

# GEA

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ANNUAL SURVEY REPORT  
ON RESEARCH,  
DEVELOPMENT,  
INNOVATION AND  
COMPETITIVENESS  
IN THE ROMANIAN INDUSTRY

February 2005

# GEA GROUP OF APPLIED ECONOMICS

An independent think-tank founded by young Romanian economists

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## ANNUAL SURVEY REPORT ON RESEARCH, DEVELOPMENT, INNOVATION AND COMPETITIVENESS IN THE ROMANIAN INDUSTRY

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## **EXECUTIVE SUMMARY**

The paper is done based on a survey on 170 Romanian firms. The results of the questionnaire show that R&D intensity depends on turnover and on geographical location. However, various sector-based R&D intensities are not conclusive (except the under-performing food and beverages industry, and the over-achiever electrical machinery sector), probably because the economic transformation is still ongoing in Romania. Furthermore, the type of ownership does not influence significantly the extent of R&D activity. One possible explanation is that local market characteristics are more important than the structure of ownership.

More than half of the respondent firms have a specialized R&D department, but most of these departments operate with very few employees. Even so, the existence of a specialized R&D department has a high rate of success, in terms of introducing finalizing a process innovation with a product innovation. On industry average, last year 81% of firms introduced new products, 61% introduced new technological processes, and 48% introduced new methods of distribution. 40% of firms increased their R&D expenses (35% as a net balance), while only a net balance of 7% increased their R&D employees.

Despite the large share of product innovators, some other figures are striking and could only be interpreted that a large share of the new products come from imports, licensing or imitation, rather than from own R&D. In this regard, 55% of product innovative firms did not increase their R&D expenses, and 40% of them do not operate a specialized R&D department, while 63% of firms which were not process innovators still acted as product innovators.

Four out of five euros invested in R&D at the level of Romanian industry come from own funds. Loans or venture capital funds are very limited or virtually non-existent. Also, less than two out of 100 industry employees attended training paid by their companies. These indicate that factors potentially conducive to innovation are not well emphasized.

Domestic competitiveness is significantly influenced by the introduction of new distribution methods. The fact that new products or new processes failed to be statistically significant for domestic competitiveness may suggest that the nature of competition on the domestic market is altered.

Instead, foreign competitiveness of Romanian firms is not influenced by the distribution method, which is a confirmation of Romanian exporters' dependency on foreign intermediaries. Foreign competitiveness is strongly and positively correlated with the introduction of new products and with the existence of a specialized R&D department. Product innovation increases foreign competitiveness, which is a sign of the normal functioning of foreign markets.

As for process innovation, it is not significant for any of the two measures of competitiveness in the main model we built. Still, it is significant for foreign competitiveness in three other less complex models, which shows again that foreign competition is more stimulating for R&D processes than domestic competition.

## **1. BACKGROUND AND RATIONALE**

This paper deals with RDI (research, development and innovation) and its relation with competitiveness at firms' level in Romania, a topic still under-researched in a country where macroeconomic stability and topics alike has captured most of the focus by now.

The issue of RDI has gained importance recently, as Romania approaches EU integration and tries to position itself within the Lisbon agenda. The current situation is far from the EU targets. Romania has total expenditures on R&D close to 0.4% of GDP, as against the 1.9% current EU-25 performance and the 3% target set for 2010. Out of it, 61% is business expenditure (OECD, 2004). The European Trend Chart on Innovation summarizes generally known factors that contribute to an under-developed innovation culture in Romania:

- low RDI expenditure in enterprises, insufficient to support advanced research.
- the absence of a competitive environment caused by incomplete economic restructuring.
- enterprises' reluctance to take on financial and commercial risks arising from R&D and the absence of financial services and instruments to mitigate the risk.
- the current type of competitiveness based on wage differentials versus the innovation driven type of economies to which Romania is trying to converge.

This paper complements various other works undertaken by the Group of Applied Economics and by the authors themselves. First, it adds the microeconomic perspective to the macroeconomic approach used in the two editions of the study "Romania: an assessment of the Lisbon agenda" commissioned in 2004 to GEA<sup>1</sup> by the Ministry of Foreign Affairs, with the support of the British Embassy in Romania.

Second, it complements another competitiveness survey done by GEA on an annual basis, as GEA (initially as part of SOREC – the Romanian Economics Society) has been the partner for Romania of the World Economic Forum since 2001. The World Economic Forum is the editor of the Global Competitiveness Report (GCR). The reason why we did not use data from that survey is linked to the time of the year when this study was prepared. Data collection for GCR 2004 ended in April 2004, while the data collection for GCR 2005 has not yet started. The survey on which this paper is based took place in the second half of December 2004 and the first half of January 2005. Also, we asked some questions that are not raised by GCR.

Firm level data about R&D in Romania is also collected by the state statistical institute (INSSE). Their two main R&D publications are nevertheless limited in their scope by the very narrow definition of the R&D departments and activity, by their focus on employees involved in R&D, and by the absence of any interpretation or analysis of the data. Instead, our paper also complements those publications too, by providing survey-based data at firms' level, with a wider understanding of RDI and competitiveness, and with a conceptualization of the results in a model.

This is not a normative paper, nor a public policy one. It only describes and interprets the results of a survey on Romanian firms about their RDI activity and its influence

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<sup>1</sup> The Romanian Centre for Economic Policies (CEROPE) was also involved in the second edition of the report.

on competitiveness. However, it could represent a basis for public policy and corporate actions towards supporting R&D.

## **2. ANALYSIS: RDI IN THE ROMANIAN INDUSTRY**

### **2.1. R&D departments**

Slightly more than half (55.3%) of the respondent firms have a specialized R&D department. This is a surprising result, since according to official statistics (INSSE, 2004) there are only 23280 R&D employees in the entire manufacturing industry. The explanation may be twofold. First, we did not ask for a minimum threshold of employees within the R&D department. Second, there might be different understandings of what research and development means. Many firms could have included in this category their market research unit, which is not the way R&D is generally perceived. However, if this is the case, it should have been reflected in the large scale development of innovative marketing and distribution methods; still, as we will later read some cross tables, the firms with R&D departments introduced new distribution methods to a lesser extent than they introduced new products and new technological processes.

The distribution of R&D departments among firms, based upon their turnover, is what one would expect it to be. Firms in the higher turnover category have the highest share of R&D departments and the lower the turnover, the lower their R&D propensity. This also confirms recent conclusions (JRC, 2004) for the EU-25 countries demonstrating that R&D intensity is linked to turnover.

