National Policies to Attract R&D-intensive FDI in Developing Countries

As multinational companies internationalize their R&D activities, new opportunities have opened up for developing countries to attract R&D-intensive foreign direct investment (FDI). However, countries that fail to raise their technological capabilities in line with the needs of multinational companies run the risk of remaining marginalized from global innovation networks. This policy brief discusses how developing countries overcome challenges and develop policy options to attract the R&D centers of multinational firms, which will help spur learning and productivity upgrading by local enterprises.

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World Bank, 2013

Introduction
As globalization intensifies, multinational companies (MNCs) have gradually modified their spatial organization strategies through ongoing fragmentation of their international value chains. This shift applies to manufacturing, logistics, sales, and back-office functions; increasingly, it also applies to more knowledge-intensive activities. In particular, corporate research and development is gradually evolving from a centralized and hierarchical node of global supply chains toward one that builds on an open network of geographically dispersed R&D centers.

As a result of such globalization, R&D-intensive FDI grew substantially from 1990 to 2010, albeit with significant differences across industries and countries:

- The annual R&D investments by foreign subsidiaries in the OECD area more than doubled between 1997 and 2007, reaching USD 89.3 billion (OECD 2011).
- Foreign subsidiaries contribute around one-third of total business expenditure for R&D in most European countries, around 15 percent in the United States and 5 percent in Japan, reaching over 60 percent in some small economies like Slovakia and Ireland (OECD 2011).
• A study by consulting firm Booz Allen Hamilton shows that the largest 1,000 companies by R&D expenditure allocate on average 55 percent of their R&D budget outside the countries where they are headquartered (Jaruzelski and Dehoff 2008). Ninety-nine percent of these firms conduct some R&D in their subsidiaries abroad, and their total number of overseas R&D sites increased by 6 percent from 2004 to 2007.

However, because R&D-intensive FDI is a very heterogeneous phenomenon it is necessary to consider the different strategic motivations and entry modes in order to better frame its developmental impact on host economies and the policy implications for those governments. R&D-intensive FDI can be defined as an investment involving a lasting interest and control of an enterprise residing in another economy for the purpose of conducting R&D activities. This may occur through greenfield investments (creation of a new R&D center overseas by a MNC or expansion of an existing subsidiary), through transnational mergers and acquisitions (full or partial acquisition of a domestic company active in R&D by a foreign company), or through transnational joint ventures (joint ownership of an R&D center by foreign and domestic entities). In addition to these possible entry modes, MNCs can internationalize many different types of R&D activities reflecting different strategic motivations. These R&D activities may be

- Demand-driven, supply-driven, or efficiency-seeking (see Table 1);
- Global, regional, or local in scope;
- Radical or incremental;
- Product- or process-oriented;
- Autonomous or highly integrated into global R&D value chains, among others.

There are also significant differences in the extent and scope of R&D internationalization by industry and by scientific field (OECD 2011).

In the past the internationalization of corporate R&D was primarily demand-driven, following the internationalization of manufacturing and sales, but since the 2000s, supply-driven motivations have been gradually becoming more important. Indeed, subsidiaries now have a more active role in global innovation networks, involving not only incremental innovations but also multi-technology product development and basic research. However, while the number of supply-driven R&D centers has increased, MNCs often operate with just a few such global R&D labs in carefully selected locations, with the historical core R&D unit in the country of origin often holding a coordinating role (Sachwald 2008).

Table 1: Types of R&D-intensive FDI

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<th>FDI type</th>
<th>Strategic motivations</th>
<th>Location drivers</th>
<th>Scope and impact</th>
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<tr>
<td>Demand-driven</td>
<td>• Knowledge-exploiting</td>
<td>• Large and dynamic markets</td>
<td>• Local scope</td>
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<td></td>
<td>• Adaptation of products, services, or processes to overseas markets</td>
<td>• Co-location of manufacturing and R&amp;D</td>
<td>• Highly dependent on the continuation of manufacturing activities</td>
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Whatever the strategic motivations, R&D-intensive FDI normally unfolds by upgrading existing subsidiaries, rather than through completely new investments. R&D mandates are often assigned through a competitive bidding process involving several potentially capable subsidiaries of the MNC already present in different countries and regions. This kind of intra-corporate competition to attract R&D is becoming more intense as global innovation networks have matured and as a growing and more diverse set of locations have acquired the threshold level of technological capabilities and infrastructure required for hosting R&D facilities. MNCs are continuously rationalizing and restructuring their international network of R&D units, often resulting in an increase in R&D expenditure overseas but a reduction in the total number of R&D units, through strategies such as regional integration of R&D efforts (for example, one dominant R&D center for Europe with a smaller network of collaborating units).

