Venture capital optimal investment portfolio strategies selection in diffusion - type financial systems in global capital markets with nonlinearities

Ledenyov, Dimitri O. and Ledenyov, Viktor O.

James Cook University, Townsville, Queensland, Australia

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Dimitri O. Ledenyov and Viktor O. Ledenyov

Abstract – The condensed research article presents some innovative research results on the venture capital optimal investment portfolio strategies selection in the diffusion-type financial systems in the imperfect highly volatile global capital markets with the incomplete information, which are characterized by the asymmetric information flows and impacted by the various types of the nonlinearities. We discuss the venture capital firms with the different organizational structures: the corporation funded venture capital firm, investment bank funded venture capital firm, private equity funded venture capital firm, state funded venture capital firm. We consider the complicated issues on the venture capital optimal investment portfolio strategies selection, evaluation of the possible returns on the investments, and implementation of exit strategies for the venture capital investment schemes. We propose that the information signals can be mixed and self-modulated during the asymmetric information flows in the information transmission channels between the market agents, resulting in the origination of the various types of the nonlinearities such as the high order harmonics, which may have a considerable impact on the venture capital investments in the diffusion-type financial system. These nonlinearities have to be taken to an account during the venture capital optimal investment portfolio strategies selection process, which is all about making the right investment choices with the application of the inductive, deductive and abductive logics. In our opinion, the State of Queensland in Australia is a very attractive place to make the venture capital investments in the hi-tech startups, comparing to other regions in the World. We conclude with the notion that the venture capital can greatly improve the macroeconomic indicators of national economies, creating the new hi-tech industries, generating the abundant wealth, and increasing the Gross Domestic Product.

JEL: C14, C33, D21, D92, G10, G14, G21, G23, G24, L 21 .

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Keywords: venture capital concept, venture capital fund, venture capital investment portfolio and strategy, corporation funded venture capital firm, investment bank funded venture capital firm, private equity funded venture capital firm, state funded venture capital firm, entrepreneurship, theory of firm, wealth creation, econophysics, econometrics, nonlinearities, asymmetric information flows, mixing and modulation of information signals, diffusion-type financial system, imperfect highly volatile global capital markets with incomplete information.

Introduction

The *venture capital* (*VC*) is considered as an important source of corporate financing in the *diffusion-type financial systems* in the imperfect highly volatile capital markets with the incomplete information, which are usually characterized by the asymmetric information flows and impacted by the various types of nonlinearities in *Jaffee, Russell (1976)*, *Leland, Pyle (1977), Stiglitz, Weiss (1981), Stiglitz (1988), Zhang (2007b), Diaconu (2012)*. The *venture capital firm* invests the *venture capital* in the selected *hi-tech startups*, which implement the entrepreneurial ideas and compete in the various product and services markets, contributing to the overall growth of national economies in *Kirzner (1973), Lucas (1978)*, *Audretsch, Keilbach (2004)*, *Samila, Sorenson (2011)*.

The *diffusion processes* have a great impact on the *physical - chemical properties* of different *chemical compounds*, hence the *diffusion theory* has been a subject of intensive research in the *physics* and *chemistry* at the research institutions and the leading universities in the *XX –XXI* centuries in *Ledenyov D O, Ledenyov V O (2012e), Ledenyov V O, Ledenyov D O, Ledenyov O P (2012f), Müller (1997)*. In addition, the intensive experimental measurements on the precise characterization of *diffusion processes* have been conducted to understand the nature of the *diffusion processes* in the *metals, superconductors, semiconductors* and *dielectrics* at the different internal and external conditions at the research laboratories at the leading universities in the *World* over the recent decades in *Ledenyov V O, Ledenyov D O, Ledenyov O P (2012f), Ledenyov D O, Ledenyov V O (2012e), Müller (1997), Chu (1997), Goretta (1998)*.

The general perception among the economists is that the *diffusion processes* can certainly have a considerable influence on the various *econometric parameters* of the *diffusion-type financial systems*, that is why *the diffusion theory* has been frequently applied to accurately characterize the *diffusion - type financial systems* in the *finances* in *Bachelier (1900), Osborne (1959), Alexander (1961), Shiryaev (1961, 1963, 1964, 1965, 1967, 1978, 1998a, b, 2002, 2008a, b, 2010), Grigelionis, Shiryaev (1966), Graversen, Peskir, Shiryaev (2001), Kallsen, Shiryaev (2001, 2002), Jacod, Shiryaev (2003), Peskir, Shiryaev (2006), Feinberg, Shiryaev (2006), du Toit, Peskir, Shiryaev (2007), Eberlein, Papapantoleon, Shiryaev (2008, 2009), Shiryaev, Zryumov (2009), Shiryaev, Novikov (2009), Gapeev, Shiryaev (2010), Karatzas, Shiryaev, Shkolnikov (2011), Shiryaev, Zhitlukhin (2012), Zhitlukhin, Shiryaev (2012), Feinberg, Mandava, Shiryaev (2013)*, *Akerlof, Stiglitz (1966), Rothschild, Stiglitz (1976), Stiglitz, Weiss (1981), Richiardi, Gallegati, Greenwald, Stiglitz (2007), Bernanke (1979, 2002, 2004, 2007, 2009a, b, c, d, e, 2010a, b, 2012a, b, 2013a, b, c, d), Bernanke, Blinder (1992), Bernanke,* *Gertler (1995), Bernanke, Reinhart (2004), Bernanke, Reinhart, Sack (2004), Bernanke, Blanchard, Summers, Weber (2013), Shiller, Pound (1989), Stock, Watson (2002), Xiaohong Chen, Hansen, Carrasco (2009), Ledenyov D O, Ledenyov V O (2013f, g, h).* In this innovative research article, we would like to limit our detailed research considerations by an assumption that the *venture capital investments* have place in the *diffusion-type financial systems* in the *imperfect highly volatile capital markets* with the *incomplete information*, which are characterized by the *asymmetric information flows* and influenced by the *various types of induced nonlinearities* in *Akerlof, Stiglitz (1966), Rothschild, Stiglitz (1976), Stiglitz, Weiss (1981), Richiardi, Gallegati, Greenwald, Stiglitz (2007).*

Discussing the early research results on ***the venture capital investments in the USA***, it makes sense to begin with literature review, beginning with the notion that the rise and fall of venture capital have been researched in *Gompers (1994)*. The research topics on the optimal investment, monitoring, and staging of venture capital have been discussed in *Gompers (1995, 1996)*. The empirical analysis of venture partnership agreements has been completed in *Gompers, Lerner (1996)*. The various types of risks during the venture capital investing have been reviewed in *Gompers, Lerner (1997)*. The various investment strategies in the corporate financing, using the venture capital, have been analyzed in *Gompers, Lerner (1998a, b).* The analysis of compensation in the *US* venture capital partnership and business interests has been completed in *Gompers, Lerner (1999a, b)*. The full venture capital funding cycle has been described in *Gompers, Lerner (1999c)*. The various determinants of corporate venture capital success have been provided in *Gompers, Lerner (2000a)*. The possible impact of fund inflows on private equity valuation has been reflected *in Gompers, Lerner (2000b)*. The venture capital revolution has been described in *Gompers, Lerner (2001)*. The new ventures funding has been studied in Gompers, Lerner, Scharfstein (2005). The venture capital investment practices have been discussed in *Gompers (2007).* The venture capital investment cycles have been precisely characterized in *Gompers, Kovner, Lerner, Scharfstein (2008)*. The allocation of venture capital to the successful companies has been shown in *Gompers, Kovner, Lerner (2009), Gompers, Lerner, Scharfstein, Kovner (2010)*. The syndication of *VC investments* has been investigated in *Lerner (1994a, b)*. The investment practices by the *venture capitalists* have been researched in *Lerner (1995)*. The selected research topics on the government as source of venture capital funding in the frames of the *SBIR* program have been considered in *Lerner (1999). Kortum, Lerner (1998)* proposed that the venture capital can increase the level of innovation in the society. *Kortum, Lerner (2000)* assessed the contribution by the *VC* to the innovation in the hi-tech industry. *Lerner, Schoar, Wongsunwai (2007)* researched some organizational aspects of the venture capital firm. *Lerner (2008)* made a few thoughtful research comments on the impact by the economic crisis on the venture capital funding dynamics in the *USA*. The empirical analysis of venture capital contracts has been performed in *Kaplan, Strömberg (2000, 2002, 2003)*. The advanced researched on the of venture capital contracts has been continued in *Kaplan, Strömberg (2004).* The private equity returns on investments have been investigated in *Kaplan, Schoar (2005)*. The annualized returns of venture-backed public companies, categorized by stage of financing, have been researched in *Shachmurove Y (2001)*. The annualized and cumulative returns on venture-backed public companies, categorized by industry, have been investigated in *Shachmurove A, Shachmurove Y (2004).* The annualized returns of ventured-backed public companies, stratified by decades and by stage of financing, have been considered in *Shachmurove E, Shachmurove Y (2004).* The entrepreneurship, innovation, trade and the growth mechanism of the free-enterprise economies in *Shachmurove Y (2007a)*. The venture capital distribution over the various geographical regions have been analyzed in *Shachmurove Y (2007b).* The investment activity of venture capital in the *United States* in the years *1996* through 2005 has been summarized in *Shachmurove (2007)*. The access to *venture capital* and the performance of *venture capital-backed star-ups* in *Silicon Valley* have been analyzed in *Zhang (2007)*. The influences by the legal differences and experience on the financial contracts have been researched in *Kaplan, Martel, Strömberg (2007, 2009)*. The different stages of financing through the evolution of firms from early business plans to public companies have been analyzed in *Kaplan, Sensoy, Strömberg (2009).* The past, present, and future of venture capital has been described *in Kaplan, Lerner (2010). Orman (2008)* developed a theoretical model to study the effectiveness of various possible organizational arrangements for the innovative startups and some issues in the startups activities financing by the *VC* funds in the *USA*. The effect of the current financial crisis on the *venture capital investments* in the *US Internet firms* has been analyzed in *Block, Sandner (2009)*. The decline of the *United States* venture capital industry, including some propositions on what the federal government should do about it, has been analyzed in *Aberman (2009)*.

Researching ***the venture capital investments in Canada***, the convertible preferred equity puzzle in *Canadian venture capital finance* has been found in *Cumming (2000)*. The determinants of *venture capital portfolio* size have been described in *Cumming (2001)*. Th *venture capital* exits in Canada and the United States have been analyzed in *Cumming, MacIntosh (2000)*. The *venture capital investment* duration in *Canada* and the *United States* has been calculated in *Cumming, MacIntosh (2001)*. The private equity investments in Canada have been overviewed in *Cumming, MacIntosh (2002a)*. The cross-country comparison of full and partial venture capital exits has been done in *Cumming, MacIntosh (2002b).* The extent of venture capital exits in Canada and the United States has been analyzed in the frames of the venture capital contracting and the valuation of high-tech firms research in *Cumming, MacIntosh (2002c).* The economic and institutional determinants of venture capital investment have been identified in *Cumming, MacIntosh (2002d).* The law and finance analysis of *venture capital* exits in emerging markets has been investigated in *Cumming, Fleming (2002).* A cross-country comparison of full and partial *venture capital* exits has been completed in *Cumming, MacIntosh (2003).* The liquidity risk and *venture capital* finance in *Cumming, Fleming, Schwienbacher (2005).* The *venture capitalist* value-added activities, fundraising and drawdowns have been analyzed in *Cumming, Fleming, Suchard (2005).* The legality and *venture capital* exits have been discussed in *Cumming, Fleming, Schwienbacher (2006).* The crowding out private equity in *Canada* has been analyzed in *Cumming, MacIntosh (2006).* The contracts and exits in *venture capital finance* have been researched in *Cumming (2008).* The preplanned exit strategies in *venture capital* have been discussed in *Cumming, Johan (2008).* The style drift in private equity has been considered in *Cumming, Fleming, Schwienbacher (2009).* The private equity returns and disclosure around the world have been studied in *Cumming, Walz (2010).*

Considering ***the venture capital investments in Europe***, it is worth to point out that the chronological history of the *VC* capital market in *Germany* has been surveyed in *Franzke, Grohs, Laux (2003),* making a comparative analysis between the *VC* capital market in *Germany* and the *VC* capital markets in the *US, UK and France.* The implication of the *VC* on the *VC* funded companies in *Germany* has been researched in *Keilbach, Engel (2003)*, analyzing the *50,000 German* firms of which roughly *1* per-cent is venture funded. *Keilbach, Engel (2003)* found the multiple evidences that the companies with the higher innovative output (measured by patent applications, corrected for size) and with the higher educated management have a larger probability of being venture funded. The *venture capital*, ownership structure, accounting standards and *IPO* underpricing in the cases of *German* companies have been investigated in *Elston, Yang (2010).* The underpricing, wealth loss for the pre-existing shareholders and the cost of going public for the venture capital backed startups has been extensively researched in *Ferretti, Meles (2011).* The first comprehensive comparative analysis between the success of *European* and *American VC*-backed portfolio companies has been provided in *Kraeussl, Krause (2011).* The survival of venture capital backed companies in France has been researched in *Pommet (2012).* The causal effect by the venture capital backing on the underpricing of the *Italian IPOs* has been investigated in *Pennacchio (2013).*

Reviewing ***the venture capital investments in Asia***, it should be noted that the *venture capital* in *Japan* has been analyzed in *Clark (1988)*. The *venture capital*, bank shareholding, and *IPO* underpricing in *Japan* have been studied in *Packer (1996)*. The *Japanese IPOs* have been researched in *Pettway, Kaneko (1996)*. The investment and operating performance of *Japanese IPOs* have also been investigated in *Cai, Wei (1997)*. The role by the *venture capital* in the *IPOs* in *Japan* has been researched in *Hamao, Packer, Ritter (1999)*, who made the following comment: "In *Japan*, most of the *major venture capital firms* are subsidiaries of securities firms and banks." *Hamao, Packer, Ritter (1999)* made the interesting observation on the role of VC during IPO process in Japan: "*Venture capital* playing a certification role in alleviating informational uncertainty about the *IPO* at the time of issue." The *venture capital industries* of *East Asia* have been described in *Kenney, Han, Tanaka (2002)*. The *venture capital industry* in *Singapore* has been overviewed in *Koh F C C, Koh W T H (2002)*. *Baygan (2003)* analyzed the trends in *South Korean VC* markets and examined the *VC* policies in *South Korea*, stating that: "The *Korean venture capital market* has grown dramatically in recent years, starting from a negligible base in the early *1990s* and almost tripling between *1998* and *2001*. *Korea* now ranks among the leading *OECD* countries in *venture capital investment* as a share of *GDP* and third in the share of *venture capital* being channeled to start-up enterprises (after the *United States* and *Canada*). *Venture capital* contributed to a proliferation of start-ups in the high - technology sectors such as the information and communications technology (*ICT*), which accounted for *64%* of *venture investments* in *2001*. *Baygan (2003) also* highlights an interesting fact: "The government jump-started the *venture capital market* in *1998* through direct infusion of equity capital, generous tax incentives and equity guarantees, and the designation of certain small firms as "*venture businesses*"." The *R&D networks* of the small and medium size companies in *Japan* have been researched in *Motohashi (2006)*. The comparative analysis of the biotechnology startups funding by the *venture capitalists* between the *State of Japan* and the *USA* has been completed in *Motohashi (2010)*. The *venture capital* affiliation with the underwriters and the underpricing of the initial public offerings in *Japan* has been researched in *Arikawa, Imad'eddine (2010)*.

Analyzing ***the venture capital investments in Africa***, it has to be mentioned that the practical recommendations on the venture capital programme for the *South Africa* have been formulated in *Stillman, Sunderland, Heyl, Swart (1999)*. The investment criteria, used by the *South African venture capitalists* in their venture screening and evaluation processes, have been analyzed in *Van Deventer, Mlambo (2008, 2009)*. The challenges and prospects in the early-stage process of the venture capital funding in *South Africa* have been presented in *Jones,* *Mlambo (2009)*. The rise and fall of *South African* venture capital have been discussed in *Lingelbach, Murray, Gilbert (2009)*.

