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## **Role and Dynamics of Corporate R&D**

Summary report of the First European  
Conference on Corporate R&D  
Seville, 8-9 October 2007

Joint Research Centre  
Directorate General Research

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European Commission  
Joint Research Centre - Institute for Prospective Technological Studies  
Directorate General Research

Contact information  
Address: Edificio Expo. c/ Inca Garcilaso, s/n. E-41092 Seville (Spain)  
E-mail: [jrc-ipts-secretariat@ec.europa.eu](mailto:jrc-ipts-secretariat@ec.europa.eu)  
Tel.: +34 954488318  
Fax: +34 954488300

<http://ipts.jrc.ec.europa.eu>  
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The European Commission collects and analyses policy-relevant information on corporate R&D through its 'industrial research and innovation monitoring and analysis activities' (IRIM) at the Joint Research Centre's Institute for Prospective Technological Studies (JRC-IPTS), in co-operation with DG Research. The *EU Industrial R&D Investment Scoreboard*, the *EU Survey on Business Trends in R&D*, the *Digest of Industrial R&D* and the *Industrial R&D Economic and Policy Analysis* are some of the products of this work (for more information on these reports see <http://iri.jrc.ec.europa.eu>).

There is, however, much more information available on the topic, some of it accessible in existing literature. But the most recent information, as well as the wealth of knowledge that which is embedded in the people who actively do research in the field, can only be tapped by bringing people together in an event such as a conference.

For this reason, JRC-IPTS and DG Research decided to host the first European conference on corporate R&D, entitled *Role and Dynamics of Corporate R&D*. It took place in Seville, Spain on 8-9 October 2007 and attracted around 150 participants from 30 countries. This Summary Report highlights the most important ideas arising from the presentations.




# Main messages from the Conference

The objectives of the Conference *Role and Dynamics of R&D* were to bring the community of researchers on corporate R&D together, learn about recent developments in the field and outline future avenues of research. A number of important messages can be extracted from the papers presented at the Conference.

## *From a policy perspective*

- Sectorally disaggregate approaches to understanding the EU's R&D performance needs to be introduced into the policy debate:
  - Aggregate R&D indicators have great limitations. There are major issues of interpretation in some of these indicators (such as R&D/GDP ratios), which require a sharper focus on disaggregate data.
  - We need to recognise that not all innovation is based on R&D, which implies using differential models of innovation that go beyond R&D-based models.
- R&D-performing firms need to be understood in the context of the sectoral or national systems of innovation in which they are embedded. This approach highlights some important features of R&D within innovation processes:
  - R&D contributes not only directly to innovation but also increases the effectiveness of other types of innovation activities.
  - Past R&D processes generate knowledge which increases the effectiveness of future R&D activities.
  - R&D activities are shaped by the market environment. The degree of competition not only determines the inclination and the ability to invest in R&D but also directly contributes to the effectiveness of R&D.
- More emphasis on the *quality* and not just the *quantity* of R&D is needed.



- The complementarity of R&D with other innovation activities has been largely neglected by policy-makers. However, the policy implications resulting from complementarities might be quite significant. More needs to be known about the nature of such complementarities and their policy implications.

- A common theme running through emerging issues in the field is the *open innovation* paradigm. This is characterised by the interaction of innovating firms with other innovation actors such as users, suppliers, producers of knowledge and policy-makers. This paradigm requires

- Focusing attention beyond a firm's R&D and innovation activities to consider other strategies for creating innovation and growth. For instance, how can firms best benefit from interacting with other innovation actors? What determines their capacity to absorb external know-how? How can intellectual property rights (IPRs) issues be dealt with in open innovation?
- Extending the unit of analysis in studies from the individual firm to the level of networks. How are networks formed, how do they survive, grow and compete with other networks? What are the links between R&D, the capabilities of actors involved in the process, the networks in which these actors are embedded and the type of innovation that emerges out of this interaction?


### *Taking stock of current research*

- There is a strengthening of database usage and integration in recent studies. While some simply rely on the Community Innovation Surveys (CIS), others use varied sectoral or firm-level databases that hugely enrich the quality of the results, such as those from confidential financial sources or from graduate employment data.

- A number of factors appear to be gaining importance in the analysis of corporate R&D, namely:

- the characterisation of innovation - for instance, moving towards a finer grained analysis of the type of innovation related to corporate






R&D (for example, new innovations vs. innovations that are within the existing knowledge base of the firm);

- the role of knowledge - such as emphasising the role of cognitive and knowledge distance among partners in R&D co-operation, as well as the stickiness and inertia of knowledge as factors that affect the outcome of R&D, innovation and co-operation;
  - the role of capabilities - for example, analysing capability accumulation in foreign subsidiaries of multinational corporations (MNCs) or recognising the relevance of experience in applications to Framework Programmes for being selected; and
  - the role of complementarities in an innovation system framework - for instance, the interaction between host country features, domestic capabilities, public policy, MNC headquarters and subsidiaries when analysing the internationalisation of corporate R&D.
- Econometric modelling shows significant advances in establishing associations between R&D and other variables of interest, but modelling is subject to some limitations:
- There is very limited advance in the measurement of variables in order to robustly establish causality and make predictions (*fundamental* measurement). The research community needs to be aware of what this kind of measurement entails.
  - The lack of common and accepted metrics in the field is a problem. Models often create arbitrary and unique units of measurement which are difficult to replicate and to compare to one another. One example is the definition of 'innovation' itself.

#### *For future research*

- Economic models for studying corporate R&D would benefit if they:
- included demand-side as well as supply-side drivers of corporate R&D;

- 
- addressed internal patterns of policy structure (such as tax credits) as treating them as simple dummy variables, such as 'policy-off' vs. 'policy-on', is highly unreliable; and
  - combined internal and external drivers of corporate R&D into the same estimations, which might require using systemic approaches to be feasible.
- Studies should include *dynamic analyses*. For instance, a dynamic view of R&D and innovation means paying attention to the inertial forces and lock-ins in innovative capabilities or to the relationship between growth, decline and transformation of innovative organisations.
  - Despite considerable progress in this area, further research is needed on the role of complementarities in innovation processes, which requires improved empirical estimates of the size and significance of complementarities between various innovative assets. There is also a need to understand the linkages between technological, organisational and other types of innovation.
  - More refined measures of innovation are needed. In particular, future innovation surveys (such as the CIS) should include new measures for the effect of process innovation. Unless there are quantitative indicators for process innovation (especially cost-cutting process innovations), the complementarities between different elements of innovation activities will not be properly understood.
  - Future research should also address in greater detail the link between innovation strategies of firms and certain elements of national systems of innovation. The empirical evidence on how such elements frame company strategies to improve competitiveness is far from exhaustive.

As the EU Commissioner for Science and Research, Janez Potočnik, has often remarked, Europe cannot base its future economic growth on cheap labour or the exploitation of natural resources. Neither does it want to grow at the expense of its citizens' hard-earned rights or the environment. The future for Europe's growth lies in becoming an increasingly knowledge-based economy.

Being knowledge-based involves many elements. One of these is investing more - and *more effectively* - in R&D. However, the EU's efforts in public R&D are not so widely at variance compared to other competing economies - it is in corporate R&D investment where the greatest gaps are evident. Here is where policy efforts could reap the greatest rewards.

What policies should be implemented? Policy-makers cannot simply make guesses at what will work. Rather, they must base any policy initiative on the best and most recent available evidence. This is not always a straightforward task.

Sometimes information is lacking - little can be done about this. If the information is available, often it is scattered among a host of publications. Sometimes policy-relevant conclusions are based on different types of studies that measure different units of analysis, which does not allow for comparison and for building towards sound conclusions.

Aware of this problem, the Conference *Role and Dynamics of Corporate R&D* (hereafter, the Conference) was conceived to address policy concerns. A series of policy questions, currently on the EU research policy agenda, were formulated and then grouped into five clusters, which became the Conference's 'thematic streams'. A sixth cluster was created for 'emerging issues' that - for some reason or another - are not currently salient in the EU research policy agenda. Just because some issues are not currently being discussed does not mean they are not important, now or in the future.

Participants were invited to contribute to these six thematic streams<sup>1</sup>. Out of 120 submissions, 40 papers were selected. Each thematic stream was assigned a rapporteur, who summed up the papers highlighting their main

1 See <http://iri.jrc.es/concord-2007>, the Conference website, for more details.



messages and showing the way forward for future research in the field.

