European Commission

# Policy Brief

# The effect of innovative SMEs' growth to the structural renewal of the EU economy

## - A projection to the year 2020 -

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## 1.Introduction

One of the main objectives of the EU's growth strategy for the coming decade is to support the creation and growth of innovative companies. Indeed, two of the five targets of the *Europe 2020* strategy are to raise the employment rate of the population and to foster innovation by raising investment in R&D to 3% of GDP at least. Innovative companies, in fact, are assumed to play an important role in generating economic growth and employment. In addition, promoting their number and growth is expected to support the renewal of the EU economy by shifting the industrial sector's composition towards more knowledge-intensive activitie[1]. Among innovative companies, R&D performing SMEs are a dynamic sub-group expected to greatly contribute to economic growth and job creation in the EU.

In the context of Europe's capacity to hit the 3% R&D intensity target in 2020, one important question arises: *To what extent can faster growth of innovative R&D-intensive SMEs drive the envisaged structural change of the EU economy towards high R&D intensive sectors?* [2] Answering this question is important to put into perspective the European research and innovation agenda's current policy emphasis on supporting higher growth of innovative companies.

This *Policy Brief* aims to contribute to the debate about how to set the right priorities and find the most appropriate policy interventions to allow Europe to reach the 3% R&D intensity target and hence its growth and employment objectives. It will first summarise stylised findings from the literature on the relevance of innovative companies for economic growth, then present results from a recent JRC-IPTS study which go some way towards answering the question posed above, and conclude by outlining some of the contributions that enrich the policy debate.

*Note*: Whereas it applies across the document, the sign '▶' indicates that the work is authored/co-authored by JRC-IPTS staff.

[1] Moncada-Paternò-Castello *et al.*, 2010 ▶

[2] The main sectors giving rise to the gap are: ICT, Pharmaceuticals & Biotechnology and Health- related.

## 2. Background - What the literature says

***Why do firms' R&D and innovation matter?*** Economic theory points to technical change as the major source of productivity growth in the long run (Solow, 1957). R&D is thus seen as the major driving force for technical change (Romer, 1990; Guellec and van Pottelsberghe de la Potterie, 2001). Both together are recognised as key elements for increasing any economy's knowledge base and, with it, its growth, productivity and competitiveness (Coccia, 2008; Mowery and Rosenberg, 1989). According to the literature, R&D performing / innovative firms are important due to their contribution to the following fundamental aspects:

*(i) Employment creation:* Comparative studies on the impact of corporate R&D investment on employment have demonstrated that an increase in R&D expenditure by 1% stimulates employment in the business sector by about 0.15% (see Bogliaccino *et al.*, 2012 ▸). This result is robust and consistent with empirical evidence from country level studies. However, while the mentioned positive impact of R&D expenditures on employment figures can generally be confirmed for the high-tech sector and services, it is not significant in traditional manufacturing.

*(ii) Firms' competitiveness:* Evidence suggests that innovating firms are both more profitable and grow faster than non-innovators (Freel, 2000; Geroski and Machin, 1992). Moreover, Kumbhakar *et al.* (2012) pointed out that there is a positive correlation between firms' R&D investment and productivity – driven by both technological progress and higher technical efficiency – which was found to be particularly acute in high-tech sectors. Accordingly, engaging in R&D activities – via technological advancement and by reducing inefficiency and waste – helps to increase productivity and thus ensures competitiveness.

*(iii) Structural changes:* The literature on the dynamics of industrial structures and the growth of innovative companies indicates that the EU's economy has a rather static structure which has hardly changed over the recent decades and, moreover, it is less knowledge-intensive than its main competing regions (i.e. Europe is rather specialised on medium than on highly knowledge-intensive sectors; see Moncada-Paternò-Castello and Cincera, 2012▸).

