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# Knowledge Caps in Industrial Development

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## 1. Introduction

In developed countries the speed of technological change is rapid and the diffusion of new knowledge is facilitated by high educational levels and production competencies. In developing countries a consistent part of the population is illiterate, domestic development of scientific and technical knowledge is absent or proceeds very slowly.

Transnational corporations organise their production across nations and, ‘on the surface ... [they] would seem to be ideal vehicles for helping underdeveloped countries’ to improve their relative position with respect to industrialised countries.<sup>1</sup> Yet they are playing only a minor role as far as knowledge accumulation in developing countries is concerned. The volume of investments in innovative-related activities performed in developing countries has increased marginally.<sup>2</sup> Productivity, which is an indicator of the effects of technological transfer and learning, has not increased indistinctively across countries and industrial sectors. It has been shown that transnationals stimulate domestic firms to become more productive only in sectors where best practices are consistent with their existing competencies and capabilities,<sup>3</sup> ‘but that there are no significant transfers of modern technologies’.<sup>4</sup> Moreover as Hymer observed,<sup>5</sup> foreign affiliates, sometimes operates in ‘enclaves’: inside, modern technologies and products manufactured for foreign markets have not much in common with the backwardness of the external environment. Under these circumstances, spillovers of knowledge and fertilisation of domestic firms through learning do not take place.<sup>6</sup>

The recognition of the link between the international division of labour and knowledge diffusion has been somehow disregarded by the economics of innovation and by development and internationalisation theories. Each of these perspectives has, in turn, addressed a specific aspect of the problem, namely: the nature of knowledge and the conditions under which technological change occurs; the importance of human capital formation and educational policies for promoting development; and the role of knowledge assets for the internationalisation of production either to exploit technological advantages abroad or to benefit from localised knowledge in host countries. In this paper, these angles are three pieces of the same picture, which are combined together in order to provide a perspective on how the knowledge incorporated in production impacts on the accumulation of localised knowledge.

As mentioned, theory affords knowledge an extremely positive role in the activation of endogenous development process.<sup>7</sup> We acknowledge this point and we go further. The

issue of knowledge formation is not just a matter of how much knowledge is accumulated. It entails also a concern about the quality of knowledge and about who controls the direction that knowledge formation takes across localities. The three theoretical perspectives on knowledge formation and technological change, local development and the internationalisation of production operated by transnational corporations have not yet been combined to provide an answer to this question.

One of the most significant stimuli to identify differences across localities in terms of their function within the international division of labour comes from Hymer's work. At the heart of his radical perspective is the awareness that the production system dominated by transnationals is defined as a hierarchy of activities and powers associated to those activities.<sup>8</sup> The hierarchical structure of the corporation is mirrored by the "macrocosm" provided by the international economy so that the application of location theory to the corporate hierarchy of functions suggests concentration of control within the economy.

Building on this perspective, we suggest that the fundamental issue that links internationalisation of production by large corporations and the formation of knowledge capital across different localities is the uneven distribution of decision-making power with respect to technologies, educational programmes and innovation related activities. This idea is rooted in the strategic decision making approach which, as Cowling and Sugden<sup>9</sup> maintain, goes to the heart of how production is carried out. The firm, as an island of conscious planning,<sup>10</sup> allows for the coordination of production from one centre of strategic decision making. Consistently, a transnational corporation is a means to control and coordinate production from one centre of strategic decision-making across national borders.<sup>11</sup> This suggests the possibility of strategic failure across economic systems, which occurs when the process of strategic decision making in an economy prevents from the achievement of a socially desirable outcome.<sup>12</sup>

In particular, the international coordination of manufacturing functions may imply at various degrees the 'fragmentation' of production knowledge. The concept of 'specialisation' has a positive meaning and refers to the acquisition and consolidation of technical, organisational and social skills together with the ability to understand, if not undertaking, the production process as a whole. In this sense, as Young argues, specialisation is beneficial both for the locality as a collective entity and for individual actors. With 'fragmentation', by contrast, we mean the creation of very narrow functions which require little or no specific technical, organisational, or social knowledge. Each mini-function can be monitored but it will hardly let the general competences and skills of the executors emerge. The link with the overall production process is hardly perceptible.<sup>13</sup> Within the international division of labour operated by transnationals we recognise the risk of excessive fragmentation, especially in those host countries where transnationals' activities support the emergence of subcontractors of the sweat-shop kind. In Transition Countries, the nature of manufacturing activities mainly related to traditional sectors is an example of how foreign capital can be a source of fragmentation that disqualifies labour.

Constraints over individuals' capabilities may not combine with local development objectives, thus leading to strategic failure. With respect to knowledge creation, the implications of strategic failure have been left unexplored. Knowledge formation is a time and capital consuming activity. Developing countries, in particular, have been recognised to have many competing needs while suffering from lack of capital.<sup>14</sup> The creation of a knowledge base is a need which struggles with other priorities. For this reason policy makers may leave the field open to foreign investors. Where in developing countries the rate of technological change and accumulation of production knowledge is mainly determined by FDI inflows, policy makers face two issues of strategic importance which both have relevant implications for the direction that development may take within regions. The first is the danger of a domination of production, technological and educational decisions by large corporations. The second relates to the need not just to promote the *rate* at which technological change takes place, but also to be aware of and promote the *direction* of such a change.<sup>15</sup> This could be done, for instance, by encouraging investments in knowledge creation (R&D and higher education) that are not only linked to corporate interests but that are meant to increase the choice options of people and to pull regions out of subordination.

Building on these considerations, we would like to deal with some of the limitations and effects of transnational corporations as means to facilitate learning and the diffusion of knowledge in developing countries. We then link the results of this analysis to phenomena of geographical polarisation of knowledge creation activities. Our aim is to provide a framework for understanding the direction of industrial development in the light of the international division of labour operated by transnationals. In particular, we focus on those aspects of production that are related to knowledge, its nature and evolution over time. Our contribution emphasises how production decisions influence the evolution of knowledge assets within firms and territories, and determine (sometimes irreversibly) the evolutionary trajectory of localities. Given the cumulative nature of learning and the close links that relate actors' opportunities with their past experiences, we argue that the technological direction defined by transnationals might not have much to offer to developing countries or, worst, might activate a vicious circle that hamper the capability of developing countries to discover and develop innovations of their own.

After having briefly introduced - in Section 2 - the knowledge concepts that we will use in this work, in Section 3 we sketch some classical economists' perspectives on those aspects of production that are mainly related to knowledge. In Section 4 we provide a sectorial characterisation of knowledge creation and innovative related activities. In Section 5 we relate FDI to the development of knowledge capital within foreign locations, paying particular attention to developing countries. Then, we apply the theoretical considerations of the previous sections to the development of local production systems, looking at those mechanisms that may favour or hamper processes of knowledge accumulation within localities. Section 6 specifically addresses the problem of strategic failure and polarisation effects in knowledge accumulation and innovation related activities. Section 7 applies Hymer's law of uneven development to the international localisation of activities, and provides an explanation of how the organisation of

production discriminates amongst economic systems with respect to knowledge formation. We end this paper by re-considering industrial development in the light of the impact of the international division of labour as it is planned by transnational corporations. Policy suggestions follow.

