Assessment of two candidate headline indicators for knowledge transfer

Report of the Knowledge Transfer Indicators Expert Group of the European Commission - Task 1

Håkon Finne, Andrea Piccaluga, Adrian Day,
Patricia Walter, Dorien Wellen

2010-06-15

Report of the Knowledge Transfer Indicators Expert Group of the European Commission - Task 1

Version of June 15, 2010

Håkon Finne (chair), Andrea Piccaluga (rapporteur), Adrian Day, Patricia Walter, Dorien Wellen.

This is a report of a group of experts invited by the European Commission to identify clearly what is covered and what is not included in two proposed **headline indicators for knowledge transfer**, as well as to discuss the extent to which the two indicators can be disaggregated according to specified dimensions.

The two proposed headline indicators are:

- **Measure of industry-academia collaboration**: the share of publicly performed research that is funded by the private sector
- **Measure of technology transfer**: cross-border cash flows related to licence revenue for technology.

The objective of the Expert Group is, through its analyses, to support the ERAC (previously CREST) knowledge transfer working group and its indicators subgroup in their choice of indicators for monitoring the implementation of the IP Recommendation of the European Commission. The validation of the two proposed headline indicators includes assessing whether they are sufficiently general, useful and robust as indicators for knowledge transfer but not whether they are the best possible indicators for any more specific objective than that. However, the group understands that they have been considered to be used as "policy indicators", i.e. indicators which may by themselves "set the direction" for policy actions at national level. In this context, the group will validate the indicators
- primarily for their validity (to what extent do they measure what they say they will)
- secondly for their dynamic qualities (under what conditions does an increase in an indicator for a particular country mean an improvement in knowledge transfer)
- and thirdly for their comparative qualities (under what conditions is a ranking between countries on an indicator also a ranking on knowledge transfer).

On the substance, according to the group the two indicators are considered useful, since they are general, fairly easy to understand, relatively robust and also well consolidated with respect to statistics practice, not least since they are not new in the field of indicators for research, innovation, science, and technology.

The two indicators also present a good degree of complementarity between them. In fact, they do not clearly overlap and given the need to identify and assess no more than two indicators, they can be considered a good choice.[1] It is understood that several other indicators contribute to the analysis and understanding of phenomena related to industry-academia engagement and technology transfer, and the group will most probably be involved in selecting and describing some of them in the context of a separate assignment

[1] Using data from EU15 countries for the years 2004 – 2008, the two indicators can be shown not to correlate.

(Task 2). Some other indicators could probably have been chosen as valid alternatives, but - on the whole - the choice of the two indicators seems quite reasonable.

After this first assessment, the group has analysed and discussed the characteristics of each indicator. In particular, for the two of them it has discussed and identified:

- **technical aspects**, i.e., specific remarks about how the indicator is or should be built, which data are or should be used, etc.
- **strengths**, i.e. qualities of the indicator which make it a good choice, with a specification on the issues that are actually addressed by it;
- **weaknesses**, i.e. relevant issues which are not addressed by the indicator as well as where it is not completely clear in terms of definition and data sources, and reasons for which the indicators can be influenced by factors different from those which are under direct observation.

In order to perform these analyses, the group has studied technical descriptions of the indicators, compiled and discussed actual data sets, and engaged in a series of what-if-discussions. Whenever possible, the group has also provided suggestions about possible improvements and ways to overcome the problems indicated. This kind of information, as well as all other technical aspects, has been described in some detail in technical annexes.

Also, the group has advised on the availability of specific sources of data for the indicators, taking into account that - in some cases – all data that exist may not necessarily be readily available in published homogeneous tables or databases.

In general terms, the experts think that paying attention to long term trends is absolutely necessary, not only because countries with a specific policy should be interested in improving their long term situation on a non occasional basis, but also because single observations will be influenced by “external” factors (such as sudden increase/decrease in GDP, without any structural change in R&D investments) which should be more correctly interpreted only through long time series.

The group has also considered possible unintended effects of the indicators in question, such as incentivisation of particular activities simply because they are analysed and published (published data are often viewed as league tables which may, in turn, be the basis for policy development). The group has agreed that, given that institution-level data will not be published and no funding will be determined by the indicators, there is limited likelihood of activity being skewed toward what is being counted. National policy choices unduly influenced by the need to ‘compete with one’s neighbour country’ also seem unlikely. This position would need to be reviewed in advance of any further use being made of these indicators.

