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Enhancing productive capacities for development, including through strengthened entrepreneurship policies and improved science and innovation policies

Key aspects of entrepreneurship and innovation policy frameworks for enhancing local productive capacities

Note by the UNCTAD secretariat

Executive summary

The most effective approach to reducing poverty in low-income countries is the development of productive capacities and the expansion of opportunities for job creation. Against this background, this note discusses practical steps in the design and implementation of entrepreneurship policies and of science and innovation policies in developing countries and countries with economies in transition.

Stemming from UNCTAD's entrepreneurship policy framework, which addresses six priority areas with a direct impact on entrepreneurial activity, a practical entrepreneurship policy toolkit is presented. The toolkit consists of four elements: (a) identification of policy areas and approaches; (b) practical step-by-step guidelines for policy implementation; (c) an online inventory of good practice entrepreneurship policies and programmes for easy reference; and (d) a set of indicators for monitoring and evaluation.

The note also suggests several areas in which active public policies can promote the emergence of effective national innovation systems, keeping in mind the specific characteristics of innovation in developing countries. Particular attention is given to the issue of investment in scientific and technological human capital, and to the role of international cooperation in science and innovation.

Introduction

1. Over recent years, UNCTAD has been arguing that the most realistic approach to seriously reducing poverty in low-income countries is the development of productive capacities and the expansion of the opportunities for productive employment that should accompany it. This notion is based on the experience of developing countries that have seen significant and durable reductions in poverty. In all of them, poverty reduction can be linked to the creation of more and productive jobs, and this, in turn, is systematically connected to the implementation of active public policies to promote economic growth through stronger domestic productive capacity.

2. An analysis of the concept of productive capacities and why it matters for poverty reduction and for development in general can be found in a number of UNCTAD publications, notably in the *Least Developed Countries Report 2006*, but also in publications produced by a growing number of international agencies – not all of which are in complete agreement on the precise meaning of the term "productive capacities". For the purposes of this note, it is sufficient to recall the definition of productive capacities used in the *Least Developed Countries Report 2006.* This definition was "productive resources, entrepreneurial capabilities and production linkages which together determine the capacity of a country to produce goods and services and enable it to grow and develop".

3. Also important for the purposes of this note is identification of the fundamental processes through which productive capacities develop, as this will, in turn, determine the domains in which policies to enhance productive capacities overlap with entrepreneurship policies and/or science and innovation policies (or science, technology and innovation (STI) policies, to use the most commonly accepted denomination). This note, in common with other recent UNCTAD documents, assumes that there are principally three closely interrelated processes through which productive capacities evolve: (a) capital accumulation; (b) technological progress; and (c) structural change.[1]

4. Any particular new technology will be embodied in machinery and equipment (physical capital) and will require explicit and tacit knowledge in order to operate, maintain and adapt that machinery (human capital). Investment in human and physical capital will be influenced by the profits expected from technological innovation. Capital accumulation and innovation are the most direct causes of structural change, which, by altering the contribution of various sectors to the total output of the economy, also influences the emergence of new opportunities for investment and innovation.

5. It follows from the reasoning above that policies in the fields of enterprise development and technological learning and innovation are at the core of efforts to

[1] See, for example, the 2010, 2007 and 2006 editions of the *Least Developed Countries Report*; the *Economic Development in Africa Report 2010*; or the background note entitled "Developing productive capacities in least developed countries: Issues for discussion", which was prepared for the 27–29 October 2010 pre-conference event to the Fourth United Nations Conference on the Least Developed Countries (LDC-IV).

upgrade and expand the productive capacities of developing countries. Building on the work that has been carried out since 2009 at sessions of the Multi-year Expert Meeting on Enterprise Development Policies and Capacity-Building in Science, Technology and Innovation, this note outlines some key aspects of entrepreneurship and STI policy frameworks, and suggests practical instruments to promote the contribution of such policies to the overall goal of enhancing productive capacities.

I. The relationship between entrepreneurship and STI policies

6. A clear relationship exists between the subject matters of entrepreneurship and STI policy, and consequently there are significant opportunities for exploiting synergies. Entrepreneurs fuel innovation by developing new or improving existing products, services or processes. New technologies and their applications stimulate the growth of new firms, and improve the efficiency and productivity of existing ones. Entrepreneurship and innovation policies are increasingly seen as being mutually supportive. However, coordination and coherence among them could be improved. Studies show that much of the research work related to entrepreneurship and innovation is pursued by different researchers, and policies are more often than not designed and implemented by different ministries within national governments.

7. It is also important to bear in mind that entrepreneurship and innovation policies can vary widely from one country to another. Context is critical. Each country is unique in terms of economic and social realities and will seek to promote entrepreneurship and innovation using whatever tools are available, and to meet specific goals relevant to the local context. While a major goal of policies in the context of the development of productive capacities will necessarily be to support growth and create employment as a means to reducing poverty, the local context may also require that entrepreneurship or STI policies consider other goals, such as the empowerment of particular categories of people (e.g. youth or women), or the solving of particular problems (e.g. environmental, agricultural, food security, energy) that have a technological component.

8. A systemic approach seems therefore most fitted to fostering innovation and entrepreneurship in developing economies. A comprehensive, interconnected set of policies can greatly contribute to developing the knowledge and technological capacity of economic actors and facilitating the essential interactions and flows of knowledge for innovation and entrepreneurship to take off. The following sections of this note present some of the areas that such sets of policies cover.

II. Entrepreneurship policies

A. Entrepreneurship and private-sector development

9. A productive-capacities-led growth strategy recognizes production and employment as the driving force behind sustainable economic development and the creation of a vibrant entrepreneurial climate, to achieve poverty reduction and to establish a more efficient energy and environmental management and crisis prevention mechanism. The role of entrepreneurship is therefore central to the attainment and sustainability of the Millennium Development Goals (MDGs), in particular MDG 1 (the eradication of extreme poverty and hunger) and MDG 8 (the development of a global partnership for development). In particular, in the post-crisis scenario, green and social enterprises are becoming the new drivers of innovation and growth. Green

entrepreneurship is becoming increasingly important because it plays a major role in the adoption of more sustainable business practices. Social entrepreneurship is also important, because it is key to the proliferation of innovative and untested business ideas that are conducive to positive social changes.