Note also that MNCs may undertake modes of innovation other than R&D, which may have an equivalent effect on learning and competence-building in host economies. Under a broad view of innovation, the role of an MNC is not limited only to its contribution to R&D efforts but can also extend to human capital development; organizational change and new business models, and marketing, branding, and design. In addition, the analysis could also be extended to include other high-value business functions such as advanced manufacturing, business process outsourcing, and technical assistance.

Some agencies and analysts adopt an industrial (rather than functional) perspective, which consists of targeting the most dynamic high-technology sectors like software, electronics and telecommunications, pharmaceuticals, biotechnology, nanotechnology, or aeronautics. Others speak of “quality” FDI or of “knowledge-intensive” FDI (OECD 2012). The logic remains the same: to use FDI as a catalyst for technological development and as a means of upgrading in global value chains.

Moreover, R&D-intensive FDI needs to be understood as part of a wider process that can be characterized as the globalization of innovation (Archibugi and Pietrobelli 2003). This includes not only FDI but also international collaboration and strategic alliances, transnational technology contracts and licensing, international trade of high technology products, and international flows of human capital. Indeed, from a development and policy perspective, the critical issue is the

| Supply-driven | • Knowledge-augmenting  
• Tapping into foreign sources of knowledge | • Quality of local universities, human capital, research infrastructure, and industrial clusters | • Global scope  
• Strong reliance on local knowledge sources, higher potential for linkages |
| Efficiency-seeking | • Cost reduction | • Standardization and fragmentation of R&D activities and offshoring of certain segments to lower cost locations | • Local/global scope  
• More footloose and highly dependent on competition based on costs |
nature and extent of cross-border technological linkages, rather than whether these linkages are organized intra-firm (through FDI) or inter-firm (through contracts and alliances).

Developing countries in global R&D networks
Since 2000, global R&D networks are becoming more multi-polar, with emerging and developing countries becoming more relevant both as destinations and sources of R&D-intensive FDI. This trend can be ascribed largely to the growing attractiveness of China and India as locations for international investment. Some indications of this trend are as follows:

• Between 2004 and 2007, among the new R&D sites opened by the largest 1,000 MNCs by R&D expenditure, 83 percent were located in China or India (Jaruzelski and Dehoff 2008).

• The number of R&D centers owned by foreign MNCs rose from only 100 in each of the two countries in 2001 to 1,100 in China and 780 in India by the end of 2008 (Bruche 2009).

• According to fDi Markets database, from 2003 to 2010 there were a total of 2,275 announcements of new FDI in R&D projects in the world, of which 43 percent were located in Asia-Pacific (author’s calculations based on fDi Markets database, Financial Times Group).

In the words of Yusuf (2012, 2), “[M]ultinational corporations are diversifying their R&D operations and transferring more of their research activities to emerging economies in order to capitalize on the elastic supply of skills and on expanding market opportunities.” The increasing attractiveness of China and India for international investment in innovation reflects that these are the largest countries in the world by population and among the countries with the highest economic growth during the last two decades. In that time they have opened up to the world economy and liberalized international capital flows. These factors have transformed them into the “hot spots” for international investment. Moreover, China and India have substantially expanded their pools of workers with scientific, engineering, and math skills and are steadily increasing both their public and private R&D (Yusuf 2012). This effort has enabled them to specialize in manufacturing and other activities like business process outsourcing to evolve toward more knowledge-intensive segments of corporate value chains, including R&D.

In addition, the capacity of emerging countries to attract R&D-intensive FDI is supported by the development of local institutions and the adoption of a proactive policy approach. For example, the governments of China and India have used their large market size and attractiveness as a bargaining tool to coordinate procurement and technology policies with approvals for foreign investment in order to increase local capabilities. They have actively encouraged foreign investors in manufacturing to open up R&D centers as well.