There was also general discussion about the changing nature of IP and associated rights and licenses – most notable the development of “open source” IP, particularly in the field of software. While such IP often includes a license, there are no central data sources (most likely because no money has been exchanged). While open source IP may become far more

significant in the future, it was agreed that the majority of activity currently considered as relevant to this group would be more traditional (protected) IP.

Indicator 1 – the share of publicly performed research which is financed by the private sector.

In common policy parlance, "Publicly performed research" usually means research performed in "Public Research Organisations" (PROs). This is a mixture of higher educational institutions, research institutes, teaching hospitals, etc., whether they are formally owned by public authorities or not, as long as they to a great extent use public funding in the pursuit of public policy. The make-up of this heterogeneous sector differs between national systems of innovation. Statistically, their intramural R&D activity is expressed as GOVERD plus HERD[2], and the indicator is the percentage of this which is funded by domestic sources in business and enterprise.

With regard to the first indicator, it is a consolidated one, which has been used for many years. This is certainly an advantage, since practitioners and policy makers are familiar with it. In general terms, the fact that the private sector funds public research, i.e. research performed in public research institutions, is to be considered positively.

In fact, it means that the private sector appreciates the capacity of the public sector to carry out good quality research which may contribute to industrial competitiveness. Also, a growing percentage of privately funded public research can represent a sign of the sustainability of research in the public sector in contexts of serious budget constraint.

This indicator reveals the share of private funding of publicly performed research and as such is essentially an input indicator. With respect to knowledge creation and transfer, however, it does not tell us anything about the productivity and the quality of public research, or the capacity of industry to extract value out of the research funded. One can assume, very broadly speaking, that an increase in percentages of funding by the private sector corresponds to satisfaction with and growing (or at least, good) relevance, quality and productivity of public research. Otherwise, in fact, industry would not decide to increase funding. Nonetheless, the indicator will be influenced by changes in the level of public funding in absolute terms (with a consequent impact on the percentage of funding by the private sector), as well as by policy changes in countries with low research budget (in these cases, minor changes in absolute terms can determine relevant variations in percentage). In countries with a larger than average SME sector one may expect a higher concentration of the nation's research capacity in institutes rather than in enterprises; this will have to be considered when comparing between countries.

[2] A fourth sector for the performance of R&D (beyond GOVErnmental institutions, institutions of Higher Education and Business and Enterprise) is the Private Non-Profit (PNP) sector. The group has not investigated whether it would make sense to include R&D in the PNP sector.

The indicator may, however, also be the object of further observations, which the group would like to address. For example, some may argue that a growing percentage of privately funded public research could be seen as describing a shift towards more applied/finalised research, and away from fundamental research, which is what in the long term provides breakthrough inventions and innovations. This kind of an interpretation would lead to different possible views between those who advocate a shift towards more applied/finalised research, and those who consider it an impoverishment of a country's S&T base. From this perspective, the indicator would have to be complemented by other indicators. Also, it may be that increasing private funding to public research may indicate an increase in R&D outsourcing from private to public labs, i.e. a sort of a substitution effect (from private to public), with a possible negative impact of employment in private research. On the other hand, theories about absorptive capacity argue that in order to better exploit external sources of knowledge, companies must strengthen internal sources as well, so that we might also suppose that increases in private funding to public sources do not represent by themselves a sign of a substitution effect, but rather a willingness to increase external acquisition as well as internal capacity.

Also, the possible influence of public subsidies to research in the private sector should be taken into account, the danger being that of including in a private sector funding contribution which the private sector obtains by way of grants or other subsidies and which are then (re)directed towards the public sector.

Attention should be devoted, in the future, to the collection of data from research contracts from the private to the public sector which are often object for tax refunds, since these kind of data should be easily available in official statistics. Public funding channelled to enterprises for R&D is sometimes awarded on the condition that it be used extramurally. As a policy measure to improve interaction between PROs and industry, it may thus have the side effect of artificially increasing private funding of publicly performed R&D in the statistics.

As a measure of knowledge transfer, the indicator is general, robust, and consolidated, and it has a sufficiently long history in many countries to provide long time series. Its main drawback is that because it is an input indicator, it is not clear how much of it is payment for knowledge transferred (as opposed to knowledge produced). With the existing data, the indicator cannot currently be further broken down into different types of interaction (donations, collaborative research, contract research, etc.).[3] While such a disaggregation would be extremely interesting, unfortunately such data are only available from direct surveys to HEIs, which are not available in every European country, and certainly not for time series of more than five years (with a few exceptions). Nevertheless, knowledge transfer does not only occur at the stage where knowledge is 'finalised' and packaged to be transferred as a completed patent or a licensable object. It also occurs at earlier stages, and industry participation in extramural research is often a prerequisite for later successful transfer.

