International patents: the role of large multinational firms in building competitive metropolitan areas

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RISIS

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INTERNATIONAL PATENTS: THE ROLE OF LARGE MULTINATIONAL FIRMS IN BUILDING COMPETITIVE METROPOLITAN AREAS

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Large multinational firms (LMF) play a crucial role in the dynamics of knowledge production worldwide.

The study conducted by **LISIS, Université Eiffel,** using inventive activities as a central marker, highlights in particular four major results:

(i) Large groups represent **80% of worldwide international inventive activities** and, contrary to many expectations, this role has increased over the last decade.

(ii) Though LMF are present in 60% of inventive metropolitan areas, the top **100 metropolitan areas worldwide concentrate 80%** of LMF international patents.

(iii) Large metropolitan areas **gather 90% of international patents in Asia, 70% in the US, but only 37% in Europe**. Europe has thus a very different structure where inventive activities are more distributed with a central role of medium-size metropolitan areas.

(iv) 'National' LMF play a majority role in the overall production of metropolitan areas: **over 90% in Asia,** and **75% in the US.** In **Europe,** this share is only **57%.** This highlights the role of LMF from other European countries (23%) and from outside of Europe (20%).

These four results question research and innovation policies and call for an open debate about their policy-mix and their role in distributive and inclusion objectives.

The study has been conducted, using in an integrated way the three major resources developed within **RISIS: CIB dataset** on large firms, **RISIS patent database** on patents, and **CORTEXT geolocation** on metropolitan areas.

1. LARGE MULTINATIONAL FIRMS PRODUCE 80% OF INTERNATIONAL PATENTS

Patents are an important **marker of technological creation,** but also of prospective markets and of internationalisation (through the geographic coverage of IP protection looked for by actors). They enable to look for simultaneously at **actor location** (the headquarter location of applicants) and at the location of the **inventive activity** (through the addresses of inventors).

The RISIS Patent Database (RPD)[1] is based on PATSTAT which gathers all the **databases from national patent offices.** RPD focuses on priority patents (i.e. the first patent taken in one country[2] (13.3M patents since 2000 and 5,1M for our reference period 2010-2014). International agreements have organised processes for extending the protection in other countries. Many authors consider this extension as an important marker of the potential market value of the patent[3]. To focus on this dimension, **OECD** (Dernis et al., 2015) has proposed a **new approach selecting patents** that have been taken in two of the 5 largest patent offices (USA, Japan, Europe, China, or South Korea). For the analyses, the researchers adopted this approach: they call the "2IP5 patent families", international patents. They represent 16.5% of the total patents for 2010-14.

The second characteristic of patents lies in **unique organisational and geographical characteristics.** Patents distinguish between the owner (the 'applicant') and the inventors (the individuals that created the invention). Inventors help us to know (thanks to their addresses) the **location of inventive activities.** This is what the researchers used to analyse **where large firms develop their activities.** Owners help **to link patents to organisations** enabling them to distinguish between large multinational firms and other actors and measure their importance.

To identify LMF the researchers have constructed **a specific dataset (CIB)** that identifies at group level their knowledge activities[4]. Three problems had to be addressed[5]. (i) The selection of the groups is based on the European Industrial R&D Investment Scoreboard[6] complemented by the list of top patent application firms listed by WIPO[7]. This gave us **3993 groups** and we mobilised the ORBIS database for finding the industrial 'group ultimate owner'. (ii) Groups may produce knowledge in multiple firms: the researchers thus identified all the subsidiaries they control (nearly 300000 companies). (iii) To measure their role in patenting, researchers had to match CIB and RPD. This required the development of a completely new tool (the PAM service)[8].

These firms are spread nearly equally between **3 continents** (see Figure 1) representing over 95% of LMF: **North America (28%), Asia (30%) and Europe (39%).**

Figure 1. The country headquarters of large multinational firms composing the CIB Database

