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

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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).

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 venture-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 start-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). The 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).

![Scheme of venture capital organization](image)

**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).” Da Rin, Nicodano, Sembenelli (2004, 2005, 2006) continue to explain: “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).”

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 investee 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) insist: “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.”

*Icí, 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) explains: “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) writes: “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 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 cyclicity 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 (2007), and Fig. 9 presents the total number of deals in venture capital investment in the United States in 1995 – 2005 in Shachmurove (2007).

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

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

![OECD venture capital investment by stages as a share of GDP, 1998-2001](image)

**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).

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

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

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

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>The entrepreneur is honest and has integrity</td>
<td>4.909</td>
<td>0.3015</td>
<td>Management</td>
</tr>
<tr>
<td>A good market acceptance for the product or service is expected</td>
<td>4.909</td>
<td>0.3015</td>
<td>Product</td>
</tr>
<tr>
<td>The venture will provide a high internal rate of return (IRR)</td>
<td>4.909</td>
<td>0.3015</td>
<td>Financial</td>
</tr>
<tr>
<td>There is a market need for the product or service</td>
<td>4.818</td>
<td>0.4045</td>
<td>Market</td>
</tr>
<tr>
<td>The entrepreneur has a great desire for success</td>
<td>4.727</td>
<td>0.4671</td>
<td>Management</td>
</tr>
<tr>
<td>The product/service has a competitive advantage over competing products</td>
<td>4.727</td>
<td>0.4671</td>
<td>Product</td>
</tr>
<tr>
<td>The venture has high valuation projections</td>
<td>4.727</td>
<td>0.4671</td>
<td>Financial</td>
</tr>
<tr>
<td>There is potential for market growth</td>
<td>4.727</td>
<td>0.4671</td>
<td>Market</td>
</tr>
<tr>
<td>The venture has significant potential for earnings growth</td>
<td>4.636</td>
<td>0.3045</td>
<td>Financial</td>
</tr>
<tr>
<td>The entrepreneur has excellent management skills/experience</td>
<td>4.545</td>
<td>0.5222</td>
<td>Management</td>
</tr>
<tr>
<td>The entrepreneur is hardworking and flexible</td>
<td>4.545</td>
<td>0.5222</td>
<td>Management</td>
</tr>
<tr>
<td>The entrepreneur has good leadership ability</td>
<td>4.454</td>
<td>0.6742</td>
<td>Management</td>
</tr>
<tr>
<td>The entrepreneur has good risk management qualities</td>
<td>4.306</td>
<td>0.6742</td>
<td>Management</td>
</tr>
<tr>
<td>The venture has high profit margin projections</td>
<td>4.272</td>
<td>0.7862</td>
<td>Financial</td>
</tr>
<tr>
<td>The entrepreneur has a good track record</td>
<td>4.272</td>
<td>0.6467</td>
<td>Management</td>
</tr>
<tr>
<td>The entrepreneur has good knowledge of the sector</td>
<td>4.181</td>
<td>1.4709</td>
<td>Management</td>
</tr>
<tr>
<td>The entrepreneur is capable of intense, sustained effort</td>
<td>4.181</td>
<td>0.6030</td>
<td>Management</td>
</tr>
<tr>
<td>The venture will provide a high absolute return</td>
<td>4.181</td>
<td>0.6030</td>
<td>Financial</td>
</tr>
<tr>
<td>The product/service has open access to the market</td>
<td>4.181</td>
<td>0.7508</td>
<td>Market</td>
</tr>
<tr>
<td>The references of the entrepreneur are reputable</td>
<td>4.090</td>
<td>0.9439</td>
<td>Management</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>There will be a tax benefit in financing the venture</td>
<td>1.909</td>
<td>0.7006</td>
<td>Financial</td>
</tr>
<tr>
<td>There will be no follow up investment required</td>
<td>2.090</td>
<td>1.3004</td>
<td>Financial</td>
</tr>
<tr>
<td>The venture will require low monitoring and administration costs</td>
<td>2.090</td>
<td>1.3004</td>
<td>Financial</td>
</tr>
<tr>
<td>The venture has BEE status</td>
<td>2.363</td>
<td>1.2863</td>
<td>Other</td>
</tr>
<tr>
<td>The venture will operate in a non-competitive industry</td>
<td>2.454</td>
<td>1.0357</td>
<td>Market</td>
</tr>
<tr>
<td>The venture will require low marketing and production costs</td>
<td>2.636</td>
<td>1.1201</td>
<td>Financial</td>
</tr>
<tr>
<td>The venture will create a new market</td>
<td>2.636</td>
<td>0.9244</td>
<td>Market</td>
</tr>
<tr>
<td>Product/service is in an early stage of life cycle</td>
<td>2.727</td>
<td>1.7373</td>
<td>Product</td>
</tr>
<tr>
<td>The venture has low overall capital requirements</td>
<td>2.727</td>
<td>1.1037</td>
<td>Financial</td>
</tr>
<tr>
<td>The venture has production capabilities in place</td>
<td>2.818</td>
<td>1.3280</td>
<td>Product</td>
</tr>
</tbody>
</table>
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)).

- Preliminary choice of projects ($\text{IRR}_{\text{proj}} > \text{IRR}_{\text{req}}$)
- Valuation of the project (discount rate = $\text{IRR}_{\text{req}}$)
- Negotiations and distribution of ownership
- Calculation of $\text{IRR}_{\text{exp}}$ on investment made by venture capitalists
- Comparison of $\text{IRR}_{\text{exp}}$ and $\text{IRR}_{\text{req}}$
- Investment decision

**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 (2004, 2005)

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

where \( I \) is the cost of the investment, \( A \) is the firm’s own equity capital which is pledged as collateral, \( I - A > 0 \) is the amount of capital, which is necessary to borrow for the firm, \( p_H \) is the probability to deliver the return \( R \), \( B \) denotes the private benefits for the entrepreneurs, \( R_u = R - R_f \) is the share of return to uninformed investors, \( R_f \) 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 (2004, 2005)

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

where \( A \) is increasing in \( \gamma \).

The amount of funds borrowed by monitored firms \( I_{vc} \) adjusts to satisfy the incentive compatibility constraint of the venture capitalist in Da Rin, Nicodano, Sembenelli (2004, 2005)

\[
I_{vc}(\beta) \geq \frac{c p_H}{\beta(p_H - p_L)}
\]

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

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 (2004, 2005)

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

where \( c \) is the monitoring cost.

Fig. 18 shows the firm’s financing choices, depending on their own equity capital in Da Rin, Nicodano, Sembenelli (2004, 2005).

Fig. 18. Firm’s financing choice as a function of their equity capital, \( A \) (after in Da Rin, Nicodano, Sembenelli (2004, 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 University 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 into 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?”

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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 together with 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 is 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.

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