Deliverable: D5-3 Integration in the Eco-System

WP 5 Promoting Openness and Capitalizing on Europe’s Creative Potential

Author(s): Ivan-Damir Anic, EIZ; Michele Cincera, ULB-Solvay-iCite; Maja Jokić, Institute for Social Research Zagreb; Martin Hud, ZEW; Andrea Mervar, EIZ; Maikel Pellens, ZEW; Bettina Peters, ZEW; Anabela Santos, ULB-Solvay-iCite.

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Coordinator: Bart Verspagen, UN-MERIT

E-mail: b.verspagen@maastrichtuniversity.nl
Note: Originally, the structure of deliverables of WP5 was different than for the other WPs. In order to be coherent with the other WP1-4 and WP6-8 and since the inputs of WP5 are needed for WP9 and WP10, an amendment to the contract was agreed upon. This Deliverable D5.3 follows the new structure of Deliverables in WP5 as stated in the amendment.
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1 Introduction

One aim of the Innovation Union is to promote openness and Europe’s creative potential. In order to achieve this goal, five different commitments have been implemented within the Innovation Union:

- **C19:** Creative Industries
- **C20:** Open Access to Research Results / Research Information Services
- **C21:** Facilitating Effective Collaborative Research and Knowledge Transfer
- **C22:** Develop a European knowledge market for patents and licensing
- **C23:** Safeguard against the use of IPRs for anti-competitive purposes

The previous deliverables D5.1 and D5.2 gave an overview over the expected effects based on a literature review, described the state of implementation and performed a quantitative or qualitative impact assessment for each of the five commitments. This deliverable will reflect how the commitment policies are likely to effect the innovation eco-system in a broader sense.
2 Creative Industries (Commitment 19)

Michele Cincera and Anabela Santos (ULB-Solvay-iCite)

2.1 Introduction

The present section of the deliverable D5.3 "Integration in the Eco-System" concerns Commitments 19.1 (Establish a European Creative Industries Alliance) and 19.2 (Setting up a European Design Leadership Board). Commitment 19.1 assumes that a wrong perception of Creative Industries contribution and risks are obstacles for their growth. Under this commitment, the EU defends the necessity to put in place structural changes in order to improve the performance of CIs (e.g. in R&D, productivity, exports,...), leading to enhanced competitiveness and more job creation. An action undertaken is the creation of a supportive ecosystem (European Creative Industries Alliance Policy Learning Platform). Commitment 19.2 is based on the necessity to better understand the role of design as a driver for innovation activities and to improve the design infrastructure and services. Under this commitment, EU actions are focused on creating a “European Design Excellence” label and a European Design innovation Platform, which could lead to more innovation and economic growth.

After a review of the literature, the data collection¹ (M1 and M10), a description of commitments’ state of implementation and direct impact assessment (M11 and M22), the present section aims to provide several “inputs” to the NEMESIS model with the final goal to integrate them in the innovation eco-system.

2.2 Direct Impact Assessment: Main Findings

2.2.1 C19.1: Establish a European Creative Industries Alliance

The main target of Commitment 19.1 was to establish a European Creative Industries Alliance (ECIA) in order to develop new forms of support for these industries and promote the wider use of creativity by other sectors. This kind of initiative combines policy learning (for showing the importance of CIs) and cooperation (to make easier access to finance for CIs) on an open platform. On the end of 2015, the open platform ECIA² was completely developed and implemented.

¹ For more details, see Anic et al. (2016).
² available at http://eciaplatform.eu
The ECIA has provided support to some 3,570 SMEs by way of mentoring, training and cross-border matchmaking. Across the nine projects carried out between 2012 and 2014, the ECIA succeeded in mobilizing at least EUR 45.8 Million directly or indirectly for the creative industries on top of the EUR 6.75 Million EU support for the initiative (ECIA, 2014).

2.2.2 C19.2: Setting up a European Design Leadership Board

The Commission Staff Working Document (EC, 2009) on ‘Design as a driver of user-centered innovation’ analyses the contribution of design to innovation and competitiveness. The results are compelling: companies that invest in design tend to be more innovative, more profitable and grow faster than those that do not. At a macro-economic level, there is a strong positive correlation between the use of design, innovation and national competitiveness.

The Commission set up the European Design Leadership Board in 2011 with the aim to make proposals to enhance the role of design in innovation policy. Recommendations from an expert group was presented in 2012 in the European Design Innovation Summit in Helsinki. Because of this, the Commission implemented an Action Plan for Design-Driven Innovation which started in 2014 until 2016, but already announced in 2013 (see European Commission 2013). The Design for Europe Platform (http://www.designforeurope.eu) is also an initiative under the action plan, showing many concrete case studies about the importance of design on innovation, and it was implemented between 2014 and 2016.

2.3 Integration of C19 into NEMESIS

2.3.1 Data and Methodology

The systemic evaluation of both commitments will have a similar methodological approach. The aim is to assess the impact of policy measures, linked with each commitment, on R&D expenditures, as stated in equation (1):

\[ BERDbyBUS_{it} = f(Commitment_{it}, X_{it}) \]  

3 According to EUROSTAT, “designs constitute means by which creators seek protection for their industrial property. Designs reflect the non-technological innovation in every sector of economic life, including services. In this context, indicators based on Design data can provide a link between innovation and the market”. https://ec.europa.eu/eurostat/cache/metadata/en/ipr_d_esms.htm
where:

- $BERD_{bus_{t}}$: Private R&D expenditures funded by the business sector
- $Commitment_{t}$: Indicator which enables to measure the effect of the commitment
- $X_{i,t}$: Set of control variables which explains the amount of private R&D investments, i.e. $BERD_{bus}$

The selection of the dependent variable (R&D expenditures) was done based on the target of the commitments and on the way the commitments will be integrated in the NEMESIS model (see D10.2.). The Commitment 19.1 (Establish a European Creative Industries Alliance) is integrated in the NEMESIS thematic “spillovers” module since creative industries have not only a direct impact on the economy (e.g. employment and value added) but also indirect impacts through their interactions with the upstream and downstream phases of the innovative process. Creative industries produce innovative outputs, which can be used as innovative inputs in other sectors of the economy. On the other hand, creative industries stimulate the demand of innovative inputs to their suppliers.

The assessment of C19.1 overall impact is done at macro-level, due to the fact that individual data of supported firms by the ECIA are not available (even under request to the ECIA). So, the conceptual framework for assessing this commitment is based on impact quantification of R&D expenditures of Creative Industries (CIs) on R&D expenditures carried out in other sectors and on economic growth, making a distinction between the pre and post-commitment implementation.

After data collection and for assessing the impact of C19.1, we estimate a R&D function (2), where R&D of non-CIs ($NCl_{RD_{i,t}}$) is explained by the R&D of CIs ($C1_{RD_{i,t}}$). Additionally, a dummy variable ($C191_{t}$) which takes the value 1 after the implementation of the commitment and 0 before is also included in the model. A set of control variables explaining private R&D investment ($X_{i,t}$) is added to ensure that the impact quantification is properly estimated.

The theory behind model (1) is based on the framework used by Guellec and van Pottelsberghe (2000) and Cincera et al. (2009), where R&D expenditures performed by the business sector and funded by the private sector ($BERD_{bus}$) is explained by different R&D policy instruments, such as the public R&D performed by Government, and in the Higher education sector, the public direct funding of private R&D (e.g. subsidies) and R&D fiscal incentives (e.g. R&D tax credits). In short, private R&D investments are driven by technology push (the costs of R&D which depends also on the public support of these activities), technological opportunity and knowledge spillovers) and demand pull (the demand for new technologies) factors. These factors are taken into account by four explanatory variables (i.e. the $X_{i}$), country fixed effects and year dummies in equation (1)\(^4\).

\(^4\) Furthermore, the Ramsey and Link tests indicate that the null hypothesis that the model has no omitted...
\[
BERD_{byBUS_{it}} = \alpha_i + \beta_1 BERD_{byGOV_{it}} + \beta_2 GOVRD_{it} + \beta_3 HIGRD_{it} + \beta_4 B_{INDEX} + u_{it}
\]  
(2)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
</table>
| BERD_{byGOV_{it}} | R&D expenditures performed by business sector and funded by government | • Grants or subsidies  
• Procurement contracts from government institutions |
| GOVRD_{it} | R&D expenditures performed by Government | • Basic or applied research and experimental development within ministries or armed forces  
• Provision of technology services, such as technology transfer, the storage and access to knowledge and scientific collections and the provision of major scientific infrastructure and facilities |
| HIGRD_{it} | R&D expenditures in the higher education sector | • R&D activities under the direct control of tertiary education institutions, university hospitals and clinics |
| B_{INDEX} | B-Index | • Composite index linked with the tax generosity concerning R&D expenditure (proxy for R&D tax incentives) |

Source: Authors’ own elaboration based on OECD (2015) Frascati Manual

Therefore, taking into account equation (1) and equation (2), the common methodological approach for commitments 19.1 and 19.2 is expressed as:

\[
BERD_{byBUS_{it}} = \alpha_i + \beta_1 BERD_{byGOV_{it}} + \beta_2 GOVRD_{it} + \beta_3 HIGRD_{it} + \beta_4 B_{INDEX} + \beta_5 \text{Commitment} + u_{it}
\]  
(3)

The variables GOVRD_{it} and HIGRD_{it} are expressed as a stock estimated by Perpetual Inventory method (PIM). This approach (4) assumes that the R&D stock (RD_S) in t is equal to the R&D expenditure (RD) in t plus the stock of R&D in t − 1, updated to period t by a depreciation rate of capital (δ). We used a depreciation rate of 15%, which is normally used by other authors (e.g. Hall

variables cannot be rejected at the 1% statistical significance level; VIF tests do not indicate any problem with multicollinearity issues between the explanatory variables. Finally, equation (1) is estimated in log-linear form, i.e. both left and hand-side variables are expressed in logarithms. This transformation is often used in macroeconomics to convert non-linear equations into linear ones.

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and Mairesse, 1995).

\[
RD_{S_{i,t}} = RD_{S_{i,t-1}}(1 - \delta) + RD_{i,t}
\]  

(4)

However, when the net R&D stock value in \( t - 1 \) for the first year of observation is unknown, we need to estimate a starting point. In the present study, the first year for which we have information is 2000. So, in year \( t = 1 (= 2000) \) the pre-sample accumulation stock is estimated as expressed in equation (5), taking into account the growth rate (\( g \)) of R&D expenditures of our sample for the period under analysis, as well as the depreciation rate (\( \delta \)).

\[
RD_{S_{i,1}} = \frac{RD_{i,1}}{g + \delta}
\]  

(5)

### 2.3.1.1 C19.1 – Creative Industries

The indicator selected for measuring the effect of commitment 19.1 is an interaction term between the Private R&D expenditures funded by the private sector and performed by Creative Industries sectors (\( BERDbyBUS.CI_{i,t} \)) and a dummy variable taking the value of 1 after the commitment implementation and 0 otherwise (\( C191_t \)). We consider as post-intervention period all the years from 2012 onward, because the measures implemented by the European Creative Industries Alliance (see D.5.2.) started in 2012. Once a division by sectors is done (Creative Industries versus non-Creative Industries), the dependent variable only included the Private R&D expenditures funded by the private sector and performed by non-Creative Industries sectors (\( BERDbyBUS.nonCl_{i,t} \)). Equation (3) is re-expressed as follows for analysing this commitment, where all the variables are expressed in percentage of GDP (except the B_INDEX), in order to control for the size of the country, and in logarithmic form:

\[
BERDbyBUS.nonCl_{i,t} = \alpha_i + \beta_1 BERDbyGOV.nonCl_{i,t} + \beta_2 S.GOVRD_{i,t} + \beta_3 S.HIGRD_{i,t} \\
+ \beta_4 B_INDEX_{i,t} + \beta_5 BERDbyBUS.CI_{i,t} + \beta_6 C191_t + \beta_7 C191_t \\
\times BERDbyBUS.CI_{i,t} + u_{i,t}
\]  

(6)

\footnote{It should be noted that the use of interaction terms in regression analysis does not rely on any theoretical basis but is merely an empirical technique common in regression analysis used to test the interaction between two (or more) explanatory variables, i.e. R&D expenditures and the implementation of Commitment C19. By having an interaction term between variables 1 and 2, the marginal effect of variable 1 is made dependent on variable 2 and vice versa.}
For selecting which sectors to include in the group of Creative Industries, we used the same approach than DCMS (2016) – see more details in D5.2. However, EUROSTAT data (main data source) for business enterprise R&D expenditures (BERD) by economic activity is only available at NACE code 2-digit and imputation of activities on CIs group required a NACE code 4-digit (see D5.2). In order to overcome this issue, we estimated an imputation key based on data of intangible assets from the AMADEUS database. For doing so, we made a selection of all firms located in EU28 and with economic activities in the NACE class listed by DCMS (2016) (which corresponds to CIs firms) and on section or division identified in column (3) of Table 2.2 (equal to the information available in EUROSTAT). For each country and for each year, between 2007 and 2015, we estimated then the aggregated value of intangible assets by class, section and division listed in Table 2.2. Imputation keys of class by section or division are then used to construct the aggregated value of BERD.

Table 2.2  Data Available on EUROSTAT for BERD by Economic Activity

<table>
<thead>
<tr>
<th>NACE Rev 2.0</th>
<th>Description</th>
<th>Information available on EUROSTAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.12</td>
<td>Manufacture of jewellery and related articles</td>
<td>All BERD for C32 activity - so need to build an imputation key</td>
</tr>
<tr>
<td>58.11</td>
<td>Book publishing</td>
<td>= to all activities of J58. Information available in EUROSTAT</td>
</tr>
<tr>
<td>58.12</td>
<td>Publishing of directories and mailing lists</td>
<td></td>
</tr>
<tr>
<td>58.13</td>
<td>Publishing of newspapers</td>
<td></td>
</tr>
<tr>
<td>58.14</td>
<td>Publishing of journals and periodicals</td>
<td></td>
</tr>
<tr>
<td>58.19</td>
<td>Other publishing activities</td>
<td></td>
</tr>
<tr>
<td>58.21</td>
<td>Publishing of computer games</td>
<td></td>
</tr>
<tr>
<td>58.29</td>
<td>Other software publishing</td>
<td></td>
</tr>
<tr>
<td>59.11</td>
<td>Motion picture, video and television programme production activities</td>
<td>= to all activities of J59. Information available in EUROSTAT</td>
</tr>
<tr>
<td>59.12</td>
<td>Motion picture, video and television programme post-production activities</td>
<td></td>
</tr>
<tr>
<td>59.13</td>
<td>Motion picture, video and television programme distribution activities</td>
<td></td>
</tr>
<tr>
<td>59.14</td>
<td>Motion picture projection activities</td>
<td></td>
</tr>
<tr>
<td>59.20</td>
<td>Sound recording and music publishing activities</td>
<td></td>
</tr>
<tr>
<td>60.10</td>
<td>Radio broadcasting</td>
<td></td>
</tr>
<tr>
<td>60.20</td>
<td>Television programming and broadcasting activities</td>
<td>= to all activities of J60. Information available in EUROSTAT</td>
</tr>
<tr>
<td>62.01</td>
<td>Computer programming activities</td>
<td></td>
</tr>
<tr>
<td>62.02</td>
<td>Computer consultancy activities</td>
<td></td>
</tr>
<tr>
<td>70.21</td>
<td>Public relations and communication activities</td>
<td></td>
</tr>
<tr>
<td>71.11</td>
<td>Architectural activities</td>
<td></td>
</tr>
<tr>
<td>73.11</td>
<td>Advertising agencies</td>
<td></td>
</tr>
<tr>
<td>73.12</td>
<td>Media representation</td>
<td></td>
</tr>
<tr>
<td>74.10</td>
<td>Specialised design activities</td>
<td></td>
</tr>
<tr>
<td>74.20</td>
<td>Photographic activities</td>
<td></td>
</tr>
<tr>
<td>74.30</td>
<td>Translation and interpretation activities</td>
<td></td>
</tr>
<tr>
<td>85.52</td>
<td>Cultural education</td>
<td>All BERD for MB5 activity - so need to build an imputation key</td>
</tr>
<tr>
<td>90.01</td>
<td>Performing arts</td>
<td></td>
</tr>
<tr>
<td>90.02</td>
<td>Support activities to performing arts</td>
<td></td>
</tr>
<tr>
<td>90.03</td>
<td>Artistic creation</td>
<td></td>
</tr>
<tr>
<td>90.04</td>
<td>Operation of arts facilities</td>
<td></td>
</tr>
<tr>
<td>91.01</td>
<td>Library and archives activities</td>
<td></td>
</tr>
<tr>
<td>91.02</td>
<td>Museums activities</td>
<td></td>
</tr>
</tbody>
</table>

Note: Column (1) reports the Statistical Classification of Economic Activities (NACE) defined by of DCMS (2016) for measuring Creative Industries activities.