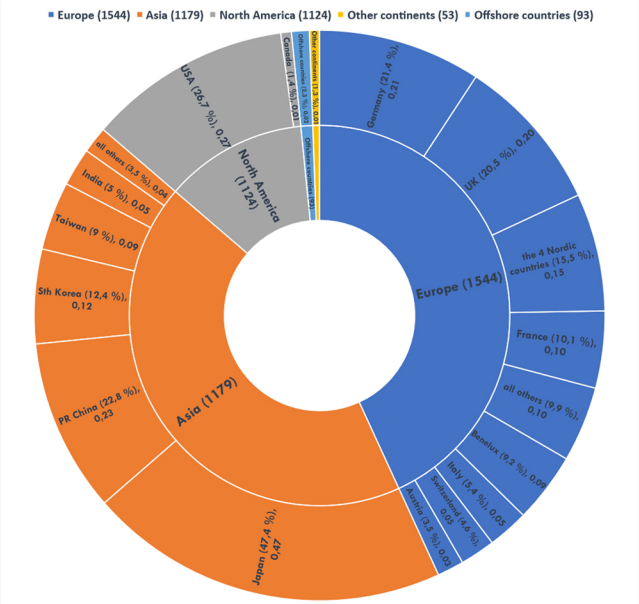


Table 1 underlines the overwhelming share of LMF in the total production of international patents (78% in 2010-14), and far from decreasing, this share has even slightly increased over the decade.

This is the result of 3 different continental trajectories. This share has strongly increased in North America (from 68 to 77%) and **this translates the rapid growth of LMF in the North American output** (as if the strong movement observed of start-up patenting remains limited to the country and does not deploy at the world level or only when start-ups are bought by LMF).

Europe, like North America, has also witnessed an increase of the role of LMF (+2,5 percentage points) but its growth in LMF patenting has been far **slower (22% compared to 39% worldwide).**

Finally Asia gathers 70% of the total increase in LMF international patenting between the two periods. Still the share of LMF in Asian international patenting has slightly decreased but remains well over 80%.

Table 1. The share of LMF in international patent

LMF/ total RPD	Asia	Europe	NA	total
2010-14	83,20%	70,00%	76,60%	77,90%
2000-04	84,70%	67,50%	67,70%	74,70%
growth rate (LMF IP)	49,90%	21,90%	30,60%	38,80%
share of the increase (LMF IP)	70,00%	13,20%	16,70%	

It seems thus difficult **to devise knowledge policies ignoring the crucial role of these few large multinational firms.** But before discussing this more in detail, it is necessary to know more on where they produce this knowledge. This builds the three next points.

2. 100 METROPOLITAN AREAS CONCENTRATE 80% OF INTERNATIONAL PATENTS

To determine the location of LMF international patents, researchers used their unique geographical characteristics: **the addresses of inventors,** the individuals that developed the invention. Thanks to the new **RISIS CORTEXT geospatial tool,** these addresses are geocoded (**24 million addresses**) and then associated with **multiple geographical levels:** classically countries and their institutional regions, but more importantly 'metropolitan areas'. OECD has devised an approach for delineating 'functional urban areas' (Brezzi M., 2012). However, its coverage is limited, **CORTEXT has thus devised a method for a full worldwide coverage**[9].

The study focuses on the **3100 metropolitan areas** (MA) of the **3 continents** considered and their presence in inventive activities.

What OECD calls 'Large metropolitan areas' (LMA) is a rare entity (183 for the 3 continents). With on average 5 million inhabitants each, they gather more than half the population of all metropolitan areas. 90% have inventive activities, and this is significant[10] for 70% of them. These **large metropolitan areas gather 70% of total international patents and of patents from large multinational firms.**
At the other extreme 60% of metropolitan areas are small (representing 11% of total urban population). Less than half gather inventive activities, and this is significant for only a quarter of them, but these some 200 inventive Small Metropolitan Areas (SMA) only produce 5% of international patents.
37% of metropolitan areas are midsize. They gather 34% of the population. 70% of them have inventive activities and this is significant for one third. These 350 midsize metropolitan areas (MMA) produce 25% of total international patents and of patents by Large Multinational Firms.

Table 2. Key features of "3 continents" metropolitan areas

3 continents MA	Number of MA	Distribution of population	Distribution of RPD patents10_14	Distribution of LMF patents 10_14
LMA	183	54,20%	69,00%	71,00%
MMA	1152	34,20%	25,70%	24,40%
SMA	1780	11,60%	5,30%	4,60%
Total	3115	100,00%	100,00%	100,00%

It's important to consider two aspects: the concentration on a limited number of metropolitan areas, and the very different productive structures between continents.
The concentration is striking: out of some 1820 inventing metropolitan areas from the 3 continents, large multinational firms are present in nearly 60% of them, but the top 100 metropolitan areas represent 82,7% of their international patents. This is 98% for the top 500 metropolitan areas.

These top 100 metropolitan areas are split between large and midsize metropolitan areas in number, but large metropolitan areas represent over 80% of international patents by LMF, even though their inventive activity (the number of patents per thousand inhabitants) is twice lower.

