Investment in capital markets

Ledenyov, Dimitri O. and Ledenyov, Viktor O.

James Cook University, Townsville, Australia

10 March 2017
Investment in capital markets

Dimitri O. Ledenyov and Viktor O. Ledenyov

Townsville, Australia
Kharkiv, Ukraine
March, 2017
To our lovely parents Oleg P. Ledenyov and Tamara V. Ledenyova.
Contents

Introduction ........................................................................................................................................8

Chapter 1. Financial capital markets from ancient time to present time........................................9

Chapter 2. Formulation of problem on financial capital investment in capital markets ..............20

Chapter 3. Solution of problem on financial capital investment in capital markets, using various investment products, vehicles and mediums ..........................................................31

Chapter 4. Investment products for financial capital investment in capital markets ..................40
  4.1 Land as investment product ........................................................................................................41
  4.2 Real estate as investment product ...........................................................................................42
  4.3 Commodity as investment product ........................................................................................44
  4.4 Bond as investment product ....................................................................................................49
  4.5 Company stock and stock option as investment products .........................................................50
  4.6 Financial security as investment product ................................................................................65
  4.7 Foreign currency as investment product ...................................................................................69
  4.8 Intellectual property as investment product ..........................................................................78

Chapter 5. Investment vehicles for financial capital investment in capital markets ...................81
  5.1 Investment bank as investment vehicle ...................................................................................82
  5.2 Investment fund as investment vehicle ..................................................................................83
  5.3 Hedge fund as investment vehicle ........................................................................................87
  5.4 Pension fund as investment vehicle ......................................................................................94
  5.5 Mutual fund as investment vehicle .........................................................................................96
  5.6 Venture capital fund as investment vehicle ..........................................................................98
  5.7 Angel investor as investment vehicle ....................................................................................111
  5.8 Investment boutique firm as investment vehicle ...................................................................114

Chapter 6. Investment mediums for financial capital investment in capital markets ..............116
  6.1 Land exchange as investment medium ....................................................................................117
  6.2 Real estate exchange as investment medium ........................................................................118
  6.3 Stock exchange as investment medium ................................................................................119
  6.4 Foreign currencies exchange as investment medium ............................................................127
6.5 Financial securities exchange as investment medium ........................................... 135
6.6 Commodities exchange as investment medium ............................................... 139
6.7 Precious metal exchange as investment medium ............................................ 142
6.8 Intellectual property exchange as investment medium ............................... 144

Chapter 7. Financial risk of investment portfolio at financial capital investment in capital markets .............................................................................................................................................................................................. 147

Chapter 8. Quantum strategies of investment portfolio at financial capital investment in capital markets ........................................................................................................................................................................................................ 173

Conclusion ........................................................................................................... 192

Acknowledgement ............................................................................................ 199

References ........................................................................................................ 206

Economics science history, finance science history ............................................. 206
Juglar economic cycle theory in economics ......................................................... 210
Kondratiev economic cycle theory in economics ................................................. 211
Kitchin economic cycle theory in economics ...................................................... 214
Kuznets economic cycle theory in economics .................................................... 214
Ledenyov economic cycle theory in economics ............................................... 216
Accurate characterization of properties of economic cycles in economics ........... 216
Disruptive technological and social innovations in economics and finances ...... 220
Metal coins, paper money, electronic money, network money, electronic cash, digital cash, bit coin, electronic payments, debit cards, credit cards, stored value cards, smart cards (electronic purses) in finances .............................................................................................................................................................................................. 224
Central banks, federal reserve bank, federal reserve system in finances .......... 235
Stock exchange history, stock exchange operation principles, company valuation, company stock emission, company stock valuation by market, company stock valuation by rating agencies in finances........................................................................................................................................239

Investment capital, investment portfolio, investment portfolio risk management in finances........................................................................................................................................245

Land investment, land valuation, land ownership, land exchange, financial capital investment product, financial capital investment medium in finances..............................................................................................................263

Commodity investment, commodity valuation, commodity derivatives, commodity futures, commodities exchange, financial capital investment product, financial capital investment medium in finances........................................................................................................................................269

Precious metal investment, precious metal valuation, precious metals exchange, financial capital investment product, financial capital investment medium in finances........................................................................................................................................293

Real estate investment, real estate valuation, real estate exchange financial capital investment product, financial capital investment medium in finances........................................................................................................................................304

Private and public firms theories in economics and finances........................................................................................................................................314

Public company investment, public company initial public offering valuation by rating agency/open market, stock exchange, financial capital investment product, financial capital investment medium in finances........................................................................................................................................321

Private company investment, private company valuation, venture capital investment, venture capital fund, angel capital investment, financial capital investment product, financial capital investment medium in finances........................................................................................................................................367

Firm’s stock option investment, traded stock options, employee/executive stock options, equity options in finances........................................................................................................................................405

Bond investment, bond valuation, financial securities investment, financial securities exchange, financial capital investment product, financial capital investment medium in finances........................................................................................................................................415
Credit derivative investment, credit derivative pricing, credit derivatives exchange, financial capital investment product, financial capital investment medium in finances……………………………………421

Foreign currencies investment, foreign currencies exchange rates valuation, ultra high frequency electronic trading, foreign currencies exchange, financial capital investment product, financial capital investment medium in finances ……………………………………………………………..451

Intellectual property investment, intellectual property exchange in finances…………………………526

Investment bank, financial capital investment vehicle in finances……………………………………540

Hedge fund, financial investment vehicle in finances…………………………………………………………543

Pension fund, financial investment vehicle in finances……………………………………………………559

Mutual fund, financial capital investment vehicle in finances…………………………………………565

Angel investor, business angel, financial investment vehicle in finances………………………..574

Investment boutique firm, investment boutique bank, financial capital investment vehicle in finances………………………………………………………………………………………………………………….590

Probability theory, statistics theory, Brownian movement theory, diffusion theory and chaos theory in econometrics, econophysics, physics and chemistry………………………………………………591

Quantum diffusion in physics, econophysics and finances…………………………………………599

Stability of investment portfolio in nonlinear dynamics, mathematics and finances………………600

Wiener filtering theory, Pugachev filtering theory, Stratonovich optimal nonlinear filtering theory, Stratonovich-Kalman-Bucy filtering algorithm, Stratonovich-Kalman-Bucy filter, particle filter in econometrics, econophysics, electrical and computer engineering………………………….603

Continuous time signals, analog signals, discrete time signals, digital signals, spectrum of signals in digital signal processing, physics and electronics engineering…………………………618

Time Division Duplex/Frequency Division Duplex spread spectrum burst communications, UMTS/WCDMA/LTE wireless communications, WCDMA optical communications, digital signal processing in telecommunications, electronics engineering, and physics………………621
Quantum physics, electronics, mechanics……………………………………………………..622

Wave function in Schrödinger quantum mechanical wave equation in quantum mechanics….627

Artificial intelligence in electronics engineering and computer science…………………………..630

Deoxyribonucleic acid (DNA), digital DNA of economy of scale and scope in biology, economics and finances…………………………………………………………………………..631

Strategy theory in management, business administration, psychology, and mathematics……..632

Game theory in strategy, management, business administration, psychology, and mathematics……………………………………………………………………………….641

Selected research papers in macroeconomics, microeconomics and nanoeconomics………..647

List of Figures…………………………………………………………………………………….655

List of Tables…………………………………………………………………………………….658

Subjects Index………………………………………………………………………………….659

Authors Index………………………………………………………………………………….666

About Authors………………………………………………………………………………….713

Back Cover………………………………………………………………………………………714
Introduction

A financial capital investment in the global capital markets creates a solid foundation for the active dynamic prosperous life by the private and institutional investors in the modern society. In this book, the authors clearly and persuasively explain the modern investment theories and practices, solving a problem on the optimal investment of the financial capital in the capital markets with the aim to get an increased return premium in the short and long time periods. We easily create an investment mindset among the interested readers by discussing the advanced research findings on the modern investment techniques application in the capital markets in the finances. Chapter 1 discuses the capital markets history from the ancient time to the present time, using the academic literature. Chapter 2 formulates the main problem on the financial capital investment in the capital markets with the aim to get an increased return premium in short and long time periods. Chapter 3 provides a possible solution to the problem on the financial capital investment in the capital markets with an aim to get the increased return premium in the short and long time periods, using the different investment products, investment vehicles and investment mediums. Chapter 4 focuses on the land, real estate, bonds, stocks, stock options, financial securities, foreign currencies, commodities as the investment products for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. Chapter 5 considers the investment banks, investment funds, hedge funds, pension funds, venture capital funds, investment boutiques firms, private investment offices as the investment vehicles for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. Chapter 6 researches the land exchange, real estate exchange, companies stocks exchange, foreign currencies exchange, financial securities exchange, commodities exchange, precious metals exchange, intellectual properties exchange as the investment mediums for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. Chapter 7 discusses the investment portfolio, the financial assets valuation, and the financial risk evaluation and mitigation during the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. Chapter 8 confers the quantum winning virtuous investment strategies creation and execution, using the inductive, deductive, abductive, quantum logics during the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. Conclusion summarizes all the important research findings and discusses their theoretical and practical implications, using the general-audience language.
Chapter 1

Financial capital markets from ancient time to present time

The capital comprises all the forms of stock-wealth, which can be used by the human to create the new wealth with application of human labour, aiming to satisfy the man’s basic and extended needs, education requirements, professional interests, cultural necessities toward the high social status achievement in a prosperous harmonious society in Marx (1867, 1893, 1894), von Böhm-Bawerk (1884, 1889, 1921), Hirsch (1896).

The first capital markets were established with the goal: to make it possible to conduct the basic financial value exchanges between the economic agents in the economies of the scales and the scopes since around 7th C.B.C. In these capital markets in the economies of the scales and the scopes, the new wealth synthesis process have been realized, using the three main objects: the Matter/Land, Labour and Capital in Joseph Penso de la Vega (1668, 1996), Mortimer (1765), Smith (1776, 2008), Ricardo (1817, 1821), Bentham (1839), Mill (1862), Hirsch (1896)).

Fig. 1 shows the new wealth creation by means of the synthesis process, using the three objects: Matter, Labour and Capital (the Land, Labour and Capital in the Political Economy).

Fig. 1. New wealth creation synthesis process with three objects: Matter, Labour and Capital.
The value of the capital can be measured with an application of the money in frames of the proposed capital pricing theories in the finances/economics sciences. The money represents a legally-established measure of wealth’s value, a freely-exchangeable unit of wealth’s value equivalent storing, a mean of wealth’s value equivalent payment and a media of wealth’s value equivalent exchange, enabling to perform the wealth exchange operations during its free circulation process among the economic agents in the economies of the scales and the scopes. The money is one of the central subjects of research in the capital theory in the political economy science in Smith (1776, 2008), Marx (1867; July, 1893; October, 1894), Bagehot (1873, 1897), von Böhm-Bawerk (1884, 1889, 1921), Hirsch (1896), von Mises (1912), Keynes (1936), Piketty (August 2013, August 15 2014), Dodd (2014), Stiglitz (2015, 2016).

Fig. 2 pictures the money definition as the unit of payment and the medium of exchange.

![Money definition diagram]

**Fig. 2.** Money definition.

Over the centuries, the money in the form of the paper money, paper notes and metal coins served mainly as the means of payments exchange in the capital markets in Del Mar (1894), Cook (1958), Carson (1962), Crawford (1970), Balmuth (1971), Thompson, Kraay, Morkholm (editors) (1973), Kagan (1982), Price (1983), Wallace (1987, 1989), Howgego (1990), Karwiese (1991), Thiveaud, Sylvain (1995), Davies (2002), Moroz V S, Moroz V S (September 2014), Yeoman (2014). The multiple historical findings confirm the fact that the financial transactions with the paper money, paper notes, and metal coins began to be introduced in mainland China since the time of the Song and Yuan dynasties. Presently, they are being used...

In the course of practical money use, the money’s design has been improved due to the multiple inventions of the writing, arithmetic, chemistry, physics, astronomy and philosophy during the historical evolution of mankind in the organized societies over the centuries in Landes (1998), Thiveaud, Sylvain (1995). The contemporary money design, meaning and impact on the value payments cycles in the classic economies of the scales and the scopes were researched in Smith (1776, 1991), Ricardo (1816, 1951), Fisher (1933), Keynes (1936), Redlich (1951), Baumol (1952), Butlin (1953), Tobin (1956), Tobin (1963), Friedman, Jacobson, Schwartz (1963), Hayek (1974, 1976a, b, 1978), Checkland (1975), Galbraith (1976), McKinnon (1979), Fama (1980), Suhr (1989), Kennedy (1989), Whitesell (1989, 1992), Woodford (2003), King (August 27 1999, November 1999), Berk (September 2002), Williams, Anderson (March 2007).

A measurement accuracy of the financial capital value depends on a number of (un)objective factors: the payment unit, the monetary system, the financial system, the financial arithmetic, the mathematics principles in the capital market in the economy of the scale and the scope. In fact, a measurement accuracy of the financial capital value may slightly differ in various financial systems in the economies of the scales and the scopes.

The central banks played a pivotal regulatory role in the financial capital evaluation, accumulation and distribution processes in the debt and equity capital markets in the economies of the scopes and the scales, including the Bank of Amsterdam (1609) in The Netherlands, Sveriges Riksbank (1664) in Sweden, Bank of England (1694) in England, since XVI century until present time in Joseph Penso de la Vega (1668, 1996), Mortimer (1765), Bagehot (1873, 1897), Roseveare (1991), Capie, Fischer, Goodhart, Schnadt (1994), Quinn, Roberts (2006). The fundamentals on the financial capital evaluation, accumulation and distribution processes in the debt and equity capital markets in the economies of the scopes and the scales were researched by the eminent scientists over the recent centuries in Smith (1776, 2008), Marx (1867; July, 1893; October, 1894), Bagehot (1873, 1897), von Böhm-Bawerk (1884, 1889, 1921), Hirsch (1896), von Mises (1912), Keynes (1936), Piketty (August 2013, August 15 2014), Dodd (2014), Stiglitz (2015, 2016). The modern financial systems at the national/global levels have been strongly influenced by the Austrian school of the financial/economic thinking, namely by the Austrian economists from the Chicago school of financial/economic thinking in Chicago, USA in von
Böhm-Bawerk (1884, 1889, 1921). Regulating a capital market through the monetary and financial policies in the modern financial systems, the central bank focuses on the two main functional tasks in Owen (1919), Willis (1923), Meltzer (2003, 2009a, b), Fox, Alvarez, Braunstein, Emerson, Johnson, Johnson, Malphrus, Reinhart, Roseman, Spillenkothen, Stockton (2005), Bernanke (2013), Ledenyov D O, Ledenyov V O (December 11-12 2015), Ledenyov D O, Ledenyov V O (2016s):

1. The financial liquidity provision;
2. The financial liquidity regulation.

The central bank fulfills its principal mission by regulating the three main sorts of the money in the capital market in the economy of the scale and the scope in Selgin, White (1994):

1. The natural money based on a single commodity;
2. The multiple commodity money;
3. The no base money.

The central bank issues/distributes/regulates a wide range of the value payments means in the capital market in the economy of the scale and the scope in Goodhart (1989, 2000):

1. The metal coins, made of precious metals;
2. The paper currencies, made of multiple layers of paper/cotton;
3. The paper checks, made of multiple layers of paper/cotton;
4. The wired payment orders, existing in the form of electronic signals;
5. The electronic money, appearing in the form of electronic signals;
6. The network money, existing in the form of electronic signals;
7. The Bitcoin/Ethereum blockchains, existing in the form of electronic signals.

The Bitcoin/Ethereum are classified as the digital crypto currencies/the money exchanges with the blockchain secure encryption/decryption/arbitration technologies in a form of the executable software code in the distributed decentralized data network such as the Internet of Things. The digital currencies introduction results in a pervasive lowering of transaction cost. The following digital currencies system definitions are accepted in Antonopoulos (2014, 2016):

1. The Bitcoin/Ethereum are the digital currencies;
2. The blockchain is a distributed relational database with the blocks of code;
3. The smart contract is a small software program to represent the financial products;
4. The proof of work is a security concept for the digital currencies;
5. The proof of stake is a security concept for the digital currencies;
6. The miner is a group of users with the biggest computer power;
7. The blockchain scaling is a methodology to scale the blockchain.
Fig. 3 provides the information on various sorts of the existing money in connection with the money bases in the modern financial systems in the economies of the scales and scopes.

