STI Policy Note

December 2016

Where to locate innovative activities?

Does co-location with production matter?

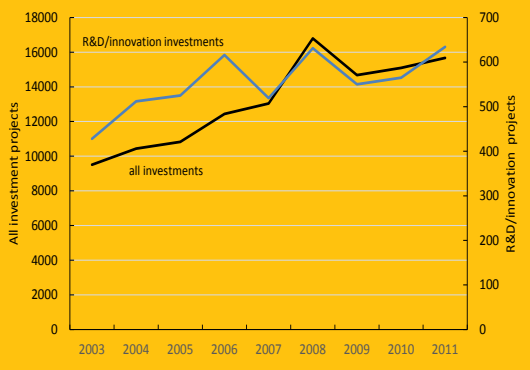
With the emergence of global value chains (GVCs), production processes have become increasingly fragmented and dispersed across different countries. R&D and innovation have typically been among the least internationalised functions of the value chain and were traditionally considered as "core activities" to be retained close to companies' headquarters. But despite the important "home bias" in global innovation, unbundling has recently also affected R&D and other innovation activities and a growing number of firms have offshored R&D and innovative activities to foreign locations.

The offshoring of R&D and innovation poses new challenges to economic policy in OECD countries and emerging economies. How can countries attract inward R&D investment by foreign MNEs and which policies are most the effective and efficient? Should outward R&D investments by MNEs be a concern for countries in which the MNEs are headquartered? Is the more recent offshoring of R&D and innovation linked to the prior waves of manufacturing offshoring; do firms prefer to co-locate innovative activities and other value chain activities such that investments in R&D and innovation are likely to follow other investments?

The argument often heard is that offshoring manufacturing today results in the offshoring of R&D and innovation tomorrow. The concern in OECD countries is that because of co-location effects between production and innovation, the loss of certain manufacturing/assembly activities may result in a loss of innovative capabilities (R&D, design, etc.) in the longer-term. The loss of core manufacturing activities may set off a reaction, which will subsequently erode adjacent activities in the value chain, both upstream and downstream, including activities related to innovation and design, all of which could eventually weaken the competitiveness of OECD countries.

The quick read

An analysis of close to 5 000 international investment projects in R&D and innovation suggests the importance of international connectivity of locations and local universities' research for the location of such investments. In addition, cost factors like the average wage levels for skilled employees in cities, the corporate tax rate, and fiscal R&D incentives are found to play an important role in MNEs' location decisions, particularly when potential locations satisfy key conditions concerning basic infrastructure. Cost factors are also found to be important in maintaining R&D and innovation at home.



At the same time, the analysis finds no evidence that prior investment in production activities abroad leads firms to follow up with R&D/innovation investments. The evidence only indicates that when firms decide about the location of R&D abroad (i.e. after the decision to offshore has been taken), they tend to prefer locations where they have already set up production activities. Indeed, having prior manufacturing activities increases the probability of follow up R&D investment in the same location.

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Moreover, the offshoring of R&D and innovative activities does not hurt activities at home. Rather, the evidence suggests that, if anything, outward investments in R&D and innovation, particularly if they concern development, design and testing, increase MNEs' innovation activities in their home city. This confirms the notion that innovation activities at home and abroad are often complementary: (foreign) investments in development, design and testing build on the results of R&D efforts (at home), while reversely the market expansion effects of (foreign) development, design and testing facilitate R&D expansion at home, also in giving more effective direction to these efforts).

Major trends in international investments in R&D and innovation

OECD countries are more important as home countries than as host countries for international investment, but BRIICS countries are catching up both as host and home countries.