*Table 1. Firms with a specialized R&D department, by firms' turnover*

	Below 1 million euro	Between 1 and 10 million euro	Between 10 and 50 million euro	Over 50 million euro	Total population of firms
% of turnover category	34.2	55.0	68.4	78.6	55.3

This distribution is generally valid when firms are considered based on the number of their employees. Two thirds of companies with more than 250 employees have an R&D department, while less than half of the smaller firms have such a department. Nevertheless, the relatively high share of small firms, with less than 49 employees, which have an R&D department (46.2%) might be explained by the booming software industry, where firms are generally small, but intensive in human capital and research.

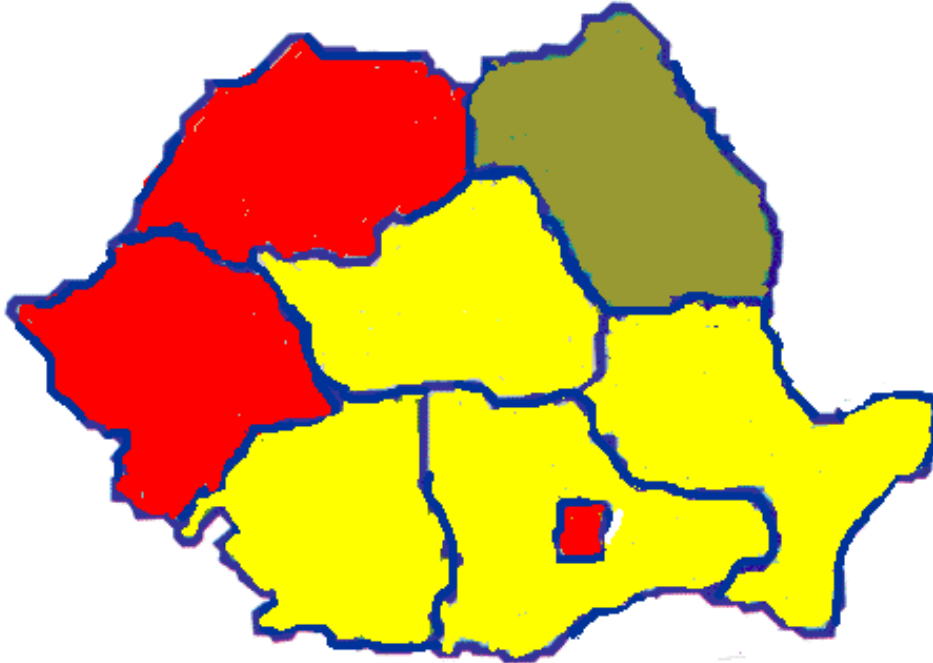
The distribution of the R&D activity at firm level by regions reflects the general view about more and less developed region. Most R&D departments can be found with firms located in Bucharest, West and North West regions, while least R&D departments are in South –West, South-East and Centre regions.

*Table 2. Firms with a specialized R&D department, by regions*

Above the average	Bucharest	68.8%
	West	61.1%
	North-West	60.0%
Around the average	North-East	55.6%

Below the average	South-Muntenia	52.4%
	South-West	50%
	South-East	43.8%
	Centre	41.4%

Figure 1. Existence of R&D departments within firms, by the location of firms



It is noteworthy that the type of ownership does not influence significantly the extent of the R&D activity – at least the one formalized in the existence of a R&D department. State firms (58.6%), private Romanian firms (53.4%) and foreign capital firms (57.9%) are all positioned close to the average (55.3%) in this respect. One possible explanation is that local market characteristics are more important than the structure of ownership. Firms, be they foreign or domestic, have rather similar strategies with respect to R&D, according to the market needs. When foreign capital firms are analyzed, it may be submitted that such behaviour reflects a limited integration of the local affiliates in the global production and innovation system of the multinational companies to which they belong.

The remark about similar R&D behaviour in terms of the existence of R&D departments irrespective of the structure of ownership contradicts widespread belief that R&D in Romania is still predominant in state owned firms (OECD, 2004 and Gheorghiu, Pislaru, Turlea, 2004). Recent privatization deals might have contributed to that level field. Another explanation might be the wider understanding of the R&D activity used in our survey.

The distribution of firms with a specialized R&D department by industrial sectors reveals interesting, but not unexpected, facts. IT, chemicals and petroleum sectors have by far the largest concentration of firms with R&D departments. Machines and equipments, and electrical machines and appliances, have also well above the average,

while textiles and clothing, rubber, means of transportation and the food and beverages sectors are below the average. It means that the latter are less equipped for enhanced competition when Romania joins the Common Market. It also means that the lohn arrangements, prevalent in the Romanian industry, have a different future, sector-tailored. The textiles and clothing industry seems not prepared to leave lohn behind and move towards own production and design, while the machines and equipment and the electrical machines and appliances have a brighter future, being more prepared, at the current stage, to develop original products and processes. A special remark regarding the food and beverages industry: its import dependency makes it hard to restructure in the direction of increased R&D attention. In the context of demanding EU food safety regulations, and in the face of fiercer competition stemming from market opening, the food and beverages industry needs to reinvent itself quickly in Romania, if it is to survive. However, the R&D activity by sectors is not as clear-cut as it seems. Later in this paper the R&D expenses and innovation activity will question the existence of R&D trends in a sector-based analysis for Romania.

*Table 3. Firms with an R&D department, by selected industrial sectors*

Above the average	Refined petroleum	100%
	IT	83.3%
	Chemicals (incl. pharmaceuticals)	71.4%
	Electrical machines and appliances	69.6%
	Machines and equipment	62.5%
Around the average	Metallurgy	54.5%
Below the average	Means of transportation	47.4%
	Textiles and clothing	45.5%
	Rubber and products thereof	38.5%
	Food and beverages	22.2%

We have seen the distribution of firms with a specialized R&D department, by various categories. What is more important now is to see the impact, the effectiveness of these R&D departments. Do they make a difference, and to what extent?

Among the firms with a specialized R&D department, the net balance of firms with higher R&D expenses is almost double (58.6%) than in the case of the total population of firms (30.6). Moreover, 91.2% of the firms with increased R&D expenses have had a specialized R&D department.

