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Institutional Support for Investment in New Technologies: the Role of Venture Capital Institutions in Developing Countries

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INSTITUTIONAL SUPPORT FOR INVESTMENT IN NEW TECHNOLOGIES: THE ROLE OF VENTURE CAPITAL INSTITUTIONS IN DEVELOPING COUNTRIES

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ABSTRACT

An important component of the institutional framework supporting investment in new technologies is venture capital institutions. A group of developing countries, especially from Asia has been rather successful in establishing and nurturing this way of financing new technologies. The present paper attempts to survey the efforts of these countries towards using venture capital institutions as financiers of new technologies. In specific terms, the paper, based essentially on secondary source material, maps out the ways in which these countries have gone about promoting venture capital based new technology firms. In addition, we analyse the VC investments in these countries in terms of stage, technology and source. The paper also develops an index of venture capital development across the selected developing countries. The index allows the ranking of the VC industry in any particular country according to its level of development.

JEL classification: G32, O31, O38
Keywords: venture capital, innovation, initial public offerings, technology financing

INTRODUCTION

Developing countries have over time emerged as leading producers and exporters of high technology products. The share of developing countries in the total world exports of high technology products have increased from just about 8 per cent in 1988 to a little over 21 per cent in 1998 (Mani, 2000). However there is considerable concentration of this activity in a few developing countries from the Asian region. In fact about 95 per cent of the developing country exports of high technology products are concentrated in just five developing countries, namely Singapore, Malaysia, Philippines, Thailand and Korea. During the same period, one also see a significant increase in the innovative activity of these countries: the number of US patents granted to innovators from developing countries increased from about a 1 per cent (of the total world) to about 6 per cent (Mani, 2002). The relatively speaking, better performance of these countries is very often attributed to the particular kind of economic policy followed by their respective governments.

This policy is usually characterized by highly open trading regimes to both foreign trade and capital. But this line of reasoning does not pay any attention at all at the considerable efforts of these countries towards strengthening the ability of their domestic enterprises to enhance their technology generating efforts. They have put in place a number of institutional arrangements for this activity to flourish. While there are significant variations in the specific components of this policy across the various countries, there is one common thread that unites them, namely the use of elements of science, technology and industrial policy that explicitly aim at promoting the development, spread and efficient use of new products, services and processes in markets or inside private and public organizations (Bartzokas and Teubal, 2002). In the context, the purpose of this paper is to examine the role of one such institutional support mechanism for growing technology-based firms in developing countries.

Technological change is the aggregate outcome of investment decisions at the firm level. By focusing on investment decisions at the firm level we can identify significant barriers to the introduction of technological change at the firm level. These barriers refer to credit constraints and knowledge gaps. The decision to invest in new technologies is constrained by uncertainty and information costs. Uncertainty is particularly high when technologies are new and still changing rapidly and investments are considerable. If certain categories of firms do not qualify for credit, they are more subject to exogenous shocks than if they did. Large established firms may survive thanks to better access to credit even though their profitability has eroded. But because barriers to credit stifle the emergence and growth of new firms, the new investment

opportunities opened by technological change and macroeconomic adjustment are not fully taken advantage of. This effect is particularly noticeable in manufacturing exports. In addition, growth and development imply structural transformation and the emergence of new firms undertaking new economic activities. Adjustment to macroeconomic shocks similarly requires that certain economic activities and firms disappear and that others emerge in their place. If new technology-based firms have limited access to credit, the introduction of new products and innovation are slowed. (Bartzokas, 2001).

Early in the growth cycle, small business typically do not have many business assets that can be easily evaluated or pledged as collateral, and have little repayment history or record of profitability upon which external suppliers of funds can rely. For such business, Venture Capital (VC) plays a critical role in the development of knowledge as information producers who can provide detailed assessment of the quality of investment plans and they can address information problems through the activities of screening, contracting and monitoring. The stage in the life cycle of Start Ups and/or New Technology Based Firms (NTBFs) the nature of the need for funding and the characteristics of the firm are important factors considered by VC investment analysts. The problem of valuing technology as an asset from a financial point of view is one of the main issues. Even after some experience, new technology-based firms may remain opaque relative to large firms. The technological role of VCs is not so much significant because of their role in the financing of research activities or the direct promotion of industrial innovation but rather because of their direct and indirect involvement in the design and execution of investment projects in innovation.

The paper is structured into four sections. The first section undertakes a quick survey of the literature on financing new technologies. This literature has largely developed against the context of developed countries. The second section examines in more detail one such financing mechanism, namely the VC institutions. The conceptual underpinning of this institution and its growth across both the developed and developing world are mapped out in this section. The third section maps out the structure of the VC industry in developing Asia. Six different dimensions of the growth of the sector in the continent are discussed. The fourth and final section summarises the main findings of the study.

I. FINANCING OF DOMESTIC TECHNOLOGY GENERATION.

The SMEs now account for a growing proportion of the manufacturing sector of developing countries. Especially during the last decade, the fastest growing segment were those NTBFs which are based on new technologies such as information technology and biotechnology.[1] These firms are generally located in industries such as communications, IT, computing, biotechnology, electronics and medical/life sciences. A general feeling is that these technology-based ventures, whether in the developed or developing country contexts, face extreme difficulties from the point of view of getting their projects adequately funded by the conventional capital market, whether debt or equity. Considerable attention has been paid to this aspect in the literature. The key characteristics of NTBFs identified in the literature (Bank of England, 2001) are that:

- their success is linked to difficult-to-value growth potential derived from scientific knowledge and intellectual property;
- they lank tangible assets in the early stages of their life cycles which may be used as collateral; and
- their products have little or no track record, are largely untested in markets, and are usually subject to high obsolescence rates.

Needless to add, these factors imply that NTBFs are more vulnerable than SMEs generally to asymmetric information about risk characteristics and default probabilities given the fact that it is not even possible for financiers to attach probabilities to the potential outcomes of these projects.

Funding of domestic technology generation has attracted a small but growing literature. This literature is almost entirely based on the experience of developed countries, though there have been some sporadic attempts at extending this to developing countries as well (Mani, 2002). The literature can be broadly classified into three categories:

[1] This was in 1997. See Lockett, Murray and Wright (2002) for the details. The term New Technology Based Firms (NTBFs) were defined for the first time by Arthur D.Little as 'independently owned businesses established for not more than 25 years and based on the exploitation of an invention or technical innovation which implies substantial technological risks'.

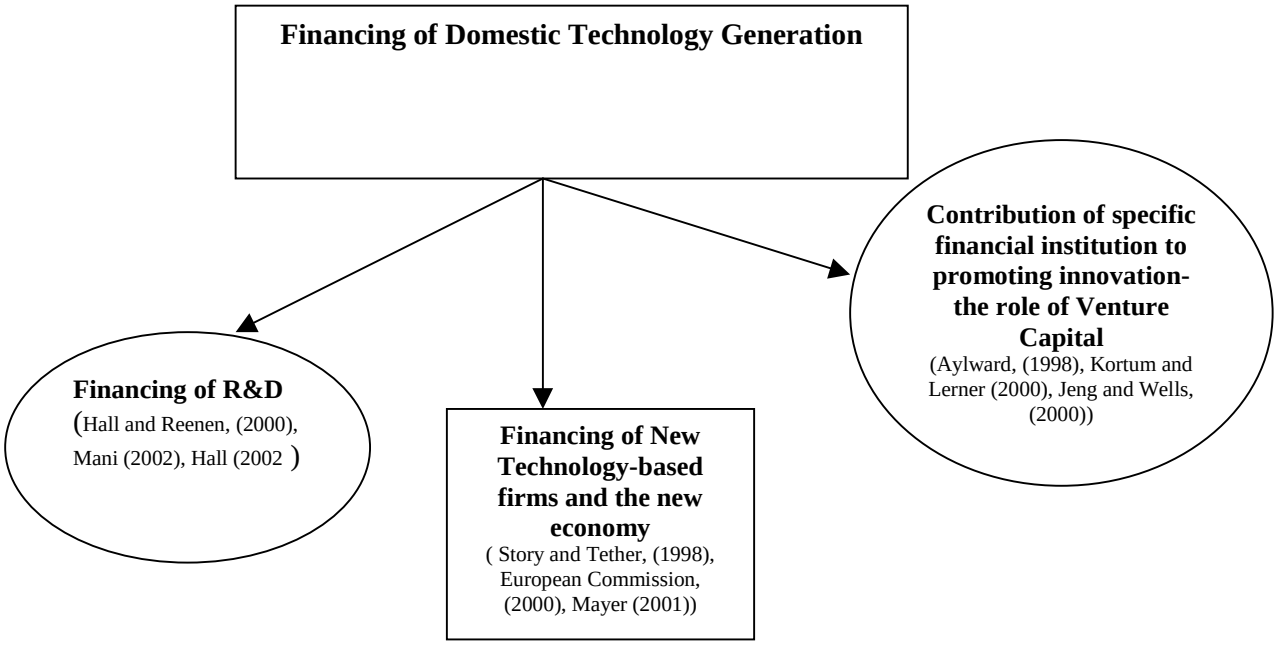


Figure 1: Classification of the literature on financing of domestic technology generation
Source: Own compilation

We shall briefly explain the central questions dealt within the first two of these three divisions. At the outset it must be made very clear that the above three categories are not necessarily mutually exclusive. There is some overlap between all the three and especially the latter two. Discussion of the last category is dealt with in the next section on the concept of venture capital.

Financing of R&D

The general belief is that most firms create technologies through the formal R&D route, though there have been some disenchantment with this position for some time now. The literature in this area has therefore focused on various fiscal arrangements, especially tax incentives of various sorts for encouraging firms to commit more resources to industrial R&D. Much of the literature on this theme focuses exclusively on the U.S. situation and the main research question analysed is the efficacy of fiscal incentives for promoting R&D. A succinct review of the various international studies can be found in Hall and Reenen (2000). Mani (2002) has made a detailed study of the various tax and research grant schemes that exist in six developing countries, namely Korea, Singapore, Malaysia, India, South Africa and Brazil. A recent attempt by Hall (2002) has attempted to link this literature with the literature on venture capital and other ways of financing technology-based startups. The main conclusions of this study are that (i) small and innovative firms experience high costs of capital that are only partly mitigated by the presence of VC; (ii) evidence of high costs of R&D capital for large firms is mixed,

although these firms do prefer internal funds for financing these investments; (iii) there are limits to VC as a solution to the funding gap, especially in countries where public equity markets are not highly developed. The paper ends by making out a case for further work on governmental seed capital and subsidy programmes.

Financing of New Technology-based enterprises and the new economy

There are two lines of inquiry in this area. The first one focuses more specifically on the financing of new technology-based enterprises while the second one has a more general focus on the financing of the so-called new economy or the high technology sector. Most of the literature fall into the first category and is based largely on the European experience. One of the more important papers is on public policy measures to support new technology-based firms in the European Union by Storey and Tether (1998). They examine five policy instruments, one of which is direct financial support to NTBFs from national governments. The study makes a distinction between support provided in direct financial terms such as loans, grants, guarantees, tax relief, etc., and indirect support provided in the form of advisory services, access to information and so on. According to their survey only three countries, namely Germany, Sweden and the UK have financial support schemes targeted exclusively and explicitly upon NTBFs. These range from outright subsidies (covering up to 75 per cent of project costs) in the case of the UK to subsidised interest rates and access to funding in the case of Sweden.

In the literature on financing of the new economy, the most important work is by Mayer (2001). The paper examines the financial sector preconditions for the successful development of the high technology sector (used synonymously with the new economy). The author examine whether the concentration of innovative activity (measured by patents) in science based industries reflect the advantage of funding these activities through stock markets and whether the more production oriented patenting activity in Germany relate to its highly concentrated ownership and large banking system. The main finding is that there is a close relation between types of activities undertaken in different countries and their institutional structures. Although stock markets are very important source of development for the successful high technology firm, they are not the most common.