***Why are innovative SMEs relevant?***[3] Recent literature (Cincera and Veugelers, 2012▸; Czarnitzki and Delanote, 2012; Ciriaci *et al.,* 2013▸) unambiguously indicates that young innovative companies tend to grow more than other firms and that the fast-growing, smaller/younger innovative firms can play a fundamental role for the EU's economic performance and presumably help to accelerate the renewal of the industrial structure in the EU. However, although about one third of EU business expenditures on R&D are made by firms with less than 500 employees, compared to the US, Europe is lagging behind in mere numbers of such R&D-investing companies of a comparably small size.[4]

Further relevant literature points to the following stylised facts: a) smaller firms tend to produce higher-quality innovations, b) optimal size-dependent R&D subsidy policies generally perform better than size-independent policies; and c) supporting small firms' investment in R&D is often more growth-enhancing than subsidising large firms (Symeonidis, 1996; Akcigit, 2009; Coad and Hölzl, 2010; Moncada-Paternò-Castello, 2011▸).

## 3. New facts / new findings from a JRC-IPTS simulation exercise

*Rationale and questions*

The current understanding of small firms' growth and what policy can contribute in this regard relies widely on incomplete information, focusing mostly on data aggregated at the national and/or industry level or on certain variables assumed to

[3] See also Annex

[4] In fact, evidence suggests that the average size of R&D intensive firms can explain the overall R&D intensity gap between the EU and the US. Such kinds of US companies are concentrated in sectors that are intrinsically R&D-intensive, thus raising the US's overall R&D performance vis-à-vis the EU (Moncada-Paternò-Castello *et al.,* 2010 ▸; Ortega-Argilés and Brandsma, 2010 ▸).

determine growth (e.g. R&D, tax regimes, constraints in terms of factor endowments).

In this light, a recent JRC-IPTS study (Voigt and Moncada-Paternò-Castello, 2012▸) addressed the following questions: How would the sector composition and the overall volume of R&D investment in Europe differ in the year 2020 compared to the figures from 2010 if the existing top R&D-investing SMEs were assumed to be on a fast growth track while the top R&D-investing large scale companies continue to grow as before? And hence, to what extent would accelerated growth of these innovative SMEs help to reach the EU R&D intensity target set for 2020?

*Methodological approach*

Empirically, the aforementioned JRC-IPTS study relied on the sample of top R&D-investing firms as provided by the EU Industrial R&D Investment Scoreboard [SB] (containing data of 1,000 EU and 1,000 non-EU based firms) in the 2010 edition. Firm-level data correspond to accounting year 2009, which is taken as the starting point for individual firm-level projections of steady growth paths over a period of 10 years, thus simulating the SB for 2020 [SB-2020].

To calculate the firms' future growth trajectories, the study supplemented data from SB-2010 with data from earlier SB waves, thus going back as far as observations from 2002 (i.e. pooled SB data) - altogether 133 EU SMEs were found -, constituting an imbalanced panel used for the purpose of simulation.

The firm's growth paths are subject to some basic (non-trivial) assumptions: all companies in the sample will grow with the same rate in terms of employment and sales, while the company-level R&D intensity (R&D/sales) is assumed to remain constant. Scenarios are distinguished for SMEs vs. large-scale companies (assumed growth paths) and with regard to high-, medium- and low-tech industries. Three growth scenarios were developedand empirically benchmarked *vis-à-vis* the reference scenario as outlined in Table 1[5] (next page).

In order to illustrate the BERD/GDP ratio (R&D intensity) of the simulated scenarios, an average annual GDP growth rate had to be assumed for the years 2010 – 2020 (resulting in a total GDP multiplier). Although per year growth rates may fluctuate quite substantially, over a longer period the assumption of the following three scenarios appeared reasonable: mean annual GDP growth 2%, 2.5% and 3%. The share of EU SB R&D investment to EU BERD (86% in 2009) is assumed to remain invariant, and the annual BERD growth is determined by the assumed overall SB annual R&D investment growth in the different scenarios.

The growth hypothesis of the different scenarios assumes non-cyclical R&D investment behaviour. Empirical evidence in this regard (European Commission, 2012▸) suggests that top R&D investors keep the growth rates of R&D investments well above GDP growth rates and, moreover, apart from 2009 (which is seen as the peak of the financial crisis) their R&D investment behaviour has been rather counter-cyclical; i.e. raising spending on R&D during the recession (ref.: 2010, 2011 figures), which gave cause to consider rather high-growth scenario projections for the period 2010 – 2020 (see especially scenarios (B) and (C) in Table 1).