## **2. Knowledge concepts**

The concept of knowledge has been used in different ways. One major difference can be found in its use as applied to individuals, organisations, and institutions. The conceptual effort of going through different analytical objects is determined by the complexity of this concept, which cannot be identified exclusively with the individual sphere or the collective sphere represented by institutions.

Although we can say that individual knowledge is subjective because it is linked to the cognitive sphere of individuals, the process of learning, both at the individual, organisational, and local level, is collective and involves social interaction. Learning is a process that refers to the acquisition of scientific and codified knowledge (the knowledge codified in a book), to the interpretation of external stimuli (the knowledge that individuals derive from observation of the external world and the ability to adapt to such stimuli), and to the imitation of other people's actions (the apprentice who follows the master's deeds). The interaction with the environment, as well as communication amongst individuals, is therefore a fundamental aspect of knowledge and learning dynamics.

In particular, following Hayek's theoretical contribution to the theory of knowledge, we will refer to individual knowledge as the subjective interpretation and use of the pieces of information that come from the environment. It can be knowledge about social norms, natural phenomena, specific activities, etc. As the cognitive sphere of each individual is different, each individual retains unique pieces of knowledge.

When referring to technological knowledge we mean the individual and organisational knowledge that is required to undertake specific production activities. It also includes the knowledge incorporated in production machineries and technologies.

Knowledge inside firms and organisations in general requires a conceptual leap. It subsumes the knowledge of individuals that is relevant to a firm's activities, but also the knowledge institutionalised in the norms and routines that have cumulated over time. Knowledge is reflected in the amount of competencies internal to the firm. However, it is not only productive knowledge that requires an appropriate organisation. Firms need both internal and external organisation to provide a framework to develop and apply their capabilities.<sup>16</sup> In this sense, setting linkages with other actors may make available more opportunities for firms to access and make use of the knowledge they have acquired.

If we enlarge the perspective to production systems, we talk about localised knowledge, which consists of the capability to learn and internalise the knowledge diffused in a particular space of production (a geographical space or a virtual community of actors), and to recombine it with the individual knowledge of each actor.<sup>17</sup> Marshall's industrial atmosphere,<sup>18</sup> for example, was the tacit and unexpressed knowledge that the inhabitants of the industrial district, from children to adults, could absorb just because of coming into everyday contact with the mesh of activities and social relations occurring within the geographical space of the district.

These notions, which have been combined and developed within the competence view of the firm, emphasise the heterogeneity of firms, in terms of what they know and what they can do. In particular, firms generate these differences endogenously, through a continuous process of knowledge accumulation and creation of routines.<sup>19</sup> Capabilities, which are associated with knowledge, represent the 'option set' of a firm and deciding which competences to construct is a strategic decision.<sup>20</sup> These assumptions provide the insights to explain production, specialisation and the division of labour amongst firms and regions.<sup>21</sup>

### **3. Knowledge in production: some classical views**

During the production process, inputs are combined by virtue of five complementary forms of knowledge. One is the knowledge of individuals, which is reflected in their 'skills, dexterity, and judgment'. The second is the knowledge incorporated inside capital goods or, in other words, the technology and the tools used to undertake production activities. The third form of knowledge is organisational, rooted in the routines and practices of the firm.

Production, however, does not occur in a vacuum, and increasing specialisation requires network relations and co-ordination amongst firms. Recent developments in the international organisation of production are characterised by the growing intensity of networks of suppliers and prime contractors which, by virtue of their linkages, extend their knowledge and production potential.<sup>22</sup> Investments in specific technologies require that firms are committed to a constant interaction with other firms specialised in complementary activities.<sup>23</sup> A fourth form of knowledge is therefore relational, and it directly reflects the capacity of firms to use the knowledge of others by means of co-ordination. The fifth type of knowledge is localised knowledge, or the knowledge diffused within a specific space.

According to Smith, the source of value in production is labour. In particular, the value of a good exchanged in the market is measured by the amount, the degree of hardness and the skills required for its production.<sup>24</sup> The knowledge that a worker must cumulate in order to produce implies his or her involvement in a process of learning. A focus on labour, therefore, stresses the importance of human capital and continuous learning not only for those activities that are directly linked to research and development, but also

(Smith would probably say ‘especially’) for those workers who are directly involved in productive activities. Besides physical capital, investments would also be directed to renew and increase labour’s knowledge.

When workers undertake production functions they make use of tools and machineries. These means of production embody the knowledge of those who designed them. In this sense, we understand capital goods as a combination of knowledge and matter.<sup>25</sup> The boy described by Smith who ‘was constantly employed to open and shut alternately the communication between the boiler and the cylinder ... observed that by tying a string from the handle to the valve which opened this communication to another part of the machine, the valve would open and shut without his assistance, and leave him at liberty to divert himself with his playfellows’.<sup>26</sup> The innovation introduced by the young boy was then installed as a standard technology in subsequent engines, and production activities could benefit from the knowledge that that young worker was able to imprint in the earlier machine.

If Smith emphasised the role of knowledge in production in terms of the division of labour and of individual skills, subsequent contributions focused more directly on the role of machines. So the question of why a firm should have introduced new machineries found an answer with Ricardo in the possibility for the capitalist to gain extra profits.<sup>27</sup> Machines substitute labour if the cost of the innovation is lower than the cost of the labour force substituted by the new technology. The overall employment per each unit of output would diminish whenever the production of machines requires less labour than that which is surrogated by the machine itself. Ricardo’s argument was reconsidered by Marx,<sup>28</sup> and nourished the still going-on debate about the implications of technological change for employment.<sup>29</sup>

Marx, however, went further. The technique (tools) applied to machines substitutes individuals, whose sphere of action shifts from that of physical production to the organisation, co-ordination and control of machineries. On the one side this impoverishes the knowledge and abilities of individuals who are confined by an extreme fragmentation of work.<sup>30</sup> On the other side the introduction of machines, over time, qualifies labour by substituting operational functions with more qualified tasks.<sup>31</sup> Machines can produce physical goods without the mediation of individuals. Individual’s production activities become those related to the design, organisation and control of machines: it shifts from physical production to the production of knowledge.<sup>32</sup> However, shifts from ordinary labour to forms of more qualified work do not occur homogeneously in the economy. Compensation mechanisms may not be thought of as instantaneous and automatic.<sup>33</sup> Furthermore, there are a number of tasks that are undertaken with the direct involvement of the labour force in manufacturing activities whose location impacts on countries’ trade balances.<sup>34</sup>

Considering the arguments presented above, classic economists rightly anticipated that the organisation of production impacts on the qualification of labour: too fragmented tasks disqualify labour. The value of production is generated by the skills and competence

of labour which come about through specialisation (as opposed to fragmentation). In parallel, technological progress is associated with specialisation and with the quality of human capital. Vice versa, technologies, which incorporate knowledge, represent a source of learning. These considerations suggest that the technological characteristics of industrial sectors imply different modalities of organisation of production and different learning possibilities at the individual level, at the level of firms and within localities.

