Regional Patterns of Co-patenting by Technological Fields, A Europe – US Comparison

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Abstract—**Theory suggests that regions provide interfaces between inter-regional flows of knowledge, as much recombining of knowledge, i.e. learning, takes place at the local level. Beyond a mere confirmation of this well-known finding, this paper illustrates that such interfaces differ with regard to the degree of technological relatedness of inter-regional flows that intersect locally – and that certain knowledge flows are more likely to be combined than others. To substantiate this claim, a differentiated set of networks of knowledge exchange is empirically developed for a number of technological fields by means of patent analysis. Moreover, we point out that general framework conditions impact on the pattern of intersection between networks. Hence, we investigate technology-specific structures of inter-regional knowledge exchange in two major regions, Europe and the United States. In the US case the networks display a pattern driven by a technological logic whereas in Europe they seem to be characterized by a hierarchy of multi-field centers.**

Keywords: Patents; Technological Innovation Systems; Europe; United States

INTRODUCTION

This paper aims to pick up the challenges posed by the fact that after nearly two decades of fruitful debate on the subject of innovation systems much has been learned about actors and institutional framework conditions, while far less is known about the third constitutive factor stressed by the NIS approach – the linkages that exist between actors and that are shaped by institutional framework conditions [1]. More precisely, while linkages and networks are gaining an ever more prominent role in theoretical debate, they have not as yet been dealt with in empirical studies very often. While their importance is recognized [2], it is often argued that such data could only be collected through interviews – which is then neglected due to resource constraints. This paper, therefore, will demonstrate that for the co-operative networks directly related to the generation of knowledge a different, database-oriented approach can be taken.

In addition to the general lack of studies, most existing literature has concentrated on global linkages *between* nations rather than on those *within* larger nations or areas of economic integration. While academic interest in transnational enterprise networks has resulted in many studies on international networking [e.g. 3], [4] patterns of sub-national, inter-regional knowledge exchange have remained an understudied issue [5]. This lack of evidence appears particularly problematic as a trend towards studies of technological systems of innovation seems to be developing [e.g. 2], [6] which suggests that the 'roots' of such systems are to be found in technological niches [6] that develop at the intersection of technological knowledge flows in learning regions [7], [8].

Finally, the lack of evidence on inter-regional networking and the regional inter-section of knowledge flows has so far prevented studies on the question of how this set-up may differ under different institutional framework conditions.

Consequently, this paper will aim to take a first step towards shedding light on the issue of inter-regional networks and the patterns of their local intersection. To do so, we will elaborate on the impact of institutional framework conditions on such networks by comparing patterns of inter-regional co-patenting within Europe and the United States. We have thus chosen to base our argument on a comparison between different areas for which econometric studies have confirmed profound structural differences [cf. e.g. 9].

Even without a detailed operationalisation of these institutional dissimilarities, this comparison provides the empirical basis for the central thesis of this study: that the fabric of knowledge exchange will be impacted on by different institutional framework conditions: general spatial hierarchies set by culture, legislation and statehood on the one hand, and technological logics of co-location on the other. It will thus substantiate the claim that technological and territorial systems of innovation cannot be thought of or conceptualised independently of each other.

CONCEPTUAL BACKGROUND

During the last two decades, multi-level, multi-layer approaches [e.g. 10] have become common in innovation system analysis. One important element of novelty in some of those approaches was to shift from a concept studying innovative activities and relevant framework conditions *within* a set of self-contained units to a concept of a networked system in which much activities are performed locally, but knowledge is frequently exchanged through inter-regional co-operative linkages [11], [7], [12], [5]. While these approaches do not deny the key importance of local knowledge exchange, access to non-local knowledge sources is acknowledged as a key complement, as on many accounts it has convincingly been argued that non-localised 'communities of practice' [15] are among the "principal mechanism[s] through which tacit knowledge related to new practices is produced and spread" [16], [17]. Consequently, the local level is assumed to play a central role as an interface where inter-regional and intra-regional flows of knowledge intersect, are adapted and recombined, i.e. learning takes place [e.g. 13], [7], [14].

In this paper we will therefore develop a methodological framework for such an approach. In doing so, however, we follow Coe and Bunnell [5] in emphasising that one cannot plausibly argue that the current "space of place" would be completely transformed into a "space of flows" [as suggested by 18], that is, detached from its institutional environment and not hindered by external influences. Instead, we argue that inter-regional flows of knowledge remain shaped by both limiting and enabling factors.

In our view, there are two key dimensions that need to be taken into account if one aims to explain the pattern of co-operative networking among the regions in an innovation system: general spatial hierarchies based on socio-economic path dependencies and universal technological interdependencies. With that approach, we acknowledge the importance of a technology-field-based approach to the study of innovation systems, while denying its supremacy to territorial approaches. Instead we argue along the lines of Markard and Truffer [6] and Koschatzky et al. [19] that both perspectives are of similar importance and complementary. While territorial approaches are better able to capture differences in the established institutional and societal framework which any innovative action is necessarily situated and embedded in [the general "landscape", in the terms of 6], sectoral and technological approaches are better able to shed light on shared practices that constitute less durable, but at a given point in time not less important institutions [the particular "regime", in the terms of 6] (cf. Fig. 1). In our view, both of these will have an impact on the structure of networks of knowledge exchange.

In short, our hypothesis is that the logic of co-operation and co-location by which networks of knowledge exchange are shaped can be understood as driven by two different logics that are superimposed on and interfere with each other (cf. Fig. 1).

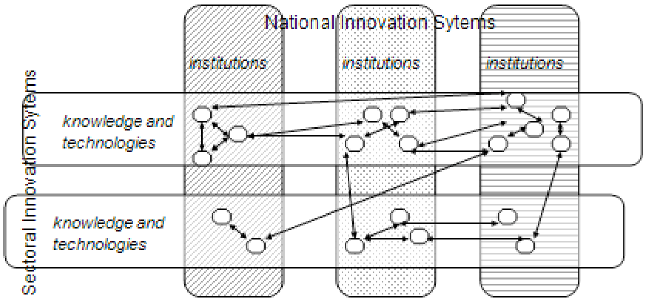

Fig. 1: The Mutual Interdependency of the
Territorial and the Technological Dimension

Source: own figure, drawing on Markard and Truffer [6], Geels [20]

The patterns of networking that we will empirically find will thus have to be understood as shaped by different "mixes" of technological specificities and national institutions.

The first assumption that technological interdependencies will drive the co-location of patent activities and hubs in inter-regional co-operation can be based on a number of well-known arguments such as the co-location of technologically related mature industries due to transaction cost savings [21], [22], a number of other territorial innovation models [22], [23] or Porter's [24] cluster approach. Additionally, one can quote the concept of local "niches" taken from literature on the evolutionary development of innovation systems. Geels [25] tellingly uses the metaphor that "technological niches", from which radical innovations emerge, represent the "local level" of the innovation process [6, p. 605]. Such "niches" are emerging at the interface of existing technological fields, where new knowledge is generated and new institutions are shaped [6, p. 606]. When taken literally, the emergence of niches is likely to happen at localities where knowledge flows intersect and become a self-reinforcing process.