A linear prediction model (according to Makhoul, 1975) has been applied to simulate the scenarios. The limitations of this study appear to be centred in the non-trivial assumptions with regard to the growth scenarios and a rather simplistic (linear) projection method, which is due to neglect of a number of other factors that are relevant to firm and sector dynamics.[6]

*Results*

Figure 1, in the next page, presents the corporate R&D investment shares by sector group in the EU in 2010 and outlines the simulated EU R&D scoreboard for the year

[5] Note: Computing a scenario of 5% annual growth of small companies was rejected as it would be much lower than their current growth path (and even be lower than the reference scenario assuming an equal growth rate of 7.1% employment CAGR 8 yrs across all EU companies; thus disregarding firm size).

[6] For more details on the methodological approach, see the corresponding study by Voigt and Moncada-Paternò-Castello, 2012▸

2020 according to the reference scenario (R-S).

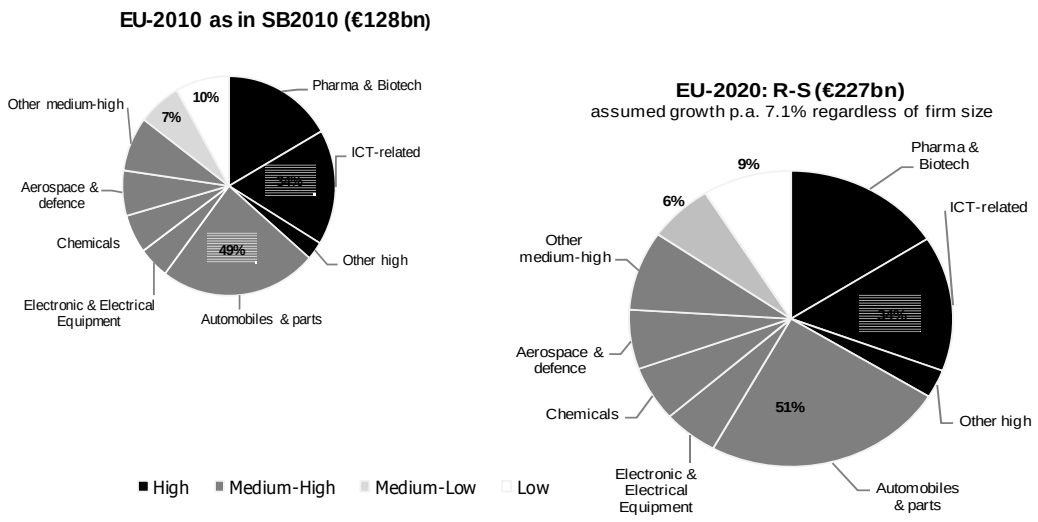
**Table 1. Scenarios of growth rates and corresponding EU firms' R&D investment in2002**

| ***Scenarios*** | ***Annual growth rates*** | ***Resulting total EU firms' R&D investment in 2020*** *(in constant 2010 €billion)* |
|---|---|---|
| Reference Scenario R-S (*status quo* growth path) | 7.1% regardless of firm size | 227 |
| Target Scenario A | SMEs: 10%<br>Large: 5.8% | 221 |
| Target Scenario B | SMEs: 20%<br>Large: 5.8% | 228 |
| Target Scenario C | SMEs: 30%<br>Large: 5.8% | 244 |

Source: Voigt and Moncada-Paternò-Castello, 2012

Note: More details about the scenarios are provided in the Annex.