#### **4. The sectorial characterisations of knowledge creation and innovation**

The intensity of the knowledge involved in different production activities varies according to scientific and technical complexity as well as to the tacit or explicit nature of knowledge. In these respects, we discriminate amongst activities both within the same sector as well as amongst different sectors. Accordingly, differences in the international division of labour can be further appreciated by distinguishing production according to the knowledge intensity of labour, technologies and products.

Knowledge and innovation are not developed across the whole economy indistinctively. As Kondrat'ev,<sup>35</sup> and lately Schumpeter<sup>36</sup> emphasised, technological progress occurs following cyclical waves, during which new technological trajectories emerge. At the same time, there may be sectors going through an expansive phase and, oppositely, sectors undergoing decline. The hypothesis that sectors differ in the rate and modalities of innovation has been interpreted by Pavitt, who distinguishes industries where firms rely on the technology produced by other sectors from those where firms support production with internal R&D. According to this main criterion, sectors are classified as 'supplier-dominated', 'scale-intensive', 'specialised suppliers' and 'science-based'.<sup>37</sup>

In particular, supplier-dominated sectors are essentially traditional labour intensive sectors (e.g. textiles and clothing, leather and footwear, wood and furniture) where innovations are largely related to processes. Technological opportunities are those determined by the new technologies and intermediate inputs produced by other sectors. The process of innovation is therefore characterised by the diffusion of best practices and innovative intermediate inputs. Knowledge is important to the extent that it allows producers to efficiently introduce the technologies produced elsewhere.

Scale-intensive sectors involve complex manufacturing systems for which both product and process innovations are important. Economies of scale can be obtained both for production and R&D activities. Firms are generally large and are likely to vertically integrate the design/manufacturing of their production technologies. Scale intensive sectors include transport, the production of electrical durable goods, chemicals, glass and other building material.

Specialised suppliers produce capital goods and focus mainly on product innovation. Firms are generally small and act in strict connection with their clients. These goods are

capital inputs for other sectors and incorporate very high technical skills of designers. The knowledge included in products is partly tacit and cumulates over time.

Science-based products complete the taxonomy. These include firms whose production is strictly linked with scientific knowledge (e.g. pharmaceuticals, aerospace, electronics and computer industries). Innovation occurs with the emergence of new technological paradigms. Appropriability of knowledge through patents is high and the innovator often benefits from a temporal advantage which allows him/her to exploit market leadership. Innovation related activities are formally developed inside R&D centres. These goods are often incorporated as intermediate products by other sectors. Firms are often of large size, although small Schumpeterian innovative firms may constitute an exception.<sup>38</sup>

This interpretation of manufacturing sectors introduces Dosi's hypothesis of technological paradigms and trajectories. According to his contribution, one of the most relevant for the economics of innovation, the variety of forms of production organisation can be explained in terms of differences of evolutionary processes amongst sectors. Advances in scientific knowledge open up new *technological opportunities*, which may be translated into innovations. New opportunities, in particular, are defined within technological paradigms.<sup>39</sup> It follows that change is the outcome of a cumulative process of knowledge creation, learning and adaptation which cannot be simply traced back to a reaction to changes in market conditions. A change in relative factor prices such as an increase in the cost of labour, or of any raw material, may not be a sufficient element for introducing labour/raw materials saving technologies. The same can be said for demand fluctuations. This perspective suggests that the context in which technological change occurs does not have to be linked only to the market, but must be understood also in terms of the opportunities offered by existing knowledge.

Whilst some knowledge may be generally available, for instance through the market for technologies, tacit and subjective forms of knowledge, which are built in firms' routines and experience, may largely differ across economic actors. Past experience is important to the extent that new opportunities emerge depending on the contextual knowledge that was cumulated earlier within the firm (scientific, technical and organisational knowledge in its tacit and explicit forms) and on the more general advancements of science and technology, eventually stimulated by changes in relative factor prices. On the one hand there is a private sphere of knowledge evolution which involves individuals and their subjective sphere as well as organisations. On the other side, individuals and firms' learning effects and is in turn influenced by the evolution of technological paradigms and general science. These knowledge elements are shared by actors operating within a particular technical or local community. Similarly, the larger set of institutions that supports the established technology and industry is oriented towards sectorial specialisation and can be considered as a further element that inhibits the shift from old to new practices and knowledge. As Veblen<sup>40</sup> stressed with his 1915 essay, the institutions suitable for a specific set of technologies could be inappropriate for the new. Perez and Freeman,<sup>41</sup> for instance, suggest that, after 1970, the rise of information technologies urged a change towards an institutional setting with respect to those needed before.<sup>42</sup> The

basic point that we retain from these contributions is that industrial sectors and firms are heterogeneous with respect to knowledge assets and that new knowledge, in the form of technologies, routines, human capital, and institutions is path dependent: radical shifts require radical changes in the set of specific assets of firms and institutions. These imply costly reform processes and time.

## **5. Transnationals and technology transfer**

The impact of production activities on local knowledge is not neutral. The taxonomy theorised by Pavitt, which finds several confirmations in applied analysis, links each sectorial group to specific innovation capacity and size characteristics. In the international economic system, the production of knowledge is increasingly linked to large capital investments that leave space for economies of scale to be realised, especially in R&D. Scale-intensive and science-based sectors are two examples of this. More generally, the size of firms is often significantly correlated with learning and R&D.<sup>43</sup>

Transnational corporations (TNCs) are firms of undoubtedly large size which have strongly impacted on the internationalisation of production. Slaughter notices that from 1979 to 1999 ‘the ratio of world FDI stock to world gross domestic product rose from 5 to 16 per cent, and the ratio of world FDI inflows to global gross domestic capital formation raised from 2 to 14 per cent. One consequence of this is that an increasing share of developing countries’ output is accounted for by foreign affiliates of multinational enterprises’.<sup>44</sup>

However, the impact of transnationals on world production is expected to be even higher. With the diffusion of networked organisations, transnationals control production far beyond the legal boundaries defined by property rights, as planning is extended to aligned suppliers and to the cascade of firms that are linked to first tier suppliers.<sup>45</sup> Sacchetti and Sugden consider ‘the boundaries of the firm as the pattern of structural influences that the firm has on other actors’ strategic decisions’.<sup>46</sup> A TNC’s technological strategy, therefore, touches upon a space that is defined by the TNC’s power to direct a number of other networked firms.

How do transnationals allocate their knowledge creating capacity across regions and countries? Outside home countries, as Vernon anticipated, the nature of technological activities carried out by transnationals seems to be concerned with the adaptation of products and production processes to local market conditions.<sup>47</sup> In particular, process innovation could be determined by differences in the labour market, according to the perspective offered by the Ricardian hypothesis.

More recently, as other contributors have observed,<sup>48</sup> the size of R&D investments and the complexity of the knowledge incorporated by technologies has pushed transnationals to look for other factors such as seeking strategic assets created abroad (e.g. host country’s technological developments). In this case, through FDI the firm exploits the

knowledge of the host country. For 'asset-augmenting activities' to take place, local knowledge assets must be consistent with the transnational's aim of reinforcing its technological advantage. Therefore, as Narula<sup>49</sup> observes, reference is to intermediate industrialising economies and industrialised economies, where the national innovation system of those countries supports top level R&D and education or offers, at a sub-national level, the possibility to benefit from agglomeration economies.