10. At the current time, developing countries – and in particular least developed countries (LDCs) – are facing a double challenge. Firstly, they must create productive jobs and livelihoods for the millions of young people who are entering the labour force each year. Indeed, the scale of the employment challenge in unprecedented. In Mali, for example, it has been estimated that the number of new entrants to the labour force was 171,800 in 2005, and that this figure will increase to a peak of 447,800 per year in 2045, when the annual additional labour force will start to decline.[2] Secondly, they must deal with the employment challenge in an open-economy context, as most of them have undertaken rapid and extensive trade liberalization. However, at the present stage, their existing production and trade structures offer very limited comparative advantages in a rapidly globalizing world driven by new knowledge-intensive products and services with demanding market-entry conditions.

11. In the face of these challenges, it is important for developing countries to recognize the close links between enterprise development, competitiveness and job creation. It is also important to build the interplay between foreign direct investment (FDI) and local productive capacities, as FDI may represent an important channel of financial resources and a driver of technological upgrading. Nevertheless, this potential will go untapped if firms in developing countries, and particularly in LDCs, are not prepared to take full advantage of it. A key factor determining the benefits that host countries can derive from FDI is related to the creation of a strong local absorptive capacity and a competitive local supplier base.

12. Entrepreneurship contributes to the strengthening of countries' domestic productive capacities and maximizes the positive spillover effects from FDI, which include technology spillovers, human capital formation, international trade integration, enhancement of enterprise development, and stimulation of competition. In turn, evidence shows that a dynamic entrepreneurial environment is also a key factor in attracting new investors and retaining them in the long run. For LDCs in particular, it is of vital importance that structural reforms not be exclusively focused on privatization and liberalization measures, but that complementary private-sector and, especially, entrepreneurship and SME-development measures be put in place too.

B. Strengthening the entrepreneurship ecosystem through UNCTAD's Entrepreneurship Policy Framework

13. A policy framework is a collection of policies that sets out the overall goals, objectives and principles, as well as the means and specific measures designed to achieve them. On the one hand, an entrepreneurship policy framework targets the pre-start, start-up and early post-start-up phases of the entrepreneurial process. On the other hand, it also includes policies aimed at providing follow-up support and facilitating the growth of already established firms. In general, entrepreneurship policy should aim at encompassing all of the phases of enterprise creation and growth, from encouraging people in the population to consider entrepreneurship as an option, to

[2] Background note entitled "Developing productive capacities in least developed countries: Issues for discussion". October 2010.

moving into the nascent stage of taking actions to start a business, to proceeding into the entry and early stages of their business and subsequently growing their business and making it sustainable.

14. Entrepreneurial activity stems from an entrepreneurship ecosystem, in which multiple stakeholders play a role in facilitating entrepreneurship. It is a system of mutually beneficial and self-sustaining relationships involving institutions, people and processes that work together with the goal of creating entrepreneurial ventures. Accordingly, policies should encompass the confluence of actors that play a role in promoting a conducive environment for entrepreneurship, and ensure a high degree of interaction and coordination among the key areas.

15. While there can be no one-size-fits-all answer to promoting entrepreneurship, recent research by UNCTAD[3] has identified six priority areas for policymakers that have a direct impact on entrepreneurial activity: (a) general entrepreneurship policy; (b) awareness and network-building; (c) access to finance; (d) entrepreneurship education and skills; (e) innovation and technology upgrading; and (f) the regulatory environment. The broad framework, however, should not be treated as prescriptive. The character of entrepreneurial activities varies with economic development, and policies need to be tailored to the development context of the country.

1. General entrepreneurship policy

16. This policy area includes the establishment of a national entrepreneurship policy, institutional arrangements for implementing policies, and monitoring mechanisms. Policies should have clear objectives and specific targets for facilitating entrepreneurship. Institutional focal points (ministries, agencies and dedicated institutions) can help coordinate the implementation of entrepreneurship policies and facilitate links with other key actors and stakeholders. While highlighting the Government's commitment to promoting entrepreneurship, it should also make clear that it is not a stand-alone field, as entrepreneurship cuts across many areas covered by various ministries and should be embedded within national policy. For example, in Rwanda, entrepreneurship policy is integrated into the overall poverty reduction strategy.[4]

2. Awareness and network-building

17. Because entrepreneurial awareness is key to enterprise creation and growth, entrepreneurship policies must start from awareness-building – even before the firm is created.[5] On the one hand, awareness-promotion policies target pre-start and start-up entrepreneurship with the aim of improving attitudes about entrepreneurship and encouraging potential entrepreneurs to formalize or to start and grow a firm. On the other hand, they also target established entrepreneurs, and foster networking between them as well as with groups of new entrepreneurs. Policies directed at this key policy area can include campaigns promoting entrepreneurship, entrepreneurship awards, programmes supporting networks of entrepreneurs, and counselling and information services tailored to their needs, among other things. A recent example is the six-month

[3] UNCTAD (2009). Key components of entrepreneurship and innovation policy frameworks. TD/B/C.II/MEM.1/6.

[4] *Economic Development and Poverty Reduction Strategy 2008–2012. (Rwanda).* Available at http://planipolis.iiep.unesco.org/upload/Rwanda/Rwanda_EDPRS_2008-2012.pdf.

