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Financing Technology for SMEs: Issues Note by the UNCTAD Secretariat

Executive summary

The sixth session of the Commission on Enterprise, Business Facilitation and Development (18–21 February 2002) chose the overarching theme "Improving the Competitiveness of SMEs through Enhancing Productive Capacity", under which a series of interrelated Expert Meetings could be convened during the time remaining before UNCTAD XI. The Commission also decided to convene the first Expert Meeting on the topic of "Financing Technology".

Technology development is a critical determinant of the ability of developing-country enterprises to compete in global markets. The ability to acquire and master technology and/or innovate requires not only information and a pool of skilled labour but also financing. The Doha Declaration calls for “positive efforts designed to ensure that developing countries, and especially the least-developed among them, secure a share in the growth of world trade commensurate with the needs of their economic development.”

The previous expert meeting on financing small and medium-sized enterprises (SMEs) explored the reasons why they have difficulty accessing financing for any purpose. Hitherto the analysis of technology acquisition, mastery and/or innovation has largely ignored the possibility that enterprises may be constrained by the availability and costs of financing. Technology investment involves considerable uncertainty, information asymmetries, new types of assets, and intangible assets to a greater degree than investment in general. Thus, SMEs seeking financing for technology face a double hurdle.

This paper examines the various programmes in the private and public sectors that are being used to finance technology. The main private-sector sources are special bank loans, leasing and venture capital. However, the requirements for developing venture capital markets are quite stringent. Therefore, government incentives may be needed. The main rationale for public or government-supported measures for financing technology is to remedy various market failures faced by SMEs. Whenever governments provide financial or fiscal relief, they should try to ensure that the benefits to the recipients are linked to performance.

CONTENTS

I. BACKGROUND ISSUES

1. This issues note explores different types of financial mechanisms that are in place to finance technology-related investments, especially those of small and medium-sized enterprises (SMEs) in both developing and developed countries. The focus of the note is on public- and private-sector mechanisms that provide direct financing to enterprises and that could be considered "best practices".[1] The UNCTAD secretariat has also prepared an extensive background paper that examines in more detail financing technology for SMEs.[2]

2. This note examines financing that is commercially oriented (i.e. investment for enhancing the productive capacity of the enterprise). Such investment includes investment in research and development (R&D), in new processes and products and in upgrading existing processes and products. Technology investment could be for technology acquisition, mastery and/or innovation.

A. Impediments to financing SMEs

3. One of the most commonly cited problems by SMEs in both developed and developing countries is the difficulty of gaining access to financing at a reasonable cost. Traditional commercial banks and investors have been reluctant to service SMEs for a number of well-known reasons, which have been explored in numerous expert meetings.[3] These reasons include the following:

- SMEs are regarded by creditors and investors as high-risk borrowers because of their insufficient assets and low capitalization, their vulnerability to market fluctuations and their high mortality rates.
- Information asymmetry arising from SMEs' often inadequate accounting records, financial statements and business plans makes it difficult for creditors and investors to assess the creditworthiness of potential SME proposals.
- The high administrative/transaction costs of lending or investing small amounts do not make SME financing a profitable business.

4. In recent years important progress has been made in developed countries in the area of SME financing. Commercial banks have adopted new technologies, such as credit scoring, that have reduced the costs of lending to SMEs while improving banks' ability to assess the risks involved. Increasing competition for customers in developed countries has driven banks to focus more on SMEs and to introduce products and services that are better tailored to them.

5. Nevertheless, especially in developing countries, SMEs remain an underserved market segment, with the majority of commercial lending going to the government or to large established enterprises, while internationally driven finance programmes tend to focus on micro lending.

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[1] Best practices should be understood as a learning tool rather than a normative concept. Their identification involves determining what works in a given situation, what lessons can be learned and what is replicable.

[2] Dossani R and Kenney M (forthcoming). *Providing Financing for Technology-Based SMEs: A Report to the United Nations Conference on Technology and Development.* New York and Geneva, United Nations.

[3] See, for example, the UNCTAD Expert Meeting on "Improving the Competitiveness of SMEs in Developing Countries: The Role of Finance, Including E-Finance, to Enhance Enterprise Development" (Geneva, October 2001).

6. The difficulties that SMEs face in obtaining financing are more pronounced when it comes to obtaining financing for technology investment. The outcome of technology investments, especially in cases of R&D projects, establishing technology start-ups, or launching or adapting new products, is highly uncertain, with possible returns materializing only after lengthy periods.

7. Following are the key characteristics of the so-called new-technology-based firms (NTBFs) identified in literature:[4]

- Their success is linked to hard-to-value growth potential derived from scientific knowledge and intellectual property.
- In the early stages of their life cycle, they lack tangible assets that may be used as collateral.
- Their products have little or no track record, are largely untested in markets, and usually have high obsolescence rates.

8. These factors imply that NTBFs are even more vulnerable than other SMEs to asymmetric information about risk characteristics and default probabilities, given that it is almost impossible for financiers to attach probabilities to the potential outcomes of the investments.[5] Financiers sometimes use expert advice to evaluate or appraise technology investments in an attempt to reduce the information asymmetry inherent in this area.

B. The importance of technology acquisition, mastery and innovation for SME competitiveness

"Lack of financing and appropriate technology is clearly a major handicap to developing-country producers and exporters, and it inhibits developing countries from deriving full benefits from their trade rights. Many solutions being proposed in the post-Doha programme will be viable only if financing is available."

