

EU's challenges for innovation based growth

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STATE OF AFFAIRS

There are many highly innovative European companies,
but on average

Europe has consistently failed to exploit its potential for
innovation-based growth,
despite a series of innovation policy strategies and
targets.

Some bits of evidence

- In the **Innovation Union Scoreboard**, the EU scores consistently behind the US. China is very quickly improving its IUS position relative to Europe.
- Europe's gap relative to the US holds across almost all components of innovation capacity (systemic deficit)
- **Business R&D intensity** remains far below that in the US, South Korea and Japan and even China
- Under fiscal consolidation pressures, the trend has been for less **public spending on R&D**. This is the case especially in the weaker, innovation-lagging countries that were under fiscal pressure, resulting in an increasing intra-EU divergence in public R&D spending.
- On **science**, the EU has caught up in quantitative terms with the US. In quality terms, the EU is catching up, but only very slowly, and mainly thanks to small pockets of excellence in specific sub-fields. Europe still has few world class institutes that excel in multiple and broader fields.

CHALLENGES

High expectations for science and innovation to bring us out of the crisis and address societal challenges;

BUT

Problems are structural and longstanding.

- Europe's failing capacity for creative destruction: **missing specialization in innovation based growth sectors and firms**
- Europe's fragmented science, research and innovation area: **missing "European Innovation Value Chains"**.
 - transfer of new science and research insights into commercial ideas that can command world-leading positions.
 - link regional and national innovation systems within a more integrated European innovation system

Challenges

- Continued/tightened **fiscal consolidation pressure**.
 - Member States/EC to freeze/cut their public RTDI budgets
- The **innovation divide** further widening in future, as the consolidation pressure is greater in innovation-lagging countries.
- Activating private RTDI investments in Europe becomes increasingly more difficult if uncertainty on growth prospects continue
- And all this while the rest of the world (Asia, US..) is forging ahead...

Diagnosing EU's innovation deficit

The nature of EU's industrial structure is a major reason for the persistent business R&D investment deficit/divide:

a deficit in the capacity for creative destruction

- EU fails to specialize in innovation based growth sectors
- EU misses « yollies » in high-growth sectors

Innovation Based Growth Sectors: sectors which (i) have an R&D intensity above average, (ii) an R&D growth rate above average and/or (iii) an above average share of young companies among its leading innovators.

aerospace, biotech, computer hardware&services, health care equipment & services, internet, pharmaceuticals, semiconductors, software, telecom equipment.

Yollies: companies born since 1975 who have made it into the R&D scoreboard of world leading innovators

Amazon, Google, Microsoft, Qualcomm, Amgen...

EU fails to specialize in innovation based growth sectors

Relative Technological Advantage (RTA) indices by sector

Innovation based growth sectors in italics

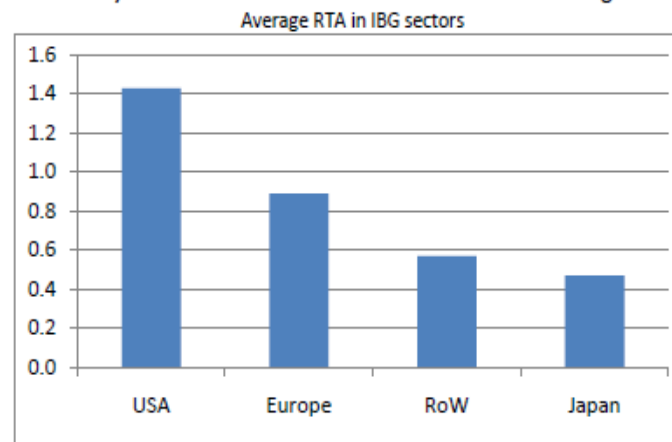
| | EUR | US |
|--|------|------|
| <i>Aerospace & defence</i> | 1,5 | 1,13 |
| Automobiles & parts | 1,26 | 0,58 |
| <i>Biotechnology</i> | 0,32 | 2,2 |
| Chemicals | 1,31 | 0,64 |
| Commercial vehicles & trucks | 1,3 | 1,06 |
| <i>Computer hardware+Computer services</i> | 0,08 | 1,39 |
| Electrical components & equipment | 1,56 | 0,18 |
| Electronic equipment+Electronic office equipment | 0,18 | 0,37 |
| Fixed +Mobile telecommunications | 1,53 | 0,2 |
| Food+Beverages+Tobacco | 0,92 | 0,74 |
| General industrials | 0,61 | 1,49 |
| <i>Health care equipment & services</i> | 0,7 | 1,86 |
| Household goods | 0,84 | 1,6 |
| Industrial machinery | 1,84 | 0,24 |
| Industrial metals | 1 | 0,3 |
| <i>Internet</i> | 0 | 2,54 |
| Oil | 1 | 0,85 |
| Personal goods | 1,44 | 0,69 |
| <i>Pharmaceuticals</i> | 1,27 | 1,16 |
| <i>Semiconductors</i> | 0,5 | 1,72 |
| <i>Software</i> | 0,51 | 2,05 |
| Support services | 0,78 | 1,19 |
| <i>Telecommunications equipment</i> | 1,38 | 1,09 |