Needless to add, that NTBFs are vulnerable to asymmetric information about risk characteristics and default probabilities given the fact that it is not even possible for financiers to attach probabilities to the potential outcomes of these projects. Indeed, there is a strategic complementarity between financial markets and investment in innovation at the firm level. If financial markets are underdeveloped, then people will choose poorly productive, but flexible technologies. Firms will choose technologies that are less risky, with many applications, but

less productive. SMEs are reluctant to engage in sophisticated technologies as long as they cannot share the risk they incur with financial markets (Bartzokas, 2001).

II. THE CONCEPT OF VENTURE CAPITAL

There is a certain amount of confusion regarding the definition of VC. It is usually referred to as one type of private equity investments. According to Jeng and Wells (2000, p. 243), "private equity investments are investments by institutions or wealthy individuals in both publicly quoted and privately held companies. Private equity investors are more actively involved in managing their portfolio companies than regular, passive retail investors. The main types of financing included in private equity investing are venture capital and management and leveraged buyouts"[2]. Excepting for the US, and especially in Europe this distinction between the two is not usually made. In the US, VC as a per cent of total private equity has increased from 18 per cent in 1993 to 43 per cent in 1999[3]. The growth of VC institutions, have to a certain extent eased this financial barrier. VC has a number of positive features when compared to other forms of financing and especially debt-financing (Table 1).

However the most distinguishing aspect of venture financing is the rendition of a number of value added services provided by the venture capitalist to its portfolio companies. But its growth especially as a source of risk capital for technology based ventures have been highly uneven not only across the world, but even within the developing world. In fact a recent study by Kuemmerle (2001) showed that there are considerable differences in the evolution of venture capital system in the three technologically developed countries namely, the United States, Germany and Japan. (See Table 2 on pp. 27-8.). It shows that USA alone has a well developed venture capital system. In the US, the pool of capital managed by venture capital firms grew dramatically during the 1980s as venture capital emerged as a truly important source of financing for small innovative firms. (See Figure 2). According to the National Science Board (2000) VC investments in the US have five interesting features. They are:

[2] However even in the US the definition of VC is not consistently followed. For instance, the National Science Foundation (2000, p. 7-26) defines VC investments in terms of six stages namely seed financing, startup financing, first-stage financing, expansion financing, acquisition financing and management and leveraged buyout. The first three are referred to as early-stage financing and the remaining three as later-stage financing. In this case the term VC and private equity are synonyms. But in the case Europe, leveraged buyouts are not treated as part of VC activity.

[3] See Pfeil (2001) for the details.

Table 1: Distinguishing features of VC financing*

	Venture Capital	Debt Financing
1. Objective	Maximise return	Interest payment
2. Holding Period	2-5 years	Short/long term
3. Instruments	Common shares Convertible bonds, options, warrants	Loan, factoring, leasing
4. Pricing	Price-earnings ratio	Interest spread
5. Collateral	No	Yes
6. Ownership	Yes	No
7. Control	Minority shareholders	Covenants
8. Impact on balance sheet	Reduce leverage	Increase leverage
9. Exit mechanism	Public offering, sale to third party, sale to entrepreneurs	Loan repayment
10. Value added services	Yes, (i) financial and strategic planning, (ii) recruitment of key personnel, (iii) obtaining bank and other debt financing, (iv) access to international markets and technology, (v) introduction to strategic partners and acquisition targets in the region, (vi) regional expansion of manufacturing and marketing operations, (vii) negotiating and executing mergers and acquisitions, (viii) obtain public listing.	Nil

Note: These features are largely based on the US experience but could be applied to the situation in Asia as well.
Source: Asian Venture Capital Journal, AVCJ (2000)

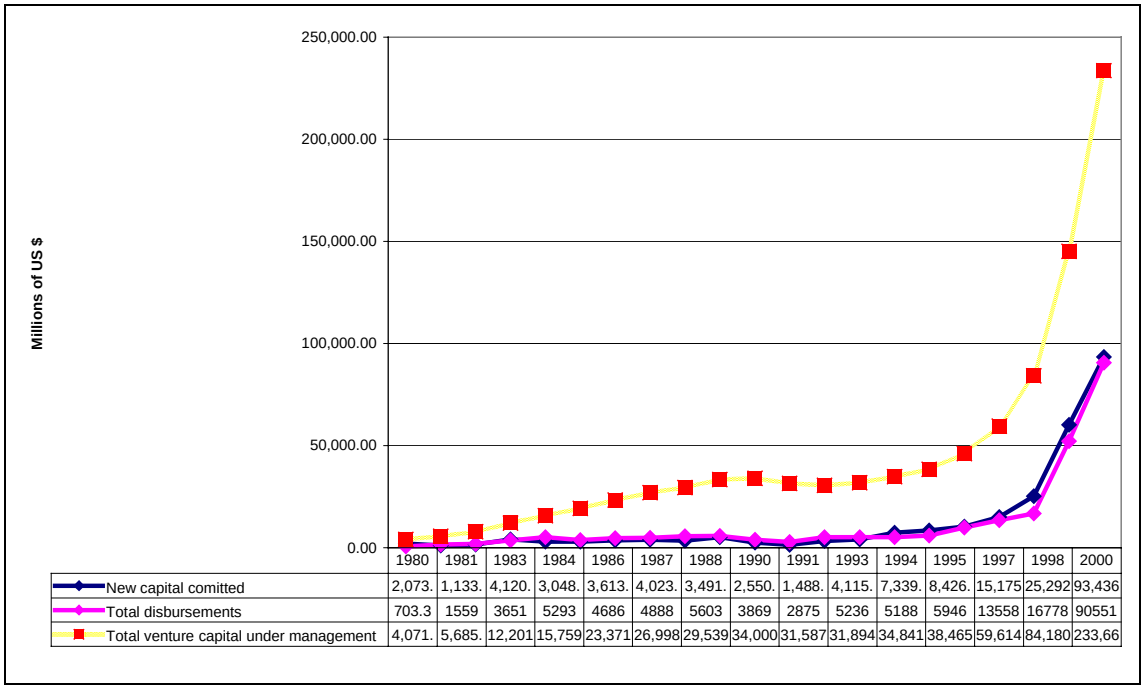
(i) From the mid 1990s onwards there has been a growing gap between the new capital raised and those that are actually disbursed by VC firms implying the availability of surplus funds for investing in new and expanding enterprises;

(ii) Since 1990, firms producing computer software or providing computer-related services generally received the largest share of new investments;

(iii) Later-stage financing (financing of expansion, acquisition or management and leveraged buyout) accounted for very nearly three-quarters of total investments. Within this stage, capital for company expansion accounted for one half of the total disbursement;

(iv) VC firms in the US cluster around locales considered to be hotbeds of technological activity such as California, New York and Massachusetts;

(v) Contrary to the popular impression, only a relatively small amount of venture capital goes to the struggling inventor or entrepreneur. Such seed financing accounted for less than five per cent of all venture capital financing during the period 1994-2000. Computer software, telecommunications, medical and health-related firms accounted for three-quarters of VC investments.



	1980	1981	1983	1984	1986	1987	1988	1990	1991	1993	1994	1995	1997	1998	2000
New capital comitted	2,073.	1,133.	4,120.	3,048.	3,613.	4,023.	3,491.	2,550.	1,488.	4,115.	7,339.	8,426.	15,175	25,292	93,436
Total disbursements	703.3	1559	3651	5293	4686	4888	5603	3869	2875	5236	5188	5946	13558	16778	90551
Total venture capital under management	4,071.	5,685.	12,201	15,759	23,371	26,998	29,539	34,000	31,587	31,894	34,841	38,465	59,614	84,180	233,66

Figure 2: Trends VC Investments, New capital committed and Total VC under management in US, 1980-2000

Notes:
1. New capital committed represents the flow of external capital to venture capitalists and VC investments denotes the actual investments by VC to investee firms.

2. There are some problems with the concept of total funds under management as some [firms] include committed capital plus capital gains, while some others define it as committed capital less liquidations. We are grateful to Andrea Schertler for drawing our attention to the nuances of VC data.

Source: National Science Board (2002).

Comparative studies have shown that there is a fundamental difference between Europe and the United States in the extent to which the venture capital industry is willing to invest in early stage technology-based ventures (Storey and Tether, 1994). Two contrasting reasons are offered to explain the comparatively low European figures. Those supplying the finance point to an absence of suitable projects, and particularly an absence of individuals with suitable managerial skills to make the project successful, as the key reason for the reluctance to invest. In contrast, those entrepreneurs seeking finance point to the technological naiveté of the financial community and the availability in Europe of comparatively high rewards for making investments in conventional sectors with which bankers are more familiar. According to the authors, there is some validity in both arguments. During the 1970s and 1980s, in both France and Sweden, there was clearly willingness on the part of financiers to invest in technology-based smaller enterprises. Unfortunately, the results were so poor that financiers subsequently became very cautious about investing in technology-based firms. This emphasis that the

selection of technology-based projects for investment is difficult. There are, of course, some specialist firms with this ability. In general and in essence, investments in technology-based firms may be deemed more uncertain, even if they are not more risky. Bankers and financiers in Europe, therefore, because they generally lack the expertise, and that expertise is expensive to acquire, have tended to favour investments outside the technology-based sector. This serves to reinforce the difficulties experienced by technology-based new and small firms in raising capital.

The growth of VC firms in the developing world is of very recent origin. In most developing countries it is not older than ten years. There are at least two reasons for this. First, most of these countries do not have one of the primary requirements for a venture capital industry, namely an exiting mechanism such as an organised market for public equity. Research has shown that (Black and Gilson, 1998, Jeng and Wells, 2000) countries which have well-developed stock markets have highly developed VC market as it provides an important form of exit to the VC investors. Second, most of them do not have large pension funds etc., which are the main financiers of VCs worldwide. But all these three factors are now changing. However a major positive factor, which can pave the way for a systematic growth of the sector in developing countries is that fact that unlike in developed countries the main locus of innovation is individuals as opposed to companies and research institutes and universities in developed countries. This is indicated by the fact that most of the patents that are granted to developing country inventors in the US are individuals from these countries. Consequently, the venture capital industry is now on a growth trajectory although highly uneven as far as the developing countries are considered. In fact the industry is just confined only to developing countries from Asia, while its growth in Latin America and Africa (even including South Africa) is very tardy or practically non existent. In some cases the VC industry exists merely as a subset of the private equity industry[4] (See Table 3).

[4] The VC industry in South Africa is an example of this. See Mani (2002) for the details.

Table 3: The uneven spread of VC across the world

	Total Capital under management (Millions of US $)	
	1991	**1999**
USA	28300(389)	134,400(620)
Germany	na	1,826
Japan	15,352 (115)*	21,729 (221)
Israel	300 (15)	3,600 (90)
Taiwan	412(22)	4,447 (132)
Korea	1,547(57)	4,986(131)
Hong Kong/ China	2,173(39)	22,288(190)
India	93(14)	1,826(44)
Singapore	868(23)	7,791(85)
Malaysia	75(8)	667(28)
Indonesia	76(8)	333(44)
Thailand	64(9)	265(15)
Philippines	16(1)	292 (14)
Australia	1,231(34)	3,616 (124)
New Zealand	14(1)**	413(16)

Note: * Figures in parentheses indicate the total number of VC firms; ** Data refers to 1993

Sources: AVCJ (2000); Kuemmerle (2001).