According to the World Bank (2010), besides China and India, the main destinations for R&D-intensive FDI in developing countries are Brazil, the Czech Republic, Hungary, Malaysia, Russia, and Thailand. In many cases, FDI in large-scale manufacturing activities (market-seeking or efficiency-seeking) naturally evolved over time to include, to some extent,
knowledge-intensive and R&D activities (competence-seeking), as in the case of the automotive industry in Brazil or the electronics industry in China or Malaysia.

However, many other developing countries lack the large and dynamic markets that countries like China, India, or Brazil can use as a bargaining tool to attract the R&D of MNCs, and they also lack the technological infrastructure, human capital, and specialized clusters that MNCs are looking for when deciding where to locate their international R&D centers. Indeed, although the emerging new geography of corporate R&D is becoming more multi-polar, this does not necessarily imply that it will be inclusive. Competition is strong and countries that fail to raise their technological capabilities in line with MNC needs risk becoming marginalized in global innovation networks.

In general, developing countries are more likely to attract demand-driven or efficiency-seeking R&D rather than supply-driven R&D, given their lower technological capabilities relative to the most technologically advanced developed countries. Along these lines, Thursby and Thursby (2006) show that the kind of R&D activities MNCs undertake in emerging countries normally entails familiar science (that is, applications of science currently used by the firm or its competitors) rather than new science (that is, novel applications of science), with the novel work remaining concentrated in the core developed countries.

Beyond merely adapting existing products and processes, another possible demand-driven motivation is designing new products for low-cost manufacturing, in order to tap into the vast market of low-income customers who cannot afford products such as refrigerators, washing machines, or cars within the range of existing high-end options designed for the middle classes of developed countries. Demand-driven and efficiency-seeking R&D subsidiaries tend to focus initially on lower-end and routine R&D activities. But lower-end R&D may evolve with time and lead to an upgrading of technological capabilities.

**Impact and policy rationales**

Given that MNCs undertake the bulk of global R&D expenditure, they determine to a large extent the geography of R&D activity. In view of the potential benefits of innovation and FDI for growth and competitiveness, attracting R&D-intensive FDI is becoming a critical concern for national policy makers, both in developed and developing countries (OECD 2011; UNCTAD 2005). In addition to its direct impact, R&D-intensive FDI can yield indirect effects or spillovers, which refer to “productivity improvements resulting from knowledge diffusion—both in the form of unintentional transmission or intentional transfer—from multinational affiliates to domestic firms, encompassing both technology and all forms of codified and ‘tacit knowledge’ related to production, including management and organizational practices” (Farole and Winkler 2012).

**Direct benefits** of R&D-intensive FDI may include the following:

- A net increase in domestic R&D activity, involving more R&D expenditure and an upgrading of technological capabilities.
• Fostering of technological change and a more innovative and dynamic production specialization.

• Creation of job opportunities for highly skilled labor locally, which could slow down or reverse the "brain drain," as well as help bring skilled human capital back to the country.

**Indirect benefits** may include the following:

• Demonstration and competition effects, because the presence of innovative MNC subsidiaries spurs domestic firms to engage in R&D and enhance the efficiency of their operations to be able to compete.

• Subcontracting of R&D activities to local research institutes and firms.

• Technology licensing and technical support to local suppliers and customers.

• Incorporating locally produced components at the design stage of new products, which opens up new markets for local suppliers and new opportunities to integrate into global value chains.

• Transfer of technological knowledge through interaction and linkages with local firms and research centers.

• Indirect employment effects, whereby the host country benefits from training provided by the MNC subsidiaries to their employees, who subsequently become available to local firms through the job market or may establish new ventures themselves.

• Follow-up investments in manufacturing to commercialize R&D results, as well as new investments by other companies through an “imitation effect.”

However, R&D-intensive FDI may also bring along some *risks* for the host economy:

• The technological activity of local firms can be “crowded out” to some extent by intensified competition for limited specialized assets, including human capital and public incentives to R&D. In many developing countries MNCs manage to attract the best scientists and engineers, offering higher pay and better career prospects. This pushes salaries up and leaves local firms and institutes with fewer and less talented people available for recruitment.