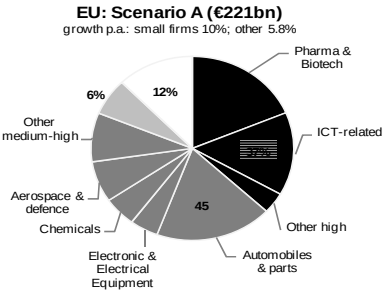
**Figure 1. Corporate R&D investment shares by sector group in EU-27** (left side) **in 2010 and as an assumed reference scenario (R-S) for 2020** (right hand side)




Source: The 2010 EU Industrial R&D Investment Scoreboard, European Commission, JRC/DG RTD and own calculations

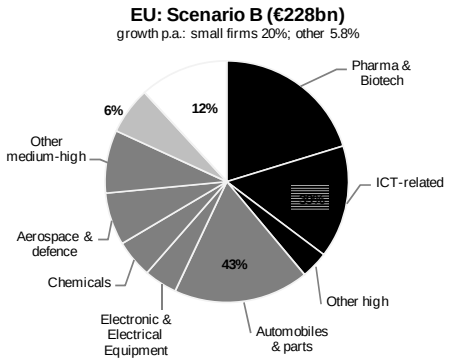
Figure 2, in the next page, illustrates the results of the projected EU Industrial R&D Investment Scoreboard for 2020 (target scenarios A, B and C).

**Figure 2. Projected EU Industrial R&D Investment Scoreboard for 2020 – R&D investment shares by sector group - Scenario results**



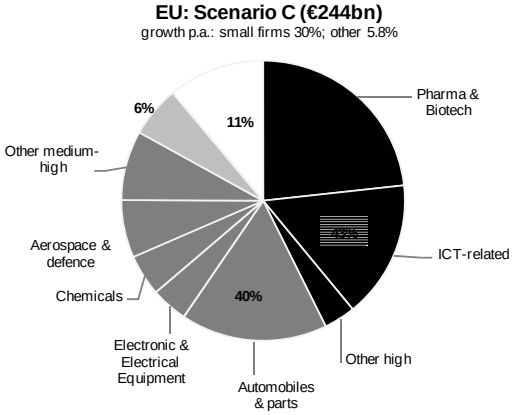

**S-A: 10% p.a. growth for SMEs until 2020**

**Compared to SB 2010**:
S-A suggests that high-tech sectors (especially Pharmaceuticals & Biotech) as well as low-tech industries may increase their sectoral shares on overall R&D investment in EU-27; medium-tech sectors (esp. Automotive & Parts) tend to decrease.




**S-B: 20% p.a. growth for SMEs until 2020**

**Compared to SB 2010**:
According to S-B, the assumed fast growth track of small firms is expected to lead to a moderate shift in terms of shares on overall R&D investments in EU-27 from medium towards high-tech sectors (thus underlining the importance of small firms, particularly for Pharmaceuticals & Biotech sector). Nevertheless, the magnitude of the increase in R&D investments remains relatively small given the assumed fast growth scenario of 20% p.a. (R&D growth +3% compared to S-A)




**S-C: 30% p.a. growth for SMEs until 2020**

**Compared to SB 2010**:
S-C represents the most optimistic growth scenario. In fact, the simulated R&D investments for the year 2020 are 90% above the figures of SB 2010 with the most significant increase expected for high-tech sectors (+140%). In contrast, the importance of medium-tech sectors for corporate R&D in Europe seems to be decreasing.

Nevertheless, the scenario illustrates that even under the assumption of extreme growth in small R&D-intensive companies over a comparably long period (as assumed in S-C), the sector composition of business R&D in Europe is not changing fundamentally. In this regard, large firms seem to matter more (small firms' growth appears relevant only in some high-tech sectors).

Legend: Black: high-tech. Dark grey: medium-high tech. Lighter grey: medium-low tech. White: low-tech

Source: JRC-IPTS (2012 ▸) calculations based on data from the 2010 EU Industrial R&D Investment Scoreboard (European Commission, JRC/DG RTD, 2011▸)

Note: Table A1 in the Annex provides more detailed information concerning the results of the scenario projections broken up by sector groups and in monetary figures.