The table presents some interesting facts. First, the total capital under management in the US industry is almost 1.81 times the combined total of all other countries. Second, the size of the VC industry in Germany is only as big as the one in India. Third, the size of the VC industry in China/Hongkong is big as the one in Japan. Finally the Japanese VC industry has shown some significant increases and it is actually much bigger than the German one. This is an interesting result as it is generally believed that the VC industry in Japan is, at best, a budding one (Kuemmerle, 2001, Hurwitz, 1999)[5]. Finally what is striking about the above table is the

[5] The term 'venture business' first surfaced in Japan in the 1960s, but it was not until the bubble-economy years in the 1980s that funds began pouring in volume. At this time, corporations accounted for the lion's share of investing, spending Y20.5bn in 1989, according to the Ministry of International Trade and Industry. Banks invested Y15.8bn in ventures that year. As the bubble deflated, investor enthusiasm for venture businesses flagged: banks and corporations were strapped for cash. Funding dropped off sharply through the 1990s and did not pick up again until 1998. However, by 1998 the situation had changed dramatically. Instead of bank employees and corporate salarymen, this time around it was young mavericks from two new Japanese companies that were investing. Softbank and Hikari Tsushin altered the course of Japanese venture capital single-handedly by sending dozens of employees out on the street to look for deals. Softbank turned up 450 such companies; Hikari Tsushin does not disclose the size of its portfolio.
See Financial Times, http://specials.ft.com/ln/ftsurveys/industry/sc23436.htm) for the details.

phenomenal growth of the industry in developing Asia. In the next section we shall analyse various dimensions of Asia's VC industry.

III. PROFILE OF VC INDUSTRY IN DEVELOPING ASIA

In this section, we consider the pattern of growth and specialisation of the VC industry in Asia. In this study we consider the following Asian countries Hong Kong/China, India, Indonesia, Korea, Malaysia, Myanmar, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand and Vietnam. The data are based on the 12th survey of Asian venture capital and private equity conducted by the VCJ(2000)[6] and the period of study is 1991-1999. The dimensions considered are (a) trends in capital under management and the geographical spread of the industry; (b) the investment profile in terms of both stage and industry-wise flows; (c)source of capital to the VC firms and the role of government in it; (d) the channels that are available for VC firms to exit from their investee firms; (e) the human resource requirement for VC firms; and (f) index of VC development across the selected countries. The main purpose here is to develop an index of VC development in each of the major Asian countries and compare it with that of the USA, Europe, Japan and Australia. Such an exercise, we feel, will enable us to make a proper benchmarking of the industry in Asia.

(a) Trends in capital under management (TCUM)

At the outset the term capital under management is defined by (1).

TCUM = TFAI + TIPCH (1)

Where,

TCUM = Total capital under management
TFAI = Total funds available for investment
TIPCH= Total investment portfolio currently held = Cumulative total of existing investments less any divestments made.

Notwithstanding the low base, the TCUM has registered an impressive rate of growth of 89 per cent per annum (Table 4). Vietnam has registered the highest rate of growth. But among the countries with at least TCUM of US $ 1.5 billion and above, it is India, which has registered a very high rate of growth. Even countries such as Korea, Singapore, and Malaysia which were hit hard by the so-called Asian financial crisis has managed to register increases in the TCUM since 1997. Perhaps the positive effects of the IT boom might have offset the negative effects of

[6] According to the AVCJ (2000), the data contained in the survey are reliable but cannot guaranteed to be complete.

the financial crisis. The only notable exception to this is Indonesia which has experienced negative rates of growth during this period.

Table 4: Trends in TCUM, 1991-1999 (in millions of US $)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average Annual Growth Rate (%)
Hong Kong/China	2,173	2,656	3,095	6,037	8,044	8,729	10,670	15,442	22,288	115.71
Singapore	868	896	1,013	1,833	3,164	3,981	4,468	5,258	7,791	99.70
Korea	1,547	1,629	1,687	1,902	2,567	3,224	1,857	2,995	4,986	27.79
Taiwan	412	470	508	562	696	1,336	1,913	3,598	4,447	122.42
India	93	113	149	243	281	784	1,016	1,053	1,826	232.93
Malaysia	75	147	160	194	437	448	406	460	667	98.67
Indonesia	76	57	99	225	245	289	426	328	333	42.27
Vietnam	10	22	131	247	303	276	292	258	318	385.00
Philippines	16	26	58	85	123	166	169	224	292	215.63
Thailand	64	90	98	117	165	201	177	242	265	39.26
Sri Lanka	4	16	20	49	64	67	71	68	68	200.00
Pakistan	4	4	3	3	7	6	6	15	57	165.63
Myanmar					112	112	113	83	36	-16.96
Total	5342	6126	7021	11497	16208	19619	21584	30024	43374	88.99

Note: * Average annual growth rates are computed by taking the arithmetic mean of annual percentage changes.
Source: AVCJ (2000)

There is, however, considerable geographic concentration (Table 5). About 95 per cent of TCUM are concentrated in just five countries namely, Hong Kong/China, Singapore, Korea, Taiwan and India. Within the top five, all the countries have increased their respective shares with the sole exception of Korea which has actually seen a significant erosion of its share primarily because its industry has grown at a much slower rate.

Table 5: Geographical spread of the VC Industry in Asia, 1991 and 1999 (Percentage share)

	1991	1999
Hong Kong/China	40.678	51.386
Singapore	16.249	17.962
Korea	28.959	11.495
Taiwan	7.712	10.253
India	1.741	4.210
Malaysia	1.404	1.538
Indonesia	1.423	0.768
Vietnam	0.187	0.733
Philippines	0.300	0.673
Thailand	1.198	0.611
Sri Lanka	0.075	0.157
Pakistan	0.075	0.131
Myanmar	0.000	0.083
Total	**100**	**100**

Source: AVCJ (2000)

Within the countries, excepting for India where there is a concentration of VC firms in the city of Bangalore (which is usually referred to as the Silicon Valley of India), there is lack of information whether the VC industry is concentrated in any region.

(b) Investment Profile

The investment portfolio and new investments have registered sharp increases over the last two years across all the countries excepting Thailand. In Thailand there has been a reduction in actual investments (Table 6). What is striking about the investment profile is the fact that despite the 'Asian financial crisis' there has been no slowing down of actual VC investments in any of the countries (excepting Thailand) worst affected by the crisis. In fact the actual investments have almost doubled within such a short period.

Table 6: VC Investments in Developing Asia, 1998-1999 (in Millions of US $)

	Investment portfolio		**New investments during**	
	1998	**1999**	**1998**	**1999**
Hong Kong/China	6715	8787	1378	1985
Korea	2969	3720	609	1253
Taiwan	2056	2951	881	1043
Singapore	1938	2830	424	1060
India	435	802	92	384
Malaysia	265	343	53	81
Vietnam	198	289	44	91
Thailand	234	264	74	53
Philippines	102	157	54	65
Indonesia	98	136	34	48
Sri Lanka	31	36	5	8
Myanmar	32	32	0	0
Pakistan	3	6	2	3
Total	15076	20353	3650	6074

Source: AVCJ (2000)

An interesting fact is that there is considerable gap between TIPCH and TCUM for most countries and especially for Hong Kong\China. In fact the ratio between TIPCH to TCUM was 0.39 in the case of Hong Kong\China for the year 1999. This can mean at

least two things: first the opportunities available for investment is far less than the amount of VC available, second it can also mean that the quality and quantity of VC professionals available for screening proposals are lacking. This latter point is subjected to some further scrutiny in the section on availability of appropriate human resource.

Industry-wide funding

It is generally believed that burgeoning venture capital industry has had a significant impact on innovation in the United States. A recent empirical study by Kortum and Lerner (2000) measure the impact VC has had on innovation and patenting in the US manufacturing sector during the period 1983-1992. The authors explain that, while innovation occurs in large and small companies, projects undertaken by corporate research labs are distinct from those funded by venture capitalists. The latter scruitnise business plans thoroughly, accept only one per cent of them, disburse funds in stages and monitor managers extensively. The impact venture capital has on innovation is particularly strong at the early stage of financing. The authors regress a measure of the number of successful patent applications, in each industry, against a measure of the number of firms that obtained venture capital backing, and against total investments. Patenting patterns across industries over a three-decade period suggest that the effect is positive and significant. The results are robust to different measures of venture activity, subsamples of industries, and representations of the relationship between patenting, R&D, and venture capital. Averaging across regressions, the authors come up with an estimate, for the impact on patenting of a dollar of venture capital relative to a dollar, of 3.1 and this estimate suggested that VC accounted for 8 per cent of industrial innovations in the decade ending in 1992. Further according to the authors, given the rapid increase in venture funding since 1992, and assuming that the potency of venture funding has remained constant, the results imply that by 1998, venture funding accounted for about 14 per cent of the innovative activity in the U.S.

However, in some countries, even in the West, majority of the VC investments have gone towards consumer related industries. So excepting for the US, VC industry is not that technology-friendly. According to Schertler (2001, p. 32), 'compared to the US share of investments in communications and computer-related enterprises to total venture capital, European private equity investors have only invested a small share of private equity in these high-technology enterprises'. Following Shertler (2001), we define the following four industries as high technology-oriented industries. These are[7] (i) Computer related; (ii) Information Technology (IT); (iii) Medical; and (iv) Telecommunications. A comparative picture of the distribution of VC investments flowing towards the high technology sector is presented in

[7] Detailed list of industries which fall into each of these categories are presented in Appendix 1.

Figure 3. It is seen that the developing Asia is marginally better than Europe on this front, but is significantly better than Japan and Australia.

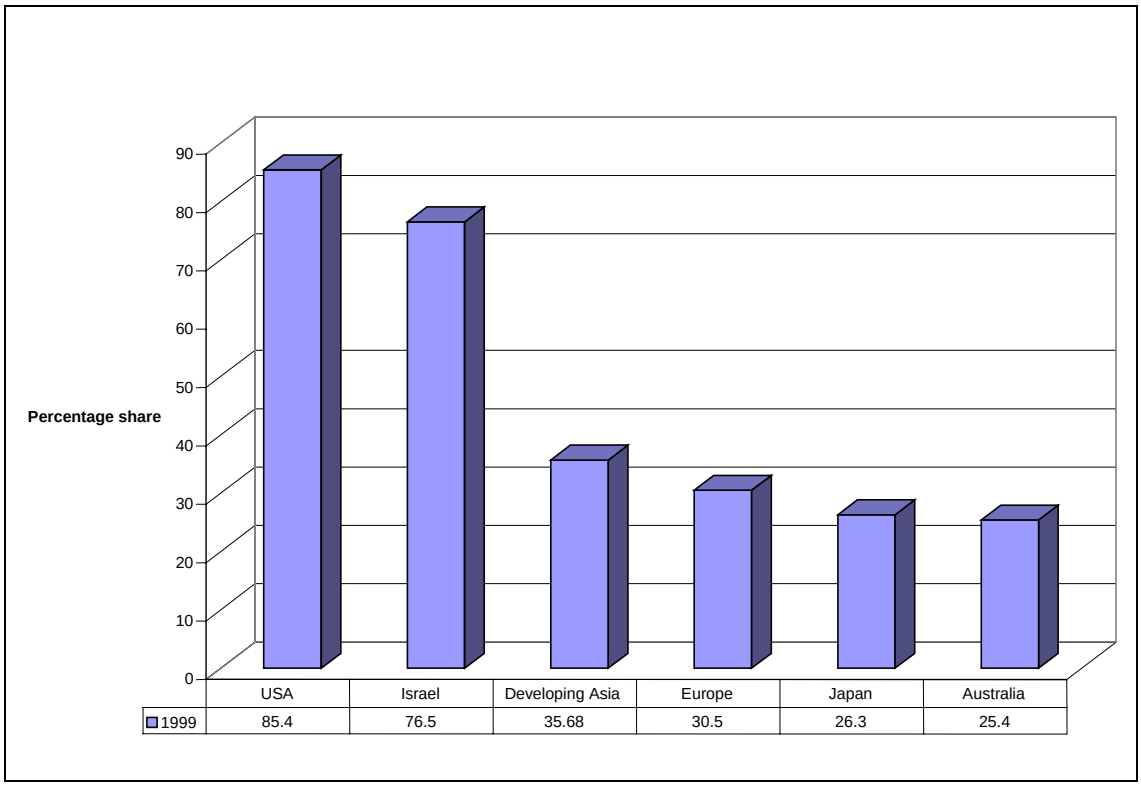


Figure 3: Distribution of VC investments flowing towards high technology sectors.
Source: AVCJ (2000), National Science Board (2000).