Source: Authors’ own elaboration.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 645884.
2.3.1.2 C19.2 – Design

As regards the indicator selected for measuring commitment 19.2 effect, we used an interaction term between the number of Community Design registrations \( \text{Design}_{i,t} \) and a dummy variable taking the value of 1 after commitment implementation and 0 otherwise \( (C192_t) \), we considered as post-intervention period all years from 2014 onwards, because the Action Plan for Design-Driven Innovation, as the results of European Design Leadership Board (see D.5.2.), started in 2014. Equation (3) is re-expressed as follow for this commitment, where all the variables are expressed in percentage of GDP (except B_INDEX), in order to control for the size of the country, and in logarithmic form:

\[
\text{BERD}_i \text{by BUS}_{it} = \alpha_i + \beta_1 \text{BERD}_i \text{by GOV}_{it} + \beta_2 S_{GOVRD}_{it} + \beta_3 S_{HIGRD}_{it} + \beta_4 B_{INDEX}_{it} \\
+ \beta_5 \text{Design}_{i,t} + \beta_6 C192_t + \beta_7 C192_t \times \text{Design}_{i,t} + u_{it}
\] (7)

2.3.2 Empirical Evidence for C19.1 - Creative Industries

2.3.2.1 Descriptive Statistics

We estimated that in 2015 the Business R&D expenditures funded by the private sector and performed by Creative Industries within the European Union achieved €8,164 million, which represents almost the double than the value in 2007 (Figure 2.1) and near to 5.8% of total Business R&D expenditures funded by the private sector (Figure 2.2). The contribution of Creative Industries to the total Business R&D expenditures funded by the private sector, between 2007 and 2015, displayed a growth trend (Figure 2.2).

Figure 2.1 Business R&D Expenditure Funded by Private Sector and Performed by Creative Industries, € Millions, 2007 – 2015, EU 23

![Bar chart showing Business R&D Expenditure Funded by Private Sector and Performed by Creative Industries, € Millions, 2007 – 2015, EU 23]

Note: Belgium, Denmark, Ireland, Luxembourg and The Netherlands are excluded due to lack of data as regards BERDbyBUS by NACE code listed in Table 2.2.

Source: Authors’ own elaboration based on EUROSTAT and AMADEUS data.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 645884.
Figure 2.2 Business R&D Expenditure Funded by Private Sector and Performed by Creative Industries (% Total Business R&D Expenditure funded by Private Sector) 2007 – 2015, EU 23

Note: The value excludes the contribution of The Netherlands, Luxembourg, Ireland, Denmark and Belgium. 
Source: Authors’ own elaboration based on EUROSTAT data.

As regards to representativeness of Business R&D expenditures funded by the private sector and performed by Creative Industries, as percentage of GDP, Figure 2.3 indicates an average increase of 4% per year. Furthermore, in 2012 and 2014, after Commitment 19.1 implementation, \textit{BERDbyBUS} of Creative Industries registered the highest growth rate (11% and 13% respectively). However, part of this increase could also the result of the Creative Europe Programme\(^6\). Yet, due to data limitation\(^7\), we are not able to isolate the effect of this last initiative. Nonetheless, taking into account the following justifications, we do not expect that the results of this analysis will be very affected by the effect of this programme:

i) The Creative Europe Programme is more focused on cultural and audiovisual sectors and in the present analysis the concept of Creative Industries is larger (see D5.2. and Table 2.2).

ii) The Creative Europe Programme does not fund directly and exclusively R&D

\(^6\) “The Creative Europe programme (CE) – in operation since January 2014 – brings together the cultural and media programmes during the 2007–2013 programming period and is designed to support activities in the cultural and audiovisual sectors and to promote cross-sectoral synergies” (Dossi, 2016:1).

\(^7\) Data limitation is due to the non-availability of indicators for Creative Europe Programme and European Creative Industries Alliance (ECIA).
expenditures (see Dosi, 2016).

iii) The financial allocation of Creative Europe Programme only represents 2.5% of the BERD by BUS of Creative Industries (Table 2.3), including a substantial budget of countries which are not analyzed in Commitment 19.1, such as, Belgium and The Netherlands (for more details about budget allocated to each country see Dosi, 2016).

Figure 2.3 Evolution Business R&D Expenditure Funded by Private Sector (% GDP) and Performed by Creative Industries, 2007 – 2015, Average EU 23

![Graph showing Evolution Business R&D Expenditure Funded by Private Sector (% GDP) and Performed by Creative Industries, 2007 – 2015, Average EU 23]

Note: The value excludes the contribution of The Netherlands, Luxembourg, Ireland, Denmark and Belgium, because any statistical data for these countries is available in EUROSTAT website about BERD by BUS in the NACE code listed in Table 2.2.

Source: Authors’ own elaboration based on EUROSTAT and AMADEUS data.

Table 2.3 Financial Allocation to Creative Europe, 2000-2020, € Millions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Average/year</td>
<td>Total</td>
<td>Average/year</td>
<td>Total</td>
<td>Average/year</td>
</tr>
<tr>
<td>Culture</td>
<td>236.5</td>
<td>33.8</td>
<td>400.0</td>
<td>57.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Media</td>
<td>454.0</td>
<td>64.9</td>
<td>755.0</td>
<td>107.9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Creative Europe</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,460.0</td>
<td>208.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>690.5</td>
<td>98.6</td>
<td>1,155.0</td>
<td>165.0</td>
<td>1,460.0</td>
<td>208.6</td>
</tr>
</tbody>
</table>

Source: Authors’ own elaboration based on Dosi (2016:10).

Concerning the relationship between Business R&D expenditures funded by the private sector and performed by Creative Industries and by non-Creative Industries, we observe in Figure 2.4 and Figure 2.5 a positive and linear correlation between both variables and in both periods, before and after the implementation of the commitment.
2.3.2.2 Interpretation of Econometric Results

Table 2.4 reports the results of regression estimations described in equation (6), using fixed effect estimators, with the aim to assess the effect of R&D activities of Creative industries on non-Creative ones, making a distinction between the period after and before commitment 19.1 implementation. As we can in the column (1) of Table 2.4 \( \text{BERDbyBUS} \) in CI has a positive effect on \( \text{BERDbyBUS} \) in non_CI, however, the coefficient of the interaction term (variable which includes the effect of CI activities after commitment implementation) reveals to be non-significant, suggesting no effect of policy intervention. Taking into account that countries are very heterogeneous, we performed several individual regressions with different groups of countries (results are available under request) and from this analysis we make a division between countries where the commitment appears to have a positive effect and other countries characterized by a negative effect. The list of these countries is displayed in Table 2.5. After a split of the whole sample in two groups, we re-estimated the model defined in equation (6). These news results are reported in column (2) and (3) of Table 2.4, and suggest that, for countries listed in Group 2, the \( \text{BERDbyBUS} \) in CI has a negative effect on the \( \text{BERDbyBUS} \) in non-CI after 2012. This finding can be explained by a substitution effect of R&D performed by CI. As regards to countries included in Group 1, column (2) in Table 2.4 shows that the coefficient of interaction term (commitment 19.1. effect) is positive but only significant at 20%. Nevertheless, we re-estimated the model for the countries included in group 1, but without the control variables, we can see on column (4) that the coefficient of the interaction term is now significantly positive at 5% level, showing some evidence of a possible positive effect of CI activities.

Note: \( \text{BERDbyBUS} \) refers to Business R&D expenditure funded by private sector.

Source: Authors’ own elaboration based on EUROSTAT and AMADEUS data.
Integration in the Eco-System

after 2012 in this group of countries.

Table 2.4 Results Fixed Effect Panel Data Regression Model: C19.1 (Creative Industries)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Y = Log(BERDbyBUS in non-CI as % GDP)</th>
<th>All sample</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(BERDbyBUS in CI as % GDP)</td>
<td>0.108***</td>
<td>0.158***</td>
<td>0.0594</td>
<td>0.180***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0314)</td>
<td>(0.0289)</td>
<td>(0.0416)</td>
<td>(0.0296)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C19.1 (=1 if year 2012-15)</td>
<td>-0.277</td>
<td>0.777</td>
<td>-0.901***</td>
<td>1.024**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.291)</td>
<td>(0.560)</td>
<td>(0.170)</td>
<td>(0.427)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C19.1 (12-15) x Log(BERDbyBUS in CI as % GDP)</td>
<td>-0.0443</td>
<td>0.0813</td>
<td>-0.122***</td>
<td>0.105**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0358)</td>
<td>(0.0609)</td>
<td>(0.0223)</td>
<td>(0.0452)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROL VARIABLES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(BERDbyGOV in non-CI as % GDP)</td>
<td>0.140**</td>
<td>0.113</td>
<td>0.107</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0657)</td>
<td>(0.0945)</td>
<td>(0.0755)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(Stock GOVRD as % GDP)</td>
<td>-0.0830</td>
<td>-0.0654</td>
<td>-0.353*</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.138)</td>
<td>(0.158)</td>
<td>(0.168)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(Stock HIGRD as % GDP)</td>
<td>0.385**</td>
<td>0.107</td>
<td>0.596***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.140)</td>
<td>(0.179)</td>
<td>(0.0666)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log (B-Index)</td>
<td>0.526</td>
<td>0.576</td>
<td>0.317</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.326)</td>
<td>(0.408)</td>
<td>(0.408)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country fixed effect</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year dummy</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-2.255**</td>
<td>-3.390**</td>
<td>-2.962**</td>
<td>-4.408***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.804)</td>
<td>(1.381)</td>
<td>(1.034)</td>
<td>(0.277)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>183</td>
<td>99</td>
<td>84</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of id</td>
<td>23</td>
<td>12</td>
<td>11</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.363</td>
<td>0.426</td>
<td>0.589</td>
<td>0.365</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald test: H0 - All coefficient = 0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Results of Wald test refers to p-value. Results of all sample excludes The Netherlands, Luxembourg, Ireland, Denmark and Belgium. The list of each countries included in each group is reported in Table 2.5.

Source: Authors’ own elaboration.

Table 2.5 Positioning of Each Country Regarding C19.1 – Creative Industries

<table>
<thead>
<tr>
<th>Group 1 = Positive interaction term</th>
<th>Group 2 = Negative interaction term</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country</strong></td>
<td><strong>Classification in IS</strong></td>
</tr>
<tr>
<td>Italy</td>
<td>Publicly Policy-led</td>
</tr>
<tr>
<td>Latvia</td>
<td>Publicly Policy-led</td>
</tr>
<tr>
<td>Lithuania</td>
<td>Publicly Policy-led</td>
</tr>
<tr>
<td>Malta</td>
<td>Publicly Policy-led</td>
</tr>
<tr>
<td>Portugal</td>
<td>Publicly Policy-led</td>
</tr>
<tr>
<td>Estonia</td>
<td>Lagging Behind</td>
</tr>
<tr>
<td>Greece</td>
<td>Lagging Behind</td>
</tr>
<tr>
<td>Poland</td>
<td>Lagging Behind</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Developing</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Developing</td>
</tr>
<tr>
<td>Hungary</td>
<td>Developing</td>
</tr>
<tr>
<td>Romania</td>
<td>Developing</td>
</tr>
</tbody>
</table>

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 645884.
2.3.3 Empirical Evidence for C19.2 - Design

2.3.3.1 Descriptive Statistics

Between 2006 and 2014 the number of Community Design applications increased on an average growth rate of 3.3% per year, reaching the value of 15,692 applications in 2014, against a level of 12,136 in 2006 (Figure 2.6). After 2014, Figure 2.6 shows a decrease of 15%, between the values of 2014 and of 2016, and a level of 13,294 applications in 2016.

Figure 2.6 Number of Community Design (CD) Applications, 2006 – 2016, EU28

As regards to the number of registered Community Designs, Figure 2.7 shows two major breaks over the period, namely in 2009 and 2016. The highest value of RCD was recorded in 2013 (60,807) and the lowest in 2006 and 2016 (53,999 and 53,722, respectively).

Figure 2.7 Number of Registered Community Designs (RCD), 2006 – 2016, EU28
As regards the value of Community Designs (applications and registered), Figure 2.8 and Figure 2.9 present their value expressed in euro per billion GDP. Similar to what we found for the number of Community Design applications, after a period of growth (2009-2013), we notice a continuous decline from 2014 (Figure 2.8). The value of registered Community Design (Figure 2.9) shows a higher declining trend (2009/11 and 2014/16) and especially after 2015.

**Figure 2.8  Community Design Applications (Euro per Billion GDP), 2006 – 2016, EU28**

![Graph of Community Design Applications](image)

*Source: Authors’ own elaboration based on EUROSTAT data.*

**Figure 2.9  Registered Community Designs (Euro per Billion GDP), 2006 – 2016, EU28**

![Graph of Registered Community Designs](image)

*Source: Authors’ own elaboration based on EUROSTAT data.*

As regards to the relationship between Business R&D expenditures funded by the private sector (BERDbyBUS) and both registered and applied Community Designs, Figure 2.10 and Figure 2.11 report a positive linear correlation.
2.3.3.2 Interpretation of Econometric Results

Table 2.7 reports the results of regression estimations described in equation (7), using fixed effect estimators. The variable Design corresponds to registered Community Designs (RCD). We considered this variable, rather than Community Design applications, based on the assumption that firms are more sensitive to the decision to innovate once a positive outcome of the registration procedure has occurred. In fact, just after the application to a Community Design, there is no guarantee of a positive outcome of the registration procedure.

As we can see in column (1) of Table 2.6 the variable Design has a positive effect on BERDbyBUS. However, the coefficient of the interaction term (variable which includes the effect of Design after the commitment implementation) reveals to be non-significant, suggesting no effect of policy intervention. Taking into account that countries are very heterogeneous, we performed several individual regressions with different groups of countries (results available upon request) and from this analysis we make a division between countries where the commitment seems to have a positive effect and countries with a negative effect. The list of these countries is displayed in Table 2.7. After a split of the full sample in two groups, we estimated the model defined in equation (6). These new results are reported in column (2) and (3) of Table 2.6, confirming the existence of two different behaviors: a positive effect on Design in some countries and a negative effect in other countries, after commitment implementation.
Table 2.6  Results Fixed Effect Panel Data Regression Model: C19.2 (Design)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Y = log(BERDbyBUS as % GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All sample</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Log(Design - Euro per billion GDP)</td>
<td>0.0834**</td>
</tr>
<tr>
<td></td>
<td>(0.0405)</td>
</tr>
<tr>
<td>C192 (2014 - 2016)</td>
<td>0.171*</td>
</tr>
<tr>
<td></td>
<td>(0.0848)</td>
</tr>
<tr>
<td>Interaction term (commitment effect)</td>
<td>-0.0258</td>
</tr>
<tr>
<td></td>
<td>(0.0681)</td>
</tr>
<tr>
<td>CONTROL VARIABLES</td>
<td></td>
</tr>
<tr>
<td>Log(BRD by GOV as % GDP)</td>
<td>0.188***</td>
</tr>
<tr>
<td></td>
<td>(0.0516)</td>
</tr>
<tr>
<td>Log(Stock GOVRD as %GDP)</td>
<td>-0.0888</td>
</tr>
<tr>
<td></td>
<td>(0.210)</td>
</tr>
<tr>
<td>Log (Stock HIGRD as % GDP)</td>
<td>-0.0809</td>
</tr>
<tr>
<td></td>
<td>(0.288)</td>
</tr>
<tr>
<td>Log(B-Index)</td>
<td>0.0930</td>
</tr>
<tr>
<td></td>
<td>(0.312)</td>
</tr>
<tr>
<td>Year dummy</td>
<td>NO</td>
</tr>
<tr>
<td>Country fixed effect</td>
<td>YES</td>
</tr>
<tr>
<td>Constant</td>
<td>-4.668***</td>
</tr>
<tr>
<td></td>
<td>(1.220)</td>
</tr>
<tr>
<td>Observations</td>
<td>307</td>
</tr>
<tr>
<td>Number of id</td>
<td>28</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.193</td>
</tr>
<tr>
<td>Wald Test</td>
<td></td>
</tr>
<tr>
<td>H0: All coefficient igual zero</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Results of Wald test refers to p-value. The variable Design corresponds to Registered Community Designs. The list of each countries included in each group is reported in Table 2.7.