Fig. 3. Money types in financial system.

Fig. 4 shows the possible means of value payment in the modern financial systems in the economies of the scales and scopes.

Fig. 4. Means of value payment in financial system.
In addition to central bank’s goal to facilitate a sustainable development of the economy of the scale and the scope, it constantly changes the interest rates on the money loans to the commercial/investment banks, as well as, it adjusts the foreign currencies exchange rates between the national currency and the major foreign currencies in the frames of the following central bank’s policies in Ledenyov D O, Ledenyov V O (2016s):

1. The monetary stability policy;
2. The financial stability policy.

As we know, the quantum physics has had the three major development stages, including the light quantum theory creation in Planck (1900c, d, 1901, 1914); the atom quantum theory development in Bohr (1922); and the wave equation derivation in Schrödinger (1926 a, b).

Discussing the nature of money together with its econophysical properties, we would like to use this opportunity to propose the Ledenyov quantum theory on the dual nature of the money in the financial system in the economy of the scale and the scope. It makes sense to explain that the Ledenyov quantum theory on the dual nature of the money in the quantum econophysics is formulated in an analogy with the Planck quantum theory on the light in the quantum physics in Planck (1900c, d, 1901, 1914).

The Ledenyov quantum theory on the dual nature of the money postulates that the money has the dual econophysical nature in the financial system in the capital market in the economy of the scale and the scope:

1. The money can be treated as a particle in frames of the particle theory of the money. The money particles could only be emitted in the quantized forms (the certain money nominal) by the treasure. The treasure on the central bank request could add/subtract these money particles to/from the financial system in the economy of the scale and the scope. The money particles of different values in the financial system in the economy of the scale and the scope could be filtered with an application of the particle filters and statistically analyzed with an application of the statistical distributions in the mathematic science;

2. The money can be considered as a wave in the frames of the wave theory of the money. These money waves with the certain wavelengths (the certain money nominal) could only be emitted in the quantized forms (the certain money nominal) by the treasure. These united waves could create the money flows in the financial system in the economy of the scale and the scope. The central bank could adjust the level of the liquidity in the financial system by adding/subtracting the money flows to/from the financial system during the corresponding regulatory policies introduction in the case of the quantitative easing/restricting policies implementations. The real mechanisms of the central bank’s regulatory policies introduction
towards the quantitative easing/restricting policies implementations could be realized through: 1) the low-interest-rates money loans provision to the commercial banks by the treasury as ordered by the central bank, aiming to add the liquidity to the real/speculative sectors of the economy of the scale and the scope; or 2) the treasure bills selling to the commercial banks by the treasury as ordered by the central bank, aiming to subtract the liquidity and decrease the inflationary expectations from/at the real/speculative sectors of the economy of the scale and the scope.

Presently, the necessary infrastructure for the electronic financial transactions realization at the financial data processing centers includes the computer servers, the remote terminals and the data communication networks. Thus, the interconnected remote terminals, including the ATM terminals, desktop computers, laptops, mobile phones and mobile bracelets complete the financial transactions by connecting to the computer servers via the software programs with the implemented communication protocol stacks, using the optical/wireline/wireless data networks with the high speed data rates transfer capabilities. More specifically, we can highlight the following hardware/software technological advancements in the information communication technologies (ICT) to implement the electronic financial transactions in the banking industry in Gabor (1946), Shannon (1948), Oppenheim, Schafer (1989), Simon, Hinedi, Lindsey (1995), Proakis, Manolakis (1996), Prisch (1998), Wanhammar (1999), Sklar (2001), Rice (2008), Ledenyov D O, Ledenyov V O (2015a):

1. Hetero-Junction Bipolar Transistors (HBT), High Electron Mobility Transistors (HEMT), Field Effect Transistors (FET), Metal Semiconductor Field Effect Transistors (MESFET), Metal Oxide Semiconductor Transistors (MOSFET), which are made of the Silicone Carbide (SiC), Gallium Arsenide (GaAr), Germanium Nitride (GeN) wide energy band semiconductor junctions, operating from the low frequencies to the ultra high frequencies range;

2. Very Large Scale Integrated (VLSI) circuits with the high density of the transistors, which operate at the ultra high frequencies range (GHz range);

3. The Digital Signal Processors (DSP), which can be designed in the forms of the standard DSP chipsets as well as the Field Programmable Gate Arrays (FPGA) chipsets;

4. The real-time operational systems like the VxWorks, QNX, Android, iOS, which execute the compiled real-time software programs at the microprocessors/microcontrollers in the radio-transceivers and remote wireless/wireline terminals;

5. The near real-time software programs made in the Assembly and C languages, which can be compiled to encode/decode the headers and the data payload envelopes in the protocol stacks at the information transmission process in the wireline/wireless/optical data links as well as to make functional automatisation of electronic devices in the electronics;
6. The high stable operation systems like the Windows, Linux, Unix, which execute the compiled software programs at the big computer servers / the desktop computers fast enough;

7. The object oriented software programs in the C++, Java++, which can be compiled to operate with the distributed relational databases at the operation systems at the big computer servers and the desktop computers reliably;

8. The high speed optical communication networks, which can function at the synchronous transfer mode (SONET) and the asynchronous transfer mode (ATM), transferring the encoded data at the long distances at the high data rates over the short time;

9. The in-fiber optical devices and components: the optical amplifiers, optical couplers, optical circulators, optical splitters, optical phase shifters, optical phasars, optical dense wave division (de)multiplexers (WDM), made of the in fiber Brag gratings, the LiNbO crystals, the Si ultrasonic transducers and the single/multiple filaments optical fibers;

10. The wireless communication networks such as the Latest Technology Evolution (LTE)/Universal Mobile Telecommunication System (UMTS)/Wideband Code Division Multiple Access (WCDMA), which may transfer the encoded data over the wireless channel at the short/long distances at the high data rates over the short time;

11. The quantum cryptography for the quantum data communication protocols for the quantum optical/space/wireless/wireline/communication networks, based on the quantum encryption techniques in the quantum mechanics, allowing the secure quantum data communications over the long distances in the space domain over the certain time periods;

12. The quantum random number generators in the quantum processors, which can allow to perform the very accurate supercomputer modeling, the very accurate quantum computer modeling and the quantum secure data communications over the long distances in the space domain at the selected time periods.

Continuing our formidable voluminous research, let us say that the modern progress in the information communication technologies made it possible to formulate and implement a concept on the electronic money in the modern financial systems in the economies of the scales and the scopes in 1986. The electronic money (e-money) is financially defined as the electronic store of monetary value on a technical device to make payments without necessarily involving bank accounts in the transaction, but acting as a prepaid bearer instrument in European Central Bank (August 1998). More clearly, the electronic money is based on a complex system of the electronic payments instruments (the digital cash, digital purse, stored-value/debit/credit cards), the financial processes (the debit, credit calculation), the information processing (the mathematical numbers computing and the storing of information at the data centers) and the

In the quantum physics, the authors invented the magnetic flux qubit; and then, designed a chipset of the quantum random number generator on the magnetic flux qubits (1024 QRNG_MFQ) for the first time Kharkiv, Ukraine in 1991, working to improve the 1024 QRNG_MFQ chipset design at Technical University of Denmark in Lyngby, Denmark in 1996-1997. We frequently discussed the 1024 QRNG_MFQ chipset at the international conferences, including the seminars at Leiden University in The Netherlands in 1998, and the University of Toronto in Canada in 1998. At later date, we discovered that the magnetic knot of vortex is in an extreme quantum limit in the quantum physics for the first time in Kharkiv, Ukraine in 1998. We designed a chipset of the quantum memory on the magnetic vortices knots in Kharkiv, Ukraine in 1999, making a report on a chipset of the quantum memory on the magnetic vortices knots at a Marconi seminar at Birmingham University in the United Kingdom in 2000, contributing to a new era of the intensive research and development (R&D) programs in the field of the quantum computing in the quantum physics in Ledenyov D O, Ledenyov V O (2015a).

In the finances, we expressed a general idea on a possible creation of the quantum money in 2000. At later date, we decided to formulate a detailed concept on the quantum money, introducing the quantum money (q-money) as a newest value storing/not storing unit, a mean of payment and an exchange medium for the first time in Ledenyov D O, Ledenyov V O (2015m). Of course, the quantum money (q-money) can be considered as a more convenient, financially innovative, technologically attractive and user/issuer friendly value storing/not storing unit, mean of value payment, and exchange medium in the advanced financial systems within the quantum economies of the scales and the scopes in Ledenyov D O, Ledenyov V O (2015m). The main financial idea behind the quantum money (q-money) is to establish a value storing/not storing q-money, which is most innovative, technologically advanced, financially efficient, economically sustainable, socially equitable, politically democratic in the financial systems within the economies of scales and scopes, aiming to achieve the millennium development goals in Ledenyov V O, Ledenyov D O (2015m, 2016s).

The introduction of the electronic money and the quantum money in the capital markets in the finances creates a strong necessity for the national governments, central banks and the international regulatory bodies to introduce a new regulatory international policies framework
with the aim to govern the processes of the emission, distribution, storing, and evaluation of the new money by the treasures in the financial systems in the economies of scales and scopes in Ledenyov V O, Ledenyov D O (2016s).

Fig. 5 depicts the money design evolution in financial system over the time.

**Fig. 5.** Money design evolution in financial system in time.

Once again, the money emission, distribution, storing, and evaluation is normally conducted by the national treasures and governed by the central banks, which create and implement the monetary stability policy, financial stability policy, and other regulatory policies. Indeed, the central bank can implement its policies by adjusting the interest rates on the money lending as well as by adding/subtracting the money flow (the liquidity) to/from the financial system in the selected economy of the scale and the scope, going from the macroeconomic indicators. The commercial and investment banks can lend the money on the interbank market, depending on the corresponding macroeconomic and microeconomics indicators. The macroeconomics indicators are uniquely defined by the economic output fluctuations in the time. There are several business cycles, which are distinguished by the financiers/economists:

1. The Juglar economic cycle in Juglar (1862);
2. The Kondratiev economic cycle in Kondratieff (1922, 1925, 1926, 1928, 1935);
3. The Kitchin economic cycle in Kitchin (1923);
4. The Kuznets economic cycle in Kuznets (1973a, b);
5. The Ledenyov economic cycle in Ledenyov DO, Ledenyov VO (2015e, f, 2016s).

Most importantly, aiming to complete the monetary and financial regulatory missions, all the central banks use an accumulated knowledge base in the social sciences and natural sciences:


The innovative research in the modern finance science by the central banks continues intensively, aiming to understand the nature of complex processes in the economics and finances with the theories, experiments and computer modeling in the field of econophysics. The research groups at the leading universities/institutions/banks make numerous attempts to re-define the research boundaries in the finances, applying the econophysics principles to solve the complex financial problems. The most recent scientific contributions by the econo-physicists have been summarized in Mantegna, Stanley (1999), Ilinski (2001), Bouchaud, Potters (2003), Sornette (2003), Yakovenko, Rosser (2009), Sinha, Chatterje, Chakraborti, Chakrabarti (2010), Chakrabarti B K, Chakrabarti A (2010), Aoyama, Fujiwara, Iyetomi, Sato (2012).

Finalizing all the above introductory philosophical discussions on the capital markets history, let us focus precisely on the problem of the capital investment in the capital markets in the finances. We will prefer to continue our breathtaking learning journey in the finances by formulating the central problem on the financial resources investment in the capital markets with the aim to get an increased return premium in the short and long time periods in Chapter 2.
Chapter 2

Formulation of problem on financial capital investment in capital markets

In the finances, the investment means an act of allocation of the financial capital in order to gain a certain profit in the form of the increased investment return premium, advantage or interest. A problem on the investment of the financial capital in the capital markets was formulated in the early research books in Joseph Penso de la Vega (1668, 1996), Mortimer (1765), Bagehot (1873, 1897). However, on that time, the prevailing scientific opinion was that a highly volatile nature of capital markets makes it quite difficult to accurately analyze, predict and calculate the investment return premium, advantage or interest.

A set of practical questions was raised by the investors on that time: What is the meaningful definition of the financial capital in the finances? What are the financial/economic variables suitable for the accurate characterization of the financial capital changes dynamics in the capital markets in the scale-frequency-time domains? What are the most appropriate measurement units to measure the financial/economic variables suitable for the accurate characterization of the financial capital changes dynamics in the capital markets in the scale-frequency-time domains? How can the process on the investment of the financial capital in the capital markets in the in the scale-frequency-time domains be optimized? How can the optimal investment decisions on the financial capital allocation in the capital markets be taken from the financial, economic and legal points of view? How can the investment return premium on the invested financial capital in the capital markets be calculated? What is the accuracy of calculation of the investment return premium on the invested financial capital in the capital markets? How successful is the investment of the financial capital in the capital markets? There were no the straightforward clear answers on the above challenging financial questions on the financial capital investment in the capital markets on that time. A general way of thinking on the investment of the financial capital in the capital markets was not based on the scientific grounds, but rather on the investors’ intuition and basic mathematical skills. One of the main reasons of existed state of matters was a lack of understanding of an important fact that the problem on the investment of the financial capital in the capital markets can only be solved, using the advanced theoretical models with the differential equations in the econophysics.
Let us write a list of the financial/economic variables for the accurate characterization of the financial capital changes dynamics in the capital markets in the scale-frequency-time domains:

1. Finances science (the financial capital value; the return premium value; the profit-to-earnings value; the total risk value; the EBITDA value);

2. Economics science (the amplitude, frequency, period, phase of the business cycle; the number of the economic events; the probability of the occurring economic events; the distributions of the occurring economic events in the scale, frequency, time domains);

3. Mathematics science (the number of the occurring events; the probability of the occurring events; the distributions of the occurring events in the scale, frequency, time domains; direction of vector in the multidimensional space, vector absolute magnitude, coordinate space);

4. Econometrics science (the number of the economic events; the probability of the occurring economic events; the distributions of the occurring economic events in the scale, frequency, time domains; the direction of the capital flow vector in the multidimensional coordinate space; financial liquidity level; interest rates; total risk level);

5. Physics science (the amplitude, frequency, period, phase of the continuous- and discrete- time signals; the central frequency of the of the continuous- and discrete- time signals; the dynamic range of the continuous- and discrete- time signals);

6. Econophysics science (the amplitude, frequency, period, phase of the continuous- and discrete- time economic signals; the central frequency and the dynamic range of the particular continuous- and discrete- time economic signals);

7. Psychology science (the deductive, inductive, abductive logics values; intellect level; decision making level; logical analysis level);

8. Computer science (the computer model input and output values; simulation time; simulation accuracy; simulation quality; random number sequence quality; random number sequence length; operating system stability).

9. Biology science: (the structure of the digital DNA of the economy of the scale and the scope).

10. Telecommunications science: (the information generation, coding, transmission and storing between the economic agents in the economy of the scale and the scope; the asymmetric information flows between the economic agents in the economy of the scale and the scope; the bit error rate during the information transmission between the economic agents in the economy of the scale and the scope).
Fig. 6 shows the financial variables to characterize an investment of financial capital in the capital markets in the short and long time periods.

Let us focus on the two most important developments, which have greatly contributed to the clarification of the problem on the investment of the financial capital in the capital markets:

1. The creation of the econometrics, including the statistical distributions theories and the probability theory, which have been developed in the research works in De Laplace (1812), Bunyakovsky (1846), Chebyshev (1846, 1867, 1891), Markov (1890, 1899, 1900, 1906, 1907, 1908, 1910, 1911, 1912, 1913), Bachelier (1900, 1914, 1937, 19 May 1941) Slutsky (1922a, b, 1925a, b, 1927a, 1937a, b), Courtault, Kabanov, Bru, Crépel, Lebon, Le Marchand (2000), Bachelier, Samuelson, Davis, Etheridge (2006).

2. The creation of the econophysics, including the heat transfer theory (the thermal conductivity theory), the Brownian motion theory, and the probability theory in Bunyakovsky (1825), Bachelier (1900, 1914, 1937, 19 May 1941), Einstein (1905, 1956), Einstein, Smolukhovsky (1936), Brush (1968, 1977).
Fig. 7 shows the illustration of the Gauss normal distribution of the probability of events.

