Emerging Markets Queries in Finance and Business

Impact of R&D and Innovation on high-tech export

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Abstract

Economic recovery and the re-launching of sustainable economic growth in EU, particularly in countries such as Romania, are to a large extent sustained by the stimulation of exports and, especially, high-tech exports. Different authors have proved, in theoretical as well as empirical approaches, the relation between some indicators of innovation performance and volume and performance of high-tech exports. In this paper, we intend to assess, at the European level, the relationship between medium and high-tech exports, on one hand, and some of the main determinants of innovation, on the other hand. The volume of research-development expenditure, both public and private, the human resources employed in knowledge intensive activities or the propensity for international commercial relation have been assumed as important causal factors for increasing high tech export in EU countries. The results of the econometric analysis conducted in this paper confirm a causal relationship between the independent variables mentioned above and the EU high-tech exports level. The specific variations at country level are also displayed. Research results also confirm a positive correlation between total R&D expenditure volume and the level of high-tech exports, with variability between countries. The influence of private R&D expenditure on high-tech exports is stronger than public R&D expenditure. Under current European and national policies for increasing the intensity of R&D funding, raising the average EU level of R&D expenditure to the target of 3% of GDP, and particularly the EU average of private R&D expenditure to 2% of GDP, may significantly boost exports and competitiveness. Romanian export policy and R&D and innovation policy should be correlated in order to maximize effects in both policy fields.

Key words: Innovation Union, R&D intensity, high tech export.

1. Introduction

Considering that many countries have overcome recession through raising exports, the policies and strategies for export stimulation are generally focused on its most dynamic component, the high-tech export. The scientific researchers are searching for the main determinants of high tech export and policy makers are strenuously searching for the most effective incentives for impelling it. As high-tech products are generally defined as products embedding R&D, we considered R&D and innovation intensity as a main predictive factor for high-tech exporting. This is expressed through the share of R&D expenditure, either public or private, in GDP

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Nowadays, when every country is seeking viable solutions for re-launching sustainable economic growth, the issue of high-tech production is highly relevant and timely. High-tech industry has proved its intrinsic power when, in times of crisis, it displayed the highest growth rate compared to medium-high tech or low tech sectors, among the EU countries. During 2005-2011, the average annual growth rate for EU 27 was 3.3%, in spite of considerable discrepancies between countries. The highest growth rate was reported by Austria and Germany (6.6%), followed by the Czech Republic (5.4%), Hungary (4.6%) and Netherlands (3.6%).[1] In Romania, despite one of the lowest growth rates for high-tech industry (1.7%), we consider worth mentioning that medium-high tech industry registered the highest annual growth rate of all EU 27 countries, that is, 12.7%. According to Eurostat database, in 2012, Germany hosted, the most numerous high-tech companies, followed by United Kingdom (6569), France (4309), the Czech Republic, Poland (3105), Spain (2971), Hungary (1682). There were 951 high-tech firms in Romania for the same year.

In 2012, therefore, only 11 countries registered in 2012, more than 90% of all European high-tech exports (see fig.nr1).

![Graph of high-tech exports in EU 28, 2012](htec-eco)

Fig. 1. Total exports of high-tech products in EU 28, by country, 2012 (%). Source: own calculations based on Eurostat files htec-eco

A share of 67.17% of high tech export volume in the EU was concentrated in only four countries in 2012: Germany (25.75%), Netherland (15.78%), France (14.95%) and UK (10.69%). Other seven countries, like Belgium (5.04%), Italy (4.18%), Czech Republic (3.33%), Ireland (3.17%), Sweden (2.92%), Austria (2.79%) and Hungary (2.36%) exported another important part of the EU high tech products, namely 23.79%. Therefore, in 2012, only 11 EU countries counted more than 90% of all EU high tech exports. The share of Romanian high-tech exports represented 0.48% in 2012 which, yet, was a significant increase compared to 2007, when its share in total European high-tech exports was of 0.18%.