Rubens Ricupero, 18 February 2002, Geneva

9. The notion that lowering trade barriers would bring increasing levels of trade to developing countries has proved to be somewhat inaccurate. With the exception of Asia, developing countries have not seen any significant growth in their exports to developed countries. (See table 1.) This has led to the realization that opening up to international trade will not by itself increase the share of developing-country exports in the world markets. Action at the micro level is needed to build up the productive capacity of the firms so that they can take advantage of these trade opportunities. Special efforts to enhance the competitiveness of SMEs are required to achieve this goal.

[4] Bank of England (2001). *Financing of Technology-Based Small Firms* (www.bankofengland.co.uk/hightech2001.pdf).

[5] Mani S and Bartzokas A (2002). *Institutional Support for Investment in New Technologies: The Role of Venture Capital Institutions in Developing Countries.* Maastricht, The United Nations University/INTECH Discussion Paper 2002-4 (www.intech.unu.edu/publications/discussion-papers/2002-4.htm).

Table 1

Value and Share of Developing-Country Exports in Total World Exports

Region		Year		
		1990	***1995***	***2000***
Africa	Billions US$	82.0	81.9	112.8
	Percentage	2.4	1.6	1.8
Asia	Billions US$	589.3	1 096.5	1 551.4
	Percentage	16.9	21.4	24.5
Latin America	Billions US$	144.7	225.2	344.1
	Percentage	4.2	4.4	5.4

Source: UNCTAD Handbook of Statistics 2001.

10. The two most important ingredients to enhance the competitiveness of SMEs are access to finance and to the new technologies. Without access to new technologies, SMEs in developing countries will continue to use outdated modes of production and will not be able to meet international quality requirements. Without access to finance, SMEs will not be able to make the necessary technology investments to innovate or even update their production processes or products so that they could compete in global markets.

11. To become and remain competitive, SMEs need to move away from being passive receivers of technology. In the past, technology was thought of as a package that could be acquired in the marketplace. Now it is understood that even using it effectively requires some tacit knowledge. Therefore, technology is not simply a package that an SME can purchase off the shelf in order to become productive:[6] its effective harnessing involves a cumulative process of learning. To merely acquire and use technology, SMEs do not need to be particularly innovative. To master new technologies, however, they need to have in place a system that is receptive to innovation. In some countries, SMEs are extremely active in R&D and in developing new and innovative products. For example, many of the recent Internet-based technologies would never have emerged without the highly innovative, flexible small enterprises that pioneered these technologies. Besides access to finance, SMEs in developing countries also need access to information and skilled labour in order to develop such technology capabilities.

12. Developing countries often face special difficulties in the commercialization of research results. Although high-level scientific research is undertaken by universities and research institutes in developing countries, it rarely leads to commercially oriented products. In some cases, the research results achieved through joint collaboration with foreign investors have been commercialized by the partners from developed countries because they have the necessary financing and market access. There is clearly room for improvement in this regard in developing countries, and new mechanisms for financing technology could play a very important role both in upgrading technology and in commercializing the results of R&D.

[6]Hallberg K and Bond J (2002). *Revolutions in Technology for Development* (www.worldbank.org/html/fpd/technet/revol.htm).

Table 2

Sources of R&D Funding in Selected Countries (1995)

Country	R&D spending as % of GNP	Business enterprises	Government	Source of funds			
				Higher education	*Private non-profit*	*Funds from abroad*	*Not distr.*
Tunisia[1]	0.30	55.5	32.3			4.0	8.2
Mexico	0.33	17.6	66.2	8.4	1.1	6.7	
China	0.61	2.8	91.0	5.7		0.5	
Chile	0.67	20.2	68.5			11.3	
India[2]	0.73	24.0	75.0	1.0			
Brazil	0.84	20.8	43.9				35.3
Italy[2]	1.03	43.7	50.2			6.1	
Germany[3]	2.31	61.4	36.7	0.3		1.6	
Finland	2.46	57.7	37.4	0.4		4.5	
United States	2.61	59.4	35.5	5.1			
Republic of Korea[2]	2.71	84.0	15.9				
Japan[4]	2.96	81.7	18.2			0.1	

[1]1997. [2]1994. [3]1993. [4]1991.

Source: UNESCO.

13. Table 2 shows R&D spending in selected countries. Obviously, developed countries spend a lot more on R&D than do developing countries. However, some newly industrialized countries are doing quite well in terms of overall R&D spending. The Republic of Korea is one of the leading countries in the world in terms of R&D spending as a percentage of gross national product (GNP). Countries such as Brazil, Chile, China and India come very close to the level that Italy spends on R&D. Brazil is set to increase public financing for R&D to US$2.5 billion (close to 1 per cent of GDP), which brings it even closer to the developed countries' levels.[7] Nevertheless, in absolute terms developed countries still outspend developing countries by a large margin in terms of private- and public-sector R&D. This places developing-country enterprises at a disadvantage when they compete with technologically more advanced products. However, it should be noted that in the past some high spenders on R&D, such as the former centrally planned economies, nevertheless did not have commensurate success in bringing products to market because of a lack of entrepreneurial ability.

14. It is also clear that the role of private-sector R&D in developing countries is relatively small, with government doing most of the R&D spending. The low level of private-sector R&D mirrors the difficulties that developing countries face in establishing mechanisms and channels to mobilize private-sector savings that could be invested in technology-related projects. For example, in many developed countries pension funds have accumulated large pools of private savings that are a major source of funding for venture capital investments. In developing countries, such pools of private-sector savings are still underdeveloped. The figures in table 2 also point to difficulties that developing countries have in transforming R&D-related spending into commercially oriented products.