Da Rin, Hellmann, Puri (2011) state: "There are a lot of public policy programs relating to *VC*, our understanding of these policies, and our ability as academics to make public policy recommendations remains limited. More and better data on public programs and policies are needed to provide more precise evaluation, and a proper cost/benefit analysis." *Da Rin, Hellmann, Puri (2011)* continue to explain their vision*:* "The *global VC industry* is a relatively young industry that is still undergoing major growing pains and significant structural changes. Researchers need to remember that they are chasing a moving target. We do not expect them to stand still in such a dynamic environment." We think that our research article will improve our understanding on the *VC industry* modern trends, and present possible approaches to the successful *VC financing deals* completion.

This research article on the *venture capital optimal investment portfolio strategies selection* in the *diffusion-type financial systems* in the *imperfect highly volatile global capital markets* with the *incomplete information*, which are characterized by the *asymmetric information flows* and impacted by *the various types of the nonlinearities,* aims both:

1) to present an unbiased open discussion forum opinion on *the venture capital optimal investment portfolio strategies selection* in the conditions of the *diffusion-type financial systems* in the *imperfect highly volatile capital markets* with the *incomplete information*, which are characterized by the *asymmetric information flows* and impacted by the *various types of the induced nonlinearities*, and

2) to enhance our general understanding on *the nature of the nonlinearities in the finances* in *Ledenyov V O, Ledenyov D O (2012a, b)*, *Ledenyov D O, Ledenyov V O (2012c, d)*, *Ledenyov D O, Ledenyov V O (2013a, b, c, d, e, f, g, h)*.

This innovative research is written with the use of the extended knowledge base on *the nonlinearities in the microwave superconductivity* in *Ledenyov D O, Ledenyov V O (2012e)*.

Venture capital investment portfolio allocation theories and practices

Let us make a definition of ***the venture capital (VC) organization*** and show its structural organizational scheme in *Da Rin, Hellmann, Puri (2011)*: "***By VC we mean the professional asset management activity that invests funds raised from institutional investors, or wealthy individuals, into promising new ventures with a high growth potential.***" *Da Rin, Hellmann, Puri (2011)* continue to explain: "*Venture investors* are organized in small partnerships of up to a dozen individual partners; these are the *VC* firms. In order to make investment in start-ups, *VC* firms raise money from institutional investors and wealthy individuals through vehicles called '*funds*.' The contract that underlies a *fund* is traditionally a *partnership*, where the *VC firm* exerts active management, and therefore assumes unlimited liability, whereas the *investors* retain unlimited liability by not interfering with the fund's operations. From this structure originate the common terms of *Limited Partners (LPs)*, for institutional investors and wealthy individuals, and of *General Partner (GPs)*, for the *VC firm*. During the ten years of the fund's typical lifetime, *GPs* make the selection of portfolio companies, can monitor, mentor and provide value added services, and ultimately exit from the companies, distributing the *returns* to their *LPs*. *GPs* receive their compensation in the form of a *management fee* and of performance-based payments called "*carried interests*" (or just "*carry*")."

Fig. 1 depicts the scheme of venture capital organization in *Da Rin, Hellmann, Puri (2011).*

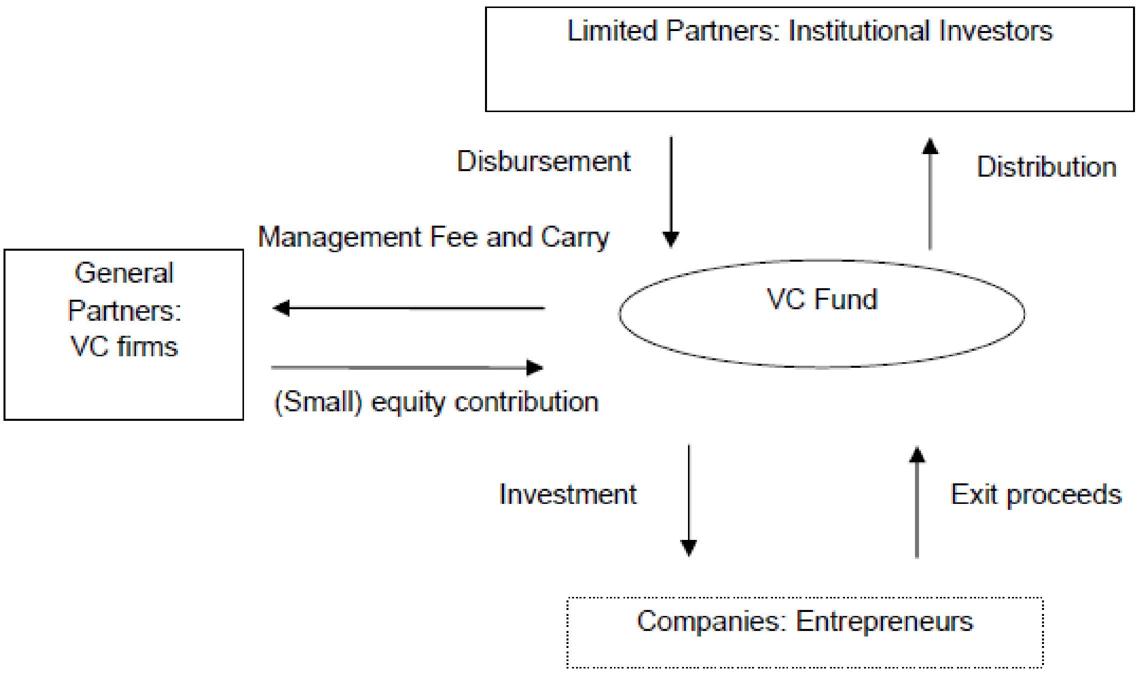

Fig. 1. *Scheme of venture capital organization (after Da Rin, Hellmann, Puri (2011)).*

Fig. 2 shows the venture capital markets in Baygan, Freudenberg (2000), and Fig. 3 depicts the simple framework of underlying factors and impact of venture capital in Baygan, Freudenberg (2000)).

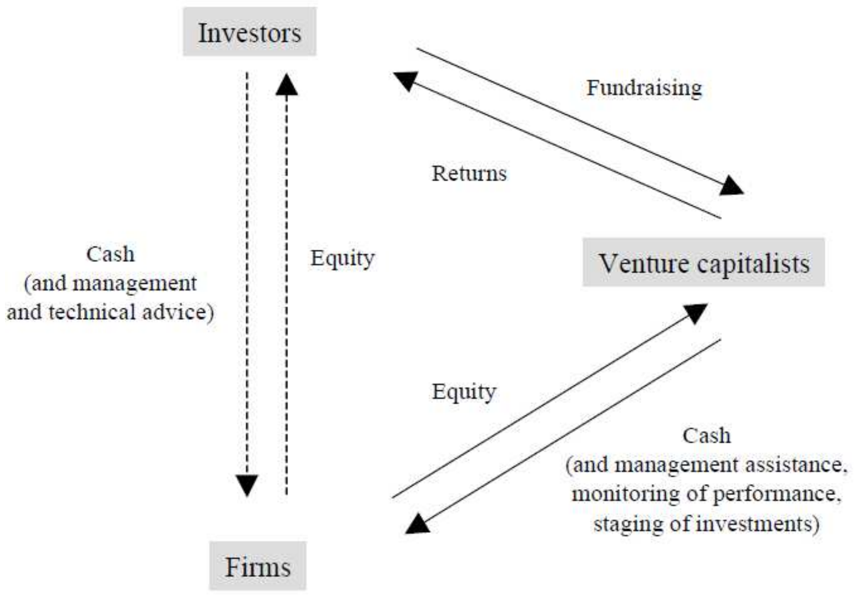

Fig. 2. *Venture capital markets (after Baygan, Freudenberg (2000)).*

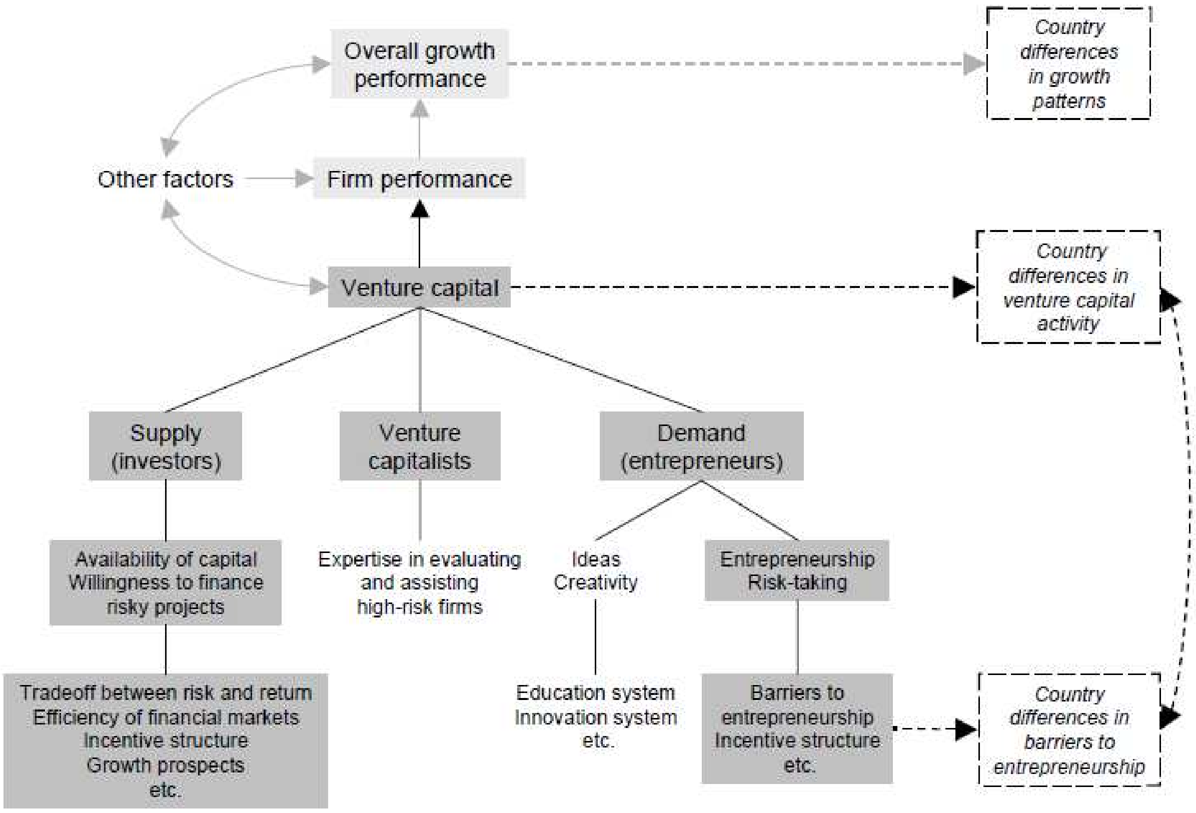

Fig. 3. *Simple framework of underlying factors and impact of venture capital (after Baygan, Freudenberg (2000)).*

Let us write, discuss and analyze a few more *Venture capital (VC)* definitions. *Da Rin, Nicodano, Sembenelli (2004)* provide the following *VC* definition: "*Venture capitalists* are increasingly recognized as financial intermediaries that overcome problems of moral hazard and asymmetric information in financial markets *Gompers (1995), Lerner (1995)*.

"*Venture capital* is a form of intermediation particularly well suited to support the creation and growth of innovative, entrepreneurial companies *Hellmann and Puri (2000, 2002), Kortum and Lerner (2000).* It specializes in financing and nurturing companies at an early stage of development (*'start-ups'*) that operate in high-tech industries. For these companies the expertise of the venture capitalist, its knowledge of markets and of the entrepreneurial process, and its network of contacts are most useful to help unfold their growth potential *Bottazzi, Da Rin and Hellmann (2004), Gompers (1995), Hellmann and Puri (2002), Lerner (1994, 1995), and Lindsey (2003)*."

Da Rin, Nicodano, Sembenelli (2006) state: "Venture capital is a form of intermediation particularly well suited to support the creation and growth of innovative, entrepreneurial companies *Hellmann and Puri (2000, 2002), Kortum and Lerner (2000)."*

Luukkonen (2007) explains: "Research on venture capital has shown that venture capitalists not only provide their investee companies, innovative entrepreneurial ventures, with finance, but impart knowhow in business areas where the investee firms lack capabilities, such as strategic management, recruitment, marketing, and networking; furthermore, they provide the investtee firms with certification and reputation *Hellman, Puri (2002); Bertoni, Colombo, (2005)*."

Geronikolaou, Papachristou (2008) write: "*Venture Capital (henceforth VC)* is financial investment channeled to the development of young, dynamic and innovative firms, and along with *R&D*, plays a major role in technological progress and innovation, most frequently proxied by the number of patent applications or grants at the appropriate level, firm, industry or country level."

Van Deventer, Mlambo (2008, 2009) explain: "*Venture capital* is a major source of funding for the entrepreneurial community and usually focuses on early stage, more risk-orientated, pre-initial public-offering business endeavours."

Block, Sandner (2009) write: "*VC* is an important means of funding for start-ups in innovative and technology driven industries because it is the vehicle used to turn innovative ideas into products that can be sold to customers. *VC* particularly matters when firms start to commercialize their innovations, that is, when they develop their products, apply for patents, look for distribution partners, seek first customers, conduct their internationalization strategies, or simply scale up their operations."

Chen, Gompers, Kovner, Lerner (2009) note: "The location of *venture capital firms* matters for the development of entrepreneurial firms because *venture capitalists* provide more than just risk capital. *Venture capital firms* typically invest in early-stage and high-technology companies where informational asymmetries are high. These are firms have highly uncertain future prospects and the potential for agency conflicts are severe. *Venture capital funding* contracts provide for staged financing and *venture capitalists* are constantly evaluating their portfolio companies (see, for example, *Sahlman (1990), Gompers (1995),* and *Kaplan and Stromberg (2003)*). *Venture capitalists* are actively involved in the governance of the companies they fund through board membership, management recruiting, and the provision of management incentives."

Inci, Barlo (2010) note: "Unlike banks, *VCs* are not passive investors. They are specialized financial intermediaries who take considerable control in their portfolio. Protective provision terms in contracts allow them to veto transactions that are unfavorable to them and board control gives them the ability to initiate new transactions."

Diaconu (2012) adds: "*Venture capital firms* do not only provide resources for financing of projects, but they give also experience in research activities and diffusion of innovations, shaping the company's business strategy."

Lazarevski, Mrsik, Smokvarski (2012) state: "*Venture capital* is an important intermediary in financial markets, providing capital to firms who otherwise have difficulties attracting financial support. Moreover, venture capital funds provide managerial expertise to the company they are investing in, and have impact on the overall economy through innovation, job creation, economic growth, increased competition and improved corporate governance."

Gvazdaitytė A (2012) suggests the following definition of the venture capital concept: *"Venture capital (VC)* - defined as equity or equity-linked investments in young, privately held companies, where the investor is a financial intermediary who is typically active as a director, an advisor, or even a manager of the firm *Kortum (1998)*. American literature understands it to be an investment by specialized *venture capital organizations (VC funds)* in high-growth, high-risk, often high-technology firms that need capital to finance growth *Black and Gilson (1998)*. While in rare instances in *Asia VC* is considered as a superset, including higher risk, smaller investments and all private type investments due to a lack of start-ups or early stage high-technology companies *Wong (2005)*. Concerning the classical concept of *VC* capital, they should more rightly be called private equity investors than venture capitalists. *Van (2000)* describes venture capital as a capital needed for the launch, early development and expansion of mostly high-tech companies with profit expectations."

Pommet (2012) writes: "A key function of *VC firm* is to provide funding and expertise to innovative companies with high growth potential."

Pennacchio (2013) explain: “The importance of *venture capital* is widely recognized in both developed and emerging countries. Providing an important source of equity funding and often supporting the management of financed firms with their domain expertise, venture capitalists facilitate the birth and the growth of new firms, especially in high technological industries. Moreover they facilitate the entrepreneurs in dealing with other financing providers: private investors, financial intermediaries, and lastly, equity markets.”

Alqatawni (2013) write: “The *venture capital (VCs)* is a powerful equity financing resource that addresses the funding necessary of entrepreneurial businesses in particular in environments of uncertainty *Rosenbusch (2012)*. *Venture capital* is one the most influential factor underlying the economic growth of some regions within the *United States Samila (2011)*. The classical definition of *VCs* is a wealthy person or progressive financial institution that is willing to provide sufficient risk capital to appraise the specific opportunity and provide financial backing for its introduction to the market place *Charpie (1967)*.”