As empirical evidence shows, however, firms producing for the world market 'may keep most of their technology production close to the home base' even in industrialised countries,<sup>50</sup> thus supporting (or at least not contradicting) Vernon's initial hypothesis.<sup>51</sup> Reasonably, FDI inflows in developing countries will provide no evidence of the technology sourcing hypothesis. As Patel and Pavitt have showed, the degree of internationalisation of R&D is not positively correlated with high technology: 'with the notable exception of pharmaceuticals... the proportion of firms' innovative activities performed domestically increases with the technology intensity of the industry'.<sup>52</sup>

Although research activities are mainly concentrated in home countries, transnationals may represent a channel for the diffusion of existing technologies and practices. Current analysis of the relationships between FDI, human capital and knowledge diffusion focuses on three main aspects. One is the upgrading of production processes by local subcontractors through the introduction of production standards. Related to the use of technical standards are voluntary processes of technological transfer and best practices from the foreign affiliate to local partners. In this case the technological paradigm which prevails in the sector determines the technologies and the knowledge that are needed for a firm to be involved in production networks.

Another aspect of interest is provided by knowledge spillovers from transnationals to local economic actors. In particular, on productivity spillovers authors recognise that FDI creates a potential for spillovers of knowledge to local firms and the labour force.<sup>53</sup> Spillovers take the nature of 'non market interdependence' or external economies. In this specific case external economies are a 'peculiarity of the production function' as the output of a firm (e.g. domestic firms) 'depends not only on the factors of production ... utilised by this firm but also on the output ... and factor utilisation of another firm or group of firms'.<sup>54</sup> Technological externalities occur, for instance, when domestic firms benefit from human capital formation by foreign affiliates, or when domestic firms upgrade their technologies by virtue of their proximity to more advanced technological realities. In both these examples the transnational aims at exploiting its ownership advantages, such as patents, trademarks or proprietary technologies in the host country. Vice versa, when it is the local knowledge that is attractive, foreign affiliates can benefit from the specific competencies of the local system, hiring skilled personnel (such as in the Irish case), or being close to centres of scientific or technological excellence (as in the case of Silicon Valley).

The examples of spillovers refer to industrialised countries, where results are however mixed.<sup>55</sup> For instance, one of the most prominent results of earlier studies is that

technologies are first transferred to high per-capita income countries, with high literacy rates and well developed manufacturing sectors<sup>56</sup> where, however, they do not always increase domestic firms productivity.<sup>57</sup> For developing countries, on the contrary, there is very little evidence of spillovers.<sup>58</sup> In particular spillovers are concentrated to middle-income developing countries while there is no support of the existence of such effects in countries with the lowest per-capita income.<sup>59</sup>

This variability of results does not allow us to create a straightforward equation between FDI and knowledge spillovers. One reason, as we mentioned earlier, is that spillovers are externalities which are not encouraged by leader firms. On this point, it has been shown that FDI and technological licensing are higher in host countries with a strong property rights system.<sup>60</sup> Consistently, Mansfield and Romeo<sup>61</sup> conclude that for joint ventures, when spillovers are more likely, US transnationals transfer only older technologies.

A second reason is that spillovers, as well as strategic forms of technological transfer, may occur if there is a basis of knowledge which allows domestic firms to understand new technological opportunities and to apply them. The innovative capability of economic actors is in their ability to integrate the knowledge of others and adapt it to specific needs, thus generating new, non-redundant knowledge.<sup>62</sup> The transformation of knowledge flows into innovative solutions is related to what Cohen and Levinthal<sup>63</sup> have defined as 'absorptive capacity', or the ability to recognise relevant external knowledge, assimilate it and apply it to commercial ends. This ability may be a precondition for new knowledge creation and for the introduction of innovation. The ability to absorb and integrate knowledge builds upon the previous learning experiences in general science and in its technological applications. Thus we find a link between present innovation and past knowledge creation: an innovation that is introduced today depends on the path opened by the research activity started previously<sup>64</sup> and by the technologies that are already in use.<sup>65</sup> Deficiencies in communication infrastructures in developing regions and the scarcity of knowledge capital, which is in turn related to low educational levels of the labour force, are major obstacles to the activation of knowledge flows between firms.

One of the major assumptions of approaches based on path dependence is that there is a degree of irreversibility for which previous decisions (for instance in terms of sunk or switching costs, knowledge basis and learning ability) may have irretrievable effects on the future opportunities of actors at the level of individuals, firms and territories. What happens at the local level with respect to production, training, education and basic research institutions, the financial system and market structure is paramount for the process of knowledge creation and technological specialisation.<sup>66</sup> Thus the decision of headquarters to locate activities with relatively low intensities of knowledge in developing countries has, under particular policy conditions, a restrictive effect on the development possibilities of the local industry and of the locality as a whole.

In those economies where the lack of local capital and knowledge leaves space for foreign investments, production decisions about learning and technological direction are the domain of transnationals. For policy makers, to rely on technological transfer from

foreign affiliates to local subcontractors or on the theoretical possibility of spillover effects implies the risk of excluding developing regions from generating autonomous innovative capabilities. With human capital being maybe poorly educated, lacking technical and managerial skills, these regions will be included in the international organisation of production to provide cost advantages to foreign investors (e.g. in terms of labour) but will be restricted to traditional, labour intensive activities characterised by a disqualifying fragmentation of tasks. These are sectors, as Pavitt emphasises, that are not autonomous generators of innovations and that do not promote R&D within the sector.

## **6. Strategic failure and polarisation effects in innovation related activities**

The assumption we make, building on path dependency, is that learning and technological dynamics can activate a virtuous circle of knowledge generation and accumulation, which can be beneficial for local systems, both because it augments the value added produced and because it impacts on the ability of local communities to access a wider range of opportunities and shape their development objectives accordingly.<sup>67</sup> Capital accumulation, however, is not exempted from generating conflicts and continuous tensions, either amongst social groups, regions or nations. Phenomena like these could be interpreted as the result of the eventual discrepancies that arise between the objectives motivating firms' strategies and the consequences (more or less unintended) that are generated at the collective level. For example, we can talk about positive unintended consequences in the case of spillovers or about negative (alternatively intentional or unintended) consequences when the development of human capital is hampered by a concentration of traditional, labour intensive sectors.

*Within regions*, transnational strategies may generate tensions due to strategic failure. Large transnationals, especially within those industrial sectors which heavily rely on R&D activities, convey great financial resources into innovation programmes. Besides, knowledge creation activities are central in the consolidation of oligopolistic or monopolistic positions and transnationals often operate in oligopolistic or monopolistic markets. Dunning<sup>68</sup> remarks that 'in some sectors (e.g. oil, tobacco, aluminium, razor blades, rubber tyres and reinsurance) the output is largely in the hands of a few large firms. In others (e.g. cosmetics, pharmaceuticals, food processing, insurance and hotels) the concentration ratio is not as high, but the sector is characterised by other market imperfections (e.g. extensive product differentiation and entry barriers).' Thus, in these sectors, control over strategic decisions with respect to innovative related activities and knowledge assets is retained at the heart of transnationals, which determine their broad corporate direction even (but not necessarily) against the will of other actors involved,<sup>69</sup> such as domestic firms, subcontractors, labour, trade unions, consumers, and governments. Examples of strategic failure of this kind can be found in pharmaceuticals where, for instance, the incentive to invest in R&D on the illnesses diffused within industrialised countries may be higher than the inducement to invest in research for finding cures to diseases that are endemic in developing countries, where purchasing power is very low and could not compensate the corporation for R&D expenses.

