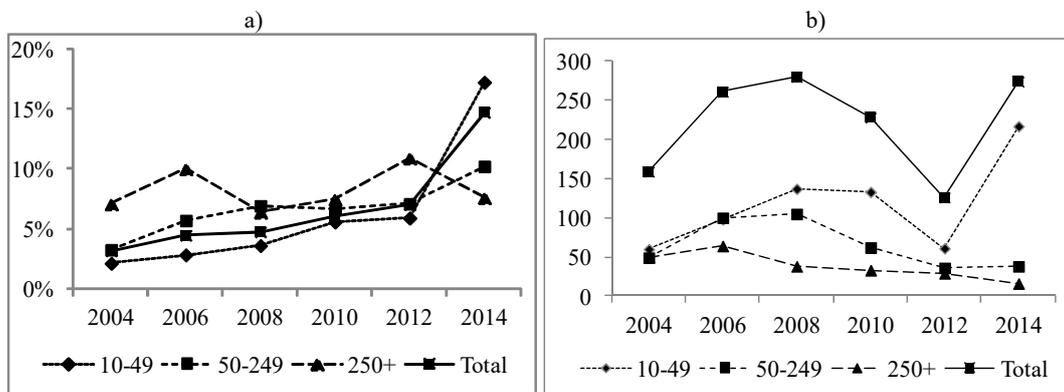
In the period 2004-2012, Romania registered the lowest proportion of firms that received public financial resources from the central budget and local authorities. That means also that the number of beneficiary firms supported by grants, loans with subsidized interest, guaranteed loans or other various tax incentives was the lowest in the EU. As we show in Figure 11, Romanian firms remain among less-supported firms in the EU from public funds (8.3% from the EU funds; 14.7% from the central government, including central government agencies and ministries; 3.0% from local authorities) in the following period:

Figure 11. Firms supported from public financial resources in countries of the EU (% of technologically innovative firms)



Analyzing the support granted from the central administration funds to innovative firms over time, by size class, as percent of technologically innovators and number of firms, correlation between them can be observed. Figure 12a shows that the share of firms supported from public funds increased at the level of all firms' size-groups in the period 2004-2014. However, although this may seem a positive trend, we must note that the number of innovative firms has fallen over time. Analyzing the number of firms receiving financial support from the central budget in Figure 12b, all groups of firms reveal a declining trend in the period 2008-2012 and an increase over the next period. Also, the pace of support for large firms is maintained, and the number and the proportion of small and medium-sized firms are grown in 2014.

Figure 12. Firms that received funding from the central government in Romania a) % of technologically innovative firms; b) number, 2014, all core activities

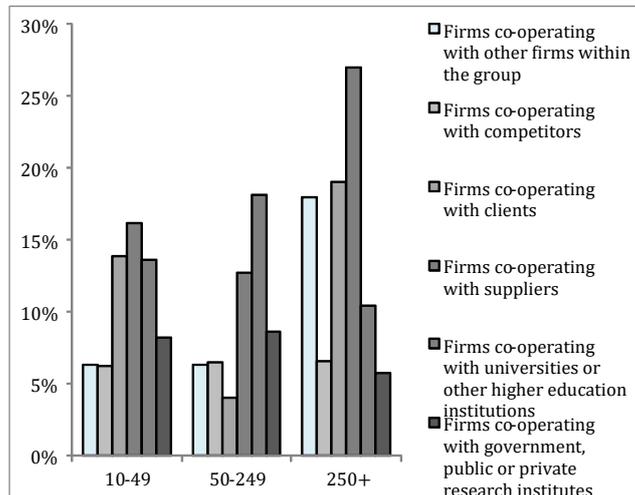


Romania also has a low absorption of EU structural funds that would complement financing resources used by innovative firms for R&D projects. This situation has been aggravated by the negative impact of the financial crisis on the economy, determining bankruptcy of a large number of SMEs or the abandonment of projects already approved due to the impossibility of participating with internally generated resources to finance their projects. The acute shortage of financial resources, including those obtained from public resources, conditioned by the co-operation activities had a negative impact on innovation outcomes.