As pointed out above, it is thus likely that activities in related technological fields will co-locate, as such co-location is mutually beneficial for a number of reasons. As the reader will realize, many of the listed arguments are general arguments for the co-location of industries. As most mature industries continue to generate knowledge, however, arguments for general co-location patterns are likely to be transferrable to patenting patterns, even though we would tend to assume that the more technology-oriented ("niches") arguments may be more relevant that the more traditional ("transaction costs").

For our study this leads to *Hypothesis 1*

- centers of activity as well as network hubs of some technological fields will display a tendency to co-locate, while those of others will not.

Moreover, we suggest that the co-location patterns caused by universal technological interdependencies will be superimposed by a number of other, more general effects.

Firstly, when disaggregating a diversified innovation system to a regional scale, significant disparities will usually be encountered [cf. e.g. 26 for the EU case]. These disparities have implications both for the level of innovative activities in and the networkedness of the less developed regions. At the local scale, there will in many cases be regional analogies to what Viotti [27] termed a 'learning system' at the national level. For many regions inter-regional connectedness may be important for lack of alternative knowledge sources [28]. In a country with a strong centre-periphery structure the overall disparities may thus generate a very similar structure across technological fields.

Secondly, cultural and institutional (national) boundaries play an important role [9], as an innovation system that is fragmented by national and language borders will tend to develop specific hierarchies within each of its sub-units rather than one large hierarchy for the whole system. In the case of an area of economic integration that is constituted by a large number of small sub-units, for example, the sub-units (nations) will tend to concentrate their activities in their specific centers within their boundaries. It thus becomes less likely that many industries will develop a strongly diverging locational pattern in the overall system.

For our study this leads to *Hypothesis 2:*

- the pattern of co-location of innovative activity as well as the pattern of co-location of network hubs will differ between the US and Europe.

METHODOLOGY

Patents as Indicators of Knowledge Generation and of Networks of Knowledge Exchange

Generally, a broad notion such as co-operative knowledge exchange is hard to capture. The different dimensions of knowledge and its transferability have been extensively discussed in prior literature [e.g. 29], [30], [31], [17], [16] and need not be re-stated at length. Since this paper aims to discuss the foundations of processes of innovation, it will focus on technological knowledge that can be applied in the production process in the foreseeable future. Consequently, patent applications are a suitable indicator to measure the generation of such knowledge, since, to be accepted, the invention documented in an application must not only fulfill the criteria of novelty and a sufficiently inventive step, but also that of commercial applicability [32], [33]. While not all applications are filed with the aim of commercial exploitation [34], they are, by legal definition, evidence of a process of the generation of applicable knowledge [33], [35]. Nonetheless, the validity of the indicator remains somewhat impaired by the fact that many firms prefer secrecy to patenting as a means of IPR protection and that some applications may only reflect a decision to protect application-oriented knowledge which was in principle available before [34]. To a degree, patent applications are therefore a fuzzy indicator. That notwithstanding, they remain the best of all possible alternatives in situations where a survey-based approach is not possible [33], but the network perspective should not be neglected.

In technical detail, this paper uses applications at the EPO, as it has been shown elsewhere that they provide a good basis for structural comparisons among countries due to their comparatively low country bias, even though the EPO is not the preferred patent office for US inventors [36].

As argued above, relevant data on inter-regional collaboration and knowledge exchange can in principle be obtained from patent statistics. In studies of the United States the issue is typically addressed by considering patent citations [e.g. 37]. When using EPO data, however, this is would not be a meaningful procedure, as under EPO rules most citations are added by the patent examiner rather than by the inventor himself, so that citations cannot be interpreted as a valid measure of interaction. This paper will therefore take recourse to co-patenting as an indicator of collaboration, as the joint mention of two inventors in a patent at least strongly suggests that two or more actors have committed a joint effort to the development of a new technology [cf. 38].

The raw data from which the co-patenting network matrices for this paper were developed was extracted from the PATSTAT database. The necessary regionalization of the data was performed on the basis of the most current OECD REGPAT regionalization dataset [39]. To mitigate any potential small number problem, relatively large territorial units of investigation were chosen (EU NUTS 1 regions and US states) and the co-patenting structure was aggregated over 5 years (from 2000 to 2004). Co-patenting relations reflect full counts, i.e. a patent with inventors from e.g. the three regions R1, R2 and R3 will be counted as a link between R1 and R2, R2 and R3 as well as between R1 and R3, based on the notion that a joint effort reflected in a patent will "establish proximity" between all pairs of regions whereas there is no plausible reason to assume that the degree of proximity established between, say, R1 and R2 should be impaired by the fact that a third inventor from R3 has also been part of the team.

To further improve the quality of the data, co-patenting relations between (often quite small) regions were only counted when at least two of the listed inventors lived in NUTS3 regions whose geographic centers are not within a range of less than 100km. Thus, it should have been possible to exclude most artifacts resulting from cross-border commuting, i.e. inventors living in different regions but actually commuting to and working together in the same organization. Such effects are relevant in the vicinity of city states in Europe and on the east coast of the US. Distances between NUTS3 regions were calculated using official EU map data for NUTS 1/3 region boundaries [40] and the GeoDa spatial analysis software [41].

Finally, in order to address the research questions put forward in this paper, different networks were developed for distinct technological fields (cf. Figures 2-5). As, in practice, patents are not classified by technological field but by a plethora of IPC classes, a meaningful aggregation was needed that allowed us to specify distinct technological fields. To do so, we have resorted to a proven classification which distinguishes 19 groupings of IPC classes and has been repeatedly used to illustrate profiles of the international competitiveness of nation states [42].

In detail, the respective categories are:

F01	Electrical machinery, Apparatus, Energy
F02	Electronic Components
F03	Telecommunications
F04	Audio-visual Electronics
F05	Computers, Office Machinery
F06	Measurement & Control Instruments
F07	Medical Equipment
F08	Optics
F09	Basic Chemicals, Paints, Soaps, Petroleum Products
F10	Polymers, Rubber, Man-made Fibers
F11	Non-polymer Materials
F12	Pharmaceuticals
F13	Energy Machinery
F14	General Machinery
F15	Machine-tools
F16	Special Machinery
F17	Transport
F18	Metal Products
F19	Textiles, Clothing/Leather, Wood/Paper/Furniture, Domestic Appliances, Food

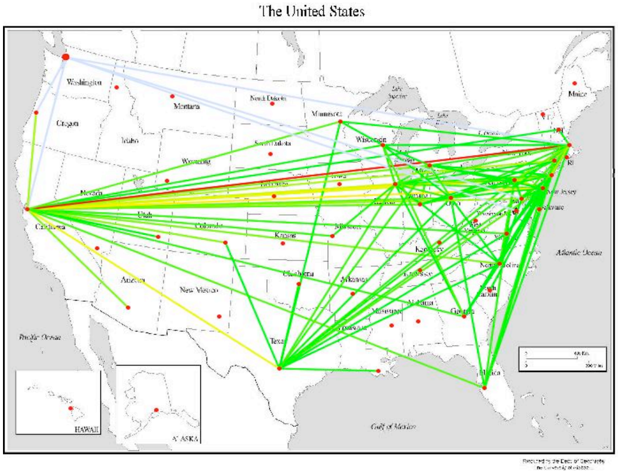

Figure 2: Network of Co-patenting, Illustrated for Total Co-patenting in the US, Relations with more than 150 co-patents; green=low, red=high number