Strategic failure also occurs when transnationals influence the formation of human capital according to their specific needs. Host countries may experience the transfer of simple or complex technologies depending on the level of a number of elements, such as the quality of their human capital and skills. The nature of these technologies defines the quality of competences that can be learned locally, thus determining what have been named the 'technological opportunities'<sup>70</sup> of local actors. Given the cumulative nature of learning processes the strategic decision of which pieces of knowledge have to be used internationally within host countries impacts on the direction that localised knowledge will take in the future. The result might not be in line with the development objectives of a country thus incurring in strategic failure. For example, when inward investments promote the demand for highly qualified professionals, scientists or specialised technicians, host countries can be enriched, over time, by diffused scientific, managerial and technical knowledge which can be used as a basis for promoting local entrepreneurship and specialisation. Conversely, a transnational might operate as an 'enclave' and siphon off the best trained individuals from the local system, thus leaving domestic firms with shortages of human capital and knowledge. This effect would negatively impact on the development of domestic entrepreneurship. Another example is that of countries that attract labour intensive activities and specialise in low value added production. Once individuals, firms, and institutions learn to perform and deal with low value added activities, they may be locked in and lack the conceptual categories to understand the evolution of knowledge in sectors characterised by higher levels of knowledge complexity.

In parallel, tensions *amongst countries and regions* may occur due to polarisation effects. As the dynamics of development follow different levels of speed, imbalances amongst local systems can generate, as Myrdal emphasised,<sup>71</sup> effects of attraction and diffusion with respect, for example, to human and capital resources, trade, or social relations. Developed localities usually exert their power of attraction with respect to the resources of less dynamic centres, whilst diffusion occurs from the strongest locality towards neighbouring systems when the push for expansion is more powerful than the attraction coming from the strongest locality. Each change in any of the two directions (attraction or diffusion) generates a cumulative movement, which will be ascending or descending depending on its causal connection with positive or negative collective effects. Adoption of a long-term perspective led Myrdal to the conclusion that a system does not move towards equilibrium of forces but - through a process of circular and cumulative causation that follows one initial effect - the system tends to incrementally depart from equilibrium. In the long run, complementary effects - and not opposite effects - tend to accelerate changes within the system. As a consequence, by virtue of the process of cumulative causation, the concept of so-called 'free markets'<sup>72</sup> would lead to the creation of regional imbalances, rather than being the mechanism to diffuse development.

The international division of labour as planned by transnationals influences economic systems at different levels and can generate those initial effects that Myrdal identified as the spark of virtuous or vicious circular cumulative causation. It can be the beginning of a

successful process of knowledge accumulation or, vice versa, it can be the foundation of a hardly reversible trend towards the settlement of unqualified labour and activities.

With respect to knowledge formation, polarisation can be observed in phenomena of concentration of innovative related activities in transnationals' home countries and, more specifically, within some OECD countries, namely Japan and Germany. Given the cumulative nature of learning and innovation, OECD countries, especially the U.S. and Europe (Germany), are likely, in turn, to attract inward foreign investment that performs innovation related activities.<sup>73</sup>

One reason for this can be found in agglomeration advantages, which provide forms of increasing return to scale in research activities. Geographical concentration of scientific and technological activities has been shown to promote further formation of innovative activities.<sup>74</sup> The importance of geographical proximity is particularly relevant for the diffusion of tacit forms of knowledge. Tacit, unobservable and complex knowledge, unlike codified knowledge, can be transferred only by means of socialisation, which means that actors are engaged in very frequent exchanges, learning things by doing them together. This process is clearly easier when actors are located in the same geographical area.<sup>75</sup> The more the technological regime of an industrial sector requires complex and tacit forms of knowledge, the more it will be characterised by geographical concentration and will determine, therefore, polarisation effects. Concentration of innovative related activities, besides, depends also on the localisation of scientific and technological competencies. The location of Universities and governmental R&D centres, for instance, may be relevant in those industries whose activities are linked to basic scientific research, such as aircraft, the production of instruments, motor vehicles and the computer industry.<sup>76</sup> Industrial agglomerations populated by firms undertaking private R&D activities are attractive for sectors where knowledge complementarities require the coordination of research efforts amongst firms or when firms can benefit of pecuniary or technological externalities, such as when part of research findings spill over.<sup>77</sup>

Countervailing forces, in parallel, can initiate a process of knowledge diffusion. Centrifugal effects may arise as a consequence of internationalisation strategies, which may pursue a variety of advantages, namely ownership, location and internalisation advantages.<sup>78</sup> Transnational corporations, in particular, contribute to spread technologies and best practices across their networks of suppliers. However, the nature of the knowledge that is passed on to domestic firms and localities depends on the law of division of labour, with the risk of promoting knowledge fragmentation instead of specialisation.

## **7. The rate and direction of technological change in developing countries**

The polarisation of innovative related activities carries important implications for the location dynamics and structure underlying the international division of labour. Conscious coordination of production by transnational corporations is pushed, on an

international scale, beyond firms' boundaries. Planning occurs between firms. In particular, transnational corporations increasingly operate as network organisations, directing and coordinating the activities of a cascade of subcontractors and suppliers. The rate and direction of innovative activities is consistently planned worldwide by a number of large transnational firms, which between the '80s and mid-1990s have increased the proportion of innovative activities performed abroad by only 2.4 percent.<sup>79</sup> Whilst major transnationals have great financial resources and are at the forefront of R&D, developing countries experience problems linked to the lack of financial capital and limited internal market. Inward investments in low-income developing regions can be hardly oriented towards the establishment of innovative related activities.

Innovative related activities (such as R&D) are located in some countries whilst they exclude others. However exclusion can be observed also when looking at ordinary production activities. The international division of labour discriminates countries and territories by allocating production activities that differ by virtue of their knowledge content. Firm's activities differ by the technology used, by the qualification of labour, and by the presence of educational programmes within firms. These characterisations are reflected in the nature of directed technology transfers, and in the nature and magnitude of possible spillovers.

The scenario of international production is compatible with a structure that divides actors into 'superior' and 'subordinate'. As Hymer<sup>80</sup> emphasised, in a world economy dominated by large transnational firms, the international division of labour is divided into three levels, from the top which is concerned with strategic planning, to the lowest, which is concerned with day-to-day events. This view advances very important welfare implications in terms of 'income, status, authority and consumption patterns'. While skilled workers and superior communication systems are a prerogative of the major centres hosting the first levels of activities, an unskilled labour force characterises those activities related solely to the presence of raw materials, markets and manpower. This means that there are host territories where, although activities are complementary to those of other localities, the level of knowledge involved in production is not high enough to pull actors out of subordination.<sup>81</sup>

Whilst Hymer's uneven development is caused by factors that are external to localities, other contributions emphasise endogenous resources and capabilities as the main determinants of development. As regards individual actors, for instance, differences in the learning capacity imply the existence of organisations where knowledge acquisition or production is poorer.<sup>82</sup> The same principle can be observed also within localities. Systems that are better able to recognise opportunities and learn from experience will gain an advantage with respect to less dynamic and receptive localities.