The Oslo Manual (2005) highlights the importance of active diffusion through collaboration. Firms innovate interacting and collaborating with other firms or institutions as well as through non-interactive open source or technology acquisition. Knowledge transfer through collaboration in R&D activities or interacting with suppliers and customers can reveal information that are not found in learning processes or firms cannot easily get. Collaboration can have a positive incidence in alleviating some obstacles associated with firms' inability to obtain funding resources due to uncertain results or that can be necessary in knowledge absorption. Collaboration can be of crucial importance for small firms that have the greatest likelihood of confronting these difficulties.

Firms involved in *active diffusion* can be identified by using the CIS data. In this respect, positive responses to one or more questions must be verified (for example: where the innovations have been developed mainly, within the enterprise/group or through co-operation?). Figure 13 highlights the extent to which technologically innovative firms in Romania were involved in active diffusion through collaboration.

Figure 13. *Innovation in co-operation in Romania, 2014 (% of technologically innovative firms), all core activities*



In spite of these potential benefits, Figure 13 demonstrates that, in general, collaboration agreements in small and medium-sized firms were the least practiced in Romania. Also, agreements with customers (14.2%) and suppliers of equipment, materials, components or software (17.8%) appear to be widespread in all firms in 2014 as well. The intensity of collaboration is higher at the level of large firms than in small and medium-sized enterprises. Co-operation agreements with other enterprises within the enterprise group (7.7%), with public or private research institutes (7.4%) and with higher education institutions (12.2%) were the least practiced in all firms in Romania according to the CIS 9. Similar characteristics we found in other EU countries as well. Co-operation between innovative firms and clients or customers (19.3%) was the most practiced at the EU average. However, Romanian innovative firms seem to understand the benefits of collaboration, registering a growing percentage of collaborative firms in 2014 than in the previous period. This fact can be partially explained by a higher percentage of firms supported from public funds in 2014.

The role of collaboration in creating and diffusing of innovations has received much attention in the literature, particularly in recent years. Co-operation agreements can reduce innovation costs and facilitate the identification, adaptation and acquisition of relevant information processes, as well as risks sharing, maximizing innovation outcomes. Various government initiatives aim to promote collaborative relationships between firms or firms groups, between research institutions and business sector, or between firms, customers and suppliers (inducing behavioral additionality). Nevertheless, some explanations have been found in the literature with respect to the significant proportion of innovative firms that do not collaborate in their ongoing innovation processes, including concerns related to modalities of benefits sharing, or the necessity to disclose information they hold to various partners (Arundel and Borody, 2003). We believe that the need of collaboration can be closely related to the characteristics of

innovation outcomes and technological equipment used in innovation processes, due to their growing complexity that can require external expertise

Intensifying collaboration can have a positive incidence on indicators of innovation output, creating the possibility of increasing turnover resulted from radical innovations, rather than achieving an outcome obtained from internal effort. Several studies that used the CIS data, in order to investigate the relationship between collaboration and the share of turnover resulted from innovations, identified a direct correlation between the two. For example, Fritsch and Lukas (2001) show that the most innovative companies in Germany were more involved in collaboration, and Tether (2002) identifies the positive incidence of collaborating agreements on the development of "new to the market innovations" in the UK.

4. Indicators of innovation output

Innovation output indicators express the innovation performance of a firm or group of firms operating in a sector or country. In general, the introductions of new or significantly improved products, processes, management methods or marketing/sales methods can be used as innovation output indicators.