[7] Aguiar Patriota G de (2002). Public policy for science and technology in Brazil. Presentation to the WTO Working Group on Trade and Transfer of Technology, Geneva, 12 June.

II. PRIVATE-SECTOR FINANCING OF TECHNOLOGY

15. This note first analyses financial mechanisms in the private sector and then treats public-sector programmes. This split is, however, not very strict in the sense that private- and public-sector schemes are in many ways interrelated. Therefore, reference is made, when appropriate, to public-sector initiatives that have an impact on private-sector initiatives.

16. Private-sector financing for SMEs can be categorized into internal and external financing mechanisms. Both are important channels for financing technology investments. Large enterprises make significant R&D and other technology investments, with funds generated internally from retained profits. This section focuses on external financing, such as bank loans, leasing and equity-based financing (e.g. venture capital).

A. Banks and special-purpose lending institutions

17. There are a number of technology-related investments in which banks could play a very useful role. These include upgrading of existing machinery by SMEs and the acquisition of proven new technologies. Here banks face difficulties similar to those in SME financing in general (see the discussion above in section A). In addition, banks' aversion to high risk will cause them to avoid technology investments that have long gestation periods; uncertain outcomes; outcomes that are difficult to value even if successful; or outcomes that quickly might be overtaken by the next wave of innovations.

18. Possible solutions could be similar to those used by SME-oriented banks:[8]

- Technology benchmarking using the technology appraisal services of agencies such as ENTAS (European New Technologies Appraisal Service) to reduce the technology information gap within the bank so as to improve the evaluation of technology-related projects and the pricing of loans for them;
- Developing new and more flexible financial products better adapted to the technology-related projects of SMEs;
- Providing training and consultancy services in the area of financing technology to customers and bank staff members; and
- Striking partnerships with business development service providers specializing in technology evaluation.

19. The **European Union** in 1991 launched "The Technology Performance Financing (TPF) Pilot Project", which focused on technology financing by commercial banks. Its objectives were to:

- Increase the involvement of commercial banks in technology financing by encouraging them to experiment with technology performance financing (TPF) as a new product in their portfolio;

[8] The UNCTAD Expert Meeting in October 2001 on "Improving the Competitiveness of SMEs in Developing Countries: The Role of Finance, Including E-Finance to Enhance Enterprise Development" examined these issues extensively. See also UNCTAD (2002), Best practices in financial innovations for SMEs (2002) (UNCTAD/ITE/TEB/Misc.1/Rev.1).

- Enable the participating banks to share experiences and good practices in financing technology projects; and
- Promote the adoption of new technologies by SMEs and help new technology-based firms enter the market.

20. Participating commercial banks agreed to test the extension of the technique of third-party financing, used widely in the energy sector, to technology. The TPF technique allows the financing of a new technology based on its performance. The European Commission provided a partial guarantee to cover the technology risk of the financier, as well as a contribution to the set-up costs of the system. The financing of technology projects originated from the participating bank's own resources. Although the TPF pilot project and the Community's support for participating commercial banks ended in 1997, most of the participating banks continue to finance technology projects and have proven to be open to such opportunities.

21. A number of commercial banks in **Malaysia** have special programmes to provide financing for SMEs. For example, the Hong Leong Bank Bhd has a programme called SMILE (Small & Medium Industries Loan Express) that is specially designed to help businesses upgrade their operations by providing financing for the purchase of industrial machinery or to build new business premises. The services provided by the bank include, among other things, asset financing packages with a flexible fixed loan repayment scheme, trade financing and working capital loan packages and management consultancy services and training programmes.

22. In other cases, countries have created special-purpose institutions when commercial banks do not provide enough financing for technology investments. The Malaysian Industrial Development Finance (MIDF) is a private-sector development financing institution in Malaysia listed on the Kuala Lumpur Stock Exchange. It assists in the creation, expansion and modernization of industrial enterprises, encouraging and promoting the participation of private capital. It provides financing in the form of long- or medium-term loans (5–15 years) or leasing and industrial hire purchase facilities for equipment, heavy and light machinery, plant and other related equipment; and provides managerial, technical and administrative advice.

B. Technology leasing

23. In developing countries, equipment leasing has received increasing attention as a possible strategy for allowing SMEs to access advanced equipment in order to upgrade their operations. An important advantage of equipment leasing is that *the leasing company generally makes the latest equipment available and ensures that it is suited to the task at hand*. The lessor usually relies more on the user's ability to generate enough cash flow to make lease payments, rather than relying on other assets as collateral. Moreover, if the equipment supplier is the one extending the lease, it may be able to better understand and monitor the lessee (though often the lease is held by a financial institution that may be ineffective at monitoring). Because a lease is focused on the cash flow generated by the equipment, a lack of credit history is less important than in the case of a loan. Also, the equipment itself becomes a significant portion of the collateral. Another benefit is that, in most countries, the costs of a lease are tax-deductible because they are an expense. (See box 1 for an example of equipment leasing to businesses.)