While there are countries with high levels of GERD or BERD intensity but with a high-tech exports
2. Literature review

Theoretically, based on the definition of high-tech exports, the relationship between R&D and innovation, on one hand, and high tech exports, on the other hand, should be a positive one. According to the most frequently employed statistical practice, (e.g. EUROSTAT, OECD, UNDP) the notion of “high tech exports” refers to the products embedding high R&D intensity, such as those manufactured within the aerospace, computers, pharmaceuticals, electrical machinery, chemistry, electronics& telecommunications industries or generated through scientific research. Generally speaking, R&D intensity could impact on the high tech export through impelling the firm production capacity for high tech products, increasing and improving the national intellectual capital, the number of patent applications and the share of the innovative enterprises. Therefore, these may be considered as important determinants of the high tech export trends. On the other hand, R&D and innovation intensity is directly linked to the absorptive capacity of the business sector that is the firms’ capability to assimilate and exploit external high tech knowledge and to raise the competitiveness of their products for exporting. Companies with higher absorptive capacity are able to better identify the real demand for new products and technologies on the foreign markets as well as to easily assimilate such products into their domestic production.

Some empirical studies published after 2004 confirmed these theoretical assumptions. With panel sets of data from different OECD, EU or Asian countries, built on various time spans, several authors statistically proved the influence of R&D investment intensity on high-tech exports. For example, Martin Srholec [2] analyzed the regression of high-tech exports on the national technologic capacity for a panel of 83 countries. The research results confirmed national technologic capacity, expressed through indicators such as R&D intensity, TIC patent per capita, gross tertiary enrolment, number of personnel computers, to be a predictive factor for the level of high-tech imports in total exports. Yet, he also noticed that this causal relation is often associated with some propensity for significant import of high-tech components, which varies among countries. Due to the fragmentation of the international high-tech production, it is very likely that considerable high-tech exports intensity coexists with low national technologic capacity. Therefore, the author suggests precaution in interpreting and using standard industrial and trade statistics in assessing high-tech exports and recommends conducting analyses on company level data.
Belay [3] gathered information for 55 developed and developing countries in order to statistically investigate the relationship between high-tech exports and several independent variables: R&D expenditures per capita, the number of scientists and engineers employed in R&D per million population, the sophistication level of buyer and inward FDI. In his multiple regression model, all these factors are positively related to high-tech exports. Yet, the highest predictive and explanatory substance belongs to inward FDI, especially for countries with low technologic capacity, that is, with low R&D intensity, confirming the conclusions of Srholec’s study.

Moreover, in his study, Tebaldi [4] conducted a multiple regression on a panel data for various countries, for the period 1980-2008, and concluded that the main determinants of high-tech exports are human capital inflow of FDI and openness to international trade. Employing other variables for basically the same potential predictive factors, like economic freedom score expressed through Index of Economic Freedom Score, or human development level expressed through Human Development Index, Gokmen and Turen [5] follow Tebaldi’s model with data from 15 European countries between 1995-2011 and concluded that, on the long run, human resources plays a significant role in the dynamics of high-tech exports. Braunerhjelm and Thulin [6] state that, according to some empirical analyses comprising 19 OECD countries between 1981 and 1999, an increase in R&D-expenditures by one percentage point brings forth a three-percentage point increase in high-technology exports. The authors built a fixed effect multiple regression models on panel data of 19 OECD countries, in order to control for heterogeneity among countries. The R&D impact may be stronger or weaker depending on country’s specialisation in high-tech subsectors. Therefore, in US and Europe, where Aerospatiale industry is developed, high-tech exports are more related to investment in R&D, whereas in information technology products manufacturing, dominated by MNC, national RDI investments and activities are less relevant with regards to high-tech exports.

It also seems that the strength of the causal relationship between RDI activities and investments on one hand, and high-tech exports on the other depends, also, on the multinational companies’ behaviour regarding the location where in-house research and innovation are quartered.[7] It is also worth noticing that empirical evidence shows that high-tech exports may capitalize on RDI results providing that there are viable institutions able to mediate and facilitate the use of research results in high-tech production. [6]

Vogiatzoglu K [8] conducts a multiple regression on 28 countries, testing several sets of independent variables, each of them comprising R&D. Its conclusion is that R&D and human capital display significant statistical effect on cross-country ICT specialization. Gorce et al [9], using a panel causality analysis for 27 countries in EU and Turkey for 1997-2007 also proves the relationship between high-tech exports on one hand and R&D on the other, high levels of R&D expenditures being correlated with high levels of exports of high-tech products.