This Summary Report presents an edited version of the rapporteurs' summaries. It is a key part of the Conference's objective of addressing policy-relevant questions on corporate R&D investment in the EU and beyond. It is also a contribution towards bridging the gap between science and policy more generally and an exercise in metabolising information which is highly technical into information which can be easily incorporated into the policy-making process.

# 1. Drivers of corporate R&D investments

(Nick von Tunzelmann, rapporteur)

This thematic stream relates to the private sector's levels and growth rates of R&D in regard to both *internal drivers* (what leads firms to increase R&D investments on their own account?) and *external drivers* (the role of framework conditions, such as government policies and human resource provision). Some papers in this section focused more on the former and some more on the latter. More study is needed of the interactions between internal and external drivers (see below).


The relevance of drivers of corporate R&D investments comes from their being seen as crucial to understanding step changes in levels of R&D carried out by the private sector, such as those implied in the Barcelona target of the Lisbon Strategy.

Drivers are essential to establishing how it might be possible to get the Lisbon Agenda back on course, especially in terms of what governments can do to raise the current 55% proportion of R&D expenditure conducted by the private sector towards the intended 2/3 ratio. Do we have to wish for miracles from internal changes or can external drivers be utilised to do the job for us?

## What we already know

The basic idea upon which the literature is building comes from the view popularised by the Lisbon Strategy of the critical significance of the 'knowledge-based economy' to economic competitiveness and performance in the recent past and still more in the century to come, coupled with a belief in our salvation from the side of technology. Unlike in mainstream 'neoclassical' economics tenets, where technology is purely exogenous ('*mana from heaven*'), the understanding here is that technological change is at least partly endogenous to the systems we are studying and hence comprehending its drivers allows for prescriptive conclusions and policy implications.

Specifically, the two main competing growth models drawn upon as underpinning the Lisbon Strategy - the *new growth* approach that follows from post-neoclassical thinking and the more heterodox *evolutionary economics* approach, both highlight the central role of R&D and innovation in endogenous ways, that is, amenable to change from factors that require



analysis. Both share a common heritage in 'Schumpeterian' thought, albeit in somewhat different ways.

In the literature, many points can already be regarded as beyond serious dispute, for instance:

- The diversity of corporate R&D behaviour depending on the sector and the size of the firms (large and small and medium-sized enterprises, SMEs), may be defined.
- Spatial effects including international interactions are inevitable, through the role of multinational corporations (MNCs), foreign direct investment (FDI) etc.
- Human capital accumulation, 'embodied' in people, is as equally important as the technology 'embodied' in machinery and equipment.


Similarly, a number of newly accepted points are becoming encompassed in the field:

- Financial factors drive internal allocations of expenditure on R&D (in the original spirit of Schumpeter).
- Interactions between human capital accumulation and R&D accumulation (as well as 'technological accumulation' more broadly) are important, for instance, via a firm's 'absorptive capacity'.
- Governments help set the field but in general should not intervene too directly, though human resource provision and market-friendly R&D tax credits can be beneficial.

### **What is new?**

Some of the key outcomes of the submitted papers (which will not be enumerated separately here) include the following:

- The most encouraging finding is that of a great strengthening of database usage and integration. While some other sections - not




surprisingly - used the Community Innovation Surveys (CIS), those under discussion here did not do so but called in other databases that hugely enriched the quality of the results, such as those from confidential financial sources or from graduate employment data. But all have in common something of the basic shortcoming of the CIS, which is 'what is *innovation*'?

- Almost all the papers showed a healthy respect for econometric validation, which could even become obsessive were it not linked to the first point about better quality data as 'input'.
- The papers generally support and underpin the role of financial factors in the decision to undertake R&D, though how to improve the financial drivers themselves was less commonly addressed as an issue.
- The importance of modelling demand-side as well as supply-side drivers came out of several of the papers, most explicitly from the paper by Guerzoni on the role of 'user sophistication', though again the question of how to raise this in turn went largely unexplored.
- Several of the papers implied that patterns of policy structure (such as tax credits) need to be assiduously modelled and that treating them as simple dummy variables (policy-off vs. policy-on) was highly unreliable. Moreover, the findings that policies tend to be taken up by the same few firms could be regarded as satisfactory or disquieting, depending on the deeper issues at stake.

There are points of contention in the field. Among the explicit but still undecided issues are the following:

- What is the appropriate unit of analysis (individual, firm, sector, region, nation etc.)? And how can these be combined? One paper using French data made a courageous attempt to link the micro-level estimators with those at a regional level.
- Because of the access to better and more disaggregate data sets, panel data on individual firms have become deservedly popular, but these mostly generate very low R2s from the extreme heterogeneity of



individual firm behaviour - how far can this be accepted as valid estimation?

- Leads and lags patterns are still unclear - partly because of the reliance, at least for the time being, on cross-sectional panels (survivor and duration models were suggested and sometimes used to illustrate such concerns)
- Profit-maximising views of firm behaviour vs. rule-of-thumb R&D allocations by firms (encapsulating the new growth vs. evolutionary economics debate) remain contentious. In other words, how far can we treat R&D expenditures 'as if' they were the outcome of rational profit maximisation, for instance in relation to cyclical determinants?
- Knowledge production functions remain popular despite having to make the assumption that 'inputs' and 'outputs' of knowledge can be clearly identified and distinguished, a proposition that some find implausible. Hence the continued resort to single-equation vs. equation systems views of R&D drivers - although it is only one facet of 'innovation', R&D is important, but maybe as 'learning' rather than for its extrinsic sake.


### What remains to be learned?

A key need for future research, as flagged above, is to combine internal and external drivers into the same estimations, based on enhanced models - systemic approaches which may be necessary to achieve this in any adequate way.

Regarding the areas which have been enlightened by research, unfortunately there remain more blind spots than recent successful achievements, among which might be included:

- More emphasis on the quality and not just the quantity of R&D, such as a reconsideration of the Barcelona Objective (reaching a R&D intensity in the EU of 3% of GDP), which implicitly puts quantity above quality. Approaches here could perhaps draw on citations etc. as used to evaluate the 'quality' of scientific publications.



- 
- The demand side needs to consider 'exogenous' drivers, for example, environmental concerns, income distribution, demography - at present the new growth approaches (especially) tend to fall back on assumptions of equilibrium and Say's Law (supply creates its own demand) which appear rather preposterous in a Schumpeterian world.
  - The precise nature of 'spillovers' needs greater attention - should we assume them to be costless (as new growth approaches tend to do) or as having costs (for example, via needs for absorptive capacity)?
  - The policy mix and the impact of indirect government policies (such as macroeconomic policy structures) on behaviour at corporate level still remain basically acts of faith.

Based on the papers encountered in this section, some predictions can be offered as to where the field may be heading, namely:

- Integrating costs and benefits views of R&D investments - one paper suitably emphasised 'bang for the buck' at firm/national level as a guideline for policy recommendations.
- The role of R&D in boosting 'absorptive capacity', including impacts that are non-monotonic and non-linear - this should also embrace the R&D role in non-manufacturing companies (including healthcare).
- The view of network-based firms - passing from 2G (hierarchical) to 3G (networked) models of corporate behaviour - are just beginning to creep into economics modelling, although it has been a standard tool of management literature for many years
- This may be an example of crosscutting interdisciplinary work that is needed for further study of the complex databases that are becoming available.




## 2. R&D in the economy (Keith Smith, rapporteur)

The papers in this thematic stream have approached a wide variety of issues, including structural analysis of R&D, determinants of R&D performance, R&D collaboration, spillovers, impacts of R&D (productivity, profitability etc.) and public policy initiatives and approaches.

In terms of method, these papers - with one exception - involved formal modelling techniques that were used either to explore problems of theory or to provide the basis for quantitative approaches of different types. The quantitative approaches were usually econometric or time series analysis, in one case combined with simulation modelling. One paper was essentially a careful analysis of the structure of R&D data and another one was more of a policy analysis of economies in which R&D data was limited in quantity and quality.