Table 3. Characteristics of Top 100 Metropolitan Areas (2010-2014)

Type MA 3_continents	N. MA	Distribution N. LMF patents	Av. inventive intensity
LMA	50	82,50%	0,93
MMA	49	17,20%	1,79
SMA	1	ns	ns
Total	100	100,00%	1,02

To sum-up in one sentence, large multinational firms produce 80% of total international patents and 80% of this production is **concentrated in 100 Top metropolitan areas worldwide.**
This global view hides very strong differences between continents, and thus, especially for **Europe,** this result needs to be nuanced for discussing policy implications.

3. THE VERY SPECIFIC SITUATION OF EUROPE REGARDING LMF PATENTING

A central reason lies in the fact that the role of Large metropolitan areas differs widely between continents. Their share in LMF international patents represents **86% for Asia** and **66% for North America** (it was only 60% 10 years earlier).

Only does **Europe witness a very different structure:** Large metropolitan areas gather only 37% of European inventive activities of large multinational firms, **the central role being taken by the large set of midsize metropolitan areas (52%, stable over the decade).**

This is further reinforced when considering the growth over the decade: LMA concentrate 60% of total growth in Asia and the US while this role is taken by midsize metropolitan areas in Europe.

Table 4. International patents of large multinational firms per type of metropolitan area (2010-2014)

LMF 10_14	Asia	Europe	North America	Total
LMA	86,30%	37,30%	65,20%	71,00%
MMA	13,40%	52,10%	25,30%	24,40%
SMA	0,30%	10,50%	9,50%	4,60%
Total	100,00%	100,00%	100,00%	100,00%

Again, the distribution is skewed. The top 100 metropolitan areas represent 82,7% of LMF international patents. They are split evenly between continents, but the size and patenting activity of top Asian metropolitan areas is such that the **30 metropolitan areas from Asia represent 60% of the production of the top 100 metropolitan areas worldwide.**

To get a better idea of the structural differences between continents, the researchers looked at the number of metropolitan areas that represent a similar share (i.e. exactly 82,7%) of the total LMF international patents of their own continent.

It takes only **9 metropolitan areas in Asia against 50 in North America (mostly the US) and 105 in Europe.**

Comparing with North America highlights **three aspects** of European specificity:

- The patenting activity of LMF in Europe per metropolitan area is **less than half of this of counterparts in North America** (830 against 1900 international patents on average).
- This is mostly borne by **European Large metropolitan areas:** compared to their North American equivalents, not only do **they concentrate far less output but this is also due to a far lower patenting intensity (0,36** international patent per thousand inhabitants against **0,60**).

- This explains the central role of **midsize metropolitan areas in Europe** that gather half the patents produced in Europe (against less than 20% in North America). These Midsize Areas have a patenting activity and a patenting intensity that are quite similar to those of their North American counterparts. It is their sheer number (68) reflecting the **European urban structure that explains their major role.**

- Table 5b shows the **very distributed nature of these top European metropolitan** areas over the whole of Europe, even if it also highlights the far lower attractivity of Eastern European metropolitan areas for R&D activities of the large multinational firms.

Table 5a, 5b. Top metropolitan areas per continent

*Notes: it gathers in each continent the top metropolitan areas to arrive at a similar share as the world share of the Top metropolitan areas worldwide (82,7%, see point 2). *average number of LFM patent per 1000 inhabitants.*

Type MA	Nbre MA	Distribution Nber LMF patents	Av. number of patents	Av. inventive intensity
Europe				
LMA	24	44,40%	1625	0,36
MMA	68	50,80%	656	0,91
SMA	13	4,80%	327	1,57
Total	105	100,00%	837	0,55
North America				
LMA	25	78,10%	2999	0,6
MMA	22	19,30%	844	1,09
SMA	3	2,60%	825	ns
Total	50	100,00%	1920	0,67

Type MA Europe Number	DE	FR	GB+IE	Benelux	Nordic Europe	Central Europe	Southern Europe	Eastern Europe	Europe
LMA	7	3	2	2	2	1	5	2	24
MMA	29	12	6	8	7	6	0	0	68
SMA	5	0	1	2	3	1	1		13
Total	41	15	9	12	12	8	6	2	105

What holds at the global level (the double concentration on Top 100 firms and metropolitan areas) does not hold for Europe. The activity of large multinational firms is far more widely **spread, driving to spread far more potential 'attractiveness' policies.**

4. THE ROLE OF NON-NATIONAL LMF IN THE DYNAMICS OF METROPOLITAN AREAS

A last issue for discussing policy implications lies in the origin of firms. The researchers classified international patents of firms depending upon the country of their headquarters: same country as the metropolitan area (national patents), another country from the same continent (intra-continental patents) and another country for other continents (inter-continental patents).