![Gauss normal distribution of probability of occurring events.](image)

**Fig. 7.** Gauss normal distribution of probability of occurring events.

Fig. 8 provides an illustration of the valuable financial papers prices evolution estimation with the probability theory in the finances in Bachelier (1900, 1914, 1937, 19 May 1941).

![Illustration of the valuable financial papers prices evolution estimation with the probability theory in the finances.](image)

**Fig. 8.** Illustration of the valuable financial papers prices evolution estimation with the probability theory in the finances in Bachelier (1900, 1914, 1937, 19 May 1941). The three Gauss normal distributions of the probabilities of the valuable financial papers prices at various time periods of 1, 5, 10 years are depicted.

In the econophysics, we can pretend to precisely characterize the money in the capital markets by comparing the money in the finances to the small particles in the physics:
1. The money in the finances can be compared to the small particles in the physics;
2. The money can spread randomly in the financial system over the time in analogy to the case, when the small particles can spread randomly in the gas/liquid/condensed matter over the time;
3. The money movement in the financial system over the time can be characterized as the fractional Brownian movement similarly to the case, when the small particles displacement in the gas/liquid/condensed matter under the potentials difference over the time can be characterized as the fractional Brownian movement;
4. The money movement in the financial system over the time can be ballistic or diffusive or captivated. In the diffusion case, the money can diffuse in the financial system over the time in analogy to the case, when the small particles can diffuse in the gas/liquid/condensed matter over the time in agreement with the classic diffusion principles in the chemistry/physics;
5. The money can be characterized by the discrete-time signals with the discretely changing money's parameters in the diffusion-type financial systems over the time similarly to the case, when the small particles can be characterized by the discrete-time signals in the diffusion-type gas/liquid/condensed matter systems with the discretely changing chemical/physical parameters over the time;
6. The money can exhibit the discrete-time multi-fractal properties in the diffusion-type financial system in the scale-time domains over the time in analogy to the case, when the small particles can demonstrate the fractal properties in the diffusion-type gas/liquid/soft-condensed matter systems in the scale-time domains over the time.

Let us take a minute and explain that, in the physics, all the existing electromagnetic signals in our nature can be conditionally classified in the two broad categories:

1. The continuous-time signals, which can be studied with the continuous-time signals filtering theory and the continuous-time signals processing theory in the electrodynamics science; the physics science; the electrical, electronics, computer engineering science in Maxwell (1890), Ledenyov D O, Ledenyov V O (2015a);
Let us clarify that, in the finances, the continuous- and discrete- time signals can be generated by the oscillating economic/financial variables over the time:

1. The continuous-time signals have been researched with the continuous-time signals filtering theory and the continuous-time signals processing theory in application to the business cycles of GDP(t), GNP(t), GIP(t), PPP(t) in the economics science in Juglar (1862), George (1881, 2009), Kondratieff (1922, 1925, 1926, 1928, 1935, 1984, 2002), Kitchin (1923), Schumpeter (1939), Burns, Mitchell (1946), Dupriez (1947), Samuelson (1947), Hicks (1950), Inada, Uzawa (1972), Kuznets (1973a, b), Ledenyov D O, Ledenyov V O (2013c, 2015d);

2. The discrete-time signals have been researched with the discrete-time signals processing theory in application to the business cycles in the economics science and the foreign currencies exchange rates in the finances science in Ledenyov V O, Ledenyov D O (2016s).

Fig. 9 shows the two signals groups by the oscillating financial variables in the finances.
Continuing our research discussion, we would like to demonstrate the continuous- and discrete-time signals waveforms in the time domain, $S_1(t)$ and $S_2(t)$.

Fig. 10 shows the continuous-time signal in the finances in Maxwell (1890), Ledenyov D O, Ledenyov V O (2015a). Fig. 11 demonstrates the discrete-time signal in the finances in Wanhammar (1999), Ledenyov D O, Ledenyov V O (2015a).

![Fig. 10. Continuous-time signal by oscillating financial variables in finances.](image1)

![Fig. 11. Discrete-time signal by oscillating financial variables in finances.](image2)

The continuous time signals can be filtered out by the continuous-time filters; and the discrete-time digital signals can be filtered by the discrete-time digital filters.

Fig. 12 shows an illustration of the function of the continuous-time signal filter in Ledenyov D O, Ledenyov V O (2015a). Fig. 13 demonstrates an illustration of the function of the discrete-time signal filter in the finances in Wanhammar (1999), Ledenyov D O, Ledenyov V O (2015a).

![Fig. 12. Continuous-time signal filter in finances.](image3)

![Fig. 13. Discrete-time digital signal filter in finances.](image4)
In the frames of the discrete-time signal processing theory, the discrete-time events can also be analyzed from their scaling properties point of view. More clearly, it was found that a mathematical set of valuable financial papers prices may exhibit a repeating pattern that displays at various scales over the time, then it was defined as a fractal in Mandelbrot (1975a, 1977). Therefore, it was assumed that the fractal theoretical model can be used to predict an evolution of the valuable financial papers prices in the scale-time domains in Mandelbrot (1997), Mandelbrot, Hudson (March 7 2006). Indeed, the scaling properties by the discrete-time events in finances, physics, electronics have been studied with an application of the chaos science by a number of famous scientists over recent decades in Mosekilde (1996-1997), Demenok (2011).


Speaking about the precise characterization of the money during the financial capital investment in the capital markets, we think that it can certainly be done in terms of the fractal and multi-fractal theories by observing, registering and analyzing the scaling properties of the discrete-time events (the money properties), characterized by the discretely changing parameters in the time-scale domains. For example, the prices of various investment assets in the capital markets can exhibit the repeating patterns that appear at various scales over the different time periods. It happens, because the prices of various investment assets depend on a big number of the discretely changing financial/economic variables in the economies of the scales and scopes. Therefore, the multi-fractals theory in the chaos science can help the private/institutional investors to make their accurate assumptions on the dynamics of changes of the prices of various investment assets in the capital markets in the finances in Mandelbrot (1960, 1963a, b, 1965, 1965, 1967a, b, 1969, 1971, 1972, 1975a, b, 1977, 1982, 1997, May 7 2006), Mandelbrot, Taylor H M (1967), Mandelbrot, van Ness (1968), Mandelbrot, Wallis (1969).
Let us discuss, at this point, our new research proposal on the quantum diffusion of the money in the capital markets in the finances. As we know, the classic diffusion of the money occurs discretely as a result of the Brownian motion of the money in the capital markets in the economies of the scales and the scopes at the gradient of the financial/economic potentials application in Shiryaev (1998a, b). It is similar to the small particles classic diffusion in the gas/liquid/(soft)condensed matter at the gradient of the electro-chemical potentials application in accordance with the classic diffusion principles in the physics in Bunyakovsky (1825), Brown (1828, 1829), Einstein (1905, 1956), Einstein, Smolukhovsky (1936), Brush (1968, 1977), Ledenyov V O, Ledenyov D O, Ledenyov O P (2006, 2012).
We formulate the Ledenyov theory on the quantum diffusion of the money in the capital markets in the economies of the scales and the scopes at the gradient of the financial/economic potentials application. It means that the money can experience the quantum diffusion in the capital markets. It is similar to the small particles quantum diffusion through the potential barriers in the gas/liquid/(soft)condensed matter or the multilayered junctions at the gradient of the electro-chemical potentials application in accordance with the quantum diffusion principles in the quantum physics in Andreev (February 1976).

The Ledenyov theory on the quantum diffusion of the money in the capital markets can be expressed in terms of the modified Schrödinger wave function in Schrödinger (1926a, b)

\[ \psi = \psi_0 \exp \left[ \frac{i (p r - q t)}{\hbar} \right], \]

where \( p \) is the impulse; \( r \) is the distance; \( t \) is the time; \( \hbar = \frac{\lambda_{QD}}{2\pi} \) – the Ledenyov constant with the quantum diffusion index (QD).

The Ledenyov theory on the quantum diffusion of the money in the capital markets can also be described in terms of the modified Schrödinger wave function, using the Feynman paths representation in Feynman, Hibbs (1965), Kleinert (2004)

\[ \psi_i = \psi_0 \exp \left[ \frac{i \left( \int p_i dr - \int \varepsilon_i dt \right)}{\hbar} \right], \]

where \( S_i = \int p_i dr - \int \varepsilon_i dt \) is the action on the money (the quantum particle) during its transposition along the trajectory \( i \); \( p_i \) is the propagator of the money (the quantum particle); \( P = \sum p_i \) is the full propagator of the money (the quantum particle), \( \hbar = \frac{\lambda_{QD}}{2\pi} \) – the Ledenyov constant with the quantum diffusion index (QD) in analogy with the Plank constant \( \hbar = \frac{h}{2\pi} \) in the physics.

Feynman proposed to order all the basic events in the form of the Feynman paths in the quantum system, using the Feynman paths representation in Feynman, Hibbs (1965)

\[ \sum_i \left\{ \prod_k \psi_k (i) \right\}_{p, x}. \]

We suggest to order all the basic events in the form of the cross-sections of Feynman paths in the quantum system, using the Feynman paths representation in Feynman, Hibbs (1965)

\[ \prod_k \left\{ \sum_i \psi_i (k) \right\}_{m, D}. \]
Then, we can derive the following equation, going from the commutation principle

\[ \sum_{i} \left\{ \prod_{k} \psi_{k}^{i}(i) \right\} = \prod_{k} \left\{ \sum_{i} \psi_{i}(k) \right\} \]

We can also write a set of the uncertainty principle expressions as

\[ \Delta p \Delta x \geq \frac{\hbar}{2}, \quad \Delta e \Delta t \geq \frac{\hbar}{2}, \quad \Delta m \Delta D \geq \frac{\hbar}{2}, \]

where \( \Delta p \) is the uncertainty of the money momentum; \( \Delta x \) is the uncertainty of the money location; \( \Delta e \) is the uncertainty of the money energy; \( \Delta t \) is the uncertainty of the time; \( \Delta m \) is the uncertainty of the money mass; \( \Delta D \) is the uncertainty of the money diffusion.

The probability of the money (the quantum particle) presence in the given point of the capital markets space at the certain time moment in the econophysical state with the corresponding econophysical impulse is equal to

\[ W = |\psi^{*} \psi|, \]

where \( ^{*} \) is the mathematical operation of complex conjugation.

Fig. 16 depicts the quantum diffusion of money at the cross-sections (CS) of the Feynman paths in the capital markets in the finances.

**Fig. 16.** Quantum diffusion of money at cross-sections of Feynman paths in capital markets.

In Chapter 3, we will search for an optimal solution to the problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, using various investment products, vehicles and mediums.
Chapter 3

Solution of problem on financial capital investment in capital markets, using various investment products, vehicles and mediums

A research on the optimal investment of the financial capital in the capital markets began in the early research books in Joseph Penso de la Vega (1668, 1996), Mortimer (1765), Bagehot (1873, 1897). Despite the numerous proposed ideas, the optimal solution was not found on that time, because the problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods is a quite challenging task to think about from all the points of view. One of the reasons to believe so is hidden in the fact that there is a big number of the changing financial/economic variables to characterize the financial capital investment in the capital markets. Paradoxically, the small short-term changes as well as the big long-term changes of the financial/economic variables may have the multiple unpredictable impacts on the performance of the financial capital in the capital markets.

Making a philosophical observation on our modern life, we can say that the humans live in the modern information societies in the environment, consisting of the multiple layers such as the atmosphere, ionosphere, stratosphere and cyber-sphere. These modern information societies can be precisely identified by the unique digital DNA(s) in Ledenyov V O, Ledenyov D O (2016p, s) in an analogy with the biological objects identification in the medicine by the DNA(s) in Miescher (1871), Kol'tsov (December 12 1927), Watson, Crick (1953), Watson (2002, 2004), Gamow (1954a, b), Library of Congress (2015), DeVinne (1985), Dahm (2008), Wikipedia (2015i). In the modern information societies, the humans like to interact with the quantum/electronic/photonic devices, designed with the application of the hardware/software components in the complex quantum/electronic/photonic systems. The hardware includes all the mechanical, electronic, photonic, quantum devices, which are made of the multilayered thin films of the metals, superconductors, semiconductors, insulators and (non)organic compounds, for the automatisation/communication purposes mainly. The software includes the multilayered protocol stacks such as the TCP/IP protocol stack for the text/audio/video communications over the Internet. Therefore, it is quite natural for the engineers to design the complex quantum/electronic/photonic systems made of the multiple layers in the electrical, electronics and computers engineering, physics, chemistry, and mathematics in Oppenheim, Schafer (1989),

In the finances, we think that the financial capital investment in the capital markets with an aim to get the increased return premium in the short and long time periods can be characterized much more accurately, researching the multiple layers in the financial capital investment process with an application of the advanced theories with the differential equations with many oscillating financial/economic variables:

1. Finances science (the general finances, accounting theories);
2. Economics science (the macro-, micro-, and nano- economics theories);
3. Business administration science (the business administration theory);
4. Management science (the governance theory);
5. Mathematics science (the statistic, probability, differential equations theories);
6. Econometrics science (the financial/economic risks, signals filtering theories);
7. Physics science (the continuous- and discrete-time signals theories);
8. Econophysics science (the quantum macro-, micro-, nano- economics theories);
9. Philosophy science (the philosophical thinking with scientific reasoning theory));
10. Psychology science (the logics, logical analysis, decision making theories);
11. Computer science (the computer modeling theory);
12. Engineering science (the financial engineering theory);
13. Biology science (the DNA theory);
14. Sociology science (the investor behaviour, the customer behaviour theories).

However, the multiple financial/economic variables can change nonlinearly in the nonlinear diffusion-type financial system in the time domain, making it difficult to predict their magnitudes precisely in Ledenyov V O, Ledenyov D O (2016s). In addition, the multiple financial/economic variables can change discretely in the nonlinear diffusion-type financial system in the time domain, making it challenging to forecast their values accurately in Ledenyov V O, Ledenyov D O (2016s). Therefore, the theoretical knowledge bases in many sciences must be beneficial for the creation of the optimal investing models, aiming to get the increased return premium at the financial capital investment in the capital markets in the short and long time periods in Ledenyov V O, Ledenyov D O (2016s). Summarizing all the above statements, we think that the multidisciplinary approach in tackling of the problem on the financial capital investment in the capital markets with the aim to get the increased return premium in the short and long time periods can be regarded as a most fruitful and optimal one from the scientific point of view.
Fig. 17 shows the sciences with the theories, which can be used to solve the problem on the investment of the financial capital in the capital markets.

![Diagram showing sciences and theories related to investment of financial capital.]

**Fig. 17. Sciences to solve problem on investment of financial capital in capital markets.**

Of course, an overall successful development of the investment economy of the scale and the scope critically depends on a created/implemented set of the regulatory policies by the state governments, aiming to encourage the financial capital investment into the real sector of the economy of the scale and the scope rather than into the speculative sector of the economy of the scale and the scope. The set of refined regulatory policies may represents a legislative base, which has to be introduced before the moment, when:

1. The additional emission of the money in the frames of the financial liquidity adding policies to finance the state budget will be introduced;
2. The additional financial resources from the international capital markets to finance the new business development programs will be attracted;
3. The additional financial resources from the national capital markets to finance the new business programs will be collected.
The solution of problem on the investment of the financial capital in the capital markets can be derived as a result of completion of the following research stages:

1. The investment problem formulation;
2. The financial capital modeling;
3. The investment process modeling;
4. The financial system modeling;
5. The investment problem solution.

Fig. 18 shows the block scheme on the optimal solution search for the problem on the investment of the financial capital in the capital markets.

![Block scheme on the optimal solution search for the problem on the investment of the financial capital in the capital markets.](image)

**Fig. 18.** Multilayered theoretical modeling to find solution of problem on investment of financial capital in capital markets.

Considering the investment process modeling, we would like to explain that the investment process can be viewed as a process of the financial capital investment in the capital markets with the goal to get an increased return premium in the short and long time periods. The investment process generally includes the following nine phases, which can be complemented by the additional phases, depending on the considered case of the research interest:
<table>
<thead>
<tr>
<th></th>
<th>1. The investment process start;</th>
<th>6. The investment risk calculation;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. The investment strategy creation;</td>
<td>7. The investment capital allocation;</td>
</tr>
<tr>
<td></td>
<td>3. The investment product selection;</td>
<td>8. The return premium generation;</td>
</tr>
<tr>
<td></td>
<td>5. The investment medium selection;</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 19 shows the block scheme of the investment process with the main stages explained.