Note: RTA are calculated as the share of the region in total sectoral R&D relative to the share of the region in overall R&D. A RTA value higher than 1 reflects that the region is technology specialized in this sector. Japan and RoW are not reported because of too few observations when disaggregating to individual sectors. Innovation based growth sectors are bold and in italics.

Source: Bruegel and World Bank, on the basis of IPTS R&D Scoreboard data.

EU fails to specialize in innovation based growth sectors

Only the US R&D-specializes in innovation based growth sectors



Source: Bruegel and World Bank, on the basis of IPTS R&D Scoreboard data.

Yollies and EU's Innovation deficit

| | EU | US |
|--|-------|-------|
| Share of Yollies in number of region's leading innovators | 23% | 51% |
| Share of Yollies in region's leading R&D | 7% | 35% |
| R&D intensity of Yollies | 4% | 10% |
| R&D intensity of Ollies | 3% | 4% |
| Share of the region's Yollies in Innovation Based Growth Sectors | 62% | 84% |
| R&D intensity of Yollies in Innovation Based Growth Sectors | 13.9% | 12.6% |

Sources: Authors' own calculations, the 2008 EU Industrial R&D Investment Scoreboard, EC, JRC/DG RTD

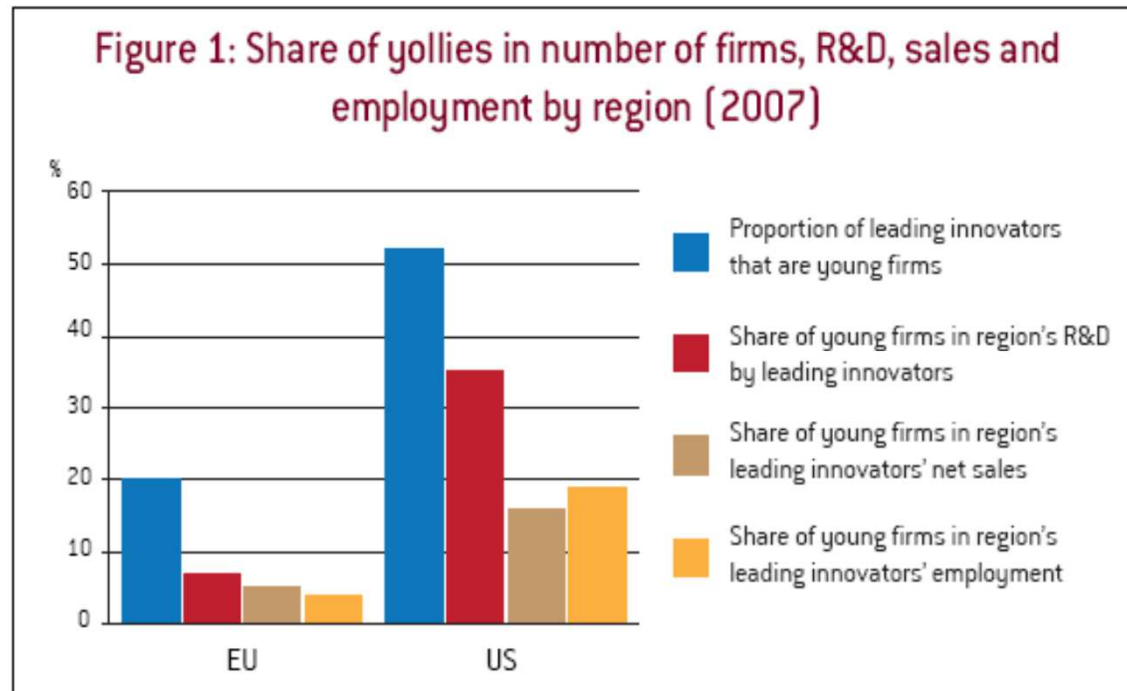
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Yollies: companies born since 1975 who have made it into the R&D scoreboard of world leading innovators

