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Policy issues

Linking national science, technology and innovation policies with FDI policies¹

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Much research has been undertaken to settle the controversial issue of whether FDI is good or bad for countries. Most studies concluded that there were positive impacts, because FDI brings efficiency gains, technology and skills transfers, etc. and, because TNCs responsible for FDI generally are unable to internalize all the gains. However, in recent years it has become apparent that the impact of FDI cannot be taken for granted, but critically depends on circumstances. The determinants include policies, TNC strategies, and how the two interact.

Meanwhile, in the wake of globalization, liberalization and technical progress, notably in ICT, the world economy is marked by sweeping structural change.³ Above all, declining costs of diffusing codified information add to previous reductions in communication and transport costs, and create new tools for firms to divide and specialize operations internationally. At the same time, tacit knowledge remains vital (Pavitt 1998). Firms intensify efforts to upgrade core business, while outsourcing

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² The views expressed in this study are those of the author and do not necessarily reflect the views of the United Nations, its Member States, or the Institutions to which the author is affiliated.

³ Throughout the developed world, technology- and skill-intensive activities are advancing (OECD 2003). In international trade, the share of high-technology products has increased markedly over the last two decades, although a certain reversal has taken place since 2000 with the consolidation in ICT (UNCTAD 2003).

other functions, and strive to become fully effective in developing, accessing and exploiting – on a global basis – all relevant knowledge in their particular areas of specialization. A key concept is that of innovation (box 1). Dependent on the ability of individuals and firms to discover and implement new ways of doing things, innovation is influenced by a range of capabilities, institutions and policies.

Box 1. The changing nature of innovation

Innovation may be defined as the development of new commercially relevant products or processes. Traditional perspectives have viewed innovation as closely related to science and technology. Mastering the expanding opportunities in scientific and technical progress is becoming an increasingly important source of innovation generating high value-added in developed countries. On the other hand, innovation can take many forms, including the commercialization of science and technology and the development and implementation of new ideas more generally, as in the form of organizational change or inventing new ways of doing things. Innovations that enhance attractiveness and accessibility to customers and users are often essential for commercialization. Furthermore, innovation is the key not only to economic progress, but also to identifying new solutions to pressing social issues, such as an ageing population or environmental degradation. Innovations may be categorized in different ways, including product and process innovations, although there is no clear-cut dividing line between the two.

Innovation must not be conceptualized as a one-dimensional, linear process leading from certain input factors. Innovation is the result of efforts by multiple actors and, is enhanced by their constructive interactions. No single actor generally manages all the skills that are useful, but, complementary competencies are crucial, allowing for a constructive interplay and information exchange between the supply and the demand side in local as well as international markets. Fostering conditions that are favourable to innovation may require reforms in a number of seemingly disparate policy domains.

Source: the author.

The establishment of local R&D generally goes together with a deepened commitment by TNCs to learn about local markets. It may be essential for the generation of knowledge that allows for enhanced efficiency as well as the diffusion of benefits to the host country (Bernstein 1989, Correa 2000). Meanwhile, there are now much enhanced opportunities for investors to establish such facilities in developing economies and countries in transition (UNCTAD 2005). This applies to Central and Eastern Europe and to rapidly developing major industrial strongholds in Asia, such as in China, and in some Latin American countries. Most foreign R&D in developing countries however, remains attracted by a small group of relatively well-off economies, whereas poorer developing countries are neglected. This is particularly worrisome, as official development assistance has diminished in scope, as accessing technologies in other ways is difficult and, as intellectual property rights regimes are fragmented and display deficiencies.

Whereas inter-country flows of technology and skills matter crucially for innovative performance, a country's ability to attract and gain from FDI and foreign R&D will much depend on domestic innovative performance. Any country or region ought to offer conditions that are favourable for the management and exchange of knowledge and technology in ways that support and upgrade their specific assets. Against this backdrop, innovation policy and FDI policy, especially in regard to foreign R&D, hinge together. Yet, the link between them is seldom explored. In this paper, we discuss how these two areas relate to each other, notably in developing countries. The next section reviews the rationale for R&D internationalization and factors influencing technology transfers. In the subsequent section, policy issues in innovation as well as in FDI and foreign R&D are introduced. The interrelated nature of these domains is discussed in the penultimate section. The last section concludes.