Source: own figure, developed on ORA, based on map data of the University of Alabama

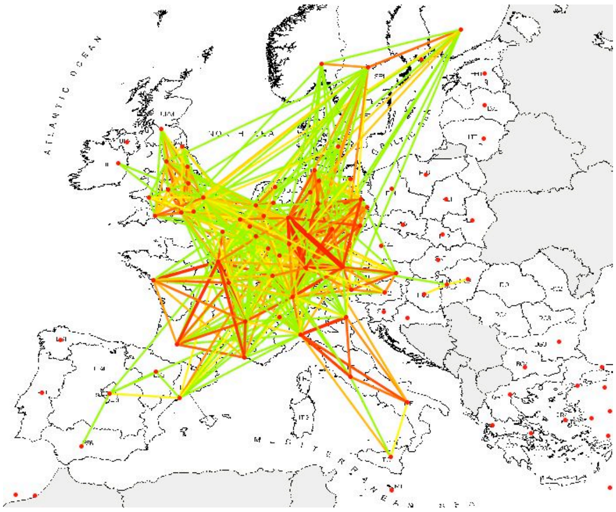

Figure 3: Network of Co-patenting, Illustrated for Total Co-patenting in Europe, Relations with more than 50 co-patents; green=low, red=high number

Source: own figure, developed on ORA, based on Eurostat map data

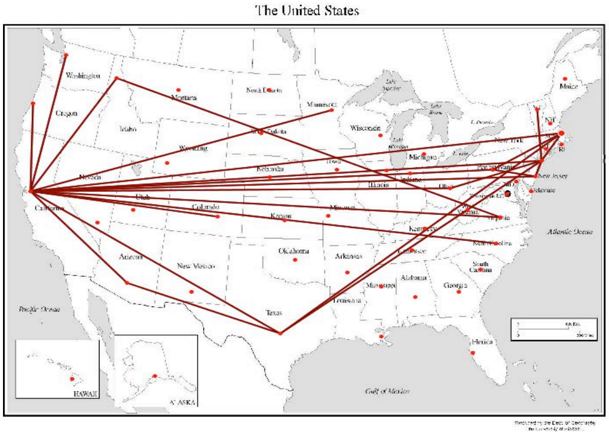

Figure 4: Network of Co-patenting, Illustrated for Electronic Components in the US, Relations with more than 20 Co-patents

Source: own figure, developed on ORA, based on map data of the University of Alabama

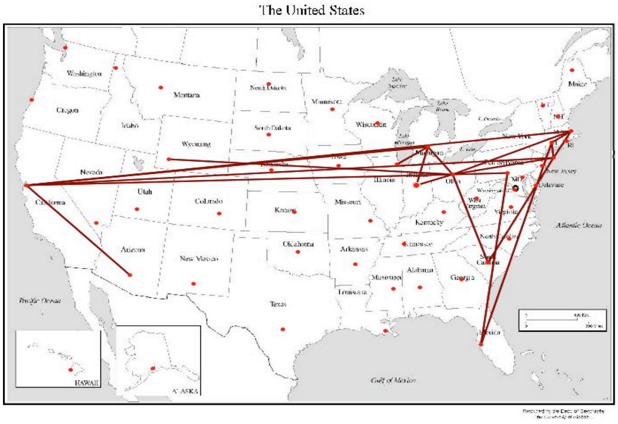

Fig. 5: Network of Co-patenting, Illustrated for Energy Machinery in the US, Relations with more than 10 Co-patents

Source: own figure, developed on ORA, based on map data of the University of Alabama

Measures of Connectivity

To reflect notions such as networkedness, connectedness and centrality, a plethora of approaches can be taken. In this study we will use measures from network analysis to be able to assign a single figure of networkedness to each region.

Within the scope of this paper it is neither possible nor necessary to extensively elaborate on the nature of all possible and the selected measures in detail. There is an extensive body of literature on network analysis from which such information can be obtained [as an introduction e.g. 43]. In brief, the following measures were selected for this analysis:

- Normalized Freeman Degree Centrality: degree centrality is defined as the number of links incident upon a node. It thus reaches only one step into the network.
- Normalized Closeness Centrality: closeness centrality is a more sophisticated measure of centrality. It is defined as the mean geodesic distance (i.e. "the shortest path") between a node and all other nodes reachable from it. Thereby it refers to the degree of effort that on average it takes to connect to information available at other points in the network.
- Normalized Eigenvector Centrality: eigenvector centrality is a measure of the importance of a node in a network. It assigns relative scores to all nodes in the network based on the principle that connections to other high-scoring nodes contribute more to the score of a node than connections to low-scoring nodes.

Technically, network measures were calculated based on the above mentioned co-patenting matrices by means of the UCINET software developed by Analytic Technologies, using the normalized form in all cases. If a region was not connected to the network at all, a value of zero was assigned. This happened for a small number of regions, mostly in Europe.

To illustrate our results, heat maps (Table 1-4) have been developed, for the absolute number of patent applications as well as the obtained network measures. They are based on straightforward correlations between the figures behind those rankings. In simplified terms, the degree of correlation illustrated in the map thus shows to what degree the respective ranking of regions in two technology fields overlaps, i.e. in other words, to what degree the respective networks of knowledge exchange are centered on and intersect in the same nodes. All correlations above 0.75 are highlighted by different shades of orange. Additionally, we have listed the average degree of correlation below each table.

RESULTS

With regard to the main hypothesis of this paper, even a brief look at the heat maps of correlations between the regional distributions of inventive activities by technological field (Table 1) illustrates that there are indeed clusters of technological fields whose centers of activity tend to co-locate.

In few fields (such as in both cases with regard to electrical machinery) are centers of activity located similar to those of all other fields. Neither, however, are there many fields (such as audio-visual electronics in Europe or transport in the US) with a location pattern that is similar to that of next to no other field. On the contrary, the heat maps in Table 1 reveal that two main clusters of co-location can be identified, one constituted by the high-tech technological fields F01 to F08 (electronics, ICT, audio-visual, medical equipment, instruments, optics) and the other by the more traditional technological fields F06 to F19 (instruments, optics, chemicals, pharmaceuticals, machinery, machine tools, rest). Moreover, a "node of intersection" seems to exist between the two, constituted by the fields of instruments, medical equipment and optics (F06 to F08).

Other than could be expected, this situation does not structurally differ between the US and Europe, giving a clear indication of the importance of global logics of technological interrelatedness that affect the logic of co-location independent of the national context and thus provide indirect evidence for the relevance of a technology-based innovation system approach. On the other hand, there is indeed a certain degree of differentiation according to the geographical area under study: In Europe, both clusters of co-location are clearly established, with a possible dominance of the one in the more traditional industries (F06-F19). In the US, in contrast, this cluster is barely traceable whereas the relatedness of co-location patterns in the high-tech field (F01-F08) seems to be stronger. Whilst in Europe activities in audio-visual electronics are to a high degree located in a different pattern than the others, this applies to energy machinery and transport in the US. On average, the degree of relatedness between location patterns of activities in different technological fields is somewhat higher in Europe than in the US (average correlation 0.7359 vs. 0.6408).