Source: Author own elaboration.

Table 2.7  Positioning of Each Country Regarding the Effect of C19.2 (Design)

<table>
<thead>
<tr>
<th>Country</th>
<th>Classification in IS</th>
<th>Country</th>
<th>Classification in IS</th>
<th>Country</th>
<th>Classification in IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Strongly Developed</td>
<td>Latvia</td>
<td>Publicly Policy-led</td>
<td>United Kingdom</td>
<td>Strongly Developed</td>
</tr>
<tr>
<td>Belgium</td>
<td>Strongly Developed</td>
<td>Lithuania</td>
<td>Publicly Policy-led</td>
<td>Malta</td>
<td>Publicly Policy-led</td>
</tr>
<tr>
<td>Denmark</td>
<td>Strongly Developed</td>
<td>Luxembourg</td>
<td>Publicly Policy-led</td>
<td>Estonia</td>
<td>Lagging Behind</td>
</tr>
<tr>
<td>Finland</td>
<td>Strongly Developed</td>
<td>Portugal</td>
<td>Publicly Policy-led</td>
<td>Greece</td>
<td>Lagging Behind</td>
</tr>
<tr>
<td>Germany</td>
<td>Strongly Developed</td>
<td>Poland</td>
<td>Lagging Behind</td>
<td>Cyprus</td>
<td>Developing</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Strongly Developed</td>
<td>Bulgaria</td>
<td>Developing</td>
<td>Hungary</td>
<td>Developing</td>
</tr>
<tr>
<td>Slovenia</td>
<td>Strongly Developed</td>
<td>Croatia</td>
<td>Developing</td>
<td>Slovakia</td>
<td>Developing</td>
</tr>
<tr>
<td>Sweden</td>
<td>Strongly Developed</td>
<td>Czech Republic</td>
<td>Developing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>Publicly Policy-led</td>
<td>Romania</td>
<td>Developing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>Publicly Policy-led</td>
<td>Spain</td>
<td>Developing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>Publicly Policy-led</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Classification in IS (Innovation System) refers to categories defined by Verspagen et al. (2018). Source: Author’s own elaboration based on results of regression estimation.
2.4 Impact of C19 on the Innovation Eco-system

The primary actors in Commitments 19.1 (Creative Industries) and 19.2 (Design) are firms, because Creative industry sector and Design activities are both included or developed by private sector. Firms are the performers of innovation, which generated economic value.

Actions taken under Commitment 19.1 are designed to support traditional industries to access services from creative industries, matching demand and supply of creative services. This in turn improves the conditions of access to finance for creative industries companies in Europe. As regards Commitment 19.2, these actions were essentially aimed at divulging information on the role and importance of design as a driver for innovation, as well as, to make policy recommendation about how to improve all the potential of design. Commitment 19, it therefore expected to increase firms’ capabilities and performance, for example through a better access to finance, and interaction between firms (demand and supply). A second group of actors in the innovation system included in these Commitments are governments which facilitate and stimulate interactions between firms.

As regards commitment 19.1 from the results of regression estimations (Table 2.4) it appears that interaction between firms is more effective, after commitment implementation, in countries classified by Verspagen et al. (2018) as Publicly Policy-led, Lagging Behind and Developing (Table 2.5). Actually, concerning countries classified as Strongly Developed, results suggest that R&D activities of Creative firms are not able to stimulate positively innovation in other sectors (Table 2.5), suggesting some weakness on collaboration and technology transfer among firms of different sectors.

Concerning commitment 19.2, the analysis made in the previous section suggests that governments regulation and legislation, as regards to the Intellectual Property Rights (as measured by Registered Community Designs) influenced positively innovation behavior (Private R&D expenditures), at least for the majority of EU28 Member states (Table 2.7).

2.5 Conclusion

The present section of the D5.3. refers to Commitment 19.1 and 19.2 linked respectively with the establishment of a European Creative Industries Alliance and to setting up a European Design Leadership Board. In D5.2. we described which actions were taken in order to implement each commitment, which are expected to increase firms’ capabilities and performance, as well, the interaction between demand and supply of creative and design services.

As statistical data at micro-level about the policy activities implemented under Commitments 19.1 and 19.2 were not available, even upon request, we decided to make the systemic evaluation of both commitments based on a simpler approach. For each commitment, we selected a variable linked with its target and field of intervention, namely the Business R&D expenditures funded by the private
sector performed by Creative Industries (BERDbyBUS in CI) for C19.1 and the registered Community Designs for C19.2. We also made a distinction between periods, using a dummy variable, which takes the value of 1 after the commitment implementation and 0 otherwise. As the result of this dummy variable, we estimated also an interaction term, which proxies the effect of BERDbyBUS on CIs or Design after commitment implementation. It should be noted that a main limitation of this approach is that we can also capture other economic effects.

Yet, despite this limitation, and taking into the analysis performed in this section of D5.3 and on D5.2., we can conclude that policy measures implemented under Commitment 19.1 and 19.2 have a positive effect on private R&D expenditures, however, some countries appears to take more advantage of them than others. For example, as regard C19.1, countries with a moderate and lower innovation performance are those where the commitment has a positive effect, which can be explained by the fact that in these countries the CI activities are less developed and public support is more needed.

The main policy recommendation, based on this analysis, rests essentially in the necessity to provide a better access to statistical data and to construct better indicators to assess the policy measures for making easier for researchers to make an impact assessment. Actually, due to data limitation, the analysis of Commitments 19.1 and 19.2 was also more restricted and limited.
2.6 References

AMADEUS database: https://amadeus.bvdinfo.com/


Design for Europe website: http://www.designforeurope.eu


ECIA platform: http://eciaplatform.eu


EUROSTAT database: http://ec.europa.eu/eurostat/


3 Open Access to Research Results / Research Information Services (Commitment 20)

Maja Jokić (Institute for Social Research Zagreb), and Andrea Mervar (EIZ)

3.1 Introduction

In the 2017 EC publication “Europe’s Future: Open innovation, open science, open to the world: reflections of the Research, Innovation and Science Policy Experts (RISE) High Level Group”, Carlos Moedas, European Commissioner for Science, Research & Innovation highlighted that “… for Europe to maintain its leading position in fundamental research, cutting edge innovation and addressing global societal challenges, openness is a pre-requisite. Without openness, research and innovation will not be able to reach its full potential, serve our citizens and ensure a sustainable, dynamic economy and a better society for generations to come” (European Commission, 2017a: 6).

The concept of open science has been rapidly developing and is much broader than the open access concept that is the subject of Commitment 20 in the Innovation Union document. Namely, Commitment 20 (European Commission, 2010: 19), in addition to promoting open access to publicly funded research, stated that Commission would aim to make open access to publications the general principle for projects funded by the EU research Framework Programmes. Furthermore, the Commission would also support the development of smart research information services that are fully searchable and allow the results from research projects to be easily accessed.

What were the reasons to include Commitment 20 in the Innovation Union document? The behaviour of professional publishers since the 1970s, when they started to continuously increase subscription fees for scientific journals, forced academic community to use the advantage of new technologies (in particular internet) and initiate open access (OA) (Björk et al., 2010; Schöpfel, 2015). Researchers in less endowed institutions have had problems to access scientific knowledge and the same applied to other knowledge users (in particular SMEs). In that way the free access to scientific information has become the challenge of 21st century (Pisoschi and Pisoschi, 2016). Besides its economic impacts the implementation of Commitment 20 also has important social impacts. While the former relates to increase in productivity of research as well as increased visibility and usage of the existing research results, the latter relates to increased transparency of research, improved science-literacy of citizens as well as opportunity for policymakers to make more evidence-based decisions.

From the perspective of Innovation Union 2010 document, the objectives set at the EU level regarding Commitment 20 have been achieved. In Horizon 2020 open access to publications has become mandatory (both “green” and “gold” model are acceptable with the possibility to pay for APCs (Article Processing Charge) in the “gold” model from the Horizon 2020 project budget).
Additionally, a pilot project on open data has also been implemented. The Commission has invested substantial resources into building appropriate infrastructure with OpenAIRE, the e-infrastructure to deposit and access peer-reviewed articles and datasets resulting from EU-funded projects, being the central one. More recent efforts by the Commission are focused on the European Open Science Cloud (European Commission, 2016), an infrastructure that should allow for depositing, sharing, and re-using scientific data and results.

At the level of member states approaches and pace of individual countries regarding implementation of OA strategies differ. Most EU member states have, at least to some extent, developed open access programs for national journals and institutional repositories which contain integral texts of research papers and professional papers, different types of reports and software solutions. However, the problem still lies in the fact that such sources of scientific information are dispersed, insufficiently promoted and hard to find. In addition to repositories with open access to project results, research articles and other scientific information, focus is now also on the repositories with open access to research data as well as on e-infrastructures to access and preserve scientific information.

In a recent strategic document European Commission has set three main policy goals for research and innovation: open innovation, open science and open to the world (European Commission, 2016). As already mentioned, open science concept is much broader but still closely related to Commitment 20. Namely, open science concept implies spreading knowledge as soon as it is available. In order to implement it Commission has established a number of groups and platforms. These include:

- **open access** (online access to scientific information for free to users);
- **open science monitor** (provides information on developments and trends in open science, over time and comparatively);
- **European open science cloud** (cloud for research data in Europe);
- **European open science policy platform** (group that advises the EC on open science policy);
- **expert group on indicators** (indicators related to open science and its impacts);
- **open science news and events** (platform to share news, events, publications etc. related to open science).\(^8\)

This chapter is structured as follows. Following the introductory notes which explain what is the Commitment 20 about, its rationale, objectives and achieved milestones, we will briefly discuss the

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concept of open science which is much broader than the open access itself but is nowadays due to rapid developments more in the focus of European Commission. Afterwards, we briefly review the main findings on Commitment 20 related to previous deliverable; explain why Commitment 20 could not be integrated into the Nemesis model and focus on the effects of the Commitment 20 on the innovation system (key actors and their interactions; different types of EU innovation systems from the perspective of Commitment 20). We finish the chapter with concluding remarks.

### 3.2 Open Science

One of the indicators of recognition and acceptance of the idea of open science as a new concept of scientific communication are the research papers which refer to this topic and are published in peer-reviewed journals. For this purpose we analysed the papers published in journals indexed in Scopus database in 2013-2017 period. The analysis included papers (n=215) that had the term "open science" in their title (Figure 3.1). The share of papers by authors affiliated with institutions in EU member countries was 46% (n=99). Interestingly, only 13% of "open science" papers were published in open access journals (OAJs), while authors from the EU countries published only 10% of papers in OAJs.

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9 We have done a similar type of analysis with the term “open access” for the first deliverable on this project (Jokić, 2016).
Interest on the topic of “open science” by authors affiliated with institutions in EU countries can be seen in Figure 3.2. Out of 28 EU countries, authors from 19 countries had one or more papers on the topic of “open science” in the period 2013-2017. These data point to substantial differences between EU countries.

The major problem remains the assessment of the impact of open access in general (as well as open science), in particular on the innovation process. Although we can, to a certain degree, measure the acceptance and recognition of open science sources among researchers through bibliometric analysis, the impact on the innovation output and economic performance remains blurred. The literature in particular mentions the case of SMEs that through free access to information can substantially improve and speed up their innovation process. Two studies for UK and Denmark have proven impact but only a comprehensive Europe-wide survey would give us more clear answer on
that question.¹⁰

**Figure 3.2** Number of Papers with Term “Open Science” in the Title by Authors Affiliated in EU Member Countries

![Bar chart showing the number of papers with the term "open science" in the title by authors affiliated in EU member countries.](image)

*Source: Own calculation.*

Finally, as Figure 3.3 indicates social science ranks second if number of published papers with term “open science” are ranked across subject fields. Largest number of papers from this subject field was, as expected, published in the field of library and information science.

As open science is a new and complex paradigm, we now very briefly review the recent additions to the literature. Vicente-Saez and Martinez-Fuentes (2018: 428) argued lately that lack of awareness on open science is due to no formal definition. Building on the extensive literature survey, they define it as “transparent and accessible knowledge that is shared and developed through collaborative networks between scientific community, the business world, political actors, and citizens”. Open science concept promotes free access to the artefacts of research, the software, data, results and scientific articles in which they appear, and additionally interested users can validate, reuse them and collaborate (Taylor et al., 2018). The common fear, foremost among researchers in respect to open science is that someone’s research ideas or results will be published by someone else. However, by analysing two case studies Laine (2017) came to the contrary conclusion. In fact, open science helped reduce unethical behaviour.

Proponents of open science believe that biggest problems of the 21st century cannot be solved without the help of many people and well-organized data sharing processes (Hesse, 2018). Since the concept represents a challenge to traditional modes of scientific practice and collaboration (Chataway et al., 2017) it will certainly take time for creators of knowledge, foremost researchers, as well as other participants and stakeholders, to accept it. Ali-Khan et al. (2017) highlights that support for open science is growing, but motivating researchers to participate in open science can remain
To be aware of current situation with the open science, we finally quote Arza and Fressoli (2018) who argue that there are many beneficial aspects of open science such as improving research efficiency, accelerating creativity, democratizing knowledge and empowering stakeholders, but the problem remains that these claims are usually based on anecdotal experiences.

### 3.3 Summary of Findings

We focus now on the narrower concept of open access and the Commitment 20 itself and briefly review the findings of previous deliverable (Jokić, 2018).

Open access (OA) refers to the practice of providing on-line access to scientific information that is free of charge to users and is reusable. Open access to “scientific information” refers here to two broad categories:

- **peer-reviewed scientific publications** (primarily research articles published in peer-reviewed journals) and

- **scientific research data** - data underlying publications and/or other data (such as curated but unpublished datasets or raw data).\(^{11}\)

As stated in OECD (2015: 18) the main **benefits of open access** may be summarized as follows. It improves efficiency in science by reducing duplication and the costs of creating, transferring and reusing data; allows more research from the same data; multiplies opportunities for domestic and global participation in the research process; increases transparency and quality in the research validation process by allowing a greater extent of replication and validation of scientific results; speeds the transfer of knowledge from research to innovation; increases knowledge spillovers to the economy; increases awareness and conscious choices among consumers; helps addressing global challenges more effectively by globally coordinated international actions; promotes citizens’ engagement in science and research – promote awareness and trust in science among citizens - greater citizen engagement may lead to active participation in scientific experiments and data collection.

As data has not allowed impact assessment of Commitment 20 the primary aim of the previous deliverable was to evaluate the level of awareness regarding the importance of OA in EU member states by measuring the number and accessibility of OA repositories and OA peer-review journals of

respective countries. Consequently, Jokić (2018) surveyed the potential of OA peer-reviewed journals by determining their number and areas of coverage. The scientific recognition, quality and importance of OA journals compared to traditional (subscription) journals were analysed by using bibliometric indicators. Additionally, attempts were made to measure the impact of OA on SMEs in Croatia and their innovation performance (Rajh and Škrinjarić, 2018). As there have been just a few studies that have investigated this important issue,\(^\text{12}\) the intention was not to generalize the results for Croatian sample to the EU level but to give some more insights into the issue that should be further investigated at the EU level.

The EU member states already have a strong tradition in open access (OA), both in building infrastructures for OA repositories and stimulating the establishment of OA journals and transition from traditional publishing to open access. The proportion of OA repositories in EU countries with respect to all repositories currently stands at 37%, and supports the assertion of the awareness of EU countries regarding the importance of public access to the research results. Though it entails a relatively high potential, currently there is no reliable data on the use of such sources, especially for some types of users such as, for example, SMEs.