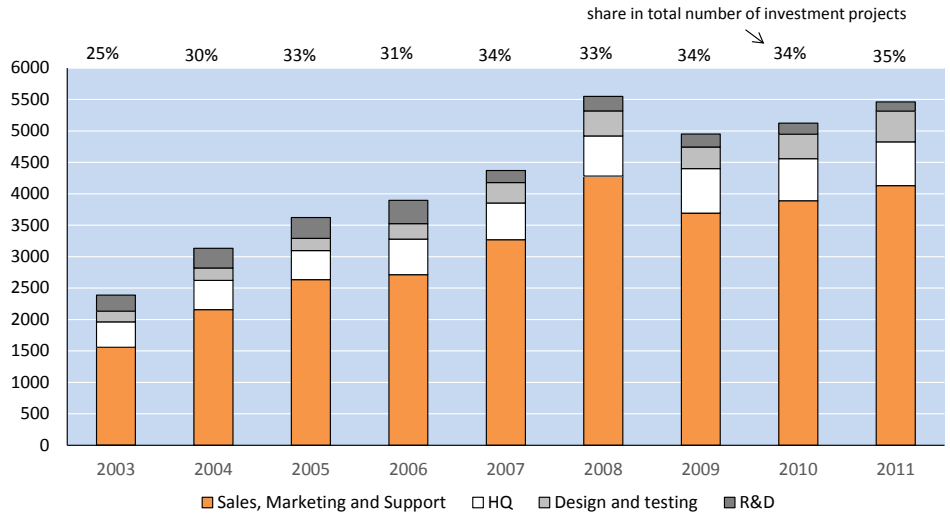
OECD countries are the source or home country for the majority of cross-border investments (including all activities and all industries): more than 80% of the 118 000 cross-border investment projects during 2003-11 are undertaken by companies with headquarters in OECD countries. This share has somewhat decreased over time as BRIICS countries have become larger investors abroad over time. Emerging economies have over time become increasingly important as locations for inward investment. OECD countries attracted between 40%-50% of international investment projects over the period 2003-11, while the BRIICS economies accounted for about one-quarter of inward investments.

Looking at pairs of home and host regions in the overall pattern of international investment projects shows that by far the largest number of investment projects is undertaken by European firms inside Europe. Intra-regional investment flows within Asia are also sizeable and growing. North America and Europe are roughly equally important as a source of inter-regional cross-border projects. Europe has been the largest investor in Asia, while there is a rough balance in North American investment projects reaching Europe and Asia. Investments from Asia to Europe are almost double the Asian investments in North America.

Production activities are the most internationalised, but other activities along the value chain are also increasingly dispersed across countries.

About two-thirds of the cross-border investment projects are production-related activities, while one third concern up- and downstream support activities. Sales, marketing and support represent the largest category of support activities; headquarters and innovative activities account for about 25% of the support activities and 8%-9% of the total number of investment projects included in the fDi Markets database.

Figure 1. Number of investment projects in up- and downstream support activities, 2003-11



Source: Belderbos, Sleuwaegen, Somers and De Backer (2016).

The majority of investment projects going to emerging economies concerns production; for example 70% of the investment projects in the People's Republic of China (hereafter "China") and Brazil are production projects, while this share is 84% for Indonesia. In countries such as the United States, Germany and Japan, the share of production activities is about 50%-55% which is significantly lower but still represents a large number of investment projects in production activities. Investments in headquarter and innovative activities are relatively more focused on OECD countries, particularly the United States and Europe.

The number of cross-border innovative projects has grown but at a slower pace than in other greenfield investments; growth in innovative investment projects is concentrated in development, design and testing.

The number of cross-border greenfield projects has shown a steady growth over the period 2003-11 with a peak in 2008 before the global economic crisis. Growth has somewhat slowed after 2008 and investment levels had not yet fully recovered by 2011. The overall trend in cross-border innovative investment projects – amounting to close to 5 000 during 2003-11 – shows a similar pattern including a peak in 2008. The growth in innovative projects in most recent years is especially driven by the strong growth in Design, Development and Testing projects, of which the number almost doubled over the period.

The need for systematic evidence at the global level

Despite the growing policy attention, systematic evidence on the patterns of international investment in innovation has surprisingly been lacking. The evidence on the international dispersion of innovative activities is rather indirect (e.g. foreign funding of R&D, share of foreign affiliates in host countries' R&D) or based on firm surveys, often for specific industries. Evidently, this limits the analysis and broader policy interpretation of the determinants and effects of the international investments and offshoring in R&D and innovation.