*Table4. Evolution of R&D expenses*

	Increased R&D expenses	Unchanged R&D expenses	Decreased R&D expenses	Balance
Total sample, %	40.0	40.6	9.4	30.6
Only firms with a specialized R&D department, %	66.0	26.6	7.4	58.6

Evidence is found in the same direction concerning the dynamics of R&D employees, but here the predominant factor is the high percentage of firms with unchanged number of R&D employees. Like in the case of R&D expenses, 89.7% of the firms which employed more R&D employees have had a specialized R&D department.

*Table 5. Evolution of R&D employees*

	More R&D employees	Unchanged R&D employees	Less R&D employees	Balance
Total sample, %	17.1	60.6	10.0	7.1
Only firms with a specialized R&D department, %	27.7	60.6	10.6	17.1

The different dynamics of R&D expenses and employees (the net balance is three times higher for R&D expenses than for R&D employees) may suggest that the sums invested per employee were very low. These different paths of growth may also indicate that the structure of R&D expenses might have shifted away from labour cost dominance to increasing the share of other R&D costs. It is worth mentioning that in 2002, according to INSSE, labour costs were by far the most important R&D costs at firms' level.

Has the existence of a specialized R&D department been reflected in the introduction of new processes and products? It appears that the existence of specialized R&D departments have better results than the firms' average: 86% introduced innovative products and 76% introduced innovative processes.

*Table 6. Cross-table: R&D department and new products*

			Has your company introduced new or significantly improved products in the last year?			Total
			Yes	No	DK	
Does your company have a specialized Research and Development department?	Yes	Count	81	13		94
		% horizontal	86.2%	13.8%		100.0%
		% vertical	58.3%	43.3%		55.3%
	No	Count	58	17		75
		% horizontal	77.3%	22.7%		100.0%
		% vertical	41.7%	56.7%		44.1%
	DK	Count			1	1
		% horizontal			100.0%	100.0%
		% vertical			100.0%	,6%
Total	Count	139	30	1	170	
	% horizontal	81.8%	17.6%	,6%	100.0%	
	% vertical	100.0%	100.0%	100.0%	100.0%	

Pearson coefficient: 0.000

Table 7. Cross-table: R&D department and new processes

			Has your company introduced new or significantly improved technological processes in the last year?			Total
			Yes	No	DK	
Does your company have a specialized Research and Development department?	Yes	Count	72	22		94
		% horizontal	76.6%	23.4%		100.0%
		% vertical	69.2%	33.8%		55.3%
	No	Count	32	43		75
		% horizontal	42.7%	57.3%		100.0%
		% vertical	30.8%	66.2%		44.1%
	DK	Count			1	1
		% horizontal			100,0%	100,0%
		% vertical			100,0%	.6%
Total	Count	104	65	1	170	
	% horizontal?	61.2%	38.2%	,6%	100,0%	
	% vertical	100.0%	100.0%	100.0%	100.0%	

Pearson coefficient: 0.000

Table 8. Cross-table: R&D department and new methods

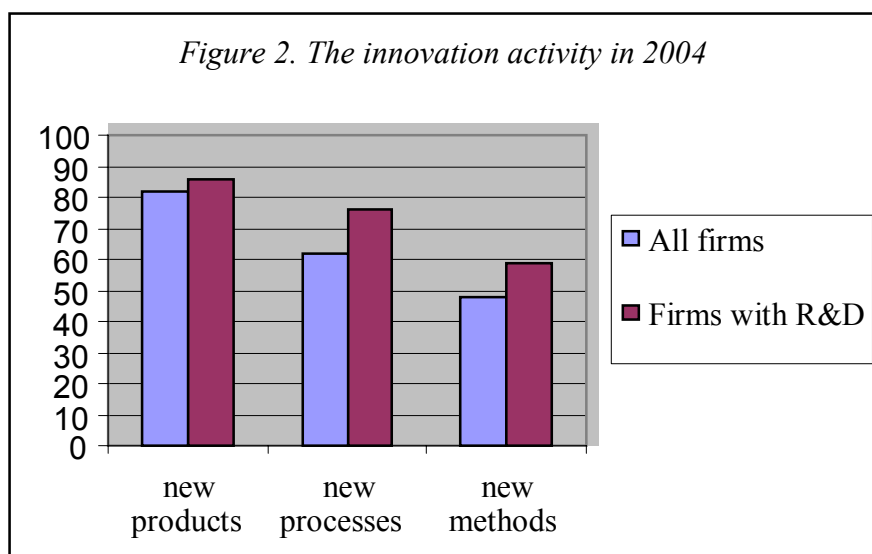
			Has your company used new or significantly improved distribution methods in the last year?			Total
			Yes	No	DK	
Does your company have a specialized Research and Development department?	Yes	Count	56	38		94
		% horizontal	59.6%	40.4%		100.0%
		% vertical	67.5%	44.2%		55.3%
	No	Count	27	48		75
		% horizontal	36.0%	64.0%		100.0%
		% vertical	32.5%	55.8%		44.1%
	DK	Count			1	1
		% horizontal			100,0%	100,0%
		% vertical			100,0%	.6%
Total	Count	83	86	1	170	
	% horizontal?	48.8%	50.6%	,6%	100,0%	
	% vertical	100.0%	100.0%	100.0%	100.0%	

Pearson coefficient: 0.000

Table 9. Firms with R&D department which were innovative

	Introduced innovative products in the last year	Introduced innovative processes in the previous year	Introduced innovative methods in the previous year
% of firms with a specialized R&D department	86.2%	76.6%	59.6%

Furthermore, against the whole population of firms, the firms with R&D department do much better in terms of innovating processes and methods, but only marginally better in terms of innovating products.



Still, one could observe that a part of the innovative products did not appear as a result of innovative processes, which shows the technological transfer that occurs with respect to technological processes.

The fact that less innovative methods of distribution are used signals an important shortcoming of Romanian firms: the weaker capacity to market their products, even when those products are innovative. Selling innovative products through an intermediary ends in less value added and less profits for the innovative firm.

*Table 10. Innovative firms which have an R&D department*

	Specialized R&D department	
	Yes	No
Firms which introduced new processes	69.2%	30.8%
Firms which introduced new products	58.3%	41.7%

An interesting picture appears if we look the other way around. The share of innovative firms without a specialized department is quite high. 30% of the process innovative firms and over 40% of the product innovative firms do not operate a specialized R&D department. These may suggest that out of the innovative firms' category, 30% (in the case of process innovation) and 40% (in the case of product innovation) are actually either importing or imitating their „new” products or processes.

