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YOUNG LEADING INNOVATORS AND THE EU'S R&D INTENSITY GAP

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Research Centre – Institute for Prospective Technological Studies (JRC-IPTS) Industrial R&D Scoreboard (European Commission, 2008) of leading innovators in terms of global R&D expenditures by age cohort. We compare the innovation profile of young versus old leading innovators in the scoreboard and examine how the contribution of young leading innovators can explain the EU's lagging leading innovation performance.

We find that compared to the US, the EU has fewer young firms among its leading innovators. But this effect only accounts for about one-third of the EU-US differential. The largest part of the differential is due to the fact that young leading innovators in the EU are less R&D intensive than their US counterparts. Further unravelling shows that this is almost entirely due to a different sectoral composition. Young leading innovators in the US are found in R&D-intensive young sectors, with biotechnology and internet being the clearest cases. We thus confirm that the EU-US private R&D gap is indeed mostly a structural issue. Bridging this gap will require the EU to nurture more young firms in young sectors, enabling them to grow to become young leading innovators.

We proceeds as follows: section 1 presents the scoreboard data being used. Section 2 describes

1 THE LEADING INNOVATORS DATASET

We start with the set of firms that belongs to the EU-1000 and non-EU-1000 biggest[3] R&D spenders in the 2008 edition of the EU Industrial R&D Investment Scoreboard[4]. This dataset has been augmented with information on the date of the establishment of firms[5]. The information on the age of firms allows us to distinguish between young and old leading innovators.

As the scoreboard database only records the biggest R&D spenders, 'young firms' are not *small* start-ups. Indeed, the average size for the young firms in our sample is 10,000 employees worldwide. Some top 'young firms' in our sample (by R&D size) are Amgen, Cisco, Google, Microsoft, Oracle and Sun. As it includes (almost) no firms with fewer than 250 employees, the scoreboard dataset is not suited for analysing the small and medium-sized enterprise dimension.

The 'young firms' in our analysis are a group of firms that have managed on their own, ie without being taken over, and in a relatively short time-span since their birth (after 1975), to grow into world leaders deploying substantial R&D resources. We will label them young leading innovators (which we call *'yollies'*) to differentiate from old leading innovators (*'ollies'*).

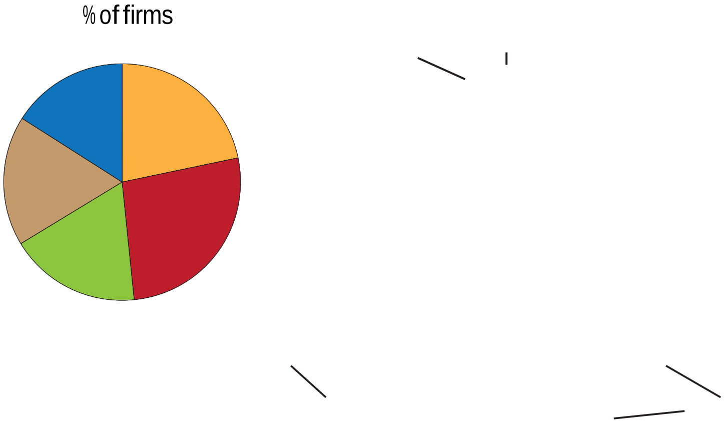
In addition to the age of firms, the dataset also contains information on the following variables: main industrial sector (according to the Industry Classification Benchmark – ICB), country of origin, net sales, number of employees, and R&D investment for each year for the period 2004-07. The geographic classification of firms is done on the basis of ownership and not by location of the activities[6].

Because data is missing for some firms, the final sample includes 1077 firms. The dataset is repre-

3. By 'big' we mean companies with R&D investment of more than €35m in 2007.

4. The European Commission JRC-IPTS has since 2004 collected annual data on companies investing the most in R&D worldwide (the EU Industrial R&D Investment Scoreboard. See: http://iri.jrc.ec.europa.eu/research/scoreboard.htm)

5. Age information has mainly been sourced from the websites of companies. This information has been crosschecked with other databases (eg Amadeus). We use the very first year of the firms' creation, ie *ex-nihilo* creation. In case of a merger and acquisition (14.9 percent of cases), the age of the oldest merged entity is considered.



sectors'. These sectors are internet, biotechnology, software, semiconductors, telecoms equipment, computer hardware, computer services, health equipment and services[9]. Young sectors are therefore basically a health/biotechnology and ICT story[10]. Table 1 also covers the electronics, telecoms services and pharmaceuticals sectors. These sectors are also present in the health/biotech and ICT nexus, and have a sizeable proportion of yollies, but young companies are much less pivotal in total R&D in these sectors.

Internet is essentially a post-1990 sector, as all

of 0.65. Japan has a ratio of just 0.08.

Among the leading innovators from the US, more than half are yollies, as Table 4 shows. By contrast, only one out of five leading innovators from Europe is young. For the US, yollies account for 35 percent of total R&D, for the EU a mere seven percent. Japan has almost no young firms among its leading innovators.