Box 1
Leasing in Uganda

DFCU Leasing is a private limited company and a subsidiary of the Development Finance Company of **Uganda**. It was established in 1994 to provide alternative medium-term equipment financing to the private sector. DFCU Leasing buys and owns equipment selected by the lessee and allows the lessee possession and use of the equipment on payment of monthly rental fees over a specified period. Plant, equipment, machinery, commercial vehicles and business cars can be leased in this manner. The lessees must be established businesses that can demonstrate the availability of sufficient cash flow to make monthly payments. The equipment cost is generally in the range of Ush 25 million–Ush 500 million (approximately US$15,000–US$300,000). Lease periods are normally between two and five years. A cash guarantee, typically 15–20 per cent of costs, is required from the lessee. Lease contracts are typically flexible, and payments can be structured to meet the particular needs of the lessee. There are also tax benefits (e.g. depreciation allowances are claimed by the lessee and the payment of value-added tax can be spread over the period of the lease).

C. The role of stock markets in technology financing

24. In the previous section it was noted that bank lending is not suitable for all types of technology financing, especially for high-risk technology investments. Here the role of risk capital comes into play, whether in the form of equity financing, venture capital, angel investment or corporate venturing. However, an important prerequisite for the efficient use of this form of capital is a highly liquid, well-functioning stock market.

25. An increasing number of countries have established secondary stock markets that designed to help new technology-oriented companies obtain equity financing. The leading example is NASDAQ in the United States, which is expanding to Europe and Japan with similar regional exchanges. Europe also has a number of new market stock lists where the criteria for listing are less stringent than on the main bourses. Examples include the Neuer Markt in Germany and the Nouveau Marché in France. In Asia, examples include MESDAQ in Malaysia, KOSDAQ in the Republic of Korea and SESDAQ in Singapore.

26. Establishing a stock exchange that is able to provide efficient and transparent pricing and is sufficiently liquid and deep to support the formation of risk capital can, however, be very difficult. It requires a regulatory environment with relatively strict laws for reporting results and with government having powers to enforce the regulations. It also requires a sufficient number of investors willing to invest in the market, such as pension funds, as well as companies that are able and willing to list on the market. Many stock exchanges established in developing countries and in smaller developed countries have not really generated enough liquidity and depth to operate efficiently. Nevertheless, a number of stock exchanges in emerging countries that *have* achieved impressive levels of market capitalization and turnover.

D. Venture capital firms[9]

27. A report by the OECD[10] described venture capital as a critical component for the success of high-technology firms and recommended that all governments consider strategies for encouraging venture capital. Venture capital has indeed played an important role in the **United States** over the past 50 years in promoting start-ups and new companies in high-growth sectors that otherwise would not have received financing due to the high risks involved. The National Venture Capital Association (NVCA) estimates that venture capital funding increased from US$20 billion to US$100 billion between 1998 and 2000 and then fell to US$38 billion in 2001 (see figure 1). Prominent companies such as Apple, Cisco, Federal Express, Intel, Oracle, Staples and many others have received venture-backed financing at early growth stages. The venture capital industry grew rapidly during the 1990s, particularly in electronics/software and biotechnology, and it is widely thought to have contributed significantly both to the strong growth of the high-technology sector and to the growth of the economy in general. The fall of high-technology share prices in 2001 has also hit the venture capital industry, as figure 1 illustrates.

28. The numerous factors behind the success of the venture capital industry in the United States include a strong entrepreneurial culture; strong university-based research in the sciences and engineering, with links to the private sector, notably clusters of high-technology firms in California and Massachusetts; and well-developed financial and equity markets.

29. The role of government, both direct and indirect, has been significant in promoting the venture capital industry in the United States. For example, policies promoting a stable macroeconomic and financial environment as well as policies to invest heavily in university-based research in sciences and engineering have indirectly contributed to the success of the venture capital industry. The most important instance of direct government involvement was the Small Business Investment Act of 1958 authorizing the formation of small business investment corporations (SBICs). This enabled individuals to form SBICs with private funds through which they could receive up to US$300,000 of Small Business Administration (SBA)-guaranteed money for an investment of US$150,000 in private capital. There were also tax and other benefits. Many of the now-illustrious venture capital firms, such as Sutter Hill Ventures and Institutional Venture Partners, began as SBICs.

30. There are signs that venture capital is starting to play an increasingly important role in some developing countries, although it is still a relatively new phenomenon in many countries. Nevertheless, venture capital is almost completely confined to Asia, while in Latin America and Africa the availability of such funding is very limited.[11]

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[9] This section draws on research in Dossani R and Kenney M (2001), Creating an environment: Developing venture capital in India, BRIE Working Paper 143, April; and Dossani R and Kenney M (forthcoming), *Providing Financing for Technology-Based SMEs: A Report to the United Nations Conference on Technology and Development*, New York and Geneva, United Nations.

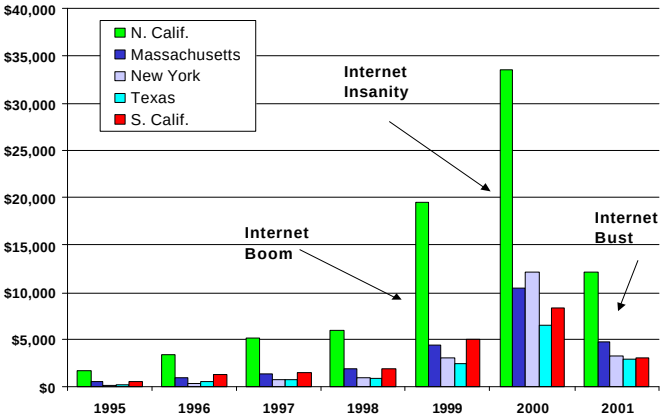
[10] Organisation for Economic Co-operation and Development (2000). *A New Economy? The Changing Role of Innovation and Information Technology in Growth.* Paris, OECD.