Furthermore, interesting results are found with regard to the correlation of measures of networkedness. Measured by degree centrality and eigenvector centrality, the degree of relatedness of location patterns is higher in Europe than in the US (average correlation 0.8204 vs. 0.7043; 0.8452 vs. 0.6838) – and in both cases for both measures higher than that of total inventive activity. Apparently, European patterns of focal nodes are identical across technologies to an even higher degree than the pattern of overall activity.

A similar tendency, however, is also visible in the US. A possible explanation for this is that single high output firms do not show up to the same extent with regard to networking as they do with regard to overall activity. In that the structure of networks reveals a potentially moderating impact on cross-technology differentiation in location patterns – since more knowledge appears to flow through the same nodes across fields than is actually generated in the same sites. Apparently, a number of key regions bind most of the network together, even though the actual activities may be more distributed.

Based on the findings with regard to degree centrality (Table 2), Europe seems to display a high degree of a classic key agglomeration-based network structure. Those regions that are central to networking activity are so across most technological fields. Quite possibly this pattern is created by the persistently high degree of importance of a limited number of national economic centers (often capital cities), through which communication is often channeled. Apparently, this underlying structure is even more relevant with regard to the pattern of degree centrality than it is for the pattern of activity.

In the US, in contrast, the pattern of co-location of central nodes with regard to degree centrality follows that observed for the co-location of total inventive activity, rather than one of co-location in key, multi-technology centers. While some states, by virtue of sheer techno-economic size (such as California, Massachusetts or New York), do indeed appear to play a key, multi-purpose role, some others (such as Texas or Ohio) have far more specialized sectoral profiles.

Remarkably, however, the average degree of co-location of hubs in Europe is a fraction lower with regard to closeness centrality (i.e. network-wide networkedness, Table 3) (average correlation 0.5272 vs. 0.5429). In both cases no clear pattern of co-location is apparent. If at all, co-location seems to occur in the "area of overlap" between F05 and F12, particularly among the field of computers, measurement and control and medical technologies. Apparently, the co-location pattern of regions with particularly high intra-field accessibility is not increased by the European framework conditions in the same way as degree centrality or eigenvector centrality.

The patterns for eigenvector centrality (Table 4), in contrast, mirror those for degree centrality in that they illustrate the difference between the European case with its multi-purpose nodes and the American case with its field-specific nodes in an even more pronounced way. Particularly, they illustrate the co-location of nodes in the high-technology fields in the US. The fact that, in Europe, there is a higher degree of multi-field co-location with regard to eigenvector centrality than there is with regard to degree centrality suggests a dense network among the strong – and in that gives support to the thesis of a network channeled through national centers. In line with that reasoning, the difference between degree centrality and eigenvector centrality is less evident in the US.

While these findings are of course affected by general patterns of disparity, we feel that it is safe to claim that they go further – as the NUTS 1 based Gini coefficient of Europe (0.695) and the state-based one of the United States (0.667) do not differ strongly. In summary, our findings confirm this paper's two main hypotheses as follows:

Hypothesis 1

- centers of activity as well as network hubs of some technological fields display a tendency to co-locate, while those of others will not.

Hypothesis 2

- the pattern of co-location of innovative activity as well as the pattern of co-location of network hubs will differ between the US and the Europe.

IMPLICATIONS FOR RTDI POLICY

In brief, our findings have implicitly confirmed that depending on the technological field, but just as much on differences in socio-economic framework conditions, patterns of knowledge exchange can look very different.

Firstly, our findings thus underline that RTDI policy-makers have to take into account both local activities *and* the inter-regional embeddedness of local actors before they start any relevant policy action. Also it supports the claim that ready-made policies (best practices) cannot be transplanted easily from one place to the other. As this paper has aimed to clarify, differences would have to be specified along three main dimensions: structure and extent of regional activities, structure and extent of regional networkedness, and the regionally relevant socio-economic framework conditions.

Secondly, the results of this study suggest that a more technologically differentiated network of knowledge exchange, such as that in the US, does not appear to constrict the overall opportunities for cross-fertilization between technology fields at the regional level. In contrast, from a mere knowledge-exchange perspective, a fragmentation in different national innovation systems is probably not beneficial as it obstructs the development of specialized patterns and limits the number of possible links in the network. Based on our results, initiatives which aim to better integrate the national innovation systems of Europe and to establish a unified European Research Area should be regarded as useful, as they could help increase the degree of freedom of co-operation between different places where knowledge is generated.

CONCLUSIONS

In short, the central aim of this brief study was to illustrate inter-regional networks of knowledge exchange and to give a first assessment of the factors that possibly shape them. Overall, our empirical findings are in line with the hypotheses that were developed from the conceptual literature.

In the methodological section of this paper we pointed out that an operationalisation for inter-regional networks of knowledge exchange can be developed based on available statistical data.

In the empirical section, we were able to show that patterns of co-location are influenced by *technological characteristics*, since the internal relations of networkedness and activity would deviate by technological fields and centers of activity and nodes of networking in certain technology fields co-locate, whereas those in others would not.

On the other hand, the results suggest that differences with regard to the co-location of activities and central nodes are not just technology-specific, but also contingent on the external institutional framework conditions, i.e. a pattern of general spatial hierarchies according to which interregional knowledge exchange in all technological fields is aligned. In the institutionally and culturally relatively homogeneous system of the US, this relates mostly to size effects, whereas in Europe, where inter-regional knowledge exchange does in many cases imply international knowledge exchange, such hierarchies are far more relevant. The fact that the national innovation systems of the European nation states are still far from fully integrated and that language boundaries and traditional affiliations continue to affect international co-operative networking creates a far more robust pattern which is superimposed on the technological logic of co-location.

Overall, this confirms our key hypothesis of interferences between mutually overlapping technological systems of innovation (that cause co-location of central nodes through a *technology driven logic*), on the one hand, and national systems of innovation (so that co-location of central nodes is caused by a *logic driven by socio-economic institutions, such as national borders*), on the other.

In summary, this study should be regarded as exploratory, and its findings as a starting point for further academic inquiry. Many suggestions made above may merit further validation through more focused approaches. Firstly, a number of reasons were suggested for certain findings in this paper. A more detailed operationalisation of those factors appears desirable. Secondly, we have so far not considered inter-national or inter-field networkedness, which would be of interest. Thirdly, patent statistics are but one possible proxy to operationalise inter-regional knowledge exchange. It would be worthwhile to repeat this exercise for co-publication data.