Let us summarize all the *VC* definitions and other research findings by saying that, in the case of most innovative ***start ups***, the funding of companies can be done with the use of *venture capital* in *Sau (2007)*: “*Venture capital (VC)* takes the form of an *intermediary* collecting financing from a group of investors (banks, pension funds, insurance companies and foundations) and investing it in the share capital of newly instituted, highly innovative firms.” *Sau (2007)* continues to explain: “In the first place the *venture capitalist* attends to the *screening* of the innovative firms, so as to reduce the degree of information asymmetry existing ex-ante. In fact, the intermediary is often in possession of specific technical competence which improves as his work of mediation grows, allowing for a shrewder selection of projects than normally made by a generic outside investor-financer or a bank *Ueda (2000)*. Moreover, by granting risk-capital the venture-capitalist not only has the possibility of appropriating part of the value generated by the firm but can also perform various, very particular functions ranging from managerial *consultancy* to *monitoring* and even *control* of the venture-backed firm. As intermediary the venture-capitalist carries out the vital activity of *information production*, generally performed by the banks in the case of firms operating in the traditional sectors. Thus the venture-capitalist not only has the function of financing in the strict sense, but also provides services that are not strictly financial but which prove fundamental[17] in the case of innovative firms, above all in the early stages of development.”

In the case of the ***publicly traded companies***, the financing of companies can be done with the use of *bank credit* directly in *Sau (2007)*: “Bank credit proves preferable to the direct issue of shares for two reasons basically: *1)* the banks are able to apply screening and delegated monitoring directly to the firms: this reduces the degree of information asymmetry, thereby minimizing the agency cost of outsider financing *Diamond (1984)*; *2)* in an environment of imperfect, asymmetrical information the credit agencies take on the function of producing information *Stiglitz (1985); Stiglitz-Weiss (1988)*, which has indirect positive effects on the very value of the firms financed. In fact, obtaining a loan often entails an increase in share prices *James (1987); Bayless - Chaplinsky (1990); Alam - Walton (1995); Jong-Veld (2001)* since, by the very fact of obtaining financing, the firms' reputation is enhanced to the eyes not only of clients and suppliers, but also of other potential investors-financers *Diamond (1991)*."

Thus, we can see that the *venture capital* represents *a hybrid form of financing in Sau (2007)*: "*Venture capital* appears as a *hybrid* form of financing: it consists in investment in risk-capital, but is also characterized by the function of intermediation performed by the venture capitalist. Over and above the traditional activities of *screening* and *monitoring,* with venture capital financing it is also possible to allocate power of control over decisions *Kaplan-Stromberg (2000, 2002)*, depending on the performance of the venture-backed firm. In this way *VC* succeeds in reconciling the points of force at work in the *market-centered* financial system with those of the *bank-centered* system *Black-Gilson (1998); Rajan-Zingales (2001)*."

Let us comment that the *VC industry* plays an important role in the national economy growth, analyzing the *VC* funding in the *USA*, *Orman (2008)* writes: "One of the major developments in *U.S.* capital markets in the recent decades has been the dramatic growth of the venture capital industry: While the amount of funds committed to venture capital was less than half a billion in *1978*, it has risen over *$30* billion by *2007*, with a peak of about *$100* billion in *2000* (in *2002* dollars). This change was spurred in large part by the *Department of Labor's 1979* decision to relax the "Prudent Man Rule", which had previously obstructed pension funds from investing substantial amounts of money in high-risk start-up ventures. Since then venture funds have been behind many of the exceptionally innovative companies, including *Cisco*, *Genentech*, and *Google*." *Orman (2008)* continues to provide the multiple example of the *VC funding* impact on the *US* economy: "The dramatic growth of the *U.S.* venture capital since the late *1970's* (a significant development in capital markets) and the accompanied explosion of innovation produced by small companies is a case in point. Even a casual observation suggests that a disproportionate share of path-breaking inventions in biotechnology, semiconductors, hard disk drives, minicomputers, software, and the internet has come out of small venture-backed companies. Examples of such companies include *Cisco, Seagate, Sun Microsystems, Oracle, Compaq, Google, eBay, Amazon.com, Genentech, Amgen,* and countless others." *Geronikolaou, Papachristou (2008)* add: "According to *Gompers and Lerner (2001)*, some of the most renowned high-tech innovators in the *US*, such as *Apple Computers, Cisco Systems, Genentech, Microsoft, Netscape, and Sun Microsystems*, have developed thanks to *VC* assistance."

The interesting fact is that most of the *VC firms* are located in the financial and *hi-tech clusters* regions in the *USA* as explained in *Chen, Gompers, Kovner, Lerner (2009):* "From *Silicon Valley* to *Herzliya*, *Israel,* venture capital firms are concentrated in very few locations. More than half of the *1,000 venture capital offices* listed in *Pratt's Guide to Private Equity and Venture Capital Sources* are located in just three metropolitan areas – *San Francisco, Boston,* and *New York*. More than *49%* of the *U.S.*-based companies financed by venture capital firms are located in these same three cities." *Chen, Gompers, Kovner, Lerner (2009)* continue to present the results of their research analysis: *"Venture capital firms* are likely to locate in areas that offer them the highest concentration of *profitable investments* since geographically close investments are easier to for the *venture capitalist* to monitor. Travel to other geographies is costly and will be undertaken only when an investment offers prospects for a high enough return to, in expectation, compensate the *venture capitalist* for the additional time and money associated with monitoring a distant investment. The resulting concentration of *venture capitalists* and entrepreneurs may pose grounds for concern given the positive public externalities associated with the establishment of new firms." We would like to add a comment that the financial clusters and the high – tech clusters are not always located at the same places in the *USA*, however the presence of the financial clusters and the high – tech clusters at the same region makes a great impact on the successful *VC industry* development in this particular region.

Lerner (2012) points out on the presence of cyclicality in the *venture capitalist industry*: "The recent changes in the *venture capital market* have been far from the first such cycles in the *venture market*. *Charts 2* and *3* depict the changing amount of venture capital funds raised and the returns from these funds." *Lerner (2012)* makes one more similar comment: "As I have highlighted, *venture capital* is an intensely cyclical industry, and the impact of *venture capital* on innovation is likely to differ with this cycle."

Let us illustrate the venture capital investments dynamics in the *USA*, analyzed in the research articles by the various authors in *Lerner (2012), Gompers (2002), Shachmurove Y (2007)*. Fig. 4 shows the venture capital fund raising over the time period of *1969 – 2001* in *Lerner (2012),* and Fig. 5 depicts the returns to the venture capital investments in the time period of *1974 – 2001 in Lerner (2012).* Fig. 6 shows the venture capital fund – raising and returns through *1969 – 1994* in *Gompers (2002),* and Fig. 7 presents the venture capital fund – raising and returns through *1969 – 2000* in *Gompers (2002).*

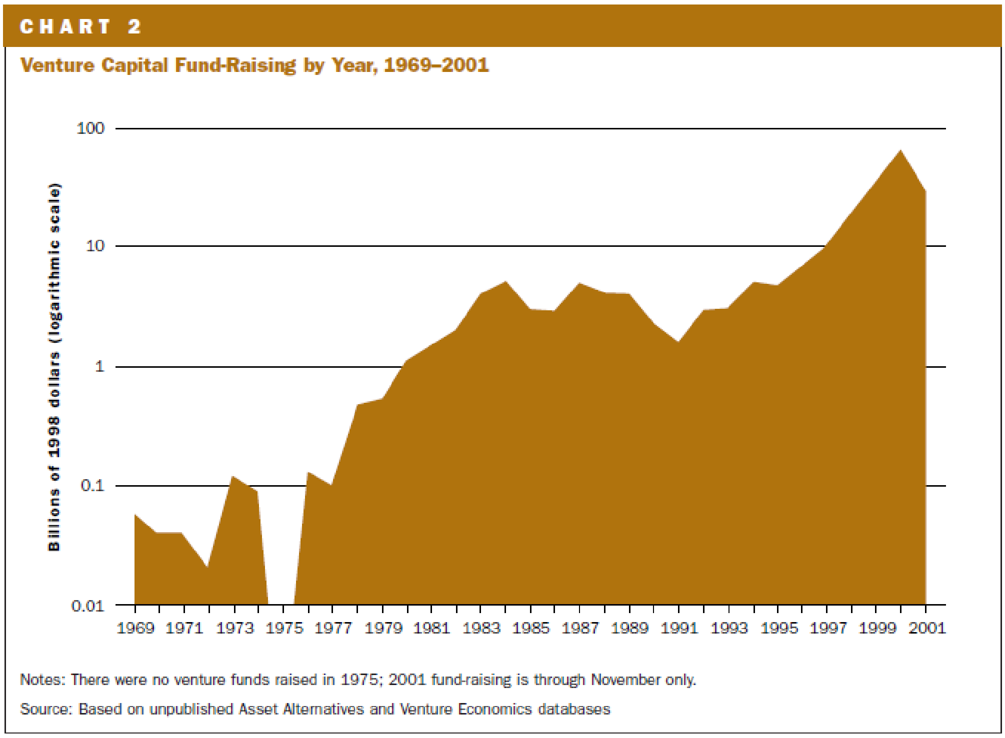

Fig. 4. *Venture capital fund raising over time period of 1969 – 2001 (after Lerner (2012)).*

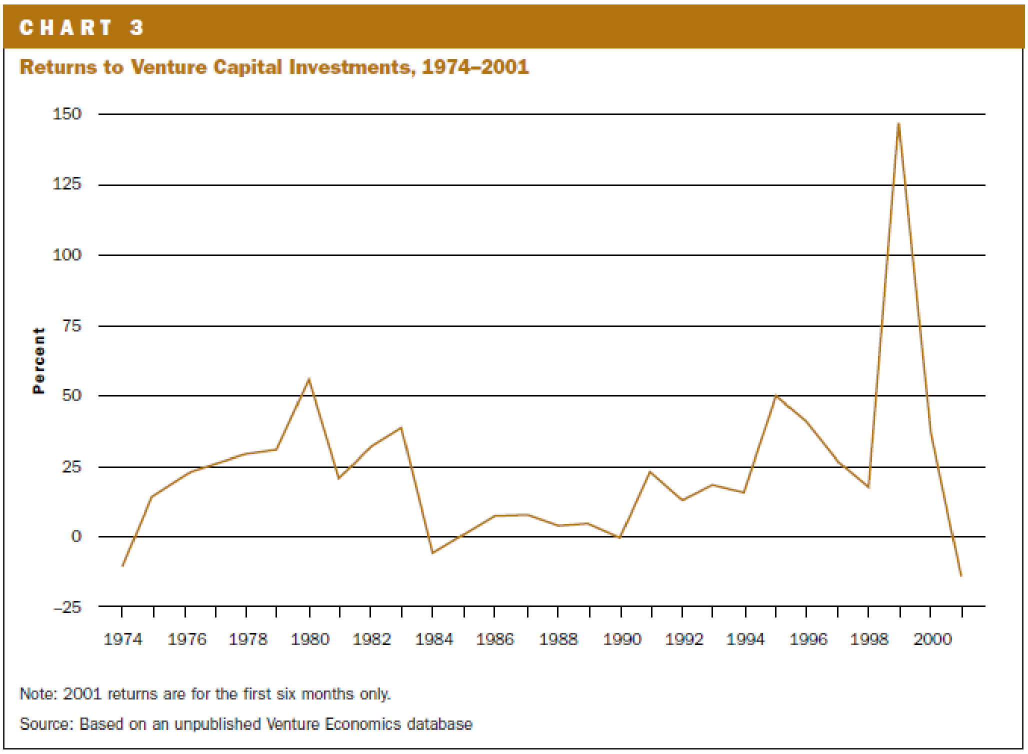

Fig. 5. *Returns to venture capital investments in time period of 1974 – 2001 (after Lerner (2012)).*

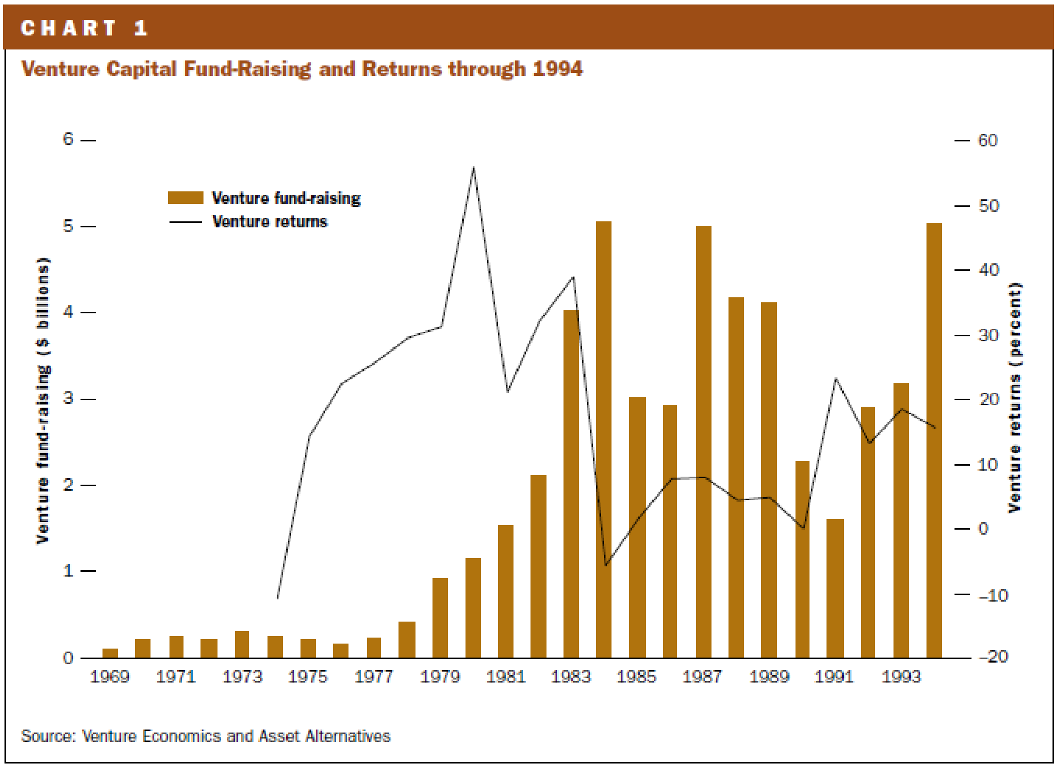

Fig. 6. Venture capital fund – raising and returns through 1969 – 1994 (after Gompers (2002)).

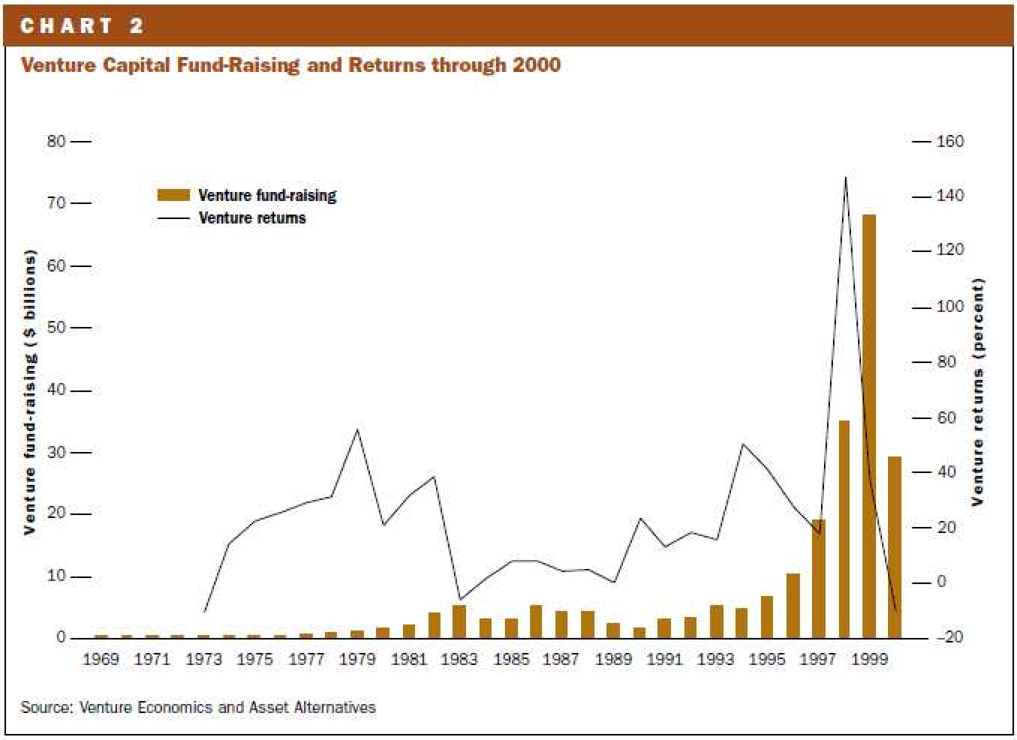

Fig. 7. Venture capital fund – raising and returns through 1969 – 2000 (after Gompers (2002)).