An apparent paradox, frequently mentioned in the literature, is that of high levels of high-tech exports coexisting with low levels of RDI performance and national technological capacity, especially in Asian countries. It seems that, often, the fast upsurge on the world market of high-tech products is not met by similar performance in domestic technologic capacity. In these cases, the high figures associated to high-tech exports are explained by a so-called “statistical illusion” [2], that is the statistical failure to differentiate between the technology embedded in imported subcomponents that are to be assembled into final products, on one hand, and the technological value added in the manufacturing processes of the plant that exports the final products, on the other.

The hypothesis that RDI investments, activities and national technologic capacity are but weak explanatory and predictive factors for high-tech exports is empirically confirmed even by authors from this kind of countries, such as China [9, 10]. For example, in a recent paper [9], the author argues that the outstanding position of China as world leader in high-tech exports volume and intensity might be overrated, only a myth. As the author pointed out, “China, the champion of high-tech products is a myth created by outdated trade statistics and incorrect product classification. High-tech products, mainly made of imported parts and components, should be called ‘Assembled High-tech’” (Xing, 2012 [10]. About the same conclusion was drawn by Fu and co-authors [11]: “the success of Chinese high-tech exports does not result from heavy R&D expenditures and technological progress”. According to their research results, the R&D expenditures and new product output, as independent variables, are weakly correlated to high-tech exports dominated by multinationals.

As we already mentioned above, a model of multiple linear regression, validated on a panel data from 55 countries shows that, especially for countries with poor own technologic capacity, where high-tech exports are brought forth by multinationals, inward FDI is an important determinative factor for the high level of high-tech exports. [3]. Yet, even then, national technological infrastructure has played a very important role in the stimulation of high-tech exports.
3. Methodology

In order to highlight the linear correlation between the medium and high-tech products export (% of total products export) on one hand, and the level of public R&D expenditure (% of GDP), the level of private R&D expenditure (% of GDP) and employment in knowledge-intensive activities (production and services – as % of total employment), on the other, we have employed a panel data model that controls for the heterogeneity of EU countries regarding R&D intensity and high tech export intensity. In Table no. 1 the variables of the model are presented.

Table 1. Variables in equation

<table>
<thead>
<tr>
<th>Notation</th>
<th>Meaning</th>
<th>Variable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP</td>
<td>medium and high-tech products export (% of total products export)</td>
<td>Endogenous</td>
</tr>
<tr>
<td>EXPRP</td>
<td>R&amp;D expenditure in the public sector as % of GDP</td>
<td>Exogenous</td>
</tr>
<tr>
<td>EXPRI</td>
<td>R&amp;D expenditure in the business sector as % of GDP</td>
<td>Exogenous</td>
</tr>
<tr>
<td>LF -</td>
<td>Employment in knowledge-intensive activities (production and services) as % of total employment</td>
<td>Exogenous</td>
</tr>
</tbody>
</table>

The data for 26 countries (all EU-27 countries, except for Luxembourg), along the 2006-2010 period have been extracted from the 2012 Innovation Union Scoreboard.

Our option for the panel data analysis was based on the following reasons:

- it captures individual variability due to cross-sections (countries in the analysis) or measurement periods;
- the econometric analysis of panel data may indicate a process of convergence in the context of a systemic approach to innovation at EU level;
- the last reason but not the least important is that the scoreboard provides relative short data series for innovation indicators.

The analysis has been performed with the EViews 7 software.

We consider a model with country-specific effects and common coefficients for the exogenous variables. As it is widely accepted, the influence of public expenditure on R&D becomes visible in the long run, involving a certain lag between the time the expenditures are made and the moment when the impact can be depicted and assessed. For this reason, a delay of two years appears in the fixed effects model for the explanatory variable of the share of public R&D expenditure in the GDP.