[5] Audretsch D et al. (2007). *Handbook of Research on Entrepreneurship Policy.*

entrepreneurship-awareness campaign organized in Abu Dhabi in 2010 by the National Economic Council.[6]

3. Access to finance

18. Seed, start-up and early-stage financing remains a major challenge for many entrepreneurs, particularly in today's financial environment. Policy measures that seek to increase access to finance could include the facilitation of access to loans, credit guarantees and equity. There is scope to give more policy support to innovative private initiatives, such as mutual guarantee societies, as a tool to make credit available to smaller enterprises on a wider basis.[7] Policymakers in developing countries should also explore a range of non-traditional approaches for providing equity to SMEs, such as "risk capital", which links the investor's investment in the SME more closely to the increase in revenue, rather than to changes in the potential sales price of its share.[8] Venture capital is another type of private equity capital that can be provided for early-stage, high-potential-growth companies. In addition, over the past few years, networks of angel investors have emerged, through which start-ups can apply for funding. The creation of business linkages between large firms and SMEs can also generate the setting-up of special funds to facilitate small-scale financing of suppliers.

4. Entrepreneurship education and skills

19. The teaching of entrepreneurial skills at all educational levels, from primary school to university, has a significant impact on levels of entrepreneurship throughout the world. Studying entrepreneurial skills should not be separated from studying other disciplines, but rather incorporated into a wide range of teaching activities. Most entrepreneurship education programmes engage established entrepreneurs as volunteer advisors, mentors and coaches, as a key success factor. What appears to work best is the combination of a good classroom instructor and a series of structured interactions with real-life entrepreneurs.[9] Many successful entrepreneurship education programmes, such as UNCTAD's Empretec methodology, encourage a shift from technical business-management knowledge to teaching entrepreneurial skills. In terms of institutional infrastructure for entrepreneurship education, many European countries have entrepreneurship chairs, or an entrepreneurship centre, but most lack cross-discipline structures supporting entrepreneurship teaching, and practice-oriented and research activities.[10] Curriculum designs introduce experiential learning through interactive teaching methods that incorporate practical experience and encourage "learning by doing". Entrepreneurship education policy should include a focus on specific segments of the population (e.g. women, minorities, youth etc.) where entrepreneurial training could have a significant impact. The policy area related to entrepreneurship education and skills was the focus of UNCTAD's 2011 Multi-year Expert Meeting on Enterprise Development Policies and Capacity-building in Science, Technology and Innovation.[11]

[6] http://www.enterprisepromotion.org/view.php?abstract=1029

[7] See studies by the European Association of Mutual Guarantee Societies, available at http://www.aecm.be.

[8] OECD (2010). Non-traditional investment structures for risk capital financing for SMEs. February.

[9] World Economic Forum (2009). Educating the next wave of entrepreneurs: Unlocking entrepreneurial capabilities to meet the global challenges of the twenty-first century. April.

[10] Fayolle A (2009). Entrepreneurship education in Europe: Trends and challenges. EM Lyon Business School. Universities, innovation and entrepreneurship: Good practice workshop. 12 June.

[11] UNCTAD (2010). Entrepreneurship education, innovation and capacity-building in developing countries. TD/B/C.II/MEM.1/9.

During this meeting, a first draft of the entrepreneurship toolkit applied to this policy area was presented and discussed in detail.

5. Innovation and technology upgrading

20. Entrepreneurship policies in this area seek not only the promotion of science and technology development, but also its use, commercialization and diffusion into society. Policies can include public investment in research and development (R&D) and technology upgrading, the provision of incentives for private investment in R&D, technology acquisition and intellectual property protection. Programmes that build linkages between researchers and industry are critical for accelerating innovation, and should be encouraged and supported. This would entail providing assistance to maintain R&D, promoting R&D in association with public procurement, and stronger links between public research institutions and the private sector. One example is the Brazilian Innovation Law,[12] under which a greater degree of freedom is given to university researchers for undertaking temporary research at private-sector universities. Enormous opportunities exist for demand-led innovation in developing countries because of the high level of unmet needs in these countries, in particular the needs of lower-income people. Of particular importance for developing countries is increased investment in pro-poor technologies and in agricultural innovations.

6. The regulatory environment

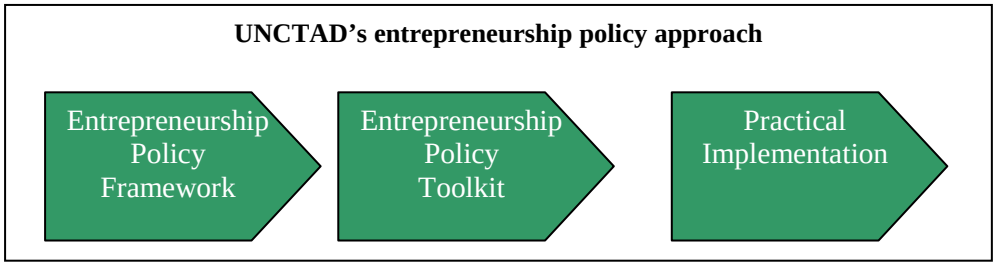
21. Policies should differentiate between the act of entrepreneurship and the enabling environment in which it takes place. Together, institutions, values and regulations form a socio-political environmental framework that strongly influences the development of entrepreneurs. Measures in this area should seek to reduce the administrative burdens related to company formation and failure, labour, taxation, international trade and investment, public procurement and commercial laws. In addition, they should provide fair and transparent enforcement of competition, health, safety and environmental regulations. Effective insolvency procedures can speed recovery from a crisis, as viable businesses are restructured as a "going concern" rather than liquidated through piecemeal sales. Streamlining and unifying formalities and procedures are other measures with a big impact that may be implemented quickly and at no big cost. Another policy tool available is the tax system, which can affect the attractiveness of self-employment to potential entrepreneurs. Simplified tax regimes and tax compliance procedures for SMEs will affect their ability to face and survive a downturn.

C. Key elements of UNCTAD's Entrepreneurship Policy Toolkit

22. The key areas of an entrepreneurship policy framework highlighted above provided the basis for the development of a toolkit on entrepreneurship policies. Its objective is to provide practical guidance to decision-makers and other stakeholders on the implementation of the identified main elements of the entrepreneurship policies. It stems from the research and policy analysis conducted for the development of this framework, and also from previous UNCTAD research in the area of SME development. It is also based on UNCTAD's practical experience in assisting countries in their efforts towards building SMEs and entrepreneurship.