[3] HERD and GOVERD can be broken down into fundamental and applied research, but the funding component cannot.

Indicator 2 – Cross border cash flows related to licence revenue for technology.

The basis for this indicator is found in international statistics on balance of payments for import and export of services. As proposed to the expert group in a preliminary version, it consisted of credit payments for export of royalties and licence fees between a single country and the rest of the world. To make the indicator comparable between countries, it was proposed to normalise it against GERD for each exporting country.

With regard to the numerator of the second indicator, the group also considers it a general, robust and consolidated one which has been the object of standardised data collection for many years. Some technical remarks are made, in order to better specify both the numerator and the denominator. The expert group understands that the indicator has probably been chosen in order to monitor the capacity and dynamism of a country in selling S&T based products and services. Also, it may contribute, especially when divided into regional components, to an evaluation of cross-country exchange of knowledge within the EU, which refers directly to the ERA objectives. This is an important issue, even if it fails in providing details about the role played by the private and the public sector (or by PROs and industry). So, besides its high degree of international harmonisation and comparability, this indicator has also some further very interesting implications, since it is technically possible to track flows from one country to another – both ways - and not only from (or to) one country to (or from) the rest of the world. This means that numerous analyses can be made to assess the position of each country in relation to all others. However, this indicator, in comparison with the previous one, should be further refined to be able to meet information needs.

Given current availability of data and planned changes to the data collection and publication procedures, the group sees an interesting scenario for the future development of this indicator. Currently, the data for “royalties and licence fees” can in principle be disaggregated into “franchises and similar rights” and “other royalties and fees”, where the latter includes payments for entertainment, software, technology licensing, and other rights, but cannot be broken down into these categories. Currently, there are also other items related to knowledge transfer, including computer services, R&D services, architectural, engineering, and other technical services, and sale of patents and licenses. Beginning for the reporting year 2013, it will be easier to distinguish fees for licences related to the use of outcomes of R&D from other licences owing to methodological improvements in the data source (balance of payments).

A focus on the in-flow of revenues prospects the situation of countries which increasingly chose to be exporters of S&T, which is certainly largely coherent with the objective of building Europe as a knowledge-based economy. However, payments made to buy S&T from other countries can also be important. With regard to this aspect, both studies in the field of Open Innovation and about the manufacturing capacities of countries tell us that a dynamism in buying S&T can in some cases be a positive signal, especially if accompanied by comparable activities in the sale of S&T services and products.

Also, the group considers that the indicator may be influenced – among others - by two specific factors. The first one is the industrial structure of countries, although it is not easy to say uniquely how differences between industrial sectors etc. may impact the indicator. Changes in the indicator may also point to structural changes in the country in question. Secondly, smaller countries might be expected to show relatively higher indicators, given their natural propensity – i.e. their need – to operate with other countries (given their small internal market).

Besides refining the numerator, the group also argues that the denominator should be reassessed. GERD provides an indication for the size of a country in terms of research undertaken there. But GERD has, technically speaking, no connection with the numerator, which makes interpretation difficult. To illustrate this, the licensing payment from Ireland in 2008 from other EU27 countries amounted to 3.5 times its GERD. Therefore the group argues that GDP could be an alternative denominator. With this, the indicator would be easier to interpret with respect to the relationship between knowledge transfer and economic development. Besides, an export and import ratio could be calculated.

Conclusions

INDICATOR 1
Describes level of engagement of private sector in funding publicly performed research. While it is an indicator of cash input to publicly performed R&D, it does not measure R&D output nor reflect the reverse flow of knowledge. Appears to be subject of a size effect whereby the lower the level of GOVERD and HERD, the higher the percentage of private funding.
Recommended use as an input indicator with caveats mentioned.

INDICATOR 2
Describes cross border transactions related to technology transfer, both inflows, outflows and derived measures. It comprises all forms of IPR including some non-technology IPR such as entertainment royalty payments and at the same time excludes all intra-country technology transfer as well as other forms of knowledge transfer.
Recommended use as a signal of general cross-border technology transfer (less suited for measuring cross-border knowledge transfer from PROs to industry), noting that it does not cover all aspects of KT and includes extraneous data. Improved accuracy available beginning 2013.

Annexes:
- technical document describing Indicator 1, prepared by Commission and Eurostat services
- technical document describing Indicator 2, prepared by Patricia Walter
- collation of time series for selected countries for the indicators, prepared by Håkon Finne.