1. Organizational changes

For most firms it is becoming untenable to rely on domestic skills and technologies alone. One of the demonstrated benefits of R&D is that it increases the ability of firms to absorb knowledge over great distances (Andersson 1998). TNCs are now faced with significant needs to diffuse and/or absorb technologies worldwide, to an extent that requires a direct presence of R&D facilities in multiple locations. Substantive benefits are derived from the proximity to similar units, favouring clusters and “herd” behaviour in location decisions (von Hippel 1994, Saxenian 1994, Almedia and Kogut 1997). The earlier purpose of primarily adapting products to local markets is now mixed with the motivation to source technology (Sachwald 1998, Mudambi 2002). Firms balance and combine internal capabilities and external uptake for the purpose of innovating more successfully (Cassiman and Veugelers 2002). A tendency towards intensified conflict between home operations and affiliates has also been observed, as reflected in difficulties for TNCs to coordinate global operations (Rajan et al. 2000, Forsgren and Pedersen 2000).

The prevalence of technology and skills transfers in part depends on organizational forms. *Backward linkages* exist when foreign affiliates acquire goods or services from domestic firms, and *forward linkages* when foreign affiliates sell goods or services to domestic firms (both denominated *vertical linkages*). *Horizontal linkages* involve interactions with domestic firms engaged in competing or similar activities.

In most industries backward linkages serve as instruments for spillovers. The drive to raise the quality of inputs serves as an incentive for TNCs to transfer skills to local providers (Chen 1996). Forward linkages are also known to be important, e.g. due to increased competition in supply markets and consumer benefits (Aitken and Harrison 1991, Pack and Saggi 1999). However, in this case the mechanisms for transfers

are less well known. Fors (1996) found technology transfers from parents to be strengthened by forward vertical integration, measured as imports of intermediates from the parent company. R&D in affiliates was found not to be decisive, neither for their own productivity nor for other parts of company groups but, a highly significant interactive effect of affiliate R&D and parent R&D on the productivity of affiliates was identified. Given that R&D in affiliates raises the ability to utilize parent technology, foreign R&D would not be expected to substitute for R&D in headquarters. To the extent that the internationalization of R&D is explained by the advancement of intra-firm exports from home countries, it should strengthen knowledge-creation in headquarters. On the other hand, when foreign R&D is driven by horizontal integration, there are fewer prospects for complementarity. Norgren (1995) observed a growing replacement of foreign R&D for home R&D in Swedish TNCs during the 1980s.

As noted, FDI and foreign R&D may also be motivated by options for *technology sourcing*.⁴ This is an important reason behind FDI flows between developed countries (van Pottelsberghe de la Potterie and Lichtenberg 2001). There is evidence that sourcing is on the rise as a motive for FDI in developing countries too, and for flows from developing to developed countries. A technical laggard may choose to enter a foreign market through FDI even where that involves substantial costs, because positive spillover effects emanate from locational proximity to a technological leader. (Fosfuri and Motta 1999, Siotis 1999).

⁴ Various studies conclude that technology sourcing has become an important determinant of the international location of R&D by TNCs (Niosi 1999, Serapio and Dalton 1999, Driffield and Love 2002). According to Narula and Wakelin (2001) for instance, domestic patents were an important long-run determinant of FDI from the United States into Germany, the Netherlands, and Sweden for the period 1973-1993.

Sourcing can occur through the acquisition of firms that possess valuable capabilities or, through the positioning of an affiliate in an environment where participation in local knowledge-generating networks enable uptake. The terms of uptake will depend on the interplay between the TNC on the one hand, and local institutions and market conditions on the other hand. Scientific excellence provides one kind of raw material. Diversity in terms of alternative sources of seed and venture capital funding, and intensive entrepreneurship, account for competition and high prices from the TNC perspective but, is likely to generate more refined input. Technology may further be obtained from other foreign affiliates, meaning that TNCs learn from each other in third countries. This is consistent with the empirical evidence of increasing internationalization of R&D (Cantwell 1995).

In general, TNCs are more prone to network if the local industry is more competitive, that is, if it consists of attractive partner firms. A small technology gap between the foreign affiliate and domestic firms generally facilitates spillovers.⁵ A dynamic domestic industry may however, serve as an attraction both for FDI motivated by the exploitation of its own technology and those driven by technology sourcing. If the latter motive dominates, entry through M&A may be anticipated. Conversely, a strong domestic industry and, the prospects for technology diffusion to make it even more productive, may represent a threat to a foreign investor. The greater the dependency of a TNC on its own technology and the greater the potential for technology diffusion, the smaller its tendency to engage in intensive clustering and, the greater its reliance on greenfield investment. If TNCs establish affiliates in enclaves, where neither products nor technologies have much in

⁵ Girma and Wakelin (2000) define a low gap in terms of a 15% difference in technology intensity, a medium gap as 15-33% and a large gap as more than 33%.

common with those of local firms, spillovers in either direction are likely to be weak.