The above figure hides considerable inter country variations in the investment pattern (Table 7 on p.28). Two propositions can be made with reference to technology specialisation. First, among the four technology areas, much of the investments have actually gone towards computers, IT and telecommunications while the medical industry (which includes biotechnology) has received only 13 per cent of the total investments. Second, it is only in Taiwan that approximately 60 per cent have gone to the high technology sector, followed by Singapore and India. Surprisingly in two other important countries, namely in China/Hong Kong and Korea only a quarter of the investments have been in high technology sectors. This may perhaps be a an explanation for the fact that the share of Hong Kong \China in total high technology exports from developing countries is not very high. The only country, which has matched the US specialisation, is the Israeli one.

An important hypothesis in the literature is the nexus between VC funding and the growth of certain high technology industries such as the IT (Singh, Singh and Weisse, 2000) and other high technology sectors. The empirical evidence from both the USA and Israel substantiates this

hypothesis. In order to see the link between the growth of VC investments and the growth of the high technology sector in the Asian countries under consideration, we do two excerises: first at the macro level and second at the micro level by taking the case of a specific country which has done excellently in terms of an index of high technology development. At the macro level, we take into account all the Asian countries. For these countries we analyse the relationship between that portion of the VC funding that flow towards the high technology sectors and the growth of the high technology sector itself (Figure 4). The two variables related are the rate of growth of the VC funding towards high technology sectors and the rate of growth of high technology exports from these countries. Since only nine of the thirteen countries in our sample are high technology exporters, we restrict our analysis to these countries. They are China, India, Korea, Malaysia, Pakistan, Philippines, Singapore and Thailand. A notable omission is Taiwan. Despite this, the correlation between the two variables appear to be very high: the zero- order correlation coefficient is (+) 0.76

Table 2: Evolution of Venture Capital Systems in the U.S., Germany and Japan

	U.S.	Germany	Japan
Fundamentals			
Legal system	common law	civil law	civil law
Financial system	market-based/separation of commercial and investment banking	bank-based/universal banks	bank-based (with keiretsu ties)/separation of commercial and investment banking
Primary locus of industrial innovation	research universities, companies	research universities, companies	companies
History			
First public effort to foster enterprise creation	1958: Small Business Investment Act	Early 1960s: Capital Investment Companies	1963: Small Business Investment Companies
First venture capital organisation involving not-for profit institutions	1946: American Research and Development Corporation (venture capital firm co funded by MIT)	1975: WFG (semi-public venture capital firm)	1975: Center for promotion of R&D Intensive Businesses (not a venture capital firm but an industry group coordinated by MITI)
First private venture capital firm	1958	1979	1973
Date of creation of first public equity market dedicated to high-growth companies	1971: NASDAQ	1997: Neuer Markt	1999: Mothers (JASDAQ, started in 1991 was not very successful)
Current State			

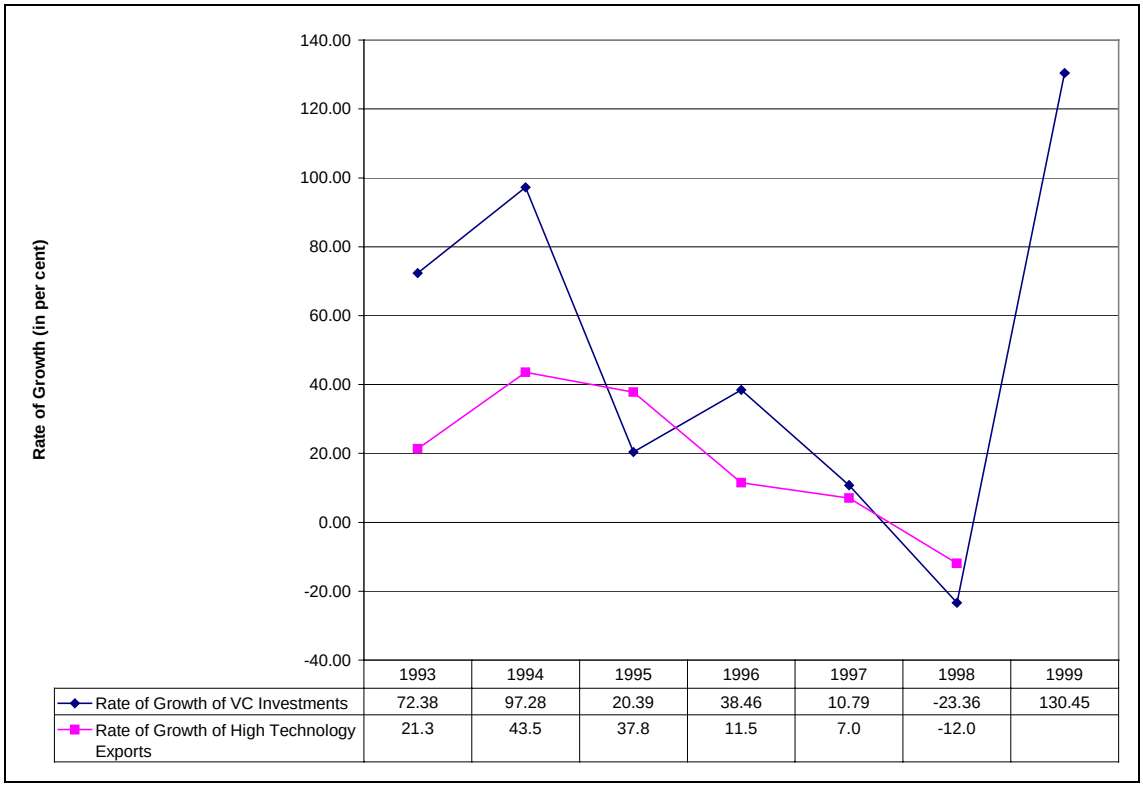
Number of registered private equity firms	1999: 620 (venture capital only)	1999: 172 private equity firms, of which 15 were pure venture capital firms	1999: 232 private equity firms, of which 10 were pure venture capital firms(author's estimates)
Private equity under management	1999: $ 400 billion	1997: $8.3 billion	1998: $12.5 billion
…….. of which percentage venture capital	1999: 33.6 per cent	1999: 22 per cent	1998: 16 per cent
Number of companies listed on high-growth exchange	NASDAQ: 4, 072 (31/01/2002)	Neuer Markt: 202 (31/12/1999)	Mothers: 10 (30/06/2000)
Market capitalisation of exchange	$2873 billion (31/01/02)	na	na
Initial public offerings in 2001	63		

Source: Adapted from Kuemmerle (2001), pp. 244-5, Rausch (1998)

Table 7: Industry-wide disbursement of VC investments, 1999
(Percentage share)

	China	Hong Kong	India	Indonesia	Korea	Malaysia	Pakistan	Philippines	Singapore	Sri Lanka	Taiwan	Thailand
Computer Related	6.7	6.5	16.4	5.9	9.8	7.7	8.1	10.2	8.4	4.5	25.1	5.2
Electronics	6	6.3	4.5	21.1	15.7	15.2	5	7	14.5	6.1	15.3	8.1
Information technology	5.9	6.3	11	8.7	5.3	13.9	0	11.6	15	7.5	24.6	7.3
Manufacturing-Heavy	6.5	8.3	5.6	8.9	11.7	12.1	36	3.1	1.9	11.4	3.9	3.1
Telecommunications	5.8	16.4	10.9	8.3	13.4	7.4	0	12.7	15.8	11.3	7.5	9.4
High-technology based	30.9	43.8	48.4	52.9	55.9	56.3	49.1	44.6	55.6	40.8	76.4	33.1
Medium and low-technology based	69.1	56.2	51.6	47.1	44.1	43.7	50.9	55.4	44.4	59.2	23.6	66.9
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: AVCJ (2000)



	1993	1994	1995	1996	1997	1998	1999
Rate of Growth of VC Investments	72.38	97.28	20.39	38.46	10.79	-23.36	130.45
Rate of Growth of High Technology Exports	21.3	43.5	37.8	11.5	7.0	-12.0	

Figure 4: Relationship between the rates of growth of VC funding and high tech exports, 1993-1999
Sources: AVCJ (2000); Mani (2000)

It must of course be pointed out that one is not making any causation between the two. Among the countries, India has the highest correlation coefficient between the two variables (+ 0.81)[8]. This is highly plausible as the country has emerged as a leading exporter of computer software and as noted earlier about 46 per cent of the VC financing in India have gone towards the high technology sector (Table 7 on p. 28). Therefore, the micro exercise is to estimate this link between VC funding (that is high tech VC funding) and software exports and this is attempted below. This link between the availability of VC financing and the growth of the domestic software industry has been discussed in the literature (Miller, 2000 and Baskar and Krishnaswamy, 2002). According to Baskar and Krishnaswamy (p. 14), VC is 'required by most software firms in India for their sales and marketing expenses rather than for product innovation'. However this proposition needs further empirical scrutiny, as the authors have not adduced sufficient factual evidence excepting for a case study. Government of India and some of the state governments within the country have now established venture capital schemes specifically targeted at the software and IT industry. (See Box 1.). Given that this is initiative is of very recent origin, it is too early to measure its impact on the performance of the industry.

[8] For an examination of the relation between the venture capital and information technology industries in India see Dossani and Kenney (2002).

The National Taskforce on the IT industry had estimated a total VC investments US $ 500 million in the five years beginning 1998[9]. At current rate of growth of VC funding towards this sector, this target appears to be easily achievable (Figure 5).

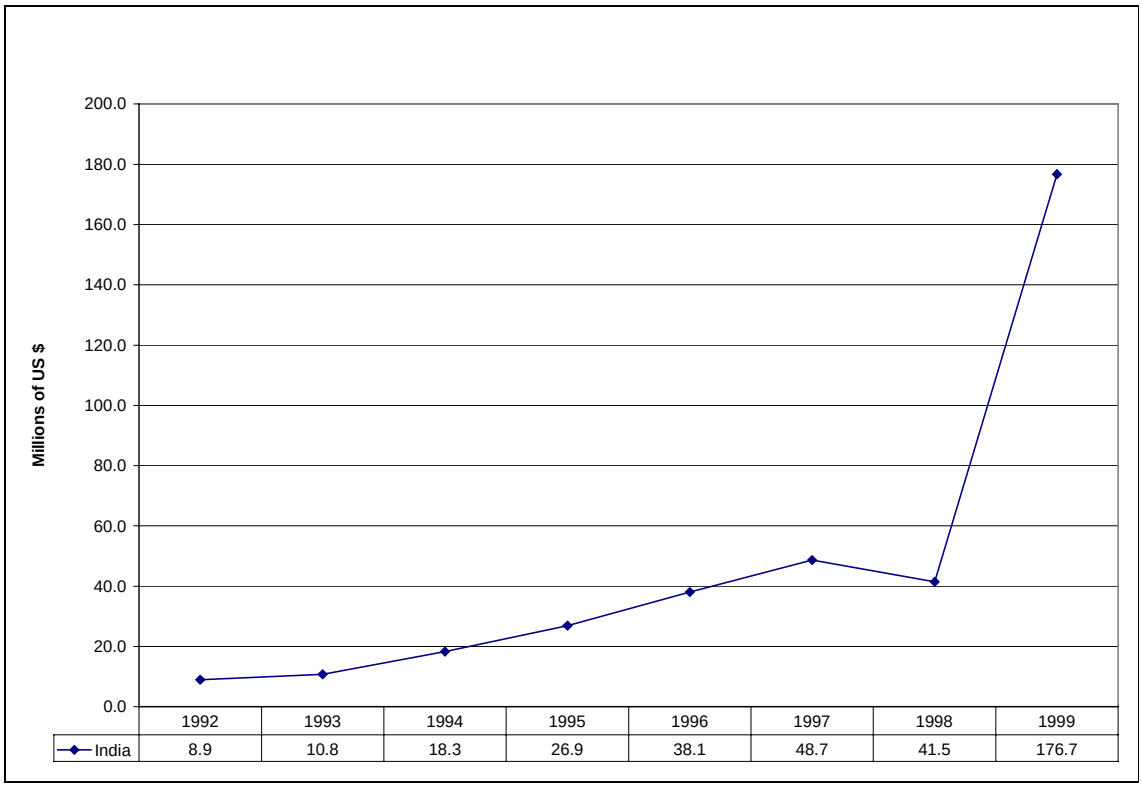


Figure 5: Estimated VC financing towards high technology sector in India, 1992-1999
Source: AVCJ (2000)

[9] See http://it-taskforce.nic.in/vsit-taskforce/bgr3.htm

Box 1: Governmental efforts to establish VC funding for the Software and IT Industry in India

Small Industries Development Bank of India (SIDBI), in association with Ministry of Information Technology, Govt. of India, has set up a 10 year close ended venture capital fund called the "National Venture Fund for Software and IT industry" (NFSIT). This was launched in December 1 1999. NFSIT has a corpus fund of Rs. 1 billion (approximately US $ 21 million) and is a dedicated IT Fund with a focus on small-scale sector. The objective of the fund, besides meeting total financial requirements of the units, is to enable these units to achieve rapid growth rates and develop and maintain global competitiveness. The fund endeavours to develop international networking and enable assisted units to attract co-investments from international venture capitalists. International linkages will help the assisted units to get a listing with foreign stock markets viz. NASDAQ; thereby achieving better valuations and offering alternate exit routes to the investors.
A portion of the Fund has been earmarked for incubation projects that involve high risks and might be used for development of software products. Software products require rigorous risk evaluation for which high degrees of expertise including international linkages are required. The fund managed to attract a number of high-class professionals as investment managers in the Asset Management Company.