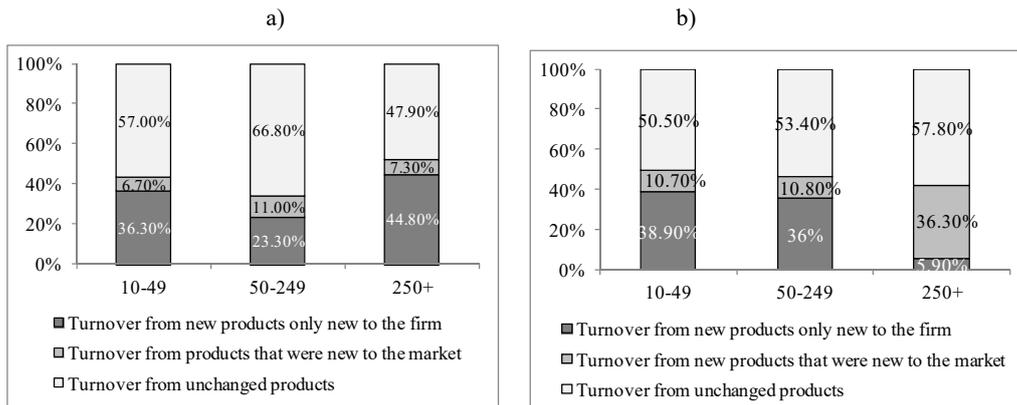
The capacity to derive benefits by capturing the extent to which ideas are able to reach the market can be reflected quantitatively by the effect of product innovations. Two quantitative innovation output indicators are often used in terms of share of turnover resulted from product innovations. OECD (2005) classifies firm's product innovation into "the introduction of a product only new to the firm" and "the introduction of a product new to the market". The latter innovation is newer than the former (OECD, 2009), and is considered to be novel, surpassing inventive activity, i.e. the development of products that require the building and use of skills more than would be necessary in adopting new technologies resulting "new to the firm innovations".

Following this classification, a comparison of the two innovation output indicators at the firm level or in various sectors can reveal the innovation performance. A first analysis based on graphs in Figure 14 shows that, *products that were new only to the firm* were more common than products that were new to the market in Romania. In general, the sum of the two indicators was higher in manufacturing than in services in the period 2004-2012. Also, small and medium sized firms in services introduced higher shares of turnover resulted from product innovations, while large firms seem to perform better in manufacturing than in services mainly by introducing a higher share of turnover from new to the market products.

Significant changes in the results of innovation activity in manufacturing occurred over time in Romania. For instance, with respect to the *share of turnover from new to the market products* registered in manufacturing by firms' size, medium-sized firms performed better (15.42%) in 2004, while large firms reported a modest dimension of this indicator, inclusively in 2006 (3.22%). Since 2008, large firms show the higher share of their turnover from new to the market products (12.10% in 2008; decreasing to 5.8% in

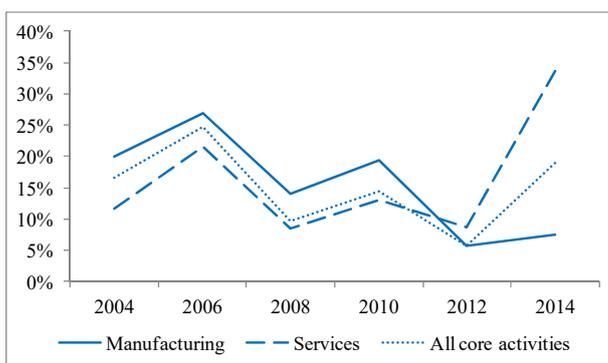
2012). In contrast, product innovation performance in services showed more modest dimensions of the two indicators than in manufacturing, and large firms had better performance than SMEs in services in the period 2002-2012.

Figure 14. Turnover from new products obtained by Romanian product innovative firms by size class: a) manufacturing; b) services (% of their total turnover), 2014



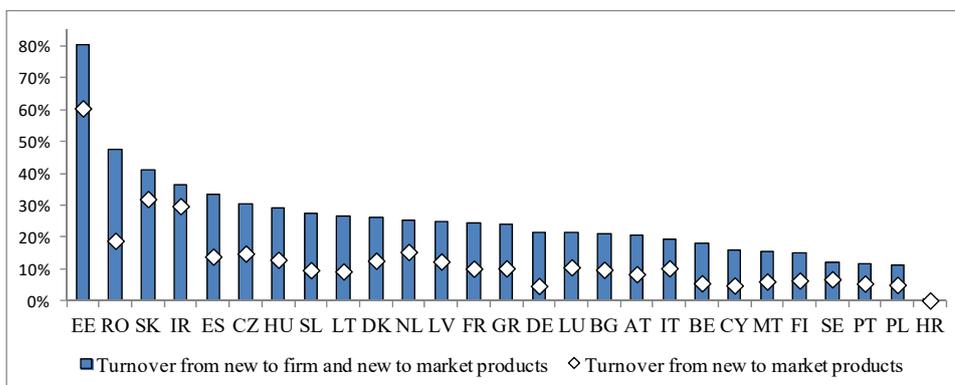
Also, the evolution of the share of turnover from new products that were new to the market over time is presented in Figure 15 and it is characterized by large oscillations in all sectors. However, the dimension of this indicator has a continued decreased trend in manufacturing particularly since 2010, that could be explained, on the one hand, by a reducing the number of innovative firms (we observed the direct link between the share of technologically innovative firms and the innovation performance indicators in Romania in the period 2004-2012). On the other hand, decreasing the share of turnover from new products that were new to the market in manufacturing is due the reducing the share of firms engaged in both continuously and occasionally R&D activities. A direct and strong link we identify between the percentage of firms engaged in R&D and the share of turnover from new products that were to the market.