Analysis of the accessibility of content of EU-published peer-reviewed journals through national journal portals, DOAJ (Directory of Open Access Journals) and Scopus databases in October 2016 showed that:

- among 28 EU members only six countries had national scientific OA journal portals: Croatia, Hungary, Poland, Slovakia, Slovenia and Spain. Germany does not have a single national portal for OA peer-reviewed journals, but it has a number of journal portals for specific scientific fields;

- EU-published OA journals indexed in DOAJ database (as more selective source compared to national journal portals) had a share of 40% in total indicating the potential of EU countries with respect to the rest of the world;

- Scopus indexed 1,429 EU OA journals, which is 9% compared to all EU peer-reviewed journals covered by Scopus.\(^\text{13}\)
  - Bibliometric analysis and journal evaluation (quartiles, h-index, SJR (SCImago Journal Ranking), CiteScore, etc.) via quartiles in the period 2012-2015, showed the prevalence of Q3 and Q2 for EU OA journals. OA journals from the country groups of strong innovators and innovation leaders are more recognized and the values of all


\(^{13}\) Relates to 2015.
bibliometric indicators are above the median. As expected, and in line with bibliometric indicators, OA journals from the other two groups of EU countries are less recognized.\(^{14}\)

- Based on acquired bibliometric indicator values, the conclusion was that OA journals from EU countries are on average of a better quality than other EU scientific journals indexed in the Scopus database.

The analysis of OA repositories of EU countries, allowed also to list major **obstacles for users**. They include:

- the absence of a national OA repository portal in a large number of EU countries;
- non-unified software solutions for the repository databases;
- a lack of uniform and user-friendly search interfaces;
- duplication of content in repositories of two or more institutions;
- diversity of content ranging from metadata to full-text publications.

How to make the results of scientific research publicly available to the whole community? In order to find a systematic solution, first and foremost, all potential categories of actors, their interests and obligations in the implementation of the open access (open science) process should be identified. Although Commitment 20 deals with only one segment of open science and that is the one that already exists in the real world and gives certain results, it basically reflects the whole idea of the open science concept.

### 3.4 Integration of C20 into NEMESIS

Commitment 20 affects innovation process through increasing “knowledge spillovers”. Its impact, except for the direction, can hardly be quantified with available data which was the main reason to initially choose “candidate” and not “selected” status for the inclusion of the Commitment 20 into the Nemesis model. Namely, as “candidates” were classified commitments that have an effect on

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\(^{14}\) In line with the Innovation Scoreboard, EU countries were divided in four categories: innovation leaders (Denmark, Finland, Germany, the Netherlands and Sweden), strong innovators (Austria, Belgium, France, Ireland, Luxembourg, Slovenia and the United Kingdom), moderate innovators (Croatia, Czech Republic, Estonia, Greece, Hungary, Italy, Lithuania, Latvia, Malta, Poland, Portugal, Slovakia and Spain) and modest innovators (Romania and Bulgaria).
innovation and indirectly on other measures of economic performance in the NEMESIS model but that cannot be incorporated in the model either because data are missing, are imperfect or incomplete or because the parameters that are needed to quantify their impacts are too uncertain. Accordingly, due to the fact that indicators on the impact of open access/open science are imperfect, the decision was not to include Commitment 20 into the Nemesis.

3.5 Impact of C20 on the Innovation Eco-system

3.5.1 Key Actors and their Interactions

The key actors involved in Commitment 20 include:

- **knowledge creators** (researchers at universities and other higher education institutions; researchers in government-owned, public and private research institutes; innovative firms; various types of professionals);
- **policymakers**: governments at the EU and member countries national level;
- **data infrastructures**: data centres, libraries, repositories, clouds and the similar;
- **research funding agencies/bodies**: government funding bodies at EU and national level, academic institutions, charity funds;
- **users**: researchers, business sector, civil organizations, citizens.

All five key categories of actors interact dynamically with each other as presented in Figure 3.4.

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15 For details, please refer to Deliverable 9-2 (Mohnen, 2018).
Knowledge creators: Open access/open science paradigm presumes a shift from the standard practice of publishing research results in traditional peer-reviewed journals towards, in a broader sense, sharing all available knowledge and data at the earliest stages of the research process. It requires a move from “publishing as fast as possible” to “sharing knowledge as early as possible” (European Commission, 2017b: 5). Although science by its definition incorporates elements of sharing, so that even the traditional (subscription) journals base their existence on researchers’ intrinsic need to communicate research results to the rest of academic community (Jokić et al., 2018), researchers and other knowledge creators will surely need time to accept the new paradigm of scientific communication. One of the important reasons is the system of evaluation of scientific work, researchers’ advancement and career promotion, but also the evaluation and ranking of universities and other higher education institutions. Predominantly these systems are not yet aligned with the open access/open science paradigm and might be one of the major obstacles in accepting the concept from the perspective of knowledge creators. The European Commission’s awareness of the problem is expressed in the ERA National Action Plan with the concrete action: Supporting and training actions for researchers including aligning with European Initiatives within Horizon 2020 (European Commission, 2017c: 28). However, this is just one of the aspects of alerting knowledge creators to the importance of open access/open science.
**Policymakers:** Over the last several years European Commission has made substantial efforts in the field of open access and more broadly, open science policy. One of the latest documents is “Implementation Roadmap for the European Open Science Cloud” (European Commission, 2018) which describes its main directions in the field. It is an outcome of extensive consultations with scientific and institutional stakeholders over 2016 and 2017 and builds on the Horizon 2020 Work Programme 2018-2020. The consultations confirmed the need for pan-European federation of research data infrastructures, in order to make a change from the current fragmentation to a situation where data can be easily stored, found, shared and reused. Roadmap gives and overview of six actions for the implementation of the European Open Science Cloud: a) architecture, b) data, c) services, d) access & interfaces, e) rules and f) governance. It serves as a basis for the further consultations with member states, the European Parliament and other relevant stakeholders on the next steps to take. It should also help stakeholders to orient their future contributions to the initiative. The extent to which each EU country will be ready and able to develop and implement the EC policy concept of open science is one of the potentially major obstacles.

**Data infrastructures:** Taylor et al. (2018) provided a graphical representation of the taxonomy of open science concept produced by the FOSTER project\(^\text{16}\) which proves (Figure 3.5) that there is a wide range of “open” concepts ranging from open access to scientific artefacts all the way to the measurement of the impact. All of these documents and data should be described by a standardized metadata system, so that they can be accessed through a single interface, either national portals and/or repositories, or common EU portal - a repository with the open science contents for all member states. European Open Science Cloud (EOSC) should allow national repositories that contain all kinds of documents and data listed in the taxonomic scheme to be accessible through a single user interface. How many of the member countries will contribute to a common portal depends on all categories of actors. EOSC is now in a pilot phase and according to the timeline a large scale European high performance computing, data storage and network infrastructure should be in place by 2022.

Figure 3.5 Open Science Taxonomy


**Research funding agencies:** The importance of research funding agencies in the whole process is crucial and they are often the drivers of the process. EU countries finance OA activities (institutional repositories and journals) through government funding, EU funds, academic institutions, private and charitable funds, and the APCs (article processing charges) model. For the EU member countries, especially in categories of modest and moderate innovators, funding requirements may limit open data and open access publishing. According to the available data on open science funding models, the European Commission works more intensively than the individual members e.g. through the commitment to finance published output from Horizon 2020 projects. Many funders at national levels also require open access to published research results and some funders increasingly require open access to research data as well.

**Users:** From the users’ point of view it is very important to have a single interface to search multiple OA repositories or a unique interface in the form of portals, to have an easy access to all reliable research sources of data and documents. The ideal solution is a single OA repository/portal at the EU level publicly available. In order for the open science content to reach the intended users, it is necessary to promote the open science concept, to conduct systematic education for all kinds of users at different levels, and to monitor and measure the usability, response and impact. Particular attention should be paid to the group of users connected to innovative processes. It is important to continuously inform this group of users about the possibilities of open science, and special attention should be given to investigate their needs.
The real implementation of the concept of open science depends on the common synergy of all five major groups of actors. The awareness of all creators of scientific information, but also policy-makers and funders on the importance and benefits of open science is crucial. On the other hand, the development and application of new technologies, tools for processing, transmission and standardization of metadata for all types of documents and data covering the concept of open science are the prerequisites without which open science cannot exist. There are also issues related to property and copyrights over documents and data that have to be solved (e.g. adjustment according to GDPR). Encouraging the use of open science, informing and educating all types of users especially those involved in innovation process and SMEs, measuring benefits and utilization as well as developing a new metric system for evaluating source and data incorporated in open science concept, opens up new features. Although open science now enjoys widespread support across scientific and technological communities, institutional and cultural barriers still stand in its way.

3.5.2 Effectiveness of Policies on Different Types of EU Innovation Systems

European Commission (2017a) in its recent strategic document on open innovation, open science and openness to the world stressed that national specificities should be taken into account when implementing policy activities and achieving goals because the EU is a community of countries with different cultural, historical, economic, and scientific backgrounds. That was also highlighted by Verspagen et al. (2018a) arguing that innovation systems in Europe differ widely by country. Further analysis by Verspagen et al. (2018b) led to the identification of four different types of innovation systems:

- **Strongly developed** (strongly developed in a general sense; all parts of the innovation system well developed and competitive): Austria, Belgium, Denmark, Finland, Germany, the Netherlands, Slovenia, Sweden, and the United Kingdom.

- **Public-policy led** (active science & technology & innovation policies but not so well-developed private sector; overall good performance): France, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta and Portugal.

- **Developing** (Depend strongly on external knowledge; weak performance, but public policy important for advancing the system): Bulgaria, Croatia, Cyprus, Czech Republic, Hungary, Romania, Slovakia and Spain.

- **Lagging behind** (Depend strongly on external knowledge; weak performance, weak public policy initiatives): Estonia, Greece and Poland.
Are there differences in the effectiveness of open access/open science policies across the various European innovation systems? At this stage, the clear answer confirmed by the analysis cannot be given. Generally, Commitment 20 policies should have positive effect on all types of innovation systems. Furthermore, Commitment 20 policies bring to the forefront the importance of “foreign” science through knowledge spillovers and should therefore allow for convergence among systems in different development stages having stronger effects on the less developed ones. Analysis on the state of open access (open access journals, repositories) in the EU countries presented an overview not only for the EU as a community, but also for each of the countries or groups of countries depending on the innovation status. However, it only opens up the need for further analysis of the organization, accessibility, usage and effectiveness of open access/open science paradigm.

In essence of Commitment 20 is open access to the results of all publicly-financed research and developing infrastructures that would allow for it, which are usually publicly financed. In that sense Commitment 20 policies should improve the capabilities of all actors, but foremost researchers both as knowledge creators and as users. Open access should also improve the interaction between the actors, not only within local, national borders but also internationally. Having in mind the characteristics of four different innovation systems described above, the policies should be more easily implemented in the three categories of innovation systems with well-developed public policy initiatives. Absorption capacities of countries might be the main obstacle for effectiveness especially due to large majority of small countries (European Commission, 2007a).

Last, but not least the major challenge remains the assessment of the impact of open access/open science in general. Although we can, to a certain degree, measure the acceptance and recognition of open access publications among researchers through bibliometric analysis, impacts on the innovation output and economic performance remain blurred. The literature in particular mentions the case of SMEs that through open access have free access to important information which might substantially improve and speed up their innovation process. Two studies for UK and Denmark have proven impact but only a comprehensive Europe wide survey would give us more clear answer on that question.17

In the Appendix we have used the headline indicators from 2016 ERA Progress Report (European Commission, 2017c) to indicate how it stands across the above defined innovation systems.

### 3.6 Conclusion

Based on the conducted analyses and available resources we can agree with the assertion that “… EU member states already have a strong tradition in open access, both in building infrastructures for OA

repositories and stimulating the establishment OA journals and transition of traditional publishing to Open Access.”

Open access/open science has made a strong progress since 2010 and in particular in the last several years. In fact, the developments in open access/open science area are so rapidly changing that the narrower concept of open access and the related infrastructures has become only one of many components of open science paradigm which is in nowadays in the focus. At the same time, open access still provides more reliable data for analysis than any other forms embraced under the notion of open science.

In this report we have identified key actors in the implementation of open access/open science policies. These include: knowledge creators of all kinds, policymakers at different levels, data infrastructures, research funding bodies as well as users in the broadest possible sense. Process of implementation of open science should benefit all types of innovation systems in Europe, and allow for convergence. Nevertheless, it will in particular benefit those where public initiatives are well-developed as it requires coordination and investment into infrastructures.

Time is needed to take full advantage of all the benefits offered by open access, and in particular the open science paradigm as all stakeholders need to adjust, especially research and innovation community (for example, SMEs). Obstacles also include the cost of switching to open access, diversity of copyright laws and legal aspects of rights ownership across countries, private sector concerns about sharing the data etc. At the same time researchers are concerned about the consequences of open access on their career progression.

In 2016 EU member states adopted Council Conclusions on the transition towards an Open Science System which asks for open access to scientific publications to be the default option for the results of all publicly funded research (the transition should end by 2020). The ERA National Action Plans (European Commission, 2017c: 28-29) already include number of action to speed up this process:

- Creating e-infrastructures to enable access to the results of publicly funded research and storage of science-related digital content;
- Developing national strategies and action plans, both for open access to publications and research data including monitoring mechanisms;
- Developing open access policies for business-oriented and applied research;

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• Requirements of open access for publicly funded research including archiving in repositories and promoting data management plans;

• Supporting and training actions for researchers including aligning with European Initiatives within Horizon 2020;

• Promoting actions in international bodies to achieve better alignments of definitions.

• Acquiring licenses for research databases,

• Promoting actions in international bodies to achieve better alignments of definitions.

Although The ERA National Action Plans defined almost all activities related to open access / open science, we believe that educational promotional activities directed towards users, especially SMEs in “developing” and “lagging behind” countries, should be additionally emphasized.

A new paradigm of open science unfolds a lot of questions for all actors in the process and, as stated in the European Open Science Cloud Declaration19 “its implementation is a process, not a project, by its nature iterative and based on constant learning and mutual alignment”.

3.7 References


Mohnen, Pierre, 2018, Deliverable 9-2 “Report on proposal for modifying the NEMESIS model, based on the analysis of the European innovation and the analysis of the 34 commitment”, WP9, project “I3U Investigating the impact of the Innovation Union”.


3.8 Appendix

2016 ERA Progress Report (European Commission, 2017c) has published headline indicator for the open access priority. The indicator that is aimed to track performance and progress of open access priority is the share of papers available in OA, regardless of the route (green OA or gold OA). In other words, it assesses how much of a country’s research is available to potential users, regardless of the mechanism by which it is made available. The results are for 2014 and the analysis was undertaken by Science-Metrix using Web of Science database.

The results are here presented in four panels of Figure A.1, where countries are grouped in line with Verspagen et al. (2018). As can be seen the differences among countries are rather small. The countries with the highest shares of research available in total OA are Luxembourg and Croatia that have about 60% of their publications (from 2014) available in OA. The EU-28 average is about 52%, while the countries with the smallest shares of publications available in OA are Latvia, Germany, and Malta with approximately 50% or less.
Figure 3.6  Share of Publications in Open Access, 2014

Panel A: Strongly developed
Panel B: Public-policy led

Panel C: Developing
Panel D: Lagging behind

Source: Own Calculation.
4 Facilitating Effective Collaborative Research and Knowledge Transfer (Commitment 21)

Ivan-Damir Anić (EIZ) and Andrea Mervar (EIZ)

4.1 Introduction

Commitment 21 deals with the questions of how to facilitate effective collaborative research and knowledge transfer. In the Innovation Union document (European Commission, 2010: 19) it is defined in the following way: “The Commission will facilitate effective collaborative research and knowledge transfer within the research Framework Programmes and beyond. It will work with stakeholders to develop a set of model consortium agreements with options ranging from traditional approaches to protect IP through to more open ones. Mechanisms are also needed to further strengthen knowledge transfer offices in public research organisations, in particular through transnational collaboration.” In essence, Commitment 21 comprises of two interrelated components - one focuses on facilitating effective collaborative research of various types, while the other addresses knowledge transfer particularly through technology transfer offices (TTOs) in universities and public research institutions.

Following the introductory section, we briefly review the commitment’s rationale, objectives, impact channels and milestones achieved. Additionally, next section presents a short summary of findings from previous deliverables followed by explanations related to (non-)integration of Commitment 21 into the Nemesis model. The effects of Commitment 21 on innovation system are presented in the fourth section of the chapter. This includes description of key actors, interactions among them as well as the policy effects of Commitment 21 on European innovation systems. The chapter ends with concluding remarks.