Also, the fact that 63% of firms which were not process innovators still acted as product innovators, introducing new products, points in the same direction: much of the product innovation is based on licensed or imitated technology (resulting in imported or imitated products). Going one step further, it could be submitted, based on the same cross-table between new products and new processes, that the new

products are new to the market (in the case of domestic market) or new to the firm (in the case of foreign market), rather than innovative *per se*.

Table 11. Cross-table: new products and new processes

			New processes		Total
			0 (No)	1 (Yes)	
New products	0 (No)	Count	24	7	31
		% horizontal	77.4%	22.6%	100.0%
		% vertical	36.4%	6.7%	18.2%
	1 (Yes)	Count	42	97	139
		% horizontal	30.2%	69.8%	100.0%
		% vertical	63.6%	93.3%	81.8%
Total	Count	66	104	170	
	% horizontal	38.8%	61.2%	100.0%	
	% vertical	100.0%	100.0%	100.0%	

## 2.2. R&D expenses

R&D expenses seem to pay off. According to the cross tables below, from the firms which increased their R&D expenditures in the last year, 91.2% introduced new products, 79.2% introduced new processes, and 69.1% introduced new methods of distribution. These figures are not only higher than the average (for the entire firm's population) but also higher than the figures for the firms with a specialized R&D department. It means that a specialized R&D department is not a must; the commitment to invest in R&D is more important. After all, one third of the firms with R&D departments did not increase their R&D expenses in 2004.

Table 12. Cross-table: new products and R&D expenses

			R&D expenses		Total
			0 (not increased)	1 (increased)	
New products	0 (No)	Count	25	6	31
		% horizontal	80.6%	19.4%	100.0%
		% vertical	24.5%	8.8%	18.2%
	1 (Yes)	Count	77	62	139
		% horizontal	55.4%	44.6%	100.0%
		% vertical	75.5%	91.2%	81.8%
Total	Count	102	68	170	
	% horizontal	60.0%	40.0%	100.0%	
	% vertical	100.0%	100.0%	100.0%	

Pearson coefficient = 0.009

Table 13. Cross-table: new processes and R&D expenses

			R&D expenses		Total
			0 (not increased)	1 (increased)	
New processes	0 (No)	Count % horizontal % vertical	52 78.8% 51.0%	14 21.2% 20.6%	66 100.0% 38.8%
	1 (Yes)	Count % horizontal % vertical	50 48.1% 49.0%	54 51.9% 79.4%	104 100.0% 61.2%
Total		Count % horizontal % vertical	102 60.0% 100.0%	68 40.0% 100.0%	170 100.0% 100.0%

Pearson coefficient = 0.000

Table 14. Cross-table: new methods and R&D expenses

			R&D expenses		Total
			0 (not increased)	1 (increased)	
New methods	0 (No)	Count % horizontal % vertical	66 75.9% 64.7%	21 24.1% 30.9%	87 100.0% 51.2%
	1 (Yes)	Count % horizontal % vertical	36 43.4% 35.3%	47 56.6% 69.1%	83 100.0% 48.8%
Total		Count % horizontal % vertical	102 60.0% 100.0%	68 40.0% 100.0%	170 100.0% 100.0%

Pearson coefficient = 0.000

However, some other figures revealed by the tables above are striking. 55.4% (more than half) of the firms which introduced new products (product innovative firms) did not increase their R&D expenses over the same time period. The same is valid for 48.1% of the process innovative firms (and, to a lesser extent, for the method innovative firms). It means either that the existent R&D resources are used more efficiently, or – more likely – that most innovative products (and about half of the innovative processes) do not even come as a result of R&D expenses, which is to say that they come from imports or from an imitative behaviour.

The evolution of R&D expenses did not correlate significantly with the ownership structure (type of capital). Foreign owned firms do not appear more R&D intensive than the local ones, as an earlier study (Damijan, Majcen, Rojec, Knell 2003)

suggested. One explanation might be a possible bias in our responses, as they include only 20% of foreign owned firms. FDI penetration in manufacturing is higher than this in terms of contribution to turnover and exports (Hunya, 2004), but lower in terms of registered firms. Leaving methodology aside, it could be submitted that foreign firms undertake their R&D activity abroad and only internalize the R&D costs through their Romanian affiliates. This is not unlikely, in an industry still dominated by low value-added assembling operations (see also table 21).

### 2.3. R&D by sectors

At a first glance, there appears to be better and worse performing sectors. E.g., the food and beverages industry falls clearly below the average in both the evolution of R&D expenses and the introduction of new products, while the electrical machines and appliances and metallurgy are clearly above the average in both cases. While metallurgy is a special case in Romania, given the ongoing restructuring of the largest steel maker, the evolution recorded for the other two sectors is in line with an earlier study on Czech firms (Kinoshita, 2000), which indicated that firms in the food and beverages industry did not engage much in R&D activity, while electrical machinery was a successful example of positive spillovers from R&D. However, the distinction made there between the R&D behaviour of oligopolistic and non-oligopolistic sectors could not be replicated to Romania in view of our survey's results.

The remaining sectors are in a rather mixed situation, or very close to the average. Moreover, as we run the correlation tests for sectors (as dummies) with new processes, respectively with new methods, the Pearson coefficient failed to be within the margins of significance.

*Table 15. Evolution of R&D expenses, by sectors*

	R&D expenses	
	Increased	Not increased
Food and beverages	27.8%	72.2%
Chemicals (and pharmaceuticals)	57.1%	42.9%
Textiles and clothing	50.0%	50.0%
Electrical machines and appliances	52.2%	47.8%
Machines and equipments	29.2%	70.8%
IT	33.3%	66.7%
Rubber processing	23.1%	76.9%
Oil processing	66.7%	33.3%
Metallurgy	54.5%	45.5%
Means of transportation	21.1%	78.9%
Industry average	40.0%	60.0%

Pearson coefficient = 0.042

Table 16. New products, by sectors

	New products	
	Yes	No
Food and beverages	72,2%	27,8%
Chemicals (and pharmaceuticals)	90,5%	9,5%
Textiles and clothing	77,3%	22,7%
Electrical machines and appliances	91,3%	8,7%
Machines and equipments	87,5%	12,5%
IT	83,3%	16,7%
Rubber processing	92,3%	7,7%
Oil processing	66,7%	33,3%
Metallurgy	90,9%	9,1%
Means of transportation	73,7%	26,3%
Industry average	81.8%	18.2%

Pearson coefficient = 0.040

These mixed or inconclusive results may suggest that in Romania it is still difficult to operate distinctions regarding the R&D intensity by sectors. Sectors belonging to what some economists (Floricele and Miller, 2003) called the New economies (more R&D intensive sectors) and the Old economies (less R&D intensive sectors) are not well separated in transition economies like Romania, with incomplete economic transformations.