4. Results

Based on the assumptions presented above, we obtained results as presented in Table no. 2:

Table 2  Results of the multiple linear regression (Dependent Variable: EXP)

| Method: Pooled Least Squares |
| Date: 02/24/13  Time: 16:03 |
| Sample (adjusted): 2008 2010 |
| Included observations: 3 after adjustments |
| Cross-sections included: 26 |
| Total pool (balanced) observations: 78 |

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
</table>

...
In this case, the coefficient $R^2$ is significantly close to 1, the Durbin-Watson test is close to 2, which means there is no first order autocorrelation of errors, and according to the tests for model coefficients we can accept that they significantly differ from 0.

The results of the calculations in terms of regression equation for each country are presented below:

\[
\begin{align*}
\text{EXP}_\text{BE} &= 2.313 + 70.926 + 8.226\times\text{EXPRP}\_\text{BE}(-2) + 9.166\times\text{EXPRI}\_\text{BE} - 2.827\times\text{LF}\_\text{BE} \\
\text{EXP}_\text{BU} &= -26.154 + 70.926 + 8.226\times\text{EXPRP}\_\text{BU}(-2) + 9.166\times\text{EXPRI}\_\text{BU} - 2.827\times\text{LF}\_\text{BU} \\
\text{EXP}_\text{CZ} &= 10.366 + 70.926 + 8.226\times\text{EXPRP}\_\text{CZ}(-2) + 9.166\times\text{EXPRI}\_\text{CZ} - 2.827\times\text{LF}\_\text{CZ} \\
\text{EXP}_\text{DE} &= -12.340 + 70.926 + 8.226\times\text{EXPRP}\_\text{DE}(-2) + 9.166\times\text{EXPRI}\_\text{DE} - 2.827\times\text{LF}\_\text{DE} \\
\text{EXP}_\text{GE} &= 11.104 + 70.926 + 8.226\times\text{EXPRP}\_\text{GE}(-2) + 9.166\times\text{EXPRI}\_\text{GE} - 2.827\times\text{LF}\_\text{GE} \\
\text{EXP}_\text{EST} &= -19.643 + 70.926 + 8.226\times\text{EXPRP}\_\text{EST}(-2) + 9.166\times\text{EXPRI}\_\text{EST} - 2.827\times\text{LF}\_\text{EST} \\
\text{EXP}_\text{IR} &= 19.559 + 70.926 + 8.226\times\text{EXPRP}\_\text{IR}(-2) + 9.166\times\text{EXPRI}\_\text{IR} - 2.827\times\text{LF}\_\text{IR} \\
\text{EXP}_\text{GR} &= -14.976 + 70.926 + 8.226\times\text{EXPRP}\_\text{GR}(-2) + 9.166\times\text{EXPRI}\_\text{GR} - 2.827\times\text{LF}\_\text{GR} \\
\text{EXP}_\text{SP} &= 0.001 + 70.926 + 8.226\times\text{EXPRP}\_\text{SP}(-2) + 9.166\times\text{EXPRI}\_\text{SP} - 2.827\times\text{LF}\_\text{SP} \\
\text{EXP}_\text{FR} &= 6.983 + 70.926 + 8.226\times\text{EXPRP}\_\text{FR}(-2) + 9.166\times\text{EXPRI}\_\text{FR} - 2.827\times\text{LF}\_\text{FR} \\
\text{EXP}_\text{IT} &= 8.060 + 70.926 + 8.226\times\text{EXPRP}\_\text{IT}(-2) + 9.166\times\text{EXPRI}\_\text{IT} - 2.827\times\text{LF}\_\text{IT} \\
\text{EXP}_\text{CY} &= 6.737 + 70.926 + 8.226\times\text{EXPRP}\_\text{CY}(-2) + 9.166\times\text{EXPRI}\_\text{CY} - 2.827\times\text{LF}\_\text{CY} \\