[11] Mani S and Bartzokas A (2002). *Institutional Support for Investment in New Technologies: The Role of Venture Capital Institutions in Developing Countries.* Maastricht, The United Nations University/INTECH Discussion Paper 2002-4 (www.intech.unu.edu/publications/discussion-papers/2002-4.htm).

31. The most successful case of venture capital funding in Asia is **Taiwan, Province of China,** where venture capital has grown to be a significant provider of capital for technology-based SMEs. By the early 1980s, it leveraged its success in becoming a low-end supplier of electronic parts to transnational corporations to become a major locus of entrepreneurial activity. In 1983, after a visit by government officials to high-technology regions of the United States, the local government resolved to develop a venture capital industry and passed legislation extending a variety of incentives to individuals willing to invest in professionally managed venture capital firms. The most significant incentive was a tax rebate of up to 20 per cent for local individuals provided they maintained their venture capital investment for at least two years.

32. Another important feature of the rebate is that it permitted overseas investments as long as a benefit to Taiwan, Province of China, could be demonstrated. Strengthened linkages with Silicon Valley resulted. One difficulty with the initial programs was that only individuals were allowed to take advantage of the tax rebate. In 1991 the statute was revised to allow corporate investors the same rebate, and a dramatic increase in investment followed. To further the growth of the venture capital industry, the local government invested funds in venture capital firms on the condition that private investors matched them. The growth of the venture capital industry is clear evidence of the policy's success. The only study examining the benefits of the tax rebate policy was by Wang,[12] who found that the multiplier effects of the government's use of tax deductions to encourage venture capital were "ten-fold or above" between 1990 and 1992. (See box 2 for an example of the venture capital process.)

Figure 1
Venture Capital Disbursement in the United States by State (millions US$)



Source: NVCA 2002.

[12] Wang L-R (1995). Taiwan's venture capital: Policies and impacts. *Journal of Industry Studies,* 2 (1): 83-94.

Box 2
The Venture Capital Process

The typical institutional format for venture capital is a venture capital firm that operates an assortment of funds raised from wealthy individuals, pension funds, foundations, endowments and various other institutional sources. The venture capitalists are typically professionals with industrial experience, and the investors are the silent limited partners. Venture capitalists invest in recently established firms that have the potential to provide very high returns in less than five years. Many of these investments fail entirely, but the successful investments are expected to more than compensate for the failures. In return for their investment, the venture capitalists expect to receive a major stake in the firm and a seat on the board of directors. This involvement in the firm extends to functions such as helping to recruit key personnel and providing strategic advice and contacts such as potential customers, strategic partners and later-stage financiers. The venture capital process is complete when the firm is sold through a listing on the stock market or is acquired by another firm. Venture capital is by nature a temporary investment, and the process requires that there be a mechanism for exiting the firm.

33. The **Republic of Korea** has had a very different experience in its attempts to create a venture capital industry. In 1982 the Korean Development Investment Corporation (KDIC) was established as a limited liability joint venture among seven Korean finance firms and several international financing institutions. KDIC's investments were concentrated in electronics-related fields. The other areas receiving significant funding were chemicals and machinery. In 1986 the Republic of Korea enacted more laws to encourage the formation of venture capital firms. Very quickly, more than 50 venture capital firms were established. However, they experienced only limited success, as there were few suitable investment opportunities.

34. The Korean venture capital industry only came into its own after 1994, when the chaebols (large Korean corporations) were permitted to create venture capital subsidiaries. To encourage the development of the venture capital industry, the Government also launched its own venture capital funds and created a programme to provide matching funds for venture capital limited partnerships. In the late 1990s, the Korean venture capital industry dramatically reduced its use of loans. Even after the KOSDAQ downturn beginning in 2000 and the difficult international situation, in 2002 the Korean venture capital industry remained relatively robust because of Korea's improved economic situation and the deregulation of the financial markets.

35. Although there are some success stories, it has proven very difficult to develop a strong venture capital industry in developing countries, despite a range of government measures such as tax incentives, loan and equity guarantees and direct loans and equity investment. The requirements for creating a viable venture capital industry are stringent:

- It is necessary that there be a constant flow of entrepreneurial firms capable of extremely rapid growth.
- The entrepreneurs must be willing to sell significant equity to outsiders and also willing either to be either acquired or to participate in a public offering.
- There must be a market for firms.
- There needs to be a sufficiently flexible labour market so that top-quality managers and technologists are available to staff a growing firm.

If any of these conditions are entirely missing, or if more than one of them is only marginally met, then it will be difficult to form a viable private venture capital industry. Beyond these conditions, in many developing nations it is necessary to consider other preconditions of a more general nature, such as a relatively stable monetary and banking system, strong rule of law and respect for contracts, and a myriad other macroeconomic conditions the lack of which hampers the development of venture capital.

36. Given the above requirements, it is questionable whether venture capital is an appropriate response to the needs of technology financing in many developing countries. The preconditions can be too demanding. Possible difficulties range from cultural factors, legal systems and entrenched institutions to a lack of adequately trained personnel. In addition, venture capital so far has had sector-specific success, taking taken hold in the electronics and biotechnology industries but failing in agriculture and low-value-added industries. Special incentives may be needed to promote venture capital in developing countries.