4.2 Summary of Findings

Why has the Commitment 21 been introduced in the Innovation union document? As the problems grow more complex and the costs of innovation rise, firms are increasingly being driven to

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20 Sections 4.1-4.3.

21 In this report the findings from two previous two deliverables related to Commitment 21: Deliverable 5-1 on “Literature review and Data collection” and Deliverable 5-2 on “State of Implementation and Direct Impact Assessment” (Anić 2016, 2017; Anić, Mervar and Škrinjarić, 2018) are put in perspective of European innovation systems.
collaborate (European Commission, 2010: 18). Many of them continue with in-house R&D, but that is often complemented with activities related to the transfer of ideas from external sources, such as universities or start-ups. Firms also collaborate on innovations with other firms, even with competitors, but also with suppliers, clients and consumers in order to better satisfy their needs or create new routes to market. Nevertheless, special place is given to cooperation with universities and other higher education institutions as well as government, public and private research institutes. This trend is spreading across manufacturing and service sectors.

Commitment 21 is about free movement of innovative ideas and its theoretical justification lies in knowledge spillovers. The main objective of Commitment 21 is to improve collaborative research effort and knowledge transfer in particular in public research organizations and thus increase capability for innovation. It focuses on spreading available knowledge, exchanging best practices, and collaborating with others but also transferring knowledge. Impact channels through which Commitment 21 operates include various types of consortium agreements in order to bring together different types of organizations, for example large companies, SMEs, universities, research institutes/centres, etc.

As far as the implementation is concerned, objectives of Commitment 21 set in 2010 strategic document (European Commission, 2010) in respect to collaborative research have been achieved. “Commission Recommendation on the management of intellectual property in knowledge transfer and Code of Practice for universities and other public research organisations” (European Commission, 2008) provided guidance on effective collaboration in research projects. Based on the experiences from Framework Programmes, Commission has also proposed simple and clear rules for participation in Horizon 2020, including rules on transfer/licensing of the results of the projects. User–friendly Model Grant Agreement supported by concise and practical guidance has been prepared and implemented. Additionally, Horizon 2020 rules for participation and dissemination of results require from the members of a consortium that is participating in an action, to conclude an internal agreement called consortium agreement.

In respect to knowledge transfer offices, the bottlenecks still exist. Although a large number of knowledge transfer offices have been established over the last decade, the quality and size of them, and the resources available to them, vary greatly across the EU. There is considerable expertise and support available, but communication within and between national networks of knowledge transfer offices seems not to be developed enough. In 2011 the Commission has launched the European TTO Circle (https://ec.europa.eu/jrc/en/tto-circle) in order to enhance collaboration on knowledge transfer among the TTOs of 25 large European public research organisations (which are not involved in teaching). One of the tasks of the TTO Circle is to improve sharing of expertise, the exchange of best practices and the development of synergies at European level in the field of IP and knowledge transfer.
In the context of the European Research Area (ERA) and policy approach on open innovation and knowledge transfer, Commission has established an Expert Group to assess what can be done to improve knowledge sharing and utilisation. The Expert Group’s report offers a new open innovation paradigm describing how to build and fund ecosystems for co-creation (European Commission, 2014). Additionally the recent ERA Progress report 2016 (European Commission, 2017) suggested that in the period 2008-2012 rise in innovative firms cooperating with public or private research institutions as well as innovative firms cooperating with higher education institutions. In spite of these positive trends knowledge transfer remains extremely diverse and underdeveloped both at EU and national levels. Major obstacles recognized by ERA Progress Report 2016 include low employment of researchers in the private sector and limited experience of researchers outside the academic circles.

In the empirical part of deliverable D5.2 (Anić, Mervar and Škrinjarić, 2018) dealing with the direct impact assessment of Commitment 21, we explored companies that were involved in EU programmes (notably Framework Programmes) in order to find whether there is a pattern that emerges for companies that have or have not participated in such programmes. The analysis has given rough indications that firms that collaborate through EU programmes had better innovation performance vs. those that have not collaborated. Specifically, we used propensity score matching and microdata from three CIS rounds: 2008, 2010 and 2012 for Bulgaria, Croatia, Czech Republic, Estonia, Germany, Hungary, Lithuania, Portugal, Romania, Slovakia, Slovenia and Spain and implemented two treatments: in the first treatment we compared firms that have not received public EU funding with those that have and in the second treatment those that were involved in Framework programmes (as a proxy for collaboration) with those that have received other kinds of public EU funding. Although the answer was broadly positive for those collaborating, the results remain only indicative due to significant deficiencies in the data.

As regards to the second part of Commitment 21, past research and in particular surveys on TTOs have shown that there is a great diversity in knowledge and technology transfer in Europe. Some TTOs in developed countries represent the third generation of TTOs, while in less developed countries TTOs are young and represent first generation of TTOs and their impact on knowledge and technology transfer is limited.

4.3 Integration of C21 into Nemesis

Commitment 21 affects innovation process through increasing “knowledge spillovers”. Its impact, except for the direction, can hardly be quantified with available data which was the main reason to initially choose “candidate” and not “selected” status for the inclusion of Commitment 21 into the Nemesis model. Namely, as “candidates” were classified commitments that have an effect on innovation and indirectly on other measures of economic performance in the NEMESIS model but that cannot be incorporated in the model either because data are missing, are imperfect or
incomplete or because the parameters that are needed to quantify their impacts are too uncertain. Accordingly, due to non-sufficient data, the decision was made not to include Commitment 21 into the Nemesis.

4.4 Impact of C21 on the Innovation Eco-system

4.4.1 Key Actors

Among science-industry interactions, collaborative research (S-I collaborative research) is one of the most important and effective channels for conveying scientific knowledge to the industry (Roessner, 1993; Schartinger, Schibany and Gasser, 2001; Perkmann and Walsch 2007). Collaborative research can range from small-scale, temporary projects to large-scale projects, often subsidized by public policy programmes (Perkmann and Walsh, 2007). The key actors related to collaborative research and knowledge transfer are education sector (i.e. universities and other higher education institutions), research institutes, firms, governments/policymakers, financial sector and consumers.

The role of universities and other higher education institutions is to provide education, undertake research and provide services to business sector. Closely interlinked with higher education institutions are research institutes that undertake basic and applied research, and can be market-driven, research-driven and public-interest driven (Verspagen, Hollanders and Noben, 2018). Previous research indicates that cooperation with firms/industry represents for researchers the opportunity to obtain government support and additional funding for their research, to purchase new equipment and hire additional researchers, to access complementary expertise, equipment and facilities, and to test the application of theories (Lee, 2000, Morandi, 2013; Ankrah et al., 2013; Borrell-Damian, Morais and Smith, 2014; Ankrah and AL-Tabbaa, 2015). It has also been shown that researchers who are more productive and who are able to mobilise more resources for research exhibit higher propensity to collaborate (Perkmann et al., 2013). More prone to collaborate with industry are higher-quality universities that offer higher level of job satisfaction, and are able to acquire public resources for research (e.g. Maietta, 2015).

To support S-I collaboration and commercialisation of research results, many universities have established Technology Transfer Offices (TTOs). The existence of TTOs and the affiliation of researchers with them increase the likelihood of researchers to participate in S-I research projects and commercialisation (Perkmann et al., 2013). Past research suggests that factors that drive the performance of TTOs include effective cooperation among TTOs, the existence of trustful links between TTOs and researchers, as well as between TTOs and industry, the existence of scientific

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22 For details, please refer to Deliverable 9-2 (Mohnen, 2018).
excellence, adequate incentives for researchers, adequate technology transfer skills of employees at TTOs, developed technology transfer networks, and conducive university regulations and procedures for technology transfer (Borrell-Damian, Morais, and Smith, 2014). Muscio (2010) also suggests that universities make greater use of TTOs if they have a clear mission and objectives, and are run by non-academic managers.

Firms (business sector) are considered to be the most important actors in innovation system. According to Verspagen, Hollanders and Noben (2018) innovative firms can be divided in four main categories - science-based innovation firms, the supply-chain driven innovation firms, externally-sourcing firms and low-profile innovators. Additionally, there are two modes of innovation - the Science, Technology and Innovation mode (STI mode), in which firms rely on formal research, and interact with knowledge institutes, and Doing, Using and Interacting mode (the DUI mode), in which firms rely on learning-by-doing, learning-by-using, interaction among their own workforce, and interaction with a broader set of external actors than just research institutes. Empirical evidence shows that the combination of STI and DUI modes is more effective for product innovation, while process innovation is more closely linked to DUI mode (Gonzalez-Pernia, Parrilli and Pena-Legazkue, 2015; Parrilli and Heras, 2016). Key motives for collaboration with science from the perspective of firms include strengthening companies’ R&D capacity, solving industrial challenges, developing new innovative products or improving existing ones, accessing new knowledge and expertise, wider research networks, reduction of costs, accessing government funding, reducing risks, and commercialization of findings (Caloghirou, Tsakanikas and Vonortas, 2001; Borrell-Damian, Morais, and Smith, 2014; Ankrah and AL-Tabbaa, 2015 Minarelli, Raggi and Viaggi, 2015; Maietta, 2015).

Previous studies indicate that higher propensity to cooperate with academic community have companies from the above-average innovative industries, companies that have higher knowledge base and those that introduce more advanced innovations. Additionally, more prone to collaboration are larger and older companies, start-ups, independent companies and companies with a higher absorptive capacity (Mohnen and Hoareau, 2003; Schmidt, 2005; Veugelers and Cassiman, 2005; Fontana, Geuna and Matt, 2006; Perkmann and Walsh, 2007; Giuliani and Arza, 2009; Arza and López, 2011; Arvanitis, Kubli and Woerter, 2011). Past research also suggests that R&D intensity is positively related to S-I collaboration (Fritsch, 2003; Schmidt, 2005; Veugelers and Cassiman, 2005; Fontana, Geuna and Matt, 2006; Arvanitis, Kubli and Woerter, 2011). Companies which invest heavily in R&D are likely to possess technological capability that allows them to absorb the knowledge developed outside the firm (Fontana, Geuna and Matt, 2006). Moreover, companies that employ highly educated employees are more likely to be engaged in S-I collaborative research. Other collaborative factors include patenting, companies’ openness to environment, market orientation, international competition, geographical proximity and agglomerations.

The government (and policy-makers in general) has an important role in innovation system. The role of governments (policymakers) in the innovation systems is to stimulate and fund research,
provide regulation and legislation (concerning R&D, property rights, organize and fund education system), provide subsidies, support technology transfer, and give tax exemptions (Verspagen, Hollander and Noben, 2018). With respect to their behavioural role, there is a trade-off between the role of government/policymakers as organizers of the system vs. facilitators (Verspagen, Hollander and Noben, 2018). In this trade-off the organizing side of the policy role represents an active policy role in organizing the innovation system, through the higher education and research institutes sectors, but also by means of a policy instruments aimed at influencing firms’ behaviour and stimulating collaboration across actor classes. Facilitation role represents the idea of a correction of market failures and uses the instruments that are focused on incentives, such as tax credits, risk sharing for finance, and subsidies (Verspagen, Hollander and Noben, 2018).

Innovation system contains also financial sector (i.e. banks and other financial institutions) that provides funds to innovative firms. Because of the substantial risks involved in the innovation process, funding is a problem for firms and by allocating funding; the financial sector takes care of risk sharing and risk allocation in the innovation process. The finance sector can either be aimed at taking risks, or be risk-averse. More risk-taking leads to more abundant funding available for innovative firms (Verspagen, Hollander and Noben, 2018).

Consumers are the final category of actors. They create demand for innovative products and buy them. Higher willingness of consumers to buy innovative services and products determine the ultimate success of innovation activities. Therefore, innovative firm may collaborate with consumers in order to better satisfy their needs or create new routes to market.

4.4.2 Interactions Among Actors: Benefits and Obstacles

Benefits of long-term collaborative research for education organisations and research institutes include increased budgets, enhanced visibility, increased range of external partners, higher specialisation of human resources as well as organisational changes that are better adapted to collaborative research (Borrell-Damian, Morais and Smith, 2014). Other benefits might include stimulated technological advancement, professionalization of the staff, training opportunities for students, feedback from practice, access to wider network and better links with industry (Ankrah et al., 2013; Borrell-Damian, Morais, and Smith, 2014). According to Ankrah and AL-Tabbaa (2015), outcomes of S-I collaboration can be categorized as economic-related outcomes (i.e. source of revenue, patents, and business opportunities), institutional-related outcomes (i.e. access to new equipment, training, and joint publications with industry), and social-related outcomes (i.e. provision of service to the community).

Publication rate of a researcher with an average level of collaboration tends to be higher than that of a researcher with no collaborative funding, with publishing performance having an inverse U-shape-relationship with the engagement. Empirical evidence also suggests that there is a positive
relationship between academics’ research quality and commercialization of research activities (Van Looy et al., 2011; Perkmann et al., 2013).

Firms benefit from collaborative activities through enhancing their knowledge base, which should help them improve production processes and develop new products (Caloghirou, Tsakanikas and Vonortas, 2001). According to Ankrah et al. (2013) the most frequently mentioned benefits for industry actors relate to more cost-effective research than in similar in-house research, improved innovative capacity, keeping-up with technological developments, solutions to specific technological problems, and access to a wider network of research expertise. Similar benefits were found also in Fontana, Geuna and Matt (2006), Decter, Bennett and Leseure (2007).

The results of government intervention in the field of S-I collaboration can be categorized as input additionality (i.e. additional impact arising from government funding), output additionality (i.e. outputs that would not have been created without collaborative policy), and behavioural additionality (i.e. the change in the behaviour of firms).

Extensive literature review by Cunningham and Gok (2012) indicates positive relationships between collaboration and increased R&D spending; government support (e.g. subsidies) and R&D spending, and various outputs (e.g. publications, patents, citations, collaborative linkages and innovative products), although the results are not conclusive. The theory suggests that the probability that firm will cooperate with a research organisation increases when it receives public support (Cunningham and Gok, 2012). Some studies also suggest that innovation policy might create behavioural additionality by increasing the internationalisation of firms, changing the organisation of innovation activities, and establishing research collaboration with universities and public research institutions.

There are also barriers that inhibit S-I collaborative research from being effective. From researchers’ point of view the barriers include low awareness of the added-value of S-I partnerships, different expectations, needs and time-frames between research organisations and industry, lengthy and complex administrative procedures at universities (Ankrah et al., 2013; Borrell-Damian, Morais and Smith, 2014). Companies are short-termed and market-oriented, while researchers are focused on their publications, and are less interested in the commercialization of their research results. While university researchers and laboratories prefer projects of a basic nature, firms expect higher benefits from projects that can be more easily applied (Banal-Estanol, Macho-Stadler and Pérez-Castrillo, 2013). While basic projects are more likely to generate academic output, they often address topics that are less directly relevant to industry (Perkmann and Walsh, 2007). Another source of conflict between the universities and business may arise from intellectual property disputes and patenting disagreements (Ankrah et al., 2013).

Although TTOs play important role in new knowledge and technology transfer, they are still underperforming, and yet there are also success stories of TTOs in the EU. The following factors may be considered as weaknesses of TTOs: lack of continuous government funding, limited capacity of
TTOs, lack of TTOs competencies, complex administrative procedures at universities, the gap in expectations between industry and public research organisations, complex management of intellectual property rights. Further obstacles involve lack of human resources at TTOs, lack of support from the universities to technology transfer (Decter, Bennett, and Leseure, 2007; Muscio, 2010; Empirica, 2014).

Barriers for S-I collaborative research from companies' point of view are the following (Fontana, Geuna and Matt, 2006; Cunningham and Gok, 2012):

1) the needs of the business is not in line with the mission and strategy of the university;

2) time scale and capacity mismatch (i.e. a university has already committed its resources and does not have the available capacity to meet the timescale that the business needs);

3) capability mismatch (a university does not have the skill set or the facilities to meet the needs of the business);

4) bureaucracy;

5) financial constraints (i.e. a university is unable to provide the service required for the price the company is willing to pay);

6) sustainability, i.e. the investment required by the university to provide the service does not have an acceptable payback period;

7) mismatch in expectations and objectives (i.e. expectations of outcomes from collaboration are not mutually recognised);

8) intellectual property issues;

9) contrasting views on the management.