#### 2.4. R&D supporting factors

The supporting environment for R&D is very complex and non-exhaustive. In this questionnaire, we only addressed two aspects reflecting this environment.

The first one referred to the financing sources for R&D. The results are beyond any doubt: 80% of the firms undertake R&D expenses from their own resources. This result is so overwhelming, that sector based differences, if any, are not significant. It is however important to note that funding R&D from own resources does not benefit from any incentive in Romania. No indirect financial measures support firms' investment in R&D.

State support for business expenditures on R&D is also very limited: only 2.4% of companies obtained public funds for R&D, and these were also very limited, as the total R&D state aid in Romania has never exceeded 20 million Euros (0.003% of GDP). The awareness of EU funding for R&D is also very limited: only 2 respondent firms in 170 admitted they accessed EU funds.

Free market support for R&D investments was also low: 3.5% of firms obtained loans for their R&D activity. Moreover, only one company in 170 interviewed benefited from a venture capital fund. The European Innovation Scoreboard (2004) indicates that hi-tech venture capital is practically non-existent, while the early stage venture capital is only 10% of the EU average). This is in fact an important issue for future consideration: the creation of a state-sponsored venture capital fund for private R&D and innovative start-ups must become a priority on the public agenda.

The small share of R&D funded through loans, venture capital or attracting EU funds also represents a rare opportunity: it shows that there is a huge potential in this respect. By their own efforts, companies operating in Romania manage to invest only about 0.2% of GDP in R&D each year (Eurostat, 2004). The gap to the 1% Barcelona target could be filled by using these alternative sources of financing. In addition to this, firms should be stimulated to invest more in R&D by means of indirect financial measures.

The second question referring to supporting R&D environment dealt with the issue of life-long learning at business level. For the entire country, official data (European Innovation Scoreboard, 2004) show that 1.3% of the employed population was involved in some form of continuous education. In our questionnaire, the mean for the 170 answers is 1.9%. On average, less than 2 out of 100 manufacturing industry employees have attended training and professional education classes, paid by their companies, for at least two weeks in the last six months. In fact, 40% of the firms have not sent any of their employees to any form of training in the last year. The lack of life-long learning at industry level increases the difficulties to adapt to new structural pressures, in a industry that still needs to suffer from serious transformations in order to become compatible with the EU structure of production (CEROPE, 2001 showed that 33 out of 100 employees needed to change their job to secure Romania's convergence to EU in terms of production structures).

It is noteworthy that the answers to this question failed to correlate significantly to any of the variables we check. Life-long learning within manufacturing industry is simply very low, irrespective of firms' turnover, ownership, sector, or location.

### **3. A MODEL: HOW DOES RDI INFLUENCE COMPETITIVENESS?**

More firms increased their domestic competitiveness than their foreign competitiveness in 2004 (55.3% against 41.2%). But the focus of our study was not on competitiveness itself, but on how does RDI influence it.

We used two binary logistic regressions, one with the dependent variable being the evolution of the firms' competitive position on the domestic market, and a second one where the dependent variable was the evolution of the firms' competitive position on the foreign market. These two regressions were made „in the mirror”, meaning that we tested the same explanatory variables on both of them. We created various scenarios, and finally chose to present five of them (A, B, C, D, E). The independent variables used were:

- PROD\_INNOV: new or significantly improved products were introduced in the last year (1-introduced, 0-not introduced)
- PROC\_INNOV: new or significantly improved technological processes were introduced in the last year (1-introduced, 0-not introduced)
- METH\_INNOV: new or significantly improved distribution methods were introduced in the last year (1-introduced, 0-not introduced)
- R&D\_DEPART: the existence of a specialized R&D department within the firm (1-existent, 0-not existent)
- R&D\_EXPENS: the evolution of R&D expenses in the last year (1-increased, 0-not increased)

- ROL\_APREC: the effect of the appreciation of the national currency ROL (1-positive effect, 0-negative effect)
- FOR\_COMPET: evolution of foreign competitiveness (1-increased, 0-not increased)
- DOM\_COMPET: evolution of domestic competitiveness (1-increased, 0-not increased)
- LLL: life-long learning, in the understanding that the firm paid for training or professional education for some of its employees, for at least two weeks in the last six months (1-it occurred, 0-it did not occur)
- TURNOVER: the turnover of the respondent firms (1-below 1 million Euros, 2- between 1 and 10 million Euros, 3-between 10 and 50 million Euros, 4-over 50 million Euros).

All the independent variables, except for turnover, are dummies. The two respective dependent variables are also dummies.

The regression tables below show very important differences in the factors influencing the domestic and the foreign competitive position. The three models (A, B and C) employing only R&D variables have a much stronger explanatory power for foreign competitiveness than for domestic competitiveness. New products positively influence foreign competitiveness, while new methods of distribution positively influence domestic competitiveness. The existence of a specialized R&D department is more significant for the foreign competitiveness than for the domestic one.

Model D, where we considered the impact of the appreciation of the national currency, shows the expected signs for the unstandardized coefficient of that variable (plus for domestic competitiveness and minus for foreign competitiveness), but not at the significance level.

The most complex model presented, E, adds new significant variables. Turnover is found to be correlated with foreign competitiveness, while domestic and foreign competitiveness influence each other, but to different extent. On the other hand, life long learning does not seem correlated to any of the two competitive positions. The explanation is probably the very low extent at which training and continuous education occurs in the manufacturing industry.

We will stay now with this last model, which has the highest explanatory power in both cases (19.1 for domestic competitiveness and 26.5 for foreign competitiveness). For domestic competitiveness, the only R&D variable which counts is the introduction of new methods of distribution. The fact that new products or new processes failed to be statistically significant for domestic competitiveness may suggest that the nature of competition on the domestic market is altered. Competition is on distribution, not on innovation; new products do not change the competitive position. A likely explanation is that market entry barriers, which are still high (in many sectors competition problems appeared in the post-privatization stage), limit competition on the domestic market. This result fits in the theoretical framework earlier developed by Voinea (2003), stating that various market power inducements granted in transition economies transform location advantages into ownership advantages, therefore diminishing the incentives for technological transfer and R&D.