[12] Lei de Inovaçao, 2004. *See:* http://www.mct.gov.br/index.php/content/view/8477.html.

23. An entrepreneurship policy toolkit, therefore, seeks to guide policymakers to move from recognition of the importance of entrepreneurship and a commitment to promote it, to the effective implementation of a national entrepreneurship policy system tailored to their development context.



24. Such a toolkit is a response to the recognition that there is a general lack of awareness about the comprehensive nature of entrepreneurship policies and how they are strictly related to other policy areas. There is also a general lack of specific guidance on what measures and policy approaches are effective for promoting entrepreneurship in the context of developing countries. This toolkit will provide a basis for policymakers to set priorities and identify what are the first or next steps to take to promote an entrepreneurial economy, depending on where they find themselves in the process. It will also facilitate gathering more and better information on entrepreneurship in developing countries.

25. UNCTAD's entrepreneurship toolkit consists of four elements for each of the six priority policy areas identified above, namely:

(a) The identification of main policy sub-areas and approaches

26. This part of the toolkit sets the groundwork to begin or continue implementation by highlighting the key players that need to be mobilized and the action areas that need to be targeted. A comprehensive entrepreneurship policy framework must be implemented at national, regional and local levels. Accordingly, the first element of the toolkit highlights the role of government institutions and their engagement with key stakeholders at all levels and for each area of the framework.

27. Secondly, the toolkit identifies the important sub-areas which policies and programmes should be targeting. These sub-areas aim to represent main actions which have emerged as key success factors in each area. For example, in the area of entrepreneurship education and skills, four important sub-areas are identified, namely: (i) embedding entrepreneurship into education and training at all levels (primary, secondary and vocational); (ii) curriculum development; (iii) teacher development; and (iv) partnership with the private sector.[13]

(b) Practical step-by-step guidelines for policy implementation

28. The emphasis of this particular element is on providing policymakers with clear and practical step-by-step guidelines and recommendations to transition into the practical implementation of identified policies and action areas. For example, in the area of entrepreneurship education and skills, the following main recommendations for action for key stakeholder groups were identified for the first action area of "embedding entrepreneurship into education and training":[14]

[13] UNCTAD (2010). Entrepreneurship education policies. October. TD/B/C.II/MEM.1/CRP.2.
[14] UNCTAD (2010). Entrepreneurship education policies. October. TD/B/C.II/MEM.1/CRP.2.

Main recommendations for policy action in the area of entrepreneurship education

Policy approaches	Overview of recommendations
National strategy	• Identify the link between entrepreneurship education and other policy objectives (economic and social) • Determine how best to position entrepreneurship education – whether as a national strategy for entrepreneurship education and/or as a subset of other strategies (education, development etc.).
National policies	• Secure ministerial (entrepreneurship ministry or ministerial-level coordinator) commitement and/or commitment from head of government • Ensure inter-ministerial coordination (working groups which include representatives of key stakeholder groups) • Develop specific policies for underserved groups (youth, women etc.)
Regional and local policies	• Target policies and funding specifically to needs at the local level • Encourage local and regional governments to work with other stakeholders in the entrepreneurial ecosystem
Cross-country policies	• Encourage collaborations on entrepreneurship and entrepreneurship education across countries (leverage resources, experiences etc).
Developing and implementing policies	• Set the strategic framework in which schools and universities can work to implement programmes and activities within their institutions • Collaborate with and provide incentives to individuals (champions), organizations (schools, companies, NGOs, foundations etc.) and networks to follow up on the strategy • Establish implementation mechanisms (public or private agencies and/or foundations) to carry out strategies and policies through a set of coherent programmes • Learn from pilot initiatives and then work to scale them across the country • Establish entrepreneurship centres as hubs for entrepreneurship education
Funding	• Facilitate a consistent and adequate level of funding for entrepreneurship education programmes • Encourage partnerships between existing programmes and initiatives, as appropriate, to better leverage resources and expand impact

(c) An online inventory of good practice entrepreneurship policies and programmes for easy reference

29. Despite the infancy of the field of entrepreneurship and a general lack of data available, there are some countries (many of which are developing countries) which have designed and implemented good policies and programmes in entrepreneurship. Measures that have demonstrated their efficiency in one country would be helpful to other countries confronted with the same problems or seeking to develop similar entrepreneurship approaches.

30. Therefore, an online inventory of entrepreneurship policies and good practices will be a part of the toolkit, to be used as a reference. It will serve three functions: (i) a clearing house connecting experts; (ii) a global resource of comprehensive information on government and non-government programmes on entrepreneurship and innovations; and (iii) a tool to identify policies to promote entrepreneurship and innovation. Ultimately, the aim is to extract useful lessons from existing entrepreneurship policies and programmes in order to gain a better understanding of good practices in the field.

31. Some of the suggested guidelines to evaluate good practice include:

(i) Whether the initiative is innovative; has clear objectives and benchmarks; seeks to reach and stimulate entrepreneurship or seed entrepreneurial attitudes, behaviours and skills in a large proportion of potential entrepreneurs; or has a tangible multiplication effect;

(ii) Whether it has successfully established programmes and dedicated institutions to support entrepreneurs and innovation;

(iii) Whether it regularly monitors the performance of its actions or the actions of others against agreed milestones and targets.

(d) Set of indicators for monitoring and evaluation

32. The question of identifying relevant indicators of entrepreneurship development is a crucial one. It is important to identify specific objectives and performance targets for each policy sub-area suggested. The process should not be limited to indicators for which data currently exist; rather, it should include those that are relevant and needed, even if there are not yet any data available.[15] It is important to ensure not only that relevant activities are assessed but also that their impact is identified and measured. For example, in relation to the education sub-area, the toolkit differentiates between input, output and outcome indicators, the latter encompassing – inter alia – social and economic impacts such as employment generation and poverty reduction. Another challenge is reliable data collection, particularly in developing countries. Systems need to be in place to enable decisions-makers to collect data in order to maximize the potential and relevance of the toolkit, adapted to a country's particular situation and challenges. Surveys provide an effective tool to acquire hands-on information and data.