Figure 15. Trend in turnover from new or significantly improved products that were new to the market, 2014(% of their total turnover), all core activities



The countries that have the highest shares of innovative active firms are not necessarily the countries that generate the highest turnover shares from innovated products, because the link between the two is not always direct. However, increasing the number of innovative firms performing R&D has a positive impact on indicators of innovation output and the ranking of Romania in the EU with respect to innovation output, progressing from the lowest in rank in terms of share of turnover from products that were new to the market in 2012 to a better place in our ranking in Figure 16.

Figure 16. Turnover from new products obtained in product innovative firms of the EU (% of their total turnover), 2014, all core activities



A better international comparison of this innovation output indicator can be made when differences in industry structure are taken into account as well as the firms' market. From this last perspective, the share of turnover from products that were new to the market refers to the firms' market that can be regional, national or international and are different in development. This is why building innovation indicator at the firm level by using firms' responses to at least one more question that could highlight the firms' market would be more appropriate to the requirements of assessing and comparing business innovation performance.

5. Conclusions

This paper analyzed the main trends in innovation activity in Romania, highlighting several weaknesses and insights emerged, as well as comparative patterns with the EU average using the CIS published data. We use the descriptive analysis of the general innovation indicators, which include innovativeness, input and output indicators. Among our findings, in respect to the main trends, we find that:

- The share of innovative firms in Romania is of the bottom of the EU and decreases continuously, reflecting a limited scale of both technological and non-technological innovation activity. Moreover, the shares of Romanian innovative firms are reducing, indicating a decrease in research efforts that characterize the Romanian economy.
- Large firms are more involved in technological and non-technological innovation than small and medium-sized firms.

- Small firms are less engaged in product innovation and are more focused on performing “new-to-firm” innovations, registering the highest proportion of process innovative firms. Most modifiers and adopters of technologies that promote defensive innovation strategies performing process innovation can be found among small firms.
- The share of innovative firms engaged in R&D activities is increasing over time, although the number of technologically innovative firms with R&D activities remains in Romania one of the lowest in the EU. Particularly large firms are engaged more in continuously R&D activities of all technologically innovative firms, where the frequency was often twice higher than in small and medium-sized enterprises.
- The sources of ideas resulted from collaborative activities for innovation in Romania and other EU countries are rather similar, clients and suppliers being the most important.
- The shares of innovative products sales in Romania are lower than in the EU average, and their levels and changes are related to business R&D expenditures and not related to restructuring of the economy.

The trends we find in the innovation activity in Romania reflect weaknesses such as:

- Low share of small innovative firms that is maintained and represents one of the main weaknesses of innovation activity in Romania.
- A very low shares of business R&D expenditures, and of firms with R&D expenditures.
- Higher shares of expenditures for embodied technology performed by Romanian firms than in the EU average.
- Although innovation can increase in businesses involved in collaboration and when information sources are diversified, Romanian firms are mainly focused on few sources, especially on collaboration with suppliers and clients.

We identify a direct link between the size of business R&D expenditures, the share of innovation expenditures and, particularly the share of the firms engaged in R&D activities and the public support for innovation in Romania. The support to a larger number of firms rather than a larger amount of support to fewer firms that would have invested in R&D regardless of public subsidy received can be more effective in stimulating of innovation activities.

Several insights emerged from our analysis that could be used for further comparative investigations on the main trends on the innovation activity in Romania:

- The share of innovative firms and the structure of innovation expenditure can explain sectoral or national developmental differences.
- The link between the shares of firms engaged in R&D activities and the shares of sales based on innovative products is direct, as well as their link to economic growth needs a further research.

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