The papers and broad issues were as follows:

- Bayar and colleagues presented a sectorally disaggregate model of the links between R&D, inter-industry R&D flows and growth outcomes across EU Member States, combined with a forecasting model that asked about the effects of achieving the Lisbon targets on EU levels of income. The paper showed strong R&D impacts and suggested that achieving the Lisbon targets would have powerful effects on EU productivity and income. The paper suggested that there would be quite marked sectoral differences, however, this would be worthy of future analysis.
- De Dominicis and colleagues focused on high-tech clusters in Europe, using patent and R&D data to show that geographical proximity plays a key role in shaping cluster performance.
- Biatour and Kegels used a multi-sector input-output framework to show that inter-industry flows of capital and intermediate goods are a key source of productivity advance in Belgium. This paper suggests that cross-border flows of embodied R&D are a key element in total factor productivity (TFP) growth, at least in smaller EU economies.
- Lelarge and Nefussi's paper rested upon a complex amalgamation of company level and trade data in order to analyse French competitive




reactions to enhanced competition from low-wage economies. The paper shows that in sectors where French firms have faced such competition they have reacted not by reducing or going out of production, but by upgrading quality. This is demonstrated by rising unit values in French trade in these sectors.

- It is known that differences between the EU and the US rest in part on structural differences, in particular differences in the size of the ICT sectors. The paper of Lindmark and colleagues explored the extent to which this is linked with differences within the ICT sector itself.
- Ortega-Argilés and Brandsma looked at company demographics as a source of EU-US R&D intensity differences, showing that a much larger population of R&D-performing small firms is present in the US and that this plays a key role in the R&D intensity differences.
- Pasimeni and colleagues looked at the needs for improved innovation performance in a range of Maghreb and Mediterranean-rim countries, arguing for an innovation-systems approach to policy development in these countries.
- Swann's paper used a formal modelling approach to explore how increased competition might impact on R&D performance and through that on growth and consumption outcomes. It showed positive effects of enhanced competition for lower degrees of competition, followed by negative effects as competition becomes very strong.

## Conclusions, old and new

Some of the results from this thematic stream of the Conference confirm or develop long-standing results, restating the importance and impacts of R&D with respect to growth, employment, TFP growth etc. This is certainly important, especially where analyses and methods are being extended to new countries or regions. We do get a sense of the general applicability of methods and results that may be rather outdated.

However, a number of papers are very innovative studies. Several of them reflect an increasing ability to use sectoral or firm-level data for analytical



purposes. This is a big step forward. A good example of this is Lelarge and Nefussi's paper on quality upgrading in French industry, which goes a long way to explaining why import penetration has not in general been dramatic in low and medium tech industries in Europe: EU firms are responding with innovative upgrading strategies.

A generally clear conclusion from these papers is that aggregate R&D indicators tell us very little. There are major issues of interpretation in aggregate indicators (such as R&D/GDP ratios), which require a sharper focus on disaggregate data.

Variety - meaning sectoral differentiation - is a big issue. The paper of Malerba and colleagues, in one of the plenary sessions of the Conference, showing that spillovers are sector-specific, is particularly important. Papers in this strand of the Conference reflected that result. Biatour and Kegels on Belgian R&D and productivity growth and Ali Bayar and colleagues on impacts of R&D growth are clear examples of the need for sectorally disaggregate approaches to understanding the EU's economic structure and performance. One implication of these papers is the need to introduce these sectoral issues into the policy debate.

### **Concluding remarks**

Big advances have been made in understanding corporate R&D. However it is vital that we do not allow this to resuscitate the 'linear model', the idea that innovation policy can consist only of R&D plus commercialisation measures. In this context, it is important to remember the recent result from Eurostat that 51% of EU innovators perform no R&D at all.

The big policy message, from a number of papers in this strand of the Conference, is the need to take a sectorally differentiated approach to policy. If we take sectoral differences seriously, which also means taking specialisation seriously, we also need differentiated models of innovation which go beyond R&D-based models. We have the data and resources to do this. This is a challenge for the next Conference.



### 3. Structure and strategy for corporate R&D (Franco Malerba, rapporteur)


The main issues examined in this thematic stream were related to small and medium-sized enterprises (SMEs), mergers and acquisitions (M&As), partnerships and co-operation, and multinational corporations. In particular, the papers addressed the following specific issues:

- What are the main barriers to innovation to SMEs? And what is the role of innovation in this respect? The case of Hamburg (Tiwari and Buse).
- What kind of impact do M&As have on total R&D expenses and on the cost of innovation? The case of the Netherlands (Cefis and Schenk).
- What are the drivers and barriers to enter a partnership between companies of different regions such as the Netherlands and the Bay Area? (Nagle and colleagues)
- What are the factors that determine the participation to R&D consortia in the Framework Programme, in terms of application and in terms of approval? The case of Spanish companies (Barajas and Huergo).
- What is the relationship between the type of networks and the capability of a foreign subsidiary? The case of Central and Eastern Europe (Jindra).
- Are the major patents of multinational corporations in a globalised industry still homebound? The case of wireless com industry (Di Minin and Palmberg).
- To what extent and why do EU firms locate their activities outside their home countries? (Dachs and Weber).

#### What is new?

The papers presented in the sessions made some relevant points that built upon previous research.


- Tiwari and Buse's paper reported a survey done on SMEs in Hamburg. It stressed that several external as well as internal barriers to innovation exist. SMEs are interested in internationalization for several



reasons: local adaptation, learning from lead markets, access to know-how and cost reduction. Internationalisation of R&D helps to mitigate the barriers to innovation. Nevertheless, challenges to internationalisation exist regarding the finding of qualified personnel, cost explosion in booming economies, IPRs, start ups and operational costs and cross-cultural issues.

- Cefis and Schenk make the major point that M&As have a positive impact on total R&D expenses and on the cost of innovation. M&As increase the total cost of innovation by acquiring new types of machinery or software, marketing activities and training cost of R&D personnel. There is a consolidation of knowledge in order to fully exploit the knowledge base. But a trade-off in innovation exists in this respect: a positive effect on innovation within the knowledge base of firms and a negative effect on innovation regarding completely new products for new markets.
- Nagle and colleagues based their analysis on interviews with companies in the Netherlands and in the Bay Area. They focused on cooperative distance measured in terms of technological knowledge, business management knowledge, relational resources, monetary resources, organization and culture. They found that technological knowledge; business management knowledge, relational resources and culture are drivers of co-operation. Barriers are diffused but mainly concern ways of doing things and differences in culture. Furthermore, lack of awareness of developments in other areas is a significant barrier.
- Barajas and Huergo looked at the factors that determine participation in R&D consortia in the EU Framework Programmes. Their database is constituted by the proposals of Spanish firms. The authors contribute to the literature by separating the probability to apply from the probability to be awarded the project. They find that the probability of application is affected by technological capabilities, exports, firm size and prior experience. On the contrary, the probability of being selected is affected by the nationality of the leader, firm size and prior experience.
- Jindra developed original data on subsidiaries in Central and Eastern Europe (CEE) from survey data and used cluster centred analysis.






He linked subsidiaries' capabilities to multiple networks and explored the R&D embeddedness of subsidiaries in domestic networks and in international networks. He then developed an interesting taxonomy of subsidiaries in terms of type of integration (*global* - international networks; *local* - domestic networks) and amount of local capabilities. He found that local capabilities increase the penetration of a subsidiary in foreign and domestic networks.

- Di Minin and Palmberg used patent data from four wireless telecommunications companies, supplemented by direct company interviews. They developed a very interesting fine-grained analysis of different relevance of patents, and found that essential patents are still homebound. The reasons can be found in organisational inertia, subsidiary long-term maturation, learning curve effects and IPRs management. Interestingly, the authors also identified an international distribution of different phases of IPRs management.
- Dachs and Weber used patent data. They add, however, the analysis of cross-border patent applications to patent counts, where the applicant and at least one inventor reside in different countries. No evidence for large-scale overseas EU R&D activities in CEE, China and India is found. The most important host countries for internationalisation remain in Western Europe and North America. This actually strengthens the European Research Area (ERA). There are no signs of a major relocation of EU R&D activities yet. Why? The reasons can be found in few incentives to foreign R&D activities in host countries, limited scientific capabilities in host countries and a focus on adaptation of existing products in host countries.

### General remarks

Some general remarks on research progress emerge from the seven papers.

- *There has been progress towards a finer grained analysis on the type of innovation related to R&D.* The distinction among types of innovation is quite relevant for understanding corporate R&D. In one of the papers there is a distinction between completely new innovations vs. innovations that are within the existing knowledge base of the firm.




In another paper, a distinction between normal patents and essential patents (that are key for system developments, future innovations and standards) is introduced.