Amazon, Google, Microsoft, Qualcomm, Amgen... LMS, Materialise

Europe has less young firms among its leading innovators



Yollies = Young Leading Innovators created after 1975

Sources: Bruegel/European Commission JRC-IPTS on the basis of the EU Industrial R&D Investment Scoreboard (European Commission, 2008).

EU less young firms among its leading innovators than US

US

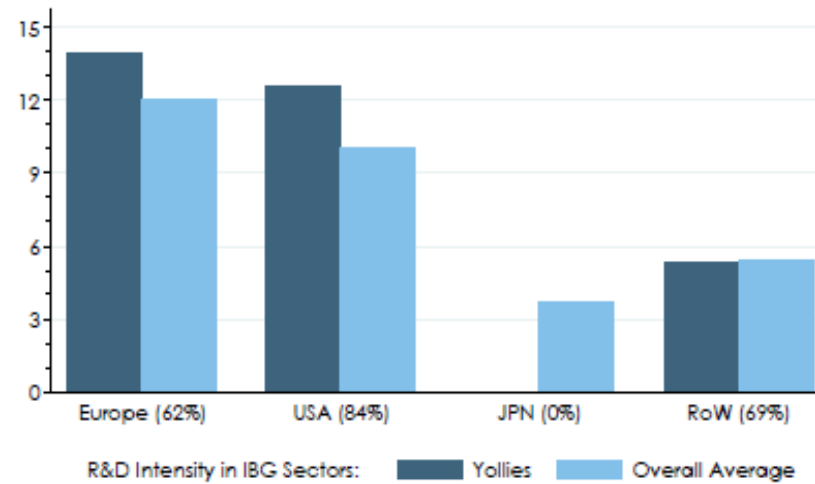
| world rank | Name | Industrial sector (ICB-3D) | R&D 2013 (€million) | R&D 3 years growth (CAGR-3y, %) | R&D intensity (%) | Employees 2013 | Employees 3-years growth (CAGR-3y, %) |
|------------|----------------------|---------------------------------|---------------------|---------------------------------|-------------------|----------------|---------------------------------------|
| 3 | MICROSOFT | Software & Computer Services | 8252,5 | 8,0 | 13,1 | 128000 | 12,5 |
| 4 | INTEL | Technology Hardware & Equipment | 7694,1 | 17,3 | 20,1 | 107600 | 9,3 |
| 8 | JOHNSON & JOHNSON | Pharmaceuticals & Biotechnology | 5933,6 | 6,1 | 11,5 | 128100 | 4,0 |
| 9 | GOOGLE | Software & Computer Services | 5735,6 | 28,1 | 13,2 | 47756 | 25,1 |
| 11 | GENERAL MOTORS | Automobiles & Parts | 5220,8 | 1,1 | 4,6 | 219000 | 2,7 |
| 12 | MERCK US | Pharmaceuticals & Biotechnology | 5165,0 | -6,2 | 16,2 | 76000 | -6,8 |
| 15 | PFIZER | Pharmaceuticals & Biotechnology | 4750,2 | -11,2 | 12,7 | 77700 | -11,1 |
| 17 | FORD MOTOR | Automobiles & Parts | 4640,7 | 8,6 | 4,4 | 181000 | 3,3 |
| 18 | CISCO SYSTEMS | Technology Hardware & Equipment | 4563,8 | 2,6 | 13,4 | | |
| 22 | IBM | Software & Computer Services | 4088,9 | 3,5 | 5,7 | 431212 | 0,3 |
| 23 | ELI LILLY | Pharmaceuticals & Biotechnology | 4010,8 | 4,2 | 23,9 | 37925 | -0,4 |
| 24 | ORACLE | Software & Computer Services | 3735,0 | 4,5 | 13,5 | 122000 | 4,0 |
| 25 | QUALCOMM | Technology Hardware & Equipment | 3601,6 | 24,9 | 20,0 | 31000 | 21,0 |
| 31 | GENERAL ELECTRIC | General Industrials | 3444,3 | 4,8 | 3,3 | | |
| 35 | APPLE | Technology Hardware & Equipment | 3244,9 | 35,9 | 2,6 | 80300 | 19,9 |
| 38 | AMGEN | Pharmaceuticals & Biotechnology | 2960,6 | 12,2 | 21,9 | 20000 | 4,8 |
| 40 | BRISTOL-MYERS SQUIBB | Pharmaceuticals & Biotechnology | 2705,4 | 1,6 | 22,8 | 28000 | 1,2 |
| 44 | EMC | Technology Hardware & Equipment | 2355,2 | 12,5 | 14,0 | 63900 | 9,6 |