Table 1: Technology-field Specific Co-location Pattern of Centres of Activity (Total Patent Applications)

EU

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.88	0.80	0.60	0.81	0.96	0.87	0.86	0.84	0.88	0.90	0.81	0.98	0.95	0.96	0.93	0.96	0.92	0.94
F02	0.88		0.81	0.75	0.89	0.85	0.79	0.90	0.69	0.75	0.78	0.66	0.80	0.76	0.78	0.78	0.77	0.74	0.86
F03	0.80	0.81		0.76	0.88	0.82	0.80	0.81	0.63	0.68	0.72	0.72	0.75	0.74	0.73	0.74	0.74	0.69	0.80
F04	0.60	0.75	0.76		0.93	0.62	0.61	0.87	0.45	0.50	0.49	0.54	0.50	0.51	0.48	0.52	0.50	0.46	0.60
F05	0.81	0.89	0.88	0.93		0.83	0.79	0.95	0.65	0.69	0.70	0.72	0.73	0.73	0.71	0.72	0.72	0.68	0.79
F06	0.96	0.85	0.82	0.62	0.83		0.93	0.88	0.82	0.84	0.85	0.86	0.95	0.94	0.95	0.90	0.93	0.86	0.92
F07	0.87	0.79	0.80	0.61	0.79	0.93		0.84	0.82	0.84	0.87	0.90	0.84	0.90	0.88	0.90	0.78	0.85	0.92
F08	0.86	0.90	0.81	0.87	0.95	0.88	0.84		0.73	0.76	0.75	0.78	0.80	0.80	0.79	0.79	0.79	0.74	0.85
F09	0.84	0.69	0.63	0.45	0.65	0.82	0.82	0.73		0.96	0.94	0.89	0.82	0.89	0.82	0.89	0.77	0.89	0.85
F10	0.88	0.75	0.68	0.50	0.69	0.84	0.84	0.76	0.96		0.97	0.86	0.86	0.92	0.85	0.94	0.80	0.94	0.92
F11	0.90	0.78	0.72	0.49	0.70	0.85	0.87	0.75	0.94	0.97		0.84	0.87	0.91	0.87	0.95	0.79	0.96	0.92
F12	0.81	0.66	0.72	0.54	0.72	0.86	0.90	0.78	0.89	0.86	0.84		0.79	0.85	0.78	0.83	0.75	0.81	0.84
F13	0.98	0.80	0.75	0.50	0.73	0.95	0.84	0.80	0.82	0.86	0.87	0.79		0.96	0.97	0.93	0.98	0.92	0.91
F14	0.95	0.76	0.74	0.51	0.73	0.94	0.90	0.80	0.89	0.92	0.91	0.85	0.96		0.97	0.97	0.92	0.95	0.94
F15	0.96	0.78	0.73	0.48	0.71	0.95	0.88	0.79	0.82	0.85	0.87	0.78	0.97	0.97		0.94	0.94	0.92	0.92
F16	0.93	0.78	0.74	0.52	0.72	0.90	0.90	0.79	0.89	0.94	0.95	0.83	0.93	0.97	0.94		0.86	0.96	0.96
F17	0.96	0.77	0.74	0.50	0.72	0.93	0.78	0.79	0.77	0.80	0.79	0.75	0.98	0.92	0.94	0.86		0.85	0.85
F18	0.92	0.74	0.69	0.46	0.68	0.86	0.85	0.74	0.89	0.94	0.96	0.81	0.92	0.95	0.92	0.96	0.85		0.92
F19	0.94	0.86	0.80	0.60	0.79	0.92	0.92	0.85	0.85	0.92	0.92	0.84	0.91	0.94	0.92	0.96	0.85	0.92	

0.7359

US

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.79	0.74	0.81	0.81	0.82	0.80	0.91	0.78	0.71	0.90	0.76	0.66	0.94	0.86	0.78	0.56	0.82	0.89
F02	0.79		0.96	0.92	0.95	0.96	0.89	0.90	0.60	0.44	0.68	0.86	0.33	0.72	0.69	0.68	0.31	0.56	0.70
F03	0.74	0.96		0.91	0.94	0.96	0.89	0.85	0.63	0.44	0.64	0.90	0.30	0.71	0.68	0.70	0.30	0.60	0.71
F04	0.81	0.92	0.91		0.95	0.89	0.83	0.91	0.61	0.41	0.67	0.81	0.32	0.71	0.64	0.61	0.31	0.53	0.72
F05	0.81	0.95	0.94	0.95		0.93	0.86	0.91	0.59	0.43	0.68	0.83	0.34	0.72	0.68	0.66	0.32	0.56	0.73
F06	0.82	0.96	0.96	0.89	0.93		0.94	0.88	0.63	0.49	0.73	0.93	0.41	0.78	0.76	0.72	0.37	0.67	0.75
F07	0.80	0.89	0.89	0.83	0.86	0.94		0.88	0.66	0.57	0.80	0.88	0.42	0.81	0.75	0.72	0.32	0.66	0.80
F08	0.91	0.90	0.85	0.91	0.91	0.88	0.88		0.73	0.57	0.81	0.82	0.43	0.85	0.70	0.71	0.34	0.62	0.82
F09	0.78	0.60	0.63	0.61	0.59	0.63	0.66	0.73		0.89	0.86	0.71	0.57	0.86	0.78	0.79	0.42	0.66	0.82
F10	0.71	0.44	0.44	0.41	0.43	0.49	0.57	0.57	0.89		0.90	0.49	0.75	0.82	0.83	0.81	0.54	0.70	0.82
F11	0.90	0.68	0.64	0.67	0.68	0.73	0.80	0.81	0.86	0.90		0.70	0.76	0.92	0.92	0.79	0.57	0.78	0.92
F12	0.76	0.86	0.90	0.81	0.83	0.93	0.88	0.82	0.71	0.49	0.70		0.38	0.77	0.73	0.65	0.34	0.65	0.71
F13	0.66	0.33	0.30	0.32	0.34	0.41	0.42	0.43	0.57	0.75	0.76	0.38		0.69	0.82	0.55	0.81	0.73	0.68
F14	0.94	0.72	0.71	0.71	0.72	0.78	0.81	0.85	0.86	0.82	0.92	0.77	0.69		0.86	0.89	0.55	0.85	0.92
F15	0.86	0.69	0.68	0.64	0.68	0.76	0.75	0.70	0.78	0.83	0.92	0.73	0.82	0.86		0.79	0.67	0.88	0.88
F16	0.78	0.68	0.70	0.61	0.66	0.72	0.72	0.71	0.79	0.81	0.79	0.65	0.55	0.89	0.79		0.43	0.78	0.83
F17	0.56	0.31	0.30	0.31	0.32	0.37	0.32	0.34	0.42	0.54	0.57	0.34	0.81	0.55	0.67	0.43		0.67	0.47
F18	0.82	0.56	0.60	0.53	0.56	0.67	0.66	0.62	0.66	0.70	0.78	0.65	0.73	0.85	0.88	0.78	0.67		0.83
F19	0.89	0.70	0.71	0.72	0.73	0.75	0.80	0.82	0.82	0.82	0.92	0.71	0.68	0.92	0.88	0.83	0.47	0.83	

0.6408

Table 2: Technology-field Specific Co-location Pattern of Network Nodes (regarding Degree Centrality)