- *The role of knowledge has been recognised as central for an analysis of R&D performance.* The key role of knowledge and cognition has been put at the centre stage in several analyses. This is absolutely crucial in analyses of R&D in the so called “knowledge based society”. These analyses have emphasised the role of cognitive and knowledge distance among partners in R&D co-operation, as well as the stagnation and inertia of knowledge as major factors that affect the outcome of R&D, innovation and co-operation.
- *Different types of capabilities have been identified as relevant in the R&D process.* Capabilities now occupy a central role in the theory of the innovative firm. In several papers they have been included in a significant way. For example, for subsidiaries of multinational corporations an analysis of capability accumulation has been developed. Another example is provided by the experience in applications to Framework Programmes, which has been recognised as relevant for success in being selected.
- *The presence of multiple networks has been recognised as relevant for R&D.* Networks are now a key dimension of R&D. Therefore, research has to fully include them in analyses of the R&D process. In this respect, the papers in this section have examined various relevant dimensions: the role of local vs. international networks, the internal networks of MNCs, the presence of links between users and suppliers, and public policy networks.
- *Links and relationships among these variables.* Finally, given the fact that the variables mentioned above are related and that innovation systems are major explanatory dimensions of innovation, links among these variables have been examined in several papers. For example, the key link between capabilities and networks has been analysed in a paper. In addition the relationship between host countries' features, domestic capabilities, MNC organization and knowledge flows has been at the centre of research scrutiny in another paper.

## What remains to be learned?

Five major avenues for future research have been identified in this field.

- Develop a deeper and more complete analysis of the link between R&D, capabilities, networks and innovation. As mentioned above, it is important to deepen the analysis of the link between R&D, the capabilities of actors involved in the process, the networks in which these actors are embedded and the type of innovation that emerges out of this interaction. This type of analysis will also shed light on the geographical and organisational boundaries of the R&D process.
- Examine the role of complementarities. Complementarities play a major role in innovation. The burgeoning research on innovation systems, in which complementarities are central, is a clear demonstration of that. This means a deeper understanding of the working of these complementarities in an innovation system framework. For example, for MNCs and FDIs the interaction between host countries features, domestic capabilities, public policy, MNC headquarters and subsidiaries is a very important aspect to analyse.
- Be really dynamic in the analysis. R&D is inherently dynamic. Therefore future studies should move in the direction of being really dynamic in their frameworks, models and empirical analyses. For example, a truly dynamic view of R&D and innovation means paying a lot of attention to the inertial forces and lock-ins in innovative capabilities and to the relationship between the growth, decline and transformation of innovative organizations.
- Use different databases jointly. The points above call for the joint use of different databases. This means expanding, linking and integrating various existing databases at the organisational and individual levels. This progress is now feasible given the increasing availability of varied and detailed micro data.
- Identify the specificities and the differences of corporate R&D. R&D is a process highly dependent on the context in which it takes place. Therefore, analyses of corporate R&D should take into account the



sectoral, national and regional dimensions. Differences in this respect need to be examined. Investigating the sectoral, national and regional specificities means as a consequence that comparative analysis is essential. It also means that, at the empirical level, generalisations could be reached by examining what is common across sectors, countries and regions, and what is not.

- Develop public policy implications. Finally, public policy analysis should be at the centre of future analyses. The papers in the Conference have highlighted several very important aspects of R&D and innovation that have major implications and lessons for policy making. Most of the papers, however, have not addressed policy implications. Future research should be carried out to fill this gap.


## 4. R&D and the dynamics of firms and sectors

(Georg Licht, rapporteur)

### Topics raised and state of the art


The papers presented at the Conference focused on the role of R&D within the innovative activity of firms, the role of in-house R&D in collaborative projects, the impact of hampering factors on incentives to invest in R&D and the impact of R&D on innovation and productivity. As such the papers are rooted in the existing literature but extend our knowledge in several dimensions. Some papers look at issues where empirical evidence was not there before. An example here is the question of the stability of R&D joint ventures. Another novel topic of the session was the focus on the complementary nature of various innovative activities.

- Conte and Vivarelli examined the link between in-house R&D and the ability to absorb and acquire knowledge and technologies developed by third parties. Based on data from the Italian CIS III, they showed that, although product and process innovation are close related, there are significant differences with regard to the role of R&D and external knowledge. Results show that R&D is strictly linked to product innovation, while acquisition of external technology is more important for process innovation. The role of R&D in innovation also varies with the characteristics of firms and technologies. Hence, small firms in low-tech sectors typically innovate without relying on R&D but base their (process) innovations on technologies developed by others.
- Catozella and Vivarelli focused on the complementarity of in-house R&D and other types of innovative activity. They convincingly demonstrated that, apart from a direct productivity-enhancing impact, R&D also increases the effectiveness of other innovative inputs, such as external R&D, investment expenditures linked to new products and processes or the acquisition of technology through, for example, licensing. Although internal research might not be a necessary precondition for a firm to innovate, it is useful to carry out R&D because of its importance in the generation of synergies that amplify the impact of other innovative inputs. In this way, the paper enlarges the understanding of the crucial role of R&D in the innovation process.
- Crespi and Pianta used industry level data based on CIS II to IV for various EU Member States. The paper looks at factors that enhance



product and process innovation. Their findings at the industry level confirm previous studies which use country-specific-CIS micro data. Product innovations are more likely in a high growth environment and countries with significant social-capital-inducing collaboration among firms and between firms and universities, in open markets and when firms try to enter foreign markets. R&D is a crucial factor for the generation of product innovation. Process innovations are closely linked to cost-cutting strategies, embodied technical change and intra-industry learning environment. R&D plays a less important role for process innovations. Furthermore, there are significant differences with regard to the role of R&D for product and process innovation in manufacturing and services. Hence, sectoral and national systems of innovation are still important in EU Member States.

- Schmidt, Schwiebacher and Sofka highlighted another important role of R&D in firms. They showed that the experience gained by performing R&D not only contributes to the generation of innovation but also is useful for deciding which R&D projects should be performed and to stop failing R&D projects in time. Therefore, R&D not only helps in generating knowledge but also enhances the selection capacity for innovation projects, even in the implementation stage.
- Aralica, Račić and Redžepagić looked at R&D activities as a growth factor of foreign owned SMEs in Croatia using a small cross-section survey of foreign owned SMEs. They found that R&D does not play a significant role for these firms. Innovation activities mainly rely on acquisition of external technologies and purchase of innovative equipment. In addition, the link to the local science base is also weak and firms mainly collaborate with other firms, which marginally induces incremental product and process innovations.
- Maican investigated R&D as a driver of productivity growth using firm-level panel data for selected R&D industries in Sweden. By means of a traditional production function approach, they found that R&D as well as competition stimulate productivity. Maican's estimates suggest that actual R&D spending is below the optimal level in all sectors. This finding is remarkable as R&D intensity in Swedish manufacturing is much larger than in most EU countries.




Increasing competitive pressure (for example, by fostering firm entry or increasing competitiveness of small firms) complements policies which promote R&D in established firms. Hence, open market policies and entrepreneurship policies are important drivers of the competitiveness of established firms.

- Duso, Pennings and Seldeslachts also looked at the link between competition and innovation. More specifically, they analysed the stability of research joint ventures (RJVs) which were registered under the US national co-operation act which allows for certain antitrust exemptions in order to stimulate firms to cooperate in R&D. The empirical approach is quite novel and interesting per se. The results of Tobit panel regressions point out the importance of various features of RJVs for the stability and the evolution of RJVs. In addition, characteristics of the product market in which the firms of a RJV operate also influence the development of RJVs. One important finding is that a more concentrated RJV structure in the product market leads to more stability. This suggests that large RJVs comprising a significant share of the firms of an industry are not so much set up for learning, but rather for standard setting and possibly to enhance product market co-operation. Besides, RJVs are less stable in more turbulent product markets (that is, with high entry and exit rates) or in a rapidly changing technological environment. RJVs in such cases are less likely a vehicle for collusion but more likely a vehicle for technology production and learning. Consequently, competition and innovation policy should take into account the dynamics of technology and product markets when forming policies to foster R&D collaboration among firms.