EU

| | | | | | | | |
|----|----------------------|-----------------------------------|---------|-------|------|--------|-------|
| 1 | VOLKSWAGEN | Automobiles & Parts | 11743,0 | 23,3 | 6,0 | 572800 | 18,7 |
| 10 | DAIMLER | Automobiles & Parts | 5379,0 | 3,5 | 4,6 | 274616 | 1,8 |
| 13 | BMW | Automobiles & Parts | 4792,0 | 20,0 | 6,3 | 110351 | 5,0 |
| 14 | SANOFI-AVENTIS | Pharmaceuticals & Biotechnology | 4757,0 | 2,7 | 14,4 | 112128 | 3,3 |
| 16 | ROBERT BOSCH | Automobiles & Parts | 4653,0 | 6,8 | 10,1 | 279739 | 0,4 |
| 19 | SIEMENS | Electronic & Electrical Equipment | 4556,0 | 2,4 | 6,0 | 367000 | -3,2 |
| 21 | GLAXOSMITHKLINE | Pharmaceuticals & Biotechnology | 4154,3 | -2,5 | 13,1 | 99817 | 0,4 |
| 27 | AIRBUS | Aerospace & Defence | 3581,0 | 5,1 | 6,0 | 144061 | 5,8 |
| 28 | ERICSSON | Technology Hardware & Equipment | 3484,8 | 0,1 | 13,6 | 114340 | 8,2 |
| 29 | NOKIA | Technology Hardware & Equipment | 3456,0 | -11,2 | 14,7 | 55244 | -25,3 |
| 32 | FIAT | Automobiles & Parts | 3362,0 | 20,2 | 3,9 | 225587 | 4,1 |
| 34 | BAYER | Pharmaceuticals & Biotechnology | 3259,0 | 0,5 | 8,1 | 113200 | 0,5 |
| 37 | ASTRAZENECA | Pharmaceuticals & Biotechnology | 3202,8 | 0,9 | 17,2 | 51500 | -5,5 |
| 39 | BOEHRINGER INGELHEIM | Pharmaceuticals & Biotechnology | 2743,0 | 3,8 | 19,5 | 47492 | 4,0 |
| 43 | ALCATEL-LUCENT | Technology Hardware & Equipment | 2374,0 | -3,6 | 16,4 | 62311 | -7,9 |
| 46 | SAP | Software & Computer Services | 2282,0 | 9,7 | 13,6 | 66572 | 7,6 |