Many state governments have already set up venture capital funds for the IT sector in partnership with local state financial institutions and SIDBI. These states include: Andhra Pradesh, Karnataka, Delhi, Kerala, Gujarat, and Tamil Nadu among others.

Source: http://www.sidbiventure.co.in/svc-01r.htm

In short VC financing is an important input for successful performance especially in the high technology sector.

Stage of financing

In a recent a recent succinct review of the facts that are known about venture capital activity, Gompers and Lerner (2001) have identified four different factors that affect the financing of young firms. They are:

(i) There is a tendency for the paid managers of a firm to indulge in wasteful expenditures, if the firm raises equity from outside investors. This is because the manager may benefit disproportionately from this activity and has not to bear its entire cost;

(ii) Likewise, if the firm raises debt, the manager may increase risk to undesirable levels;

(iii) It may be difficult to write a contract governing the financing of a firm if the effort of the entrepreneurial firm cannot be ascertained with complete confidence. This arises in a situation when all the outcomes of the firm cannot be correctly predicted; and

(iv) The above three gives rise to uncertainty and informational asymmetries in the case of young firms.

The above four factors are likely to be acute for companies with intangible assets and whose performance is difficult to assess. A very good illustration of this is in the case of high technology companies with a heavy reliance on R&D, especially in their early stages (seed,

startup and first stage financing). The theoretical expectation is that specialised financial intermediaries such as venture capital institutions are designed to reduce these information gaps and thus allow firms to receive the financing that they cannot raise from other external sources[10].

Mayer (2001) has outlined the sources of capital for a young high technology firm through its various stages of growth (Figure 6) At the initial stages of such a firm a lion's share of the financial input emanate from own savings of the entrepreneurs and from their family members and relatives. Whatever external equity these firms are able to generate are raised from informal venture capital sources referred to as business angels (wealthy or reasonably wealthy private investors). In actuality, even in the best situation namely in the US case (Figure 7) not more than a quarter of the VC funding has actually gone towards this stage. In fact there has been considerable erosion in the share of all early stages in total investments over time.

The factors that determine the different contributions of business angels and venture capitalists to start-up financing has been examined in Van Osnabrugge (1998). This was done by comparing the initial screening, due diligence, investment criteria, contracts, monitoring and exit routes employed by the different types of investor. The results of the analysis (quoted in Mayer, 2001) showed two important differences between the two groups. First, that venture capitalists act like institutions following principal-agent relations of limiting risks through monitoring, while business angels place more emphasis on ex post involvement. This differential behaviour is very much a function of the nature of ownership of VCs. Second, from the very outset VC are focused on exit and expect a much higher rate of return than business angels: in the UK these were almost double the rates expected by business angels. It is against this background that we analyse the stage of financing of VC firms in the developing Asian context.

[10] VC employ a number monitoring and information tools to scruitnise investee forms before providing them with capital. Afterwards the investee firms are monitored very closely. The monitoring and information tools of venture capitalists include: meting out financing in discrete stages over time; syndicating investments with other venture capital firms; taking seats on a firm's board of directors; and compensation arrangements including stock options. For a detailed survey of a number of studies documenting the efforts of VCs in employing these tools, see Gompers and Lerner (2001).

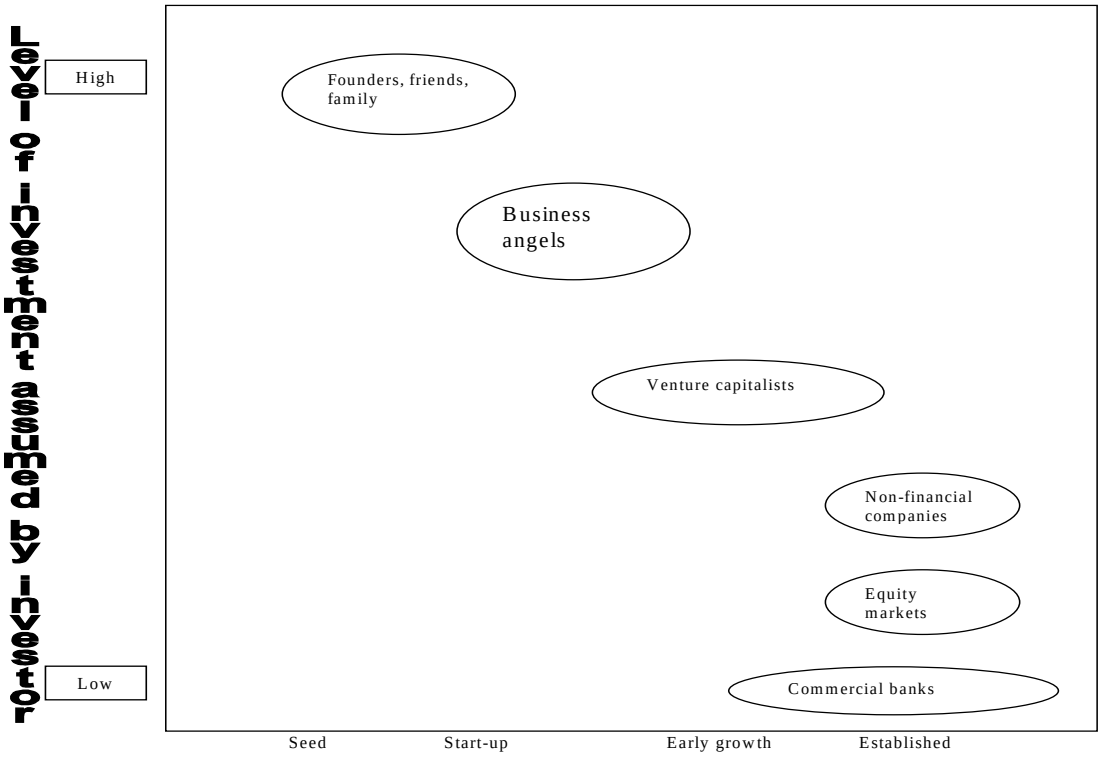
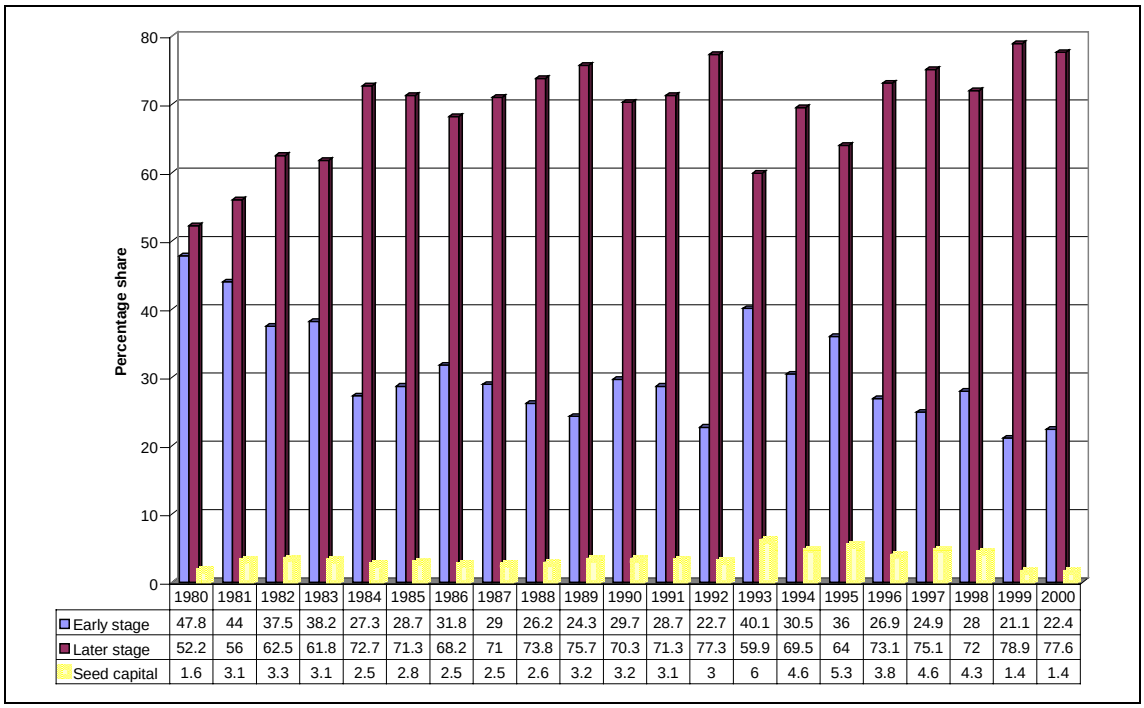


Figure 6: Stages in the financing of a typical high technology firm
Source: Mayer (2001), p. 7



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Early stage	47.8	44	37.5	38.2	27.3	28.7	31.8	29	26.2	24.3	29.7	28.7	22.7	40.1	30.5	36	26.9	24.9	28	21.1	22.4
Later stage	52.2	56	62.5	61.8	72.7	71.3	68.2	71	73.8	75.7	70.3	71.3	77.3	59.9	69.5	64	73.1	75.1	72	78.9	77.6
Seed capital	1.6	3.1	3.3	3.1	2.5	2.8	2.5	2.5	2.6	3.2	3.2	3.1	3	6	4.6	5.3	3.8	4.6	4.3	1.4	1.4

Figure 7: Share of early stage financing in total VC investments in the USA, 1980-2000
Source: National Science Board (2002)

The Asian countries have a much better performance in terms of funding projects at their early stage (seed and startup). In fact the weighted average ratio of early stage financing to later stage for all the countries in the sample is 0.48 (Figure 8). Only the ratio for India is greater than unity implying a preponderance of early stage financing. China is the only other country, which has a ratio greater than the average. The availability of good quality high-tech projects in India and China may be an explanation. Also most of the Indian venture capital firms were initially based on governmental funding though this has changed in the recent period and this helped them to be really venturesome. This shows, despite its relatively speaking small size, the Asian VC industry is showing signs of sound development. Within the early stage, much of the funding is towards the startup stage (Table 8) and within the expansion stage (which consists of expansion, mezzanine (also known as bridge finance), buyout/buy in, turnaround/restructuring); it is the expansion stage, which accounts for the maximum share. Lack of consistent time series data does not allow us to track any inter temporal changes in investments across the various countries.

(c) Source of Funds

In terms of source of funds, the situation in developing Asia is somewhat similar to Japan and Israel than in the US (Table 9). Corporations account for the single largest share, while in the

US the sources are somewhat equally distributed. Pension funds, which is an important source in the US case, is not in the case of Asian countries. This is because the size of pension funds in most of these countries is not sufficiently large and regulations prevent them from investing in VC funds. Government agencies form only about 10 per cent. This shows that in most developing countries, the VC funds are private backed. The micro picture is, of course, quite different (Table 10 on p.41).