### Contribution of the papers

The presentations in both sessions contributed to a deeper understanding of the role of R&D in the innovation process. In line with previous studies, the papers highlighted the crucial role of embeddedness of firms in the sectoral and national systems of innovation. This refers to, for example, the possibility of collaborating with universities, research institutes and other firms, the ability of firms to profit from the innovation activities of other firms in the sector or the openness of product markets to entry. More importantly, the papers point to three important features of R&D within innovation processes:

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- R&D contributes not only directly to innovation but also increases the effectiveness of other types of innovation activities. The relation of R&D to other forms of innovation activities is complementary in nature.
  - Past R&D processes generate knowledge which increase the effectiveness of future R&D activities, for example, via an increased ability to select R&D projects as well as to assess and reassess the success probability of R&D projects.
  - R&D activities are crucially related to and shaped by the market environment, most notably competition in the product market or industry. Competition is an important driver of R&D investment. In addition, R&D seems to be more productive in competitive environments.

The complementarity of R&D and other innovation activities is widely neglected by scholars and innovation policy makers. In fact, the idea and the empirical evidence of complementarity are convincing. The literature has investigated the complementary relation of selected features of R&D process only (for example, the complementarity of in-house R&D and outsourced R&D). The papers enhance our understanding that R&D is complementary to a much wider set of activities: R&D increases the effectiveness of new machinery, acquired or licenced technologies, outsourced R&D or training and human-capital investment. In addition, in-house R&D is an enabling factor of collaboration between firms and universities. Accordingly, innovation and R&D policy as well as firms need to recognise the role of R&D as an investment in absorptive capacity, selection capacity, evaluation capacity of new developments in a scientific, technological and economic domain.

Finally, the interlinks of competition and innovation have been the topics of considerable study in the past. Nonetheless, the empirical evidence is still inconclusive. The emerging evidence points towards an U-shaped relation between competition and innovation. The papers indicate that the relation is somewhat more complex. The degree of competition in a market not only determines the inclination and the ability to invest in innovation or R&D but competition also directly contributes to the effectiveness of R&D.




## Avenues for future research

There are two challenges which arise from the sessions. Despite considerable research in the past our knowledge about the interlinkages between various types of investments in R&D, knowledge and innovation as well as between competition and other characteristics of product markets, input markets and R&D and innovation strategies of firms is far from complete. We should know more about the role of complementarities in innovation processes. We need improved empirical estimates about the size and significance of the degree of complementarities between various innovative assets, here the papers made an initial step forward. Furthermore, there is a call for understanding the links between technological, organisational and other types of innovation by using present CIS data. However, there is a lack of more refined measures of innovation. For that reason, future CIS should include new measures for the effect of process innovation. Complementarities between different elements of innovation activities might be different between product and process innovation. Unless there are quantitative indicators for process innovation (particularly for cost-cutting process innovations), we will not be able to understand complementarity.

Innovation policies have largely neglected complementarities in the innovation process. However, policy challenges resulting from complementarities might be significant. That is why we should learn more from the nature of complementarities and their implications on innovation. As there is a lack of theoretical and empirical work on the topic, the policy lessons for complementarities are less obvious. For instance, assume that in-house R&D and investment in new innovative machinery are complements - what does this imply for innovation policy measures? Should policy interventions still focus on R&D or should policy address also complements to R&D such as human capital and physical investment?

Last, future research should also tackle, in a more detailed manner, the link between firm innovation strategies and certain elements of national and sectoral systems of innovation. The conceptual basis is well established, however the empirical evidence on how certain elements frame company strategies to improve competitiveness is far from exhaustive. Moreover, additional work should be done on the design and impact of policy



interventions in the presence of complementarities and embeddedness of innovation activities in a wider context (product markets, technological strategies of firms etc.).

## 5. New perspectives on the measurement, evaluation and impact of corporate R&D


(Carlos Montalvo, rapporteur)

This summary is based on approximately 25 papers presented at Conference, rather than merely the ones that corresponded to this thematic stream. The concept of 'measurement' is pervasive in almost all papers and authors frequently claim to have measured or assessed influences and/or impacts.

### State of the art in measurement of R&D


The measurement of R&D and innovation has been deemed a major challenge for many years. As early as 1962 Kuznets pointed out that the major problem in understanding the economic effect of technical change was the failure of scholars to effectively measure innovation. Sound evaluation of R&D itself and policies promoting R&D require the generation of reliable data and valid measurement. What is the state of the art of data reliability and measurement? Are there new approaches?

- There is common acknowledgement of limitations regarding quality and reliability of data. Such limitations in general arise from issues such as secrecy and a lack of disclosure of the very nature of R&D in relation to the competitive strategies of firms, the diverse interpretation of R&D across firms, differing information systems and accounting of fiscal regimes and costs, and the lack of representative sampling and generalisations. In addition, a great limitation factor is the cost of data gathering and the sustainment of data infrastructures that collect data over time (decades) to enable longitudinal studies.
- There have been substantial advances in the description and definition of 'attributes', that is to say, *contents* to be measured (or assessed). Similarly, there are advances concerning the description of relationships between R&D and a number of concepts that might determine the scope of R&D, innovation and economic performance (this is confirmed and discussed in the reports of other thematic streams). Such descriptions constitute the hypothesized *structure* of the contents described.

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- There is very limited advance in the measurement of variables in order to robustly establish causality and make predictions (*fundamental* measurement). Instead, most of the achieved measurement establishes correlations between two or more variables (*conjoint* measurement). The papers show significant advances establishing associations between R&D and other variables of interest, including the direction of potential influences (positive, negative, direct or inverse).
  - There is a preference of the authors of the papers for measurement methods based on econometric modelling. These methods present problems when applied to highly aggregate and heterogeneous samples such as industrial and services sector structures (in terms of firm sizes and levels of investments in R&D), while a better understanding is reached when fixed sectoral and firm effects are controlled for. However, it is common knowledge that the distribution of R&D and innovation may be skewed and in this case non-parametric methods might be appropriate.
  - The lack of common and accepted metrics in the field limits what can be achieved. For instance, similar effects arise when the level of aggregation is changed from a macro to meso, or micro levels. That is, variables that seem important, for example, in determining levels of investment or location of R&D facilities, lose relevance when the level of aggregation changes. Here disparate, conflictive and counter-intuitive results have much to do with the unit of measurement used in each case.
  - Advances in the field regarding the validity of measurement (or the validity of the theories underpinning measurement) thus far have covered face and concurrent validity in some depth. Much less has been achieved regarding predictive, content and structural validity.

### The way forward

The challenges faced by the community interested in R&D and innovation studies are similar to the measurement problems that other epistemic communities in the social sciences are facing. The way forward is to continue to strengthen any framework underlying the gathering of data



and, of course, continue the strengthening of data infrastructures. It would be highly valuable that data gathering is guided by theory and hypothesis testing. As R&D and innovation become more critical for the competitiveness of Europe in the coming decades, the need for better monitoring becomes more urgent in terms of strategy, policy analysis and design.

Research in the field would benefit from tapping into non-parametric and non-linear methods of analysis and measurement - establish clearly what type of measurement and validity the study intends to achieve (or has achieved). Given the desirability of sophisticated models that allow for establishing causality and prediction (*fundamental* measurement), there is a need for the community to become aware of what this kind of measurement entails. There is still a long way to go to establish predictive, content and structural validity in R&D strategy and policy studies.

Further research in the field is needed to develop comprehensive theories that integrate diverse R&D drivers that are currently considered separately. It is highly desirable to have a good understanding and measurement of the perceived reality of decision makers on the firm side (that is, elicited perceptions of R&D managers and strategists). This type of R&D research is very likely to bring more complications to the formulae, as it will require reconciling data of a very different nature. This type of data is likely to include extensive and intensive attributes (expressed and revealed preferences of firms' decision makers) and the non-linearity of decision systems in firms. In turn, this will bring more difficulties to measurement, as it implies the reconciliation of revealed and expressed preferences and systemic analysis where central trend methods have little to offer. Here the field would benefit from tapping into non-parametric methods like multi-dimensional scaling, partial least squares regressions and structural equations as additional methods to establish content and structural validity. Advances in the direction outlined above are likely to provide a sound basis to solving the long-standing problem of measuring the contribution of technical change to economic performance appropriately.



## 6. New and emerging issues in corporate R&D (Reinhilde Veugelers, rapporteur)

Research into corporate R&D is constantly developing and is not necessarily bound by the thematic streams outlined above. The Conference invited contributions that pushed the boundaries of this area of inquiry further by addressing new and emerging issues from a variety of different viewpoints.