\text{EXP}_\text{LAT} &= -20.556 + 70.926 + 8.226\times\text{EXPRP}\_\text{LAT}(-2) + 9.166\times\text{EXPRI}\_\text{LAT} - 2.827\times\text{LF}\_\text{LAT} \\
\text{EXP}_\text{LIT} &= -22.004 + 70.926 + 8.226\times\text{EXPRP}\_\text{LIT}(-2) + 9.166\times\text{EXPRI}\_\text{LIT} - 2.827\times\text{LF}\_\text{LIT} \\
\text{EXP}_\text{HU} &= 22.643 + 70.926 + 8.226\times\text{EXPRP}\_\text{HU}(-2) + 9.166\times\text{EXPRI}\_\text{HU} - 2.827\times\text{LF}\_\text{HU} \\
\text{EXP}_\text{MAL} &= 39.971 + 70.926 + 8.226\times\text{EXPRP}\_\text{MAL}(-2) + 9.166\times\text{EXPRI}\_\text{MAL} - 2.827\times\text{LF}\_\text{MAL} \\
\text{EXP}_\text{NE} &= -1.332 + 70.926 + 8.226\times\text{EXPRP}\_\text{NE}(-2) + 9.166\times\text{EXPRI}\_\text{NE} - 2.827\times\text{LF}\_\text{NE}
\end{align*}
\]
\[ \text{EXP}_{\text{AU}} = -1.701 + 70.926 + 8.226 \times \text{EXPRP}_{\text{AU}}(-2) + 9.166 \times \text{EXPRI}_{\text{AU}} - 2.827 \times \text{LF}_{\text{AU}} \]
\[ \text{EXP}_{\text{PO}} = 0.710 + 70.926 + 8.226 \times \text{EXPRP}_{\text{PO}}(-2) + 9.166 \times \text{EXPRI}_{\text{PO}} - 2.827 \times \text{LF}_{\text{PO}} \]
\[ \text{EXP}_{\text{POR}} = -0.728 + 70.926 + 8.226 \times \text{EXPRP}_{\text{POR}}(-2) + 9.166 \times \text{EXPRI}_{\text{POR}} - 2.827 \times \text{LF}_{\text{POR}} \]
\[ \text{EXP}_{\text{RO}} = -10.304 + 70.926 + 8.226 \times \text{EXPRP}_{\text{RO}}(-2) + 9.166 \times \text{EXPRI}_{\text{RO}} - 2.827 \times \text{LF}_{\text{RO}} \]
\[ \text{EXP}_{\text{SLO}} = 6.479 + 70.926 + 8.226 \times \text{EXPRP}_{\text{SLO}}(-2) + 9.166 \times \text{EXPRI}_{\text{SLO}} - 2.827 \times \text{LF}_{\text{SLO}} \]
\[ \text{EXP}_{\text{SLOVK}} = 15.1517 + 70.926 + 8.226 \times \text{EXPRP}_{\text{SLOVK}}(-2) + 9.166 \times \text{EXPRI}_{\text{SLOVK}} - 2.827 \times \text{LF}_{\text{SLOVK}} \]
\[ \text{EXP}_{\text{FIN}} = -10.754 + 70.926 + 8.226 \times \text{EXPRP}_{\text{FIN}}(-2) + 9.166 \times \text{EXPRI}_{\text{FIN}} - 2.827 \times \text{LF}_{\text{FIN}} \]
\[ \text{EXP}_{\text{SW}} = -2.603 + 70.926 + 8.226 \times \text{EXPRP}_{\text{SW}}(-2) + 9.166 \times \text{EXPRI}_{\text{SW}} - 2.827 \times \text{LF}_{\text{SW}} \]
\[ \text{EXP}_{\text{UK}} = 13.018 + 70.926 + 8.226 \times \text{EXPRP}_{\text{UK}}(-2) + 9.166 \times \text{EXPRI}_{\text{UK}} - 2.827 \times \text{LF}_{\text{UK}} \]

Calculations show that the fixed effects of the analyzed countries are significant. However, when we tested a random effects model, the obtained results led to its rejection. Due to the fact that the Hausman test confirms a correlation between the random effects and the exogenous variables, the fixed effects model is validated. These tests are not presented here given the paper’s length requirements.