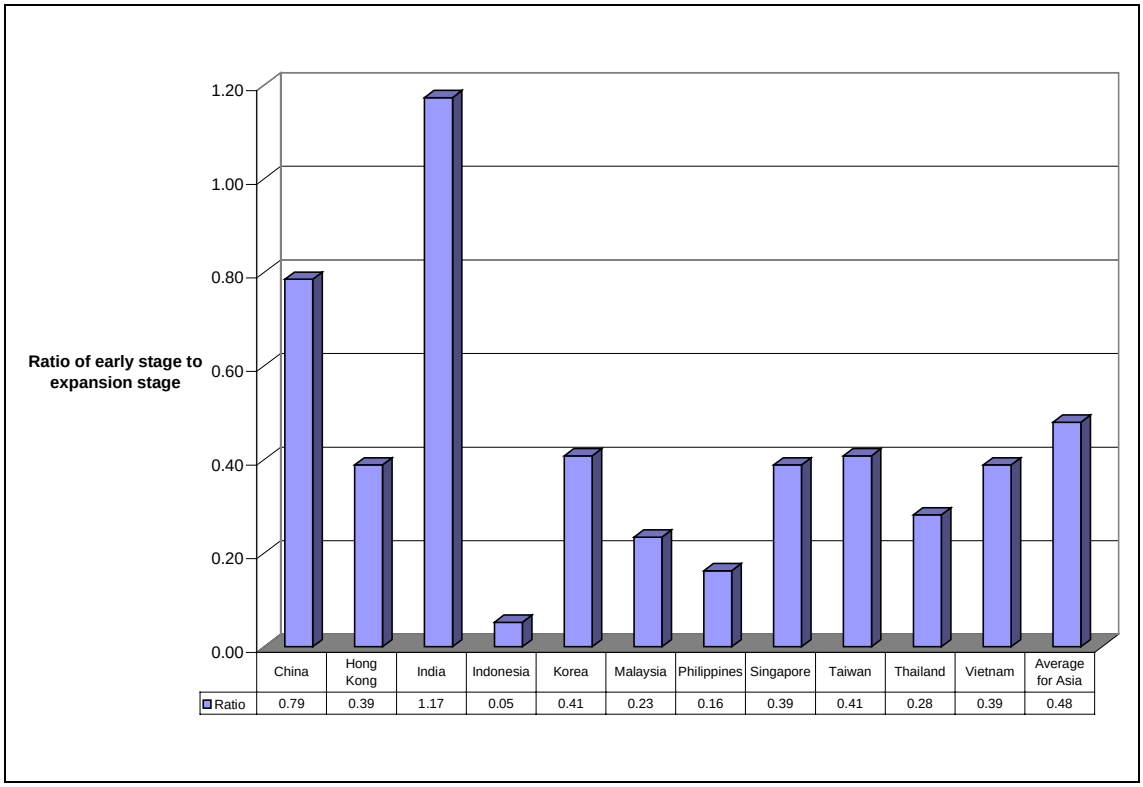


Figure 8: Ratio of early stage financing to expansion stage in Asia, 1999
Source: AVCJ (2000)

Table 8: Distribution of stage-wise investments of VC in Asia, 1999 (Percentage share)

	Seed	Start-up	Early stage	Expansion	Total
China	10	34	44	56	100
Hong Kong	3	25	28	72	100
India	7	47	54	46	100
Indonesia	1	4	5	95	100
Korea	6	23	29	71	100
Malaysia	2	17	19	81	100
Philippines	2	12	14	86	100
Singapore	6	22	28	72	100
Taiwan	6	23	29	71	100
Thailand	3	19	22	78	100
Vietnam	0	28	28	72	100
Japan	3	15	18	82	100
Israel	10	42	52	48	100
Australia	6	11	17	83	100
USA	4	24	28	72	100

Source: AVCJ (2000); National Science Board (2002)

Table 9: Source of funds to VC, 1999
(Percentage shares)

	Developing Asia*	Australia	Japan	Israel	USA
Corporations	47	8	54	39	16
Insurance companies	17	7	17	11	11**
Banks	13	10	18	22	
Government agencies	10	13	3	13	0
Pension funds	6	55	4	4	18
Private individuals	5	6	2	8	19
Endowments	0	0	0	0	15
Others	2	1	2	3	22***
Total	**100**	**100**	**100**	**100**	**100**

Notes: * Weighted average of all the countries, but excludes data on Philippines; ** Refers to both insurance and banks; *** Includes foreign investors also
Sources: AVCJ (2000); Gompers and Lerner (2001)

Table 11: Geographical breakdown of VC sources, 1999
(Percentage shares)

Country	Domestic	Foreign		
		Total	Other Asian	Non-Asian
1. China	28	72	33	39
2. Hong Kong	7	93	16	77
3. India	34	66	6	60
4. Indonesia	42	58	18	40
5. Korea	75	25	5	20
6. Malaysia	51	49	24	25
7. Myanmar	18	82	70	12
8. Pakistan	91	9	0	9
9. Philippines	89	11	10	1
10. Singapore	27	73	35	38
11. Sri Lanka	75	25	6	16
12. Taiwan	85	15	4	11
13. Thailand	35	65	22	43
14. Vietnam	14	86	6	80
15. Australia	89	11	6	5
15. Israel	78	22	3	19
16. Japan	82	18	3	15

Source: AVCJ (2000)

It is only in Malaysia, that the government is an important source of funds. Majority of the capital for the Asian VC companies has emanated from domestic sources itself (Table 11). But there are some notable exceptions to this like China, Hong Kong, India and Singapore. In these cases much of the VC has actually originated from Western sources. This shows that intra Asian investments are quite limited.

Governmental programmes of various sorts have played an important role in establishing and pump priming the VC industry even in developed countries. A survey of these in the OECD countries can be found in OECD (1998) and Jeng and Wells (2000). These governmental schemes vary from providing legal infrastructure and specifically tax exemptions to establishing funds that invest directly in private equity projects. Among the developing countries in our sample, there has been explicit governmental support for establishing a VC industry in all the countries and especially in India and Singapore. A detailed survey of this can be found in Mani (1997 and 2002).

Apart from the domestic governments of these countries, a major impetus for the establishment and growth of the VC industry in developing countries have emanated from multilateral institutions such as the World Bank and one of its affiliates, namely the International Finance Corporation (Aylward, 1996; Pfeil, 2001). In fact as Mani (1997, p. 232) documents the genesis of the VC industry in India can be traced to a series of efforts by the World Bank in the 1980s as part of its 'Industrial Technology Development Project' in India. As part of this project a loan of $45 million was made available to the government to support four venture capital entities for financing technologically innovative and growth oriented small enterprises. The government, however, relent this amount to four state-owned venture capital firms.

(d) Exiting VC Investments

VC investments being primarily in the equity of the investee firm, the return to the VC is in the form of capital gains to be made while off loading the shares at a later date when the venture has achieved some maturity. It is this capital gain to be made that brings in a return to the VC. There are at least five main exit options (British Venture Capital Association, 2002). (See Figure 9).

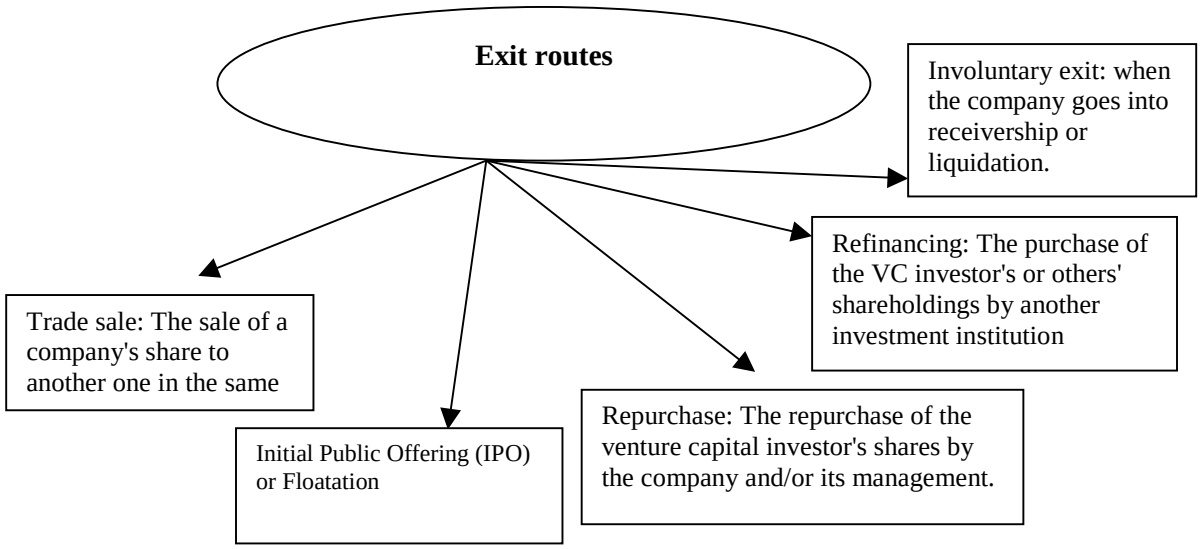


Figure 9: Exiting from VC investments- the five routes
Source: British Venture Capital Association (2002)

Of the five, the two most important and commonly used exits are trade sales and the IPO routes. In the US, 56 per cent of the number of all IPOs (in 1999) were venture backed, while in terms of money it was about a third (Gompers and Lerner, 2001). According to Jeng and Wells (2000), IPOs are the most attractive option for liquidating the funds.

Korea has the highest rate of divestment (defined as the amount divested per year taken as a percentage of TCUM). This is presented in Table 12. However some of the major countries such as China, Hong Kong, and India had low rates of divestment. It must of course be mentioned that the divestment rate is subject to at least two kinds of interpretations. First a high divestment rate may suggest the easy of exit for VC firms. Second, on the contrary, it may also mean that the VC firms are not holding on to their investments for a sufficiently long period of time. But given that the data only refers to just two recent years, it is rather difficult to draw any firm conclusions. Whether the higher rate of divestment in the East Asian countries is due to the financial crisis requires some further research. Alternatively the low rates of divestment in some of the major countries may in fact been a reflection of the regulatory framework with respect to the lockup period (Mani, 2002), and the easy availability of the routes of exit. The various exit mechanisms followed in the Asian situation are summarised in Table 13 (p. 42.). IPOs are the only exit route in most of the countries and therefore as noted by Jeng and Wells (2000), it is indeed one of the determinants of VC investment.