[15] UNCTAD (2009). Key components of entrepreneurship and innovation policy frameworks. TD/B/C.II/MEM.1/6.

III. STI policies

33. This section of the note will argue that while STI holds large potential to contribute to the enhancement of the productive capacities of developing countries, significant gaps remain in the capacity of many of them to harness knowledge and technology for development. A number of specific characteristics of innovation in developing countries are presented, and the important role that public policy must play in the creation of effective national systems of innovation is emphasized. In this context, particular attention is given to investment in scientific and technological human capital and to the role of international cooperation in STI.

A. Public policy and the technology gap

34. As mentioned in the introduction to this note, the notion that technological progress and innovation are key to the enhancement of productive capacities has been strongly articulated in a number of UNCTAD reports, and the reader is referred to them for an in-depth discussion of the ways in which these mechanisms operate.[16] Suffice it to reiterate here that knowledge provides the basis on which technological progress and innovation develop, and that in the long term, technology and innovation drive the improvements in productivity that support economic growth and raise living standards. Equally important is the fact that technological progress and innovation are among the driving forces of structural transformation of economies, both at the national and the global level.

35. Over the last few decades, scientific knowledge has been generated at an increasingly fast pace, as a result of the growth of research budgets and the availability of powerful research tools created by the rapid development of ICTs. This process has been supported by global opportunities for accessing and disseminating knowledge, following the opening of borders to international trade and the movement of persons, as well as significant progress in transportation and communication technologies. Consequently, knowledge has become more important economically, in terms of investment in and production of knowledge-based goods and services. The adoption of new technologies, and the improvement in human capital through knowledge, have enhanced economic performance and increased factor productivity in many industrialized and emerging economies. At the same time, the fast pace at which new technologies are being developed, but also becoming obsolete, has profoundly changed the process of knowledge creation and acquisition, so that firms need to engage in sustained efforts to continuously upgrade their knowledge base, and individuals are increasingly expected to consider learning as a lifelong undertaking.

36. The challenge is therefore to harness knowledge for development by actively supporting the production of ideas and innovations, as well as their dissemination and use. This implies the existence of human and institutional capacities, an enabling environment, and operative linkages between the producers and users of knowledge and technology. Public policies are crucial in all these regards. For example, public policies are crucial in the establishment of many of the institutions that create and diffuse knowledge, and in defining the sets of incentives that influence their activity. Financial regulations affect the extent to which capital, including venture capital, is available to innovative entrepreneurs. Public policy is also influential in the establishment of institutions for standard-setting and norm-setting and for other technological infrastructure (metrology services, test laboratories

[16] As well as the various editions of the *Least Developed Countries Report* mentioned in footnote 1, see the *Information Economy Report 2010*.

etc.). Of critical importance are public policies that have an impact on the availability of qualified human resources and local training and research institutes: schools that train technicians, research institutes that are sources of technological innovations, and specialized institutes that prepare qualified businesspersons and policymakers.

37. Attempts to measure technology gaps between countries use some specific indicators related to technology embodied in capital goods or linked with human capital (such as patents, scientific publications, and licences). Such indicators tend to capture information about the amount of STI inputs available, and then leave wide gaps when it comes to information about the innovation outcomes of the processes in which those inputs are used. They also tend to provide little coverage of innovative activity not taking place at the technical frontier or taking place outside the formal sector – which tends to be more important in developing countries. But even with these qualifications in mind, any examination of indicators, such as electric power consumption, telephone mainlines, internet penetration, broadband installation, road density, rail density, machinery and technical equipment, patents, scientific publications, and the number of researchers, scientific graduates and engineers etc., indicates that the technological gaps between rich and poor countries remain large and that their sizes correlate with income levels.

38. Alongside the gaps described by what few indicators are available, there are some frequent general observations in the literature about STI in developing countries. One of them is the need to adapt the concept of innovation itself, in the context of developing countries. Innovation in developing countries is much more frequently incremental than radical, and with the exception of a very few developing countries, it rarely takes place at the frontier of scientific and technological knowledge but instead involves the adaptation, imitation and enhancement of technologies obtained from abroad. Frequently, innovative activity consists in introducing products, services or processes that are new to the firm or to the market, rather than new to the world.

39. A second observation is that weak technological absorptive capacities at the level of individual firms (e.g. weak operational, engineering and managerial capabilities) are often compounded by weak STI-related infrastructure and support services and the lack of linkages between users and providers of knowledge. Physical infrastructure tends to be inadequate for more technology-intensive production methods, and developing countries' financial systems often do not provide innovative enterprises with enough access to capital on competitive terms. In short, the national innovation system (NIS) is incipient or non-existent.

40. In spite of all this, some newly industrializing countries have successfully reduced the technological gap and have even surpassed some of the industrialized countries. Their catching-up experiences demonstrate that coherent and carefully crafted technology policies can considerably strengthen competitiveness and promote entry into more complex and higher-level technology sectors. A number of key lessons can be drawn from these experiences:

41. Domestic innovation cannot be achieved without access to international markets, technology transfer, and learning. In turn, increased exports to international markets are the results of domestic technological capacities and innovations. Strategic investments in human resource development, education, infrastructure and openness to foreign technologies are critical.

42. Simply opening to free trade and investment flows will not be sufficient to develop technology. Without active government support through efficient STI policies, countries at the low end of the technology ladder may find themselves stagnating in low-technology specialization, and may lose their competitiveness over time.

43. Skills development, industrial specialization, enterprise learning and institutional change create cumulative, self-reinforcing processes that promote further learning. It is very difficult for countries trapped in a development pattern characterized by low-technology, low-skill and low-learning specialization to change course without a concerted shift in a large number of interacting markets and institutions. Foreign technology transfer, either through trade or FDI, or through other channels such as international partnerships or contribution from the diaspora, can play a useful role.