Title	**Public R&D expenditure financed by business**
Exact definition	Public R&D expenditure (GOVERD+HERD) financed by the business sector as % of total public R&D expenditure The *denominator* includes all R&D expenditures performed in the higher-education sector (HERD) and in the government sector (GOVERD) of a country. This data is computed by the National Statistical Institutes based on the R&D survey sent to the national R&D performers of these two sectors (universities, university hospitals and clinics, public research institutes). In this survey, public R&D performers also indicate the sources of funds (i.e. government, business, abroad) for their R&D expenditures. The *numerator* is the amount of these R&D expenditures that are financed by the business sector. R&D expenditure data by sectors of performance and sources of funds is provided by each country in accordance with the definitions and methodologies of the *Frascati Manual*, the OECD reference manual on proposed standard practice for surveys on R&D. Therefore, this data is known as both reliable and internationally comparable.
Who has proposed it?	The ERA Expert Group on Knowledge Transfer.
Why has it been proposed?	This indictor is supposed to give a measure of public-private cooperation in R&D in a given country. It is meant to measure the propensity of the business sector to finance R&D in the public sector. The assumption is that a tighter public-private cooperation should translate into a higher share of public research financed by the business sector. In practice, the values taken by this indicator in countries do not match what can be anticipated. It appears that countries with very low levels of public R&D expenditure rank very high with this indicator, because precisely of the low level of public funding of R&D. In contrast countries with higher levels of public R&D expenditure and better public-private cooperation rank low.
Sources and reliability	Eurostat, reliable, internationally comparable
Availability of data: Member State coverage / international coverage	EU-27, OECD countries
Regularity of updates	Annual. *Comment: According to the CR 753/2004 obligatory data provision by the MSs on this indicator is required bi-annually (for each odd reference year), but Eurostat receives data from majority of the countries on annual (voluntary) basis and in most of the cases is in a position to calculate EU total on annual basis.*
Value(s) for EU-27 and international comparison	EU-27: 7.3%, US: 3.1%, JP: 2.2%, CN: 14.1%, KR:8.9. Note: 2007 data
Values at Member State level	UK: 5.8%, FR: 4.0%, LV: 8.7%, RO: 9.5%, PL: 5.0%, SI: 11.7%, SK:10.1%, HU:13.9%, FI:9.5%, CZ:6.6% - Note: 2008 data DE:12.7%, AT:6.4%, TR:19.9, BE:10.7%, ES:7.9%, SE:5.0%, IT:2.3%, PT: 2.1% - Note: 2007 data
Are the data susceptible to significant change?	No.

Fiche indicator nr 11 bis

Evaluation of the proposed headline indicator with particular focus on cross-border technology transfer

Patricia Walter

ERA objective: to promote public-private cooperation and knowledge transfer

Proposed core ERA indicator: share of license revenue from abroad as % of GERD (General Expenditure on R&D)

1. Concerning the numeraire, the Balance of Payments offer internationally standardized and therefore comparable data.

2. According to the effective methodology of the Balance of Payments, the Balance of Payments Manual, 5th edition, and the Manual on Statistics of International Trade in Services 2002, the standard component "Royalties and license fees" can be disaggregated into "Franchises and similar rights" and "Other royalties and license fees". The latter includes payments for
    a. the authorised use of intangible, non-produced, non-financial assets and proprietary rights and,
    b. through licensing agreements, the use of produced originals or prototypes (manuscripts, computer programs, cinematographic works and sound recordings).[1]

3. The Balance of Payments also covers payments for research & development, meaning payments for basic research, applied research and experimental development of new products and processes. In principle, respective activities in the physical sciences, social sciences and humanities are covered as well as commercial research related to electronics, pharmaceuticals and biotechnology.

    Further on, research results can also be sold outright. The sale of patents and licenses is covered in the capital account of the balance of payments.

4. "Other patent and license fees" and "Research and development" are reported to EUROSTAT on a yearly basis as part of the Questionnaire Y1 "International Trade in Services and Remittances". Data are disaggregated on a "Level 2" basis which differs between single countries within the EU.

    The sale of patents and licenses is included in the item "Acquisition/disposal of non-produced, non-financial assets", which is reported to EUROSTAT as part of the quarterly Questionnaire Q1 and cannot be further detailed.