On the other hand, foreign competitiveness is strongly and positively correlated with the introduction of new products. Product innovation increases foreign competitiveness, which is a sign of the normal functioning of foreign markets. Foreign demand reacts positively to product innovation, while domestic demand is still not educated in this regard. This result is similar to that reported in a recent study on a panel of firms operating in Spain (Barrios, Gorg, Strobl, 2003), where own R&D activity was found to be an important determinant of export intensity (the latter could be regarded as a proxy for foreign competitiveness).

The fact that methods of distribution are not found to be significantly correlated with foreign competitiveness is an indication of Romanian exports' dependency on foreign intermediaries.

As for process innovation, it is not significant for any of the two measures of competitiveness in the model E. Still, it is significant for foreign competitiveness in three other less complex models (B, C, D), which shows again that foreign competition is more stimulating for R&D processes than domestic competition.

The competitive position on the domestic market is correlated with the competitive position on the foreign market. The correlation is stronger the other way around, as domestic competitiveness provides a platform for foreign competitiveness.

Turnover is not significant for domestic competitiveness. Distribution capabilities are likely enhanced by flexibility or other variables not accounted for in our model, than by turnover. The opposite is true for foreign competitiveness: turnover is significant. The explanation could be that the exports of Romanian firms are generally low value-added, which means high turnover is needed to secure higher profits, in nominal terms.

***Regression with the dependent variable: competitive position on the domestic market***

	A	B	C	D	E
PROD_INNOV	0.366 (0.456)	0.267 (0.455)	0.318 (0.460)	0.360 (0.457)	0.120 (0.479)
PROC_INNOV	0.155 (0.396)	0.278 (0.383)	0.153 (0.396)	0.145 (0.395)	0.062 (0.414)
METH_INNOV	0.811** (0.362)	0.732** (0.366)	0.745* (0.370)	0.730* (0.367)	0.704* (0.384)
R&D_DEPART	0.775** (0.351)		0.572 (0.414)	0.795* (0.353)	0.539 (0.437)
R&D_EXPENS		0.715* (0.370)	0.398 (0.438)		0.503 (0.482)
ROL_APPREC				0.547 (0.387)	0.530 (0.397)
FOR_COMPET					0.729* (0.376)
LLL					-0.269 (0.383)
TURNOVER					-0.160 (0.215)
Constant	-0.741 (0.410)	-0.552 (0.389)	-0.711 (0.411)	-0.855 (0.421)	-0.471 (0.585)
<i>n</i>	170	170	170	170	170
<i>Adjusted R sq.</i>	14.2	13.4	14.8	15.7	19.1

***Regression with the dependent variable: competitive position on the foreign market***

	A	B	C	D	E
PROD_INNOV	1.260** (0.520)	1.177 ** (0.513)	1.298** (0.525)	1.264** (0.521)	1.450*** (0.555)
PROC_INNOV	0.629 (0.390)	0.824** (0.379)	0.637* (0.391)	0.647** (0.392)	0.519 (0.413)
METH_INNOV	-0.121 (0.356)	-0.085 (0.359)	-0.070 (0.363)	-0.083 (0.361)	-0.148 (0.385)
R&D_DEPART	0.840** (0.350)		1.004** (0.423)	0.833** (0.351)	0.775* (0.450)
R&D_EXPENS		0.254 (0.350)	-0.302 (0.430)		-0.551 (0.487)
ROL_APPREC				-0.235 (0.371)	-0.289 (0.401)
DOM_COMPET					0.793** (0.381)
LLL					0.488 (0.396)
TURNOVER					0.541** (0.487)
Constant	-1.989 (0.512)	-1.687 (0.481)	-2.020 (0.516)	-1.950 (0.516)	-3.690 (0.790)
<i>n</i>	170	170	170	170	170
<i>Adjusted R sq.</i>	17.8	14.1	18.1	18.1	26.5

Note: The two tables report the unstandardized coefficient and, in brackets, the standard error. The levels of significance are \*\*\* for 1%, \*\* for 5% and \* for 10%.

These models made an attempt to explain how much of the evolution of competitiveness can be explained by the dynamics of the RDI activity. The highest explanatory power of the models was 19.1% for domestic competitiveness and 26.5% for foreign competitiveness. It is a not a bad result for a model with only a few variables. Still, this means that the most powerful explanatory variables are not accounted for by these models. RDI activity only explains one fifth of domestic competitiveness and one quarter of foreign competitiveness. There are other explanatory factors that influence decisively competitiveness, and they regard other aspects than RDI. We do not intend to speculate which are these other variables; but our result shows the degree of significance RDI has on the competitiveness of Romanian firms. We consider that, in time, this significance should increase if we are to perform better on both the domestic and foreign markets. One remark is that, however, foreign market is ore sensitive to innovation than domestic market – at least this is what our results suggest.

#### **4. CONCLUDING REMARKS**

The results of the questionnaire confirm, for Romania, what the 2004 EU Industrial R&D investment scoreboard found for EU-25: R&D intensity depends on turnover and on geographical location. However, various sector-based R&D intensities are not conclusive (except the under-performing food and beverages industry, and the over-achiever electrical machinery sector), probably because the economic transformation is still ongoing in Romania.

However, the type of ownership does not influence significantly the extent of R&D activity. One possible explanation is that local market characteristics are more important than the structure of ownership. For foreign capital firms, this reflects a limited integration of the local affiliates in the global production and innovation system of the multinational companies to which they belong.

More than half of the respondent firms have a specialized R&D department, but most of these departments operate with very few employees. Even so, the existence of a specialized R&D department has a high rate of success, in terms of introducing innovative processes and products.

On industry average, last year 81% of firms introduced new products, 61% introduced new technological processes, and 48% introduced new methods of distribution. 40% of firms increased their R&D expenses (35% as a net balance), while only a net balance of 7% increased their R&D employees.

Despite the large share of product innovators, some other figures are striking and could only be interpreted that a large share of the new products come from imports, licensing or imitation, rather than from own R&D. In this regard, 55% of product innovative firms did not increase their R&D expenses, and 40% of them do not operate a specialized R&D department, while 63% of firms which were not process innovators still acted as product innovators.

Four out of five euros invested in R&D at the level of Romanian industry come from own funds. Loans or venture capital funds are very limited or virtually non-existent. Also, less than two out of 100 industry employees attended training paid by their companies. These indicate that factors potentially conducive to innovation are not well emphasized.

The model we built to see how much of the domestic and foreign competitiveness is explained through RDI has quite a large explanatory power, at least in view of the small number of variables used.