44. The role of public policy in STI extends beyond the questions related to the creation of advanced scientific and technological skills in particular sectors of the economy. Measures targeted at increasing technological awareness and skills in the population at large, providing incentives – particularly for young people – to pursue training and education that equips them to be technology users, innovators and creators, and generally incorporating STI considerations into overall development strategies, are common features of the experience of countries that have succeeded in technological catch-up. Equally important is the notion that STI competencies can only be enhanced by entrepreneurial skills, and a culture of collaboration which often requires existing habits in both academia and the private sector to be challenged, and which presents an additional and critical issue for policymakers' consideration.

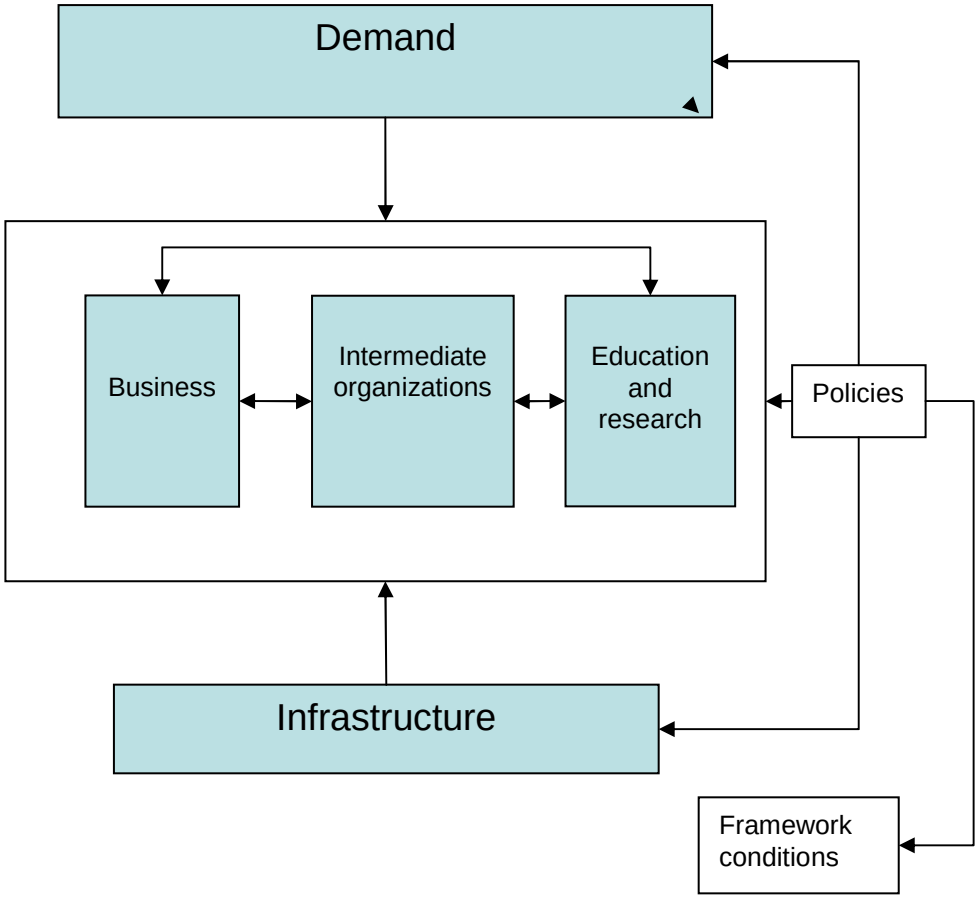
B. Strengthening national innovation systems

45. The broad policy and institutional framework supporting STI is built on models which vary between countries and have evolved over time. Broadly speaking, STI frameworks have evolved from so-called "linear" models of innovation into models based on the concept of the NIS.

46. Linear models imply that there is a direct causal relation from initial impulse to final outcome, which is innovation; the initial impulse can be either of a "supply push" nature, that is, it originates from government initiatives to set up institutions and policies to encourage R&D, or of a "demand pull" nature, that is, the initial impulse comes from the demands and needs existing in the markets. Linear models of the "push" category tend to emphasize supply-side policies (e.g. investment in training, R&D, and national ICT infrastructures), while "pull" models imply demand-side policies (e.g. market stimulation, user training, or the establishment of uniform standards). In practice, national policies have often been volatile mixtures of technology push and demand pull models, reflected in swings of emphasis between interventionist and laissez-faire policies.

47. Today, the concept of the NIS strongly influences the formulation of STI policy in most developed countries, and in an increasing number of developing ones. With the emergence of the concept of the NIS, the more recent thinking and policymaking in STI has been to broaden its scope beyond the traditional field of R&D to pay much more attention to the concept of innovation. In this context, the organizational, institutional, economic and social aspects of the process of innovation are increasingly important for STI policy. Although there are many definitions of an NIS, in simple terms this concept refers to the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies. The main elements of an NIS are presented schematically in figure 1.

Figure 1
Main elements of a national innovation system



48. A key idea of the NIS perspective is that firms do not innovate in isolation. Innovation depends on the existence of a variety of agents and institutions (much greater in scope than just technology providers and technology users) and on the effectiveness of the interactions between these agencies and institutions. The ability and propensity of an enterprise to innovate not only depends on its access to knowledge from research institutes or technology services centres, but also on many other factors, including access to finance; access to human resources; adequate basic physical infrastructure; firm-level capabilities (design, operation, maintenance, managerial); inter-firm linkages and collaboration and partnerships in R&D among academic and commercial entities; general business services; and demand conditions.

49. According to this approach, the qualitative and quantitative aspects of the interactions and flows of knowledge between a set of actors that includes the business subsystem (firms, farms, cooperatives etc.), the knowledge-production subsystem (universities and research centres) and intermediate organizations (technology brokers and extension services) are critical. These interactions are enabled (or not) by infrastructural elements (physical, financial, cultural and institutional), and are oriented and driven by a combination of market forces (demand for final and intermediate products) and government policies and interventions. Policy therefore needs to consider a very broad range of matters:

(a) The most prominent of these is how to increase the supply of knowledge into the system, generally through measures to reinforce the education and research subsystem and build up human capital. Supply-side policies should be complemented with demand incentives. It is also necessary to promote the generation of strong links between knowledge creators and disseminators on the one hand and users of knowledge on the other.