• The risk of crowding-out is especially acute in the case of transnational mergers and acquisitions, where the only short-term effect for the host country is a change of ownership, while in the medium to long-run there is a trade-off between the potential for expansion and upgrading, on the one hand, and, on the other, the risk that the acquirer ends up reducing the subsidiary’s R&D mandate to avoid duplication with other preexisting R&D centers within the MNC's global network. For example, the acquisition of Brazilian firms by MNCs in the automotive and telecommunications industries during the 1990s resulted in a scaling down of R&D activities in the acquired firms (UNCTAD 2005).
• MNCs may concentrate their R&D activity on problems that are of little relevance to the local economy, diverting scarce technological resources from more useful purposes.

• The MNC R&D centers may end up acting as enclaves, with insufficient linkages with local actors and very limited knowledge transfer.

Altogether, the net impact on a host economy depends on the nature of the R&D undertaken by MNCs and the specific circumstances of the host economy. As explained by Farole and Winkler (2012), the factors to be considered include: (1) the FDI motive, sourcing strategy, and technology potential, (2) the absorptive capacity of local firms and the technology gap between foreign firms and local firms, and (3) the host country’s institutional framework. Indeed, in order to tap into the potential externalities, countries need to develop a threshold level of absorptive capacity, which can be defined as the ability to acquire, assimilate, and exploit knowledge developed elsewhere. The development of domestic skills and innovation capabilities is essential not only to attract FDI in R&D but also to reap the potential benefits associated with such investments.

Policy rationales

Government intervention to attract R&D-intensive FDI may be justified by past market failures or present imperfections. For example, in the case of R&D a well-known market failure is that firms are not sensitive to the positive externalities of knowledge creation. If left to the market, they would under-invest in R&D due to the difficulty of appropriating the results, because of the nature of knowledge as a quasi-public good, and also due to the duration and risk inherent in R&D projects. These market failures arguably apply to a larger extent to the specific case of MNC subsidiaries, which operate in more unknown markets where the risk of knowledge spillovers may be perceived as higher. With regard to FDI, an example of market failure is that those who decide the allocation of R&D centers within global innovation networks lack perfect information about all potential countries and regions, implying that their location decisions may be biased.

Beyond market failures, the literature on innovation systems has played an important role in shaping a new policy approach, bringing along the notion of systemic failures as a rationale for innovation policies. Within this framework, policy makers are expected to intervene when the system of knowledge generation and diffusion does not achieve its objectives of contributing to innovation and technological progress in an efficient manner, because of the lack of well-developed networks between the different actors of the system, or because of institutional weaknesses, or because of an inadequate provision of research infrastructure, and so on. Thus, the role of governments is not limited to providing funding for education and R&D, but extends further to facilitating linkages and enhancing the dynamism of the national innovation system.

Developing countries are also increasingly aware of the importance of R&D-intensive FDI and its role as a mechanism for technological transfer and “catching-up.” However, they tend to face more difficulties than developed countries in attracting the R&D of MNCs and they may see a higher need of government intervention because of the presence of more acute market failures and systemic inefficiencies. Even if a country manages to attract some R&D-intensive FDI, the
expected benefits do not accrue automatically. As argued earlier, a threshold level of absorptive capacity is required in order to tap into the potential externalities.

**Overview of policy options**

FDI promotion policies in developing countries tend to focus initially on improving the business climate and attracting as much FDI as possible through deregulation, liberalization of capital flows, and privatization of state-owned enterprises. However, a shift in FDI policies can be observed, focusing more on the quality rather than only on the quantity of FDI. Recognizing the heterogeneity of FDI, the aim is to target the most desirable FDI to meet specific development objectives. This approach often translates into targeting higher value-adding operations of MNCs, including R&D, business process outsourcing, and headquarter functions, as well as high-technology and high-growth industries such as information technologies, biotechnology, or nanotechnology.