The main results of the scenario analyses can be summarized as follows:

a) The simulated scenarios suggest that corporate R&D spending of the *EU Industrial R&D Investment Scoreboard* listed companies will rise by a total of 70 - 90% until 2020 in comparison to the figures from SB-2010 (depending on the assumed scenario and subject to a series of assumptions).
b) The ratio of Business Enterprise Expenditure on R&D [BERD]/GDP in EU-27 is expected to increase to 1.6 - 2.0% by 2020 and may thus reach the Europe 2020 target in this regard (3% GERD, of which 2/3 should come from the business sector), if both the most optimistic firm growth scenario and the lowest assumed GDP growth projections are realised.
c) The share of high-R&D-intensive sectors in terms of total expenditure on R&D in Europe is forecast to increase from 34% in SB-2010 to at least 37% (low-growth scenario) and possibly 43% in the highest-growth scenario. In turn, shares of low- and medium-low-R&D intensive sectors are expected to remain virtually unchanged.

As the simulated scenarios vary according to the assumptions concerning small firms' growth, the magnitude of the differences in the results provides a good indication of the importance of small vs. large firms for certain sectors.

**Overall, the projection indicates that, if one expects the present small R&D-intensive firms to be an engine for a substantial structural change in the European economy**, from being driven by medium-tech sectors towards a high-tech-based economy, **this requires either a significantly longer timescale for the assumed fast growth track than the simulated 10 years, or that small firms' growth figures exceed the assumed annual 30%** (as in the most optimistic scenario). Neither eventuality appears to be particularly realistic. (i.e., increase volume and R&D intensity, by generating and/or absorbing more R&D and innovation also in less technological intensive sectors, and diversify sector of business activities towards more knowledge-intense ones).

## 4. Policy implications

This article aims to illustrate the capacity of the current population of top innovative SMEs to drive the necessary structural shift of the European economy towards more knowledge-intensive sectors. Though relying on strong assumptions and a methodologically rather simple linear projection, the results help to put into perspective the level of ambition of the EU R&D intensity target and contribute to the debate on where the EU research and innovation policy agenda should place the emphasis to reach its objectives.

In sum, the scenario simulations have revealed that - by relying especially on the existing population of R&D-intensive SMEs - the EU will probably not manage to accelerate sufficiently the renewal of the economic structure towards knowledge-intensive sectors and thus achieve the objective set out for the year 2020. In fact, even in the most optimistic scenario hypothesised the EU will hardly change its industrial structure (i.e. high-tech sectors will still contribute 43% of the total private R&D investment in 2020, from a share of 34% in 2010), which will continue to be substantially different from its US counterpart (in which, for example, high-tech sectors contribute 68% of the total private R&D investment already in 2010). This comparatively slow rate anticipated with regard to the shift of the EU's sector composition hinders the efforts made to close the gap of private R&D investment between the EU and its main competitors.[7].

Hence, it can be concluded that to accelerate the renewal of the industrial structure in the EU, besides stimulating a more frequent creation of innovative firms and facilitating SMEs to tap into R&D activities, we will also need an increase in R&D activities performed by large-scale corporations. This illustrates the importance of stimulating the creation of new technology-based firms, the growth of both smaller and large innovative companies and the need to promote the coexistence of

[7] See Moncada-Paternò-Castello *et al.*, 2010 ‣ on the EU-US corporate R&D investment gap

innovative and competitive firms of different sizes which may follow different growth paths.

Overall, there is also need of increasing R&D investment volumes in less technological intensive sectors, promoting their R&D absorptive capacity and their diversification towards more knowledge-intensive activities.

In this respect, the EU research and innovation policy agenda needs to find the right policies and instruments to support the growth of the whole range of innovative companies, covering a large spectrum of options[8] from framework conditions to fim-level incentives. This implies the need for differentiated policy instruments targeting different firm classes (by size, age, business model, industry, etc.) and sectors (from high R&D to low R&D-intensive ones). In addition, measures to support new high-tech ventures and their rapid growth are of the utmost importance.

**Acknowledgements**

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[8] Policies to foster private R&D and innovation address following fields: a) framework and market conditions (e.g. infrastructures, economic stability, internal market rules, the labour market, the financial market for innovation, innovation demand, entrepreneurial culture, etc.), b) Factor endowment/capability: appropriate governance and management of science/technology-based business, knowledge/skills, absorptive capacity, c) Individual and social incentives.