Fig. 8 shows the total *venture capital* activity in the *United States 1995 – 2005* in *Shachmurove Y (2007),* and Fig. 9 presents the total number of deals in *venture capital investment* in the *United States* in *1995 – 2005* in *Shachmurove Y (2007).*

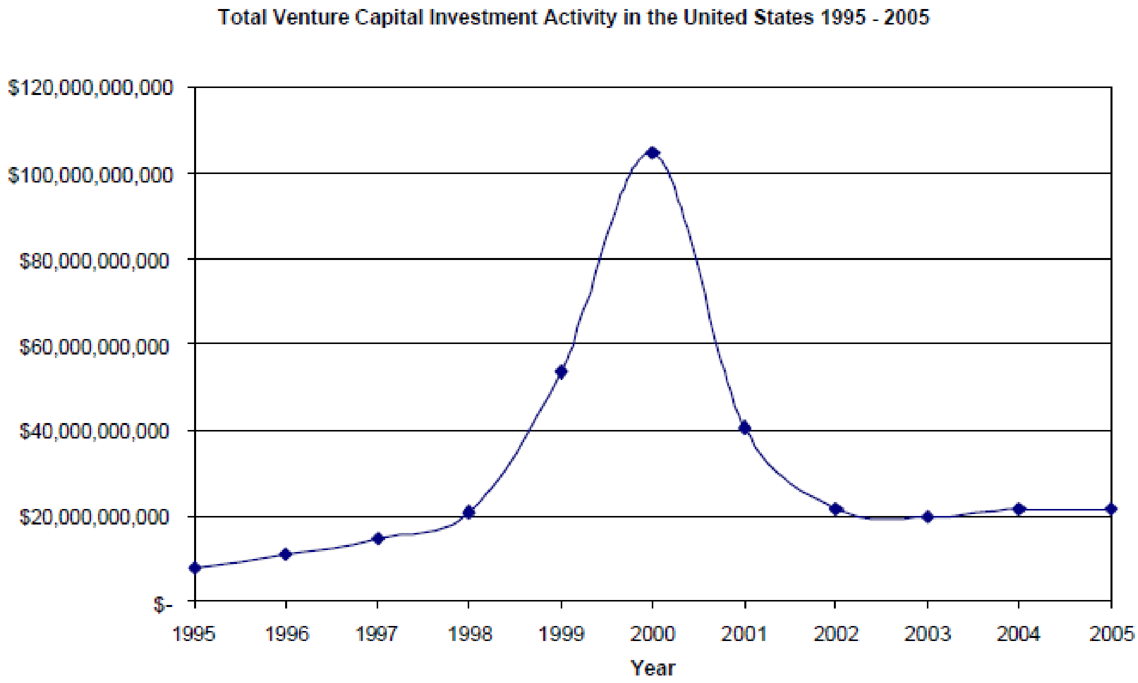

Fig. 8. *Total venture capital activity in the United States 1995 – 2005 in Shachmurove Y (2007).*

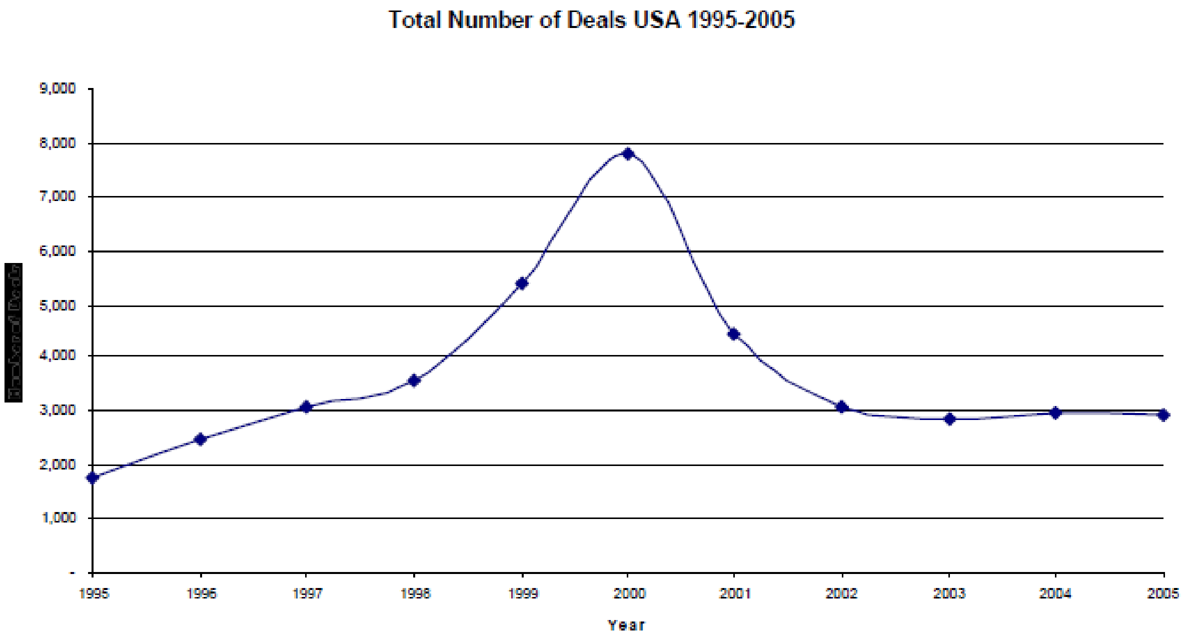

Fig. 9. *Total number of deals in venture capital investment in the United States in 1995 – 2005 in Shachmurove Y (2007).*

Fig. 10 depicts the *venture capital* under management by the investor type in *Canada* in 1992 – 2001 *in Cumming, MacIntosh (2003b)*, and Fig. 11 shows the venture capital funds in *Canada* in 1988 – 2001 *in Cumming, MacIntosh (2003b).*

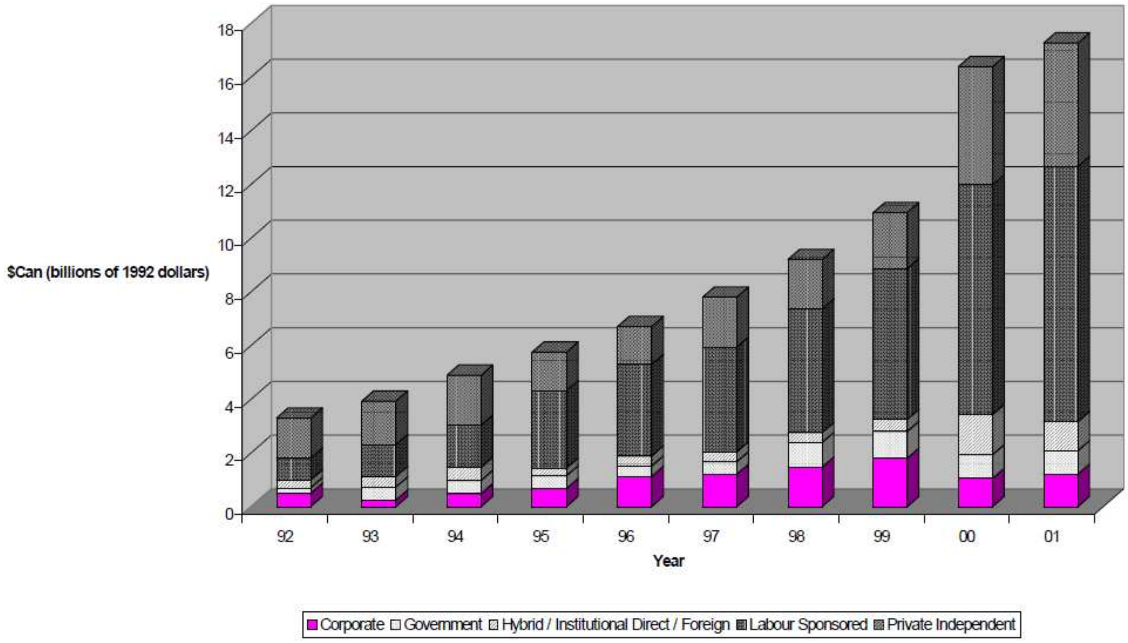

Fig. 10. *Venture capital under management by investor type in Canada in 1992 – 2001 (after Cumming, MacIntosh (2003b)).*

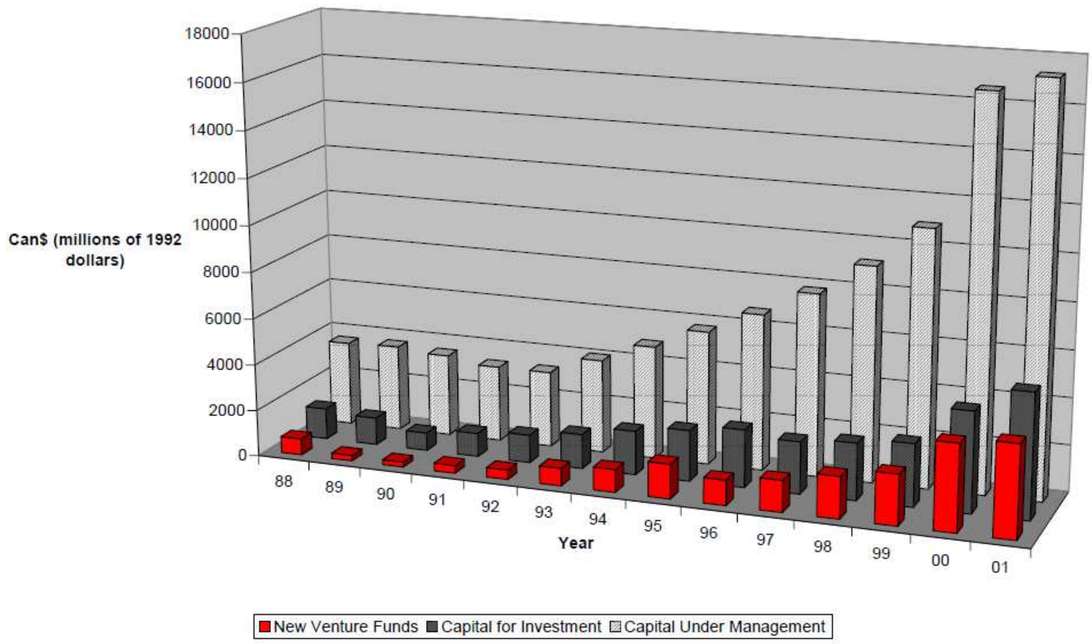

Fig. 11. *Venture capital funds in Canada in 1988 – 2001 (after Cumming, MacIntosh (2003b)).*

Fig. 12 shows the stages of *venture capital investment* in *Canada* in 1977 – 2001 *in Cumming, MacIntosh (2003b),* and Fig. 13 provides information on the *venture capital exits* in *Canada* in *1991 – 1998 in Cumming, MacIntosh (2003b).*

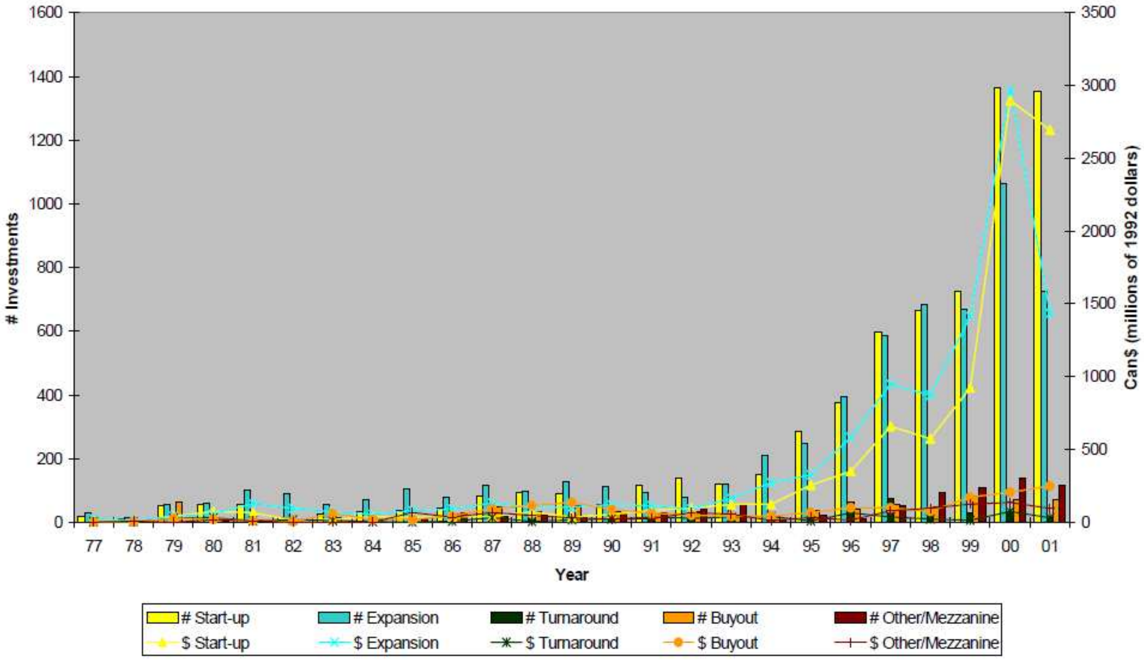

Fig. 12. *Stages of venture capital investment in Canada in 1977 – 2001 (after Cumming, MacIntosh (2003b)).*

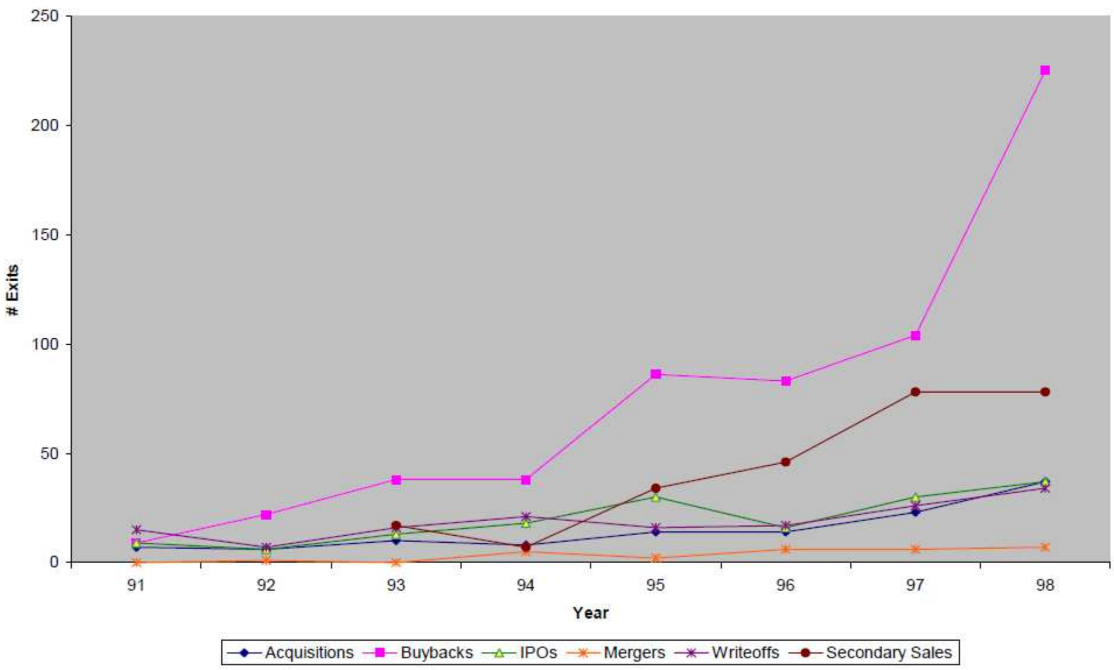

Fig. 13. *Venture capital exits in Canada in 1991 – 1998 (after Cumming, MacIntosh (2003b)).*

Let us explain that there is a big number of different *VC* industry development programs in many countries *in Sau (2007)*: *"SBIR (Small Business Innovation Research) and SBIC (Small Business Investment Company) in the USA, the ETF (European Technology Facility), I-TEC (Innovation and Technology Equity Capital) and LIFT (Linking Innovation, Finance and Technology) in the European Union*."