![Diagram of investment process]

**Fig. 19.** Block scheme of investment process with main stages.
At this point, we can clearly see that there are the three main activities at the core of any investment process in the capital markets in the finances:

1. The selection of the investment products;
2. The selection of the investment vehicles;
3. The selection of the investment mediums.

Let us conditionally draw the investment star planetary system in our abstract philosophical imagination with the purpose to make it easy to memorize all the three important components of the financial capital investment process in the capital markets in the finances.

Fig. 20 shows the investment star planetary system in the finances galaxy.

![Investment Star Planetary System](image-url)

**Fig. 20.** Investment star planetary system in finances galaxy.

In general, the problem on the investment of the financial capital in the capital markets can be approximately solved, using the theoretical modeling with the mathematical differential equations with a number of the interdependent financial/economic variables at the specified boundary conditions in the econometrics and econophysics sciences. The final result can only be obtained with a certain accuracy, which is a sum of the following accuracies: the accuracy of the financial capital modeling, the accuracy of the investment process modeling; and the accuracy of the nonlinear dynamical financial system modeling.
Let us focus our attention on the **investment products/asset classes/instruments**, which are being sold to the prospective investors by the financial firms/institutions in the capital markets at present time. We would like to give an example on the investment products by listing a certain number of the possible investment products such as the land, real estate, government bonds, companies stock, companies options, financial securities, foreign currencies, commodities, and antique/modern arts. We can continue this short list with many more entries, because a number of the innovative financial products increases every day exponentially.

All the investment products/asset classes/instruments can be classified into the two broad categories:

1. The real investment products/asset classes/instruments, which include the real financial products like the land, real estate, commodities;
2. The imaginary investment products/asset classes/instruments, which include the synthesized financial securities and other derivatives.

Fig. 21 depicts the investment products/instruments in the capital markets.

**Fig. 21. Investment products in capital markets.**
Let us concentrate on the investment vehicles/intermediary, which can be used by the prospective private/institutions investors in the capital markets in the finances. We would like to give an instance of the investment vehicles, presenting a certain number of the investment vehicles such as the investment banks, investment funds, hedge funds, pension funds, investment boutiques, investment firms, investment corporations, investment groups, investment angels.

All the investment vehicles can be classified into the two broad categories:

1. The real investment vehicles, which include the real financial institutions like the banks, funds, firms;

2. The virtual investment vehicles, which include the virtual financial institutions like the structured investment vehicle (SIV).

The investment vehicles can be rated by the rating agencies, depending on the financial performance indicators demonstrated by the investment vehicles in the capital markets.

Fig. 22 shows the investment vehicles in the capital markets.
Let us focus on the investment mediums, which are present in the capital markets. We prefer to define the investment medium as the medium of the investment products exchange in the capital markets. We would like to give an example on the investment mediums, providing a certain number of the investment mediums such as the land exchange, real estate exchange, stock exchange, foreign currencies exchange, financial securities exchange, commodities exchange, precious metals exchange, patents exchange, antique arts exchange.

Fig. 23 provides information on the investment mediums in the capital markets.

In Chapter 3, we decided to divide the investment process on the multiple layers and shortly discussed a possible practical application of the investment products, the investment vehicles, the investment mediums in the investment process at the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. In the forthcoming research chapters, we will comprehensively discuss an application of the investment products (Chapter 4), the investment vehicles (Chapter 5), the investment mediums (Chapter 6) in the investment process at the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.
Chapter 4

Investment products for financial capital investment in capital markets

The investment product (the investment asset class / investment instrument) is something, which is synthesized by the natural process or developed by the human efforts process with the purpose of the value estimation, the value storing and the value incrementing by the way of financial capital investment with the aim to get an increased return premium in the capital markets in the short and long time periods. There are many different types of investment products with the natural or artificial properties, created by the financial organizations in the capital markets in the finances.

Fig. 24 shows the investment products in the capital markets in the finances.

---

**Fig. 24.** Investment products in capital markets in finances.
Illustrating the investment product conception in Fig. 22, we decided to draw a marvelously simple picture of the star with the multiple beams of the radiating light. In our imagination, we can conditionally associate this image in the astrophysics with the researched topics in the finances by thinking abstractly and cognitively about the two things:

1. The star, consisting of the numerous investment products in the capital markets galaxy; and
2. The radiating beams of the light with the different wavelengths, corresponding to the specific investment product in the capital markets galaxy.

4.1 Land as investment product.

Now, let us consider the numerous investment products in the capital markets in the finances in details, conducting our research discussion in order of investment attractiveness of the investment products. We would like to begin with the consideration on the land, which is a scarce natural resource of limited availability on our planet. In the finances, the land can be classified as an investment product (an investment asset class and an investment instrument) for the financial capital investment with the aim to get an increased return premium in the short and long time periods, because the land can be freely traded at the land markets in the economies of the scales and the scopes.

The straightforward investment idea by the investor is to forecast the land prices changes dynamics; then to invest the financial capital into the selected land at a certain time moment; after that moment to wait for some time period, and finally to sell the land at the certain time, obtaining an increased return premium at the land market in the short/long time periods.

There may be many classifications of the land types in the economics, including the agricultural, urban, industrial lands, which can be evaluated, sold and purchased on the land markets. The land pieces can be situated at the various locations, for instance, in the central districts in the city or in the suburban areas far away from the downtown. Therefore, the land valuation depends on a number of the land properties, which uniquely characterize the selected land site in the land market.

The land is freely traded at the certain prices at the land exchanges in the land markets worldwide, however the big landlords with a lot of the privately owned land can keep the land sites for the re-selling purposes only for the long time, restricting the development projects realization in the big cities and elsewhere. In agreement with the reputable economists’ opinions, the land trade / exchanges can be further stimulated by the adaptation of the progressive single
tax in the frames of the land value taxation theory in George (1879, 1881, 2009), Hirsch (1896), Morris, Heathcote (2007).


4.2 Real estate as investment product.

The real estate can also be considered as one of the investment products (a fixed tangible investment asset class and an investment instrument) for the financial capital investment with the goal to get an increased return premium in the short and long time periods, because the real estate is freely traded at the real estate markets on a global scale.

In fact, the real estate can be considered as a largest category of the residential, commercial, and industrial properties assets to make the investments in (see Johnson (2006)). There are the two most frequently used ways to invest in the real estate:
1. The direct investment in the real estate by buying the real property;
2. The indirect investment in the real estate, using the private equity investment in the real estate asset class in the financial investment portfolio in Friedman (March 1971).

In the case of the seasoned private/institutional investors, the main investment idea is to predict the real estate prices dynamics; then to invest (in)directly the financial capital into the selected real estate at a certain time moment; after that to wait for some time period, and finally to sell the real estate at the certain time moment, obtaining an increased return premium at the real estate market in the short or long time periods.

4.3 Commodity as investment product.

We have already discussed the land and the real estate as the investment products. The land and the real estate are also frequently regarded as the commodities. In the academic literature, the commodity can be described as an investment product (an investment asset class and an investment instrument) for the financial capital investment with the aim to get an increased return premium in the short and long time periods, because the fact that the commodities are freely traded at the global commodities markets.

In general, the commodity investment products (the commodity investment asset classes) may include, but not limited to: the extracted natural resources, the processed row materials and some other transportable products, which are freely exchanges and traded at the global commodities markets. For example, the following things can be classified as the commodities in Gilbert (March 2010):

1. The precious metals (the gold, silver, platinum, palladium);
2. The industrial metals (the copper, aluminum, steel);
3. The extracted minerals (the potassium, calcium, iron ore);
4. The extracted energy sources (the crude oil, heating oil, gasoline, natural gas);
5. The generated energy (the nuclear, solar, wind energies);
6. The harvested agricultural products (the wheat, corn, cocoa, coffee, cotton, sugar);
7. The produced livestock (the feeder cattle, live cattle).

The investment into the commodities has been considered as a sensible thing to do among the professional seasoned investors during the time of high volatility in the capital markets. The prime investment idea is to forecast the commodities indexes values changes dynamics; then to invest the financial capital into the selected commodities at a certain time moment; after that, to wait for the investment expectation realization for some time period; and finally, to sell the commodity investment products at the commodities market, obtaining the increased return-on-investment (ROI) in the capital markets in the short or long time periods.

The commodities indices are regularly published and updated by the investment rating agencies and the investment firms in Yamori (September 7 2009):

1. The Tokyo Commodity Exchange’s Nikkei-TOCOM Commodity Index;
2. The Goldman Sachs Commodity Index (GSCI);
3. The Dow Jones AIG Commodity Index;
4. The (DJ-AIGCI) Deutsche Bank Liquid Commodity Index;
5. The Rogers International Commodity Index;
6. The Standard & Poor’s Commodity Index;
7. The Reuters Commodity Research Bureau Index
8. The Deutsche Bank Liquid Commodities Index.

There are the three most applicable ways to invest the financial capital into the commodities in Demidova-Menzel; Heidorn (August 2007):

1. The direct investment into the physical commodities indices, which are freely traded at the commodities exchanges in the commodities markets;

2. The direct investment into the commodity futures, which are freely traded at the commodity futures markets. The futures are defined as the valid business contracts to buy a definite quantity of the selected commodity at a certain price at a future delivery date. The backwardation situation occurs in the case, when the futures prices of commodities are below the spot prices of commodities. The contango situation has place in the case, when the futures prices of commodities are above the spot prices of commodities;

3. The direct/indirect investment into the commodity producing companies stocks, which are freely traded at the stock exchanges in the capital markets.
It may be interesting to note that the prices changes dynamics of the global commodity derivatives such as the oil, copper and some other commodity futures derivatives may have the fractal nature in Mykhailovska (2014). Presumably, the prices changes dynamics of both the physical commodities indices and the commodity futures derivatives in the capital markets can be more accurately characterized in the frames of the chaos science in Baumol, Benhabib (1989), Blank (1991), DeCosters, Labys, Mitchell (1992), Yang, Brorsen (1993), Chatrath, Adrangi, Dhanda (2002).

In this context, we would like to express our research opinion that the prices changes dynamics of both the physical commodities indices and the commodity futures derivatives in the capital markets may be much better characterized, using the recently proposed theories in the quantum chaos science, the quantum microeconomics science and the quantum macroeconomics science in Ledenyov D O, Ledenyov V O (2015h, i, j).

4.4 Bond as investment product.

The bond can also be related to the investment products (an investment asset class and an investment instrument) for the financial capital investment with the aim to get an increased return premium in the capital market in the short and long time periods, because the various types of bonds are constantly and freely exchanged at the global bonds markets.

Actually, there are many possible types of the inflation linked/protected callable/(non)callable bonds, which are issued by different market agents in the financial systems in the economies of the scales and scopes:

1. The sovereign bonds;
2. The treasury bonds;
3. The municipal bonds;
4. The corporate bonds;
5. The bank bonds.

The basic investment idea behind the investment deal with the bonds is to predict the bonds prices fluctuation dynamics; then to invest the financial capital into the selected bonds at a certain time moment; after that to wait for some time period, and finally to sell the bonds at the increased prices at the certain time moment, obtaining the increased return premiums at the bonds markets in the short or long time periods.


4.5 Company stock and stock option as investment products.

The firm’s preferred/common stock (the company’s shares) can be regarded as an investment product (an investment asset class and an investment instrument) for the financial capital investment with the aim to get an increased return premium in the short and long time periods, because the company’s stock is freely exchanged at the stock exchange in the capital market.

The simple investment idea is to foresee the firm’s stock prices changes dynamics; then to invest the financial capital into the selected company’s stock at a certain time moment; after that to wait for some time period, and finally to sell the company’s stock at the certain time moment, obtaining an increased return premium at the stock market in the short or long time periods.

Discussing the company’s stock, let us explain that the theory of the firm (the company) in the classic microeconomics science investigates the firm’s organizational structure, the firm’s functional performance, the firm’s economic variables change forecast, and the firm’s operation financing schemes. A big number of the research articles, reports, chapters and books on the theory of the firm in the classic microeconomics science have been written by the academicians and the practitioners in Babbage (1832), Ueda (1904, 1937), Marshall (1923), Berle, Means

In recent years, the quantum theory of the firm in the quantum microeconomics science has been proposed in Ledenyov D O, Ledenyov V O (2015k). The quantum theory of the firm in the quantum microeconomics theory in the quantum econophysics science takes into account the premises that there may be the quantum economic processes in the nonlinear dynamic economic system over the certain time period, which have to be discovered, described and considered in details. In this context, the quantum theory of the firm postulates that the discrete-time transitions from one level of the firm’s economic performance to another level of the firm’s economic performance will occur in the nonlinear dynamic economic system at the time moment, when in Ledenyov D O, Ledenyov V O (2015k):

1. The present land, labour and capital resources are (added and absorbed) / (released and radiated) in the form of quanta, decreasing or increasing the general energy entropy in the nonlinear dynamic economic system (the nonlinear medium);

2. The disruptive scientific/technological/financial/social/political innovation(s) is/are introduced into or withdrawn from the nonlinear dynamic economic system (the nonlinear medium), creating the resonance conditions to amplify/attenuate the value of the firm’s economic performance, during the evolution process of the economy of scale and scope in the time domain (Note: the resonance can result in the increase/decrease of the energy of the electromagnetic wave in the electrodynamics science);

3. The firm’s business processes population inversion mechanism is present, when a) the every business process in the firm can be conditionally compared to the electron in the atom, b) the discrete increase of business process value in the firm can be conditionally associated with the discrete increase of electron’s energy in the atom during the energy pumping process in the laser, c) the land, labour and capital resources release at the population inversion mechanism
realization in the firm can be conditionally regarded as the light radiation at the population inversion mechanism action in the laser;

4. The derived formula to describe the discrete-time EBITDA changes during the firm’s economic performance variations in terms of the quantum theory of the firm is

\[ \text{\( \Delta \text{EBITDA}(t) = \text{EBITDA}(t)_m - \text{EBITDA}(t)_n \)} \] (1)

\[ \text{\( \Delta \text{firm's value}(t) = \text{firm's value}(t)_m - \text{firm's value}(t)_n \)} \] (2)

where: \( \lambda_{\text{micro}} \) – Ledenyov constant,
\( \omega \) – cyclic velocity,
\( t \) – time,
EBITDA – the Earnings Before Interest Tax Depreciation Amortization,
Firm’s value – the firm’s market capitalization minus the firm’s long term investments and debt.

5. The Ledenyov distribution of a number of excited firms’ business processes of certain value at the selected level (state) in the economy of scale and scope in terms of the quantum microeconomics theory is

\[ \frac{N_m}{N_n} = \exp\left( -\frac{\left( \text{EBITDA}(t)_m - \text{EBITDA}(t)_n \right)}{\lambda_{\text{micro}}T} \right) \] (3)

\[ \frac{N_m}{N_n} = \exp\left( -\frac{\left( \text{firm's value}(t)_m - \text{firm's value}(t)_n \right)}{\lambda_{\text{micro}}T} \right) \] (4)

where: \( \lambda_{\text{micro}} \) – Ledenyov constant,
\( N_m \) – number of firms’ processes of certain value at the state (m),
\( N_n \) – number of firms’ business processes of certain value at the state (n),
\( N = N_m + N_n \) – general number of firms’ processes of certain value in the economy of scale and scope,
\( t \) – time,
\( T \) – temperature of the economy of scale and scope, which corresponds to the level of entropy of the economy of scale and scope (the level of information/business activities by the firms),
EBITDA – the Earnings Before Interest Tax Depreciation and Amortization,
Firm’s value – the firm’s market capitalization minus the firm’s long term investments and debt.
In other words, let us emphasize the fact that the quantum theory of the firm states that there may be the discrete-time induced transition(s) between the different levels of the firm’s EBITDAs (the firm’s values) in the nonlinear dynamic economic system at the time, when the following things are present in Ledenyov D O, Ledenyov V O (2015k):

1. The land, labour and capital, which can be added and absorbed / released and radiated in the form of quanta in the nonlinear dynamic economic system (the nonlinear medium);

2. The discrete-time fluctuational processes, which can appear in the form of the disruptive scientific/technological/financial/social/political innovation(s) that absorb or release the available land, labour and capital resources, creating the resonance, in the nonlinear dynamic economic system (the nonlinear medium) during the evolution process of the firm in the economy of scale and scope in the time domain;

3. The firm’s business processes population inversion mechanism, which occurs at the following condition: \( \frac{N_2}{N_1} > 1 \).