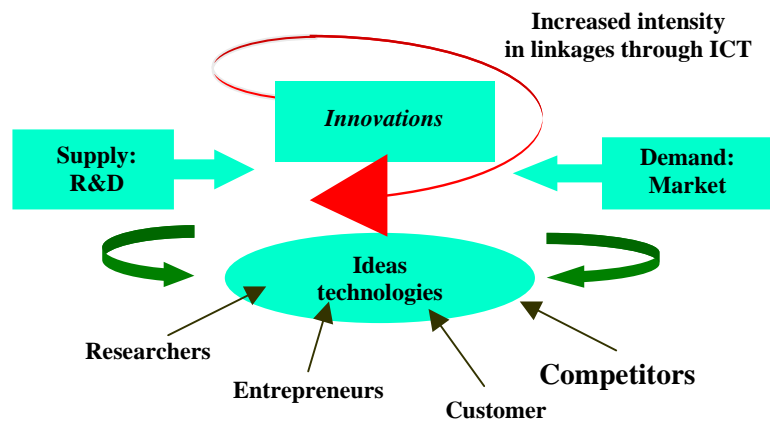
In either case, local R&D may represent an instrument for TNCs to become more effective in channelling and adjusting technologies and skills for their enhancement locally and/or, in packaging them locally for the sake of generating benefits for the company group as a whole. Strategies to exploit own technology vs. sourcing local technology cannot simply be associated with the benefits or costs for a host country nor for a home country. A dynamic knowledge-intensive region may be anticipated to display extensive knowledge-transfers in both directions. In such an environment, firms and individuals possess high competencies in identifying the most favourable locations and organizational forms for various ventures in research, commercialization and production. Whereas it is generally impossible to make any sharp distinction between the noted functions in practice, various factors may push TNC and affiliate behaviour in one direction or the other. An environment plagued by heavy distortions and a mix of certain strengths but severely lacking capabilities in other respects, is likely to experience one-sided knowledge flows and various undesirable consequences.

Put together, current trends are commonly interpreted as a move from “competence exploitation” to “competence creation” in foreign affiliates or, of a shift from “assembly-type operations” towards “research intensive operations” or “strategic asset-seeking investment”. There is the notion of a shift in the orientation of affiliates from “home-base exploiting activity” to “home-base augmenting activity” (Kuemmerle 1996). Furthermore, the geographical reach of affiliates has generally increased significantly. All of these factors in which the internationalization of R&D plays an important role, have consequences for the functioning of affiliates and how they interact with the local environment.

2. Innovation and FDI policy domains

Many countries, developed and developing, now place innovation policy at the very top of their policy agenda, although not always with a clear view of what it entails. The evolution of innovation policy is commonly influenced by its origin, as it has generally emanated from a traditional approach motivated to establish a science base complementary to higher education. Innovation used to be viewed as the linear, one-dimensional output of science and technical progress. However, a number of countries face “paradoxes” in innovative performance, in the sense that R&D is not accompanied by growth. Innovative performance depends on how a range of players interact in bridging the demand for new and better products and, the supply of technology and knowledge. Reduced transaction costs due to the advance of ICT serve to intensify interactions and the innovation process (figure 1).

Figure 1. The intensifying innovation spiral



Source: the author.

Innovation depends on a number of related factors. How much R&D is pursued in an economy matters but represents merely one aspect. The composition of R&D is

important, as is the access to R&D in the rest of the world. The ability to make use of the results of R&D further depends on knowledge and skills in the work force, on competition, governance, organizational modes, on conditions for entrepreneurship and risk-taking, the quality of public institutions, and so on. Both well-functioning private markets and public service functions are needed, and mismatch between them causes problems (Metcalf 1995).