Fig. 14 shows the *OECD venture capital investment* by stages as a share of *GDP* in *1998 - 2001 in Baygan (2003).*

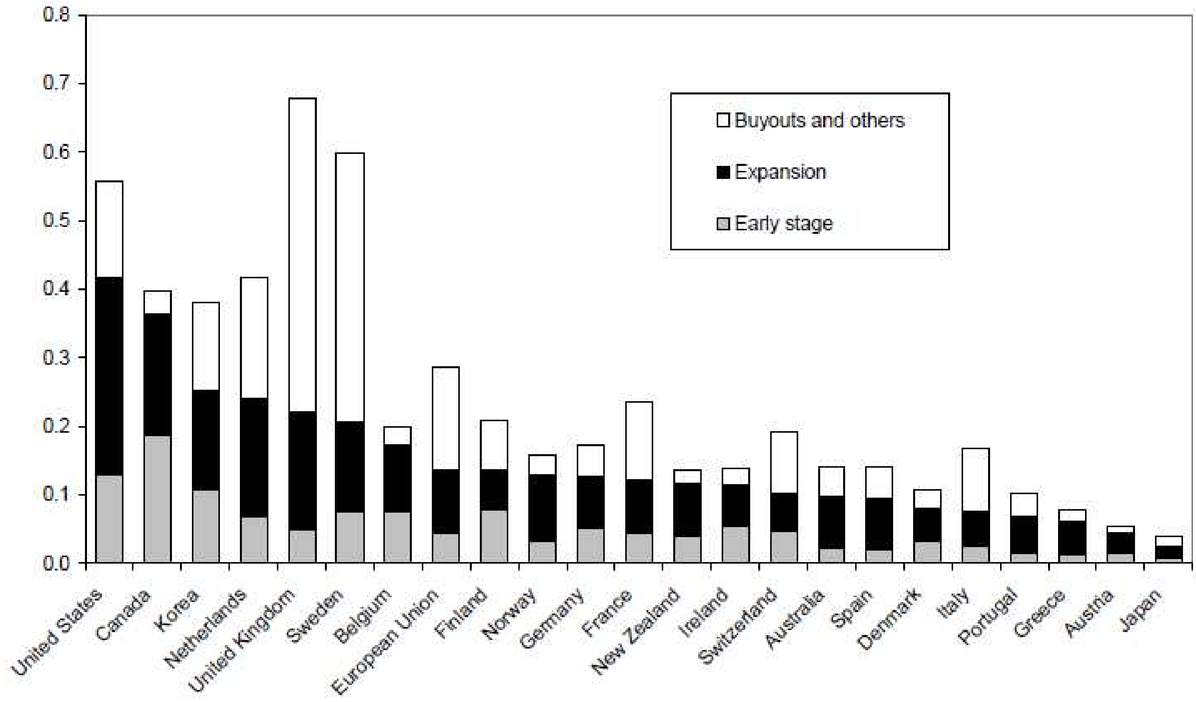

Fig. 14. *OECD venture capital investment by stages as a share of GDP, 1998-2001 (after Baygan (2003)).*

Da Rin, Nicodano, Sembenelli (2006) point out: "The creation of 'active' *venture capital markets*, i.e. *venture capital markets* which provide strong support for early stage and high-tech ventures, has received a high priority by economic policy. As economies become ever more dependent on innovation and entrepreneurship for achieving sustained growth, governments around the world have been trying to replicate the diffusion and success that *venture capital* has achieved in the *United States*." Let us add that the creation of the *VC* market requires the presence of social, scientific, financial and information technology infrastructures. *Gvazdaitytė (2012)* explains: "Literature analysis has shown that the main conditions, needed to create *venture capital industry* are: *appropriate financial market structure, human resources* *availability, source of opportunities, supporting institutions and government policy*. As well the collaboration between *universities, private companies* and *governments* is essential."

Tab. 1 shows the agents involved in creating *venture capital industry* in *Gvazdaitytė (2012).*

Agents	Formal functions	Informal functions
Universities	Nurture innovations	Incubate start-ups
	Accumulate expertise	Socialize agents
	Provide trained workers	
Large firms	Nurture innovations	Incubate start-ups
	Develop innovations	Acquire start-ups
	Accumulate expertise	Partner with start-ups
		Provide trained workers
		Socialize agents
Law firms	Accumulate legal expertise	Embed start-ups
	Handle legal issues	Network the cluster
Recruitment agencies	Favor labor market	Network the cluster
Media	Circulate information	Publicize start-ups
		Sustain an entrepreneurial culture
Consulting groups	Accumulate business expertise	Provide trained workers
	Supply expertise to start-ups	
CPA´s (Certified Public Accountant)	Accumulate accounting expertise	
	Handle accounting issues	
Investment banks	Organize IPO of start-ups	Signal start-ups
	Organize acquisitions of start-ups	
Commercial banks	Enable financial transactions	

Tab. 1. *Agents involved in creating venture capital industry (after Gvazdaitytė (2012)).*

The modern research projects, aiming to create the extended knowledge base on the *venture capital investments,* have been conducted by many world renowned scientists: *Rind (1981)*; *Tyebjee, Bruno (1981), Bruno, Tyebjee (1983, 1986), Tyebjee, Bruno (1984), Chan (1983), Felda, DeNino, Salter (1983), Wilson (1983); Merkle (1984); Hutt, Thomas (1985),* *MacMillan, Siegel, Narasimha (1985), MacMillan, Zemann, Narasimha (1987); Beatty, Ritter (1986), Nevermann, Falk (1986), Timmons, Bygrave (1986); Block, Ornati (1987), Bygrave (1987), Bygrave, Timmons (1992), Robinson (1987), Ruhnka, Young (1987, 1991), Ruhnka, Felman, Dean (1992), Sandberg, Hofer (1987), Stedler (1987); Brophy, Guthner (1988), Clark (1988), Eisinger (1988, 1993), Florida, Kenney (1988), Florida, Smith (1993), Gladstone (1988), Harris, Raviv (1988), Hofer (1988), MacMillan, Kulow, Khoylian (1988), Sandberg, Schweiger, Schmidt (1988), Siegel R, Siegel E, MacMillan (1988), Tirole (1988); Benveniste, Spindt (1989), Gorman, Sahlman (1989), Holmstrom, Tirole (1989), Poterba (1989a, b); Amit, Glosten, Muller (1990a, b), Amit, Brander, Zott (1998), Barry, Muscarella, Peavy, Vetsuypens (1990), Barry (1994), Chan, Siegel, Thakor (1990), Hisrich, Jankowitz (1990), Sahlman (1990, 1993), Sykes (1990); Dixon (1991), Megginson, Weiss (1991); Sapienza (1992), Sapienza, Gupta (1994), Sapienza, Manigart, Vermeir (1996); Hall, Hofer (1993), Rosenstein, Bruno, Bygrave, Taylor (1993), Sahlman (1993); Admati, Pfleiderer (1994), Aghion, Tirole (1994), Anton, Yao (1994), Berglöf (1994), Bhidé (1994), Fried, Hisrich (1994), Gompers (1994, 1995, 1996, 1998, 2002, 2007), Gompers, Lerner (1996, 1997, 1998a, b, c, 1999a, b, c, d, 2000a, b, 2001a, b), Brav, Gompers (1997), Baker, Gompers (2003), Brav, Gompers (2003), Gompers, Lerner, Scharfstein (2005), Gompers, Kovner, Lerner, Scharfstein (2006, 2008), Gompers, Kovner, Lerner (2009), Gompers, Lerner, Scharfstein, Kovner (2010), Knight (1994), Kroszner, Rajan (1994), Lerner (1994a, b, 1995a, b, 1998, 1999, 2002, 2008, 2009), Kortum, Lerner (1998, 2000), Lerner, Shane, Tsai (2003), Lerner, Schoar (2004, 2005), Lerner, Moore, Shepherd (2005), Lerner, Schoar, Wongsunwai (2007), Lerner, Sorensen, Strömberg (2009), Chen, Gompers, Kovner, Lerner (2009), Lerner, Tåg (2012), Puri (1994, 1996), Puri, Robinson (2011); Anton, Yao (1995), Elango, Fried, Hisrich, Polonchek (1995), Hart (1995), Jain, Kini (1995), Loughran, Ritter (1995), Willner (1995); Muzyka, Birley, Leleux (1996), Packer (1996), Pettway, Kaneko (1996); Amit, Brander, Zott (1997), Cai, Wei (1997), Chevalier, Ellison (1997), Gilford (1997), Karsai, Wright, Filatotchev (1997), Wright, Robbie, Ennew (1997), Manigart, Wright, Robbie, Desbrieres, De Waele (1997), Manigart, Baeyens, Hyfte (2002), Manigart, De Waele, Wright, Robbie, Desbrieres, Sapienza, Beekman (2000, 2002); Bergemann, Hege (1998), Berger, Udell (1998), Berger, Schaek (2011), Black, Gilson (1998), Cornelius , Isaksson (1998), Fried, Bruton, Hisrich (1998), Gerke (1998), Hellmann (1998, 2000, 2002, 2006, 2007), Hellmann, Puri (2000, 2002), Becker, Hellmann (2005), Hellmann, Lindsey, Puri (2004, 2008), Hyde (1998), Jacobs, Scheffler (1998), Karsai (1998, 2003, 2004), Karsai, Wright, Dudzinski, Morovic (1999), Lin, Smith (1998), Marx (1998), Marx, Strumsky, Fleming (2009), Murray, Marriott (1998), Prowse (1998), Rajan, Zingales (1998), Trester (1998), Wright, Robbie (1998), Zider (1998); Aernoudt*

(1999), Bliss (1999), Bygrave, Hay, Peeters (1999), Gilson (1999), Gilson, Schizer (2002, 2003), Gulati, Gargiulo (1999), Hamao, Packer, Ritter (1999), Leopold (1999), Neher (1999), Shepherd (1999), Shepherd, Zacharakis (1999), Stillman, Sunderland, Heyl, Swart (1999); Baygan, Freudenberg (2000), Baygan (2003), Bharat, Galetovic (2000), Cumming (2000, 2001, 2008), Cumming, MacIntosh (2000, 2001, 2002a, 2002b, 2002c, 2002d, 2003a, b, 2006), Cumming, Fleming (2002), Cumming, Fleming, Schwienbacher (2005, 2006, 2009), Cumming, Fleming, Suchard (2005), Cumming, Johan (2008), Cumming, Walz (2010), Gans, Stern (2000, 2003), Gans, Hsu, Stern (2002), Jain, Kini (2000), Jeng, Wells (2000), Kaplan, Strömberg (2000, 2001, 2002, 2003, 2004, 2009), Kaplan, Schoar (2005), Kaplan, Martel, Strömberg (2007), Kaplan, Sensoy, Strömberg (2009), Kaplan, Lerner (2010), Karaömerlioğlu, Jacobsson (2000), Koski (2000), Lee (2000), Lehtonen (2000), Quindlen (2000), Schefczyk (2000), Schertler (2000); *Bascha, Walz (2001), Engel (2001a, b, 2002); Francis, Hasan (2001), Fredriksen, Klofsten (2001), Hyytinen, Pajarinen (2001), Keuschnigg, Nielsen (2001, 2003a, b, 2004a, b), Keuschnigg (2003, 2004a, b), Kanniainen, Keuschnigg (2004), Kirilenko (2001), Lockett, Wright (2001), Maula, Murray (2001), Peng (2001), Seppä, Laamanen (2001), Seppä (2003), Shachmurove Y (2001, 2007a, b), Shachmurove A, Shachmurove Y (2004), Shachmurove E, Shachmurove Y (2004), Sorenson, Stuart (2001); Allen, Song (2002), Audretsch, Lehmann (2002), Bottazzi, Da Rin (2002a, b, 2004), Bottazzi, Da Rin, Giavazzi (2003), Bottazzi, Da Rin, Hellmann (2004a, b, 2008, 2009), Brander, Amit, Antweiler (2002), Brander, De Bettignies (2009), Brander, Egan, Hellmann (2008), Brander, Du, Hellmann (2010), Chesbrough (2002), Cestone (2002), Davis, Schachermayer, Tompkins (2002), Dossani, Kenney (2002), Kenney, Han, Tanaka (2002), Eisele, Habermann, Oesterle (2002), Everts (2002), Koh F C C, Koh W T H (2002), McGlue (2002), Moskowitz, Vissing-Jørgensen (2002), Shane, Cable (2002), Shane, Stuart (2002), Zook (2002); Becker, Hellman (2003), Bergemann, Hege (2003), Hege, Palomino, Schwienbacher (2009), Casamatta (2003), Casamatta, Haritchabalet (2007), Cornelli, Yosha (2003), Davila, Foster, Gupta (2003), Franzke, Grohs, Laux (2003), Gawlik, Teczke (2003), Gilson, Schizer (2003), Hirukawa, Ueda (2003), Inderst, Muller (2003), Keilbach, Engel (2003), Leleux, Surlemont (2003), Rindermann (2003), Schertler (2003), Schmidt (2003), Schmidt, Wahrenburg (2003), Stuart, Sorenson (2003), Wang C K, Wang K, Lu (2003), Wasserman (2003, 2006), Woodward, Hall (2003); Aghion, Bolton, Tirole (2004), Avnimelech, Kenney, Teubal (2004), Avnimelech, Teubal (2004), Baum, Silverman (2004), Berk, Green, Naik (2004), Da Rin, Nicodano, Dittmann, Maug, Kemper (2004), Hsu (2004), Inderst, Müller (2004, 2009), Inderst, Müller, Muennich (2007), Jones, Rhodes-Kropf (2004), Lee, Wahal (2004), Megginson (2004), Michelacci, Suarez (2004), Mishra (2004), Peggy, Wahal (2004), Repullo, Suarez (2004),*