Attracting R&D-intensive FDI requires a more proactive kind of policy intervention—unlike generic FDI policies, which can rely largely on investment liberalization, macroeconomic stability and international promotion. The objective guiding FDI policies would be to progressively attract higher value-adding segments of corporate value chains, a key component of which are R&D activities. As argued earlier, besides attracting new flows of R&D-intensive FDI, a related policy objective would be to reap the benefits associated with the existing R&D activity of MNC subsidiaries by stimulating their embeddedness into the national innovation system (for example, linkages with local firms and universities) and by augmenting the absorptive capacity of domestic agents (for example, human capital, research infrastructure, public R&D).

There are many different policy instruments that can be used to attract R&D-intensive FDI, involving a close coordination of innovation policy and FDI policies (Table 2). On the one hand, the role of innovation policy is to improve the investment climate for R&D by identifying and acting upon the strengths and weaknesses of the national innovation system. The objective would be to provide the necessary infrastructures, public R&D, human capital, and regulatory regimes, in addition to fiscal and financial incentives to private firms undertaking R&D. On the other hand, the role of FDI promotion policies is to improve the image of the country as an R&D location and to provide targeted services to both potential and existing foreign investors in R&D. In most countries, these kinds of policies are implemented by investment promotion agencies (IPA). The positive impact of FDI promotion policies can also be indirect, through the IPA’s policy advocacy role. Indeed, IPAs are often the main government interlocutor with foreign investors, and therefore are uniquely capable of guiding policy reform programs toward the dynamic needs of MNCs.

Within this broad policy framework, the next sections discuss some of the most pressing areas for public policies aimed at attracting R&D-intensive FDI in developing countries. Specific government actions and strategies should follow from an intelligence gathering and technology foresight exercise, including consultations with the private sector and the managers of existing MNC subsidiaries.
Table 2: Policies to attract R&D-intensive FDI

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<th>Policy area</th>
<th>Key policies</th>
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| Innovation policies | • Public R&D, universities, and scientific infrastructure  
|                | • Human capital and attraction of foreign talent                           
|                | • Fiscal and financial incentives to corporate R&D                           
|                | • Clusters and linkages                                                     
|                | • Intellectual property rights regime                                       |
| FDI policies   | • FDI incentives                                                             
|                | • Performance requirements                                                  
|                | • International marketing                                                   
|                | • Pre-investment and after-care services to foreign investors                 
|                | • Policy advocacy                                                            |

Public R&D, universities, and scientific infrastructure

Building domestic research capacity is critical for attracting and anchoring R&D-intensive FDI to the local economy. A key challenge for developing countries is to strengthen their universities and public research institutes by recruiting adequate staff and providing them with adequate funding and equipment to carry out R&D and by providing postgraduate education in science and technology subjects, as demanded by foreign investors in R&D.

It is important that public R&D centers comply with the standard requirements of MNCs - for example, Russia is known for building high quality R&D centers, but they often lack the quality assurance, accreditations, and experience with contractual research that enables these centers to form linkages with MNCs. Capacity-building efforts should focus on a demand-oriented upgrading of technological capabilities in response to MNC needs, with the aim of creating the conditions that enable existing subsidiaries to embrace new R&D mandates. It would be very risky to embrace radical programs to specialize in new R&D areas with the hope that this will be followed by new private investments.

In addition to universities and public R&D labs, science and technology parks may be attractive for MNCs as they facilitate networking with other firms and research centers, provide the necessary infrastructure and administrative support, and offer a pleasant working environment. A possible policy instrument to attract R&D-intensive FDI is to offer “research hosting” services to foreign firms through science and technology parks, which can include subsidized office space, access to R&D infrastructure and equipment, administrative services, and support in applying for R&D incentives.

Human capital

The availability of world-class scientists and engineers is another critical location driver for R&D-intensive FDI. Developing countries can initiate policies to increase the number of scientists and engineers by encouraging young people to choose a career in science and engineering, offering grants and increasing the budgets of universities and research centers, facilitating exchange of
researchers between the public and the private spheres, and setting up mechanisms for life-long learning. Innovation requires not only engineers and scientists, but also staff with a broad range of qualifications, including technicians, administrative staff, and skilled workers. Tertiary education institutions should focus on all these different levels, and specific programs should be developed in the appropriate industries and specializations for which demand exists. Policymakers should aim at addressing innovation skills gaps across these different levels.