Table 12: Divestment Rate in VCs, 1999

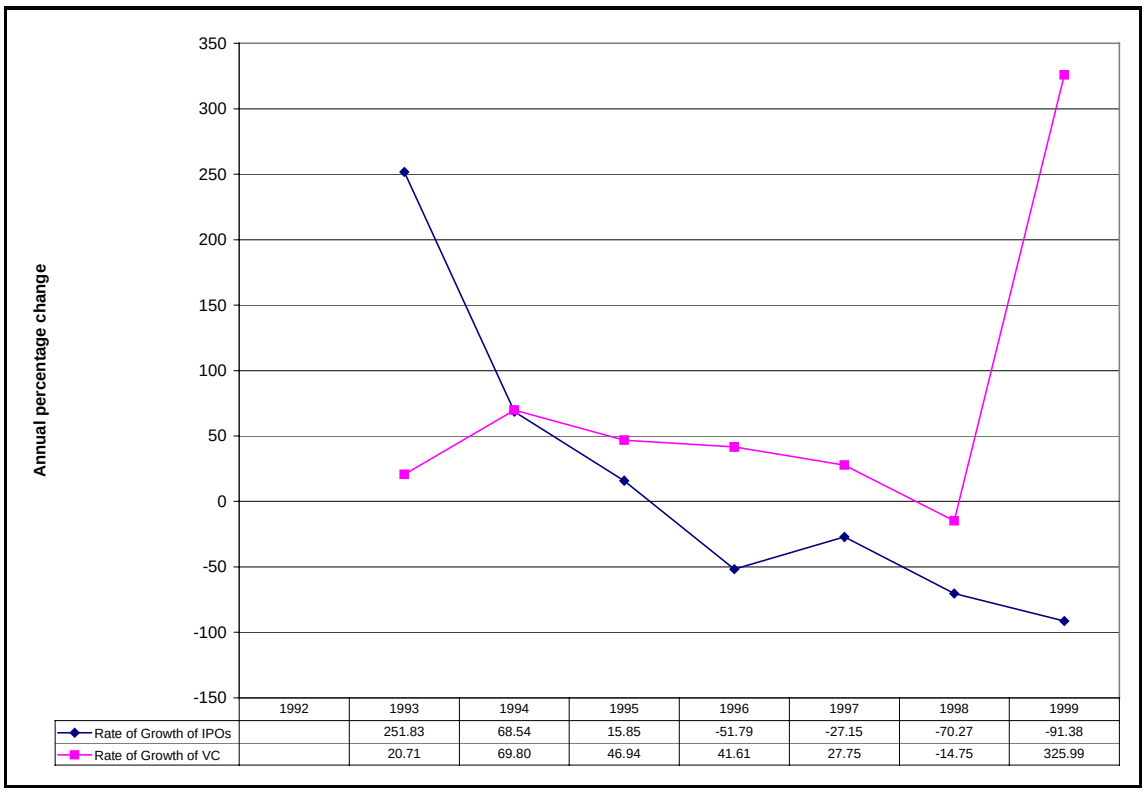
	Divestment Rate 1998	Divestment Rate 1999
Korea	14.47	13.24
Indonesia	2.30	6.41
Thailand	5.13	5.36
Taiwan	3.24	4.38
Philippines	1.43	2.12
Singapore	1.13	1.89
Sri Lanka	1.71	1.77
Malaysia	0.34	0.39
India	0.20	0.35
China	1.57	0.27
Hong Kong	2.73	0.02
Vietnam	3.88	0.00
Pakistan	0.00	0.00
Australia	5.50	6.51
Israel	7.82	9.33
Japan	11.89	4.03

Source: AVCJ (2000)

In fact Jeng and Wells (2000) identifies two specific reasons as to why it is an important source of exit to a VC investor. (i) According to the literature the most attractive option for exit is through an IPO. A study by Venture Economics (1998) quoted in Jeng and Wells finds that US $ 1.00 invested in a firm that eventually goes public yields a 195 per cent return for a 4.2 year average holding period. The same investment in an acquired firm only provides an average return of 40 per cent over a 3.7 year average holding period; (ii) If regaining control is important to an entrepreneur, IPOs are the best choice given the fact that the other options such as trade sales frequently result in loss of control. The empirical work of Black and Gilson (1998) statistically established, for the first time, a direct positive link between the existence of a well developed stock market and IPOs and the growth of VC financing, though of course the study was restricted to the US case. Building on this, Jeng and Wells established the same result for a group of 21 developed countries over the period 1986-1995. Apart from IPOs, they also included six other independent variables namely accounting standards, labour market rigidity, market capitalisation, and GDP growth, availability of private pension funds and government support programmes. Among all these the IPO variable turned out to be most important determinant of especially later stage VC investment across the selected countries. Our own qualitative study (Table 12) shows that this is indeed the likely case in our sample of developing countries. Since data on country-wide IPOs are not readily available[11], we are constrained to

[11] However data on the total number and amount of IPOs in five countries, namely Malaysia (since 1998, http://www.klse.com.my/website/listing/ipo1998.htm), Hong Kong (since 1994, http://www.hkex.com.hk/listedco/newlist/1994.xls), Singapore (only for 2002,

limit the analysis only to one country, namely India. For India, we relate the rate of growth of annual VC investments during the period 1993 through 1999 to the corresponding IPOs (actual subscription of issues by new companies). The results are presented in Figure 9 and it shows a rather high degree of positive correlation between the two variables, if one omits the two terminal years of 1993 and 1999. However, more sophisticated tests are required before one can draw any firm conclusions about the importance of IPOs for the successful growth of VC financing in developing countries.



	1992	1993	1994	1995	1996	1997	1998	1999
Rate of Growth of IPOs		251.83	68.54	15.85	-51.79	-27.15	-70.27	-91.38
Rate of Growth of VC		20.71	69.80	46.94	41.61	27.75	-14.75	325.99

Figure 10: Relationship between IPOs and VC Investment in India, 1993-1999
Sources: AVCJ (2000); Reserve Bank of India: http://rbi.org.in/sec7/25891.doc?

http://info.sgx.com/webipo.nsf/IPO+By+Closing+Date?OpenView), Taiwan (only for 1999, http://www.tse.com.tw/plan/factbook/2000/table2.htm) and S.Korea (from 1999 onwards, http://www.kse.or.kr/eng/list/ncop/listNewCorp.jsp) are available. But in most case the data merely refers to amount offered and not amounts actually subscribed.

Table 10: Country-wide source of funds to VCs, 1999
(percentage shares)

	China	Hong Kong	India	Indonesia	Korea	Malaysia	Myanmar	Pakistan	Singapore	Sri Lanka	Taiwan	Thailand	Vietnam
Pension funds	7	9	2	9	3	1	0	0	5	1	1	7	16
Corporations	42	43	61	34	49	30	40	37	43	33	67	37	33
Banks	18	8	15	8	18	17	23	31	14	50	7	36	31
Government agencies	12	6	9	19	12	45	15	8	19	4	1	0	3
Insurance companies	18	30	7	13	9	5	7	8	10	5	8	11	11
Private individuals	1	4	5	2	4	1	0	12	7	6	15	6	1
Others	1	0	0	15	5	2	15	4	2	1	1	3	5
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: AVCJ (2000)

Table 13: Profile of Exit Routes for VC firms in Asia, 1998

Country	Market Capitalisation (Millions of US $)	Size of the IPO Market (Millions of US $)	Remarks
1. China	284, 766 (853)*		Exits in China remain problematic, only one stock exchange, handful of Chinese companies are listed on the Hong Kong stock exchange and on NASDAQ.
2. Hong Kong			IPOs and trade sales constitute the most frequently used exit routes. Two stock exchanges, the second one being the Growth Enterprise Market launched in 1999.
3. India	64,498(5860)	1,796 (1575)**	There are 22 stock exchanges.An OTC was established in 1992. Some high tech companies are listed on NASDAQ.
4. Indonesia	9,709 (287)		The Pakades (government assisted) guidelines outline multiple divestment avenues for VC firms. Exits can be made via the capital market, private placements and the sale of shares. An OTC was established in 1994
5. Korea	137,859(748)		Trade sales and IPOs are the viable routes. OTC (Korean Securities Automated Quotation System) was established in 1996
6. Malaysia	28,889(736)		A new OTC (MESDAQ) was established in 1999, but attracted only one listing
7. Pakistan	5,418(773)		IPO is the only route.
8. Philippines	9,992(221)		Trade sales and IPOs are the viable routes. Companies prefer regional exchanges.
9. Singapore	94,469		IPOs and trade sales . An OTC (SESDAQ) was established in 1986. Two Singaporean companies aere listed on the NASDAQ.
10. Sri Lanka	281 (233)		IPOs, buy-back of shares and the sale of shares to third parties are the main routes.
11. Taiwan	884,698 (437)		IPOs is the main exit route. More than 200 venture backed Taiwanese companies are listed on the US OTC market
12. Thailand	20,734(418)		The main exit route is trade sales. An OTC was established in 1995. About 400 firms are listed (as on December 31, 1999). The other exchange, the Securities Exchange of Thailand (SET)also allowed the floatation of Vietnamese companies and Thai-Vietnamese joint ventures. The main exit route, however, is trade sales and not IPOs.
13. Japan	2,495,757		
14. Australia	874,283		
15. Israel	39,628		

Notes: * Figures in parentheses indicate the number of companies that are listed on the stock exchange; ** Figures in brackets indicate the size of market capitaluisation in millions of US $ of India's OTC exchange

Source: AVCJ (2000); http://www.sebi.gov.in/pmd/aprmar01.htm; International Finance Corporation (1999)

(e) Human resource requirement for venture capital

VC as we have noted is a specialised form of financing technology-based ventures. So the human resource requirement for this sort of an agency is much more than other forms financial institutions such as normal commercial and development banks. Venture funds typically look for talented managers who can spot clever new ideas around them. It is not difficult to understand that without these business leaders ideas remain untapped and founds dormant. The sophisticated nature of the human resource requirement for the VC industry may easily be gleaned from the five different stages in typical VC investment process (Figure 11).

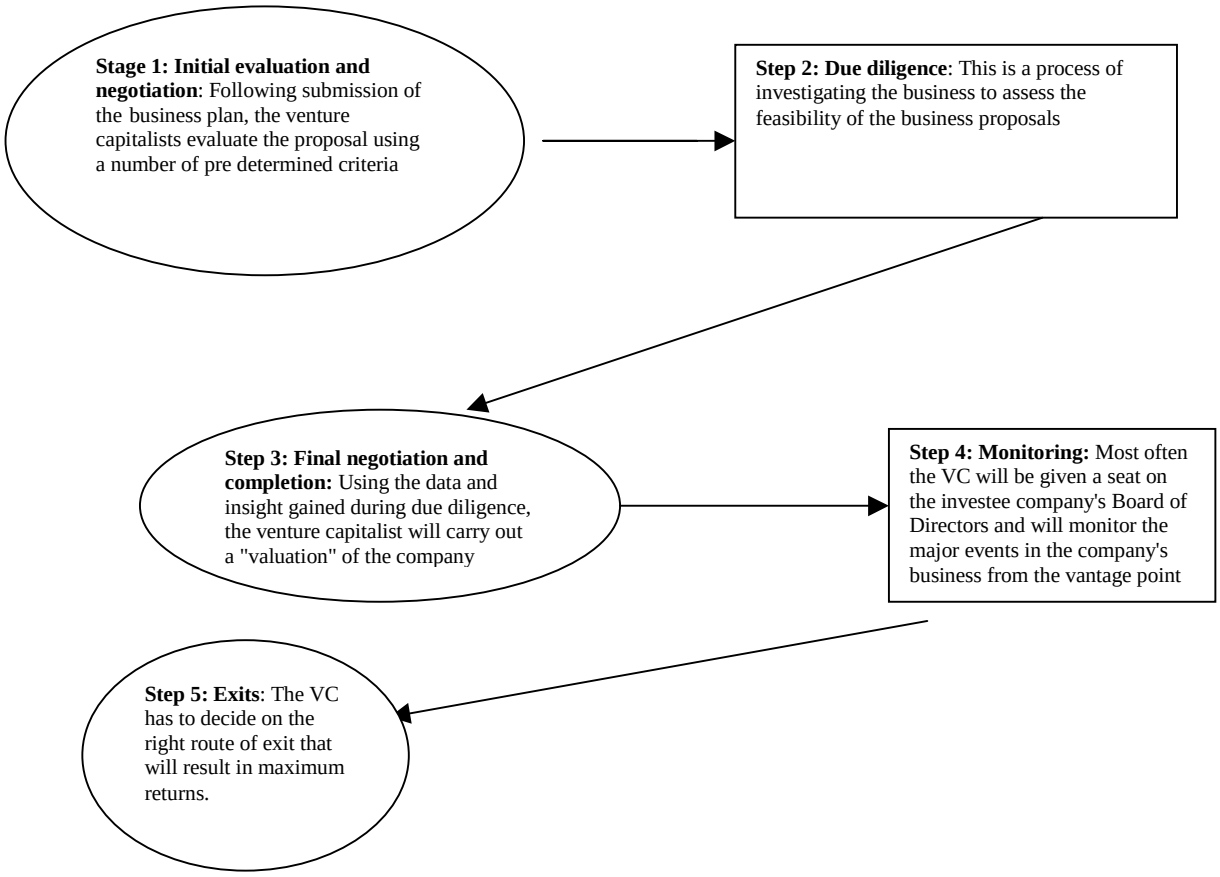


Figure 11: The five stages in a typical VC investment process
Source: AVCJ (2000)

Given the fact that most countries are new to this industry, lack of availability of VC professionals can be an important detriment to the successful growth of the industry. In fact, as shown by Table 14, the density of VC professionals per 10, 000 labour force is extremely low: Singapore and Korea are the only two countries which have a reasonable number. Even in countries like India, there have been serious shortages of

VC personnel especially at steps 2 and 3[12]. So this is another aspect which may require some governmental intervention to create an adequate pool of VC professionals.