We analyzed also the association between high-tech export (measured by the share of high tech export in the total export), and the intensity of R&D (measured by the share of government expenditures in total R&D expenditure, on one hand and the share of business expenditures, on the other), using multiple linear regression. In table 3 we described the variables of the multiple linear model.

Table 3. New variables in equation

<table>
<thead>
<tr>
<th>Notation</th>
<th>Meaning</th>
<th>Variable type</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH_</td>
<td>high-tech products export of each analyzed country (% of total products export) in the reference year “i”, i=2007-2012</td>
<td>Endogenous</td>
</tr>
<tr>
<td>GOVRD_(-5)</td>
<td>R&amp;D Government expenditure of each country (% of GDP) in the year “i-5”</td>
<td>Exogenous</td>
</tr>
<tr>
<td>EXPRI</td>
<td>private R&amp;D expenditure of each country (% of GDP) in the reference year “i”</td>
<td>Exogenous</td>
</tr>
</tbody>
</table>

Using data from EUROSTAT database for the period 2007-2012 (all EU-27 countries), we obtained the following results, presented in Table no 4:

Table 4 Results of the multiple linear regression (Dependent Variable:HIGH)

Method: Pooled EGLS (Cross-section weights)
Date: 07/01/13   Time: 19:29
Sample (adjusted): 2007 2011
Included observations: 5 after adjustments
Cross-sections included: 26
Total pool (unbalanced) observations: 128
Linear estimation after one-step weighting matrix
Cross sections without valid observations dropped

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>6.434040</td>
<td>1.327501</td>
<td>4.846732</td>
<td>0.0000</td>
</tr>
<tr>
<td>GOVRD?(-5)</td>
<td>14.42059</td>
<td>3.862409</td>
<td>3.733573</td>
<td>0.0003</td>
</tr>
<tr>
<td>EXPRI?</td>
<td>3.681355</td>
<td>1.005846</td>
<td>3.659960</td>
<td>0.0004</td>
</tr>
<tr>
<td>Fixed Effects (Cross)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>_BE--C</td>
<td>-5.754779</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>_BU--C</td>
<td>-7.950554</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>_CZ--C</td>
<td>1.333636</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Considering a 2 year lag for the public expenditure for R&D to become visible in the growth rate of high-tech exports, the multiple regression model on high-tech exports, involving the share of government budget appropriations or outlays for R&D (GovRD) in GDP, the share of business sector expenditure for R&D (BussRD) and the share of human resources employed in knowledge intensive activities in total employment (HR) as independent variables is validated through statistical tests, having considerable explanatory power (Adjusted R-squared is very high). The regression equation states that, generally speaking and considering the whole panel of statistic units, 1 percentage point increase in GovRD should account for an increase of 8.23 percentage points in the share of high-tech exports in total exports, after two years, all other variables held constant. An increase of 1 p.p. in BussRD determines a quasi-simultaneous increase in high-tech exports of 9.17 percentage points, all other variables held constant. As far as the intensity of labour force employed in knowledge intensive sectors, the causal relationship is negative, that is, for 1 p.p increase in labour force intensity, the high-tech exports intensity decreases by 2.83 p.p. In a multiple regression model considering a temporal lag of 5 years for the impact of public R&D expenditure on high-tech exports, with BussRD and GovRD as independent variable, we notice that 1 p.p. increase in public R&D is expected to lead to an increase of 14.42 p.p. in high-tech exports intensity in 5 years’ time, which is with 6.19 p.p. higher than the impact of the same variable for a 2 year lag model. If we extend the lag from 5 to 7 years, the positive effect will further increase from 14.42 p.p to 16.07 p.p.