Most importantly, the firm can be classified as the private company or the public company, going from the company ownership rights. In the case of the public company, the company’s stock is issued at the stock exchange at the initial public offering process (IPO), traded freely among the investors at the stock exchange, and valued by the open market at the stock exchange. The main reason for the private company to become the public company is to get an access to the financial capital, which is needed to finance the company’s present/further business processes towards both the sustainable effective operation and/or the new products/services introduction in the selected markets in Ledenyov D O, Ledenyov V O (2014b).

The Initial Public Offering (IPO) process, including: the company initial valuation by an independent established audit firm, the IPO valuation at the stock exchange, the emission of the shares of the company’s stock at the stock exchange, the company’s stock re-evaluation by the open market at the stock exchange, has been researched in Ledenyov D O, Ledenyov V O (2014b). In general, it is necessary to remember that the initial listing requirements for the public companies at the stock exchanges on the various capital markets are different. The IPO techniques, including: the fixed-price offerings, the auctions, the book-building, depend on many economic factors in Ledenyov D O, Ledenyov V O (2014b). The IPO initial underpricing, the long-run performance and the after-market liquidity existing problems may have many different origins in Ledenyov D O, Ledenyov V O (2014b). The cost of acquiring capital at the stock exchange for the company can be calculated, using the techniques in Ideas At Work (2006), Ledenyov D O, Ledenyov V O (2012d), Schnoor (2006) (see Chapter 8).
The valuation of the initial public offering of the company equity at the stock exchanges in the imperfect highly volatile global capital markets with the induced nonlinearities is a complex task from all points of view. The Discounted Cash Flow (DCF) is a most widely used model of the direct valuation of the IPOs. Cogliati, Paleari, Vismara (2010) propose an equation to value the IPO with the DCF model:

\[
EV_{IPO} = FCFF_{IPO} \left[ \sum_{i=1}^{T} \left( \frac{1+g_1}{1+WACC} \right)^i + \left( \frac{1+g_1}{1+WACC} \right)^T \sum_{i=1}^{\infty} \left( \frac{1+g_2}{1+WACC} \right)^i \right]
\]

Cogliati, Paleari, Vismara (2010) suggest an equation to estimate the expected growth rates, implied in the IPO prices:

\[
P_{IPO} = \frac{FCFF_{IPO}}{WACC \cdot NSH_{pre}} \left[ \frac{(1+g_1) \left[ (1+WACC)^T - 1 + (1+g_2)(1+g_1)^{T-1} \right]}{(1+WACC)^T} \right] - \frac{D_{IPO}}{NSH_{pre}}
\]


Another point of special interest is the underpricing of the initial public offering of the company equity at the stock exchanges in the imperfect highly volatile global capital markets with the induced nonlinearities.
The underpricing the initial public offering of the company equity at the stock exchanges in the imperfect highly volatile global capital markets with the induced nonlinearities in the IPO process can be written as in Pennacchio (2013)

\[
\text{Underpricing} = \left(\frac{P - P_{\text{IPO}}}{P_{\text{IPO}}}\right) \cdot 100,
\]

where \( P \) is the closing price in the first day of trading, and \( P_{\text{IPO}} \) is the offer price of the stocks.

We propose the Ledenyov theory on the origins of the underpricing and long term underperformance effects in Ledenyov D O, Ledenyov V O (2014b), which states that the underpricing and long term underperformance can be explained by the changing information absorption capacity by the investors on the company equity value in the conditions of the asymmetric information flows, depending on both:

1. The internal factors:
   a) The investor’s ability to conduct the creative imperative integrative intelligent conceptual co-lateral adaptive logarithmic thinking with an application of the inductive, deductive and abductive logics analysis as far as the fundamental value of company equity is concerned;
   b) The ultra fast decoding of acquired information on the fundamental value of company equity;
   c) The ultra fast processing of acquired information on the fundamental value of company equity.

2. The external factors:
   a) The presence of the asymmetric information on the fundamental value of company equity between the investors and the underwriters (issuers);
   b) The agency problems in relation to the fundamental value of company equity.

One of the most intriguing questions to understand is: What would be the long term performance of the initial public offering of the company equity at the stock exchanges in the conditions of the imperfect highly volatile global capital market with the induced nonlinearities? The aftermarket performance is measured, using the Buy-and-Hold Abnormal Returns (BHAR), which are calculated for the stock $i$ over a time period $T$ as in Loughran and Ritter (1995), Cogliati, Paleari, Vismara (2010)

$$BH_{t,T} = \prod_{t=1}^{T} \left(1 + R_{t,t} \right) - 1,$$

$$BHAR = \frac{1}{N} \sum_{i=1}^{N} \left[ \left( \prod_{t=1}^{T} (1 + R_{i,t}) \right) - \prod_{t=1}^{T} (1 + R_{M,t}) \right],$$
where $R_{it}$ is the return of stock $i$ at the time $t$, and $N$ is the number of stocks in the portfolio.


Now, let us shortly discuss the **firm’s stock option**, which can be considered as an investment product (an investment asset class and an investment instrument) for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, because the firm’s stock options are constantly issued, traded and exercised at the stock options market.

Let us make a clear general definition of the option by saying that the option is a financial contract to buy/sell the underlying financial security at a predetermined price on a specified date. There may be a big number of different types of the options in the finances:

1. The traded firms’ stock options;
2. The allocated employee’s/executive’s firms’ stock options;
3. The traded equity options: Asian Options, Barrier Options, Compound Options, Look-back Options, Vanilla Stock Options, Vix Options.

In general, we can say that the call/put traded options can be issued for the different asset classes in the capital markets in the finances. However, in this research discussion, we would like to focus on the firm’s stock options trading at the stock exchanges in the capital markets in particular in Investopedia (2016). The firms’ stock options trading at the stock options exchanges can gain some financial profit or bring some unexpected financial losses to the trader/investor, depending on the concrete circumstances in the capital markets at the certain time moment in Black (1975), Lakonishok, Inmo Lee, Pearson, Poteshman (2007), Investopedia (2016).

The option pricing models in the capital markets in the finances has been researched in Bierman (1967), Black, Scholes (1973), Merton (1973), Cox, Ross, Rubinstein (1979), Hull (1997), Scott (1997), Taylor (December 2007). The firm’s stock option value depends on various factors, including the firm’s stock price, the firm’s characteristic microeconomic / macroeconomic variables in the economy of the scale and the scope within which the firm operates in Baule, Tallau (2013).

There may be observed the certain financial variables interdependencies between:

1. The firm’s stock options price/volume traded at Chicago Board Options Exchange (CBOE) and the firm’s stock price/volume traded at New York Stock Exchange (NYSE);
2. The firm’s stock options price/volume traded at Chicago Board Options Exchange (CBOE) and the firm’s market valuation;

at the selected stock exchange(s) in the capital market(s) in Easley, O’Hara, Subrahmanya Srinivas (1998), Kalok Chan, Peter Chung, Wai-Ming Fong (2002), Timraz, Al-Shubiri (2012), Baule, Tallau (2013).

Going to the next topic, let us comment that, in some cases, the executives/employees can be compensated by the employee/executive stock options, which represent a right to buy a share of stock at a fixed price (an exercises/strike price) before a specified date after the vesting period and they cannot be sold to the outside investors in Lewellen (1968), Saly (1994), Heath, Huddart, Lang (May 1999), Hall, Murphy (2000, 2003), Uchida (2006), Campbell (Winter 2007), Babenko, Lemmon, Tserlukевич (2011), Perobelli, de Souza Lopes, Da Silveira (2012).

Considering the next subject, let us say that there may be issued the equity options in the capital markets. More information on the equity options will be presented in next sub-chapter.

The company stock options have been researched in Weinberg, Patton (1963), James Boness (April 1964), Bierman (September 1967), Lewellen (1968), Hirshleifer (1970), Black, Scholes (1973), Black (1975), Merton (1973, 1997), Fisher (March 1978), Klemkosky (1978),
4.6 Financial security as investment product.

The financial security can also be treated as an investment product (an investment asset class and an investment instrument) for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, because the financial securities are constantly traded at the financial securities market.

The most popular investor’s idea is to foresee the financial securities values changes dynamics; then to invest the financial capital into the selected financial securities at a certain time moment; after that to wait for some time period, and finally to sell the financial securities at the financial securities market, having made an increased return premium in the short or long time periods.

In general, the financial securities may include the structured credit products such as the financial derivative with the changing value, which depends on the values of other basic financial variables. The financial derivative is regarded as an insurance contract frequently. There are many types of derivatives, which give the fixed income investors a fully rated and leveraged exposure to the main credit derivatives indices in Ledenyov D O, Ledenyov V O (2013a):

1. Credit Derivatives: Collateralized Debt Obligations (CDO), Constant Proportion Debt Obligations (CPDO), and investment protection mechanisms such as the Synthetic Collateralized Debt Obligations (SCDO), Credit Default Swaps (CDS), Credit Default Swap Index (CDSI), Loan only Credit Default Swaps (LCDS), Credit Default Swaps of ABS (ABCDS), Variance Swaps (VS), Constant Proportion Portfolio Insurance (CPPI), Contracts for Difference (CFD).

The credit derivative makes it possible to transfer the credit, interest rate, price, currency, liquidity risks of a financial loan to other financial investor without the real sale of the financial loan in Lucas, Goodman, Fabozzi (2006, 2007). The Collateralized Debt Obligations (CDO) are based on the pool of bonds: 1) the corporate bonds, secured against the company’s balance sheet, or 2) the covered bonds, secured against the pools of mortgages or public-sector loans. The structure of the pool of bonds consists of both the riskiest slice and the conservative slice. The pieces of the pool of bonds are sold to the financial investors in the form of the CDOs. The
Synthetic Collateralized Debt Obligations (Synthetic CDO) replaces the pools of bonds with the Credit Default Swaps (CDS). The swaps insure against a bond default. Owners of bonds can buy CDS on their bonds to protect themselves.

2. Equity Derivatives: Futures, Asian Options, Barrier Options, Compound Options, Look-back Options, Vanilla Stock Options (put and call options), Vix Options.

The futures contract is an agreement to buy or sell an asset for a certain price at a specified time moment. The Call Option is an option to buy a certain asset by a certain date for a certain price (the Strike Price), and the Put Option is an option to sell a certain asset by a certain date for a certain price (the Strike Price), and the Stellate Option is a double option to buy or sell a certain asset by a certain date for a certain price (the Strike Price). It is necessary to distinguish the American Options vs. European Options: the American option can be exercised at any time during its life and the European option can be exercised only at maturity. Also, it is necessary to remember the distinction between the Options vs. Futures/Forwards Contracts: the Futures/Forward Contract gives the holder the obligation to buy/sell at a certain price, and the Option gives the holder the right to buy or sell at a certain price.

3. Other Derivatives: Interest Rate Swaps.

4.7 Foreign currency as investment product.

The foreign currency(s) can be qualified as an investment product (an investment asset class and an investment instrument) for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, because the foreign currencies are constantly indexed, traded and exchanged between the traders/investors in the foreign currencies exchange markets in Ellis, Metzler (editors) (1949), Machlup (1949), Robinson (1949).

We can easily describe an investment process scenario by the private/institutional investors by saying that the increased return premium can be generated by introducing a selected investment product by means of a selected investment vehicle into a preferred investment medium, pursuing an investor’s expectation to obtain an increased return premium in the foreign currencies exchange markets in the short or long time periods in Ledenyov V O, Ledenyov D O (2016s). In other words, in a practical case, the basic investment idea by the private/institutional investors is to make a best possible assumption on the foreign currencies exchange rates change.
dynamics in the time; then to invest the financial capital into the selected foreign currency(s) at a
certain time moment; after that to wait for ultra short/short/long time period, and finally to sell
the foreign currency at the electronic trading process, deriving an increased return premium in
the foreign currencies exchange markets (FX) in the short and long time periods in Ledenyov V
O, Ledenyov D O (2016s).

Let us write a formula for the spot exchange rate $S_{t|m}^{t|m}$ of the Currency$^1$ in relation to the
Currency$^2$ in FX markets in Morgenegg (1990), Müller, Dacorogna, Olsen, Pictet, Schwarz,
Morgenegg (1990), Dacorogna, Müller, Nagrel, Olsen, Pictet (1993), Peters (1994), Ghysels,
O (2016s):

$$S_{t|m}^{t|m} = \left[ \frac{\text{Currency}^1}{\text{Currency}^2} \right]_{t|m}, \quad t \geq t_0, \quad m > 0,$$

where $S_{t|m}^{t|m}$ is the spot exchange rate,

$\text{Currency}^1$ is the currency no 1,

$\text{Currency}^2$ is the currency no 2,

$m$ - the month,

$t$ - the time.

Let us introduce a formula for the change of the spot exchange rate in the time domain in
FX markets, $\Delta S_t$ in Ledenyov V O, Ledenyov D O (2016s):

$$\Delta S_t = S_t - S_{t-1} = \left[ \frac{\text{Currency}^1}{\text{Currency}^2} \right]_{t} - \left[ \frac{\text{Currency}^1}{\text{Currency}^2} \right]_{t-1},$$

where $\Delta S_t$ is the change of spot exchange rate over time,

$\text{Currency}^1$ is the currency no 1,

$\text{Currency}^2$ is the currency no 2,

$t$ - the time.

Let us show a formula for the calculation of the electronic trading frequency in FX
markets and explain that the electronic trading in FX markets can be performed at the ultra high
frequencies (UHF) in Ledenyov V O, Ledenyov D O (2016s)

$$f = \frac{\text{Number of ticks}}{\text{Time period}},$$

where $f$ is the frequency.
Finally, we would like to comment that an accurate characterization of the foreign currencies exchange rates at the ultra high frequencies electronic trading in the FX markets can be achieved, using in Ledenyov V O, Ledenyov D O (2016):

1. The mathematical analysis methods (the probability and statistics distributions formulas);
2. The financial analysis methods (the macroeconomics and microeconomics formulas);
3. The electronic analysis methods (the Stratanovich-Kalman-Bucy filtering algorithm in the Stratanovich – Kalman – Bucy filter formulas), and
4. The quantum analysis methods (the Ledenyov quantum econophysical wave equation formula).


4.8 Intellectual property as investment product.

The intellectual property can be characterized as an investment product (an investment asset class and an investment instrument) for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, because the intellectual property can be traded and licensed at the foreign currencies exchange markets.

The protection of the intellectual property rights was legally introduced at the 1883 Paris Convention in Paris, France in Schmitt (2016). Presently, the intellectual property should be considered as an important investment product (a strategic asset class) in Kite (2009), Palfrey (October 2011), including the patents, trade secrets, copyrights, and trademarks in Blair, Cotter (June 2005), Holland, III, Reed, Lee, Kimmel, Peterson (2007), Palfrey (October 2011). Indeed, the intellectual property is a key determinant in the processes of the wealth creation and the wealth management by the firms in Schmitt (2016).

The intellectual property is regulated by the intellectual property law in Howe, Griffiths, Sherman, Pottage, Gangjee, Bently, Hudson, Dreier, Breakey, Balganesh, Carrier, Burrell, Hudson, Lametti, Dussollier (September 2013). The nature of the juridical rights, which can be considered as the intellectual property rights, has been debated in Templeman (1998).

The intellectual property valuation, exploitation and infringement damages have been researched in Smith, Parr (2005), Holland, Benedikt (2014). The intellectual property licensing has been discussed, to some extent, in Parr (2007).
Finalizing our research polemics on the investment products in the capital markets in the finances, we would like to add a short comment that a full list of possible investment products is not limited to the above listed investment products, asset classes and the investment instruments. More clearly, the financial capital investment can be done by the private/institutional investors into the antique/modern arts, the rare/modern books, the old/modern Swiss mechanical watches, the retro/modern automobiles, the retro/modern yachts, and many other valuable things, which constitute the wealth from the economic point of view.

Looking forward, we would like to express our research opinion that the digital currencies, including the Bitcoin and the Ethereum, can be considered as one of the perspective investment products, asset class and the investment instrument for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. Presently, the Bitcoin and the Ethereum can be traded/exchanged at the digital currencies exchange markets, exhibiting the increasing valuation trend in the global capital markets.