It matters greatly whether countries are able to coordinate reforms in ways that can allow firms and individuals to be subjected to consistent incentives and support in regard to their means to innovate. One aspect concerns the degree to which countries pursue governance approaches and evaluations so as to allow for orderly learning processes and thereby, also facilitate gradual improvement. Such learning should not be piecemeal, but allow for gains in efficiency as well as across policy domains and in the division of public-private responsibilities which, on purpose or inadvertently, exert an important influence on conditions for innovation (Andersson et al. 2004). The economies generally viewed as having organized themselves the best in this area include notably Australia, Finland, Singapore and the United Kingdom. Others, such as Chile, China, France, Germany, the Republic of Korea, the Netherlands, Sweden, Switzerland, Taiwan Province of China and the United States, are viewed as strong in individual areas. For all economies however, specific weaknesses or bottlenecks tend to weaken their overall performance. In addition, institutions and policy frameworks are adjusted only slowly, whereas the needs of technology and the economy evolve more quickly.

Traditionally, FDI policies have been based on a reasoning different from that of innovation policies. In order to enhance the local gains of FDI, some governments levied performance requirements on TNCs in the 1960s and 1970s. The effectiveness of such measures was gradually called into

question, either because they discouraged FDI in the first place or, because investor behaviour was distorted in unwanted ways. In multilateral negotiations, countries have gradually opted to reduce their room for discretion in levying mandatory requirements on investors, whereas incentives promoting voluntary actions remain viable.

Today, most countries, and also many regions, pursue policies to attract FDI, including particularly high value-added activities. Beyond the measures directly targeting foreign investors, other relevant policies include privatization, regulatory reforms and competition policies, the provision of physical or legal infrastructure, tax incentives, and measures to enhance cooperation between foreign affiliates and local players in order to underpin the establishment of long-term links, the training of local staff, the transfer of skills to domestic firms, and so on. Whereas outright subsidies to foreign investors are (at least publicly) shunned, competitive pressures lead countries into taking various initiatives in order to come out on top in firms' investment decisions, some of which may take the form of a detrimental race for attracting FDI (Oxelheim and Ghauri 2003). However, the complexity of the interplay between foreign and domestic players, with the nature of links and spillover effects dependent on the way in which the strategies of foreign affiliates and local players relate in the specific case, calls for precision rather than generality in FDI-policies. There is a rationale for underpinning the establishment of centres of excellence in priority areas, cherishing specific forums and networks for exchange of information between key domestic and foreign actors and, fostering rather than countering the development of professional networks of business angles and venture capitalists.

3. Interrelated agendas

Countries around the world display markedly varying conditions for innovation. However, they are sharing the

experience that no single policy measure or piece of reform is likely to be effective in bringing a radical improvement in innovative capacity. Improving innovative performance may require both enhanced capabilities and revised incentives among a number of actors. On the other hand, specific deficiencies and weaknesses may hamper the overall setup. It is no coincidence that bottlenecks often remain and are difficult to remove over extended periods of time. The prevailing institutional, industrial and social fabric in an economy tends to shape sets of interdependent structures that are not easily overturned. In particular, inefficiencies commonly derive from the influence of well-organized vested interests, which are likely to suffer inevitable losses once their privileges are undercut, whereas the gains are spread relatively thin on the vast number of, often unaware, much less well organized consumers and producers (Olson 1965).

Whereas each country is unique, certain kinds of issues tend to be particularly important in different kinds of countries. There are now examples of impressive leapfrogging processes in the adoption of sophisticated technologies in some LDCs, e.g. through the diffusion of cellular technologies. Even where more basic infrastructure in transport and communication are lacking, LDCs invest disproportionately in ICT and are able to reap significant favourable impacts, if sound regulatory conditions are in place (UNCTAD 2002). However, progress needs to be cherished and recorded differently than in developed countries (Diyamett and Wangse 2001). Developing countries face stern challenges when it comes to raising the capability of private firms to absorb and use the kinds of technology that enter through TNCs.⁶ The academic research community and innovative capacity in industry are often de-linked, hampering the establishment of effective incubators and science parks, seed and venture capital funding, etc. At the

⁶ See Kokko (1994) in the case of Mexico, Kokko et al. (2001) for Uruguay, and Kathuria (2002) and Görg and Strobl (2001) for India.

same time, technology and modern skills need to harmonize with traditional social and community-based conditions that are key to their broad-based application.