Domestic competitiveness is significantly influenced by the introduction of new distribution methods. The fact that new products or new processes failed to be statistically significant for domestic competitiveness may suggest that the nature of competition on the domestic market is altered. Competition is on distribution, not on innovation; new products do not change the competitive position.

Instead, foreign competitiveness of Romanian firms is not influence by the distribution method, which is a confirmation of Romanian exporters' dependency on foreign intermediaries. Foreign competitiveness is strongly and positively correlated with the introduction of new products and with the existence of a specialized R&D department. Product innovation increases foreign competitiveness, which is a sign of the normal functioning of foreign markets.

As for process innovation, it is not significant for any of the two measures of competitiveness in the main model. Still, it is significant for foreign competitiveness in three other less complex models, which shows again that foreign competition is more stimulating for R&D processes than domestic competition.

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## **Annex A. METHODOLOGICAL NOTES**

This report is based on a survey addressed to a representative sample of firms from the Romanian industry. The selection was made by sector of activity<sup>2</sup>, turnover, and location. We received 170 valid answers (the rate of response was approximately 40%). The distribution of answers maintained the main characteristics associated with the initial sample.

Thirteen<sup>3</sup> industrial sectors were selected, based on their relative share in industrial output. In the selection process, we excluded some sectors given their resemblances with selected sectors<sup>4</sup>. We acknowledge that selecting sectors within the industry represents a limitation in itself. Yet, we consider that the sample and the answers received are representative for the industry as a whole, given the distribution of answers by sector, turnover, employees, and regions. It is noteworthy that the aggregated turnover of the 170 respondent firms was close to 6 billion Euros in 2003 (about 12% of Romania's GDP).

The distribution of the 170 valid answers is as follows.

- By sector: machines and equipment – 14.1%, electrical machinery and appliances – 13.5%, textiles and clothing – 12.9%, chemicals (incl. pharmaceuticals) – 12.4%, means of road transportation – 11.2%, food and beverages – 10.6%, rubber and plastic products – 7.6%, metallurgy – 6.5%, IT hardware – 3.5%, radio, TV and communications equipment – 2.9%, mining and quarrying – 2.9%, oil processing – 1.8%. Although it may seem that in some sectors the number of respondents was low, we argue in favour of their representativeness: among the respondent firms, there are the market leaders in metallurgy<sup>5</sup>, oil processing<sup>6</sup>, rubber<sup>7</sup> and plastic products, IT hardware<sup>8</sup>. On the other hand, the number of replies for radio, TV and communications equipment was too low to report the results by sector. Also, the responses within the means of road transportation sector fail to incorporate the two leading companies<sup>9</sup>, which refused to answer; hence, the results for this sector must be treated with caution.
- By turnover: less than 100,000 euro – 4.1%; between 100,001-1,000,000 euro – 18.2%; between 1,000,001-10,000,000 euro – 47.1%; between 10,000,001-50,000,000 euro – 22.4%; over 50,000,000 euro – 8.2%.
- By number of employees: less than 49 employees – 15.3%; between 50-249 employees – 27.6%; more than 250 employees – 57.1%.
- By ownership structure: state owned – 20%; private owned, local capital – 60%; foreign owned – 20%.

The questionnaire was addressed indirectly to the firms' managers (by fax and email). We were confronted with non-responses mainly from foreign owned companies,

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<sup>2</sup> By the NACE classification (main activities of the national economy).

<sup>3</sup> Textiles and clothing were considered together.

<sup>4</sup> E.g., we excluded the footwear sector because its evolution has been virtually identical with the evolution of the textiles and clothing industry, except for the fact that its contribution to exports, for example, is four times lower than that of textiles and clothing.

<sup>5</sup> Ispat Sidex

<sup>6</sup> Petrom and Rompetrol

<sup>7</sup> Continental

<sup>8</sup> Softwin

<sup>9</sup> Dacia Renault and Rodae.

which seemed quite often reluctant to provide even information that should not have been regarded as sensitive.

### **Limitations**

We acknowledge a number of limitations in our survey methodology, as described below:

- We refer only to industry. Services are not accounted for in this report, although they might be more dynamic than industry in promoting and adapting to innovations.

- We do not analyze time series. The results reflect the picture of only one year, 2004. Hence, we can not discuss about trends, but only about the dynamics recorded in one year.

- Linked to the previous remark, we do not account for time lags. It might be that competitiveness, domestic and foreign alike, reacts to RDI with a certain time lag. However, we questioned firms about the products, processes and methods that have been introduced, marketed, not about the prospective ones. It means that the time lag may in fact be limited.

- We did not ask about percentages like the share of R&D expenses in turnover, or about absolute figures. Instead, we asked about the evolution of the R&D expenses. Companies registered in Romania are not obliged to disclose information on their R&D expenses, as there is not such a compulsory line in their balance sheets. What we obtained is a dynamic, not a static picture.

- We questioned firms about the existence of a specialized R&D department, but did not define either the structure or the dimensions of such a department. Official statistics (MER, as quoted by Gheorghiu, Pislaru, Turlea, 2004) accounts for only 310 companies in Romania, public or private, that have a specialized RDI department with a minimum of eight employees working within. We did not follow this narrow definition because we did not want to limit companies' response options. The number of R&D employees is a different issue, and we treated it separately. Also, firms in the IT industry are not included in the official statistics for R&D, which did not seem right to us. Our approach led to more than half of the respondent firms saying that they have a specialized R&D department – probably, in most cases, with less than eight employees.

- The definition of various innovative activities is not specified. We wanted to see the firms' perceptions about their RDI activity, rather than the calculation of statistical indicators that may also be inaccurate. We divided innovation in three segments: product, process and distribution method. Official statistics (INSSE, 2004) only refers to product and process innovators, which might overlook the large number of local firms with innovative distribution methods. Romania is, after all, a country where more than half of total imports are for final consumption. Our hypothesis in this regard was validated by the large number of firms declaring themselves as method innovators. Also, we did not specify whether product, process or method innovation refers to company itself or to the market. When a company states that it introduced a new process, for example, it might be a technology new for the company itself, but well known to other competitors and to the market. This different, wider, approach to the understanding of RDI, may explain the difference between our results (that more than half of the surveyed firms are product or process innovators) and the INSSE statistics stating that only 17% of firms are successful innovators (slightly more than 20% in the manufacturing industry). However, the INSSE data are also based on a survey, which has been extrapolated to the whole population of firms.