Discussion

At present, European Union map presents considerable diversity regarding the intensity of R&D investment (share of R&D in GDP) as well as the intensity of high tech exports (share of the high tech exports in the total exports or high tech manufacturing export in total manufacturing export) (See Fig.nr.2 and Fig.nr.3). The pictures are, also, relevant for proving the discordance between these two kind of indicators.
Fig. 2. High-tech exports intensity (%), 2012.
Source: Eurostat database, htec_trd files

Reviewing the figures presented above, it is apparent that only five of the top 10 countries of EU, regarding the share of R&D expenditures in GDP are included in top 10 European countries considering the share of high-tech exports in total exports. Finland, the country with the highest R&D intensity reported a high-tech exports intensity of only half the European average. In contrast, Romania, despite being among the countries with the lowest share of R&D expenditures in GDP – especially business expenditure, is ranked above Poland, Portugal, Spain, Lithuania, Latvia and Greece as regards the high-tech exports intensity.

Together with the indicators already presented, there are still others that may present a more complete picture on the way and intensity that national RDI expenditures and results are embedded in high-tech products: the technologic intensity of production processes, firms’ innovativeness, the national absorptive capacity, the level and intensity of RDI results exploitation expressed mainly through patents, etc.

Given that it is statistically difficult to differentiate between the exported high-tech products that harness the contribution of the national scientific research activities on one hand, and those that are the product of mere imported components assembling, on the other, the results of econometric analyses performed on aggregated data should be cautiously interpreted.

Fig. 3. Intensity of R&D expenditures (gross expenditure for R&D as a share of GDP), 2011
Source: Eurostat database, rd_e_gerdtot files

Therefore, it is understandable why, according to World Competitiveness Report elaborated for 2013-2014, China, which is acknowledged for high performance in high-tech exports, ranks only the 58th in 114 countries regarding the production process sophistication. Other countries, like Switzerland, Netherland, Austria, Norway, Sweden, Great Britain and Denmark, with a relatively lower high-tech exports intensity are still ranked among the first 20 countries after the aforementioned indicator. This indicator is an expression of the extent to which the manufacturing processes employ intensive methods of process technology of previous generation or the world’s best and most efficient process technology. [11] (p. 530) . The same document confirms that other indicators as well - such as Company spending on R&D, Quality of scientific research institutions, Availability of Scientists and Engineers, Availability of latest technologies or University-Industry Collaboration in R&D – confers to China and to other Asian countries with outstanding performance regarding
high-tech exports, lower ranks than those of the many European countries included in the top 20.

5. Conclusions

1. Increasing of BERD intensity (EXPRI as % of GDP) leads, on short term (the reference year), to the increasing of medium and high-tech products export in the same year (as % of total products export). The increasing with +1% of R&D expenditure in the business sector (as % of GDP) leads on short term (in the reference year) to the growth of high-tech products export in the same year (as % of total products export) of +3.68%.

2. Intensity of public R&D expenditure has a positive effect on the medium and high-tech products export, with a 2 year delay (lag). In order to have a shorter term effect, they must be directed towards supporting private research, which is more clearly targeted towards immediate profit. The increasing with +1% of R&D Government expenditure (as % of GDP) has a positive effect on the high-tech products export, with a 5 year delay (lag) and leads to a growth of +14.42%. If we increase the lag from 5 years to 7 years, we will find that the positive effect will increase from +14.42% to +16.07%.

3. Increasing the share of employment in knowledge-intensive activities (production and services) in the total employment, on short term (the same year), leads to the decrease of the share of medium and high-tech products export, due, partially, to the efforts necessary to integrate, train and adapt the new workforce to activities in medium and high technology, efforts which may lead to a recoil of exports.

4. The fixed effects, represented in the model equations by the free coefficients, are different from a country to another, due to specificity of national economies. Generally speaking, the coefficient with negative values are specific for the countries where the effects of the crisis were felt more in this period: Bulgaria, Estonia, Greece, Lithuania, Latvia and Portugal.

5. The specific fixed effects which are different both in sign and in value may suggest a break in the convergence process among Member States.

6. The growth of medium and high-tech products exports suggests increased competitiveness at panel level, therefore at EU level. The obtained model confirms the fact that the innovation growth strategy (the growth of R&D investments) can lead to a growth in competitiveness. Therefore, achieving, at EU level, the medium level of R&D expenditure for enterprises of 2% of GDP may have an important effect in this respect.

References