(b) Human capital development policies need to support the emergence of a sufficiently wide and deep pool of operational, engineering, managerial and research skills. This requires well-sequenced investments in basic education, vocational training, on-the-job training programmes, and more advanced managerial, engineering and scientific education. Many developing countries face serious shortages in design and engineering capabilities, which have tended to worsen in recent years.

(c) The promotion of stronger linkages between the various players in the national innovation system includes a very wide scope of interventions. Some of them are support for research networks, incentives for inter-firm collaboration, and the facilitation of linkages between public research institutions and enterprises, and between national firms and subsidiaries of foreign companies. This may require the establishment of public-funded technology intermediation and/or consultancy services. Policies to encourage public–private partnerships, the development of technology clusters, and the promotion of technology parks are other examples of policies in this broad area.

(d) Depending on the degree of technological advancement of an economy, policies regarding intellectual property rights may have an important role in facilitating transfer of technology from academia to the productive sector and from international to domestic markets. In so doing, policymakers need to strike a balance between incentives for creativity and society's interest in maximizing the dissemination of knowledge and information.

(e) Policy needs to consider how to finance innovation. Developing countries may explore the applicability of the venture capital market model of some developed countries. Fiscal incentives may also have a role to play. Development assistance from multilateral and bilateral agencies also needs to consider this aspect of STI development.

50. Clearly, the State has a major responsibility in facilitating the establishment and strengthening of an NIS and coordinating its operation. The institutions and mechanisms that generate and diffuse knowledge cannot rely on market mechanisms alone. Common practice in both developed and developing countries provides numerous examples of public policies to support knowledge creation (such as tax subsidies, intellectual property protection, government funding and government procurement) and to support knowledge diffusion (such as the establishment of libraries and communications networks).

51. At the same time, the challenges of designing, implementing, monitoring and adjusting such a vast and complex range of policies are considerable. The capacity of STI institutions in many developing countries remains quite limited in this regard. There is a need to invest in building such capacity, for which the development of networks connecting the private and public sectors will be crucial. Developing a shared repository of evidence-based international best practice would represent a useful contribution to this process. Collecting internationally comparable data on STI in developing countries, of which very little is currently available, would also facilitate drawing practical lessons from compared national experiences.

C. Investing in S&T education and training infrastructure

52. Education – especially science education at all levels – is important not only for increasing general science and technology literacy, but also for enabling developing countries to build up a critical mass of scientists, researchers and engineers. However, in many countries, there is a deficit of engineers and scientists. Recent years have also witnessed a worrying trend whereby the percentage of university enrolment in science, mathematics and engineering has been decreasing. Concerted efforts are urgently needed to reverse this trend and encourage science education. In this context, improving gender balance in the field of science and technology is a worthwhile goal, not only in terms of equity and fairness, but also because increasing the numbers of female scientists and engineers is an effective way of building the needed critical mass of human capacity in STI.

53. The problem of scarcity of human capacity in STI is further exacerbated in many developing countries by serious problems of "brain drain." By some estimates, up to one third of R&D professionals from the developing world reside and work in OECD countries. Academic and research institutions in many developing countries have not expanded sufficiently to absorb graduates in science and technology, and there are not sufficient employment opportunities in the productive sectors. The conditions of work are poor compared to those in developed countries. Professional opportunities are fewer, due to insufficient demand for scientific and technological skills by firms and public-sector institutions, poor physical infrastructure, lack of financial resources, and the consequent absence of a critical mass of researchers required to create active research communities.

54. Retaining a larger share of STI talent in the country is a long-standing challenge for developing countries. Active policies targeting young graduates, in an overall supportive framework for STI and for employment opportunities in innovative activities, may deliver results in this regard, but developing countries may also explore how closer ties with expatriates can generate talents for research for their countries of origin through collaborative projects. These links often provide sources of new technologies through investment in the home countries. Some countries, such as India and Pakistan, have benefited from expatriate scientists or those who have returned from abroad.

55. Even when science and technology professionals remain in their home countries, their attention is often diverted away from research of local relevance. This is because work on scientific problems that are of interest to the international community stands a better chance of receiving both academic recognition and opportunities for collaborative research from well-funded institutions. This creates a situation where the scarce resources in developing countries are diverted to benefit developed countries.

56. In order to address this problem, a review of the academic reward system, particularly within developing countries, is necessary. Innovative compensation and reward structures should be created to promote research directed to addressing national and regional development challenges. Educational institutions need to provide students not only with an understanding of fundamental principles and technological trends, but also applied skills and industry-specific technological knowledge. Coursework on entrepreneurship and business management should also be introduced, thereby preparing students for the rigours of managing innovative enterprises, as well as facilitating a culture of entrepreneurship.

57. In contrast with their developed-country counterparts, many universities in developing countries have not established sufficiently strong linkages with industry. Such collaborative efforts have become quite pronounced in the developed world, providing benefits to both parties. Industry obtains access to state-of-the-art university laboratories, talented research scientists and a pool of potential recruits. Universities receive industry's financial support, necessary to conduct their work and expand their resources, and they also receive feedback from industry to adapt research to the needs of the economy. Well-

thought-out intellectual property policies, incentives for the involvement of academic staff in joint projects with industry, efforts to develop an entrepreneurial culture in the university, and investing in building the necessary managerial skills for successful transfer-of-technology programmes are some factors that contribute to the success of university-business collaboration. Notwithstanding these mutual benefits, attention should also be given to the need for universities to preserve their independence in R&D activities, which should not be uniquely driven by commercial objectives.

58. For universities to be able to fully contribute to S&T-based regional development, appropriate support mechanisms are necessary, including implementing tax incentives for research and industry–university collaboration, and making capital available through venture financing or affordable loans. Governments can encourage industry–university R&D linkages by establishing formal institutional relationships. Research networks or consortia can provide opportunities for cross-sector information-sharing and collaboration without requiring a major investment by individual parties.