When companies perceive that they have diminished control over proprietary information, the likelihood of their involvement in S-I collaboration is lower (Ankrah et al., 2013). Other risks are market-related risks arising from uncertainty in the success of new products or technologies and the risk of incompetent and incomplete transfer of knowledge and technologies (Lee and Win, 2004; Ankrah et al., 2013). One study shows that S-I collaborations often produce interesting outcomes (e.g. insightful technical paper, a proposed process or a new computer code), but those outcomes have minor or no impact on company productivity or competitiveness, while roughly 50% of the examined projects resulted in major outcomes (i.e., produced new ideas or solutions to problems, developed new methods of analysis or generated new intellectual property of potential benefit for the company) (Pertuze et al., 2010).
The importance of continued public funding and support is essential in all stages of the collaboration, from early stages of idea development or discovery to later stages leading to potentially commercial prototypes and other research outputs (Borrell-Damian et al., 2014). This is particularly the case when costs are considered as an important obstacle to conduct innovation activities inside the company, while collaboration offers the opportunity to apply for and receive government subsidies and decrease costs of innovation activities in this way (Veugelers and Cassiman, 2005). Therefore, lack of or reduced government support for R&D collaborative projects hinders S-I collaboration. Partners involved in the EU research programs pay to a great extent attention to rules and procedures, imposed by universities or government funding agencies, which prolongs the research and makes it more difficult (Bruneel, D’Este and Salter, 2010; Bach, Matt and Wolff, 2014).

4.4.3 Effectiveness of Polices on EU Innovation Systems

Both the literature review and the empirical analysis in the previous deliverable (Anić, Mervar and Škrinjarić, 2018) have confirmed that collaborative research have important positive effects on the innovation output and economic performance. Collaborative research is an important part of the European Commission’s current research strategy, as it brings together specific expertise, resources and equipment from different disciplines and various countries. Its potential benefits are in its contribution to novel approaches, higher research impact, and improved innovations. However, its potential is yet not exploited adequately.

ERA Roadmap (European Commission, 2015) has defined the share of product and/or process innovative firms cooperating with public or private research, as a main indicator and a proxy for measuring the private sector’s willingness to collaborate with public research and higher education institutions. According to ERA Progress Report 2016 (European Commission, 2017) the average annual growth rate was 3.5% over the period 2008-2012 for innovative firms cooperating with public or private research institutions and 1.3% for innovative firms cooperating with higher education institutions. Figure 4.1 and Figure 4.2 present the more recent data based on Community Innovation Survey 2014.

The countries that had, according to CIS 2014 data, the highest share of innovative firms (product and process) that are cooperating with research institutions (education institution and/or research institutes) include Austria, Finland, Belgium and Slovenia. Their shares suggest that almost a quarter of all innovative firms cooperate with research institutions. The lowest shares were at the same time present in in Cyprus, Malta and Bulgaria with shares in the range of 5-7%. Although indicator shows positive trends over time, its level is still rather low.
Figure 4.1  Share of Enterprises Engaged in Any Type of Cooperation, 2014

Note: Includes all types of innovative enterprises; cooperation refers to other enterprises, enterprise group, competitors, clients, customers, suppliers, higher education institutions, research institutes. Data is not available for all countries in Panel B.

Source: Eurostat, CIS 2014.
Past research found positive relationships between collaboration and increased R&D spending; government support (e.g. subsidies) and R&D spending, and various outputs (e.g. publications, patents, citations, collaborative linkages and innovative products). The theory also suggests that the probability that firm will cooperate with a research organisation increases when it receives public support (Cunningham and Gok, 2012). This indicates that government policies have an important role in stimulating S-I collaboration and collaborative research. Although a number of public policy initiatives promote science-industry collaboration, the potential of this type of S-I collaboration is not adequately realised, especially in less developed economies. There is a consensus that S-I collaborative research has to be further improved, while knowledge and technology transfer has to be intensified (Arvanitis, Kubli and Woerter, 2011; European Commission, 2014; 2017). As companies and public research organisation have different views on collaborative research issues, the question of improving this type of cooperation is very complex. Large diversity in knowledge and technology transfer in Europe suggests that policy should target and stimulate the process of knowledge and technology transfer differently.
4.5 Concluding Remarks

Past research suggests that universities and research organisations can make compatible their core mission (e.g. excellence in academic research) and successful long-term collaborative research, if there is a good institutional support (Borrell-Damian, Morais, and Smith, 2014). In order to make knowledge and technology transfer effective, it is necessary that universities and research organisations become more entrepreneurial and more than just suppliers of knowledge and talent.

Some recommendations related to the role of universities and research organisations in the ecosystem include: developing trustful relationship between the partners (e.g. building trust, developing personal contacts); strengthening institutional leadership in promoting and supporting collaborative research (i.e. improve leadership competences, persuade academic research staff to collaborate with industry, link collaborative research with teaching); identifying relevant research topics for all stakeholders (i.e. balance between the research needs of the university and those of the companies); continued public funding and support for collaborative research; defining clear expectations and goals for the collaboration, defining the institution’s role in the knowledge transfer process; as well as enhancing the degree of professionalization of staff involved in the collaborative research projects (Borrell-Damian, Morais, and Smith, 2014).

TTOs’ role in the field of collaborative research should be strengthened. More funds should be targeted towards TTOs, pinpointing European research projects more towards technology transfer and TTOs (Empirica, 2014). Human resource management appears to be a central issue for TTOs in Europe. Skill development within universities and research organisations should be aimed at developing the entrepreneurial and innovation skills of scientists as well as the legal, administrative and coordination skills of support staff that facilitate the entrepreneurial engagements of academics (European Commission, 2014). Parallel with skill development, an appropriate incentive schemes should be developed to stimulate scientists, academics and TTO staff to engage in co-creation processes with the users of their knowledge, e.g. recognition of the entrepreneurial engagements of academics/scientists beyond the traditional recognition of publications and scientific impact (European Commission, 2014). The European IPR Helpdesk also plays an important role in strengthening the role of TTOs. In order to improve their effectiveness at the EU level raisin, the visibility of the Helpdesk among beneficiaries is of important. Furthermore, the importance of IP management as an effective tool for exploiting research results needs to be emphasised.

Convergence of TTOs activities, including organisation and expected impacts at the EU level is very important. Related to this is an improvement in the system that would help first generation of TTOs to grow and achieve the level of real provider of services to the community. Croatian case showed that some of possible improvements for making TTOs more effective in less developed EU countries might include the improvement of overall innovation framework at the state level that would define the status of TTO better, provision of more financial resources to TTOs by the government and
universities, better support to human resources, minimising bureaucracy and more autonomy in the work of TTOs, and improvements in the national innovation systems in the way that would facilitate better networking and cooperation among national and international TTOs.

Here are some recommendations for companies for making collaborative research more successful (Pertuze et al., 2010):

1) define the project’s strategic context as part of the selection process (determine collaboration opportunities, define specific outputs that provide value for company, identify international users of outputs);

2) select boundary-spanning project managers with in-depth knowledge, the inclination to network, the ability to make connections,

3) share with the university research team the vision of how the collaboration can help the company,

4) invest in long-term relationships,

5) establish strong communication linkage with the university team,

6) build broad awareness of the project within the company,

7) support the work internally both during the contract and after, until the research can be exploited.

Collaborative research needs to be considered as a “public good”, particularly in terms of how it contributes to building sustainable ecosystem of cooperation between the university and its external partners (Borrell-Damian, Morais, and Smith, 2014). Governments and policymakers should have the role of influencing firms’ behaviour and stimulating S-I collaborative research. The importance of continued public funding and support is considered essential in all stages of the collaboration (Borrell-Damian, Morais, and Smith, 2014). Policy recommendations (either at the EU, Member State or stakeholder level) might include offering better modes of coordination across the actors, building innovative markets, innovation hubs and networks, enhancing the role of universities as co-creators and interactive partners in innovation systems, building more innovative-friendly financial instruments and institutions (European Commission, 2014).

Finally, the financial sector should be more risk-taking oriented, which leads to more abundant funding available for innovative firms. Venture capitalists (VCs) and other risk capital providers must play more important role in the area of knowledge transfer and open innovations (European Commission, 2014).
4.6 References


Arza, Valeria and Andrés López, 2011, “Firms’ linkages with public research organisations in Argentina: Drivers, perceptions and behaviours”, Technovation, 31(8), pp. 384-400.


D’Este, Pablo and Pari Patel, 2007, “University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?”, Research policy, 36(9), pp. 1295-1313.

Empirica, 2014, “Knowledge transfer Office co-operation and intellectual property markets”, IU21 KT Study: Support to the development and implementation of Innovation Union commitment 21 on knowledge transfer, Bonn: Empirica.


Mohnen, Pierre, 2018, Deliverable 9-2 “Report on proposal for modifying the NEMESIS model, based on the analysis of the European innovation and the analysis of the 34 commitment”, WP9, project “I3U Investigating the impact of the Innovation Union”.


255–268.


5 Develop a European Knowledge Market for Patents and Licensing (Commitment 22)

Maikel Pellens (ZEW)²³

5.1 Introduction

5.1.1 Objectives and Background

Commitment 22 of the Innovation union reads as follows: “By the end of 2011, working closely with Member States and stakeholders, the Commission will make proposals to develop a European knowledge market for patents and licensing. This should build on Member State experience in trading platforms that match supply and demand, market places to enable financial investments in intangible assets, and other ideas to breathing new life into neglected intellectual property, such as patent pools and innovation brokering.” (European Commission, 2013a).

The commitment aimed to bolster the European knowledge market for patents and licensing. This is a relevant and necessary initiative, as research shows that a large share of intellectual property, in Europe and elsewhere, remains underused (European Commission, 2013a; Gambardella, Giuri, & Mariani, 2005; Kamiyama, Martinez, & Sheehan, 2006). The PatVal survey (Gambardella, Giuri, & Mariani., 2005) reported that surveyed European patent holders fail to license 38% of those patents which they would like to license out: the average survey respondent licensed out 14% of their portfolio, and would like to license out another 9%. At the same time, that market for licensing and royalties has grown from 55-60 billion USD to 100 billion USD between the mid ‘90s and the 2000s (Athreye and Cantwell, 2007).

Failure to activate intellectual property is especially problematic considering that the market for technologies is becoming more and more important for innovation. On the one hand, firms search for external knowledge to complement and enhance their own research and development efforts. On the other hand, firms need to acquire intellectual property to ensure their freedom to operate (Arora & Gambardella, 2010; Athreye & Cantwell, 2007; Robbins, 2006; Sheehan, Martinez, & Guellec, 2004).

Currently, technology trading and licensing is slowed by issues in the market for technologies. These can be summarized as a lack of market safety, information asymmetries and other uncertainties which

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drive up transaction costs, and the valuation of technologies.

Issues regarding market safety relate to, on the one hand, the facilitating role that markets for technology might play for non-practicing entities (Pénin, 2012). On the other hand, closely related to information asymmetries and technology valuation, the risk of loss of appropriation might further hamper technology trading and licensing because of considerations of safety. This creates tension between technology owners, who need to protect their intellectual property, and potential buyers, who need said information as to assess the technology which is put up for sale or licensing (Agarwal et al., 2014; Dushnitsky and Klueter, 2011; Silveira and Wright, 2010). When patents constitute more than one technology, which is typical for so called complex technologies, hold-up issues are added to the problem (Pisano, 1991).

The market for technologies suffers from high transaction costs: extending technology search to unknown alternatives is expensive (Sorenson and Stuart, 2001). Search costs are among the most common reasons for not engaging in technology licensing (Razgaitis, 2004; Arora and Gambardella, 2010). Beyond the search stage, negotiations for technology trade and licensing are highly complex processes, especially when they involve simultaneous negotiations with many partners, likely leading to a ‘winner’s curse’ where firms that manage to license a technology are likely to overpay (Arora and Gambardella, 2010).

The valuation of technologies is hampered by the fact that there is not one agreed on model of patent valuation (Van Zeebroeck & van Pottelsberghe de la Potterie, 2011) and the high skew in the value of technologies (Gambardella, Harhoff, & Verspagen, 2008; Scherer & Harhoff, 2000). Even when a value is defined, issues persist, as communicating a value might in itself transfer too much knowledge about the technology (Morgan and Wang, 2010; Lemley and Myhrvold, 2008).

5.1.2 State of Implementation

The objective of commitment 22 was to consider different options for enhancing the valorization of intellectual property in Europe. To achieve this, expert groups were created focusing on opportunities for a European financial market place for intellectual property (IP) (European Commission, 2011), and potential instruments for patent valorization (European Commission, 2012). Based on the output of the expert groups, a staff working document was realized which laid out the important barriers faced by European companies in the valorization of their intellectual property (European Commission, 2012c). A third study tackled the specific issue of the valuation of IP (European Commission, 2013b), and a fourth considered patent aggregation instruments, such as pools, as potential solutions.
Concerning the creation of a financial market for intellectual property rights, European Commission (2011) concludes that it would not be worthwhile to establish before significant improvements took place in the market for intellectual property assets. The authors also recommend to establish a network to further investigate potential policy actions. With regard to the market for intellectual property, the report highlights the need to defragment the European market for intellectual property, as a unified market will stimulate intra-European trade and licensing. Moreover, European actors, especially research institutions and SMEs, should be made aware of opportunities for valorization. Efforts directed at ensuring high patent quality and enforceability might increase confidence in the market for IP, and further professionalizing technology transfer infrastructure could bolster IP circulation.

The expert group on patent valorization (European Commission, 2012) considered the main factors prohibiting the utilization or licensing of intellectual property. They concluded that the main causes are transaction costs in the search, negotiation, and valuation processes behind intellectual property transactions. The group considered various levers to reduce these costs. Concerning platforms to match supply and demand, the group concluded that Europe should only develop public initiatives if and when private actors settled on a preferred business model. The group also considered the use of services to promote commercialisation, and recommended that member states use consulting and financial support to encourage valorization. Patents funds were also considered as potential policy tool, but these were found to carry too much risk of focusing on short-term returns.

The expert group on intellectual property valuation identified the main barriers for IP valuation (European Commission, 2013b), which include too little transaction data, too little trust in value assessments, the exclusion of IP out of annual reports, and the unwillingness to accept intangible assets as collateral for loans.

The expert group on patent aggregation considered the use of patent pools and funds as tools for overcoming the issues hampering the development of the European intellectual property market (European Commission, 2015). The group concluded that there is not sufficient evidence for the positive externalities associated with these tools to warrant broad implementation, but supports using them in cases where clear market failures can be overcome by their use to advance technological progress, especially as response to social challenges.

Summarizing, the European Commission commissioned several studies in the context of Commitment 22. These studies provided a cautious perspective that warned against initiatives that carry too great a risk of missing the target (for instance, online trading platforms) or whose benefits

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24 See deliverable 5-2 for a more in-depth discussion.
are not supported by current scientific understanding (for instance, the general use of patent pools).

5.2 Direct Impact Assessment: Main Findings

As Commitment 22 exclusively entailed investment by the European Commission in studies, and not in concrete actions, there were no real-world results to assess in the direct impact assessment. Rather, the impact assessment focused on 1) the rationale behind the commissioned studies, and 2) a critical reflection of the conclusions reached by these studies. Furthermore, the impact assessment considered 3) the current state of development of the online matching platforms for intellectual property, 4) the potential for monitoring the market through patent data, and 5) the potential impact of intellectual property rights issues on firm performance, the latter through a micro-econometric analysis of firms responding to the 2008 wave of the German Innovation Survey.

Concerning the first two points, the impact assessment concluded that the state of the art of economic research warrants the perspective put forward by the European Commission: this is an important issue in innovation policy. A critical assessment of the conclusions drawn in the studies conducted as part of the commitment deemed the conclusions drawn by the respective expert groups to be appropriate and well-founded. The main conclusion of the assessment concerning online matching platforms was that, the private market for online matching platforms had still not converged on a dominant business model, which means that public actors should hold off from investing in such platforms. The updated search identified 13 new platforms, beyond the 12 platforms listed in European Commission (2012), with widely varying approaches.