EU

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.94	0.90	0.92	0.94	0.98	0.92	0.93	0.89	0.90	0.94	0.89	0.99	0.97	0.97	0.96	0.98	0.96	0.95
F02	0.94		0.89	0.89	0.91	0.92	0.85	0.88	0.78	0.80	0.86	0.78	0.92	0.88	0.90	0.87	0.90	0.87	0.89
F03	0.90	0.89		0.94	0.95	0.89	0.85	0.85	0.76	0.79	0.84	0.80	0.87	0.86	0.85	0.85	0.86	0.86	0.88
F04	0.92	0.89	0.94		0.97	0.93	0.89	0.93	0.79	0.80	0.85	0.85	0.90	0.89	0.89	0.88	0.89	0.89	0.91
F05	0.94	0.91	0.95	0.97		0.96	0.94	0.94	0.85	0.86	0.88	0.90	0.92	0.92	0.91	0.91	0.91	0.91	0.94
F06	0.98	0.92	0.89	0.93	0.96		0.94	0.96	0.88	0.89	0.90	0.93	0.97	0.95	0.97	0.95	0.96	0.93	0.96
F07	0.92	0.85	0.85	0.89	0.94	0.94		0.92	0.91	0.91	0.91	0.96	0.89	0.93	0.89	0.91	0.87	0.90	0.95
F08	0.93	0.88	0.85	0.93	0.94	0.96	0.92		0.88	0.88	0.88	0.91	0.92	0.93	0.92	0.92	0.92	0.88	0.94
F09	0.89	0.78	0.76	0.79	0.85	0.88	0.91	0.88		0.98	0.95	0.94	0.88	0.96	0.88	0.94	0.85	0.91	0.92
F10	0.90	0.80	0.79	0.80	0.86	0.89	0.91	0.88	0.98		0.96	0.92	0.90	0.96	0.90	0.96	0.87	0.93	0.93
F11	0.94	0.86	0.84	0.85	0.88	0.90	0.91	0.88	0.95	0.96		0.90	0.92	0.97	0.93	0.96	0.89	0.97	0.93
F12	0.89	0.78	0.80	0.85	0.90	0.93	0.96	0.91	0.94	0.92	0.90		0.86	0.94	0.88	0.92	0.83	0.89	0.95
F13	0.99	0.92	0.87	0.90	0.92	0.97	0.89	0.92	0.88	0.90	0.92	0.86		0.97	0.97	0.96	0.99	0.96	0.94
F14	0.97	0.88	0.86	0.89	0.92	0.95	0.93	0.93	0.96	0.96	0.97	0.94	0.97		0.96	0.98	0.94	0.97	0.96
F15	0.97	0.90	0.85	0.89	0.91	0.97	0.89	0.92	0.88	0.90	0.93	0.88	0.97	0.96		0.97	0.96	0.96	0.94
F16	0.96	0.87	0.85	0.88	0.91	0.95	0.91	0.92	0.94	0.96	0.96	0.92	0.96	0.98	0.97		0.94	0.97	0.96
F17	0.98	0.90	0.86	0.89	0.91	0.96	0.87	0.92	0.85	0.87	0.89	0.83	0.99	0.94	0.96	0.94		0.94	0.91
F18	0.96	0.87	0.86	0.89	0.91	0.93	0.90	0.88	0.91	0.93	0.97	0.89	0.96	0.97	0.96	0.97	0.94		0.94
F19	0.95	0.89	0.88	0.91	0.94	0.96	0.95	0.94	0.92	0.93	0.93	0.95	0.94	0.96	0.94	0.96	0.91	0.94	

0.8204

US

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.81	0.82	0.79	0.83	0.88	0.87	0.90	0.81	0.77	0.92	0.88	0.79	0.89	0.93	0.88	0.82	0.86	0.90
F02	0.81		0.95	0.93	0.95	0.91	0.87	0.91	0.70	0.54	0.72	0.84	0.53	0.71	0.66	0.76	0.56	0.61	0.72
F03	0.82	0.95		0.96	0.97	0.94	0.91	0.93	0.78	0.59	0.71	0.90	0.48	0.77	0.67	0.82	0.55	0.67	0.78
F04	0.79	0.93	0.96		0.97	0.92	0.89	0.88	0.68	0.46	0.65	0.87	0.45	0.68	0.60	0.73	0.50	0.60	0.72
F05	0.83	0.95	0.97	0.97		0.94	0.89	0.91	0.70	0.53	0.71	0.86	0.51	0.73	0.67	0.79	0.57	0.67	0.76
F06	0.88	0.91	0.94	0.92	0.94		0.94	0.90	0.77	0.61	0.77	0.95	0.57	0.81	0.75	0.85	0.62	0.76	0.83
F07	0.87	0.87	0.91	0.89	0.89	0.94		0.91	0.77	0.65	0.80	0.92	0.57	0.84	0.75	0.86	0.61	0.78	0.89
F08	0.90	0.91	0.93	0.88	0.91	0.90	0.91		0.80	0.68	0.84	0.88	0.63	0.82	0.77	0.86	0.63	0.72	0.84
F09	0.81	0.70	0.78	0.68	0.70	0.77	0.77	0.80		0.90	0.86	0.84	0.61	0.92	0.80	0.89	0.66	0.69	0.83
F10	0.77	0.54	0.59	0.46	0.53	0.61	0.65	0.68	0.90		0.90	0.66	0.72	0.89	0.82	0.87	0.79	0.77	0.82
F11	0.92	0.72	0.71	0.65	0.71	0.77	0.80	0.84	0.86	0.90		0.78	0.86	0.91	0.93	0.90	0.84	0.82	0.91
F12	0.88	0.84	0.90	0.87	0.86	0.95	0.92	0.88	0.84	0.66	0.78		0.53	0.81	0.77	0.83	0.58	0.71	0.83
F13	0.79	0.53	0.48	0.45	0.51	0.57	0.57	0.63	0.61	0.72	0.86	0.53		0.73	0.83	0.69	0.89	0.70	0.71
F14	0.89	0.71	0.77	0.68	0.73	0.81	0.84	0.82	0.92	0.89	0.91	0.81	0.73		0.85	0.95	0.76	0.86	0.92
F15	0.93	0.66	0.67	0.60	0.67	0.75	0.75	0.77	0.80	0.82	0.93	0.77	0.83	0.85		0.85	0.82	0.85	0.86
F16	0.88	0.76	0.82	0.73	0.79	0.85	0.86	0.86	0.89	0.87	0.90	0.83	0.69	0.95	0.85		0.71	0.85	0.94
F17	0.82	0.56	0.55	0.50	0.57	0.62	0.61	0.63	0.66	0.79	0.84	0.58	0.89	0.76	0.82	0.71		0.78	0.72
F18	0.86	0.61	0.67	0.60	0.67	0.76	0.78	0.72	0.69	0.77	0.82	0.71	0.70	0.86	0.85	0.85	0.78		0.90
F19	0.90	0.72	0.78	0.72	0.76	0.83	0.89	0.84	0.83	0.82	0.91	0.83	0.71	0.92	0.86	0.94	0.72	0.90	

0.7043

Table 3: Technology-field Specific Co-location Pattern of Network Nodes (regarding Closeness Centrality)