A common theme that ran through these papers was the *open innovation* paradigm. This is characterised by the interaction of innovating firms with other innovation actors (users, suppliers, producers of knowledge, policy makers etc.).

Bajeux-Besnainou and colleagues directly examined the formation of innovation networks, stressing their heterogeneity of members and dynamics (entry-exit). The major motive identified in this paper for joining a network was to reduce the uncertainty of entering technology areas new to the firm.

The paper by Könnölä began by observing that 'firms have moved from basic research and technology push to systemic and closer to the market innovations'. In an open innovation paradigm, firms should use a broader framework than the classical technology roadmaps when doing technology foresight exercises.

The paper by Belderbos and colleagues examined how access to university research may drive large R&D active firms to locate R&D abroad, close to the centre of academic excellence. They found strong evidence for these industry-science links, at the heart of an open innovation strategy to influence firms' location decisions.

Barrios and colleagues take this co-location of innovation actors in agglomerations further by studying the impact of local and international spillovers on a firm's productivity in Ireland. The authors found that MNCs present in the country can be favourable to the host country by providing access for local firms to global knowledge spillovers, but these spillovers are not obvious. At least in Ireland, these spillovers are not occurring through R&D done by foreign subsidiaries, but rather through the access foreign subsidiaries provide through their parent firm link to R&D in the host country.



Sapprasert discussed the specific case of service sector innovations, stressing how service firms innovate differently, with a bigger importance of ICT and organizational change. Their higher reliance on acquiring technology and know-how externally makes them intrinsically more open-innovation-minded.

An open innovation paradigm raises important issues:


- What are the implications of open innovation for firms/actors managing R&D?
- What are the implications for researchers studying R&D?
- What are the implications for policy-making?

Open innovation requires focusing attention beyond one's own R&D activities to consider other external sourcing innovation strategies for creating innovation and growth. It also requires examining further how firms can appropriate the benefits from open innovation. We need to know more about the capacity to absorb external know-how and IPR issues in open innovation. For research in corporate R&D, it also requires extending the unit of analysis from the individual firm to the level of networks: how are they formed, how they survive, grow and compete with other networks?

Mostly ignored in the papers, but also in general in the literature, is the impact of open innovation on innovation policy-making. Policy-makers are active members of the open innovation system. In a number of settings they operate as users (public procurement) or as promoters, instigators or providers of basic infrastructure (such as clusters, platforms, science parks etc.).

Should policy makers be favourable to open innovation, taking that this is good for innovation and growth? Or should they worry about the formation of closed clubs? Should they be stimulated? In other words, are the private incentives to join networks not aligned with the social value of such networks? And if they should be stimulated, how could this be achieved? Via direct intervention in a selected top-down network or






through creating the right framework conditions for these networks to arise bottom-up in a socially valuable fashion?

Overall, the open innovation perspective does not require radically new ways of looking at innovation and innovation policy. We do not need to start from scratch, we already have analysed these issues, but we need to give them a more central place in research and the policy agenda than they currently occupy.



## Papers presented at the Conference

- Adelmoula, Myriam and Jean Michel Etienne (ERMES-CNRS, Université Paris II Panthéon Assas, France). *What determines R&D investment in French firms: A two-part hierarchical model with correlated random effects.*
- Aghion, Philippe (Harvard University, US / Paris School of Economics, France), Philippe Askenazy (Paris School of Economics, France / Banque de France), Nicolas Berman (University Paris 1, France / Banque de France), Gilbert Cette (Banque de France / Aix-Marseille II University, France) and Laurent Eymard (Banque de France). *Credit constraints and the cyclicalities of R&D investment: Evidence from France.*
- Aralica, Zoran (The Institute of Economics, Croatia), Domagoj Račić (The Isle of Knowledge, Croatia) and Denis Redžepagić (The Institute of Economics, Croatia). *R&D activities as a growth factor of foreign owned SMEs in Croatia.*
- Jean-Jacques Paul (IREDU / Université de Bourgogne / CNRS, France). *The innovative activities of graduates in European companies.*
- Aschhoff, Birgit (ZEW - Centre for European Economic Research, Germany). *Who gets the money? The dynamics of direct R&D subsidies in Germany.*
- Bajeux-Besnainou, Isabelle (Department of Finance, George Washington University, US), Sumit Joshi (Department of Economics, George Washington University, US) and Nicholas Vonortas (Department of Economics, Center for International Science and Technology Policy, George Washington University, US). *Uncertainty, networks and real options.*
- Barajas, Ascensión and Elena Huergo (CDTI / GRIPICO-Universidad Complutense de Madrid, Spain). *International R&D cooperation within the EU framework programme: The case of Spanish firms.*
- Barrios, Salvador (Joint Research Centre, European Commission), Luisito Bertinelli (CREA, Université du Luxembourg), Andreas Heinen (Universidad Carlos III Madrid, Spain) and Eric Strobl (Ecole



Polytechnique Paris, France). *Exploring the link between local and global knowledge spillovers.*

Battisti, Giuliana (Aston Business School, UK), Amid Mourani and Paul Stoneman (Warwick Business School, UK). *Pursuing a basic principle of measurement performance: The case of a firm level innovation scoreboard.*

Bayar, Ali; Frederic Dramais; Amela Hubic; Jeffrey Malek-Mansour; Cristina Mohora; Masudi Opese (EcoMod & Universite Libre de Bruxelles, Belgium) and Hector Pollitt (Cambridge Econometrics, UK). *An analysis of R&D spillover, productivity, and growth effects in the EU.*


Belderbos, René (Katholieke Universiteit Leuven, Belgium / Eindhoven University of Technology, the Netherlands), Bart Leten (Katholieke Universiteit Leuven, Belgium) and Shinya Suzuki (Katholieke Universiteit Leuven, Belgium). *Does excellence in academic research attract foreign R&D?*

Biatour, Bernadette and Chantal Kegels (Federal Planning Bureau, Belgium). *R&D and the multifactor productivity growth: The role of externalities in a small European open economy.*

Catozzella, Alessandra (University of Pavia, Italy) and Marco Vivarelli (Joint Research Centre, European Commission). *The catalysing role of in-house R&D in fostering the complementarity of innovative inputs.*

Cefis, Elena (Bergamo University, Italy / Utrecht University, the Netherlands) and Hans Schenk (Utrecht University, the Netherlands). *The impact of Mergers and Acquisitions on technology sourcing strategies.*

Conte, Andrea (Max Planck Institute of Economics, Germany) and Marco Vivarelli (Joint Research Centre, European Commission). *R&D and embodied technological change: The role of firm size and sector belonging.*



Crespi, Francesco (University of "Roma Tre", Italy) and Mario Pianta (University of Urbino, Italy). *Which innovation? The search for new products and processes in European manufacturing and services.*

Dachs, Bernhard and Matthias Weber (ARC - Austrian Research Centres, Austria). *R&D without patents? Foreign R&D activities of European enterprises in Central and Eastern Europe and Asia: A patent analysis.*

de Dominicis, Laura (Vrije University Amsterdam, the Netherlands), Raymond J.G.M. Florax (Purdue University, US / Vrije Universiteit Amsterdam, the Netherlands) and Henri L.F. de Groot (Vrije Universiteit Amsterdam / Tinbergen Institute Amsterdam, the Netherlands). *Regional clusters of economic activity in Europe: Are social and geographical proximity the key determinants?*


Di Minin, Alberto (MAIN Laboratory, Scuola Superiore Sant'Anna, Italy) and Christopher Palmberg (ETLA - Research Institute of the Finnish Economy, Finland). *Why is strategic R&D (still) homebound in a globalized industry? The case of leading firms in wireless telecom.*

Duso, Tomaso (Humboldt University / WZB - Wissenschaftszentrum Berlin, Germany), Enrico Pennings (Erasmus University Rotterdam, the Netherlands) and Jo Seldeslachts (WZB - Wissenschaftszentrum Berlin, Germany). *The dynamics of research joint ventures: A panel data approach.*

Elschner, Christina; Christof Ernst and Georg Licht (ZEW - Centre for European Economic Research, Germany). *The impact of R&D tax incentives on R&D costs and income tax burden.*

Erdil, Erkan and Teoman Pamukçu (Science and Technology Policies Research Centre, Middle East Technical University, Turkey). *Globalization, trade liberalization and R&D expenditures in candidate countries: Evidence from manufacturing sector in Turkey.*