5. The OECD compiles the Technology Balance of Payments, which is a special extract from the overall Balance of Payments including "Franchises and similar rights", "Other

[1] Distributive rights for audiovisual products are included in „Audiovisual and related services".

royalties and license fees", "Sale of Patents and licenses", "Architectural, engineering and other technical services", "Research and development" and "Computer services".[2]

6. Starting in 2013, the Balance of Payments will be compiled according to a new methodology, the Balance of Payments Manual, 6th edition. Until 2012, these guidelines should be implemented in the EU regulation on the Balance of Payments, which are the basis for compiling external statistics within the EU. Research and development services as well as its outcome, patents and licenses, will then be treated in a different way.

   Charges for the use of intellectual property n.i.e. will comprise of

   a. proprietary rights, arising from R&D (patents, trademarks, copyrights, industrial processes and designs) and
   b. licenses to reproduce or distribute intellectual property, produced originals and prototypes (books, computer software).

   Research & Development services will cover

   c. payments for basic research, applied research, experimental development of new products and processes and also the
   d. outright sale of the results of R&D.

   Both indicators will be available in greater detail. Charges for the use of intellectual property n.i.e. will be subdivided into

   e. franchises and trademark licensing fees as well as
   f. licenses for
      i. the use of outcomes of R&D,
      ii. to reproduce and/or distribute computer services and
      iii. to reproduce and/or distribute audivisual and related services.

   Research and development services will be disaggregated into

   g. work undertaken on a systematic basis to increase the stock of knowledge,
   h. sale of proprietary rights arising from R&D[3] and
   i. other R&D (testing and other product/process development activities).

7. A sectoral breakdown, indicating who is carrying out R&D and gaining revenues from its results, whether public institutions or private companies, is not part of the reporting requirements for the Balance of Payments.

   In Austria, the central bank runs a survey system to compile cross-border trade in services. Therefore it is known which companies are engaged in cross-border knowledge transfer and these data are published in separate statistics. Predominately, large, transnational companies are gaining license fees and revenues from cross-border R&D. Only a minor

[2] See "Manual for the Measurement and Interpretation of Technology Balance of Payments Data – TBP Manual" (OECD, 1990) as part of the so-called "Frascati family" of OECD guidelines.
[3] In contrast to the Frascati definition.

part of revenues from cross-border knowledge transfer can be attributed to universities and research institutes.[4] .

8. Concerning the denominator, it is common practise to describe cross border flows and transactions in relation to a country's or economic area's gross domestic product (e.g. export and import ratio). The GDP is available in current prices as are the transactions captured in the current account of the balance of payments.[5] Furthermore, the trade balance in goods and services contributes to the GDP in the form of the net export. The methodology applied in the National Accounts and the Balance of Payments is therefore to a large extent harmonised.

9. General Expenditures on R&D (GERD) also offer an indicator which is standardized within EU- and OECD-countries. It relates to R&D carried out within the respective country, irrespective of the source of financing (domestic or foreign). According to the Frascati Manual, R&D not only covers physical sciences, but also social sciences and humanities. It further takes account of basic research, applied research and experimental development.

10. In summary, the proposed headline indicator is to be evaluated as follows:
    a. The numeraire is not part of the denominator. Therefore it is a mere comparison of two data sets for analytical purposes, but no actual ratio.
    b. Knowledge transfer is approximated by the authorized use of patents, produced originals or prototypes from abroad.
    c. The origin of these assets is not necessarily domestic.
    d. It does not cover sales of patents and licenses nor cross border R&D.
    e. The numeraire can be specified as revenues from "Other royalties and license fees", excluding "Franchise and similar rights".
    f. Currently, no further distinction can be made between types of intellectual property rights and weather it relates to technology or cultural copyrights.
    g. Starting with the reporting year 2013, a distinction can be made between licenses for
        i. the use of outcomes of R&D,
        ii. to reproduce and/or distribute computer services and
        iii. to reproduce and/or distribute audivisual and related services.

11. Amendments could be made as follows:
    a. The numeraire could be extended to cover revenues from "Franchises and similar rights", "Other royalties and license fees", "Research and development", "Architectural, engineering and other technical services" and "Computer services".

[4] For estimating the share of R&D financed by foreign companies see FATS (Foreign Affiliates Statistics).
[5] For trade in services, respondents have to report the invoice value exclusive of value added tax.

i. This would give a comprehensive picture of cross-border technology transfer.

ii. Data are reported on a regular basis to EUROSTAT.

iii. They are also collected by the OECD as part of Technology Balance of Payments.

iv. From 2013 onwards, the indicator would also cover sales of patents and licenses.

v. It could then be specialized according to information needs[6].

b. The denominator could be changed to GDP.

i. The headline indicator would then serve as an actual ratio as trade in services is part of net exports of GDP.