EU

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.66	0.64	0.46	0.48	0.65	0.54	0.61	0.66	0.73	0.63	0.68	0.52	0.58	0.61	0.76	0.72	0.61	0.68
F02	0.66		0.56	0.64	0.63	0.64	0.60	0.77	0.63	0.70	0.63	0.49	0.57	0.51	0.61	0.59	0.56	0.74	0.46
F03	0.64	0.56		0.50	0.76	0.76	0.65	0.61	0.59	0.85	0.84	0.50	0.56	0.62	0.53	0.56	0.34	0.58	0.59
F04	0.46	0.64	0.50		0.56	0.50	0.59	0.69	0.51	0.55	0.56	0.40	0.54	0.53	0.65	0.46	0.43	0.55	0.51
F05	0.48	0.63	0.76	0.56		0.68	0.57	0.61	0.59	0.70	0.75	0.50	0.50	0.54	0.47	0.40	0.25	0.58	0.49
F06	0.65	0.64	0.76	0.50	0.68		0.57	0.75	0.70	0.78	0.68	0.61	0.44	0.55	0.53	0.65	0.35	0.61	0.50
F07	0.54	0.60	0.65	0.59	0.57	0.57		0.52	0.48	0.67	0.65	0.37	0.59	0.58	0.57	0.54	0.48	0.57	0.56
F08	0.61	0.77	0.61	0.69	0.61	0.75	0.52		0.58	0.66	0.59	0.55	0.47	0.41	0.65	0.56	0.43	0.71	0.44
F09	0.66	0.63	0.59	0.51	0.59	0.70	0.48	0.58		0.73	0.79	0.75	0.49	0.65	0.50	0.76	0.40	0.61	0.53
F10	0.73	0.70	0.85	0.55	0.70	0.78	0.67	0.66	0.73		0.84	0.68	0.62	0.63	0.58	0.66	0.46	0.71	0.56
F11	0.63	0.63	0.84	0.56	0.75	0.68	0.65	0.59	0.79	0.84		0.61	0.62	0.77	0.53	0.63	0.41	0.67	0.70
F12	0.68	0.49	0.50	0.40	0.50	0.61	0.37	0.55	0.75	0.68	0.61		0.43	0.46	0.48	0.68	0.26	0.54	0.36
F13	0.52	0.57	0.56	0.54	0.50	0.44	0.59	0.47	0.49	0.62	0.62	0.43		0.68	0.75	0.66	0.56	0.67	0.57
F14	0.58	0.51	0.62	0.53	0.54	0.55	0.58	0.41	0.65	0.63	0.77	0.46	0.68		0.58	0.66	0.54	0.61	0.64
F15	0.61	0.61	0.53	0.65	0.47	0.53	0.57	0.65	0.50	0.58	0.53	0.48	0.75	0.58		0.62	0.60	0.58	0.50
F16	0.76	0.59	0.56	0.46	0.40	0.65	0.54	0.56	0.76	0.66	0.63	0.68	0.66	0.66	0.62		0.64	0.61	0.58
F17	0.72	0.56	0.34	0.43	0.25	0.35	0.48	0.43	0.40	0.46	0.41	0.26	0.56	0.54	0.60	0.64		0.53	0.59
F18	0.61	0.74	0.58	0.55	0.58	0.61	0.57	0.71	0.61	0.71	0.67	0.54	0.67	0.61	0.58	0.61	0.53		0.45
F19	0.68	0.46	0.59	0.51	0.49	0.50	0.56	0.44	0.53	0.56	0.70	0.36	0.57	0.64	0.50	0.58	0.59	0.45	

0.5272

US

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.75	0.59	0.36	0.55	0.54	0.56	0.67	0.59	0.55	0.78	0.56	0.36	0.40	0.21	0.52	0.83	0.20	0.55
F02	0.75		0.77	0.54	0.69	0.67	0.65	0.80	0.67	0.62	0.95	0.67	0.45	0.49	0.30	0.66	0.94	0.28	0.64
F03	0.59	0.77		0.58	0.58	0.54	0.55	0.60	0.55	0.50	0.76	0.57	0.34	0.38	0.14	0.54	0.74	0.15	0.56
F04	0.36	0.54	0.58		0.54	0.47	0.49	0.60	0.43	0.43	0.51	0.34	0.50	0.23	0.26	0.40	0.46	0.25	0.45
F05	0.55	0.69	0.58	0.54		0.92	0.90	0.61	0.85	0.82	0.66	0.87	0.65	0.61	0.47	0.86	0.67	0.42	0.88
F06	0.54	0.67	0.54	0.47	0.92		0.91	0.52	0.87	0.86	0.66	0.91	0.73	0.64	0.54	0.89	0.67	0.53	0.89
F07	0.56	0.65	0.55	0.49	0.90	0.91		0.54	0.84	0.86	0.64	0.88	0.65	0.66	0.48	0.87	0.65	0.48	0.90
F08	0.67	0.80	0.60	0.60	0.61	0.52	0.54		0.48	0.48	0.76	0.54	0.35	0.35	0.20	0.49	0.76	0.20	0.50
F09	0.59	0.67	0.55	0.43	0.85	0.87	0.84	0.48		0.95	0.72	0.87	0.67	0.67	0.50	0.89	0.71	0.47	0.90
F10	0.55	0.62	0.50	0.43	0.82	0.86	0.86	0.48	0.95		0.68	0.89	0.69	0.69	0.55	0.90	0.68	0.57	0.91
F11	0.78	0.95	0.76	0.51	0.66	0.66	0.64	0.76	0.72	0.68		0.67	0.51	0.52	0.31	0.69	0.97	0.37	0.64
F12	0.56	0.67	0.57	0.34	0.87	0.91	0.88	0.54	0.87	0.89	0.67		0.64	0.61	0.48	0.88	0.67	0.48	0.90
F13	0.36	0.45	0.34	0.50	0.65	0.73	0.65	0.35	0.67	0.69	0.51	0.64		0.42	0.69	0.65	0.50	0.66	0.64
F14	0.40	0.49	0.38	0.23	0.61	0.64	0.66	0.35	0.67	0.69	0.52	0.61	0.42		0.26	0.68	0.56	0.66	0.65
F15	0.21	0.30	0.14	0.26	0.47	0.54	0.48	0.20	0.50	0.55	0.31	0.48	0.69	0.26		0.48	0.29	0.42	0.56
F16	0.52	0.66	0.54	0.40	0.86	0.89	0.87	0.49	0.89	0.90	0.69	0.88	0.65	0.68	0.48		0.70	0.54	0.89
F17	0.83	0.94	0.74	0.46	0.67	0.67	0.65	0.76	0.71	0.68	0.97	0.67	0.50	0.56	0.29	0.70		0.34	0.66
F18	0.20	0.28	0.15	0.25	0.42	0.53	0.48	0.20	0.47	0.57	0.37	0.48	0.66	0.66	0.42	0.54	0.34		0.44
F19	0.55	0.64	0.56	0.45	0.88	0.89	0.90	0.50	0.90	0.91	0.64	0.90	0.64	0.65	0.56	0.89	0.66	0.44	

0.5429

Table 4: Technology-field Specific Co-location Pattern of Network Nodes (regarding Eigenvector Centrality)