Roman, van Pottelsberghe de la Potterie (2004), Sembenelli (2004), Sternberg (2004), Ueda (2004); Bergemann, Hege (2005), Cochrane (2005), Da Rin, Hege, Llobet, Walz (2005), Da Rin, Nicodano, Sembenelli (2005, 2006), Da Rin, Hellmann, Puri (2011), De Carvalho, Calomiris, De Matos (2005), Dessein (2005), Dessí (2005), Dimov, Shepherd (2005), Dushnitsky, Lenox (2005, 2006), Dushnitsky, Lavie (2008), Ernst, Witt, Brachtendorf (2005), Ge, Mahoney J M, Mahoney J T (2005), Hsu, Kenney (2005), Hsu (2006, 2007), Klepper, Sleeper (2005), Klepper, Thompson (2010), Kõomägi (2005a, b, c), Kõomägi, Sander (2006), Lai (2005, 2007), Mäkelä, Maula (2005), Mayer, Schoors, Yafeh (2005), Mayer, Schoors, Yafeh (2005), Neus, Walz (2005), Wong (2005), Zook (2005); Antonelli, Teubal (2006), Cassiman, Ueda (2006), Colombo, Dimov, De Clercq (2006), Eckhardt, Shane, Delmar (2006), Ellul, Pagano (2006), Gebhardt, Schmidt (2006), Grilli, Piva (2006), Fallick, Fleischman, Rebitzer (2006), Franco, Filson (2006), Franco, Mitchell (2008), Isaksson (2006), Mathews (2006), Motohashi (2006, 2010), Nielsen, Keuschnigg (2006), Proimos, Murray (2006), Riyanto, Schwienbacher (2006), Wadhwa, Kotha (2006), Zhang (2006, 2007a, b); Bernile, Cumming, Lyandres (2007), Campbell, Kraeussl (2007), Colombo, Dawid, Kabus (2007), de Bettignies, Brander (2007), de Bettignies, Chemla (2008), de Bettignies (2008), Engel, Keilbach (2007), Hochberg, Ljungqvist, Lu (2007, 2010), Hsu (2007), Jovanovic, Szentes (2007), Lai (2007), Li, Prabhala (2007), Luukkonen (2007, 2008), Mann, Sager (2007), Pintado, De Lema, Van Auken (2007), Robinson, Stuart (2007), Sau (2007), Schwienbacher (2007, 2008), Sørensen (2007), Tykvová (2007); Aizenman, Kendall (2008), Broughman (2008), Broughman, Fried (2010), Davidsson, Steffens, Gordon, Senyard (2008), Geronikolaou, Papachristou (2008), Hand (2008), Hirukawa, Ueda (2008a, b), Katila, Rosenberger, Eisenhardt (2008), Lindsey (2008), McMillan, Roberts, Livada, Wang (2008), Orman (2008), Rossetto (2008), Schwienbacher (2008, 2009), Sorenson, Stuart (2008), Winton, Yerramilli (2008), Nahata (2008), Phalippou (2008), Phalippou, Gottschalg (2009), Puri, Zarutskie (2008), Van Deventer, Mlambo (2008, 2009); Aberman (2009), Bengtsson, Ravid (2009), Bengtsson, Hand (2011), Bengtsson, Sensoy (2011), Block, Sandner (2009), Clarysse, Knockaert, Wright (2009), Cockburn, MacGarvie (2009), Duffner, Schmid, Zimmermann (2009), Fitza, Matusik, Mosakowski (2009), Fulghieri, Sevilir (2009a, b), Jones, Mlambo (2009), Krohmer, Lauterbach, Calanog (2009), Lingelbach, Murray, Gilbert (2009), Litvak (2009a, b), Masulis, Nahata (2009, 2011), Norbäck, Persson (2009), Samuelsson, Davidsson (2009), Van de Vrande, Vanhaverbeke, Duysters (2009); Arikawa, Imad'eddine (2010), Benson, Ziedonis (2010), Bienz, Walz (2010), Cantner, Stützer (2010), Cowling, Murray, Liu (2010), Dushnitsky, Shapira (2010), Elston, Yang (2010), Groh, Liechtenstein (2010), Hall, Woodward (2010), Inci, Barlo (2010), Ivanov, Xie (2010), Jegadeesh, Kräussl, Pollet (2010), Korteweg, Sørensen (2010), *Metrick, Yasuda (2010, 2011), Obschonka, Silbereisen, Schmitt-Rodermund, StuetzerNascent (2010), Samila, Sorenson (2010, 2011), Sevilir (2010), Zarutskie (2010), Zacharakis, Erikson, George (2010); Ball, Chiu, Smith (2011), Cherif, Gazdar (2011), Das, Jo, Kim (2011), Ferretti, Meles (2011), Kandel, Leshchinskii, Kraeussl, Krause (2011), Kerr, Nanda (2011), Li, Abrahamsson (2011), Samila, Sorenson (2011), Tian (2011), Yuklea (2011); Diaconu (2012), Gvazdaitytė (2012), Lazarevski, Mrsik, Smokvarski (2012), Lim, Cu (2012), Pommet (2012), Rosenbusch, Brinckmann, Müller (2012), Yitshaki (2012); Alqatawni (2013), Brettel, Mauer, Appelhoff (2013), Pennacchio (2013), Stuetzer, Obschonka, Davidsson, Schmitt-Rodermund (2013), Stuetzer, Obschonka, Schmitt-Rodermund (2013).*

Venture capital optimal investment portfolio strategies in highly volatile global capital markets with nonlinearities

Let us begin with the formulation of the *innovative start-ups financing problem* in the frames of *the theory of corporate finance* in *Tirole (2006*). The main three problems in the startups funding are outlined in *Orman (2008)*:

1. "First, specialized research ventures require substantial upfront resources but do not generate cash flows for a long time.
2. Second, research ventures are typically surrounded by substantial uncertainty concerning their potential outcomes.
3. Finally, most of the assets of a research venture is intangible and hence cannot be used as collateral.

All of these issues potentially reduce the willingness of suppliers of capital to provide financing to such ventures. In extreme situations, these difficulties may even cause *credit-rationing* in *Stiglitz and Weiss (1981)*."

The *VC financing* represents a possible solution for the above mentioned financial problems in the cases of innovative start-up companies. There are a number of different investment stages in the *venture capital financing*. Therefore, let us provide some information on the *different VC financing stages* in the process of the innovative startup company development in *Geronikolaou, Papachristou (2008): "European Venture Capital Association's (EVCA)* terminology split *VC* into three stages namely,

1. ***Seed finance*** (intended for new firms in order to evaluate their initial concept),
2. ***Start-up finance*** (aiming at the development of the firm's product before the firm has sold any products), and

3. ***Expansion finance*** (aiming to assist the growth and expansion of the firm).”

Sau (2007) proposes a general scheme of the most innovative *start-ups financing*:

1. Insider capital, informal private equity and easy-term public financing (***Seed***)*;*

2. Venture capital financing (***Start-up****);*

3. Self-financing, bank and/or business credit (***Early Growth***);

4. *Direct issue of bonds and public equity* (***Sustained Growth***).

Gompers (2002) distinguishes a few investment stages in the innovative startup company:

1. **Start-up**: Company with a skeletal business plan, product, or service development in preliminary stages.

2. ***Development: Stage*** at which product or service development is under way but the company is not generating revenues from sales.

3. ***Beta***: For companies specializing in information technology, the phase at which the product is being tested by a limited number of customers but not available for broad sale. For life sciences companies, beta is synonymous with a drug in human clinical trials or a device being tested.

4. ***Shipping***: The stage at which the product or service is being sold to customers and the company is deriving revenues from those sales but expenses still exceed revenues.

5. ***Profitable***: The stage at which the company is selling products or services and the sales revenue yields a positive net income.

6. ***Restart***: The stage at which the firm is recapitalized at a reduced valuation, accompanied by a substantial shift in the product or marketing focus.

Van Deventer, Mlambo (2008, 2009) write: “There have been several studies done trying to identify the different stages and criteria of the *decision-making process*. Studies on the processes and criteria used by *venture capitalists* have been done by *Tyebjee and Bruno (1984), MacMillan et al. (1985; 1987), Fried and Hisrich (1994), Shepherd (1999), Kaplan and Strömberg (2003), Kakati (2003), Ge et al. (2005)* and *Pintado, De Lema and Van Auken (2007)*. According to *Larsson and Roosvall (2000:4)*, the process is generally conducted in such a way that new ventures must first pass an initial screening, which is typically a review of the business plan. “This is then followed by meetings, a due diligence phase and negotiations around the more detailed issues regarding the investment.””

Fig. 15 shows the general *VC financing scheme* in *Eisele, Habermann, Oesterle (2002).*

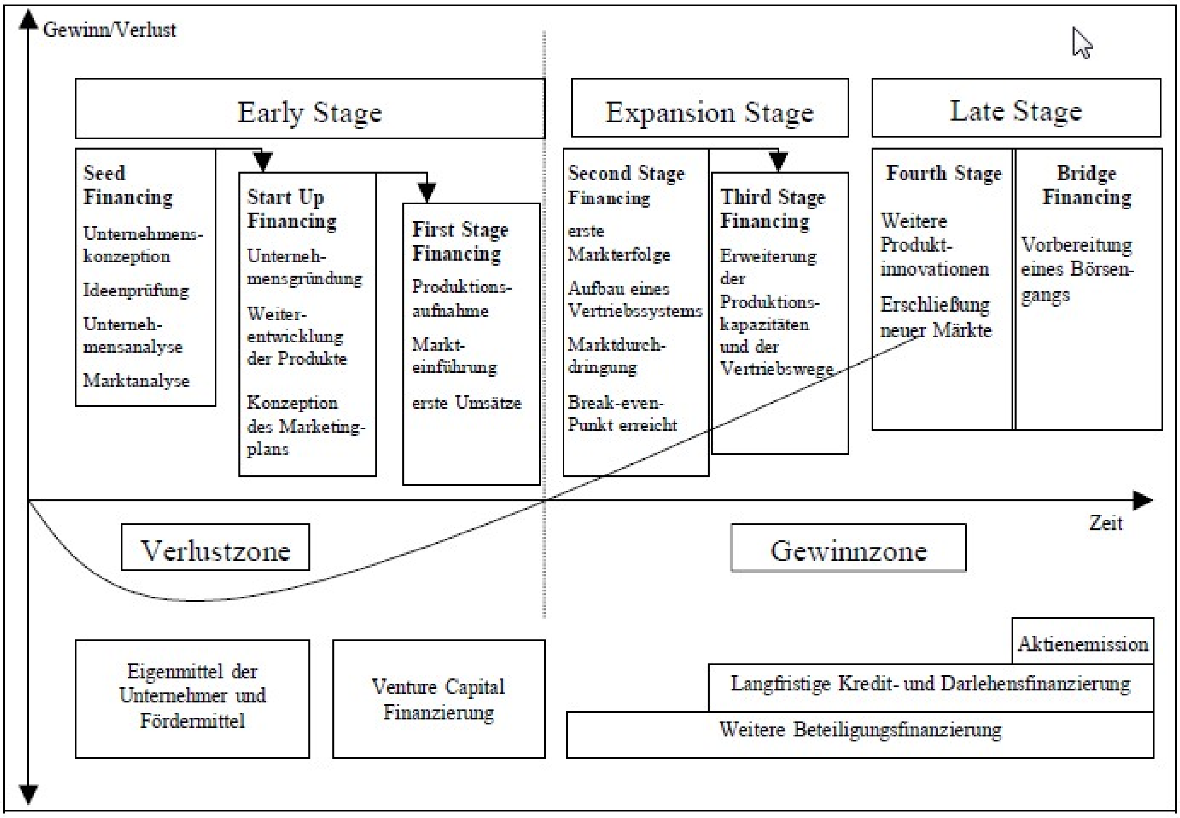

Fig. 15. *Venture capital financing scheme (after Eisele, Habermann, Oesterle (2002)).*

In the process of the optimal *VC* investment portfolio selection, the *VC* firms complete a number of important tasks in *Keilbach, Engel (2003)*: "*...Venture capital firms* screen potential portfolio firms to select out those with the best growth perspectives. The innovative potential (as signalled by patent applications and by the founders' education levels) play an important role in that respect. This screening process is very selective though successful since *venture capital funded firms* display indeed higher (twice as large) growth rate as compared to firms of a control group. This stronger growth rate seems to be a result of a *commercialization* of previous innovations since innovation outputs of venture funded firms do not differ from non venture funded but otherwise strongly similar group of firms of a control group. A plausible explanation for this finding could be that *venture capital* investors assist their portfolio firms in this commercialization effort, rather than in further innovation effort, in an attempt to maximize sales, hence value, of their portfolio firms. *Commercialization* is probably done by *financial means* but also by *means of management assistance*."

There are several criteria, which can be classified into the *two groups* such as the *important criteria* and the *unimportant criteria* in the process of the decision making on the *VC financing*. Tab. 2 presents *the criteria rated as important* by participating *VCs*, and Tab. 3 shows *the criteria rated as not important* by participating *VCs* in *Van Deventer, Mlambo (2008, 2009)*.

Criterion	Mean	Std. Dev.	Category
The entrepreneur is honest and has integrity	4,9091	0,3015	Management
A good market acceptance for the product or service is expected	4,9091	0,3015	Product
The venture will provide a high internal rate of return (IRR)	4,9091	0,3015	Financial
There is a market need for the product or service	4,8182	0,4045	Market
The entrepreneur has a great desire for success	4,7273	0,4671	Management
The product/service has a competitive advantage over competing products	4,7273	0,4671	Product
The venture has high valuation projections	4,7273	0,4671	Financial
There is potential for market growth	4,7273	0,4671	Market
The venture has significant potential for earnings growth	4,6364	0,5045	Financial
The entrepreneur has excellent management skills/experience	4,5455	0,5222	Management
The entrepreneur is hardworking and flexible	4,5455	0,5222	Management
The entrepreneur has good leadership ability	4,4545	0,5222	Management
The market is big	4,4545	0,6876	Market
The entrepreneur has good risk management qualities	4,3636	0,6742	Management
The venture has high profit margin projections	4,2727	0,7862	Financial
The entrepreneur has a good track record	4,2727	0,6467	Management
The entrepreneur has good knowledge of the sector	4,1818	1,4709	Management
The entrepreneur is capable of intense, sustained effort	4,1818	0,6030	Management
The venture will provide a high absolute return	4,1818	0,6030	Financial
The product/service has open access to the market	4,1818	0,7508	Market
The references of the entrepreneur are reputable	4,0909	0,9439	Management

Tab. 2. *Criteria rated as important by participating VCs (after Van Deventer, Mlambo (2008, 2009)).*

Criterion	Mean	Std. Dev.	Category
There will be a tax benefit in financing the venture	1,9091	0,7006	Financial
There will be no follow up investment required	2,0909	1,3004	Financial
The venture will require low monitoring and administration costs	2,0909	1,3004	Financial
The venture has BEE status	2,3636	1,2863	Other
The venture will operate in a non-competitive industry	2,4545	1,0357	Market
The venture will require low marketing and production costs	2,6364	1,1201	Financial
The venture will create a new market	2,6364	0,9244	Market
Product/service is in an early stage of life cycle	2,7273	1,7373	Product
The venture has low overall capital requirements	2,7273	1,1037	Financial
The venture has production capabilities in place	2,8182	1,3280	Product

Tab. 3. *Criteria rated as not important by participating VCs (after Van Deventer, Mlambo (2008, 2009)).*

Fig. 16 shows the venture capital decision-making process in *Kõomägi, Sander (2006),* and Fig. 17 depicts the quantitative decision-making process among venture capitalists in *Estonia* in *Kõomägi, Sander (2006).*

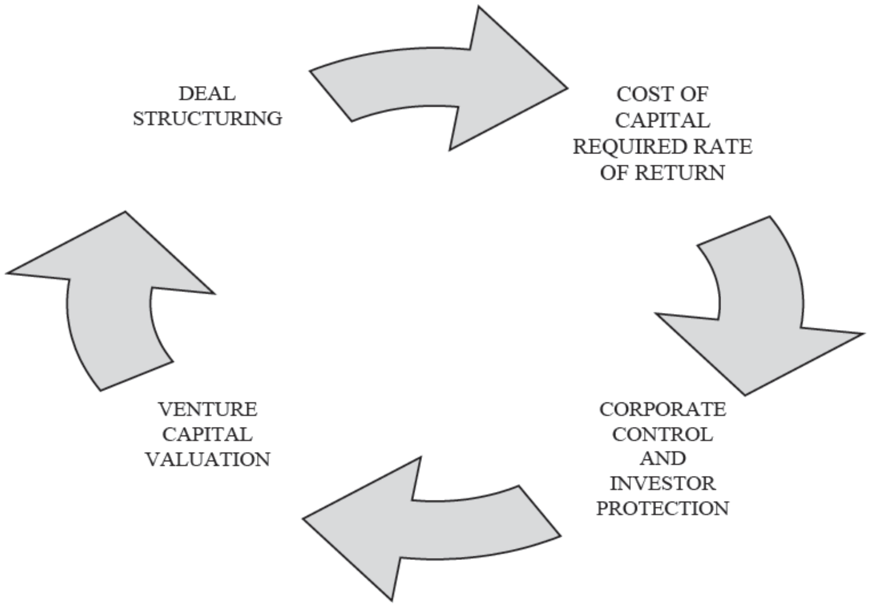

Fig. 16. *Venture capital decision-making process (after Kõomägi, Sander (2006)).*