37. A review of private-sector initiatives confirms that most developing countries have functioning banking systems. However, what policies and measures are necessary to entice commercial banks to lend to SMEs, and particularly to SMEs that want to invest in new technology? Would government loan guarantees and/or technology advisory services decrease the perceived risks of these investments? Or should governments instead encourage the establishment of special-purpose institutions and give up the commercial banks? The conditions for establishing a venture capital market are stringent even if a developing country already has a viable stock market. Should governments give special incentives to venture capitalists and exercise special controls over venture capital funds? Should they provide matching funds? Or should they rely on leasing as a more viable option to bank lending and venture capital?

III. GOVERNMENT SUPPORT FOR FINANCING OF TECHNOLOGY

38. The *World Investment Report* of 2002[13] identifies the following categories of government incentives for investment:

- *Financial incentives* such as grants, subsidized credits and insurance at preferential rates;
- *Fiscal incentives* including tax holidays, tax reductions or exemptions on profits, capital, labour, sales, value added, particular expenses, imports and exports; and
- *Other incentives* such as subsidized infrastructure, subsidized utilities, market preferences, various kinds of regulatory incentives linked to ownership and other preferential treatment.

39. These categories cover a plethora of various types and forms of incentives that have been used by government to promote technology investments. Many government schemes combine elements of all three categories. This section will provide some examples of financial and fiscal incentives provided for technology investments. (The category of other incentives is beyond the scope of this note.)

[13] UNCTAD (forthcoming). *World Investment Report 2002.* New York and Geneva.

40. There are differences in how governments organize the provision of grants, subsidies and other financial incentives. The overall responsibility may reside with a ministry of sciences and technology or the equivalent, but responsibility is also often split to reflect the competencies of different ministries. Responsibility may also be delegated to national agencies, regional administrations or specialized funds or schemes. It is difficult to draw conclusions as to what is the most effective way of organizing support for technology.

41. Governments consider a wide range of criteria when providing financial assistance for technology. Obvious ones include a project's technical merit or commercial potential t. However, also usually considered are social issues such as promoting certain regions or disadvantaged entrepreneurs. Of course there needs to be a balance between both types of considerations, but the guiding principle should be that projects receiving assistance should have the potential to become commercially viable.

42. Many question whether there is a case for government intervention to support SME access to financing for technology-related investments. However, a recent study by the National Bureau of Economic Research[14] concludes that "there is fairly clear evidence, based on theory, surveys, and empirical estimations, that small and start-up firms in R&D-intensive industries face a higher cost of capital than their larger competitors and than firms in other industries". This points to the existence of a market failure, which could justify government intervention in the area of technology financing for small enterprises.

43. Market failures are often caused by positive externalities that the market cannot fully capture. For example, there is a case for government support when the public benefits outweigh those that are privately appropriable in terms of job creation, exports, cluster development or development of indigenous technology.[15] Externalities may result from scale effects, learning processes or technology spillovers. Incentives may also be used to attract a "first mover investor"[16] or compensate for deficiencies in local infrastructure. Whenever governments provide financial or fiscal relief, they should try to ensure that the benefits to recipients are linked to performance. Programmes should operate in an open and transparent way, with regular reporting of and accounting for costs.[17]

A. Types of financial incentives

44. Governments can provide various forms of direct financial assistance to enterprises to promote technology. Perhaps the most typical of these are **grants** or **awards**. Matching grants are usually preferable since they can improve the efficiency of the government intervention. In some cases the enterprise might be required to repay the grant; for example, in Israel R&D grants are repaid to the government in the form of royalties if a project reaches a commercially viable stage.

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[14] Hall BH (2002). *The Financing of Research and Development,* NBER Working Paper No. 8773. Cambridge, Mass., National Bureau of Economic Research (papers.nber.org/papers/W8773).
[15] Dossani R and K M (2002). Providing Financing for Technology-based SMEs: A report to the United Nations Conference on Technology and Development (Geneva: United Nations), forthcoming.
[16] Moran TH (1998). *Foreign Direct Investment and Development: The New Policy Agenda for Developing Countries and Economies in Transition.* Washington, D.C., Institute for International Economics.
[17] Hughes A and Brewster H (2002). *Lowering the Threshold: Reducing the Cost and Risk of Private Direct Investment in Least Developed, Small and Vulnerable Economies.* London, Commonwealth Secretariat, Economic Affairs Division.

45. Another fairly common way of subsidizing technology is through **soft loans.** The loan can be provided to the enterprise directly by a government agency or through a financial intermediary. In the latter case, the government could provide the funds to the intermediary as a loan, or it could provide some sort of **interest rate subsidy** to compensate for the difference between the market rate and the subsidized rate. Another form of subsidy to promote lending to technology is a government **guarantee** for a loan, as was the case in the European Union pilot programme to promote lending by commercial banks for technology-based projects that was discussed in the area of financing technology in section II-A.

46. Other ways for a government to provide funding for technology-related investments include **equity participation** (e.g. through **government venture capital funds)** or the more indirect form of **government procurement** (e.g. a government agency could purchase technology-related products from local SMEs at subsidized prices).

47. Government schemes to promote technology cover a range of investments, from R&D to upgrading existing plant and equipment. A variety of instruments are used. This document gives examples first for technology upgrading in Malaysia and Tunisia and then for financing R&D in the United States, the European Union and China.