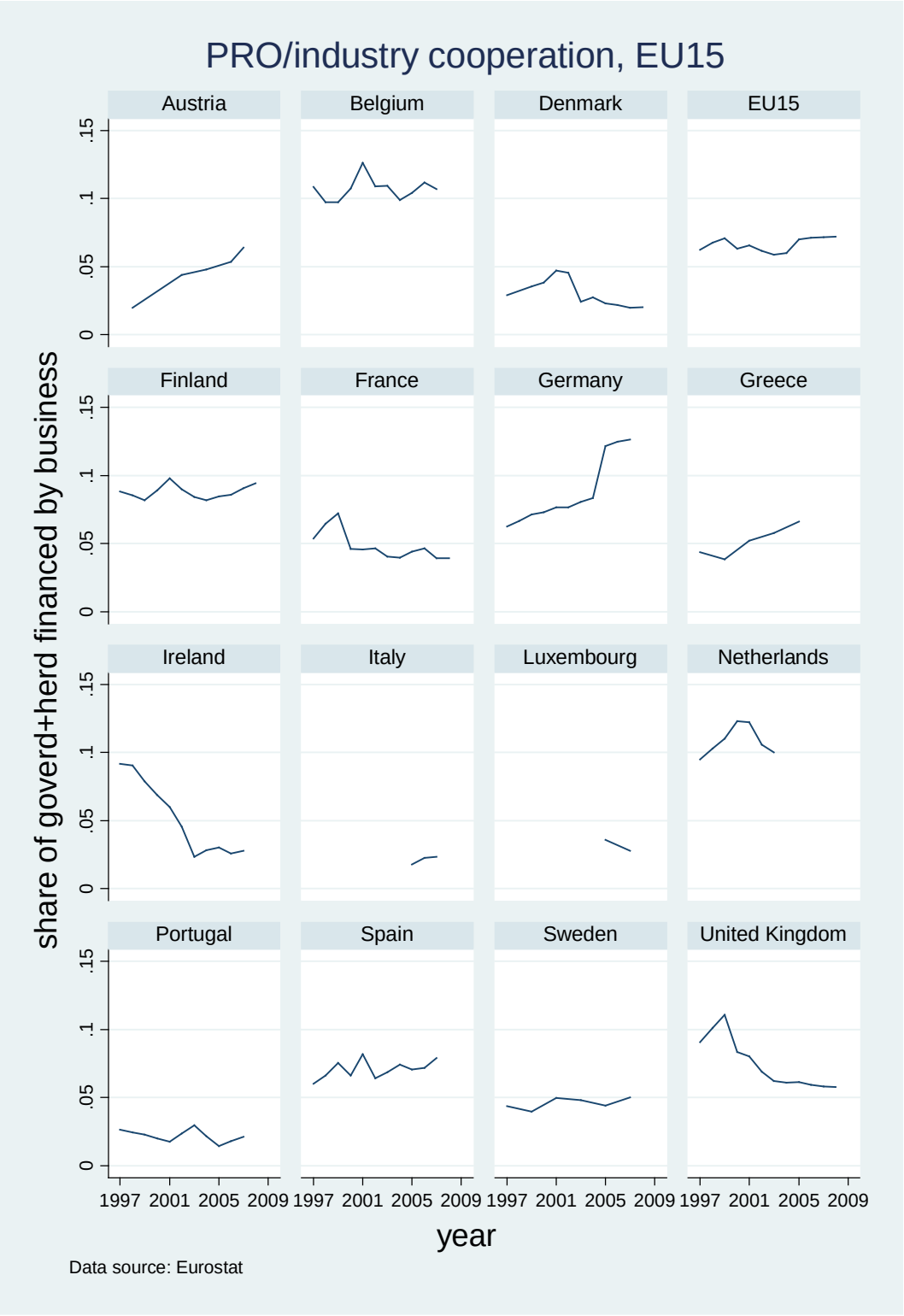
ii. It would relate technology transfer to economic development.

iii. An export and import ratio could be calculated.

[6] Besides further details on "Charges for the use of intellectual property" and "Research and development", "Architectural, engineering and other trade related services" will be subdivided into (i) Architectural services, (ii) Engineering services and (iii) Scientific and other technical services.

Annex 3: Time series of the two indicators for EU15 countries using readily available data, showing development trends and comparability between countries.