In Chapter 4, we have discussed a big number of the most attractive investment products for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. We began our consideration with the oldest well known investment products, moving forward to the newest and perspective investment products.

In Chapter 5, we will consider the investment vehicles for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, providing the terms definitions with the brief research discussions.
Chapter 5

Investment vehicles for financial capital investment in capital markets

The investment vehicle is a real/virtual financial firm, which is established to administer the allocated financial capital by making the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. There are many types of investment vehicles with the various financial resources, distinctive organizational structures and different investment strategies, which aim to obtain the increased return premiums in the capital markets in the finances in the short/long time periods.

Fig. 25 shows graphically the investment vehicles in the capital markets in the finances.

![Fig. 25. Investment vehicles in capital markets in finances.](image-url)
Using our cognitive thinking, let us imagine a new star with the multiple radiating beams of light in the finances galaxy. In this case, we make the two simple assumptions that:

1. The star is created by the numerous investment vehicles;
2. The radiating beam of the light with the different wavelength corresponds to the certain investment vehicle in the capital markets.

5.1 Investment bank as investment vehicle.

The investment bank is an investment vehicle, which is founded to collect, borrow, administer, invest, increase the customers’ financial capital by making the financial capital investments in the capital products in the capital markets with the aim to get an increased return premium in the short and long time periods. In other words, the investment bank is a classic example of the financial organization, which operates with the main goal to invest the financial capital in the numerous investment projects and to maximize the return-on-the-investment in the capital markets in the selected time periods.

The theory of investment banking closely describes the investment bank operation principles Morrison, Wilhelm (2007, November 15 2008). The investment bank has an organization structure with many departments, including the investment department, actions department, fixed income instruments department, financial management department in Corovai (2015). A presence of the investment fund management capability within the investment bank is an important characteristics of investment bank in Ferguson (1996). Hence, the investment bank can create, promote and sale a number of the investment products, including the securities and the credit derivatives in Ferguson (1996). The investment banks compete for both the lucrative investment opportunities realization and the capital market share with other investment banks (the internal competition) as well as the investment funds (the external competition) in the capital markets in Ferguson (1996). However, in practice, some investment banks can be considered as relatively inefficient investment vehicles due to various objective/subjective reasons. Therefore, the private investors may also be interested to invest their financial resources, using some other investment vehicles in the global capital markets. Summarizing our discussion on the investment banking, we would like to comment that the investment banks as an investment vehicle for the financial capital investment in the capital markets with the aim to get increased return premium in the short and long time periods have been researched in Howell (1953), O'Donnell (1957), Pontecorvo (1958), Mandelker, Raviv (1977), Beatty, Ritter (1986), Smith (1986), Keeley, Pozdena (June 19 1987), McDonough (1987), Walter, Smith (1989), Carter, Dark (1992), Chemmanur, Fulghieri (1994), Sussman (1994), Clark (April 1995),

5.2 Investment fund as investment vehicle.

The investment fund is an investment vehicle, which is usually established to collect and to administer the financial capital by making the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. There may be many possible types of the investment funds, including:

1. The private equity fund (it focuses on the startups);
2. The venture capital fund (it invests in the startups);
3. The focus fund (its manager has to own the shares of fund);
4. The aggressive fund (it focuses on the shareholder value maximization);
5. The special situations fund (it invests in the selected companies);
6. The “alpha” fund (the “alpha” is a term for the added-value by a top manager);
7. The covered call fund (it uses the derivatives to reduce the investment risk);
8. The mezzanine fund (it is a fund of the funds);
9. The mutual fund (it pools the financial resources and invests in the stocks);
10. The index fund (it pools the financial resources and invests in the indices’);
11. The pension fund (it specializes in the pension investment in various companies);
12. The sovereign wealth fund (it is created by the state-backed investors).

Among all the existing types of the investment funds, the private equity funds deserve a special attention, because they focus on the early stage financing and the growth capital investing in the startup companies, playing a considerable role in both the search for a chairman of the board of directors and the development of a sustainable business model of the startup company. We can say that the private equity fund model relies on the loading up a startup company with the financial debt. More clearly, the private equity fund invests the financial equity into the startup company, forcing the startup company to use an optimal business model, to change the management team and to accept the implied financial obligations. The private equity fund
continues to administer all the product/service development phases by the startup, monitoring all the meetings by the board of directors and discussing all the business process developments. The private equity fund creates the necessary leverage for the startup company by presenting the abundant financial capital to the startup at the cheapest rates for the certain time periods and by optimizing the startup’s business model. We can certainly highlight a fact that the private equity fund does the financial engineering, focusing on the shareholder value maximization as opposed to the quarterly earnings increase.

Tab. 1 displays the financial parameters to characterize the private equity fund.

<table>
<thead>
<tr>
<th>Specialization by Segment</th>
<th>Private Equity Model</th>
<th>Investment Strategy</th>
<th>Private Equity Managers</th>
<th>Private Equity Investors:</th>
<th>Profit Split</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venture Capital</td>
<td>Raising Capital</td>
<td>Fund Size</td>
<td>General Partners</td>
<td>Limited Partners</td>
<td>20% Gen Partners</td>
</tr>
<tr>
<td>Growth Capital</td>
<td>Investing Capital</td>
<td>Commit Period</td>
<td></td>
<td></td>
<td>80% Lim Partners</td>
</tr>
<tr>
<td>Large BuyOuts</td>
<td>Providing Capital</td>
<td>Fees</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tab. 1.** Financial parameters to characterize private equity fund.

Fig. 26 shows the private equity investment scheme.

**Fig. 26.** Private equity investment scheme.
Aiming to maximize the return-on-investment (ROI), the investment banks/funds/firms frequently attempt to sell the hedge fund replication products to the investors, providing the private/institutional investors with an access to the hedge funds’ high return premiums at the significantly lower costs in Takahashi, Yamamoto (2008), Ledenyov D O, Ledenyov V O (2013h).

Roncalli, Weisang (2008) proposed a theoretical representation for the procedure of the hedge fund investment portfolio strategies replication to capture the nonlinear return on investments, which can be decomposed into the following two stages:

\[ r_{k}^{HF} = \sum_{i=1}^{m_1} W_{k}^{(i)} r_{k}^{(i)} + \sum_{i=m_1+1}^{m_1+m_2} W_{k}^{(i)} r_{k}^{(i)} + \eta_{k}, \]

\[ r_{k}^{Clone} (d) = \left( 1 - \sum_{i=1}^{m} \hat{W}_{k+d+1|k+d}^{(i)} \right) r_{k}^{(0)} + \sum_{i=1}^{m} \hat{W}_{k+d+1|k+d}^{(i)} r_{k}^{(i)}. \]

In this case, the investment banks/funds/firms must have the technical capabilities to track the hedge funds’ investment strategies, applying the so called Bayesian filters in Javaheri, Lautier, Galli (2002), Roncalli, Weisang (2008), Takahashi, Yamamoto (2008), Ledenyov D O, Ledenyov V O (2013g):

1. The Stratanovich – Kalman – Bucy filters;
2. The Particle filters.

5.3 Hedge fund as investment vehicle.

The hedge fund is also an investment vehicle in the form of an unregulated/weekly regulated/self regulated investment fund, which is created for the financial capital investment in the capital markets with an aim to get the increased return premium and to achieve the positive absolute returns in the short and long time periods, using various active investment strategies in Mitra (2009), Ledenyov D O, Ledenyov V O (2013h).

The first hedge fund was established by Albert Wislow Jones in 1949, implementing the main investment strategy towards the hedged equity investments in the capital markets. Winslow attempted to eliminate the market risks, introducing the hedging technique in the finances. The hedging is an act of the market risk mitigation at the financial capital investment by making an investment in the weakly related investment products in Fung (1999a), Mitra (2009), Ledenyov D O, Ledenyov V O (2013h). Presently, the hedge funds improve the efficiency and liquidity of the global financial markets, however they may also create the certain risks to financial stability in view of possible volatility increase as a result of the risky investments in Papademos (2007).

Let us consider the problem on the hedge fund’s investment return premium calculation, which is the measurable investment return. Takahashi, Yamamoto (2008) write the following formula to evaluate the hedge fund’s investment return premium

\[ R_i = \alpha_i + \sum_k \beta_{ik} F_k, \]

where

- \( R_i \) is the return of fund \( i \);
- \( F_k \) is the return of factor \( k \);
- \( \beta_{ik} \) is the exposure of fund \( i \) to factor \( k \);
- \( \alpha_i \) is the rest of return \( R_i \).

The investment return premium by the hedge funds can also be written as in Freed, McMillan (2011)

\[ R^f = \alpha^f + B^f X_T + \epsilon^f, \]

where

\[ B^f = [\beta_{1}^f, \beta_{2}^f, \ldots, \beta_{n}^f], \]

\[ X_T = [X_T^1, X_T^2, \ldots, X_T^n]. \]
In the case of the portfolio of hedge funds, the investment return premium of a portfolio of the hedge funds is

$$\sum_{i=1}^{n} w_i R_i = \sum_{i=1}^{n} \alpha_i + \sum_{i=1}^{n} (w_i \beta_{1i} + \ldots + w_n \beta_{nk}) F_k,$$

where

- $w_i$ is the weight on fund $i$.

Gibson, Wang (2010) write the formula for the hedge fund portfolio return as

$$r_{i,t} = \alpha_{i,0} + \alpha'_{i,1} z_{t-1} + \beta'_{i,0} f_t + \beta'_{i,1} (f_t \otimes z_{t-1}) + \epsilon_{i,t},$$

$$f_t = \alpha_f + A_f z_{t-1} + \epsilon_{f,t},$$

$$z_t = \alpha_z + A_z z_{t-1} + \epsilon_{z,t},$$

where

- $r_{i,t}$ is the return of hedge fund $i$ in excess of riskless rate in month $t$;
- $z_t$ is the vector of $M$ business cycle variables observed at the end of month $t$;
- $f_t$ is a vector of $K$ zero-cost benchmarks;
- $\beta_{i,0}$ is the fixed component of fund risk loadings;
- $\beta_{i,1}$ is the variable component of fund risk loadings;
- $\epsilon_{i,t}$ is fund-specific event, which is assumed to be uncorrelated across hedge funds and over time, and normally distributed with mean zero and variance $\Psi_i$.

Gibson, Wang (2010) note that the problem of the optimal hedge fund investment portfolios formation can be solved by the optimization of the investment portfolio, namely each investor forms his/her portfolio by maximizing the conditional expected value of a quadratic utility function

$$U \left( W_t, R_{p,t+1}, a_t, b_t \right) = a_t + W_t R_{p,t+1} - \frac{b_t}{2} W_t^2 R_{p,t+1}^2,$$

where

- $W_t$ denotes the time $t$ invested wealth;
- $b_t$ reflects the absolute risk aversion parameter;
- $R_{p,t+1}$ is the realized excess return on the optimal of hedge funds computed as

$$R_{p,t+1} = 1 + r_{ft} + w_i r_{i,t+1}$$

where
• $r_t$ being the risk-free interest rate;
• $r_{t+1}$ denoting the vector of excess fund returns;
• $w_t$ denoting the vector of optimal hedge fund allocations.

The optimization problem reduces to the equation

$$w_t^* = \arg\max_{w_t \geq 0} \left\{ w_t' \mu_t - \frac{1}{2 \left( 1 / \gamma_t - r_{ft} \right)} w_t' \Lambda_t^{-1} w_t \right\},$$

where

• $\gamma_t = (b_t W_t) / (1 - b_t W_t)$ is the relative risk-aversion parameter,
• $\Lambda_t = [\Sigma_t + \mu_t \mu_t']^{-1}$, with $\mu_t$ and $\Sigma_t$ being respectively mean vector and variance matrix of future hedge fund returns;
• the possibility of leveraging and short selling is excluded when forming optimal hedge funds’ portfolios.


In general case, the problem on the optimization of the investment portfolio return premiums by the hedge funds can be solved with an application of the Probabilistic Global Search Lausanne (PGSL) algorithm, Multi-level Co-ordinate Search (MCS) algorithm, Matlab Direct Search algorithm, Matlab Simulated Annealing algorithm, Matlab Genetic algorithm in the case of a Fund of the Hedge Funds (“FoHF”) in Minsky, Obradovic, Tang, Thapar (2009).

In Fig. 27, the dependence of the investment return premiums on the different investment strategies implementation by the hedge fund over a certain time period is shown. This dependence is created, going from the research in Boyson, Stahel, Stulz (2008), Ledenyov D O, Ledenyov V O (2013h).

Fig. 27. Dependence of investment return premiums on different investment strategies by hedge fund over selected time period.
Let us make a plausible explanation on the modern hedge fund organization structures in details. The hedge funds maximize the investment return premium by optimizing the internal operations efficiency due to in Ledenyov D O, Ledenyov V O (2013h):

1. The optimization of internal organizational expenses, connected with the internal operations, by outsourcing the trading transactions to the prime brokers (the investment banks);
2. The optimization of external organizational expenses, connected with the taxation, by minimizing the taxes due to the registration in the tax heavens with the low income taxation level.

There are many possible hedge fund organization structures models with the certain advantages and disadvantages in Mitra (2009), Cao, Ogden, Tiu (2011), Ledenyov D O, Ledenyov V O (2013h):

1. The traditional investment bank model;
2. The inside-only hedge fund model;
3. The straddling hedge fund model;
4. The straddling “feeder” fund of funds model;
5. The stand-alone outside hedge fund model;
6. The outside “feeder” fund of funds model.


1. The convertible arbitrage: An investment in the investment products such as the convertible fixed income securities (the bonds) for the long time and to company common stock (the stock) for the short time to get an increased investment premium over the time;
2. The distressed securities: An investment in the investment products such as the financial securities, impacted by a distressed situation, to get an increased investment premium over the time;
3. The long/short equity hedge: An investment in the investment products such as the long/short equity to get an increased investment premium over the time;
4. The equity market neutral: An investment in the investment products such as the financial securities with a total net exposure of zero to get an increased investment premium over the time;
5. The event driven: An investment in the investment products such as the financial securities with the significant transactional activity, including the spin-offs, mergers and
acquisitions, industry consolidations, liquidations, reorganizations, bankruptcies, recapitalizations and share buybacks, to get an increased investment premium by predicting the price movement over the time;

6. The global macro: An investment in the investment products such as the interest rates, foreign exchange rates and physical commodities with the extreme price valuations in stock markets, predicting their price movements, to get an increased investment premium over the time;

7. The merger arbitrage: An investment in the investment products such as the companies securities with the extraordinary corporate transaction activities: the acquisition or merger proposals, exchange offers, cash tender offers and leveraged buy-outs, to get an increased investment premium over the time;

8. The relative value arbitrage: An investment in the investment products such as the financial securities to make the spread trades to get an increased investment premium from a relationship between the two related securities instead of from the market direction over the time.

9. The emerging markets: An investment in the investment products such as fixed income securities in emerging markets around the world to get an increased investment premium over the time.

10. The fixed income arbitrage: An investment in the investment products such as the interest rate swap arbitrage, US and non-US government bond arbitrage, forward yield curve arbitrage, and mortgage-backed securities arbitrage to get an increased investment premium over the time.

11. The managed futures: An investment in the investment products such as the listed financial and commodity futures markets and currency markets around the world to get an increased investment premium over the time.

12. The diversified debt: An investment in the investment products such as the diversified debt to get an increased investment premium over the time.

13. The multi-strategy: An investment in the different investment products, dynamically allocating the financial capital among the selected investment strategies to get an increased investment premium over the time.

14. The fund of funds: An investment in the investment products such as the other hedge funds to get an increased investment premium over the time.

The hedge funds organization, investment strategies, investment return premiums and related research topics in the finances have been researched in Brown, Harlow, Starks (1996), Brown, Goetzmann, Park (1997), Brown, Goetzmann, Ibbotson (1998), Brown, Goetzmann,
5.4 Pension fund as investment vehicle.

The pension fund is an investment vehicle, which is founded to collect, borrow, administer, and most importantly increase the financial capital by making the financial capital investment in the capital markets with the goal to get an increased return premium in the short and long time periods.