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# ANNEX

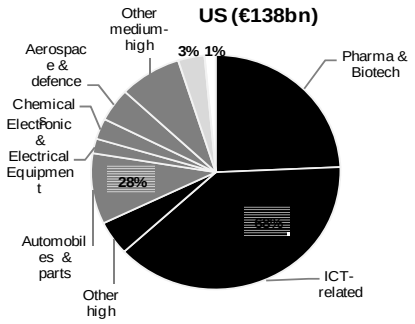
## *I. More on the relevance of SMEs vs large firms in the EU*

The 20.7 million SMEs represent more than 98% of all businesses in the EU and hold 67% of the total employment in the EU (EC, 2012).[9] On the other hand, in most EU countries large-size enterprises account for a considerable part of the value added of the business sector despite representing a comparably very small share of the total population of businesses (OECD, 2012).[10] Moreover, the share of business enterprise expenditures on R&D (BERD) in terms of Gross Value Added (GVA) of EU large-size enterprises is about five times as high as that of SMEs (EC, 2013).[11]

## *II. R&D investment shares by sector group in the US in 2010*

For possible comparison with the information on EU-27 presented in Figure 1, Figure A1 below reports R&D investment shares by sector group in the US in 2010.

***Figure A1 - R&D investment shares by sector group in US in 2010***




Legend: Black: high-tech. Dark grey: medium-high tech. Lighter grey: medium-low tech. White: low-tech

Source: The 2010 EU Industrial R&D Investment Scoreboard (European Commission, JRC/DG RTD, 2011 ).

## *III. More information about the scenario building*

Reference scenario (RS): All firms may grow at the same growth rate of 7.1% (unweighted average 8 years' employment CAGR across all EU SB firms) regardless of the corresponding company size. This reference scenario corresponds to a simple extrapolation of the *status quo* average growth paths (i.e. a continuation of the 2002-2009 growth trajectory until 2020).[12]

[9] European Commission (2013) EU SMEs in 2012: at the crossroads. Annual report on small and medium-sized enterprises in the EU, 2011/2012. ECORYS, Rotterdam, September 2012.

[10] OECD (2012), Entrepreneurship at a Glance 2012, OECD Publishing - doi: 10.1787/entrepreneur_aag-2012-en

[11] European Commission (2013). Share of Business enterprise expenditures on R&D (BERD) to the gross value added (GVA) – Unpublished calculations by DG Research and Innovation/Economic Analysis Unit based on OECD, Eurostat and DG Enterprise and Industry.

[12] Employment CAGR 8yrs across all 2,000 SB firms: 6.1% (only EU: 7.1%); large-scale firms in EU: 5.8%, in RoW: 4.8% (all large firms together: 5.3%); SMEs in EU: 15.0%, SMEs in RoW: 12.6% (all: 14.6%).

Target Scenario (A): R&D-intensive SMEs in the SB grow 10% per year until 2020. Note: The average annual employment growth rate calculated for the corresponding sample of firms for the period 2002 – 2009 was 15% (i.e. this scenario is rather 'pessimistic' as it assumes a decline in small firms' average growth patterns). Firms other than SMEs are assumed to grow 5.8% per year until 2020, which represents the average 8-year employment CAGR for all firms which have not been classified as SMEs at any point between 2002 and 2009.

Target Scenario (B): 20% annual growth rate for SMEs: Implicitly this scenario corresponds to the definition of a fast growing firm as agreed by OECD and EUROSTAT: A company is thus classified as being 'fast growing' if, in a consecutive three-year period, in each of these years a minimum of 20% increase in either sales or employment is achieved.[13] All other SB firms (non-SMEs) are assumed to grow 5.8% per year until 2020.

Target Scenario (C): 30% annual growth rate for SMEs, while all other firms in the SB grow 5.8% per year until 2020 (equal to the average over the previous years).