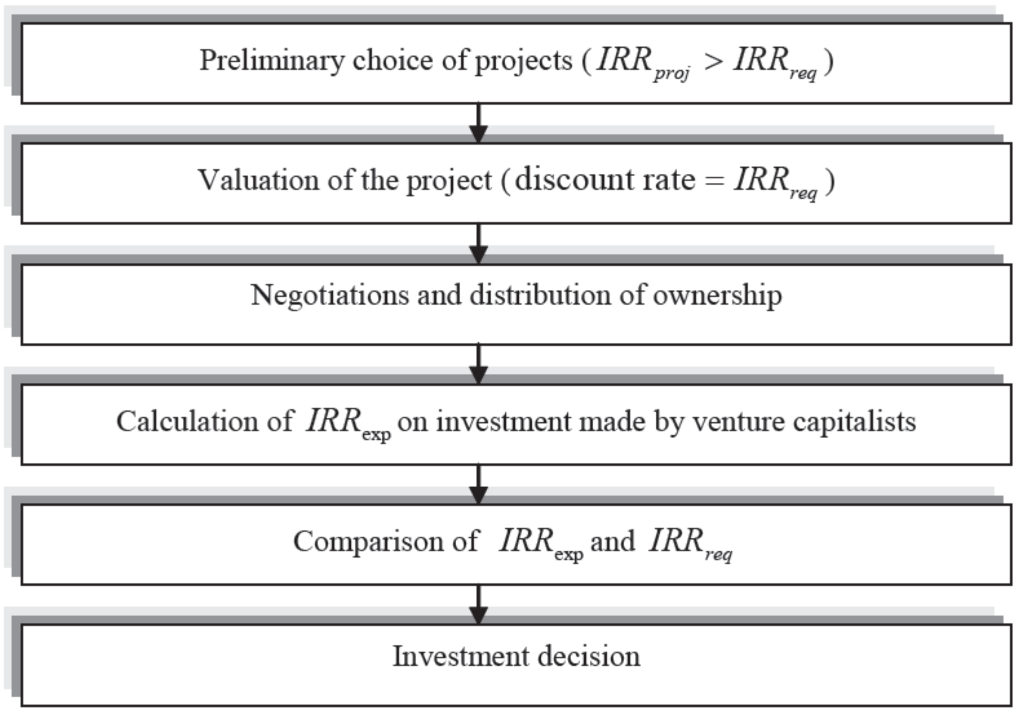

Fig. 17. *The quantitative decision-making process among venture capitalists in Estonia (after Kõomägi, Sander (2006)).*

The necessary and sufficient condition for the *startup firm* to obtain the financing from the uninformed investors is in *Da Rin, Nicodano, Sembenelli (2005)*

$$\gamma\left(\boldsymbol{I}-\boldsymbol{A}\right)\leq \boldsymbol{p_H R_u}=\boldsymbol{p_H}\left[\boldsymbol{R}-\left(\frac{\boldsymbol{B}}{\boldsymbol{p_H}-\boldsymbol{p_L}}\right)\right],$$

where $\boldsymbol{I}$ is the cost of the investment, $\boldsymbol{A}$ is the firm's own equity capital which is pledged as collateral, $\boldsymbol{I-A>0}$ is the amount of capital, which is necessary to borrow for the firm, $\boldsymbol{p_H}$ is the probability to deliver the return $\boldsymbol{R}$, $\boldsymbol{B}$ denotes the private benefits for the entrepreneurs, $\boldsymbol{R_u=R-R_f}$ is the share of return to uninformed investors, $\boldsymbol{R_f}$ is the share of return, retained by the firm.

Therefore, the market value of the loan (the left hand side) cannot exceed the firm's expected income (the right-hand side). Firms are then able to raise finance from uninformed investors if and only if in *Da Rin, Nicodano, Sembenelli (2005)*

$$\boldsymbol{A}\geq \bar{\boldsymbol{A}}\left(\gamma\right)=\boldsymbol{I}-\left(\frac{\boldsymbol{p_H}}{\gamma}\right)\left[\boldsymbol{R}-\left(\frac{\boldsymbol{B}}{\boldsymbol{p_H}-\boldsymbol{p_L}}\right)\right],$$

where $\boldsymbol{A}$ is increasing in $\boldsymbol{\gamma}$.

The amount of funds borrowed by monitored firms I_{vc} adjusts to satisfy the incentive compatibility constraint of the *venture capit*alist in *Da Rin, Nicodano, Sembenelli (2005)*

$$\boldsymbol{I_{vc}}\left(\beta\right)\geq\frac{\boldsymbol{c p_H}}{\beta\left(\boldsymbol{p_H}-\boldsymbol{p_L}\right)}$$

where $\boldsymbol{\beta}$ is the rate of return to venture capital, $\boldsymbol{\beta=p_H R_{vc}/I_{vc}}$.

The necessary and sufficient condition for a firm to be financed by both uninformed investors and venture capitalists is then in *Da Rin, Nicodano, Sembenelli (2005)*

$$\boldsymbol{A}\geq \underline{\boldsymbol{A}}\left(\gamma,\beta\right)=\boldsymbol{I}-\boldsymbol{I_{vc}}\left(\beta\right)-\left(\frac{\boldsymbol{p_H}}{\gamma}\right)\left[\boldsymbol{R}-\left(\frac{\boldsymbol{b}+\boldsymbol{c}}{\boldsymbol{p_H}-\boldsymbol{p_L}}\right)\right]$$

where $\boldsymbol{c}$ is the monitoring cost.

Fig. 18 shows the firm's financing choices, depending on their own equity capital *in Da Rin, Nicodano, Sembenelli (2005).*

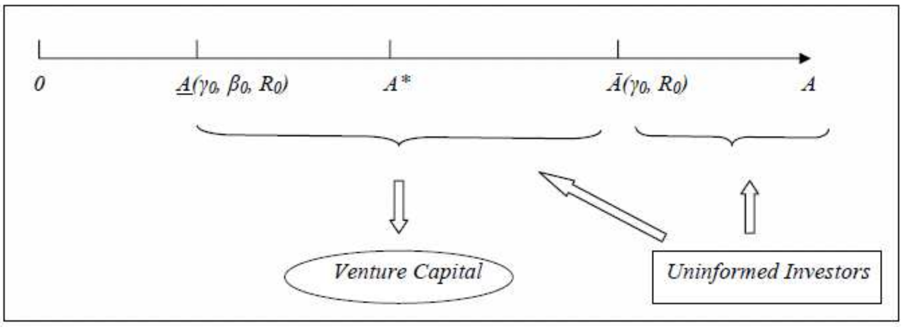

Fig. 18. *Firm's financing choice as a function of their equity capital, A (after in Da Rin, Nicodano, Sembenelli (2005)).*

Fig. 19 shows the *factors*, impacting the *early-stage venture capital* in *South Africa* in *Jones, Mlambo (2009),* and Fig. 20 represents some information on the activity areas, where the venture capitalist is responsible for implementation in *Luukkonen (2008).*

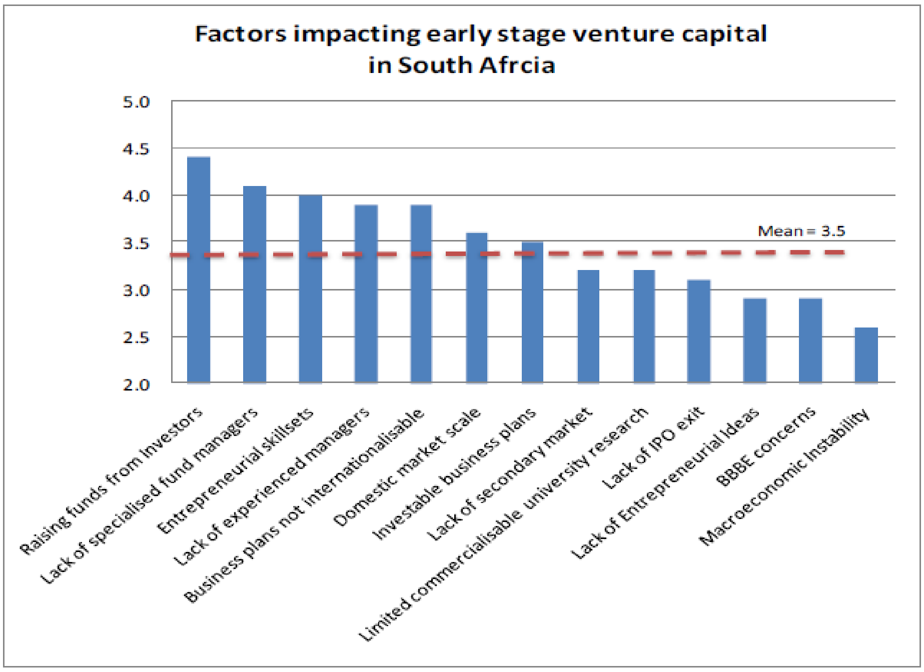

Fig. 19. *Factors impacting early-stage venture capital in South Africa in Jones, Mlambo (2009).*

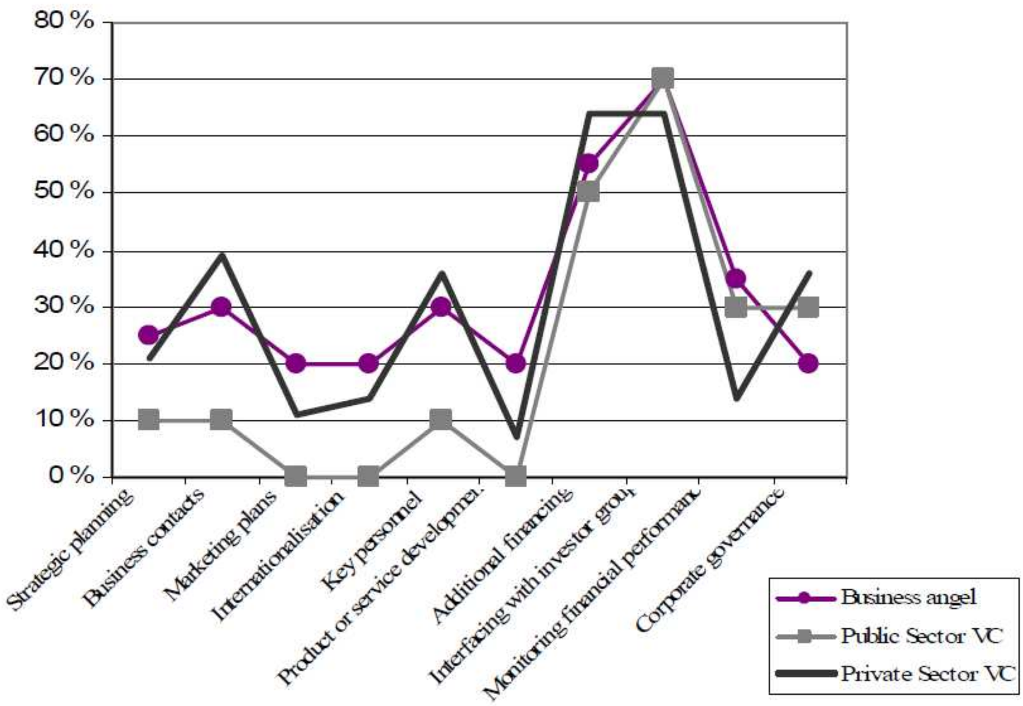

Fig. 20. *Activity areas where the venture capitalist is responsible for implementation (after Luukkonen (2008)).*

Da Rin, Hege, Llobet, Walz (2005) write: “The theoretical and empirical literature has focused on a relative small number of factors as the leading performance drivers in *venture capital* success. First, *venture capitalists* are typically active investors: they provide monitoring and advising besides capital. Second, the *venture capital industry* has long resorted to a wide array of specific contractual mechanisms to mitigate agency conflicts, in particular instruments of contingent control and stage financing.”

Aiming to increase the *venture capital success*, the *venture capitalists* tend to conduct the *VC networking and form the syndicates*.

Da Rin, Hellmann, Puri (2011) explain: “*Bubna et al. (2011)* examine the clustering in *VC partner* choices. They find that *VCs* tend to syndicate with preferred partners drawn from clusters that they call *VC* “communities.” Using flexible community detection algorithms originating in the *physical sciences*, they examine the number of communities, their composition, and their effect on performance. They find that *VCs* communities are structurally complex, with heterogeneity in some characteristics such as size and influence but homogeneity in characteristics in other dimensions such as stage focus. ***Firms funded by community VCs are more likely to experience a successful exit***.”

Lai (2005) writes: “*Venture capital firms (VCs)* form syndicates that compete to invest in deals.” Fig. 21 shows the *VCs networking scheme* in *Lai (2005).*

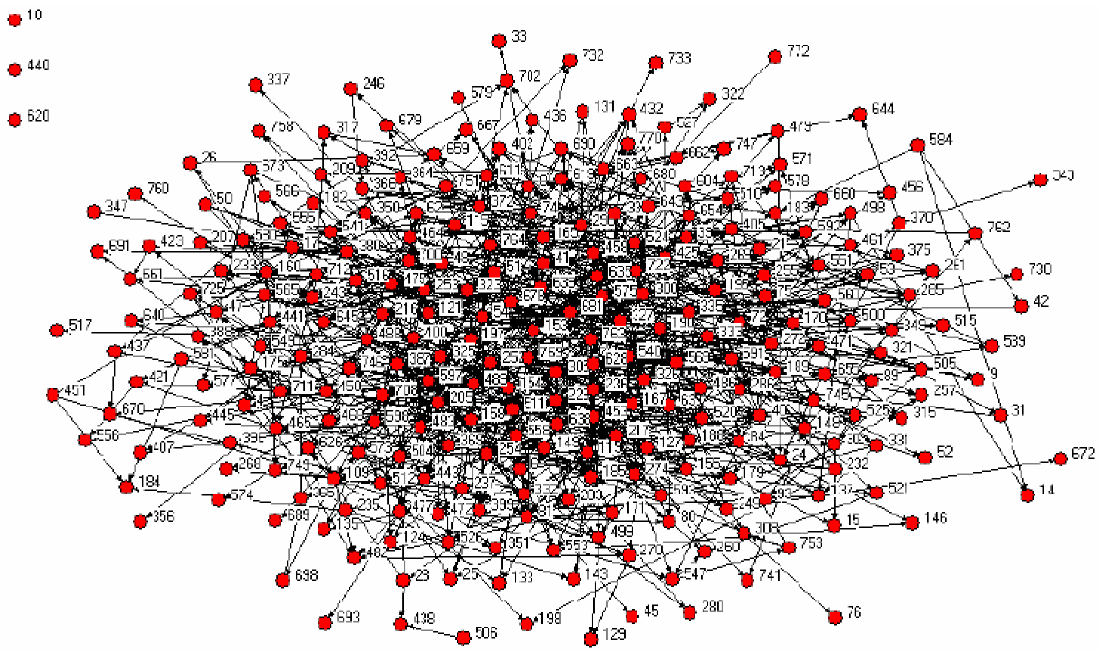

Fig. 21. *VCs networking scheme: VCs are depicted as nodes. An arrow from one VC to another means that the former has selected the latter in a previous syndicate. Isolated nodes on left are VCs who select no VCs before. All lead VCs are shown, but only candidate VCs who have been selected by some lead VC are shown (after Lai (2005)).*

Let us discuss the ***asymmetric information problem between the various market agents.*** The impact by the *investments* on the economy performance has been studied in *Akerlof, Stiglitz (1966)*. The *theory of innovation* has been researched in *Stiglitz (1969)*. The fact that the competition and entrepreneurship are important factors for the economy growth has been outlined in *Kirzner (1973)*. The *theory of firm* has been well formulated in *Jensen, Meckling (1976), Lucas (1978)*. The problems of the *imperfect information, uncertainty* and *credit rationing* between the market agents in the conditions of market economy have been considered in *Jaffee, Russell (1976)*. The existence of the *credit rationing problem in the markets with the incomplete information* has been also confirmed in *Stiglitz, Weiss (1981)*, *Stiglitz (1988)*. The *new theory of the firm*, taking to the account the *asymmetric information flows*, has been proposed in *Greenwald, Stiglitz (1990)*. It has been discovered that in *Greenwald, Stiglitz (1990):* "Imperfect information affects both the internal organization of firms and its external relations with labor, capital and product markets." The *asymmetric effect of diffusion processes* has been explained in *Richiardi, Gallegati, Greenwald, Stiglitz (2007).*

Zhang (2007b) explains: "*VC investment* is characterized by ***an asymmetric information problem between equity investors and the entrepreneur*** *Leland and Pyle (1977)*; *Amit et al. (1990)*; *Fried and Hisrich (1994); Gompers (1995). VC* investors often bet millions of dollars on a start-up, whose future success will in large part be determined by the quality of the founder. Usually investors possess less information about the entrepreneur's ability and the viability of his business plan than the entrepreneur himself does. This ***information asymmetry prevents venture capitalists from investing a large amount of money in start-ups***." *Zhang (2007b)* notes: "There are many ways to overcome this *asymmetric information problem Gompers and Lerner (1999)*. In a sense, the general practice of staged investment in the *VC industry* is meant to provide a partial solution to this problem *Gompers (1995)*. ***Venture capitalists almost always make investment decisions stage by stage: they only provide a small amount of money to a start-up initially, and base later investment decisions on the start-up's performance.*** In this way, *venture capitalists* can evaluate the entrepreneur's ability and the viability of his plan over time. Furthermore, as another solution to the *asymmetric information problem*, *venture capitalists* rely heavily on the *referrals of social contacts* to identify and evaluate an entrepreneur *Tyebjee and Bruno (1984)*."