Source: EC-IPTS R&D Scoreboard; Colored Firms are born after 1975

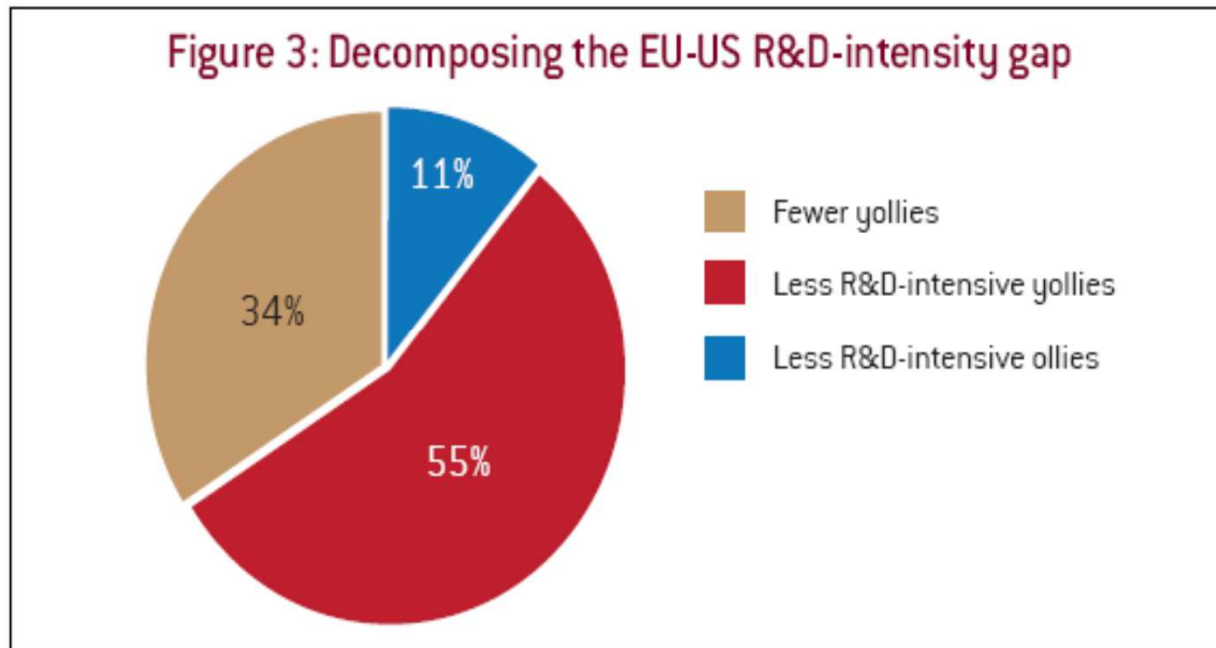
Europe has fewer Yollies in IBG Sectors, but within IBG sectors, EU yollies are as R&D intensive as US counterparts



Note: the share of Yollies in IBG sectors is in parentheses

Missing Yollies matters critically for closing EU's R&D gap

The lower R&D intensity of EU Yollies is the largest factor responsible for the total EU-US R&D intensity gap



Sources: Bruegel/European Commission JRC-IPTS on the basis of the EU Industrial R&D Investment Scoreboard (European Commission, 2008).

Europe's missing young digital innovators

| | All | ICT |
|--|------|------|
| R&D-to-Sales ratio | 3.2% | 6.1% |
| R&D growth (2010-2013) | 6.4% | 7.8% |
| Share ICT in total Scoreboard R&D | | 35% |
| Share Young (° >1975) among Scoreboard Firms | | 75% |
| Share of Youngest (°>1990) Scoreboard Firms | | 25% |

| | ALL | EUR | US | Asia |
|---|-------|------|--------|------|
| Region's share in ICT global R&D Scoreboard R&D expenditures | 100% | 19% | 49% | 27% |
| R&D-to-Sales ratio (RDI); ICT sectors | 6.2% | 5.5% | 8.6% | 4.2% |
| R&D growth (2010-2013); ICT sectors | 7.75% | 2.2% | 10.25% | 6.7% |

Source: R&D data are based on the EC-IPTS Scoreboard firms from ICT; JRC-IPTS-Scoreboard (2015)