Concerning the potential for monitoring the market for technologies through patent indicators, the impact assessment underlined the need for good monitoring tools. Current ones, such as those stemming from patent offices, are likely to be insufficient because of their administrative and incomplete nature, and geographical heterogeneity in data coverage. Despite these limitations, the impact assessment documented positive trends in licensing and ownership changes, which possibly indicate a positive evolution in the market for intellectual property. This is, however, hard to confirm without additional data collection efforts.

To shed further light on the functioning of the market for patent and licensing, the impact assessment additionally provided evidence from the German contribution to the 2008 Community Innovation Survey, which included questions on whether firms are confronted with issues related to intellectual property rights. This analysis showed that a significant share of German firms experiences issues with accessing necessary intellectual property, and that firms relatively often need to cancel planned projects, or abandon or modify innovation projects in progress because of this. The prevalence of these issues correlates positively with firm size. The analysis also showed that firms are equally likely to experience negative outcomes as they are to successfully acquire or license the relevant intellectual property, further highlighting existing frictions in the market for technology.
Concerning the potential impact of creating a better functioning market for technology in Europe, regression analysis based on the German survey data showed that firms which report issues with accessing intellectual property are not significantly more successful in terms of innovation. The analysis also did not find differences in innovative success between firms which attain access to intellectual property through the market on the one hand, and those who implemented a project despite the risk of infringement, or who changed or abandoned projects on the other. However, these results should be seen as purely descriptive, as this analysis is quite limited. It needs to abstract project-level intellectual property issues into firm-level performance, and does not account for potential endogeneity issues.

### 5.3 Integration of C22 into NEMESIS

Commitment 22 was deemed to not lend itself to modeling within the NEMESIS model because no concrete policy changes have as of yet been implemented. While a study estimating the impact of a market for technology could in principle be used to generate estimates within the NEMESIS model, a study of sufficient breadth and depth is not known to the author at the time of writing. Moreover, as the functioning of the market will critically depend on the specific design of the initiatives involved, the use of such analysis would also be limited.

In case concrete policy actions aimed at implementing a European market for technologies will be taken by the European Commission in the future, they should be accompanied by additional data collection efforts in order to be able to properly estimate the impact of the market for technology. Current tools for monitoring the market for patents and licensing do not provide enough systematic information to assess the market’s fluidity, and efforts should be made to collect more data tracking either the trade of technologies, or the share of firms reporting issues regarding the sale, acquisition, and licensing of technologies.

### 5.4 Impact of C22 on the Innovation Eco-system

This section reflects on the impact of Commitment 22 on the European innovation eco-system. As the initiatives that might result from the actions undertaken in the context of Commitment 22 remain as of yet hypothetical, this section focuses on the expected impact of a better functioning European market for patents and licensing in general. Table 5.1 summarizes the expected impacts.
Table 5.1  Expected Impacts of Commitment 22 on European Innovation Eco-System

<table>
<thead>
<tr>
<th>Panel A: Impact on actors and behavioural roles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected impact</strong></td>
</tr>
<tr>
<td>European market for patents and licensing, progress in IP valuation, and general stronger valorization of IP leads to higher investment in innovation and higher probability of successful innovation</td>
</tr>
<tr>
<td>- Higher likelihood of being able to valorize innovations through market</td>
</tr>
<tr>
<td>- Lower probability of unsuccessful innovation due to failing to acquire or license critical intellectual property</td>
</tr>
<tr>
<td>Progress in IP valuation and use of intangibles as guarantee eases financing of innovative firms. This indirectly further increases investment in innovation, as more innovative ventures can attract necessary funding</td>
</tr>
<tr>
<td>Firms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Impact by innovation system type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Innovation system type</strong></td>
</tr>
<tr>
<td>Strongly developed</td>
</tr>
<tr>
<td>Public-policy led</td>
</tr>
<tr>
<td>Developing</td>
</tr>
<tr>
<td>lagging behind</td>
</tr>
</tbody>
</table>

Source: Author's assessment of expected impact of Commitment 22.

5.4.1  Impact on Actors and Behavioural Roles

5.4.1.1  Direct Effect: Increased Innovation Investment and More Successful Innovation

A better functioning European market for patents and licensing will directly affect the value of innovation and hence generate more incentives to innovate. This is due to both better valorization of innovation and better possibilities for acquiring licenses or ownership for those technologies that
innovators need to ensure their freedom to operate.

A better functioning market for technologies increases the incentives to innovate by allowing firms to valorize inventions which are not directly useful to the goals pursued by the firm. If firms cannot find buyers or licensees for these inventions, they have no value and the investments that generated them are lost. If they can be valorized, however, they will still generate some nonzero revenue. Hence, a better functioning market for patent trade and licensing will increase the expected value of patenting: even though the value of any given patent is uncertain ex ante, inventors know that they are more likely to valorize any technology they develop to the extent of its value of the market, thus generating more revenue through technology creation.

When patents can generate more revenue, the incentives to engage in innovation become greater. This should drive up innovation investment throughout the economy, as all forms of innovation expenditures become more promising compared to other forms of investment. Of all innovation actors in European national innovation systems, firms should be affected most: the prospect of trading or licensing technologies is one of the critical incentives for firms to innovate (Teece, 1986).

Prior research has also highlighted that technology trade and licensing is especially important in sectors such as pharmaceuticals and electronics (Anand and Khanna, 2000; Grindley and Teece, 1997). Note that only potential innovators can be included in the group of affected innovators. Those who would not innovative at any expected return will not be affected. Nevertheless, increasing the value of innovation has the potential of transferring many firms from less innovation-rich behavioural roles to more innovation-oriented ones. Additionally, firms which lack own capabilities to navigate the currently very high search and transaction costs involved in patent trading and licensing, such as SMEs, are likely affected more than larger firms with more financial resources for these activities.

Beyond firms, higher education institutes and semi-public or public research institutes can also be expected to be affected by a stronger market for patents and licensing. As these institutions generate technology through the commercialization of research results, they will likely be enticed by a higher expected value of innovation to transform more research results into technologies. This, in turn, results in a stronger flow of science-based technologies to the wider economy.25 These arguments are of course most applicable to those research actors that are already more focused on applied research topics, as they are more likely to develop technologies to be put on the market than more basic streams of research. Another nuance to be made is that many universities and research institutes have developed effective technology transfer offices that, like many large firms, actively

25 An indirect effect of this dynamic might be an additional boost in innovation incentives among science-based firms, which can then build on a wider base of applied knowledge. The latter argument however depends critically on whether research institutes also transform knowledge in their commercialization activities, or merely commercialize what is already available.
manage the institute’s intellectual property portfolio. Therefore, the potential gains might be smaller for public research and higher education institutes than for small and medium-sized firms, who often lack such facilities.

The other mechanism through which a better functioning market for patents and licensing will impact the incentives to innovate is by improving innovator’s capacities for finding and acquiring critical use rights for their innovations. This will allow firms to circumvent holes in their IP portfolio, and reduce the number of innovation projects which are not successful because of these issues. This will in turn increase the rate of successful innovation, resulting in a higher expected value of a given investment in innovative activities (Müller, Cockburn, and MacGarvie, 2013).

Issues with regard to the acquisition of technologies affect all firms, but will be especially relevant for science-based and externally-sourced firms, which rely to a much greater extent on outside knowledge. Particularly SMEs will be affected, as they possess fewer resources to invest in the costly search and transaction processes involved.

This issue is also particularly important for firms which use so-called complex technologies. Complex technologies are those technologies where a typical invention spans too many aspects for any one expert to capture. Examples are technologies used in the automobile and aircraft industry or in the computing and telecommunication industries. Products in these sectors typically rely not on single patents, as is more often the case in for instance the pharmaceutical industry, but are rather constituted out of a portfolio of patents. As one firm rarely owns all relevant use rights to a complete product, the ability to negotiate use rights is critical to successful innovation. (Rycroft and Kash, 2002).

This acquisition aspect of the market for technologies is less relevant for research institutions, as they can usually pursue their own research and experimental work under exemptions from intellectual property law maintained in European member states (Jaenichen and Pitz, 2015)

5.4.1.2 Indirect Effect: Increased Financing of Innovative Firms Leads to yet More Innovation

The studies generated under commitment 22 also considered actions to encourage the use of intellectual property as collateral for debt capital, which is often problematic (European Commission, 2013b). Especially SMEs suffer from limited access to finance for their innovation projects because of the financial sector’s hesitation to accept intangibles as guarantees. This is further made difficult by the lack of unified IP valuation practice.

Improvements in the market for patents and licensing that would impact the valuation of intellectual property or the use of intangible assets as debt capital would, from the perspective of the national innovation system approach, directly impact the finance sector, which provides funding to innovative
firms. A common framework for the valuation of intellectual property would reduce uncertainty for financiers, allowing them to take on more risk-taking lending behavior by funding more innovative firms. At the same time, allowing firms to use intangible assets, particularly intellectual property, as collateral for debt finance expands the set of firms which can be considered as potential lending recipients. The latter is especially relevant for SMEs which have a particularly strong need for external funds for their innovative activities, especially when it comes to pursuing radical innovation projects (Czarnitzki and Hottenrott, 2011; Czarnitzki, Hottenrott, and Thorwarth, 2011).

The direct effect of Commitment 22 on the European national innovation systems through the finance sector is hence that more resources are available for firms to use as innovation inputs. This should result in more investment in innovation by firms, especially by those firms which would otherwise be constrained in their innovative activities. Therefore aggregate innovative outputs should, ceteris paribus, increase.

5.4.2 Effect on Types of Innovation System

The effects described above are relevant for all European national innovation systems, as they directly affect the important pan-European goal of achieving economic growth through excellence in research and innovation. Nevertheless, some differences in the nature of the expected impact can be delineated along the level of development of the type of national innovation system. Column 2 of Table 5.2 summarizes the conclusions of Verspagen, Hollanders, and Noben (2018) concerning Europe’s innovation system.

Concretely, strongly developed and public-policy led innovation systems, which show strong or good innovation performance, can be expected to grow further and gain international competitiveness as a result of a better functioning market for technologies. In developing, and to some extent in lagging behind innovation systems, developing the European market for patents and licensing forms an opportunity to encourage innovation which are to a larger extent reliant on external sources. However, as the private sector typically shows weaker innovation performance in developing and laggings behind innovation ecosystems than in strongly developed or public policy-led ecosystems, this is more an opportunity for catch-up through international knowledge diffusion for developing and lagging behind ecosystems than for more developed ones. Verspagen et al. (2018) highlights in this regard that especially developing ecosystems might benefit from the better international diffusion of technologies inherent in a better functioning market for patents and licensing, as long as the necessary absorptive capacity is present.

A well-functioning market for patents and licensing is especially important for firms innovating in complex technologies, as these necessitate more complex licensing structure to ensure freedom to operate. A better functioning market for patents and licensing has the potential to ease hold up issues, leading to less failed innovation because of inability to acquire critical intellectual property rights. Therefore, the degree up to which national innovation ecosystems rely on complex
technologies is also informative of the potential impact of improving the market for patents and licensing.

Table 5.2  Expected Impacts of Commitment 22 by Innovation System Type

<table>
<thead>
<tr>
<th>Country</th>
<th>System type</th>
<th>Reliance on complex industry</th>
<th>Country</th>
<th>System type</th>
<th>Reliance on complex industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Strongly developed</td>
<td>5.66%</td>
<td>Italy</td>
<td>Public policy-led</td>
<td>4.35%</td>
</tr>
<tr>
<td>Belgium</td>
<td>Strongly developed</td>
<td>2.68%</td>
<td>Latvia</td>
<td>Public policy-led</td>
<td>1.30%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Developing</td>
<td>2.93%</td>
<td>Lithuania</td>
<td>Public policy-led</td>
<td>1.10%</td>
</tr>
<tr>
<td>Croatia</td>
<td>Developing</td>
<td>2.13%</td>
<td>Luxembourg</td>
<td>Public policy-led</td>
<td>-</td>
</tr>
<tr>
<td>Cyprus</td>
<td>Developing</td>
<td>-</td>
<td>Malta</td>
<td>Public policy-led</td>
<td>-</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Developing</td>
<td>10.26%</td>
<td>Netherlands</td>
<td>Strongly developed</td>
<td>2.77%</td>
</tr>
<tr>
<td>Denmark</td>
<td>Strongly developed</td>
<td>3.33%</td>
<td>Poland</td>
<td>Lagging behind</td>
<td>3.75%</td>
</tr>
<tr>
<td>Estonia</td>
<td>Lagging behind</td>
<td>3.08%</td>
<td>Portugal</td>
<td>Public policy-led</td>
<td>1.91%</td>
</tr>
<tr>
<td>European Union</td>
<td>-</td>
<td>4.78%</td>
<td>Romania</td>
<td>Developing</td>
<td>3.82%</td>
</tr>
<tr>
<td>Finland</td>
<td>Strongly developed</td>
<td>-</td>
<td>Slovakia</td>
<td>Developing</td>
<td>6.95%</td>
</tr>
<tr>
<td>France</td>
<td>Public policy-led</td>
<td>3.16%</td>
<td>Slovenia</td>
<td>Strongly developed</td>
<td>-</td>
</tr>
<tr>
<td>Germany</td>
<td>Strongly developed</td>
<td>9.50%</td>
<td>Spain</td>
<td>Developing</td>
<td>2.56%</td>
</tr>
<tr>
<td>Greece</td>
<td>Lagging behind</td>
<td>0.44%</td>
<td>Sweden</td>
<td>Strongly developed</td>
<td>5.16%</td>
</tr>
<tr>
<td>Hungary</td>
<td>Developing</td>
<td>10.28%</td>
<td>United Kingdom</td>
<td>Strongly developed</td>
<td>3.09%</td>
</tr>
<tr>
<td>Ireland</td>
<td>Public policy-led</td>
<td>2.34%</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: System type: source: Verspagen, Hollanders, and Noben (2018). Reliance on complex industry: % of added value stemming from complex industries. Complex industries defined as manufacture of computer, electronic, and optical products, of electrical equipment, of machinery and equipment n.e.c., of motor vehicles, trailers, and semi-trailers, of other transport equipment. 2014. No data available for Cyprus, Finland, Luxembourg, Malta, and Slovenia.

Source: Author's calculation based on Eurostat.

Column 3 of Table 5.2 shows the share of value added by industries which strongly rely on complex technologies out of all value added. The table shows that some countries from developed as well as developing innovation ecosystem strongly rely on complex technologies. In developing countries, Germany (9.50%) as well as Austria (5.66%) draw higher than average shares of added value from related sectors. A stronger market for patents and licensing could therefore be particularly important for further development of these industries in Germany and Austria. Developing countries which rely in large extent on industries marked by complex technologies are the Czech Republic (10.26%), Hungary (10.28%), and Slovakia (6.95%). Hence, gains in innovative competitiveness in these industries through a better functioning market for patents and licensing might have an even stronger impact on the national economy.

On the other side of the spectrum, some public policy-led and lagging behind countries rely only to a very small degree on industries related to complex technologies. Among public policy-led countries, Latvia (1.30%) and Lithuania (1.10%) stand out. Among lagging behind countries, Greece
(0.44%) relies much less on these industries than other lagging behind countries (Estonia: 3.08%, Poland, 3.75%). Whatever benefits the national innovation systems in these countries might enjoy due to a better functioning market for patents and licensing, their economies will only benefit in a more limited sense from gains in industries reliant on complex technologies.

5.5 Conclusion

This chapter provides a reflection on the implications of Commitment 22, to develop a European knowledge market for patents and licensing, on the European national systems of innovation. It also discusses the commitment, actions taken, and their impact. Whereas Commitment 22 consisted of a series of valuable studies but no concrete policy changes, the potential impact of a better functioning European market for patents and licensing is clear and worthwhile. Less uncertainty about the potential for valorization of inventions, and of firm’s opportunities for acquiring necessary technologies, will increase the return to investment in innovation and therefore the level of investment. It will also increase the chances that innovation will be successful and allow for easier debt finance of potential innovators. This will generate more innovation throughout the European innovation ecosystems. What this means for individual member states depends, however, also on the type of their ecosystem.
5.6 References


Sorenson, O. and T. E. Stuart (2001), Syndication Networks and the Spatial Distribution of Venture Capital Investments, American Journal of Sociology 106 (6), 1546-1588.