Pennacchio (2013) writes: "A measure that is widely used in the economic literature to examine the role of *venture capitalists* in *IPOs* is the underpricing: the difference between the price of the shares in the first day of trading and the price of the shares offered to investors. The analysis of the *venture capital* backing's effect on the *IPO* underpricing is a suitable way to investigate ***whether venture capitalists are able to reduce the asymmetric information that arises in the IPO process*** and the cost of flotation for the issuers. Many theories explain the underpricing in a context of ***asymmetric information between the actors involved in the IPO***, typically issuing firms, underwriters and investors *Baron (1982); Rock (1986); Benveniste and Spindt (1989); Beatty and Ritter (1986)*. According to such theories, the underpricing represents a proxy of the ex-ante uncertainty regarding the issue that increases with the increasing of the degree of information asymmetries *Eckbo (2008)*."

We propose that the *information signals* can be mixed and self-modulated during the *asymmetric information flows* in the *information transmission channels* between the various *market agents*, resulting in an origination of the different types of the ***nonlinearities*** such as the *high order harmonics*, which may have a considerable impact on the *VC's* decision making process on the *venture capital investments* in the *diffusion-type financial system*. In our opinion, these *nonlinearities* have to be taken to an account during the *venture capital optimal investment portfolio strategies selection* process, which is all about making the *right investment choices,* using the *econophysical econometrical analysis* in *Greene (2008)* with the application of the *inductive, deductive* and *abductive logics* in *Martin (1998-1999, 2005-2006)*. Thus, let us provide the definitions for the different types of logics, which can be used in the *venture capital optimal investment portfolio strategies selection process* in *Martin (1998-1999, 2005-2006)*:

Inductive logic — the logic of what is operative — reasons from the specific to the general. Induction allows inferring ***a*** entails ***b*** from multiple instantiations of ***a*** and ***b*** at the same time.

Deductive logic — the logic of what must be — reasons from the general to the specific. Deduction allows deriving ***b*** as a consequence of ***a***. In other words, deduction is the process of deriving the consequences of what is assumed.

Abductive logic –the logic of what could possibly be true –reasons through successive approximation. Abduction allows inferring ***a*** as an explanation of ***b***, because of this, abduction allows the precondition ***a*** to be inferred from the consequence ***b***.

Conclusion

This research article presents some innovative research results on the *venture capital optimal investment portfolio strategies selection* in the *diffusion-type financial systems* in the *imperfect highly volatile global capital markets* with the *incomplete information*, which are characterized by the *asymmetric information flows* and impacted by the *various types of the* *nonlinearities*. We discussed the *venture capital firms* with the different organizational structures: the *corporation funded venture capital firm, investment bank funded venture capital firm, private equity funded venture capital firm, state funded venture capital firm*. We provided a comprehensive review on the *venture capital investments* academic literature. We considered the complicated issues on the *venture capital optimal investment portfolio strategies selection*, *evaluation of the possible returns on the investments*, and *implementation of the exit strategies for the venture capital investment schemes*. We proposed that the information signals can be mixed and self-modulated during the *asymmetric information flows* in the *information transmission channels* between the various market agents, resulting in an origination of the various types of the *nonlinearities*, which may have a considerable impact on the venture capital investments in the *diffusion-type financial system*. These *nonlinearities* have to be taken to an account during the *venture capital optimal investment portfolio strategies selection process*, which is all about making the *right investment choices* during the *econophysical econometrical analysis* with the application of the *inductive, deductive* and *abductive logics*. In our opinion, the development of *venture capital industry*, including the *venture capital firms* and the *venture capital funded high-tech startups,* can greatly improve the macroeconomic indicators of national economies by creating the *new hi-tech startups,* generating the *new wealth*, and increasing the *Gross Domestic Product*. We focus on the fact that the *business reputation* of a *venture capital firm* is a valuable firm's asset in the conditions of strong business competition. Of course, there are some differences between the *VC financing* approaches in various countries, for instance, *Motohashi (2010)* writes: "*Japanese VCs* are less likely to invest in early stage startups, while *US* ones are involved in "*screening*" and "*monitoring*" activities of venture businesses. This may be related to under-developed private equity markets in *Japan* and substantial *VC* investments in *Japan* are organized by bank affiliated *VCs*." We think that, in the present time, the *VC industry* in the *State of Queensland is* in a rapid development phase, because the *State of Queensland* has adopted all the necessary policies to become a very attractive place for the *venture capital investments* in the *hi-tech startups* in *Australia*, comparing to other regions in the *World*. We think that the *globalization* will have a considerable influence on the *VC industry*, creating the new high potential growth *financial and hi-tech clusters* with a big number of the *VC firms* in *Australia* and *in Asia*. At the same time, we have to remember that as it is explained in *Lerner (2012)*: "My analysis suggests that the market for *venture capital* may be subject to substantial imperfections and that these imperfections may substantially lower the total social gain achieved by *venture finance*." We would like to conclude with the optimistic statement in *Kraeussl,* *Krause (2011)*: "*Entrepreneurship, innovation, and venture capital (VC)* are pivotal to success in economic development, as they provide for wealth creation and a rising standard of living."

Acknowledgement

The initial idea to make an innovative research on the *venture capital optimal investment portfolio strategies selection* in the *diffusion-type financial systems* in the *imperfect highly volatile global capital markets* with the *incomplete information*, which are characterized by the *asymmetric information flows* and impacted by the *various types of the nonlinearities*, came up to the first co-author's mind during both:

1) the innovative research on *the nonlinearities in the microwave superconductivity* at *James Cook Univer*sity in *Townsville, Queensland, Australia,* and

2) the *R&D* practices in the *venture capital funded hi-tech startups* in *Brisbane, Queensland* in *Australia* in recent years.

In this research, we proposed that the *information signals* can be mixed and self-modulated during the *asymmetric information flows* in the *information transmission channels* between the market agents, resulting in the origination of the various types of the *nonlinearities* such as the *high order harmonics*, which may have a considerable impact on the *venture capital investments* in the *diffusion-type financial system*. In our opinion, these *nonlinearities* have to be taken to an account during the *venture capital optimal investment portfolio strategies selection* process, which is all about making the *right investment choices* during the *econophysical econometrical analysis* process with the application of the *inductive, deductive* and *abductive logics*. ***We firmly believe that the venture capitalists must think wisely on the venture capital optimal investment portfolio strategies selection in the diffusion-type financial systems in the imperfect highly volatile global capital markets with the incomplete information, which are characterized by the asymmetric information flows and impacted by the various types of nonlinearities.*** In our opinion, there are the *numerous growing risk factors*, which have to be considered by the *venture capitalists* during the *venture capital investment decision making process* in the *diffusion type financial systems*.

We would like to say that, in our research, the *main direction of thinking* on the *venture capital optimal investment portfolio strategies selection* in the *diffusion-type financial systems* in the *imperfect highly volatile global capital markets* with the *incomplete information*, which are characterized by the *asymmetric information flows* and impacted by the *various types of nonlinearities*, is mainly defined by some very innovative initial research results on the *imperfect*

information, *asymmetric information*, and *theory of firm*, which were obtained by *Prof. Joseph E. Stiglitz, Columbia University,* and *The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2001 laureate,* who was graduated with the *Ph. D degree* from *Massachusetts Institute of Technology (MIT)* in *Stiglitz (2001, 2002)*: *"*It was the hey-day of *MIT* with first-rate professors (I had at least four *Nobel Prize* winners as professor: *Samuelson (Nobel Laureate in 1970), Solow (Nobel Laureate in 1987), Modigliani (Nobel Laureate in 1985),* and *Arrow (Nobel Laureate in 1972)*) teaching first-rate students." Analyzing the recent developments in the *US economy*, *Prof. Joseph E. Stiglitz, Columbia University* provided the following accurate characteristics to the present state of *the US financial system* in *Stiglitz (2013)*: "The *financial system* has become even more concentrated, exacerbating the problem of banks that are not only too big, too interconnected, and too correlated to fail, but that are also too big to manage and be held accountable." In our opinion, *Prof. Joseph E. Stiglitz* was one of the first scientists, who mentioned a great possible influence by *the asymmetric information flows* between the various *market agents* on the *venture capital investments* in the *diffusion-type financial system.* We think that these *risk factors* can be directly connected with *1)* the *financial and monetary stabilities* of *financial systems*; *2)* the *increasing degree of volatility* in the *global capital markets* in the time of uncertainty; *3)* the *presence of necessary knowledge base* and *practical skills* to precisely evaluate the new innovative technology, necessary venture capital investments and possible returns-on-investments.

We would like to express our kind sincere gratitude to *Prof. Dr. Ben Shalom Bernanke, Chairman of the Board of Governors of the Federal Reserve System* for the insightful thoughtful scientific discussions in the finances and economics and considerable research interest by encouraging us to think wisely in the course of our advanced research and to make everything possible to complete the research program timely by giving us access to the electronic copies of his most recent research articles, analytic research reports, informative slide presentations, minutes of research discussions on the various financial topics and strategic economic issues within the scope of our research interest as well as an electronic copy of his very innovative *Ph. D. Thesis*: "Long-term commitments, dynamic optimization, and the business cycle," supervised by *Stanley Fischer, Professor of Economics, Massachusetts Institute of Technology, USA*. *Bernanke (2013b)* stated recently: "When I was in graduate school, my teacher, *Stanley Fischer*, introduced me to the work of *Milton Friedman* and *Anna Schwartz*, which demonstrated that monetary policy can have enormous effects on how the economy performs, for good or for ill. That realization helped motivate me to specialize, in graduate school and after, in monetary economics and related fields." *Bernanke (2013c)* continued to explain: *"Stan* was my teacher in graduate school, and he has been both a role model and a frequent adviser ever since. An expert on financial crises, *Stan* has written prolifically on the subject and has also served on the front lines, so to speak--notably, in his role as the first deputy managing director of the *International Monetary Fund* during the emerging market crises of the *1990s*. *Stan* also helped to fight hyperinflation in *Israel* in the *1980s* and, as the governor of that nation's central bank, deftly managed monetary policy to mitigate the effects of the recent crisis on the *Israeli* economy. Subsequently, as *Israeli* housing prices ran upward, *Stan* became an advocate and early adopter of macroprudential policies to preserve financial stability. *Stan* frequently counseled his students to take a historical perspective, which is good advice in general, but particularly helpful for understanding *financial crises*, which have been around a very long time." Describing the current economic crisis *Bernanke (2013c)* makes the following comments*:* "The recent *crisis* echoed many aspects of the *1907* panic. Like most crises, the recent episode had an identifiable trigger--in this case, the growing realization by market participants that subprime mortgages and certain other credits were seriously deficient in their underwriting and disclosures. As the economy slowed and housing prices declined, diverse financial institutions, including many of the largest and most internationally active firms, suffered credit losses that were clearly large but also hard for outsiders to assess. Pervasive uncertainty about the size and incidence of losses in turn led to sharp withdrawals of short-term funding from a wide range of institutions; these funding pressures precipitated fire sales, which contributed to sharp declines in asset prices and further losses."

Let us note that the financial crisis in the *USA* has a strong impact on the *venture capital investments* in the conditions of the *diffusion-type financial system* in *Block, Sandner (2009)*: "a *financial crisis* can have a strong, exogenous impact on *VC* activity, which can then lead to a severe "funding gap" in the financing of technological development and innovation. Unlike the last slowdown of *VC* activities after the collapse of the *New Economy* bubble in the year *2000*, the current slowdown came more as an exogenous shock. In the current crisis, it was clearly not unrealistic expectations regarding the *Internet* and the *New Economy* but instead a malfunctioning financial sector that initiated the downturn that caused the slowdown." Let us also highlight the fact that, in the conditions of the economic crisis, many serious questions have to be answered in *Block, Sandner (2009):* "Many questions are left unanswered and provide good opportunities for future research.

1. Does the impact of financial crises on *VC* activity differ among industries or regions? For example, is there a similar effect of the financial crisis in biotechnology or semiconductor fields?

2. How do start-ups receiving funding in this financial crisis differ from start-ups that had received funding before the financial crisis?

3. Is there a kind of selection effect, where only the more promising ventures receive funding?

4. How do the start-ups respond to the challenges posed by the financial crisis and the difficulties encountered in the search for *VC* funding?

5. Does a lower success rate of *VC*-backed companies lead to a decline in the performance of *VC* funds? And ultimately, over a long time period, does *VC* as a financing instrument for innovative start-ups become severely harmed as an effect of the crisis?"

Most importantly, we would like to highlight the fact that there are not enough words to express the first author's sincere thanks to *Prof. Janina E. Mazierska, Personal Chair, Electrical and Computer Engineering Department, James Cook University, Townsville, Australia* and *former IEEE Director and IEEE Fellow*, who helped the first author to develop both the logical mathematical analysis skills and the abstract scientific thinking ability to tackle the complex scientific problems on *the nonlinearities in the microwave superconductivity* as well as on *the nonlinearities in the finances*, applying the interdisciplinary scientific knowledge together with the advanced computer modeling skills during his innovative research projects at *James Cook University* in *Townsville, Australia* in *2000-2013* after the graduation from *V. N. Karazyn Kharkov National University* in *Kharkov, Ukraine* in *1994 - 1999*.

We also thank *Prof. Oleg P. Ledenyov* for a number of interesting encouraging thoughtful scientific discussions and his helpful research comments on the special criteria for the *virtuous optimal venture capital investment strategies selection* in the process of *the venture capital optimal investment portfolio allocation* in the *diffusion-type financial systems* in the *imperfect highly volatile global capital markets* with the *incomplete information*, which are usually characterized by the *asymmetric information flows* and affected by the *various types of nonlinearities*.

Dr. Jack Welch, former *Chairman and CEO of General Electric (GE)* corporation once stated in *Welch (2005)*: "My obsession with *golf* lasted for almost sixty years, from my first days playing and caddying at age ten. … *Golf* was wonderful. It gave me great friends that I've enjoyed for decades and always will, and all the fun of competing." The matter of fact is that, at present time, the *most successful venture capitalists* have a lifelong passion for the innovation, intensively relying on the *mobile offices* with the *Apple's MacBookPro* laptop computers, *iPAD Air* tablets and *iPhone5S* mobile phones to connect, discuss, analyze and make the *most profitable venture capital investment deals*, when playing the *golf* in *Europe, North America,*

Asia and *Australia in the various time zones*. At the same time, the authors as well as some other *venture capitalists* keep an old tradition to determine the time for business meetings and to make the business decisions in various time zones, using the high complication *Swiss mechanical watches* by *Vacheron Constantin*. Finally, it worth to say that, playing the golf around the *World*, we frequently apply the *integrative creative thinking techniques* to select the *VC virtuous investment strategies* and make the *VC investment* deals, hence we deeply grateful to *Profs. Roger L. Martin* and *John C. Hull* from the *Rotman School of Management, University of Toronto, Canada* for the numerous thoughtful long-hours scientific discussions on *the nonlinearities in the finances.*

*E-mail: dimitri.ledenyov@my.jcu.edu.au

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