The fDi Markets database (developed by fDi Intelligence – a corporate division of the Financial Times ltd) is probably the most comprehensive database of international investments worldwide. It includes more than 118 000 cross-border (greenfield) investments across all countries, industries and activities (including close to 5 000 for R&D and innovation) for the period 2003-11. Greenfield investments are only recorded in this database when they lead to new physical projects or expansions of existing investments which create new jobs and capital investments; hence, joint ventures are only included when they lead to a new physical operation. Accordingly, mergers and acquisitions and other equity investments – which are often motivated by financial motivations rather than strategic considerations – are excluded from the database. The database collects information on cross-border investments across different activities (production, R&D, design, testing, sales, marketing and support, headquarters, etc.) across the globe.

An important share of global innovative investments is taking place among "global" cities, with a growing role for Asia.

Large metropolitan areas with strong international connections, or "global" cities, are major locations for inward and outward investment projects in R&D and innovation. About 40% of these investments are directed towards 57 of these global cities. The pattern of cross-border innovation investments at the level of global cities shows the importance of major cities in Asia: Shanghai, Bangalore, Singapore, and Beijing each attracted more than 100 of these projects. The dominance of these cities is more pronounced for more applied projects (development, design and testing) than for more research-oriented projects. Moreover, the importance of global cities as hosts of innovation investments is almost matched by their importance as sources of innovation investments. About 38% of R&D and innovation investments are due to MNEs based in the 57 global cities: the set of cities responsible for cross-border investments in R&D and innovation includes major cities in industrialised countries where firms have their headquarters, such as Paris, Tokyo, London, Munich and New York.

Table 1. Inward and outward cross-border investment projects in R&D and innovation by major "global" city, 2003-11

	Inward	Outward		Inward	Outward
Amsterdam	7	72	**Miami**	4	13
Athens	0	2	**Milan**	18	13
Atlanta	9	24	**Montreal**	19	18
Bangalore	248	11	**Moscow**	22	4
Bangkok	17	11	**Mumbai**	40	32
Barcelona	49	10	**Munich**	32	139
Beijing	128	12	**New York**	13	116
Berlin	10	8	**Osaka**	13	61
Boston	25	62	**Paris**	43	213
Brussels	17	29	**Philadelphia**	5	7
Budapest	25	2	**Prague**	16	2
Chicago	11	36	**Rio de Janeiro**	14	1
Copenhagen	17	10	**Rome**	2	5
Dallas	12	20	**San Francisco**	20	90
Dubai	27	7	**Santiago**	5	1
Dublin	39	27	**Seoul**	57	88
Dusseldorf	12	18	**Shanghai**	346	9
Edinburgh	18	2	**Singapore**	205	21
Frankfurt	9	2	**Stockholm**	17	53
Geneva	5	60	**Sydney**	15	5
Hamburg	11	7	**Taipei**	25	25
Hong Kong	36	19	**Tokyo**	43	205
Houston	7	31	**Toronto**	22	44
Lisbon	1	2	**Vancouver**	7	2
London	47	165	**Vienna**	15	4
Los Angeles	19	20	**Warsaw**	14	1
Madrid	21	7	**Washington**	8	12
Melbourne	23	7	**Zurich**	4	20
Mexico City	14	1	**TOTAL**	1 908	1 878

Source: Belderbos, Sleuwaegen, Somers and De Backer (2016).

The location drivers of R&D and innovation

A detailed analysis of the close to 5 000 cross-border investments in R&D and innovation (including pure research, development, R&D but also design and testing) allows an assessment of the firm characteristics as well as location factors (in the home as well as host country) that affect firms' decisions to offshore R&D and innovation. Particular attention has been paid to earlier company investments in order to identify possible

co-location and feedback effects between production and R&D/innovation activities. As these co-location effects typically stem from interaction over smaller distances, the analysis focuses on the role of major metropolitan areas, in particular "global cities" (instead of countries).