However, the two causal dimensions (exogenous and endogenous) may be subject to a vicious circle. Localities with poor concentration of knowledge assets and, presumably, decision-making centres, have less strategic decision-making power than localities with superior resources. At the same time, this relative lack of power hinders the possibilities

of weak localities to be evenly included in the dynamics of knowledge diffusion and creation. If such a circle is activated, the impact of the technological direction planned worldwide by transnationals becomes a very influential element that underlies both the exogenous and endogenous determinants of uneven development.

An interesting phenomenon is the so-called telematic democracy based on the diffusion of the world wide web. In particular, as far as trade and production are concerned, it is argued that markets are 'free' by virtue of the potential for communication that has been opened by the internet. Whilst this process is getting more and more structured and diffused in western countries, there are localities that are excluded from such a radical change in technologies (Figure 1). With respect to countries that are below the poverty line, for instance, the technological gap is getting larger, and the speed at which the gap increases is higher than before. The top of the 'marching column'<sup>83</sup> has been able to activate a virtuous circle around the accumulation of capital and the diffusion of knowledge (Figure 2). On the contrary, where there is a lack of development, in terms of capital accumulation the speed at which elsewhere information circulates and knowledge is created amplifies the gap between richer and poorer localities, thus activating a vicious spiral that jeopardises the development of capital and knowledge in poor localities. As an example we plot in Figure 1 the diffusion of personal computers for selected countries. The two curves, continuous for the period 1996--98 and dotted for 1990, represent the interpolation of points that relate the number of personal computers with the degree of development of each country. Each of the selected countries is ranked according to the Human Development Index (HDI)<sup>84</sup> on the horizontal axis: the more a country is graphically located far from the origin of the axis, the lower its HDI.

### **Figure 1 and Figure 2 about here**

A comparison between the situation in 1990 and 1996--98 shows that the technological gap between developed and less developed countries is getting larger. Furthermore, if we associate considerations on technology with capital accumulation using net FDI flows as a proxy for a country's increase in assets (Figure 2), we observe that progressively capital tends to concentrate where there is the knowledge to use it effectively. Capital concentrates in developed countries or in newly industrialised countries (mainly in the Asian region).<sup>85</sup> Especially in this example, the elasticity of the 1998 interpolation curve decreases with respect to 1987--92, which means that the HDI rank is substantially increasing its power in explaining the difference between countries.

## **8. Policy implications and conclusions**

Production decisions are mainly taken by firms and, at the international level, by transnational corporations. The division of labour across firms and localities, in particular, has been accentuated by the increasing complexity of knowledge contents in production. Complementary activities are compatible, however, with a hierarchy of

functions across localities that is characterised by different levels of knowledge contents and by different levels of economic power.

The evolution of localised knowledge is strongly influenced by the characteristics of its production activities. In particular, local resources and production decisions of firms exert a reciprocal influence on each other. On the one side local systems offer specific knowledge assets that may attract production activities. On the other side firms settle their activities also on the basis of location advantages. This mutual influence generates a process of cumulative and circular causation between the accumulation of resources and the production functions localised on a territory. Localities that are typified by labour intensive activities and limited knowledge assets will attract activities that require manpower without highly qualified competences. The resources of a local system - in terms of the knowledge embedded in technologies, learning and research abilities, and relationships - will not expand. Oppositely, host countries where specific knowledge has been cumulating over time will attract firms because of their knowledge resources. If the knowledge of foreign affiliates is then spread outside, the high knowledge content of production activities located within the system will further improve the amount of technological, human and relational resources of the territory.

The problem of knowledge accumulation in developing countries cannot be solved by totally relying on inward investment flows from transnationals. Although FDI may, within particular institutional contexts, eventually stimulate the demand for qualified labour (e.g. managers, engineers, researchers), there are elements for arguing that within the international division of labour there are activities with different knowledge contents that are associated with specific locations.

First, innovative activities are mainly retained in the country of origin, whilst if the host market is large enough, R&D is performed abroad to adapt product or process to different market conditions.

Secondly, the innovativeness of the technologies transferred to host countries can be assessed according to two reference points. One is the technological endowment available in the country of origin. The other is the knowledge and technological capital of the host country. With respect to the first, there are no significant transfers of modern technology and domestic firms can at best become more productive in sectors where the technology used is consistent with their capabilities. When comparing foreign technologies with domestic ones, however, there may be a technological upgrading. This suggests that the gap between foreign and domestic technology may be there to stay. Technological transfer to transnationals' suppliers follows the rate and direction decided by headquarters, whilst eventual spillovers can take place only in sectors where domestic capabilities allow local firms to understand and apply the hints leaking from foreign affiliates.

Third, thanks to agglomeration economies, innovative environments attract more investments, thus drawing off resources from other economic systems. This effect can

promote knowledge accumulation where the quality of production activities in terms of technologies, R&D and human capital is high. Conversely, localities with poor knowledge assets will not activate a virtuous cumulative process, thus enlarging the initial gap.

Processes of cumulative causation of this sort, as Myrdal maintained, hamper convergence amongst regions and localities, enlarging the gap between dynamic localities where capital has been consolidated over time and localities where resources have remained poor. Where the knowledge capital attracts new resources virtuous cumulative processes will promote further accumulation, whilst where resources are scarce and knowledge does not spread outside firms, the dynamics of technological change and learning will be jeopardised by firms' strategic choices and by the power of attraction of more advanced areas.

Though this is far from conclusive, it provides some justification for policy which compels developing countries to be aware of the limits of foreign capital with respect to local knowledge development. Transnationals possess undoubtedly great financial resources. However to say this is not 'the same thing as saying that they serve the general interest as well as their own, that they are the best way to exploit the possibilities of modern science'.<sup>86</sup> Likewise, when promoting the demand for more qualified labour, transnationals' needs impact on education policies. The risk is that countries dominated by foreign investments 'develop a branch plant outlook, not only with reference to economic matters, but throughout the range of governmental and educational decision making'.

Where foreign investment prevails, the rate and direction of technological change and knowledge creation will be decided by transnationals to suite their own interests. This defines the nature and direction of localised knowledge and commits technological and human capital development to the opportunities defined by the corporate strategy. This scenario, as the theory of path dependence suggests, may have irreversible effects. Once a locality, together with its institutions and organisations, has committed to a specific learning and research strategy that is functional to the corporate interests of foreign capital, a change in direction would imply a change in the nature of the relationships that have been established between firms and local institutions. Moreover, this would imply the use of existing competences to search for new knowledge. This can enlarge the opportunities of domestic firms and entrepreneurship. However it requires time, capital and, most importantly, the ability of local actors to effectively define local development goals.