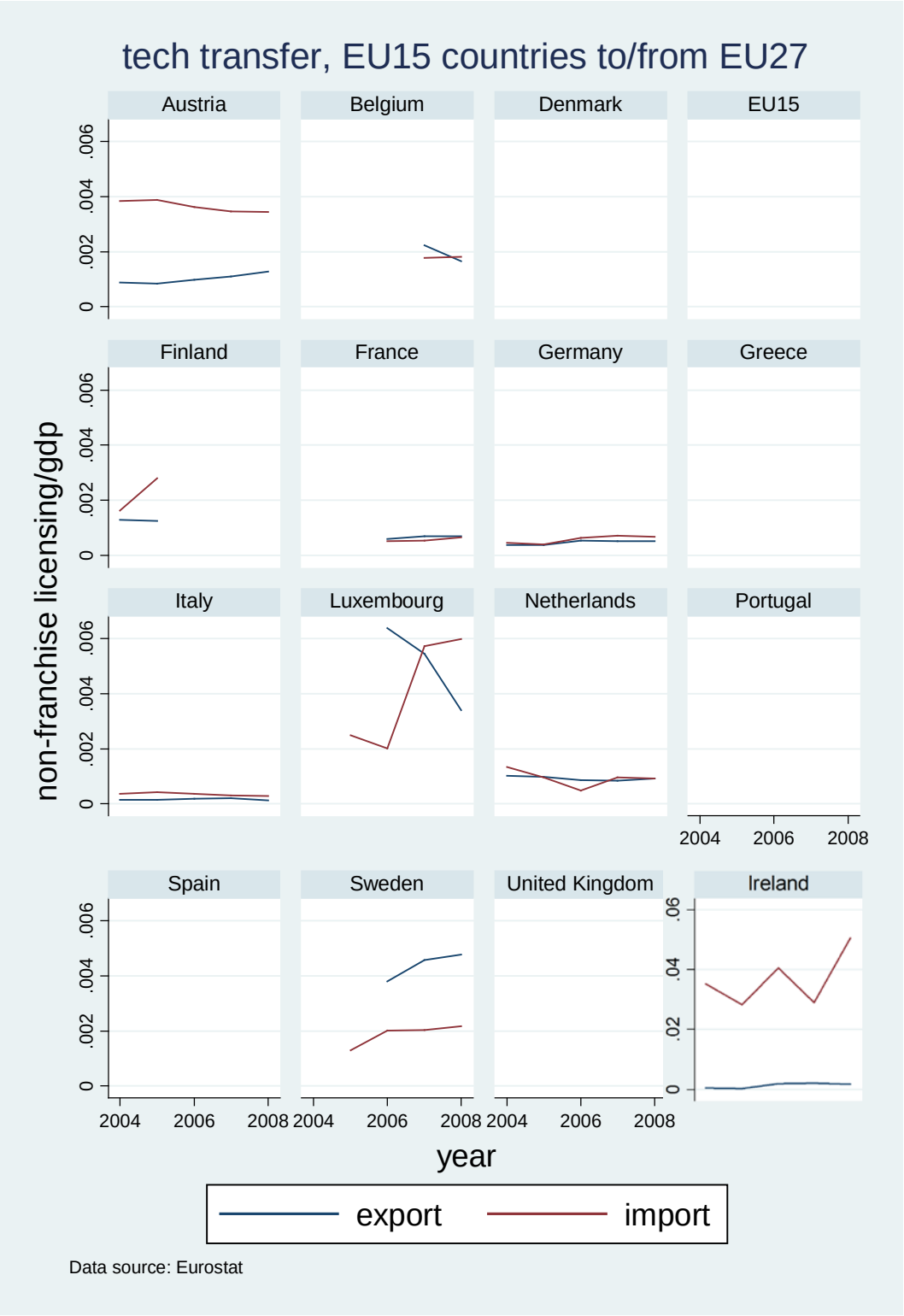
1: INDICATOR 1: Share of public research financed by private sector



Data given for EU15 countries only. Reasonable time series available for other EU27 countries and some others. The fluctuations are much higher in some of the new member states, and the maximum score in those data reach close to 0.3.