A main purpose of the pension fund is to make the retirement income provision for the beneficiaries. Speaking clearly, the public/private pension funds provide the employer-sponsored pension benefits to the beneficiaries in the frames of the defined benefit plan, the defined contribution plan and the hybrid scheme plan in Evans, Orszag, Piggott (editors) (January 1 2008). The private/public pension fund makes the centralized financial capital contributions collection, then it invests the collected financial capital into the various investment products (the investment asset classes) with the help of the experienced fund managers, and after some time it expects to get the positive return-on-the-investment (ROI) in Clark (July 13 2000, March 27 2003, 2008), Evans, Orszag, Piggott (editors) (January 1 2008). Most importantly, the pension fund investment policy is usually directed toward the beneficiary’s wealth maximization, depending, to a certain extent, on the type of the selected plan: the defined contribution plan, the defined benefit plan, the hybrid scheme plan in Bodie (October 1988), Bodie, Kane, Marcus (1989). The Boards of Trustees oversees all the financial capital investments by the pension fund.
managers, having the statutory authority over the pension fund investment activities in Kakabadse N, Kakabadse A, Kouzmin (2003).

The public/private pension funds compete with other investment vehicles in the capital markets, however they are considered to be relatively inefficient in view of the following reasons: the weak control over the selected plans by the pension fund managers, the high operating costs by the public/private pension funds and the existing difficulties with finding of the highly skilled/experienced pension fund managers in Impavido (2008). The public/private pension funds are not immune from the high volatility in the capital markets, which is caused by the economic variables fluctuations in the economies of the scales and the scopes in Antolin (2008).

5.5 Mutual fund as investment vehicle.

The mutual fund is a pooled investment vehicle, which is founded to collect, borrow, pool together, process, and increase the borrowed financial capital by making the financial capital investment into the selected investment products in the chosen investment mediums in the capital markets with the goal to get an increased return premium in the short and long time periods.

The mutual fund’s distinctive features for the prospective investor, comparing to other investment vehicles, include in Sharpe (January 1966), Prather, Bertin, Henker (2004), Anderson, Ahmed (2005):

1. The professional management by fund managers;
2. The professional marketing by fund managers;
3. The professional distribution by fund managers;
4. The small-medium-big investments acceptance;
5. The investment assets classes diversification;
6. The investment transaction cost savings;
7. The total investment risk reduction.

In fact, the family of mutual funds can be created within the main mutual fund in Ciamarra, Hornstein (2015). The mutual fund as an investment vehicle can be described in terms of the following economical parameters in Sharpe (January 1966):

1. The small/medium/big investors clientele;
2. The financial capital value under the management;
3. The investment strategies;
4. The former/present financial performance;
5. The management fee level.

The various financial metrics can be applied to analyse the mutual fund performance over the time in Soongswang, Sanohdontree (2011):

1. The traditional fund performance evaluation measures;
2. The data envelopment analysis (DEA) measure;
3. The Pearson’s correlation coefficients;
4. The cover of six different investment horizons.

In real life situation, the mutual funds, generally, like to invest the financial resources into the large firms shares, assuming to reach the high return-on-investment at the low market risk. However, it is necessary to remember that the mutual fund’s performance depends on a number of discretely changing macroeconomic/microeconomic factors in the financial system in the
selected economy of the scale and the scope in Sharpe (January 1966), Jensen (June 1968), Arditti (1971), Fama (June 1972), Scott, Klemkosky (1975), Kon, Jen (April 1979).


5.6 Venture capital fund as investment vehicle.

The venture capital (VC) is considered to be an important source of corporate financing in the economy of the scale and the scope. The venture capital concept on the startup firms funding by venture capital from the venture capital funds was created by George Doriot, General, Harvard Business School, Harvard University and by Karl Comptom, President, Professor, Massachusetts Institute of Technology in the USA in 1946 in Allen (2012).

Thus, the **venture capital fund** is an investment vehicle, which is created for the wealth management by making the venture capital investment in the startup companies with the aim to get an increased return premium in the capital markets in the short and/or long time periods. The American Research and Development (ARD) fund was a first VC fund in Allen (2012). The VC fund typically operates in the capital markets, which are impacted by various types of nonlinearities due to the asymmetric information flows between the economic agents in Jaffee, Russell (1976), Leland, Pyle (1977), Stiglitz, Weiss (1981), Stiglitz (1988), Zhang (2007b), Diaconu (2012). The VC fund can manage the financial capital from many venture capital firms by investing it into the selected startups, which are working on the entrepreneurial ideas to deliver the product/services to the certain customers at selected markets and contributing to an overall growth of national economies in Kirzner (1973), Lucas (1978), Audretsch, Keilbach (2004), Samila, Sorenson (2011). The founders and owners of the successful startup firm are called as the unicorn(s), if the total valuation of the startup is above one billion US dollars.
Discussing the early research results on the venture capital investments in the USA, let us explain that the rise/fall of venture capital was described in Gompers (1994). The optimal investment of venture capital was discussed in Gompers (1995, 1996). The empirical analysis of venture partnership agreements was done in Gompers, Lerner (1996). The various types of risks at the venture capital investing were 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 Y (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% 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 the IPO process in Japan, writing that the venture capital plays 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 that the government created the venture capital market in 1998 through a direct injection of the equity capital, a creation of the generous tax incentives and an establishment of the equity guarantees, and a designation of the certain small firms as the 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 industry have been discussed in Lingelbach, Murray, Gilbert (2009).

1. The general partners (GPs) are the Venture Capital firms;
2. The limited partners (LPs) are the institutional investors (the banks, pension funds, insurance companies and foundations) and the private investors (the wealthy individuals);
3. The venture capital is a financial capital (an equity financing resource) to invest into the start-up company with the focus on the early stage product/service development, the high risk business plan realization, pre-initial public-offering business creation;
4. The venture capital fund is an investment vehicle with the lifetime of 8-10 years;
5. The venture capital firm is a partnership among the venture capitalists to provide an expertise in the financial capital investment, the business strategy creation, the business management and the human resources management in the start-up company;
6. The venture capitalist is an active investor-financier with the capital markets knowledge, the entrepreneurial process experience, and the network of business contacts, who performs a function of the intermediation between the private/institutional investors and the start-up in the conditions of the asymmetric information flows;
7. The startup company is a privately held early stage hi-tech company with the business plan and the high growth business potential.
8. The venture capital industry is an industry created of the VC funds, which has a cyclical business nature.

Fig. 28 shows the venture capital organization scheme.

Fig. 28. Venture capital organization scheme.
Let us formulate 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. The big upfront financial resources requirement at the time, when there will be no the cash flows for a long time;
2. The big substantial uncertainty on the final potential outcomes in forms of developed products or services;
3. The presence of intangible assets in start-up company, which cannot be used as collaterals to get the financing.

All of the above listed issues can potentially reduce the willingness by financiers to provide financing to the new ventures, causing the credit-rationing in Stiglitz, Weiss (1981). Therefore, the VC financing represents a possible solution for the above mentioned financial problems in the cases of the innovative high-tech start-up companies.

There is a number of the different possible 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):

1. The seed financing, intended for new firms for the initial concept evaluation);
2. The start-up financing (aiming at the development of the firm’s product before the firm has sold any products);
3. The expansion financing (aiming to assist the growth and expansion of the firm).

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

1. The insider capital, informal private equity and easy-term public financing (Seed);
2. The venture capital financing (Start-up);
3. The self-financing, bank and/or business credit (Early Growth);
4. The direct issue of bonds and public equity (Sustained Growth).

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

1. The start-up stage: the phase, when the company has a business plan for the product or service development;
2. The development stage: the phase of product/service development, when the revenues from sales are not generated;
3. The beta stage: the phase of the product testing by a limited number of customers. For example: the device testing;
4. The shipping stage: the phase at which the product/service is being sold to customers, generating the small revenues stream with the expenses still exceeding the revenues;
5. The profitable stage: the phase at which the company is selling products or services, generating a positive net income;

6. The restart stage: the phase at which the firm is recapitalized at a reduced valuation, pursuing the product or marketing focus shift.

The necessary and sufficient condition for the startup firm to obtain the financing from the uninformed investors can be written as 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)

$$I_{vc}(\beta) \geq \frac{cp_H}{\beta(p_H - p_L)}$$

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.

Let us consider the typical venture capital investment scheme at the venture capital investment deal making process by the venture capital fund in Tyebjee, Bruno (1984), Da Rin,

Fig. 29 shows the venture capital investment scheme at the venture capital investment deal making process by the venture capital fund.

![Diagram of venture capital investment process scheme](image)

**Fig. 29.** Venture capital investment process scheme.
Let us discuss the asymmetric information problem between the various market agents at VC investment process. The impact by the investments on the economy performance has been studied in Akerlof, Stiglitz (1966). The theory of the 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 different 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 also discovered that the imperfect information affects both the internal organization of the firms and the external relations with the labor, capital and product markets in Greenwald, Stiglitz (1990). The asymmetric effect of the diffusion processes has been explained in Richiardi, Gallegati, Greenwald, Stiglitz (2007). Leland, Pyle (1977), Amit et al (1990), Fried, Hisrich (1994), Gompers (1995), Zhang (2007b) highlighted the fact that the VC investment is characterized by an asymmetric information flows between the equity investors and the entrepreneur. This information asymmetry may prevent the venture capitalists from the investing of financial capital in the start-ups. There are two possible ways to overcome this problem in Tyebjee and Bruno (1984), Zhang (2007b): 1) the stage by stage investments of the financial capital by the venture capitalist into the startup; and 2) the evaluation of the startup owners by their entrepreneurial history. Pennacchio (2013) stresses an important role of the venture capitalists in the IPOs, saying that the analysis of the venture capital backing’s effect on the IPO underpricing is a suitable way to investigate whether the venture capitalists are able to reduce 1) the asymmetric information in the IPO process and 2) the oscillations of the company stock price in the case of the IPO process. Ledenyov D O, Ledenyov V O (2013i) 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. Ledenyov D O, Ledenyov V O (2013i) think that 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.

5.7 Angel investor as investment vehicle.

The angel investor or the business angel is an investment vehicle under the management by a private investor (a high-net-worth individual), who intends to make his/her own financial capital investment in the early-stage high-risk private unquoted startup-companies with the aim to get an increased return premium in the capital markets in the short and long time periods; and to take an active part in the business management as an advisor/member of the board of directors in the startup of interest in Wetzel (1981, 1983), Mason, Harrison (2008), Lerner, Schoar, Sokolinski, Wilson (August 2015), Landström, Mason (2016a, b).

The business angel term was coined in Wetzel (1981, 1983). The main conditional distinction between the angel investors and the venture capitalists is in their investment practices: the angel investors provide the small amounts of capital in order of US$50k–US$5m to the early-stage high-risk startups, whereas the traditional venture capitalists have almost abandoned the early-stage high-risk startups investment opportunities space in Van Osnabrugge (2000), Mason (2016). The angel investing as an investment vehicle for the private equity investing is almost 33 years old, whereas the venture capital investing is around 60 years old in Wetzel (1981, 1983), May, Manhong Mannie Liu (2015).
The startup’s financing chain from the company’s foundation phase to the company’s maturity phase may include the following stages in the time domain in Mercil (2006):

1. The founders financing at initial stage;
2. The angel investors financing at product/service prototype stage;
3. The venture capitalists financing at product/service rollout stage;
4. The corporate investors financing at product/service rollout stage;
5. The investment banks financing at growth stage;
6. The IPO financing at expansion/maturity stage.

Indeed, the angel investors play a significant role in the inclusive financing of the early-stage startups in the economies of the scales and scopes, because they provide the seed capital for the hi-tech business ventures at the time, when these companies have a limited access to the financial resources from the traditional financial banks and institutions in Rubenstein (1958). In other words, the business angels stimulate the R&D and business activities in the early-stage high-risk startups by deploying the relatively small amounts of seed capital toward the highly innovative transformative technological solutions development in the selected startups. In addition, the business angels can contribute the so-called smart capital in the form of the product/service knowledge, business experience and contacts networks to the selected startup. These startups may potentially create the innovative products/services for the consumers, adding the economic value to and increasing the economic output of the economies of the scales and the scopes in Jensen (2002).

There may be the business angel networks (BANs) to effectively match the solo angel investors / the angel investors group(s) / the angel investors syndicates to the perspective early-stage high-risk startup companies with the aim to form the effective investment relationships in the economies of the scales and the scopes in EBAN (European Business Angel Network) (2005). The BANs increase the transparency, improve the efficiency, and decrease the search time toward the business deal making/brokering in the business angel investment market.

The startup’s financing process by the business angel(s) has the following investment stages in Mason, Rogers (1997), Landström, Mason (2016a, b):

1. The startup’s application stage;
2. The startup’s pre-screening stage;
3. The startup’s detailed due diligence stage;
4. The BA’s investment entry into selected startup stage;
5. The BA’s investment exit from selected startup stage.
In some cases, the business angels can form a group of the business angels to make the crowd-investing (the crowd-funding), which is a new form of the financing, when the a number of the small investors finance the startup business plan by collecting the necessary funds on the Internet in Sidman (2015), Hornuf, Schwienbacher (October 29 2016).

Of course, the creation and introduction of the progressive economic regulation policies frameworks by the governments can further stimulate the business angels activities to make the financial/knowledge capital investments into the perspective early-stage high-risk private unquoted startup-companies within the corresponding business ventures clusters in the economies of the scales and the scopes.

5.8 Investment boutique firm as investment vehicle.

The **investment boutique firm** represents an investment vehicle in the form of a small brokerage investment advisory firm on the wealth management towards the financial capital growth by making a limited number of the financial capital investments into the capital markets with the aim to get an increased return premium in the short and long time periods.

In other words, the investment boutique firm is a small brokerage investment advisory firm with the specialization in both the single corporate finance client sector (the telecommunications sector, the media sector, the retail sector) or the ultra-high net worth individuals, performing the private equity management and the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods in Hall (2007), Morrison, Wilhelm (Winter 2007).

Goodhart, Schoenmaker (March 2016) proposed to differentiate the four-tiers in the investment banking system in the capital markets in the finances, positioning the investment boutique firm at the tier four:

1. The global investment banks-giants;
2. The regional investment banks;
3. The national investment banks;
4. The small specialist advisory wealth management investment boutiques.

It makes sense to comment that the investment boutique firms industry has a different development dynamics, comparing to the investment banking industry in the global financial centers in the recent years in Hall (2007). In some cases, the investment boutique firms successfully compete with and challenge the big investment banks in the global capital markets. In other cases, the investment boutique firms pick up the outsourced businesses from the big investment banks such as the M&A advisory services or financial assets trading in the global capital markets in Morrison, Wilhelm (Winter 2007). The investment boutique firms in the finances have been researched in Thrift (1994), Luenberger (1997), Hall (2007), Morrison, Wilhelm (Winter 2007), Office of Career Services August (2012), Weihong Song, Wei Jie, Lei Zhou (2013), Goodhart, Schoenmaker (March 2016), Thomson Reuters (2016), Wikipedia (2016).

Finally, reviewing the ongoing trends in the investment vehicles in the finances, we would like to highlight the recent important developments such as a presence of an increasing number of the private investment offices in the financial industry around the World. The private investment office is an investment vehicle, a narrow specialized investment boutique firm and an investment advisory firm on the wealth management, which takes care about the accumulated wealth by the ultra-high-net-worth individuals. The main objective by the private investment office is to increase the financial capital by making the highly selective financial capital investments into the high-quality investment products in the capital markets with the aim to get an increased return premium in the short and long time periods.

In Chapter 5, we have already discussed the numerous investment vehicles for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

In Chapter 6, we will conduct a research discussion on the investment mediums for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.
Chapter 6

Investment mediums for financial capital investment in capital markets

The investment medium is a financial environment, where the allocation of the financial capital to the investment product with an application of the investment vehicle is conducted in the process of the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. There are many different types of investment mediums with the various characteristic properties, which also serve as the mediums of exchange in the capital markets in the finances.

Fig. 30 shows the investment mediums in the capital markets in the finances.

Fig. 30. Investment mediums in capital markets in finances.
Exploring the finances universe, let us assume that one of the observable stars has the multiple light emitting beams, radiating the light in the surrounding space. In this case, the following two theoretical premises can be made:

1. The star is formed of the different investment mediums;

2. The radiating beam of light with the different wavelength corresponds to a certain investment medium in the capital markets.

Let us consider the investment mediums (the exchange mediums) by paying a lot of attention to the notable research results on the subject of research interest.