Guerzoni, Marco (Jena Graduate School / Schiller Universität, Germany). *The impact of market size and users' sophistication on innovation: the patterns of demand and the technology life cycle.*



Hall, Bronwyn H. (UC Berkeley, US / University of Maastricht, the Netherlands), Dominique Foray (Ecole Polytechnique Fédérale de Lausanne, Switzerland), Jacques Mairesse (University of Maastricht, the Netherlands). *Pitfalls in estimating the returns to corporate R&D using accounting data.*

Jindra, Bjoern (Halle Institute of Economic Research, Germany / SPRU, University of Sussex, UK). *Global integration and local capability as determinants of multinational subsidiaries' R&D embeddedness: Evidence from emerging economies in Central East Europe.*

Könnölä, Totti (Joint Research Centre, European Commission). *Innovation roadmap: Exploring alternative futures of industrial renewal.*

Kuittinen, Hanna (Lappeenranta University of Technology / School of Business, Finland). *Sectoral and firm-level differences in innovation performance: Evidence from Finnish manufacturing firms.*


Lelarge, Claire (SESSI-CREST) and Benjamin Nefussi (INSEE-CEPII ). *Exposure to low-wage competition, activity changes and quality upgrading: An empirical assessment.*

Lindmark, Sven; Geomina Turlea and Martin Ulbrich (Joint Research Centre, European Commission). *Corporate R&D in the ICT sector.*

Lokshin, Boris (University of Maastricht / UNU-MERIT, the Netherlands), Pierre Mohnen (University of Maastricht / UNU-MERIT / CIRANO, the Netherlands). *Measuring the effectiveness of R&D tax credits in the Netherlands.*

Maican, Florin (Gothenburg University, Sweden). *Productivity dynamics, R&D, and competitive pressure.*

Malerba, Franco; Maria Luisa Mancusi (CESPRI, Bocconi University, Italy) and Fabio Montobbio (Insubria University / CESPRI, Bocconi University, Italy). *Innovation, international R&D spillovers and the sectoral heterogeneity of knowledge flows.*



Mazzucato, Mariana (Open University, UK) and Massimiliano Tancioni (University of Rome, Italy). *Stock price volatility and patent citation dynamics: The case of the pharmaceutical industry.*

Nagle, Monique; Tessa van der Valk; Floortje Alkemade and Marko Hekkert (Utrecht University, the Netherlands). *Stimulating international cooperation in high technology sectors: A framework based on cooperative distance.*

Ortega-Argilés, Raquel and Andries Brandsma (Joint Research Centre, European Commission). *EU-US differences in the size of R&D intensive firms: Do they explain the overall R&D intensity gap?*

Pasimeni, Paolo (Directorate-General for Regional Policy, European Commission), Anne-Sophie Boisard, Rigas Arvanitis (IRD - Institut de Recherche pour le Développement, France) and Rafael Rodríguez-Clemente (CSIC - Spanish Council for Scientific Research, Spain). *Towards a Euro-Mediterranean innovation space: Ideas for research and policy making.*

Sapprasert, Koson (TIK - Centre for Technology, Innovation and Culture, University of Oslo, Norway). *The impact of ICT on the growth of the service industries.*

Schmidt, Tobias; Franz Schwiebacher and Wolfgang Sofka (ZEW - Centre for European Economic Research, Germany). *The effects of innovation experience on project selection: Better the devil you know.*

Swann, Antonia Jennifer (York University, Canada). *A theoretical model of competition and its impact on R&D, growth & welfare.*

Tiwari, Rajnish and Stephan Buse (Institute of Technology and Innovation Management, Hamburg University of Technology [TUHH], Germany). *Barriers to innovation in SMEs: Can the internationalization of R&D mitigate their effects.*





## Guest speakers, chairpersons and rapporteurs

### Guest speakers

Peder Christensen (Directorate-General for Research, European Commission). *The perspective of the Lisbon Strategy.*

Dominique Foray (Ecole Polytechnique Fédérale de Lausanne, Switzerland). *Corporate R&D in EU and US.*

José Antonio Moreno Delgado (Engineering Vice President, Abengoa, Spain). *R&D for growth and sustainability: The experience of Abengoa.*

Ullrich Schröder (UEAPME - European Association of Craft, Small and Medium - sized Enterprises). *SMEs vital to Europe's R&D efforts, in co-operation with industry, universities and regions.*

John van den Elst (Digital Systems Department Manager, Philips Applied Technologies, the Netherlands). *R&D at Philips: Efficiency in open innovation systems.*

Max von Zedtwitz (Tsinghua University, China). *Corporate R&D in Asia.*

### Chairpersons

René Belderbos (Katholieke Universiteit Leuven, Belgium / Eindhoven University of Technology, the Netherlands)

Andries Brandsma (Joint Research Centre, European Commission)

Constantin Ciupagea (Institute for World Economy, Romania)

Bronwyn H. Hall (UC Berkeley, US and University of Maastricht, the Netherlands)

Peter Kind (Joint Research Centre, European Commission)

Jos Leijten (TNO - The Netherlands Organisation for Applied Scientific Research)



Stephane Lhuillery (Ecole Polytechnique Fédérale de Lausanne, Switzerland)

Jacques Mairese (University of Maastricht, Netherlands)

Pietro Moncada-Paternò-Castello (Joint Research Centre, European Commission)

Marco Vivarelli (Joint Research Centre, European Commission)

Nicholas S. Vonortas (George Washington University, US)

### **Rapporteurs**

Georg Licht (ZEW - Centre for European Economic Research, Germany)

Franco Malerba (Bocconi University, Italy)

Carlos Montalvo (TNO - The Netherlands Organisation for Applied Scientific Research)


Keith Smith (University of Tasmania, Australia)

Reinhilde Veugelers (Bureau of Economic Policy Advisers, European Commission and Katholieke Universiteit Leuven, Belgium)

Nick von Tunzelmann (University of Sussex, UK)

## Posters displayed at the Conference

- Aceto, Danilo (European Research Office, University of Rome "Tor Vergata", Italy). *EU-Co-financed RTD at the University of Rome "Tor Vergata": Framework Programme of RTD of the EU.*
- Battaglion, Maria Rosa (University of Bergamo) and Daniela Grieco (Bocconi University, Italy). *R&D competition with radical and incremental innovation.*
- Beneito, Pilar; María Rochina-Barrachina and Amparo Sanchis-Llopis (University of Valencia, Spain). *R&D-experience and innovation success.*
- Bulli, Sandra (Department for Innovation, Universities and Skills, UK). *University - industry collaborations in the UK.*
- Erdil, Erkan and Dilek Çetin (Middle East Technical University, Turkey). *Innovation and inter-firm relations: Ankara Sincan industrial district.*
- de Finance, Xavier; Denis Huguenin and Marie de Lattre-Gasquet (Agence Nationale de la Recherche, France). *Do firms involved in R&D public-private partnerships have special characteristics?*
- Grablowitz, Alexander (Joint Research Centre, European Commission), Patrice Laget (INSERM, France), Ana Delicado (University of Lisbon, Portugal). *Business R&D in Europe: Trends in expenditures, researcher numbers and related policies.*
- Kriaucioniene, Monika and Arminas Ragauskas (Kaunas University of Technology, Lithuania). *Transition via R&D: Emerging forms and strategies of corporate R&D in the catch up countries (Lithuanian case).*
- Kubeczko, Klaus and K. Matthias Weber (Austrian Research Centres: Systems Research, Technology Policy Department, Austria). *The role of framework conditions for private R&D in the New Member States.*
- Nguyen Thi, Thuc Uyen (International Network for Studies in Technology, Environment, Alternatives, Development, CEPS/INSTEAD, Luxembourg). *Relation between uncertainty, internal competences and R&D cooperation: An empirical analysis of Luxembourg firms.*



Pavelkova, Drahomira; Adriana Knapkova and Libor Friedel (Tomas Bata University, Czech Republic). *R&D investments: Model to measure and manage its influence on performance.*

Lostes, Antoni Paz (LEITAT Technological Center, Spain). *Do not promote the corporate R&D, but the market intelligence.*

Poel, Martijn (TNO & Delft University of Technology, the Netherlands), Jan-Frens van Giessel and Geert van der Veen (Technopolis, the Netherlands). *Corporate and public R&D in the Flemish broadcasting sector: The role of R&D programmes and media policy.*