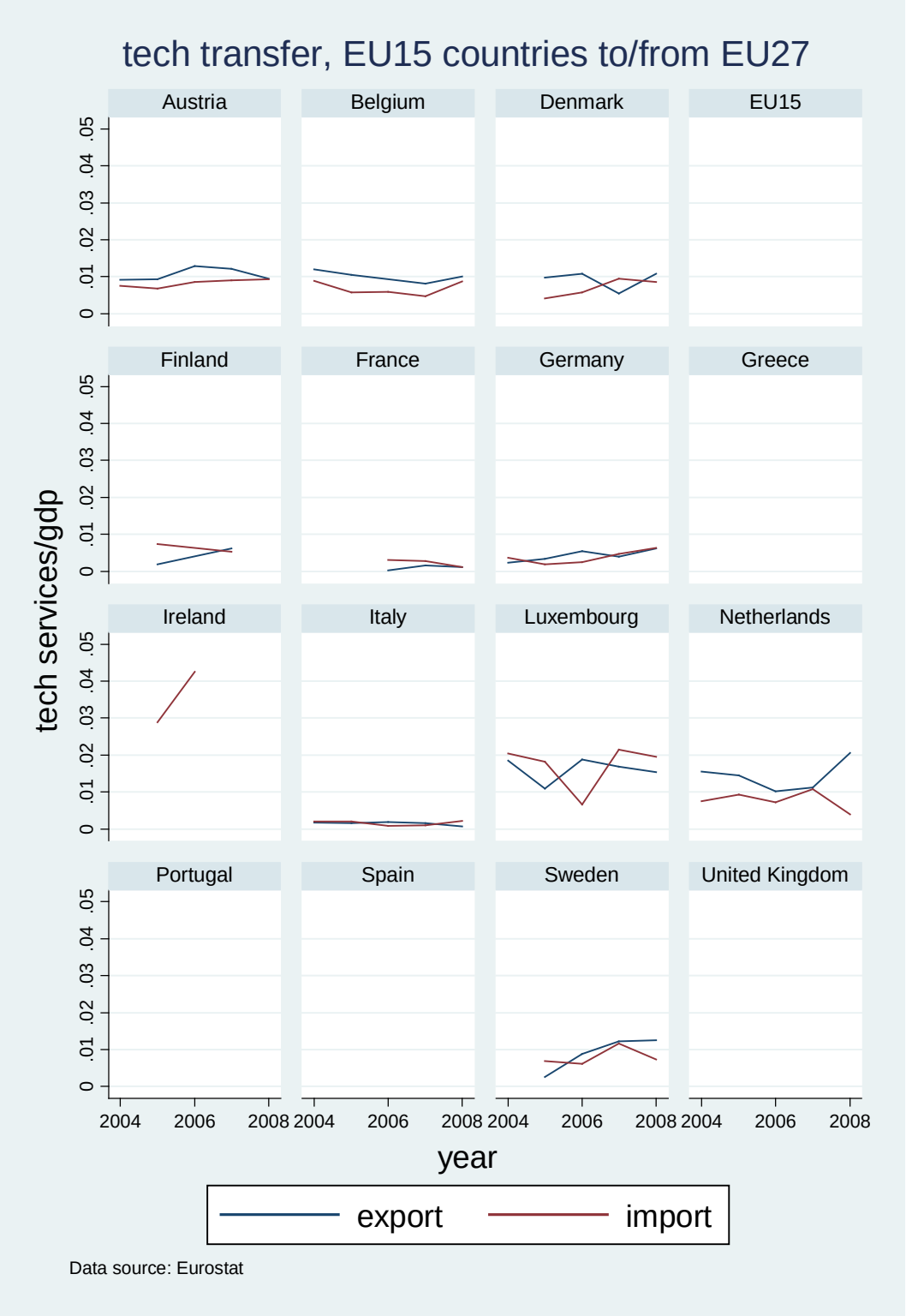
2: INDICATOR 2: Cross-border cash flows related to licence revenue for technology

2.1: Licensing revenue (item 892 credit, black) to EU15 countries from the rest of EU27 and licensing expenditure (item 892 debit, red) from EU15 countries to the rest of EU27, normalised by GDP



Ireland is not displayed at a different scale because its values are up to 10 times higher than many other countries. Item 892 is the narrowest available definition: non-franchise type royalties and licence fees. Older data are available for some of these countries, but they are reported differently on Eurostat's web site. Some data are available for other countries.

2.4: Licensing and similar revenue (several items credit, black) to EU15 countries from the rest of EU27 and licensing expenditure (several items debit, red) from EU15 countries to the rest of EU27, normalised by GDP



Note: “Several items” means a sum of the following:
item 263 Computer services
item 266 Royalties and license fees (which includes items 891 (franchise) and 892 (other))
item 279 Research and development services
item 280 Architectural, engineering and other services
Older data are available for some of these countries, but they are reported differently on Eurostat’s web site. Some data are available for other countries.