Globally Metropolitan Areas are constituted of 79% of national patents, 14% of intercontinental ones and 7% on intra-continental ones. But these global features hide **strong continental differences.**

Asia depends mostly on **national patents** (91%) and this is true for both LMA and MMA, even if over the last 10 years this share has reduced, thanks to a very strong rise of intra-continental patents (multiplied by 5, 3.2%) and a 50% growth of inter-continental patents (5,6% in 2010-14).

71% of LMF patents taken in **North America** have a **national origin** (and this has been reinforced between the 2 periods: + 2 points), reducing the share of inter-continental patents (27,2% in 2010-14).

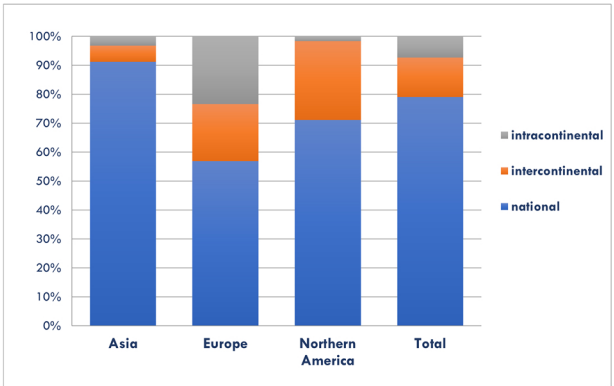
But the striking figures relate to **European metropolitan Areas:**

- First, they have a very different composition: if national patents are still the majority (57%), **nearly half the patents are borne by firms from other European countries** (23%) **or from other continents** (20%).

- Second, this movement **has deepened between the 2 periods,** the national share having reduced by 6% while the intracontinental one increased by 3% and the intercontinental one by 17%.

- Third, this is true for the 3 types of Metropolitan Areas with an unexpected inverted curve: **Small Metropolitan Areas** depend more than **Large Metropolitan Areas** on **intracontinental patents** (25% against 22%) and on intercontinental ones (23% against 19%). European **Midsize Metropolitan Areas** stand in-between.

Figure 2. Origin of large multinational firms in the production of Metropolitan Areas



5. POLICY IMPLICATIONS

These results suggest that it would be useful to open a **debate** on the framing of **research and innovation policies**, specifically around three central questions.

First, these policies have been focused over the last decade on **small and start-up firms** and have largely overseen the role of large firms. This raises strong questions when observing that these few large multinational firms represent **80% of inventive activities.** We should ask whether these firms are 'anchor tenants' that play an important role in supporting the **overall dynamics of territories** and whether policies should go beyond **generic instruments** (such as research tax credits that apply to all national subsidiaries).

Secondly, these firms are located in a limited number of territories. In **Europe,** where the activity is far more distributed than in the other continents, **the top 100 metropolitan areas** represent also **80% of total LMF inventive activities.** There is thus clearly a notion of the critical size that renders these territories attractive. And this raises a **second policy question,** especially important, if we consider that knowledge has become a critical feature of growth: How can we combine **support to the international competitiveness** of these territories with the objective of **inclusion** and equal **access to knowledge** for all territories? Does it require an overarching framing policy, or should we leave territories to develop their **own strategies?**

Third, only half these large firms are **national** (while de facto core development policies remain national), the other half is split between European and 'non-European' **multinational firms.** And this is true for all types of metropolitan areas in Europe. Being transversal to all, it might be interesting to look at ways for opening more widely **knowledge policies to all actors present in the territories,** and not only to national or European actors.

Notes

[1] For complete details on its production, see Laurens at al. 2019).

[2] Europe has created in 1973 the European Patent Office, in parallel with national offices and a specific process for insuring multi-country coverage in Europe. The EPO counts today 38 members.

[3] Still 3/4th of world patents are 'singletons', only taken in one country.

[4] For the time being it focuses on patents, but incorporation of other resources (publications, trademarks and EC research projects as well as their involvement in SDGs) is on-going.

[5] For detailed explanations see: Laurens et al., 2019, CIB documentation

[6] https://iri.jrc.ec.europa.eu/scoreboard

[7] https:/wipo.int

[8] The matching generated over 50000 couples: 4 on average per head of group, and 1 in 8 subsidiaries (12,5%)

[9] See the CORTEXT Geocoding and geospatial documentation for a full explanation of the process and resources mobilised.

[10] Though we have taken a very low level of activity: 10 patents per year.

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