Building a strong human capital base is not only about growing indigenous talent, but also about attracting and retaining talent. Thus an inflow of highly skilled researchers from abroad should be facilitated to enlarge the home talent base and to enable flexible intra-firm employee mobility, as demanded by foreign investors. Different policies can encourage this effort, such as making the conditions of local researchers and university professors more attractive to foreign candidates, reforming the immigration legislation and procedures, reducing income tax for high-skilled immigrants, or facilitating the accreditation of foreign qualifications.

Policy initiatives should also incentivize the return of national researchers located abroad, with the aim of transforming the original brain drain into a “brain circulation”, with benefits for the national innovation system. Moreover, building links with the diaspora of national scientists and business managers working in foreign countries may be a useful mechanism for investment promotion purposes, as demonstrated by the experience of China and India. Similarly, in Chile, an initiative called Chile Global (http://www.chileglobal.net) was established to create a network of successful Chilean business people abroad to promote knowledge-intensive businesses and partnerships, enhance technological transfer, and increase the supply of investment projects.

**Financial and fiscal incentives to business R&D**

Fiscal incentives can include a favorable tax treatment for R&D expenditure, for example in the form of accelerated depreciation, tax holidays, tax credits, or import tariff exemptions. At the same time, financial incentives may include the direct funding of business R&D projects by the government through grants or subsidies, preferential loans (including interest allowances), or equity stakes.

Incentives may influence the MNC’s final R&D location decision when competing locations rate similarly in the rest of the list of attraction factors (OECD 2011). But incentives cannot compensate for a country’s weaknesses in other, more important, location factors, such as the quality of universities and the availability of well-trained engineers and scientists. Since 1990 there has been a widespread increase in governments’ use of incentives to stimulate corporate R&D, including many developing countries like Brazil, India, Malaysia, Mexico, and South Africa (UNCTAD 2005). However, incentives should be offered cautiously, after carefully considering the potential spillovers and linkages and how these would translate to actual benefits for the host economy.

A first obvious policy to promote R&D-intensive FDI is to provide equal opportunities for foreign-owned firms and local firms to gain R&D funding. In terms of governance, most countries have set up public agencies to distribute R&D incentives to business, and IPAs can only inform
foreign investors of the incentives available but lack any control over incentives themselves. However, in some countries like Ireland and Singapore investment promotion agencies may negotiate incentives directly with foreign investors in a more tailored and proactive manner.

**The intellectual property rights regime**

From a headquarters perspective, among the main drawbacks of R&D offshoring are the potential loss of control over R&D and the risk of intellectual property (IP) theft. Therefore, another priority for governments aiming to attract R&D-intensive FDI is to develop a clear and enforceable IP regime. Developing countries tend to have weaker IP regimes and judicial systems than developed countries, which may act as a barrier for the attraction of certain types of MNC R&D. For example, despite China’s growing attractiveness for R&D-intensive FDI, according to Gupta and Wang (2011,1), the country is “notorious for its counterfeiters, pirates, and IP scofflaws,” and this represents perhaps the single biggest challenge that foreign direct investors face in China. Beyond regulatory reform, governments of developing countries should also try to ensure that an adequate skill formation in IP regulations is available in the country, for example, by sponsoring IP specific seminars and courses and by identifying specialized law firms and consultants that can be contacted by potential foreign investors.

**Creating clusters around MNCs and fostering linkages**

Building a dynamic national innovation system where universities and public research institutes collaborate with firms is critical to attract R&D-intensive FDI and to capture the associated knowledge spillovers. Indeed, the opportunities for industrial upgrading and the benefits for the host country are magnified when MNC subsidiaries become embedded in the domestic milieu by collaborating with local firms, universities, or business associations.

A typical policy instrument is to provide programs to support the formation of supplier networks and technology clusters around MNC subsidiaries. This effort involves not only information and brokerage services to connect firms together, but also capacity-building initiatives to upgrade local firms to be better able to meet the requirements of MNCs. The case of Czech Republic is an example of the success of industrial policies aimed at building linkages, through initiatives such as the Supplier Development Programme launched in 1999. This program developed an online database of potential suppliers to multinational corporations operating in different sectors, and provided training and technical support to a selected group of Czech firms in areas such as technology management, quality control and organizational change.