Europe's missing young digital innovators



| | ALL | Layer I | Layer II | Layer III |
|--|--------------|---|--------------------------------------|---------------------------------|
| | | Electronic Equipment, Technology Hardware & Equipment | Telecom Operators (Fixed and Mobile) | Internet; Software; IT services |
| % Young in ICT Scoreboard Firms | 75% | 67% | 52% | 93% |
| % Youngest firms | 25% | 19% | * | 40% |
| % Young in ICT Scoreboard R&D | 57% | 48% | 23% | 85% |
| R&D Growth (2010-2013) Young | 12.1% | 11.4% | 2.2% | 13.7% |
| R&D Growth (2010-2013) Old | 2.8% | 3.3% | -0.4% | 1.1% |
| RDI Young | 8.3% | 6.5% | 1.5% | 12.9% |
| RDI Old | 4.9% | 6.0% | 1.7% | 5.0% |

| | LAYER I | | | | LAYER II | | | | LAYER III | | | |
|--|---------|-----|-----|-------------|----------|-----|------|-------------|-----------|------|----|------|
| | ALL | EUR | US | ASIA | ALL | EUR | US | ASIA | ALL | EUR | US | ASIA |
| Share of Layer in Region's ICT Scoreboard R&D | | | | | | | | | | | | |
| 68 | 69 | 57 | 88 | 5 | 13 | 2 | 5 | 27 | 18 | 41 | 7 | |
| R&D Intensity RDI | | | | | | | | | | | | |
| 6.25 | 8.4 | 8.0 | 4.4 | 1.6 | 1.5 | 1.4 | 2.1 | 10.4 | 10.7 | 12.3 | * | |
| R&D Growth (2010-2013) | | | | | | | | | | | | |
| 6.9 | 0.75 | 9.4 | 5.2 | 0.65 | -0.8 | 7.2 | -1.3 | 11.4 | 11.5 | 11.5 | * | |

| | LAYER I | | | | LAYER II | | | | LAYER III | | | |
|--|---------|-----|-----|------------|----------|-----|----|-------------|-----------|------|-----|------|
| | ALL | EUR | US | ASIA | ALL | EUR | US | ASIA | ALL | EUR | US | ASIA |
| Share of Young in ICT Scoreboard Firms | | | | | | | | | | | | |
| 67 | 35 | 72 | 48 | 52 | 27 | 85 | 71 | 93 | 87 | 95 | 85 | |
| R&D Intensity RDI of Young ICT Scoreboard Firms | | | | | | | | | | | | |
| 6.5 | 7.8 | 9.1 | 5.2 | 1.5 | * | * | * | 12.9 | 11.1 | 14.5 | 3.9 | |
| R&D Intensity RDI of Old ICT Scoreboard Firms | | | | | | | | | | | | |
| 6.0 | 8.25 | 6.7 | 4.9 | 1.7 | * | * | * | 5.0 | 6.8 | 5.9 | * | |

Source: R&D data are based on the EC-IPTS Scoreboard firms from ICT; JRC-IPTS-Scoreboard (2015)

Why Europe is missing Yollies in Innovation Based Growth Sectors (compared to US)?

- Lower rates of return from Innovation

- For every one euro invested in R&D, a US High Tech Yollie receives 20 cents in terms of additional generated output, c.p.
- For EU Yollies: 4 cents, non-significantly different from 0

Source: Cincera & Veugelers (2014); Exploring Europe's R&D deficit relative to the US: differences in the rates of return to R&D of young leading R&D firms, *Research Policy*,

- More financially constrained

- EU Yollies almost 4 times more cash constrained than US Yollies

Source: Cincera, Ravet & Veugelers (2014); R&D financing constraints of young and old innovation leaders in the EU and the US, *Economics of Innovation and New Technology*,

- Risk-taking financial markets
- Higher (Re-)entry & exit costs
- Inflexible labour markets
- Segmented product markets
- IPR effectiveness
- Insufficient linking in “innovation system”
 - Industry science links
 - Large incumbents and small new entrants
 - Public Private partnerships
- Government policy

...

The Policy Agenda

WHAT WE NEED:

more focus on improving capacity for structural change through Schumpeterian creative destruction:
new leading firms (Yollies) in new markets;

Will the current emphasis on framework conditions, -improving access to finance, improving access to skills, improving access to a large market and strengthening partnerships – although **necessary, be sufficient to address the specific barriers for development of new innovation based growth markets and firms** - access to *early risk financing*, access to *frontier science*, access to risk-taking *lead customers and complementary suppliers*, *specialized know-how and skills*?

Evaluating/Monitoring –Evidence-on–Effects- in-Sectors” based policy approach

A close monitoring of emerging innovative markets