6 Safeguard Against the Use of IPRs for Anti-competitive Purposes (Commitment 23)

Martin Hud (ZEW)

6.1 Introduction

Intellectual property rights (IPRs) grant rights to exclude others from using codified knowledge, at least temporarily. In so doing, IPRs impair competition. This means that the intersection of IP and competition law gives rise to some types of strategically anti-competitive misconduct of IPRs (Von Graevenitz et al., 2007). In practice, there are two important kinds of agreements that involve the use of IPR and competition law, i.e. standardization agreements and technology transfer agreements (especially patent pools). Even though both kinds of agreements give rise to significant efficiency gains (Geradin, 2009; EC, 2010a; Gallini, 2011; Mariniello, 2011), they can lead to substantial anti-competitive outcomes. Specific risks entail patent hold-up and foreclosure of competition (Shapiro, 2001; Régibeau and Rockett, 2004; Lemley, 2007; EC, 2014a). Due to the expiry of the old regulations and guidelines and in order to prevent anti-competitive practices related to standardization and technology transfer agreements, the European Commission (EC) recently revised guidelines firms can use as a benchmark to evaluate whether or not their agreements infringe EU competition law.

With respect to standardization agreements, the revised guidelines on horizontal cooperation agreements\(^{26}\) and the updated Block Exemption Regulations (BERs) on research and development\(^{27}\) and on specialization and joint production\(^{28}\) entered into force in January 2011 (Seitz, 2011). The main changes that have been introduced in the updated horizontal guidelines are a significant revision of the standardization chapter and a new chapter on information exchange (EC, 2010b). The


new guidelines reinforce the need for firms to assess by themselves whether or not their horizontal agreements infringe Article 101(1) TFEU and – if so – whether or not the exemption conditions of Article 101(3) TFEU are met (EC, 2010b). Hence, the new guidelines should increase the legal certainty concerning standardization agreements and they are supposed to “[…] prevent competition concerns from arising from the outset, rather than only addressing concerns ex-post.”.29 Furthermore, the then Vice President of the European Commission, Joaquín Almunia, stated that: “One of the overarching goals of the new rules is to contribute to the Commission’s Europe 2020 strategy, in particular by promoting innovation and competitiveness.”.30

Similar to the BERs and guidelines of horizontal cooperation agreements, the rules for the assessment of technology transfer agreements were recently revised as well. In May 2014, a revised version of the technology transfer guidelines31 and of the Block Exemption Regulation32 (TTBER) entered into force (EC, 2014b; Cook, 2014). The revised regime guides firms on how to license in ways that stimulate innovation and to not raise anti-competitive concerns (ECN, 2014; EC, 2014c). It aims at strengthening research and innovation (EC, 2014c).

6.2 Direct Impact Assessment: Main Findings

6.2.1 Standardization Agreements

The revised chapter promotes a standard-setting system that is open and transparent and as such


increases the transparency of licensing costs for IPRs used in standards (EC, 2010b). In so doing, it defines specific criteria according to which the firms' standardization agreements will not be considered as anti-competitive within the meaning of Article 101(1) TFEU (EC, 2010b). These criteria constitute the “safe harbour” and include: (i) the participation in standard-setting is unrestricted and open to all relevant competitors; (ii) the procedure for adopting a standard is transparent and adheres to the good faith disclosure of SEPs; (iii) the standardization agreements contain no obligation to comply with the standard; (iv) the standardization agreements provide access to the standards on fair, reasonable and non-discriminatory (FRAND) terms (Slaughter and May, 2016). However, if one or more safe harbour criteria were not met the standardization agreement would not be presumed to restrict competition (Slaughter and May, 2016). Rather, the firms would have to assess whether or not their agreements can fall under Article 101(3) TFEU.

In general, it can be regarded as a positive development that the new guidelines mainly recognize the pro-competitive nature of standardization agreements (Morais, 2013). However, the main issue with the new chapter is that it aims at preventing competition law infringements from arising in the first place, but does not provide clear solutions in case a law issue arises (Seitz, 2011; Morais, 2013). For instance, the guidelines do not clarify what would happen if one of the participants who had not committed to FRAND terms charged excessive above-FRAND licensing fees after the adoption of the standard. Even if it could be proven that the standardization agreement infringed Article 101 TFEU, the standard would be invalid which would harm the firms that have widely applied the standard (Seitz, 2011; Ghelcke, 2011). Another issue is the practical significance of the (revised) standardization chapter in terms of judicial precedents. For instance, there have been major EU law cases concerning “patent ambush” (the Rambus case)33 and the licensor’s non-compliance with FRAND terms they committed to (Motorola34, Samsung35, Qualcomm36).37 However, the legal base for those cases was not Article 101 TFEU but Article 102 TFEU (or others). This means, the horizontal guidelines did not play a decisive role in these cases even though standard-essential patents (SEPs) and FRAND terms were an essential part of the cases. In addition, based on the EC’s decisions made between January 1, 2000, and December 15, 2016, there have only been 65 antitrust cases with Article 101 TFEU having

33 The EC was concerned that Rambus had engaged in “patent ambush”, i.e. Rambus intentionally concealed SEPs a standard and subsequently claimed royalties for those SEPs; see: http://europa.eu/rapid/press-release_IP-09-1897_en.htm?locale=en.


37 Only Motorola was found to having infringed EU competition law.
been the legal base. The vast majority of those cases have not concerned standardization agreements or FRAND terms but other types of cooperative agreements, such as joint ventures.

### 6.2.2 Technology Transfer Agreements

The revised regime guides firms on how to license in ways that stimulate innovation and to not raise anti-competitive concerns (ECN, 2014; EC, 2014c). It aims at strengthening research and innovation (EC, 2014c). In contrast to the standardization chapter (see Section 6.2.1), the new TTBER and technology transfer guidelines have not been substantially changed but just incrementally improved. The new rules largely recognize that license agreements are typically pro-competitive and do not harm EU competition law (Cook, 2014).

There have been five major modifications. First, certain types of clauses do not fall automatically under the TTBER, thus are not automatically exempted anymore (ECN, 2014). They have to be assessed on a case-by-case base. This concerns all exclusive grant-back obligations and termination clauses in non-exclusive licensing agreements (EC, 2014b). Second, a new test has been introduced for when ancillary purchases of raw materials or equipment and trademark licensing is covered by the TTBER (Verheyden et al., 2014). Third, all passive sales restrictions between licensees have been removed from the TTBER (EC, 2014b). Fourth, the new rules also give guidance on IPR settlement agreements (EC, 2014c). Fifth, and most importantly, the EC acknowledges that patent pools have become an important tool for technology licensing (Cook, 2014). For this reason, the revised guidelines discuss patent pools in much more detail than before and also formulate a comprehensive safe harbor for patent pools for the first time (Cook, 2014). This is supposed to promote the creation of pro-competitive patent pools (EC, 2014c). The criteria for the new safe harbor for patent pools are:

1. participation in the pool creation process is open to all interested IPR owners;
2. sufficient safeguards are adopted to ensure that only essential technologies (which therefore necessarily are also complements) are pooled;
3. sufficient safeguards are adopted to ensure that exchange of sensitive information (such as pricing and output data) is restricted to what is necessary for the creation and operation of the pool;
4. the pooled technologies are licensed into the pool on a non-exclusive basis;
5. the pooled technologies are licensed out to all potential licensees on FRAND terms;
6. contributors and licensees are free to challenge the validity and the essentiality of the pooled technologies;
7. contributors and licensees remain free to develop competing products and technology (Verheyden et al., 2014).

Similar to the horizontal cooperation agreements, the practical significance of these revised rules with respect to technology (IPR) licensing is rather ambiguous as the vast majority of the 65 identified

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38 See the EC online archive for competition cases: [http://ec.europa.eu/competition/elojade/isef/index.cfm](http://ec.europa.eu/competition/elojade/isef/index.cfm).
Integration of C23 into NEMESIS

According to the SEURECO survey, the commitment 23 ("Safeguard Against the Use of IPRs for Anti-competitive Purposes") has been classified as a mere “Statement”: “This commitment is a simple "statement" without precise quantitative objectives. It has no direct quantifiable impact on the European Innovation system.” In this regard, commitment 23 refers to a mere juridical revision of parts of the EU IP/competition law.

In order to properly analyze the new regimes concerning standardization and technology transfer agreements reliable data to empirically assess and disentangle the direct impact is required. Up to now, this kind of data is not yet existing. One would need detailed firm-level data on innovation activities, standard-setting, standard-setting organizations, patent pools, IPR licensing agreements, and competition measures. Given an availability of this kind of data for the minimum period of 2009 to 2016, it would be possible to quantify effects of both regime modifications on innovation. Nevertheless, it would still be difficult to integrate it into the NEMESIS model as it is a sectoral model. Commitment 23 addresses the interplay of innovation and competition of individual firms and the interactions with each other. A sectoral model would fail to incorporate the individual level's dynamics.

For these reasons, commitment 23 cannot be integrated into the NEMESIS model.

Impact of C23 on the Innovation Eco-system

As presented in the previous sections of this Chapter, commitment 23 concerns the revisions of two EU guidelines addressing the potential anti-competitive misconduct of firms at the interface of IP and competition law. Both, the updates of the guidelines on horizontal cooperation agreements and on technology transfer agreements including the respective revised Block Exemption Regulations were designed to stimulate research and innovation and to provide more legal certainty regarding those types of agreements than before. With respect to the two broad categories defined in the Innovation Union Report by Verspagen et al. (2018), the policy modifications underlying commitment 23 are aimed at both increasing capabilities of the actors in the system and stimulating interaction between them and at the conditions that enable innovative activities, or obstacles that hinder them. Hence, the commitment addresses not one but the two categories (see Table 6.1).

The purpose of the new standardization chapter is to give guidance on how to ensure that standardization agreements are competitive and that access to the standards is provided on FRAND terms (EC, 2010a). It gives companies the necessary freedom to cooperate in a globalised market place, while minimizing the risk of agreements to be harmful to industry and consumers (EC, 2010c). Regarding the new guidelines on technology transfer agreements, the most important change has been the acknowledgement that patent pools have become an important tool for technology licensing and the associated definition of a safe harbor for patent pools. By removing uncertainty, i.e. information asymmetry, the new regimes (should) make standard-setting and IP-licensing more efficient than before. Given the adherence to the horizontal guidelines, no competitor can be excluded from a standard-setting organization. Furthermore, the IPR-holding participants are encouraged to disclose ex ante the possession of SEPs, to license them on FRAND terms, and are not obliged to comply with the standard. Hence, not only the most efficient standard should be the outcome of the selection process since every interested competitor can participate but also the accessibility should be provided on a fair, reasonable and non-discriminatory base. In this way, the best technology can but does not have to be implemented by all interested actors. Similar applies to patent pools where no interested IPR-holder can be refused to participate in the pool, every participant is required to contribute only essential patents, licensors and licensees remain free to develop alternative technologies, and where IP is externally licensed on FRAND terms as well.

The policy revisions underlying commitment 23 should therefore benefit almost all actors in general but firms in particular. First, consumers profit from a better standard and/or technology incorporated in new products, which should be offered at lower costs since all competitors are enabled to use the technology at a fair and reasonable price. Due to the potential for a wider dissemination of IP-protected knowledge consumers should also benefit from more innovation activities. Second, the government eventually benefits from a larger knowledge stock leading to higher productivity and a more competitive economy. Third, the benefit to the education sector including public research institutes is not clear and may depend on the extent to which public education and research institutions are typically involved in standard-setting and patent pool participation and in taking licenses. Since these actors do not tend to be a competitive threat to companies, they may be not affected by anti-competitive misconduct anyway. Fourth, the firm sector profits most from the new guidelines. Firms that do not possess IPRs being essential to either a standard or a patent pool are probably the biggest winners. These (potential) licensees cannot be excluded from standard-setting and are able to take licenses on FRAND terms. In contrast, licensors (essential patent holders) lost somewhat traction regarding their potentially relatively strong position in selecting new determining technologies (standard-setting), granting access to patent pools and in determining the price of licenses. Furthermore, non-disclosure of essential patents (standard-setting) and inclusion of non-complementary patents (patent pools) would infringe EU competition law. Hence, licensors was taken an at least theoretically strategic important tool of anti-competitive misconduct. A common advantage benefiting licensors and licensees equally from is that they have been given guidelines at
hand they can use to check whether any of their licensing agreements infringe EU competition law or not. This may prevent costly lawsuits and lead to more licensing agreements, thus interaction between firms.

**Table 6.1** Summary about the Commitment’s Main Policy Changes with Respect to the two Broad Categories

<table>
<thead>
<tr>
<th>Commitment</th>
<th>Aim: Increase of capabilities of the actors and stimulation of interaction</th>
<th>Aim: Improvement of conditions for innovation activities / Removal of obstacles hindering innovation activities</th>
</tr>
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</table>
| Commitment 23: “Safeguard Against the Use of IPRs for Anti-competitive Purposes” | • Access to the participation in standard-setting and patent pools should be open to every interested competitor (standard-setting) and IPR-holder (patent pool) | • Ex ante disclosure of the possession of SEPs  
• Licensing on FRAND terms  
• Licensing to every interested actor  
• Standards must not be complied with (standard-setting); competing products and technology can be developed (patent pools) |

*Source: Own representation.*

With respect to the four identified EU innovation systems, the revised regimes may rather give the developing and the lagging behind innovation systems a structural advantage. Firms in a strongly developed or publicly policy-led innovation system may have been adversely affected. In a strongly developed innovation system, which is a rather science-based innovation mode, firms are very innovative (frontier firms), compete in international markets and are typically supported by or cooperating with public policy, universities and other (public) research institutions. Firms in this environment may be more frequent licensors and participants in standard-settings and patent pools than licensees. As already discussed in the previous paragraph, the new regimes may have reduced the incentives for licensors to act anti-competitively. They may have to face tighter competition than before. Similar, though less strong, may apply to firms in a publicly policy-led innovation system. There, innovation in the private sector by itself is not particularly well-developed in this group but public policy initiatives spur firm innovation “extrinsic”. Hence, it is rather likely that firms in this innovation system are increasingly licensors as well. In contrast, firms in the other two innovation systems, i.e. developing and lagging behind, significantly depend on external knowledge sources to innovate. Given a sufficient absorptive capacity, the firms would substantially benefit from

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40 See Verspagen et al. (2018) for the definition of the four EU innovation systems.
international technology diffusion. This makes it likely that firms in these environments are more frequent licensees than in the other two innovation systems. The new regimes, which opened “the door” for participation in standard-setting and patent pools for every interested party and enabled firms to take licenses on FRAND (non-prohibitive) terms, thus may be more able to close the technology gap faster than before.

Anti-competitive misconduct of IPRs is rather inherent to complex technology industries such as the biotechnology, telecommunication and semiconductor industries (Kortum and Lerner, 1999; Hall, 2005; Hall and Ziedonis, 2001; Ziedonis, 2004; Von Graevenitz et al., 2013; Noel and Schankerman, 2013). Products in complex technology sectors usually incorporate not only a single invention but many separate components, each of which may be subject to one or more patents (Von Graevenitz et al., 2007). These patents are complementary: If a firm wants to use a patented technology, e.g. for development and production purposes, it needs access to a bulk of patents to not get sued for patent infringement. The ownership of patents in complex technology sectors is often fragmented and – in order to get access to those patents – firms may have to negotiate with a large number of IP owners on licensing terms (Gilbert, 2010). This means that independent of the particular innovation system, firms operating in these industries should have benefited the most from the revised guidelines, which make it easier and more affordable to obtain necessary IPRs than before.

6.5 Conclusion

The EU implemented revised guidelines on horizontal cooperation agreements and the two Block Exemption Regulations in 2011. In 2014, a revised version of the technology transfer guidelines and of the accompanying Block Exemption Regulation (TTBER) entered into force. The new regimes were designed to stimulate research and innovation and to provide more legal certainty regarding those types of agreements than before. The new policies do not work only on stimulating the interaction between the actors but also on improving the conditions for innovation activities and the removal of obstacles hindering innovation. Particularly firms not holding IPRs being essential to either a standard or a patent pool are probably the largest beneficiaries as they can participate in standard-settings and patent pools and can take licenses on FRAND, i.e. non-prohibitive, terms. Licensors probably have lost somewhat their leverage on anti-competitive misconduct of IPRs. While firms in strongly developed and publicly-led innovation systems may have been adversely affected by the new regimes, the opposite may hold for firms in developing and lagging behind innovation systems.
6.6 References