Establishing knowledge-intensive linkages between MNCs and local firms faces many challenges, as illustrated by the case of Costa Rica. Despite the arrival of large flows of FDI in high technology industries since the late-1990s, linkages between multinational subsidiaries and Costa Rican supplier networks remain scarce and concentrate on lower end services such as security, cleaning, or packaging. Indeed, a threshold level of absorptive capacity is required in order to engage knowledge-intensive linkages with MNCs. Knowledge linkages between MNCs and local actors will be irrelevant in the absence of high-quality human capital, research institutions, and clusters of innovative firms. Even in some of the most successful technological clusters in developing countries like Bangalore in India, linkages between multinational
subsidaries and local firms and universities remain very ill-developed in general terms (D’Costa 2006).

The role of governments as linkage facilitators and skills coordinators should not remain limited to promoting linkages between MNCs and domestic suppliers or partners; it should extend further to linkages with universities and public research centers. This effort would include joint-research projects as well as subcontracting of certain research activities. Universities and public research centers also offer MNCs technical services for testing and consultancy. Another policy option is to stimulate entrepreneurship through provision of incubation and start-up support services with a focus on specific areas that could benefit from the R&D activity of established multinationals. Armenia, Chile, and Ireland have launched new initiatives along these lines.

**Performance requirements**

Some countries, for example India and China, have intensively put conditional requirements on FDI in the past, such as the need to establish a joint-venture with a local firm, to engage in local sourcing, or to facilitate technology transfer. But integration into the world economy and into international institutions such as the World Trade Organization (WTO) has attenuated this reliance on performance requirements.

Although the use of mandatory requirements related to R&D and technology transfer is not prohibited by the WTO Agreement on Trade-related Investment Measures, it has become increasingly restricted in international investment agreements (UNCTAD 2005). The benefits of performance requirements related to R&D are questionable because it is unlikely that firms will establish R&D activities in the absence of a clear business case, and because they may deter firms from investing in the country in other kind of activities if forced to conduct R&D. In any case, mandatory R&D requirements appear to be rare, and it is more common to link R&D criteria to the award of public incentives (UNCTAD 2005).

**“After-care” services to foreign investors**

Typically, investment promotion agencies focus their efforts on international marketing and pre-investment services to facilitate the initial investment in the country of foreign MNCs, providing tailored information and assistance in obtaining the necessary permits and applying for incentives. However, IPAs targeting R&D-intensive FDI need to place a higher emphasis on after-care services, because MNC subsidiaries generally engage in R&D activities sequentially over time rather than overnight through a completely new investment. Along these lines, IPAs should evaluate the existing stock of foreign subsidiaries in order to identify specific opportunities for upgrading, followed by enhanced dialogue and collaboration with subsidiary managers and by the offering of customized aftercare services and incentives.

**Conclusions**

When designing targeted strategies to promote R&D-intensive FDI, policy makers must select the most appropriate policy mix considering the country’s circumstances. This task is very difficult because it involves diverse government departments and agencies and because the relative efficiency of the various policy instruments is uncertain and hard to evaluate. Some
policy instruments may have a short-term impact, such as fiscal and financial R&D incentives, while others, such as improving the education system, will only have visible effects in the long run after sustained investments.

Despite large differences, a common characteristic of the most successful countries following FDI-assisted development strategies is that they have sought not only to attract FDI but also to develop and upgrade domestic capabilities and location advantages in tandem. For example, in Ireland, since the 2000s, the government has offered generous fiscal and financial incentives to FDI in R&D, but has simultaneously made massive investments in education and scientific infrastructure, with a strong focus on promoting university-industry collaboration (Dorgan 2006).

In developing countries, the upgrading efforts to better link with MNCs require “system coordination initiatives” to improve the education system, infrastructures, and institutions, as illustrated by the case of the electronics industry in Malaysia (Rasiah 2002). In any case, governments of developing countries should set realistic policy targets by coupling their country’s potential location advantages with the dynamics of global innovation networks. Attracting R&D-intensive FDI is not an easy task because it requires advanced technological infrastructure and capabilities and because competition among countries is becoming more intense, within a context of continuous restructuring and segmentation of global value chains.
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http://scheller.gatech.edu/directory/faculty/thursby_m/pubs/where%20is%20the%20new%20science.pdf