Potters, Lesley and Raquel Ortega-Argilés (European Commission, DG-JRC-IPTS, Knowledge for Growth Unit, Industrial Research & Innovation). *R&D and labour productivity: Testing sector differences with micro data.*

Rotondi, Zeno (Capitalia, Ferrara University, University LUISS of Roma, Italy), Kim P. Huynh (Indiana University, US). *R&D spending, local banks, and knowledge spillovers.*


Saur-Amaral, Irina and Joaquim José Borges Gouveia (Department of Economics, Management and Industrial Engineering, University of Aveiro, Portugal). *Drug development in Portugal: Understanding associated risks.*

Sautter, Björn; Sabine Hafner-Zimmermann and Günter Clar (Steinbeis - Europa - Zentrum, Germany). *Corporate R&D strategies in a world of open innovation - implications for regional innovation policy.*

Selcuk Akgul, Ahmet (Universitek Education & Consulting, Turkey). *Two successful cases of corporate R&D from Turkey as a developing country.*

Somaya, Deepak; YoungJun Kim and Nicholas Vonortas (George Washington University, US). *Exclusive licensing and complementary assets.*

Vicente, María Rosalía; Matías Mayor and Pilar Quindós (Applied Economics, University of Oviedo, Spain). *The efficiency of R&D activities*



in the European Union: A cross-region study accounting for spatial dependence.

Vázquez Muñoz, Eri (FUNDITEC, Spain). *The ip4inno Project: Intellectual property for innovation.*



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## Annex 5

# List of participants

Danilo Aceto, University of Rome "Tor Vergata", Italy

Zoran Aralica, The Institute of Economics, Croatia

Birgit Aschhoff, Centre for European Economic Research (ZEW), Germany

Philippe Askenazy, Paris School of Economics, France

Chulwoo Baek, Institute of Science and Technology Evaluation and Planning, South Korea

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Andries Brandsma, Joint Research Centre, European Commission

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Anna Brussa, Ministry of Economy, Poland

Sandra Bulli, Department for Innovation, University and Skills, UK

Alessandra Catozzella, University of Pavia, Italy

Elena Cefis, University of Bergamo, Italy

Funda Celikel, Joint Research Centre, European Commission



Dae Seung Choi, Institute of Science & Technology Evaluation and Planning, South Korea

Peder Christensen, DG Research, European Commission

Ernst Christof, Centre for European Economic Research (ZEW), Germany

Constantin Ciupagea, Institute of World Economy, Romania

Andrea Conte, Max Planck Institute of Economics, Germany

Francesco Crespi, University of Rome III, Italy

Bernhard Dachs, Austrian Research Centers (ARC), Austria

Nicola Davenport, CORDIS, European Union

Laura de Dominicis, Vrije Universiteit Amsterdam, the Netherlands

Xavier de Finance, Agence Nationale de la Recherche, France

Alberto Di Minin, MaIn Lab - Scuola Superiore Sant'Anna, Italy

Frederic Dramais, EcoMod & Université Libre de Bruxelles, Belgium

Erkan Erdil, Middle East Technical University, Turkey

Svenja Espenhorst, Heidelberg University, Germany

Pedro Faria, IN + / Instituto Superior Técnico, Portugal

Peter Fatelnig, DG Information Society, European Commission

Ruiz Manuel Fialho, Institute Politécnico Beja, Portugal

Dominique Foray, Ecole Polytechnique Fédérale de Lausanne, Switzerland

Zoe Geogopoulou, Ministry of Economics, Greece

Elkana Getz, The Neaman Institute for Advanced Studies in Science and Technology, Israel

Daphne Getz, The Neaman Institute for Advanced Studies in Science and Technology, Israel



Xabier Goenaga, DG Research, European Commission

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Technology, Austria

Michał Górczyński, CASE-Doradcy, Poland

Daniela Grieco, Bocconi University, Italy

Marco Guerzoni, Friedrich Schiller Unviersität, Germany

Bronwyn H. Hall, UC Berkeley, US and University of Maastricht, the  
Netherlands

Margit Harjung, Federal Ministry for Transport, Innovation and Technology,  
Austria

Joost Heijs, Universidad Complutense Madrid, Spain

Ángel Honrado López, LEITAT Technological Center, Spain

Amela Hubic, EcoMod & Université Libre de Bruxelles, Belgium

Elena Huergo, GRIPICO-Universidad Complutense de Madrid, Spain

Denis Huguenin, ANR - Agence nationale de la recherche, France

Ari Jantunen, Lappeenranta University of Technology, Finland

Björn Jindra, Halle Institute for Economic Research, Germany and SPRU, UK

Teresa Jonek, The Royal Academy of Engineering Sciences, Sweden

Anna Kaderabkova, Centre for Economic Studies, Czech Republic

Chantal Kegels, Federal Planing Bureau, Belgium

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Frank Knecht, VDMA - European Office, Germany

Totti Könnölä, Joint Research Centre, European Commission

Tanja Korosec, Ministry of Defence, Slovenia



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Anaïs Le Corvec, ESOF 2008, Spain

Karolina Leib, DG ECFIN, European Commission

Jos Leijten, TNO - Organisation for Applied Scientific Research, the Netherlands

Claire Lelarge, SESSI-CREST, France

Xavier Lepot, A.S.T., Belgium

Bart Leten, Katholieke Universiteit Leuven, Belgium

Stephane Lhuillery, Ecole Polytechnique Fédérale de Lausanne, Switzerland

George Licht, Centre for European Economic Research (ZEW), Germany

Sven Lindmark, Joint Research Centre, European Commission

Boris Lokshin, MERIT/University Maastricht, the Netherlands

Florin Maican, Goteborg University, Sweden

Jacques Mairesse, University of Maastricht, the Netherlands

Joffrey Malek, EcoMod & Université Libre de Bruxelles, Belgium

Franco Malerba, Bocconi University, Italy

Maria Luisa Mancusi, Bocconi University, Italy

Petr Maršík, Ministry of Industry and Trade, Czech Republic

Jordi Mas, ESOF 2008, Spain

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Drahomira Pavelkova, Tomas Bata University in Zlin, Czech Republic

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Lucio Picci, Joint Research Centre, European Commission


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Martijn Poel, TNO - Organisation for Applied Scientific Research, the Netherlands

Hector Pollitt, Cambridge Econometrics, UK

Lesley Potters, Joint Research Centre, European Commission

Antonio Puente, DG Research, European Commission



Philippe Richard, ONERA - The French Aerospace Lab, France

María Rochina Barrachina, University of Valencia, Spain

Victor Rodriguez, TNO - Organisation for Applied Scientific Research, the Netherlands

Patricia Romeiro, Instituto de Economía y Geografía - CSIC, Spain

Zeno Rotondi, Capitalia Banking Group, Italy

Amparo Sanchis Llopis, University of Valencia, Spain

Koson Sapprasert, University of Oslo, Norway

Bjoern Sautter, Steinbeis-Europa-Zentrum, Germany

Hans Schenk, Utrecht University, the Netherlands

Petros Schinas, Ministry of Economy, Greece

Ullrich Schröder, European Association of Craft, Small and Medium-sized Enterprises

Franz Schwiebacher, Centre for European Economic Research (ZEW), Germany

Sujai Shivakumar, The National Academies, US

Keith Smith, University of Tasmania, Australia

Petr Soukup, Ministry of Industry and Trade, Czech Republic

Antoni Soy Casals, Generalitat de Catalunya, Spain

Mariagrazia Squicciarini, VTT, Finland

Shinya Suzuki, Katholieke Universiteit Leuven, Belgium

Antonia Swann, York University, Canada

Ian Thomas, Government of Alberta, Canada

Rajnish Tiwari, Hamburg University of Technology (TUHH), Germany



Anni Tuppuru, Lappeenranta University of Technology, Finland  
Geomina Turlea, Joint Research Centre, European Commission  
Martin Ulbrich, Joint Research Centre, European Commission  
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## Abstract

The Conference *Role and Dynamics of R&D*, held on 8-9 October 2007, brought together the community of researchers on corporate R&D to learn about recent developments in the field and outline future avenues of research. A number of aspects of corporate R&D were covered, such as its drivers and determinants, its role in the economy, firm and sector dynamics, and methodological issues. Designated rapporteurs summarised and documented the most important messages of the papers presented and the debates that followed. This Summary Report is an edited compilation of their work.



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