48. **Penang**, **Malaysia,** has 34 technology financing schemes for SMEs. Three of these include the following:

- The *Industrial Technical Assistance Fund (ITAF)* was set up in 1990 to prompt SMEs to upgrade their technical capabilities in areas such as product development, design, quality and productivity enhancement. Assistance is given in the form of grants, with 50 per cent of the project costs borne by the government and the remainder by the applicant.
- The *Modernization & Automation 2 Scheme (MAS)* is a soft loan scheme aimed at promoting the use of modern technology processes by Malaysian-owned SMEs. The scheme assists SMEs in the acquisition of new machinery and equipment. Loan amounts are up to RM1 million and up to 75 per cent of the machinery or equipment purchased, with an interest rate of 4 per cent p.a. and loan periods of 5–10 years.
- The *Normal Loan Scheme* offers project loans, leasing, and share financing. The scheme offers lease financing of machinery and equipment for a minimum amount of RM100,000, at 5 per cent interest and for a maximum period of 5 years. With regard to share financing, the scheme offers to take up equity in companies for amounts ranging from RM100,000 to RM5 million, with an interest rate of 5 per cent and a maximum period of 5 years.

49. In **Tunisia**, the Government provides financial incentives to new entrepreneurs. These comprise capital grants, grants for studies, technical assistance fees and expenses relating to the acquisition of sites or premises necessary for the implementation of industrial projects, and equity participation. New entrepreneurs may receive the following benefits: a capital grant of 10 per cent of the cost of the equipment, up to a ceiling of D100,000; a government grant towards defraying the cost of the project study (this grant is set at 70 per cent of the cost of the project and may not exceed D20,000); a minimum equity participation granted to manufacturing and service-sector projects; and payment by the Government of a third of the price of the land or premises required for the project, up to a ceiling of D30,000.

50. The Government also subsidizes training expenses involved in the acquisition of technology and technological expertise. These include payment of up to 50 per cent of the cost of human resource training in connection with technological investment, up to a ceiling of D125,000; training expenses include registration fees, transport and accommodation costs and other training-related outlays. They are paid from the budgeted funding of the Ministry for Vocational Advancement and Employment.

51. The *United States Small Business Innovation Research (SBIR)* programme aims to increase government funding to small high-technology companies for R&D with commercial potential. The specific aims include stimulation of technology innovation in the small-business sector; increased use of this sector to meet the R&D needs of the Government; increased use of minority and disadvantaged individuals in this process; and expanded commercialization of the results of federally funded R&D. In Phase I, SBIR awards up to US$100,000 towards the expense of evaluating a concept's scientific or technical merit and feasibility. If the project is deemed promising, it can receive up to US$750 000 in Phase II. To promote the commercialization of R&D, the Small Business Administration (SBA) operates a computer database to link SBIR awardees with venture capital firms. Further, a pilot programme, the Small Business Technology Transfer (STTR) programme, provides funding for research proposals that are developed jointly by a small firm and a scientist in a research organization. Since its inception in 1982, approximately US$8.6 billion in awards have been made for more than 50,000 projects. One in four projects has resulted in the sale of new commercial products or processes.[18]

52. In the **European Union**, the Community Research and Development Information Service (CORDIS) is hosting a new service to help SMEs benefit from European research funding. Innovative SMEs can apply for research funding through the SME Specific Measures scheme. In the first stage, SMEs receive an Exploratory Award, which covers part of the cost of conceiving and preparing a complete project proposal to one of the RTD programmes. In the second stage, there are five different types of project proposals that may be prepared using an Exploratory Award:

- *Cooperative research projects (CRAFT):* These enable groups of at least two SMEs with similar technical problems and without adequate in-house R&D capabilities to engage third parties ("RTD performers") to carry out most of the research on their behalf.
- *RTD projects or collaborative research projects:* These are open to enterprises possessing the internal capacity to undertake their own research; at least two enterprises must pool their efforts.
- *Demonstration projects:* These are designed to prove the viability of new technologies on completion of the research phase, where the technologies concerned still face technical and technological uncertainties and are thus not yet ready for marketing.
- *Projects that combine research and demonstration activities in respect of new technologies.*
- *Innovation projects:* These are pilot projects resulting from research where transnational transfer of a technology is involved.

[18] Organisation for Economic Co-operation and Development (2000). *Small and Medium Entreprise Outlook, 2000.* Paris, OECD.

53. As table 2 indicates, governments provide the lion's share of funding for R&D in developing countries. In **China** most research institutes are state-owned, and most of the country's research programmes are financed by the Government. A new initiative will allow research institutes that carry out Government-sponsored research projects to claim ownership of the intellectual property resulting from such research. The measure represents a significant shift in the management of science and technology in China, and it replaces the current practice according to which the results of all Government-sponsored research belong to the state. The new approach follows current practice in other countries by allowing the intellectual property rights to remain with the scientific personnel in order to promote the commercialization of R&D. This could encourage, for example, the formation of science-based companies.

B. Types of fiscal incentives

54. Nearly every nation in the world uses fiscal and tax incentives to encourage R&D and investments in sophisticated machinery and there are also specific programmes for SMEs. These incentives can include tax holidays, credit rebates and various accounting procedures such as accelerated depreciation.