International connectivity and university research play important roles in the attractiveness of cities for inward innovation investments.

Analysis at the level of global cities identifies important location drivers of the cross-border R&D and innovation decisions by MNEs. Beyond factors highlighted in previous studies (market size and growth, English proficiency, same language, etc.), the evidence suggests the importance of international connectivity of locations, which facilitates MNEs' operations and the knowledge flows within multinational networks. Such connectivity is provided by airport infrastructure and is also reflected in cross-border R&D collaboration by inventors in the city. Another salient aspect observed is the positive role of local universities' research strengths – as indicated by universities' applied research leading to university patenting – if university research is in domains relevant to the sector of the investing MNCs. These findings point to potentially positive effects of policy initiatives focusing on international R&D collaboration, infrastructure for global travel and transactions, and support for entrepreneurial universities.

The differences in the role of locational drivers between more research and more applied innovation investments are not very pronounced.

There are relatively few differences in the location determinants of R&D projects versus Design, Development and Testing investments. Differences are only a matter of degree. Two core motivations of R&D internationalisation prevail: to adapt products and processes to host country conditions and help expansions in foreign markets (more applied R&D and innovation) and to create new technologies and benefits from foreign R&D capabilities (more research). The evidence confirms that research investments, as compared with more applied investments, are to a greater extent attracted to cities with strong universities but less so by local market size. Fiscal R&D incentives only attract research investments, which is most likely due to the fact that more applied investments may fall outside the scope of R&D schemes and may therefore not always qualify for R&D tax relief.

Cost factors matter in inward and outward decisions.

Cost factors are often regarded as secondary considerations in the location decisions of international R&D and innovation. The evidence from this analysis, however, suggests that cost factors do play an important role in MNEs' location decisions. This is particularly so because an increasing number of potential locations satisfy key conditions concerning basic infrastructure, moving cost factors to the forefront of attention. Hence, the wage level (for skilled employees) in cities is an important factor in the ability of locations – be it countries or cities – to attract investments in R&D and innovation. Moreover, higher wages are a significant factor driving MNEs to invest in R&D and innovation abroad. Increasing population density, related to congestion costs and pressure on land prices and rents, also has a negative influence on outward investments decisions.

The available evidence points at increased (fiscal) competition between OECD countries to attract (inward) investments in R&D and innovation.

Taxation related to international investments in R&D and innovation is observed to be another important cost factor affecting location decisions. Among major cities in OECD countries – locations satisfying key conditions concerning basic infrastructure – corporate tax rates reduce inward investments while fiscal R&D incentives encourage these. Previous research had already shown that government support may play some role, especially in the final stages of the decision-making process for foreign R&D investments, although such support cannot compensate for the negative effects of other (more) important factors in the business environment.

In addition, there has been a clear pattern in OECD countries and elsewhere (almost without exception) to reduce corporate tax rates and increase fiscal incentives for cross-border investments in R&D and innovation. These two observations suggest that OECD countries are increasingly engaged in fiscal competition to attract these types of investments. The consequence may be a continuous rise in the costs of attracting investments without a corresponding increase in investments in the OECD area. Co-ordination between countries and guidelines on fiscal incentives should aim at increasing policy efficiency and take into account the negative effects of such policy competition.

Firms have a strong tendency to co-locate R&D and innovation activities with existing manufacturing activities within GVCs; this pattern is more pronounced in engineering intensive industries.

With the increasing globalisation of MNEs' value chains and given the advantages of spatial co-location of R&D and innovation activities with other value chain activities within GVCs, there is a distinct relationship between R&D/innovation decisions and other value chain investments by MNEs. Although about two thirds of cross-border projects in R&D and innovation are not associated with prior value chain investments (in a five-year period) by the MNE, there is robust evidence that prior manufacturing activities increase the probability of follow up R&D/innovation investment in the same location. Prior investments by a firm in R&D and innovation in a city are also often a precursor of similar investments in that city.