EU

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.93	0.93	0.96	0.98	0.99	0.96	0.94	0.93	0.94	0.97	0.90	0.99	0.98	0.98	0.97	0.98	0.98	0.98
F02	0.93		0.89	0.89	0.92	0.92	0.87	0.88	0.82	0.83	0.90	0.78	0.92	0.90	0.92	0.89	0.91	0.88	0.90
F03	0.93	0.89		0.92	0.96	0.93	0.90	0.87	0.85	0.87	0.91	0.83	0.93	0.92	0.91	0.90	0.93	0.91	0.92
F04	0.96	0.89	0.92		0.97	0.96	0.94	0.94	0.87	0.88	0.93	0.88	0.95	0.93	0.95	0.93	0.95	0.96	0.95
F05	0.98	0.92	0.96	0.97		0.98	0.97	0.95	0.92	0.93	0.97	0.91	0.97	0.96	0.97	0.96	0.97	0.97	0.98
F06	0.99	0.92	0.93	0.96	0.98		0.98	0.97	0.92	0.93	0.96	0.93	0.98	0.97	0.98	0.96	0.97	0.96	0.99
F07	0.96	0.87	0.90	0.94	0.97	0.98		0.96	0.94	0.93	0.95	0.97	0.95	0.96	0.95	0.95	0.93	0.95	0.98
F08	0.94	0.88	0.87	0.94	0.95	0.97	0.96		0.91	0.91	0.92	0.92	0.94	0.93	0.95	0.92	0.93	0.92	0.95
F09	0.93	0.82	0.85	0.87	0.92	0.92	0.94	0.91		0.99	0.97	0.93	0.92	0.97	0.91	0.95	0.90	0.94	0.94
F10	0.94	0.83	0.87	0.88	0.93	0.93	0.93	0.91	0.99		0.98	0.92	0.93	0.97	0.93	0.97	0.92	0.95	0.95
F11	0.97	0.90	0.91	0.93	0.97	0.96	0.95	0.92	0.97	0.98		0.90	0.96	0.98	0.96	0.98	0.94	0.98	0.96
F12	0.90	0.78	0.83	0.88	0.91	0.93	0.97	0.92	0.93	0.92	0.90		0.89	0.92	0.90	0.91	0.86	0.90	0.95
F13	0.99	0.92	0.93	0.95	0.97	0.98	0.95	0.94	0.92	0.93	0.96	0.89		0.98	0.97	0.97	0.99	0.98	0.97
F14	0.98	0.90	0.92	0.93	0.96	0.97	0.96	0.93	0.97	0.97	0.98	0.92	0.98		0.96	0.98	0.96	0.98	0.98
F15	0.98	0.92	0.91	0.95	0.97	0.98	0.95	0.95	0.91	0.93	0.96	0.90	0.97	0.96		0.97	0.96	0.97	0.97
F16	0.97	0.89	0.90	0.93	0.96	0.96	0.95	0.92	0.95	0.97	0.98	0.91	0.97	0.98	0.97		0.96	0.98	0.97
F17	0.98	0.91	0.93	0.95	0.97	0.97	0.93	0.93	0.90	0.92	0.94	0.86	0.99	0.96	0.96	0.96		0.97	0.96
F18	0.98	0.88	0.91	0.96	0.97	0.96	0.95	0.92	0.94	0.95	0.98	0.90	0.98	0.98	0.97	0.98	0.97		0.97
F19	0.98	0.90	0.92	0.95	0.98	0.99	S0.98	0.95	0.94	0.95	0.96	0.95	0.97	0.98	0.97	0.97	0.96	0.97	

0.8452

US

	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19
F01		0.78	0.81	0.80	0.79	0.89	0.87	0.90	0.79	0.74	0.92	0.88	0.72	0.89	0.93	0.89	0.78	0.80	0.88
F02	0.78		0.91	0.87	0.92	0.83	0.80	0.91	0.68	0.54	0.72	0.76	0.48	0.69	0.66	0.76	0.49	0.54	0.67
F03	0.81	0.91		0.94	0.94	0.90	0.90	0.94	0.78	0.62	0.72	0.87	0.42	0.79	0.70	0.85	0.48	0.64	0.77
F04	0.80	0.87	0.94		0.95	0.87	0.86	0.90	0.68	0.49	0.67	0.84	0.41	0.71	0.64	0.77	0.44	0.56	0.72
F05	0.79	0.92	0.94	0.95		0.87	0.84	0.90	0.66	0.50	0.67	0.79	0.41	0.68	0.66	0.77	0.47	0.60	0.70
F06	0.89	0.83	0.90	0.87	0.87		0.93	0.89	0.75	0.60	0.76	0.94	0.50	0.82	0.77	0.87	0.56	0.73	0.81
F07	0.87	0.80	0.90	0.86	0.84	0.93		0.91	0.75	0.65	0.80	0.90	0.51	0.86	0.79	0.88	0.58	0.75	0.88
F08	0.90	0.91	0.94	0.90	0.90	0.89	0.91		0.78	0.65	0.84	0.88	0.56	0.81	0.80	0.87	0.57	0.67	0.82
F09	0.79	0.68	0.78	0.68	0.66	0.75	0.75	0.78		0.88	0.81	0.83	0.51	0.90	0.78	0.89	0.59	0.63	0.80
F10	0.74	0.54	0.62	0.49	0.50	0.60	0.65	0.65	0.88		0.84	0.65	0.63	0.87	0.80	0.83	0.78	0.74	0.81
F11	0.92	0.72	0.72	0.67	0.67	0.76	0.80	0.84	0.81	0.84		0.77	0.85	0.89	0.92	0.88	0.86	0.76	0.88
F12	0.88	0.76	0.87	0.84	0.79	0.94	0.90	0.88	0.83	0.65	0.77		0.46	0.83	0.79	0.85	0.52	0.65	0.82
F13	0.72	0.48	0.42	0.41	0.41	0.50	0.51	0.56	0.51	0.63	0.85	0.46		0.65	0.74	0.62	0.88	0.60	0.64
F14	0.89	0.69	0.79	0.71	0.68	0.82	0.86	0.81	0.90	0.87	0.89	0.83	0.65		0.85	0.95	0.74	0.84	0.92
F15	0.93	0.66	0.70	0.64	0.66	0.77	0.79	0.80	0.78	0.80	0.92	0.79	0.74	0.85		0.86	0.79	0.81	0.86
F16	0.89	0.76	0.85	0.77	0.77	0.87	0.88	0.87	0.89	0.83	0.88	0.85	0.62	0.95	0.86		0.67	0.82	0.94
F17	0.78	0.49	0.48	0.44	0.47	0.56	0.58	0.57	0.59	0.78	0.86	0.52	0.88	0.74	0.79	0.67		0.75	0.71
F18	0.80	0.54	0.64	0.56	0.60	0.73	0.75	0.67	0.63	0.74	0.76	0.65	0.60	0.84	0.81	0.82	0.75		0.88
F19	0.88	0.67	0.77	0.72	0.70	0.81	0.88	0.82	0.80	0.81	0.88	0.82	0.64	0.92	0.86	0.94	0.71	0.88	

0.6838

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