55. In a recent study of legal measures and tax incentives for R&D in **India, Japan** and the **Republic of Korea**, Pawan[19] shows that already in the early 1950s Japan began tax incentive programmes for technological development. In the Republic of Korea, efforts to encourage R&D were not launched until the late 1960s. Under Korean law, firms are allowed to retain funds (up to 20 per cent of total income before taxes) for technology development, and these profits are not taxed. This is a very powerful benefit since it encourages firms to reinvest 20 per cent of their profits in R&D. The private sector in India was encouraged to undertake R&D only in the late 1970s when, for example, the Government created an enhanced investment allowance for plant and machinery. India also has a weighted tax deduction equal to 133 per cent for in-house research.

56. **Costa Rica**, like many other countries, provides "free trade zone incentive packages" to attract foreign direct investment (FDI), especially into the electronics sector. The free trade zones offer advantages such as exemption from import duties, taxes of profits, export taxes and other taxes as well as various subsidies (e.g. for training programmes). These free trade zones have indeed been very successful in creating an electronics industry in Costa Rica. Since 1997, some 190 firms have operated in the free trade zones. The greatest success for Costa Rica has been Intel's decision to invest more than US$400 million to establish a semiconductor base in the country. The fiscal and financial incentives, although probably necessary, were not sufficient to explain Costa Rica's success in attracting FDI into its electronics sector. Many other countries offer packages that are financially more generous. Costa Rica had the advantage of political stability, a commitment to economic openness and an excellent education system. The efforts of CINDE, Costa Rica's national promotion agency, as well as political support from the president of the country on down played an important role in the process.

[19] Pawan S (1998). Legal measures and tax incentives for encouraging science and technology development: The examples of Japan, Korea and India. *Technology in Society*, 20 (1): 45–60.

57. In Malaysia, Pioneer Status and Investment Tax Allowance (ITA) incentives are given to companies engaged in manufacturing and in some other sectors such as agriculture and forestry. "Pioneer Status" exempts the company from the payment of income tax for 70 per cent of statutory income for a period of five years. Companies engaged in high-technology activities can qualify for Pioneer Status or ITA on the basis of a special list of Promoted Activities and Products. The tax exemption can apply to up to 100 per cent of statutory income for high-technology companies.

58. Small-scale companies are eligible for incentives provided under the Promotion Investment Act of 1986. They are granted Pioneer Status automatically if they manufacture products or participate in activities listed as promoted products; they receive full exemption from customs duty on raw materials, components, machinery and equipment, if these are not available locally. The Industrial Adjustment Allowance Incentives (IAA) target companies that undertake industrial adjustment programs. The IAA provide an allowance of up to 100 per cent of capital expenditures.

59. There is considerable debate over the relative effectiveness of financial versus fiscal subsidies. Cash grants may be more effective since they cut the initial costs of an investment, while a tax holiday kicks in only when an enterprise starts making a profit. Thus, financial incentives may be the better option for promoting investments that are uncertain and long-term. However, in many cases it is easier for cash-strapped developing countries to give tax holidays. This, however, works best to differentiate among countries that have already established enabling business environments. Thus, while developed countries are able to choose among financial and fiscal incentives, developing countries may have to rely on the latter.

IV. CONCLUSIONS

60. This note has explored the public- and private-sector mechanisms that provide technology financing to enterprises. Many creditors and investors are reluctant to lend to SMEs because of perceived high transaction costs and high risks. Such reluctance results in market failures. Technology financing can be both risky and demanding. Given the added uncertainties attached to investing in technology, SMEs face a double hurdle in accessing financing.

61. Regarding private-sector financing, traditional creditors are often ill equipped to evaluate and appraise opportunities in connection with technology investments. In addition, commercial loans are not always appropriate for technology investments. Equity-based financing, especially venture capital, can play a useful role. However, the conditions for establishing a venture capital industry are stringent and most developing countries would have great difficulty meeting them. Added to these usual difficulties are the recent failures of high-technology companies and the collapse of high-technology markets, which have made even the most willing creditors and investors reluctant to invest in this sector for the foreseeable future.

62. Thus, the rationale for public-sector intervention in the form of subsidies and incentives is better than ever before. What options do developing countries have in choosing between financial and fiscal incentives? In many countries, government policy is biased against SMEs and favours large enterprises, particularly in the area of subsidies and incentives. Therefore, what targeted interventions and safeguards should be adopted to ensure that public

mechanisms are cost-effective and do not lead to further market distortions, moral hazard, or outright corruption?

63. There is also the additional issue of whether these subsidies and incentives comply with World Trade Organization rules in the medium and long term. In the interest of policy coherence between the national and international levels, effective and permissible interventions need to be designed. International organizations, particularly financial institutions, can assist in designing, funding, and implementing these policies. Whatever policy space or grace period developing countries have in promoting technology investment should be exploited as effectively and imaginatively as possible in order to grow competitive SMEs. These last considerations are beyond the scope of this note and might be the logical next step in the exercise.

64. Participants in the expert meeting may wish to review the existing public- and private-sector mechanisms to identify measures and best practices that are replicable in developing countries. They may wish to consider the following questions:

- What are the most feasible and/or effective measures for promoting private-sector technology in developing countries?
- In the case of venture capital, what measures could help developing countries meet the stringent conditions for creating an efficient venture capital system?
- With regard to financial and fiscal incentives for technology investment, what specific measures in these areas can developing countries apply to encourage investment in technology?
- Where national initiatives are likely to fall short of encouraging the technology investment necessary for countries to be competitive, what assistance can international and regional financial institutions provide?
- How can developing countries arrange the timing and sequencing of national policies and mechanisms so that they are consistent with international obligations?