In LDCs, innovation is likely to be closely associated with incremental improvement rather than science-based discovery. Here, public support of orderly transactions and the provision of basic education, micro-credit, and also the endorsement of entrepreneurship irrespective of gender and ethnic belonging, are more important for spurring innovation than academic credentials or the protection of intellectual property rights. While managing assets related to the environment and cultural heritage may hold the key to societal gains in local communities (Finger and Schuler 2002), overcoming barriers to learning and new initiatives emanating from traditional perceptions and attitudes may be a prerequisite for adjustment and innovation (Hamel 2005). Capacity building and reform in such respects must precede or match, the attraction and arrival of foreign R&D facilities, if there is to be any wider receptive basis in the form of skilled workers and constructive customers and citizens.

In advanced developing countries, such as Malaysia, Thailand and Brazil, gains from FDI and foreign R&D have been seen to depend on skills upgrading (Best 2001, van Assouw *et al.* 1999). TNC investment in skills is unlikely to suffice unless synergies can be put in place with local training policies and complementary services. On the one hand, inward FDI may account for the decisive impetus for setting off broad-based innovation processes. On the other hand, TNCs cannot be anticipated to induce what is required in a developing country. Whether foreign R&D will be established based on a long-term strategy for knowledge-generation will much depend on the local outlook. Domestic firms, universities and public authorities all count, including in their capacities as prospective partners of relevance to R&D. Some studies have concluded that policy makers should support local competitors in the

domestic business community, rather than target FDI (Wang and Blomström 1992).

In order to build appropriate conditions, remove barriers and gain inspiration, international comparison and drawing lessons from other countries can be helpful. Nevertheless, sound innovation policies are not merely legislated from above. Own competencies need to be developed, which is not facilitated by the superficial marketing of the approaches developed by others (Ellerman et al. 2001). Paving the way for innovation requires the involvement of multiple stakeholders or, at least their willingness to accept novel solutions to prevalent problems.

4. Conclusion

Beyond the mere size of FDI and foreign R&D, the question is the roles they play in an economy. Various factors influence observed outcomes. Although most empirical studies conclude that FDI tends to be positive for home as well as host countries, recent work has rendered ambiguous conclusions, and pointed to a complex picture. FDI and globalization bring structural changes that adapt to prevailing conditions and incentive structures.

Today, there is a strong drive for TNCs to diffuse R&D facilities internationally and to allow for enhanced creativity and strategic initiative in individual units. Foreign R&D brings a potential for enhanced commitment to local markets, and adjustment and enhanced diffusion of technology and skills. At the same time, TNCs need to foster an appropriate division of labour between their units for the purpose of internalizing benefits within the group. Individual units are generally motivated to manage knowledge and process or product development in ways that benefit the group as a whole. It is an open question whether they will source technology locally or add technologies so as to help upgrade and strengthen the local

environment. Broadly speaking, R&D-facilities in developing countries continue to have limited scope. Given insufficient infrastructure, deficiencies and rigidities in work force skills and labour mobility, weak product/market competition, the absence of local research institutions that can support commercialization of technology in early stages, public authorities and governance that provide risks for technological lock-in and, disconcerting disturbances in playing rules over time, TNCs cannot be expected to establish strongly committed R&D facilities in any particular host country. On the other hand, a country that is not only offering promising growth prospects but, which has put in place an institutional and micro-based fabric conducive to mutually enhancing knowledge exchange, has considerably better chances of enticing foreign technology in ways that will add to the dynamism of the local environment. It is essential that policies in support of FDI and foreign R&D are designed and implemented in tandem with an upgraded broader policy agenda to enhance innovation and growth.

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FDI, R&D and technology transfer in Africa: an overview of policies and practices

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Generally, FDI flows to Africa have expanded only marginally and are still at levels behind those of other developing regions. Africa accounted for less than 1% of global FDI inflows in the late part of the 1990s (UNCTAD 2001). While inflows to developing countries as a group increased from \$20 billion to \$75 billion between 1981 and 1985, Africa's share of that inflow dropped (UNCTAD 1999). Historically, low rates of FDI inflows to the region have been explained by hostile policies, unstable political environments characterized by civil wars and armed conflicts, a lack of effective regional integration efforts, poor and deteriorating infrastructure, burdensome regulations or, a lack of institutional capacity to implement FDI policies and, a lack of institutional clarity to promote investment in Africa.