Please note that all company data have been adjusted for both inflation and exchange rate effects[14], i.e. all figures are converted into values corresponding to 2010 prices in Euros. Accordingly, all presented scenario results are directly comparable (no further adjustment or discounting needed).

## *IV. More information about the results of the scenario projections*

Table A1 below provides volumes and shares for both the SB 2010 and the scenarios by sector group in terms of R&D intensity.

***Table A1 - Results of scenario projections by sector – R&D investment (€)***

| | **SB 2010** | | **R-S** SB 2020 reference scenario (all firm sizes + 7.1% p.a.) | | SB 2020 **Scenario A** (SMEs +10% p.a.) | | SB 2020 **Scenario B** (SMEs +20% p.a.) | | SB 2020 **Scenario C** (SMEs +30% p.a.) | |
|---|---|---|---|---|---|---|---|---|---|---|
| R&D investment by SB companies from EU (€billion/million) | 128bn | % | 227bn | % | 220bn | % | 228bn | % | 244bn | % |
| Pharma & Biotech | 20397 | 15.9 | 36308 | 16.0 | 41086 | 18.6 | 46133 | 20.2 | 56785 | 23.3 |
| ICT related | 19070 | 14.9 | 33488 | 14.8 | 32485 | 14.7 | 34441 | 15.1 | 38571 | 15.8 |
| Other high-tech | 3970 | 3.1 | 6987 | 3.1 | 8100 | 3.7 | 8337 | 3.7 | 8839 | 3.6 |
| Automobile & parts | 27408 | 21.4 | 55185 | 24.3 | 41030 | 18.6 | 41043 | 18.0 | 41070 | 16.8 |
| Electronic & Electricals | 6994 | 5.5 | 12528 | 5.5 | 9960 | 4.5 | 10064 | 4.4 | 10283 | 4.2 |
| Chemicals | 7473 | 5.8 | 13595 | 6.0 | 11532 | 5.2 | 11544 | 5.1 | 11569 | 4.7 |
| Aerospace & Defence | 7998 | 6.2 | 14668 | 6.5 | 16000 | 7.2 | 16044 | 7.0 | 16136 | 6.6 |
| Other medium-high | 12073 | 9.4 | 19671 | 8.7 | 19093 | 8.6 | 19226 | 8.4 | 19508 | 8.0 |
| Medium-low-tech | 9487 | 7.4 | 14689 | 6.5 | 14328 | 6.5 | 14349 | 6.3 | 14396 | 5.9 |
| Low-tech | 13106 | 10.2 | 20274 | 8.9 | 26918 | 12.2 | 26927 | 11.8 | 26946 | 11.0 |

Note: Following the OECD approach (2005), sectors are split into four groups according to the R&D intensity:

- High-tech: R&D intensity (R&D/sales) above 5%
- Medium-high tech: R&D intensity (R&D/sales) between 2% and 5%
- Medium-low tech: R&D intensity (R&D/sales) between 1% and 2%
- Low-tech: R&D intensity sector group: below 5%.

For details see European Commission: The 2010 EU Industrial R&D Investment Scoreboard.

[13] See: OECD-EUROSTAT (2005).

[14] For more details, see pages 9-11 of the corresponding study (Voigt and Moncada-Paternò-Castello, 2012) http://iri.jrc.ec.europa.eu/documents/10180/12134/Projection%20of%20R%26D%20Intensive%20Enterprises%27%20Growth%20to%20the%20year%202020%20-%20Implications%20for%20EU%20policy

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Abstract

The Policy Brief addresses the following question: To what extent the high-growth of current innovative R&D-intensive SMEs can drive the envisaged structural change of the EU economy towards high R&D intensive sectors? It aims to contribute to the debate about how to set the right priorities and find the most appropriate policy interventions to allow Europe to reach the 3% R&D intensity target and hence its growth and employment objectives. It first summarises stylised findings from the literature on the relevance of innovative companies for economic growth, then presents results from a recent JRC-IPTS study which go some way towards answering the question posed above, and concludes by outlining some of the contributions that enrich the policy debate.

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