Table 14: Density of VC professionals (per 10,000 labour force)

	1998			1999		
	Total labour force	Total number of VC professionals	Density of VC professionals	Total labour force	Total number of VC professionals	Density of VC professionals
China	744,065,792	494	0.007	750,903,424	609	0.008
India	430,076,416	212	0.005	440,901,696	247	0.006
Indonesia	96,747,224	189	0.020	99,370,376	189	0.019
Korea	23,354,290	409	0.175	23,757,006	435	0.183
Malaysia	9,049,440	59	0.065	9,333,810	78	0.084
Myanmar	23,477,220	6	0.003	23,865,132	6	0.003
Pakistan	48,685,340	6	0.001	50,141,880	9	0.002
Philippines	30,387,212	44	0.014	31,114,466	60	0.019
Singapore	1,936,866	331	1.709	1,943,106	453	2.331
Sri Lanka	8,093,318	25	0.031	8,258,475	28	0.034
Thailand	35,935,892	356	0.099	36,328,216	381	0.105
Vietnam	39,178,240	28	0.007	39,765,196	30	0.008
Japan	67,755,760	1786	0.264	67,968,088	1711	0.252
Australia	9,525,508	369	0.387	9,654,203	421	0.436

Source: AVCJ (2000); World Bank (2001)

(f) Index of VC Development

We are now in a position to arrive at a summary measure which captures the extent to which a country's VC institutions are developed to service technology-based. This is called the index of VC development (VCDI). It consists of two separate indices combined into one. The two separate indices are (i) Finance Index (FI); and (ii) Technology Index (TI). The FI captures the extent to which the VC institutions in a particular country finance early stage ventures, namely at the seed and startup stage. It is computed by taking the relative share of this stage in the total

[12] Analysing the Indian situation with respect to the availability of VC professionals, McKinsey, the management consultancy firm : "We have reviewed what's going wrong here (in India) and one issue recurs: we just can't hire quickly enough. To get world class valuations, we need world class people. But we can't find enough talented leaders to start and run a company. This is the biggest single barrier [for VCs]." See Financial Times, http://specials.ft.com/ln/ftsurveys/industry/sc23446.htm.

VC investments in a specific country during a particular time period (year). The TI, on the contrary, captures the extent to which the total investments flow towards high technology sectors, namely computer related, IT, medical and telecommunications sectors in a specific country during a particular time period (year). For any component of the VCDI, the individual indices can be computed according to the general formula:

$$\text{Index} = \frac{\text{Actual } x_i \text{ value - minimum } x_i}{\text{Maximum } x_i \text{ - minimum } x_i} \qquad (2)$$

For both the FI and TI, we assume that the maximum and minimum values (in percentage terms) are 100 and 0 respectively.

The VCDI is conducted in three steps. In the first step, we construct the FI and TI for each of the countries in our sample plus, the USA, Europe, Japan and Australia for one particular year, namely 1999[13]. In the case of the FI, the x_i value is the percentage share early stage financing in total investments during a year and in the case of TI is the percentage share of total financing going towards the high technology sectors. In the second step, we attach weights to each of the two indices. The weights (w_i) are based on the relative share of a county's VC investments during the year under consideration in the total VC investments for that year. In the third and final step we take a simple arithmetic mean of the two indices as shown in (3):

$$VCDI_C = \frac{(w_i FIc + w_i TIc)}{2} \qquad (3)$$

The $VCDI_C$ thus computed for the selected countries for the year 1999 are charted in Figure 12. The following inferences can be drawn:

- For all the countries, excepting for India, the TI is greater than FI. This implies that India is the only country for which a large share of the VC investments flows towards the early stage.
- On a world scale, the VC industry in countries such as Thailand, Vietnam, New Zealand, Philippines, Indonesia, Sri Lanka and Pakistan are very insignificant.
- The VC industry in Korea, Taiwan, China and Singapore are more or less at the same degree of development.
- The index clearly maps out the difference between the US and rest of the world.

[13] The choice of the year is purely dictated by the availability of data.

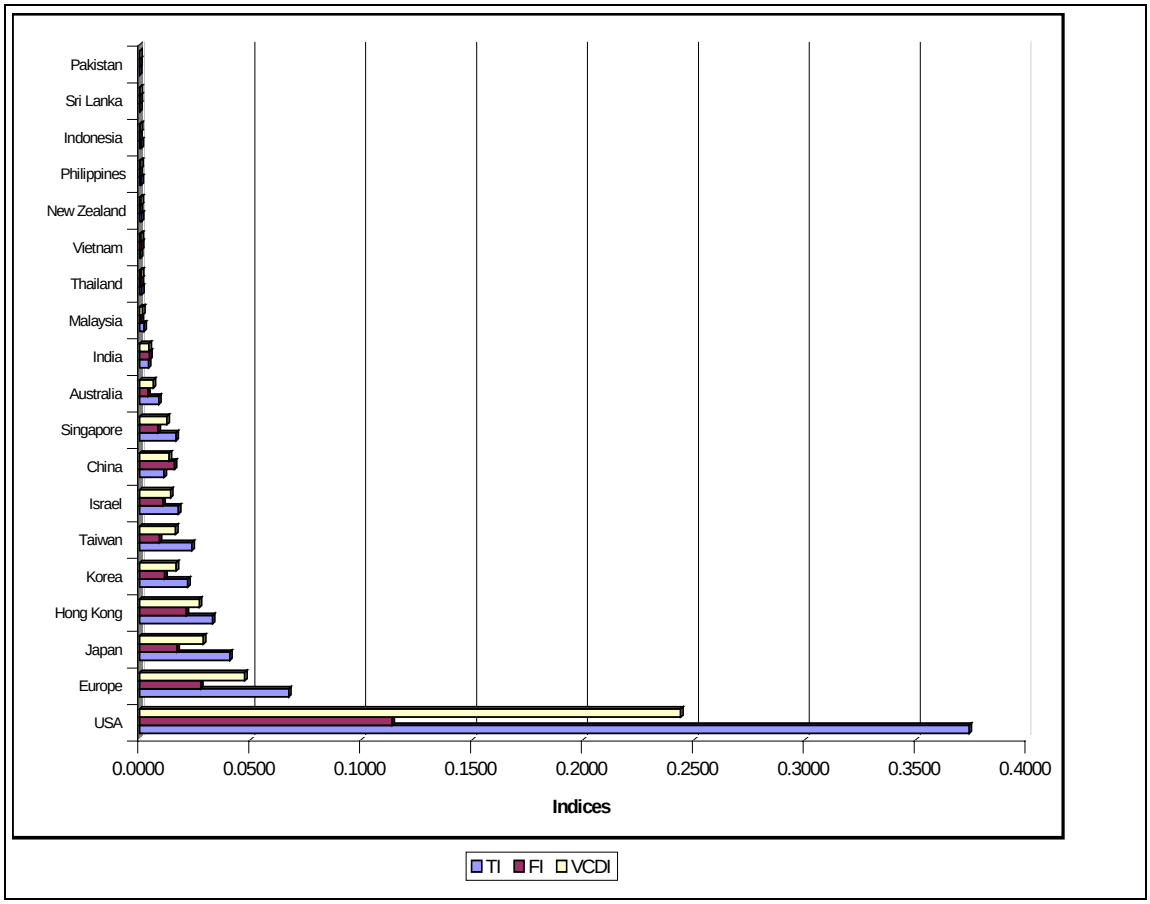


Figure 12: Index of VC Development, 1999
Source: Appendix 2

An year- wise computation of the VCDI will allow us to chart the growth trajectory of the VC industry in a specific country compared to rest of the world especially as a source finance to technology-based firms in their early stage.

CONCLUSIONS

The role of VC as an input to innovation is now a more or less accepted fact, though the empirical substantiation for this statement has come only from the US. However, our present analysis has sought to extend this line of reasoning to developing countries. Although uneven in its spread across of countries, the concept of VC is now fast spreading to most countries and especially to those countries which have well developed exit mechanisms such as reasonably well functioning stock market. An examination of the relationship between VC investments and the growth of the high technology sector shows a positive relationship between the two. This macro exercise has been further substantiated by a micro one by taking the specific case of India, which has emerged as a successful exporter of computer software. This is a hypothesis, which needs further empirical scrutiny. The successful growth of the industry also requires the availability of adequate quantity of VC professionals and an avenue such as IPOs for a proper exit. The study concludes by constructing an index of VC development, which allows one to benchmark the degree of VC development in a country with that of the best practice. Such a comparative analysis of performance should aid policy makers in redirecting the efforts of their local venture capital institutions towards the enhancement of innovative activities in new technologies.

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APPENDIX 1: INDUSTRY CLASSIFICATION ACCORDING TO THE AVCJ

Manufacturing – Light

Furniture

Leather products

Lumber & wood products

Office equipment

Precision instruments

Tobacco

Materials – other

Manufacturing – other light

Media

Information services

Magazines and periodicals

Movies – production

Newspapers

Television and radio stations

Theatres

Medical/Biotechnology

Doctors and services

Drugs – OTC/prescription

Pharmaceuticals

Hospital management

Home healthcare

Diagnostic/therapeutic products

Mining and metals

Iron and coal

Natural resources – other

Oil & gas – exploration and development

Oil & gas – refining and retail

Precious metals

Retail/Wholesale

Automotive

Books and printed material

Clothing and apparel

Eating and drinking

Electronics

Energy – gas, oil, and alternative

Food and drugs

Wholesale – trade

Wholesale – consumer

General merchandise

Specialty retail – other

Services – Non-financial

Advertising/public relations

Business services

Consulting

Educational

Engineering

Legal

Medical

Personal services

Temporary help

Services – other non-financial

Telecommunications

Cable

Cellular and wireless

Phones and related equipment

Satellite

Service provider

Textile and clothing

Textiles – manufacturing

Textiles – raw materials

Transportation/Distribution

Airlines

Air cargo

Buses

Cabs and cars

Couriers

Pipelines

Railroad

Rockets and orbital

Shipping

Trucking

Warehousing

Travel/hospitality

Airport services

Hotels and lodging

Restaurants and pubs

Travel agencies

Tourism services – other

Utilities

Electric

Gas

Water

APPENDIX 2: INDEX OF VC DEVELOPMENT ACROSS COUNTRIES, 1999

	TI	FI	VCDI
USA	0.3740	0.1138	0.2439
Europe	0.0673	0.0276	0.0474
Japan	0.0407	0.0169	0.0288
Hong Kong	0.0329	0.0210	0.0270
Korea	0.0217	0.0113	0.0165
Taiwan	0.0236	0.0089	0.0163
Israel	0.0175	0.0105	0.0140
China	0.0110	0.0157	0.0133
Singapore	0.0164	0.0083	0.0124
Australia	0.0087	0.0037	0.0062
India	0.0041	0.0045	0.0043
Malaysia	0.0020	0.0007	0.0013
Thailand	0.0009	0.0006	0.0008
Vietnam	0.0004	0.0008	0.0006
New Zealand	0.0008	0.0004	0.0006
Philippines	0.0007	0.0002	0.0005
Indonesia	0.0008	0.0001	0.0004
Sri Lanka	0.0002	0.0002	0.0002
Pakistan	0.0000	0.0001	0.0000

Source: Computed from AVCJ (2000)

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