59. When they are part of a comprehensive policy to support the development of STI capabilities, instruments such as technology offices, and technology parks and incubators can stimulate research commercialization and subsequent enterprise growth. Other similar mechanisms have been used with success. For example, Taiwan Province of China has used R&D consortia to foster cooperation between laboratories in the government-funded Industrial Technology Research Institute and local enterprises. This joint effort has resulted in technology transfer and innovative processes and products.

60. The improvement of higher education will not be fully effective at stimulating innovation unless it is also accompanied by an expansion of opportunities for graduates to apply their skills and talents. With a significant amount of R&D activity occurring in the private sector, business enterprises serve as a primary source of demand for S&T specialists. By providing employment opportunities and career paths for scientists and technologists, enterprises encourage students to enrol in scientific and technological fields. As more students graduate with relevant skills and motivation, this growing pool of human capital will, in turn, attract more enterprises to the region, thus creating a virtuous, self-reinforcing circle of technological capacity development and R&D activity. Government could review whether firms, particularly SMEs, face negative or positive incentives when hiring the university graduates. Possible positive incentives could include tax breaks or financial aid, to support internships or offset the initial cost of hiring and training new employees. Enterprises could also be encouraged to employ students as interns or part-time researchers, laying the foundation for later employment.

D. International cooperation

61. While from the discussion above it is clear that the prime responsibility to build science and technology foundations rests with national actors coordinated by the State, given the large technological gaps noted earlier, the question of technology diffusion and transfer from lead technology producers to less advanced countries is also of crucial importance for developing countries to be able to narrow these gaps.

62. Market-based mechanisms for technology transfer through trade, FDI and licensing have always been used by developing countries to acquire new technologies. However, although trade and FDI have indeed contributed to the technological progress of some developing countries, for many others countries – particularly the LDCs – they have not, due to these countries' weak absorptive capacities and the particularities of their insertion into international trade and investment flows.

63. There is, therefore, a need to simultaneously address issues of technological absorptive capacity, increased exposure to and transfer of foreign technology, and endogenous knowledge accumulation. While at the national level, STI policy should be mainstreamed into overall development strategies and should consider STI issues through a holistic approach, the knowledge and technology dimensions should also be incorporated into international, regional and South–South development frameworks and policies.

64. In this context, international transfer of technology remains an irreplaceable ingredient of the policy mix. While the preceding paragraphs have noted how innovation policy for development covers a much more extended field than intellectual property issues, the increasingly restrictive regimes for intellectual property are increasing the costs for access to foreign technology, and many learning-by-doing methods, for example reverse engineering, may not be possible any more. There are several established mechanisms that offer some potential for transfer of technology. These include arm's length arrangements in the form of inter-firm strategic alliances for R&D, public–private partnership projects (for example between public research institutes in developing countries and foreign firms), or taking advantage of the movement of physical persons. However, in most cases, weak local capacities make it difficult for lower-income countries to fully benefit from such approaches. Some other possible avenues that may be considered in order to facilitate a more effective transfer of knowledge and technology to developing countries include the following:

- Enabling LDCs to take full advantage of the flexibilities available to them in the area of intellectual property, for example by identifying best practices in the implementation of the commitments made by developed countries in this regard. Another possible area for flexibility is to distinguish between basic research and commercially applied research, with the possibility of making the former (including related databases) available free of charge. Flexibility could also be applied in the form of exemptions or exceptions for acute public health, environmental and social needs of poor countries.
- Facilitating the transfer of the technology generated by public-sector entities.
- Exploring ways of giving fuller consideration to transfer of technology and innovation issues in regional trade agreements and of deepening regional approaches to technology and innovation cooperation.
- Applying open access regimes more broadly. In some areas involving extensive cumulative innovation, such as computer software, biotechnology or other public domains of common knowledge, open access arrangements may be the most efficient forms for advancing knowledge while maximizing dissemination.
- Strengthening international partnerships for generating and sharing innovations, involving both public and private sectors and with effective participation by developing countries. For example, many global initiatives have been launched, with the financial support of the public and private sectors, to enhance global research and information capabilities, so as to overcome crucial problems in the areas of rural development, the environment, and health in poor countries.
- Increasing global support for building capacity in developing countries, especially the LDCs, to enhance human capital, infrastructure and institutions in order to develop their scientific and technical knowledge. There is a strong case for donors to increase "knowledge aid" and aid for science and technology.

IV. Issues for further consideration

65. This note has briefly reviewed some challenges and opportunities in relation to the critical development need to strengthen productive capacity through STI and entrepreneurship. As part of its policy dialogue, the members of the Commission may consider the note as background for a discussion of some of the following points:

On STI policies:

- What strategies can developing countries consider for building a sustainable knowledge and skills base? How can the experiences of successful developing countries be replicated?
- What STI capacities should be built as a matter of priority in the State and in the private sector?
- What should the priorities in building an NIS in a developing country be? How can the emergence of collaborative links between knowledge institutions and the productive sector be encouraged?
- How can market-based mechanisms contribute to enhancing STI capabilities in developing countries?
- How can international cooperation contribute to such strategies? What specific actions can be undertaken at the international level to reduce the knowledge gap?
- What role can UNCTAD's policy analysis and technical assistance play in supporting the development of STI capabilities in developing countries?

On entrepreneurship policies:

- What measures are needed to facilitate the role of entrepreneurship policies and related actions in building local productive capacities?
- What reforms in the policy or business environment have proven effective practices in breaking new ground and creating a more conducive environment for entrepreneurship?
- What kind of institutional arrangements are needed for promoting coordination between the different policy areas and levels of governments, ministries and various stakeholders to ensure an effective and coherent functioning of the enabling entrepreneurship ecosystem?
- What are national good practices in measuring progress in building the entrepreneurship base?
- How can UNCTAD's entrepreneurship policy toolkit be leveraged to maximize its usefulness for member States?
- How can it be adapted to the specific developmental context and socio-economic situation of individual countries?