The knowledge accumulated under the form of human, physical and relational capital can activate the development of further knowledge, which provides an incentive to local firms and institutions to become centres of strategic decision-making and shape the direction of development consistently with the objectives expressed at the local level. Local institutions may play a major role in re-launching the possibility for developing a knowledge based production. A first step, not surprisingly, should be towards the

enhancement of education programmes. Governments could encourage 'brains' to go back to the country of origin, drawing on the example of Silicon Valley, which started industrial agglomeration around 'academic stars'. Universities can be involved in promoting the birth of spin-off firms, which represent the link between scientific and high value added academic research and entrepreneurship. Local institutions, far from being irrelevant, should be active in conveying the knowledge produced locally into production and in creating new specialisations through a continuous tension towards innovation and specialisation as opposed to fragmentation. For firms a policy suggestion is to work in partnership, exchanging ideas and developing intuitions via external competences, where necessary. Given the dispersed nature of knowledge, policy should focus also on the activation of channels for knowledge exchanges without promoting subordination of local firms.

The policy suggestions that we have just mentioned can not be easily implemented within developing countries and, if they could, as Hirschman<sup>87</sup> reminds us, we would not be talking of developing but developed countries. However, this perspective should be taken as an indication of a general direction, aware of the strict connections between knowledge formation and the international organisation of production, given the role that transnationals play within it.

#### Notes

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39. Dosi, *Ibid.*, p. 137. A *technological paradigm* brings together needs and possible solutions by applying a number of scientific concepts together with a number of related technologies for the implementation of each solution. Archetypes (models

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*tecnologica e struttura produttiva*, pp. 37-62. In both cases innovative processes are based on pre-existing knowledge, either in the forms of paradigms or, in the case of radical innovations, on the previous inventions or research results. On radical innovation see: Joseph, A. Schumpeter, *Theorie der wirtschaftlichen Entwicklung*.

66. On the role of institutional actors with respect to the development of countries' knowledge assets, see: Bengt-Åke Lundvall (Ed), *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning* (Pinter Publishers, 1992); Patel and Vega. 'Patterns of Internationalisation of Corporate Technology', p. 154; Nelson, 'The Co-evolution of Technology, Industrial Structure, and Supporting Institutions'.
67. Knowledge assumes here another significance with respect to productive knowledge. It is seen as the perception and recognition of the impact that individual action exerts at the collective level. When this kind of knowledge is institutionalised at the collective level (for instance, through norms and rules which govern economic interactions), local institutions can be better able to isolate behavioural patterns that are not consistent with local development policies and feedback their decisions, thus regulating individual actions that discord with local aims and objectives.
68. John Dunning, *Multinational enterprises and the global economy* (Addison-Wesley, 1993).
69. Maurice Zeitlin, 'Corporate ownership and control: the large corporations and the capitalist class', *American Journal of Sociology*, Vol. 79, No. 5 (1974), pp. 1073-1119.
70. Nelson and Winter, *An Evolutionary Theory of Economic Change*.
71. Gunnar Myrdal, *Economic Theory and Under-Developed Regions* (Duckworth, 1957). Italian translation: *Teoria Economica e Paesi Sottosviluppati* (Feltrinelli, 1974), pp. 21-23 and 39-42.
72. Neo-classic economic theory has addressed economic development from a perspective based on the concept of stable equilibrium. Not least, this powerful concept has been at the basis of the theory of so-called 'free markets', where markets have been considered the most effective mechanisms that lead to stable equilibria. In this context the notion of stable equilibrium has been used as an ideal reference point towards which economic systems should be oriented and, as a consequence, equilibrium has been used as a measure to formulate value judgements about the development of economic systems. One clear problem however remains. Stable equilibrium theories have not succeeded in explaining differences between regions and nations in terms of economic development. Cf. Myrdal, *Economic Theory and Under-Developed Regions*, p. 20 (Italian translation). Critiques to the concept of free markets are based on the idea that power is a constituent element of economies and that economic actors do not have equal power when interacting on the market. Sacchetti and Sugden, 'The Governance of Networks and Economic Power', pp. 672-4.
73. Parimal Patel and Keith Pavitt, 'Uneven (and Divergent) Technological Accumulation among Advanced Countries: Evidence and a Framework of

- Explanation', p. 303, in: G. Dosi *et al* (Eds), *Technology, Organization, and Competitiveness*, pp. 289-317.
74. Brian W. Arthur, 'Silicon Valley Locational Clusters: When Do Increasing Returns Imply Monopoly?' *Mathematical Social Sciences* Vol. 19 (1990), pp. 235-51; Annalee Saxenian, *Regional Advantage. Culture and Competition in Silicon Valley and Route 128* (Harvard UP, 1994); Maryann P. Feldman, *The Geography of Innovation* (Kluwer Academic, 1994).
  75. However, there may be exceptions related to the 'mental proximity' of actors, which is the proximity of organisational views when this is not the outcome of some actor imposing its own view over the view of someone else. In particular, we use the notion of mental proximity to indicate the degree of compatibility in objectives, strategies, and means to achieve them. Taking an institutionalist perspective, we maintain that whenever actors can understand each other on the basis of shared norms, values, and beliefs, then mental proximity does not necessarily require geographical concentration. Rather, it is consistent with dispersed communities of actors. When members of dispersed communities interact, they draw the boundaries of networks beyond localities and national borders. In this sense, knowledge in production is exchanged, adapted, and created as the 'real' outcome of actors who are mentally close but geographically distant for at least most of the time.
  76. These sectors have been identified by Patel and Pavitt through an analysis of the geographic location of large firms' US patenting activities. Cf. Patel and Pavitt, 'Uneven (and Divergent) Technological Accumulation', p.304.
  77. The degree of non observable knowledge as well as the effectiveness of the legal framework which regulates appropriability of innovation plays an important role in regulating the magnitude of this kind of externality.
  78. Dunning, *Multinational enterprises and the global economy*. However, the strategies pursued through FDI can be interpreted from other perspectives, namely 'divide-and-rule' strategies and imitation and risk reduction strategies. For a deeper treatment, see: Christos N. Pitelis and Roger Sugden (Eds), *The Nature of the Transnational Firm* (Routledge,1991).
  79. Patel and Pavitt, 'National Systems of Innovation Under Strain: The Internationalisation of Corporate R&D'.
  80. Hymer, 'The Multinational Corporation and the Law of Uneven Development'.
  81. Specialisation as a means to organize production has been explained by neoclassical economics in terms of efficiency. However – expanding on Smith's *Wealth of Nations* – Marglin has emphasized that the choice of the division of labour lies 'between the workman whose span of control is wide enough that he sees how each operation fits into the whole and the workman confined to a small number of repetitive tasks. It would be surprising indeed if the workman's propensity to invent has not been diminished by the extreme specialization that characterizes the capitalist division of labor'. Cf. Marglin, 'What do bosses do?' pp. 60-112. These considerations, we argue, can be applied when looking at the division of labour across localities. In particular we refer to the distinction between 'fragmentation' as opposed to 'specialisation' described in Section 1.