3.2 The innovation profile of young leading innovators by region

As Table 4 shows, yollies' share of R&D is higher than their share of net sales, both in the US and the EU, indicating that in these regions yollies have a higher R&D intensity compared to their older counterparts. But for the US this is more evident, leaving a higher R&D intensity differential for US yollies as compared to the EU, as Table 5 documents. For Japan and the reinnheir share of rsapccount f720(di.2(y c)11.2(o)15.2(m)20(p)9.8(ar)16.21J(t)24(h)23(an t

BOX 2: DIFFERENCES IN TOTAL R&D INTENSITY BETWEEN THE EU AND THE US DECOMPOSED BY AGE

The difference in total R&D intensity between the EU and the US can be decomposed by age of firm in the following components (see Annex 2 for the exact formulas):

Structural effect: the difference in shares of the age groups between the US and the EU. A positive structural effect will capture that the EU has fewer companies of the high R&D-intensive type as compared to the US. These are the yollies.

Intrinsic effect: the difference in R&D intensity between the US and the EU for both age groups (young and old). A positive intrinsic effect will capture whether young/old companies in the EU are less R&D intensive than their US counterparts.

Both the intrinsic and the structural effects are indeed positive. In relative terms, the structural effect is the least important as it contributes 34 percent of the EU-US R&D intensity differential. This leaves 66 percent of the R&D intensity EU-US differential explained by the intrinsic effect. This intrinsic effect is to the tune of 84 percent caused by the young firms, ie 55 percent of the EU-US R&D intensity differential is explained by the lower R&D intensity of EU yollies as compared to US yollies.

Total difference in RDI RDI^{US} - RDI^{EU}	Structural effect	Intrinsic effect		
		Total	Young	Old
3.8	5.81.3	2.5	2.1	0.4
100%	34%	66%	55%	11%

BOX 3: DIFFERENCES IN YOLLIES' R&D INTENSITY IN THE EU AND THE US DECOMPOSED BY SECTOR

The difference in the R&D intensity of yollies in the US and the EU (ie the intrinsic effect of Box 2) can be decomposed along the sectoral dimension in the following components (see Annex 2 for the exact formulas):

Structural effect: the difference between the US and the EU in shares of the sectors in which the yollies are located. A positive structural effect will capture that the EU has fewer yollies than the US in high R&D-intensive sectors.

Intrinsic effect: the difference in R&D intensity of yollies between the US and the EU by sector. A positive intrinsic effect will capture whether yollies in the EU are less R&D intensive than their US counterparts within the same sector.

Total difference in RDI^{y} $RDI^{y,US}$ - $RDI^{y,EU}$	Structural effect	Intrinsic effect
3.11	2.87	0.24
100%	92%	8%

Both the intrinsic and the structural effects are positive. But almost all of the difference in yollies' R&D intensity between the US and the EU is due to the structural effect (ie the different sectoral composition).

Although the difference in R&D intensity between the US and the EU for old companies was less important, it was nevertheless responsible for 11 percent of the overall R&D-intensity gap. A similar decomposition exercise can be performed for the ollies:

Total difference in RDI^{o} $RDI^{o,US}$ - $RDI^{o,EU}$	Structural effect	Intrinsic effect
1.19	1.56	-0.37
100%	131%	-31%

The largest factor explaining the difference in the case of ollies is again the positive structural effect, with US old leading innovators more present in high R&D-intensity sectors. But for ollies, the intrinsic effect is negative, ie EU ollies within the same sector are on average more R&D intensive than their US counterparts.

R&D intensive than US yollies. Is it a case of wrong sectoral specialisation? Are EU yollies operating in less R&D-intensive sectors or are EU yollies less R&D intensive when compared to their US counterparts in the same sectors[16]?

Again we use a decomposition analysis to calculate the sizes of these effects (see Box 3).

As Box 3 details, almost all of the explanation for than their US counterparts, counteracting the overall positive intrinsic effect. In healthcare equipment, there are fewer yollies in the EU as compared to the US, reinforcing the structural effect from Box 3.

In the ICT nexus, semiconductors is the sector most responsible for the structural effect in the EU-US yollies RDI gap, while the internet sector is the clearest case of a structural EU yollies problem, as there are no EU leading innovators while in the US, they are all yollies. The EU also has relatively fewer of its yollies in computer hardware and telecoms equipment

When comparing R&D growth performances within the same age category, the EU only has a small disadvantage relative to the US, both for yollies and for ollies. In the US, yollies have the highest contribution to overall R&D growth, being responsible for almost half of US R&D growth. In the EU by contrast, yollies account for only 10 per-

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ANNEX 1: TABLES

Table A1: Contribution of yollies by sector

	Yollies as % of firms	Yollies share of R&D	RDI yollies	RDI ollies	Sector's share of total R&D
Aerospace & defence	20.5	3.1	4.5	2.8	4.2
Automobiles & parts	14.5	3.7	4.2	3.8	17.5
Biotechnology	90.9	91.8	9.2	26.7	2.2
Chemicals	11	4.1	3.2	0.8	4.5
Commercial vehicles & trucks	4.5	1.8	2.9	2.3	1.7
Computer hardware	63.4	36.4	4.6	3.8	4.6
Computer services	64.3	12.6	5.5		