There is scant information on the sectoral composition of FDI in Africa. However, available data show that more than 50% of total FDI inflows to the region target natural resource industries, especially mining. The strong relationship between FDI flows and natural resources has been well researched and evidenced. For example, in Ghana investors from the United States, Canada and Australia have been interested in gold. Between 1988 and 1998, more than 60 prospecting and reconnaissance licences were awarded to companies from these countries. In Guinea, more than \$130 million had been invested in the Aredor mine by 1996. In the United Republic of Tanzania, mining is the largest industry for FDI and gold is the largest branch. By 1998, total cumulative FDI in mining was

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estimated at \$370 million. Mining attracted 65% of FDI, services 19% and manufacturing 16%. More than 90% of the \$1.5-billion FDI inflows to Nigeria in the 1990s targeted the petroleum and natural gas industries. The petroleum industry also dominates FDI in Angola (UNCTAD 2001).

The agricultural industry of the region has attracted more modest FDI. Some of the major projects of the 1990s included Del Monte's investment of more than \$9 million in banana plantations in Cameroon, Lonrho's \$7.5-million investment in tea estates in the United Republic of Tanzania and, Aberfoyle Holding's multimillion dollar investment in palm oil in Zimbabwe. In the same vein, a large part FDI inflows to Uganda went to the beverages, sugar, and food processing industries and coffee and tea plantations. Uganda also attracted some manufacturing investment in the textiles and packaging industries. Outside manufacturing and agriculture, liberalization of the telecommunication industry attracted considerable investment, while in Ethiopia the hotel industry was the largest recipient (UNCTAD 2001).

African countries are reforming their policies, legislation and institutional arrangements to attract FDI. They treat FDI as a major source of capital for their economic change and development. Some of them are putting emphasis on FDI as a carrier of new scientific knowledge and technological innovation. Investment policies and laws of a growing number of African countries contain provisions aimed at encouraging foreign investors to contribute to the strengthening of the national scientific and technological bases by targeting R&D. Despite these efforts, the R&D content of FDI flows to Africa is very low. This is mainly because of weak domestic R&D capabilities and, in many cases, the absence of institutional mechanisms that provide explicit incentives to investors to target knowledge-based and -intensive activities.

Most African countries have embarked on wide-ranging policy, political and institutional reforms aimed at reducing (and, if possible removing) barriers to entry of foreign capital, particularly FDI. Trade and investment liberalization, privatization and the creation of various incentives for foreign investment have received considerable attention from governments. Regional economic integration bodies and free trade zones have been created to enlarge the size of markets and to adopt common investment regimes at subregional and regional levels. These efforts are based on the recognition that FDI can stimulate economic growth, generate new employment opportunities, promote the transfer of new technologies and contribute to environmental sustainability in the region.

The surge of interest in FDI and TNCs has been so high that in many countries there have been high expectations in terms of what these companies can do, and generally on the development effects of FDI. While FDI can indeed, contribute to national economic and social development in many ways, the engagement and performance of domestic actors are crucial. The effect of FDI largely depends on the policies of the host country. This goes beyond the mere liberalization of economies. Deliberate measures to develop human capital and the physical and social infrastructure can also be valuable ways to enhance the quality of FDI that countries can attract.

The role of TNCs and FDI in promoting the scientific and technological development of African countries is the subject of increasing policy debate and academic research (Oyelaran-Oyeyinka 2004). There is concern about the extent to which FDI stimulates R&D in and transfer of new technologies to Africa. The nature of policies and institutions that are necessary to encourage R&D-based FDI is at the heart of the debate. The main focus of policy makers is on the necessary reforms that should be instituted by their countries to attract the type of FDI that builds or strengthens their domestic R&D capabilities and stimulates local technological learning.

It has been demonstrated in Africa that TNCs tend to invest in R&D in those countries that:

- have a minimum domestic R&D capacity;
- provide legal and economic incentives for knowledge-based investments; and
- provide flexibility for local institutions to forge R&D partnerships with foreign affiliates.

The cases of Kenya and South Africa show that for FDI to contribute to R&D, host-country technology policies should converge with FDI legislation. In the case of Kenya, restrictive measures pertaining to the granting of research permits to foreigners and the absence of a national strategy focusing on knowledge-based investment have restrained FDI to a few R&D-oriented activities, mainly in agriculture. In the case of South Africa, there are explicit strategies to encourage foreign affiliates to engage in R&D. In South Africa local companies and affiliates of TNCs are increasingly investing in R&D. FDI is a growing but not really significant carrier of R&D in the automobile industry, ICTs and agriculture.

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