- Two of the questions asked firms to assess their competitive position on the domestic and foreign market. We did not indicate firms a specific approach for understanding competitiveness, for fear that some companies might have said that they do not calculate some specific indicator. In the absence of a clear definition of competitiveness, we expected that the respondents had approximated it by market share. However, it could have been more accurate to specify a certain way to measure competitiveness, such as the profit rate. Yet, this information was officially available only for the year 2003, while the questionnaire referred to 2004 evolutions. Also, if we asked about it in the questionnaire, we would have run the risk of non-responses, due to the fact that the indicator may be perceived as confidential.

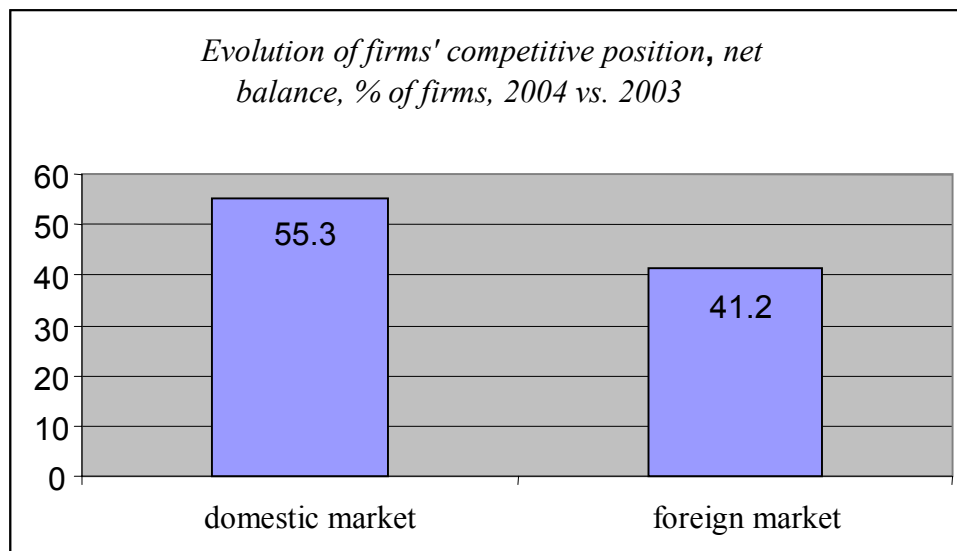
**Annex B. DESCRIPTIVE STATISTICS: aggregated answers to the questionnaire**

*Q1. Which was the evolution of your competitive position on the domestic market in 2004?*

	Frequency	Percent
Improved	103	60.6
Unchanged	56	32.9
Worsened	9	5.3
Don't know/ no answer (DK/NA)	2	1.2
Total	170	100

*Q2. Which was the evolution of your competitive position on the foreign market in 2004?*

	Frequency	Percent
Improved	80	47.1
Unchanged	64	37.6
Worsened	10	5.9
DKI/NA	16	9.4
Total	170	100



*Q3. Has your company introduced new or significantly improved products in the last year?*

	Frequency	Percent
Yes	139	81.8
No	30	17.6
DK/NA	1	0.6
Total	170	100

*Q4. Has your company introduced new or significantly improved technological processes in the last year?*

	Frequency	Percent
Yes	104	61.2
No	65	38.2
DK/NA	1	0.6
Total	170	100

*Q5. Has your company used new or significantly improved distribution methods in the last year?*

	Frequency	Percent
Yes	83	48.8
No	86	50.6
DK/NA	1	0.6
Total	170	100

*Q6. Does your company have a specialized Research and Development department?*

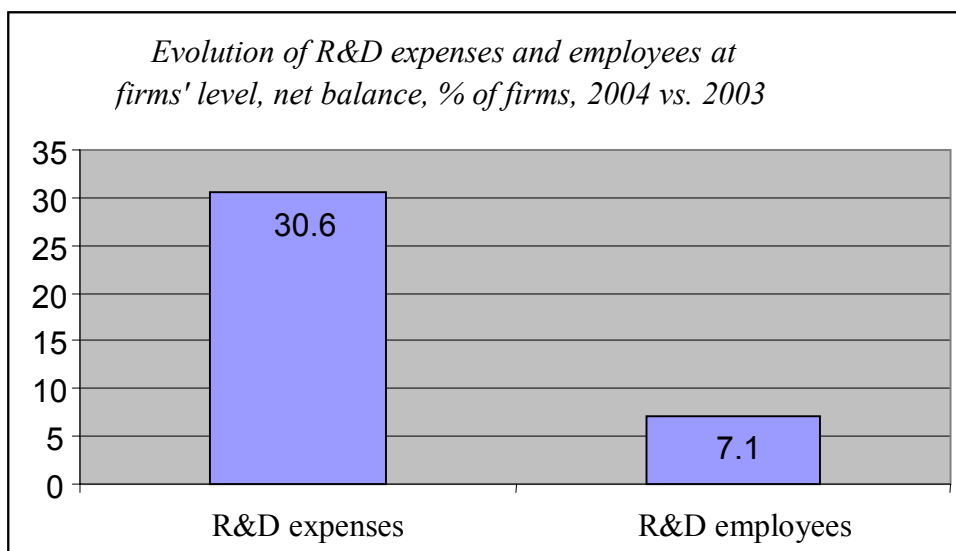
	Frequency	Percent
Yes	94	55.3
No	75	44.1
DK	1	0.6
Total	170	100

*Q7. Which was the evolution of your company's R&D expenses, as % of turnover, in the last year?*

	Frequency	Percent
Increased	68	40.0
Unchanged	69	40.6
Decreased	16	9.4
DK/NA	17	10.0
Total	170	100

*Q8. Which was the evolution of your company's R&D employees, as % of total employees, in the last year?*

	Frequency	Percent
Increased	29	17.1
Unchanged	103	60.6
Decreased	17	10.0
DK/NA	21	12.4
Total	170	100



*Q9. Which is the main financing source for your R&D expenses?*

	Frequency	Percent
Own resources	136	80.0
Loans	6	3.5
Public funds	4	2.4
European Union programs	2	1.2
Venture capital	1	0.6
DK/NA	21	12.4
Total	170	100

*Q10. How many of your employees have attended training and professional education classes, paid by your company, for at least two weeks in the last six months?*

	Frequency	Percent
0%	69	40,6
below 5%	60	35,3
between 5 and 10%	21	12,4
over10%	20	11,8
Total	170	100,0