82. Hamel, for example, has noticed that in strategic alliances - depending on the degree of access and internalisation of new knowledge that partners can achieve by working together - there may be a relevant 'reapportionment of skills' between partners. This uneven learning changes the relative power of actors within the alliance. Therefore, the distribution of power within economies may also be partly linked to the endogenously determined capabilities of individuals and organisations. See: Gary Hamel, 'Competition for Competence and Inter-Partner Learning within International Strategic Alliances', *Strategic Management Journal*, Vol. 12, special issue (1991), pp. 83-103; and Herbert A. Simon, 'The Many Shapes of Knowledge', *Revue d'Economie Industrielle*, 2nd semester, No. 88 (1999), pp. 23-41.
83. Borrowing from Tocqueville, Daniel Bell presented the process of growth as a 'marching column'. The disposition of the column reflects income distribution, which does not change significantly over time, while the column - as a whole - advances. Whilst this advancement occurs, the bottom of the column reaches and overcomes the point where the top was at the time before. However, as the whole column is moving, the bottom could never be where the top is, unless it breaks the rank and runs to the front. Daniel Bell, *The Coming of the Post-Industrial Society* (Heinemann, 1974); Fred Hirsch, *Social Limits to Growth* (Harvard UP, 1976). Italian Translation: *I limiti sociali allo sviluppo* (Bompiani, 1991), p. 176.
84. The HDI is based on three indicators: life expectancy at birth; adult literacy rate and combined primary, secondary and tertiary gross enrolment ratio, GDP per capita (adjusted PPP US \$). Human Development Index for high human development countries is 0.8 and above, for medium human development countries is between 0.5 and 0.799, for low human development countries is below 0.5. UNDP, *Human Development Report 2000* (Oxford UP, 2000). Italian translation: *Rapporto 2000 su Lo Sviluppo Umano* (Rosenberg and Sellier, 2000), p. 302.
85. The World Bank 1996 report states that 30 per cent of GDP in developing countries is produced in eight countries that are mainly Asian. This share of GDP generated two thirds of overall FDI flows in 1990-93. Conversely, over the past decade ratios of FDI to GDP fell in most of the other world regions (mainly Sub-Saharan Africa). World Bank, *World Development Report 1996: From Plan to Market* (Oxford UP, 1996), p. 22.
86. Hymer, 'The Efficiency (Contradictions) of Multinational Corporations', p. 443.
87. Albert O. Hirschman, *The Strategy of Economic Development* (Yale UP, 1963). Italian Translation: *La strategia dello sviluppo economico* (La Nuova Italia, 1968), pp. 2-6.

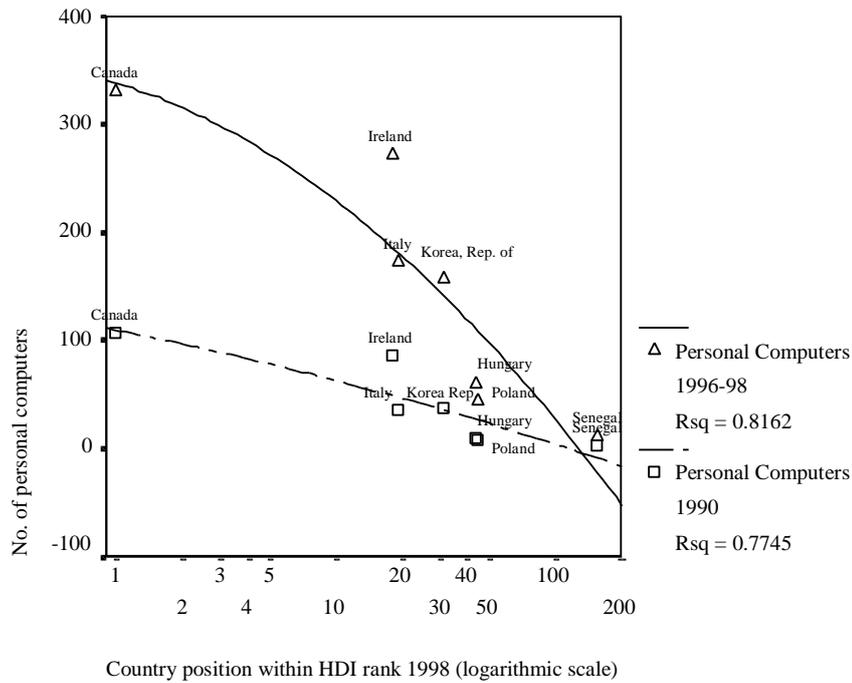


Figure 1: Technological Gap between selected developed and less developed countries. Number of personal computers per 1000 people in 1990 and 1996--98. Source: authors elaboration on UNDP data (UNDP, 2000)

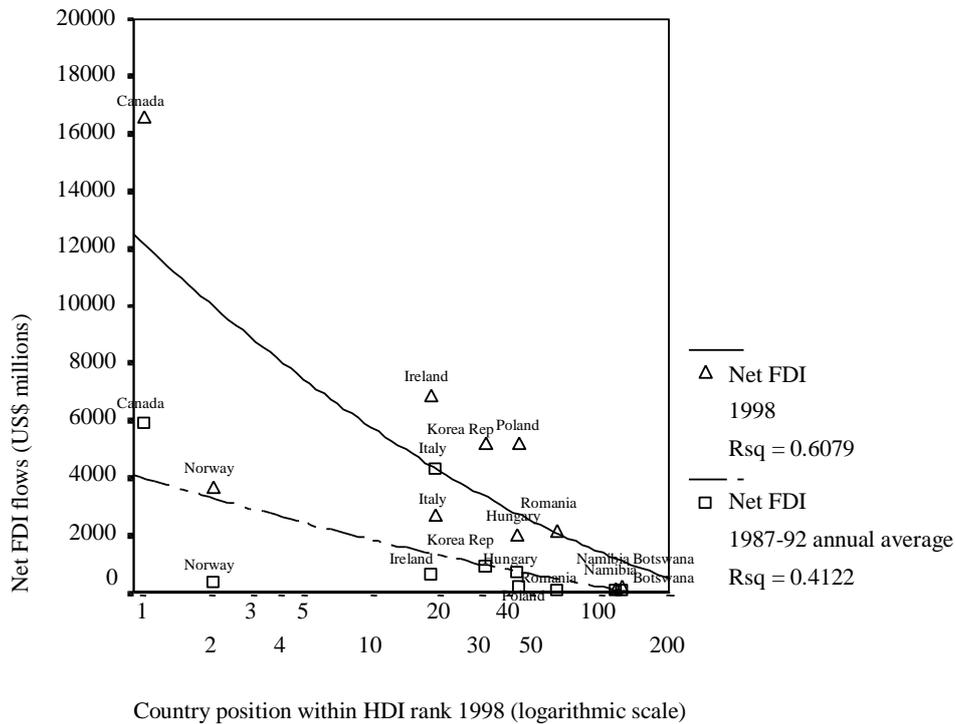


Figure 2: The Capital Accumulation Gap: net foreign direct investment flows for selected developed and less developed countries in 1987--92 and 1998. Source: authors elaboration on UNDP data (UNDP, 2000)