Table 2. Investments in R&D/innovation following previous investment project by the firm at the global city level, 2003-11 (in % of total number of R&D/innovation investments)

	All countries	Developing countries	Developed countries
No prior FDI	67	60	72
Prior FDI	33	40	28
Prior Core Investment	15	20	11
Prior R&D and innovation	33	40	28
Prior Headquarters	5	6	5
Prior Up/downstream (other)	8	11	5

Source: Belderbos, Sleuwaegen, Somers and De Backer (2016).

In engineering industries there tends to be a closer interaction between manufacturing and R&D and innovation, as technology development is characterised by short product life cycles and continuous innovation in processes. The evidence indeed suggests that co-location forces between manufacturing and R&D/innovation activities are significantly stronger in industries with higher engineering intensity. The implication of such co-location tendencies is that policies to attract manufacturing investments indirectly influence the incentives for international investments in R&D and innovation.

Notwithstanding these positive co-location effects, the analysis finds no evidence that prior investment in production activities abroad lead firms soon to follow up with R&D investments. The evidence only indicates that when firms decide about the location of R&D abroad (i.e. after the decision to offshore has been taken), they tend to prefer locations where they have already set up production activities. The claim that the offshoring of production today will result in the offshoring of R&D and innovation tomorrow is not supported.

The evidence suggests that, if anything, outward investments increase MNEs' innovation activities in their home city.

The pattern of new cross-border investment projects in R&D and innovation during 2003-11 shows that a substantial share of these types of projects is destined for Asian markets, with internationally connected "global" (internationally connected) cities such as Shanghai, Beijing, Bangalore and Singapore acting as major hosts. However, partially as a result of the global financial crisis, these locations showed a decline in inward R&D/innovation investments in the most recent years under investigation (2008-11). In contrast, major industrialised economies such as the United States, Germany and the United Kingdom have received a growing number of R&D and innovation investments in recent years. At the same time, India and China have become increasingly important as source countries of international investments of R&D and innovation. Hence, there appears to be an emerging pattern in global investments towards a greater balance in outward and inward investments in R&D and innovation in OECD countries.

A key characteristic of cross-border R&D/innovation investments is that the majority of these projects concern development, design and testing, i.e. activities that often need to take place in close proximity to MNEs' major markets. The evidence suggests that, if anything, outward investments, if they concern development,

design and testing, increase MNEs' innovation activities in their home city. The offshoring of R&D and innovative activities does not necessarily hurt activities at home, rather the opposite. This conforms to the notion that R&D and more applied investments are likely to be complementary: research activities drive product and process innovations, and design and development activities drive commercialisation, market expansion and ultimately the returns to research investments. In other words, investments in development, design and testing build on the results of R&D efforts, while the market expansion effects of applied investments facilitate R&D expansion and give more effective directions to R&D.

Incentives for R&D/innovation investments by MNEs will encourage international knowledge flows, and the benefits of policy induced investments are likely to be spread internationally.

There is a distinct possibility that incentive-driven inward investments in R&D and innovation in industrialised countries (by emerging market MNEs) draw on the local innovation base, with an important part of the created and sourced knowledge feeding into R&D/innovation and manufacturing activities in their home operations. Policy makers should be aware that cross-border knowledge transfers combined with a global cost optimisation of firms' R&D/innovation activities are essential factors in MNEs' competitiveness and growth prospects. National or subnational policies to provide incentives to MNEs' investments, both foreign and domestic MNEs, are likely to generate knowledge flows and productivity effects abroad as well as domestically. The more interconnected the global economy becomes, the higher the risk of leakage effects from domestic policies.

Further reading

Belderbos, R. L. Sleuwaegen, D. Somers and K. De Backer (2016), "Where to Locate Innovative Activities in GVCs? Does Co-Location Matter?", *OECD Science, Technology and Industry Policy Papers*, No. 30, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlv8zmp86jg-en.

Website

https://www.oecd.org/sti/ind/global-value-chains.htm

Directorate for Science, Technology and Innovation Policy Note

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