6.1 Land exchange as investment medium.

Let us stick with the notion of the book and begin our consideration by saying that the land exchange can be regarded as one of the oldest investment mediums, which was created by the humans in the initial economies of the scales and the scopes on our planet. Indeed, the sellers of the land tried to make the direct land sales deals with the buyers of the land for the farming purposes mainly at the land exchanges in the primitive economies of the scales and scopes. At the later time, the trading land types included the farming land, the forest land, the building construction land, etc.

6.2 Real estate exchange as investment medium.

Undoubtedly, the real estate exchange can be considered as an investment medium, which was established by the economic agents in the initial economies of the scales and the scopes at the ancient times. Obviously, the real estate exchange was an exchange medium, where the numerous business deals on the real estate properties between the sellers of the real estate and the buyers of the real estate were completed. The real estate property includes the private homes, business shops, business centers, trade markets, public buildings and cathedrals, built of the different materials such as the wood, clay, stone, red bricks and concrete.

6.3 Stock exchange as investment medium.

Let us follow on with a comprehensive discussion on the history of the firms’ stock exchange, which is one of most attractive investment mediums from the investor’s point of view. We would like to be focusing on the historical heritage, the regulatory aspects, and the operation principles, considering the European, American and Asian stock exchanges mainly. Most importantly, we would like to conduct the research discussion, using the obtained research findings in Ledenyov D O, Ledenyov V O (2013f).

The Amsterdam Stock Exchange is probably the oldest stock exchange, which was founded in Amsterdam in the Netherlands in 1602 in Joseph Penso de la Vega (1668, 1996),
Viveen (2013), Shiryaev (1998a). The Amsterdam Stock Exchange has had the multiple periods of sustainable development and sharp decline, reflecting the historical economical development stages in The Netherlands in recent centuries in Landes (1998).

In the seventeenth century, the Britain succeeded the Netherlands as the biggest economy, throwing in the age of innovation by the way of the industrialization in Landes (1998), Viveen (2013). At that time, the British financial system was emulated to some degree from the Dutch financial system, for example, Munro (2003) writes: “Many English observers were praising the Dutch financial system as the one to emulate.” The London Stock Exchange (LSE) has its historical beginnings since 1700 in Michie (1999, 2001). The LSE as a financial institution was established with a main goal to facilitate the development of the financial securities exchange market, and it has a long history of operations since early 1801 in Maddison (1875), Morgan, Thomas (1961), Michie (1988), Michie (1999, 2001), Neal (2005). The first LSE regulation framework was officially printed in February, 1812 in Neal (2005). Since that time, the LSE played one of the key roles in the first global capital market creation in Neal (2005). The LSE remained the world's most innovative stock exchange in the global capital market until recently in Neal (2005), however it gives up slowly to the Asian stock exchanges, because of the multiple impacts by the globalization process and the UK’s Brexit political initiative.

The Paris Stock Exchange (PSE) represents the core of the financial securities exchange market in France since 1801 in Courtois (1855), Maddison (1875), Arbulu (1998a, b), Petit (2006), Hautcoeur, Riva (2007), Gallais-Hamonno, Georges (2007), Le Bris, Hautcoeur (2011). In the IXX-XX centuries, the Paris Stock Exchange evolved to become a stock exchange with the big perspectives for the European investors in Arbulu (1998a, b). Presently, the Paris Stock Exchange tries to attract the new public listed companies from the London Stock Exchange, attempting to become a new growing international center in Europe.

The New York Stock Exchange (NYSE) conducts its operations in New York, USA since 1817 in Shiryaev (1998a). The NYSE is one of the biggest companies’ stock exchanges in the world, because of both: 1) it has one of the most advanced technical infrastructures, and it has an access to the biggest economy of the scale and the scope in the USA. The New York Stock Exchange was modernized extensively, implementing the several electronic trading technology upgrade phases in recent decades. The NYSE is regarded as a financial industry leader with the considerable expertise in the financial securities trading as explained in numerous analytic reports by the financial experts. Besides, in the present time, the NYSE works intensively to attract the new companies to conduct the IPO from mainland China, Hong Kong, Singapore,
aiming to overcome the severe consequences of economic downturns in the USA such as the IT industry bubble crush in 2001 and the financial industry collapse in 2008.

The Tokyo Stock Exchange (TSE) was founded in Tokyo, Japan in 1878 in Hamao, Hoshi, Okazaki (2005). The TSE represents a most innovative platform for the companies’ stock exchange, mainly dealing with the public listed companies in Japan. The relative isolation of the financial system in Japan from the rest of the World makes it difficult for the foreign companies to be listed at the TSE. The negative interest rates by the central bank in Japan are mainly stipulated by the presence of:

1. The high rate of the state budget deficit,
2. The practice of sales of the government bonds to the Japanese firms mainly, and
3. The lack of desire by the central bank to disseminate the Japanese Yen as a mean of payment around the World.

Therefore, a number of the listed foreign companies at the TSE is relatively small presently.

The global stock exchanges have various efficiencies of operations, which are mainly defined by the structure of organizational rules, listed companies valuations, national financial systems state and by some other factors in agreement with the theory of financial exchange organization in Davis, Neal (1998), Pirrong (1999, 2000). There is a considerable increase of the listing requirements for the companies at the global stock exchanges, aiming to make the companies as transparent as possible for the investors during the investment decision making process toward the investment portfolios building in Davis, Neal, White (2003), Elton, Gruber (1995). The global investors pursue a plenty of the different investment strategies at the modern stock exchanges, which can be characterized by the Return-on-Investment (ROI) and other parameters in Lowenfeld (1907, 1910), Gregory, Harris, Michou (2001). The most innovative stock exchanges include the Amsterdam, London, Melbourne, Frankfurt, Paris, Frankfurt, New York, Toronto, Tokyo, Shanghai, Hong Kong and Singapore stock exchanges in Hart, Moore (1996), Goetzmann, Ibbotson, Peng (2000), Le Bris, Hautcoeur (2011).

Today, the competition among the various stock exchanges for both 1) the public companies and 2) the investors increases exponentially as a result there is a trend toward the stock exchanges integration, which is realized by the means of the Mergers and Acquisitions (M&A) process between the different stock exchanges in Di Noia (2001). For example, the Amsterdam Stock Exchange merged with the Brussels Stock Exchange (BSE) and the Paris Stock Exchange to establish the Euronext in 2000 in Ledenyov D O, Ledenyov V O (2013f).

Let us sum up our discussion on the companies stock exchanges as an investment medium by saying that an accurate characterization of the stock market indexes trends dynamics
in the conditions of the nonlinear capital flows during the electronic trading by the companies shares at the stock exchanges in the global capital markets becomes an important research task at our time in Ledenyov D O, Ledenyov V O (2013f). During the accurate characterization, the dependence of the stock market indexes on the company valuation, the dependence of the stock market indexes on the foreign currencies exchange rates, the dependence of the stock market indexes on the interest rates, the dependence of the stock market indexes on the strategic commodities, and the impact by the nonlinear capital flows on the stock market indexes must be taken to an account in Ledenyov D O, Ledenyov V O (2013f).

Jordan, Ritter (2008a), Bradley, Chan, Kim, Singh (2008b), Busaba, Benveniste, Guo (2001),
Hoffmann-Burchardi (2001), Holmén, Högfeldt (2001), Houge, Loughran, Suchanek, Yan
(2001), Maksimovic, Pichler (2001), Purnanandam, Swaminathan (2001), Rehkugler, Schenek
(2001), Schatt, Roy (2001), Schatt, Broye (2003), Sentis (2001), Sentis (2002), Sentis (2004),
(2004), Biais, Bossaerts, Rochet (2002), Biais, Faugeron-Crouzet (2002), Blondell, Hoang,
(2002), Cheng, Mak, Chan (2002), Deloof, de Maeseneire, Inghelbrecht (2002), Easton, Taylor,
Giudici, Roosenboom (2002), Giudici, Roosenboom (2005), Hauge, Loughran, Suchanek,
Xueming Yan (2002), Kim, Kitsabunnarat, Nofsinger (2002), Kiss, Strehle (2002), Kutsuna,
(2002), Xie (2002), Baginski, Wahlen (2003), Barondes, Nyce, Sanger (2003), Bartlett, Shulman
(2003), Binay, Pirinsky (2003), Bourjade (2003, 2008), Clarke, Dunbar, Kahle (2003), Derrien,
Womack (2003), Doeswijk, Hemmes, Venekamp (2005), Ellul, Pagano (2003), Goergen,
Khurshed, McCahery, Renneboog (2003), Gounopoulos (2003), Gulati, Higgins (2003), Higgins,
Gulati (2003), Hoberg (2003), Hong, Kubik (2003), Huyghebaert, Van Hulle (2003), Jelic,
Briston (2003), Kaneko, Pettway (2003), Karolyi, Stulz (2003), Kraus, Burghof (2003),
Lemmens (2003, 2007), Lemmens (2004, 2007), Manigart, de Maeseneire (2003), Neuhaus,
Schremper (2003), Nounis (2003), Ofek, Richardson (2003), Peristiani (2003), Pham, Kalev,
Steen (2003), Roosenboom, Van der Goot (2003), Roosenboom, Van der Goot, Mertens (2003),
Roosenboom, Van der Goot (2005), Roosenboom (2007), Smart, Zutter (2003), Van Bommel,
Vermaelen (2003), Van der Goot (2003), Weber, Willenborg (2003), Arugaslan, Cook,

Let us add a few words on the firms’ stock options exchange, which is an investment medium for the firms’ stock options trade/exchange by the experienced investors in the capital markets. The Chicago Board Options Exchange (CBOE) represents a main platform for the stock options trading in the USA. The operating rules for the Chicago Board Options Exchange (CBOE) are described in Chicago Board Options Exchange (1996).

6.4 Foreign currencies exchange as investment medium.

Moving to the next topic, we would like to continue our research discussion with a consideration on the foreign currencies exchange, which can also be described as one of the investment mediums in the capital markets in the finances in Ledenyov V O, Ledenyov D O (2016s).

The foreign currencies exchange markets have been established, pursuing a goal to facilitate the international trade by the goods and services between the various states with the different financial systems and the distinctive units of payment in XIX – XXI centuries in Ellis, Metzler (editors) (1949), Machlup (1949), Robinon (1949). Going from the research in Ellis, Metzler (editors) (1949), Machlup (1949), Robinon (1949)), we can definitely say that the growing international trade resulted in:

1. The constant need to exchange the foreign currencies;
2. The strong necessity to rate the foreign currencies;
3. The necessity to establish the foreign currencies exchange markets.

In our time, the global investors like to conduct the investments in the foreign currencies in the global capital markets, making their assumptions on the foreign currencies exchange rates trends dynamics as well as pursuing the only main goal to get the increased return premiums in the foreign currencies exchange markets in the short and long time periods in Goodhart (1992), Goodhart, Hall, Henry, Pesaran (1993), Goodhart, O’Hara (1995), Goodhart, O’Hara (1997).
As we already know, in the Schumpeterian technical and social innovations disruption age, there is a big number of unlimited opportunities toward a new era of the ultra high frequency electronic trading in the foreign currencies exchange markets has been created due to an increasing application of the computations processing in the range of ultra high frequencies in the modern finances in Ledenyov V O, Ledenyov D O (2016s).

Of course, there is a number of scientific methods for an accurate forecast of the foreign currencies exchange rates oscillations dynamics during the ultra high frequency electronic trading in the foreign currencies exchange markets in the short and long time periods in Ledenyov V O, Ledenyov D O (2016s). More specifically, the investors’ assumptions on the FX rates can be significantly improved, using the modern techniques on a precise characterization on the foreign currencies exchange rates at the ultra high frequencies electronic trading in the foreign currencies exchange markets in the short and long time periods, which can be realized with an application of the mathematical, financial, electronic and quantum analysis methods in Ledenyov V O, Ledenyov D O (2016s).

Miller, Eichengreen, Portes (editors) (1989), Van Hagen (1989), Allen, Taylor (1990), Allen,
Karjalainen (1999), Courakis, Taylor (1990), Diebold, Nason (1990), Flood, Hodrick (1990),
Foster, Viswanathan (1993), Holthausen, Leftwich, Meyers (1990), De Long, Shleifer, Summers,
Waldmann (1990), Domowitz (1990, 1993), Domowitz, Steil (1999), Johansen, Juselius (1990),
(1990, 1995), Mishkin (1990), Müller, Dacorogna, Olsen, Pictet, Schwarz, Morgenegg (1990),
Müller, Dacorogna, Dave, Pictet, Olsen, Ward (1993), Müller, Dacorogna, Dave, Olsen, Pictet,
Black (1991), Bossaerts, Hillion (1991), Burnham (1991), Campbell, LaMaster, Smith, Van
Choi, Elyasiani (1997), Curcio, Goodhart (1992), Curcio, Goodhart, Guillaume, Payne (1997),
De Grauwe, Decupere (1992), De Grauwe, Grimaldi (2006a, b), Edison (1992, 1993, 2003), Edison,
1998), Gosh (1992), Guillaume, Dacorogna, Dave, Muller, Olsen, Hamon, Jacquillat (1992),
Guillaume, Pictet, Dacorogna (1995), Guillaume, Dacorogna, Dave, Muller, Olsen, Pictet
Chinn, Marsh (2004), Cheung, Chinn, Pascual (2004, 2005), Dacorogna, Muller, Nagrel, Olsen,
Pictet (1993), Dacorogna, Muller,
6.5 Financial securities exchange as investment medium.

The high investment culture among the private/institutional investors is a golden key to the long-term prosperity of the economy of the scale and the scope. As we know the investors frequently like to invest the financial capital into the numerous financial securities with the help of various investment vehicles in the different investment mediums such as the financial securities exchanges in the capital markets in the finances.

Actually, there are the two big groups of the financial securities exchanges, where the most innovative investment products such as the financial securities, including the credit derivatives, are traded among the financial dealers/organizations in Heckinger, Mengle (2013), Steigerwald (2013), Heckinger, Ruffini, Wells (2014):

1. The over-the-counter (OTC) derivatives exchanges, where the derivatives contracts (the swaps) are confidently negotiated/exchanged between the counterparties. All the OTC derivatives contracts are cleared/settled on the bilateral basis or on the Counterparty Clearing House basis;

2. The listed derivatives exchanges, where the derivatives contracts are openly traded/exchanged among all the interested parties.

The financial futures derivatives contracts were openly traded/exchanged at the Chicago Mercantile Exchange since 1972. Presently, the financial derivatives contracts are traded at in Heckinger, Mengle (2013), Steigerwald (2013), Heckinger, Ruffini, Wells (2014):
1. The Chicago Mercantile Exchange (Group CME Group);
2. The Chicago Board Options Exchange (CBOE);
3. The Deutsche Börse AG;
4. The European Exchange (Eurex);
5. The Hong Kong Stock Exchange;
6. The London Stock Exchange (LSE);
7. The Moscow International Currency Exchange (MICEX-RTS);
8. The National Stock Exchange of India (NSEI);
9. The New York Stock Exchange (NYSE Euronext);
10. The Singapore Stock Exchange;
11. The Tokyo Stock Exchange (TSE);
12. The Toronto Stock Exchange (TSE).

The statistics on the trading by the financial derivatives contracts is conducted by the World Federation of Exchanges (WFE).

6.6 Commodities exchange as investment medium.

Focusing on the forthcoming issue, we would like to explain that the commodities exchange is one of the investment mediums in the capital markets in the finances. The commodities exchanges have been created to facilitate the commodities trading on a global scale.

There are the following commodity exchanges in Demidova-Menzel, Heidorn (August 2007), Yamori (September 7 2009):

1. The Commodity Exchange (COMEX);
2. The New York Mercantile Exchange (NYMEX);
3. The Chicago Board of Trade (CBOT);
4. The Tokyo Commodity Exchange (TCE);
5. The Tokyo Grain Exchange (TGE).

6.7 Precious metal exchange as investment medium.

Considering the next topic of our research interest, it makes sense to explain that the precious metals exchange and the industrial metals exchange can also be defined as the existing investment mediums in the capital markets in the finances, where the precious metals are being valued, traded, sold and bought at the certain open-market prices by the metal traders as requested by the investors/industrialists around the World.

In general, let us make a few short remarks that the precious metals, including the gold, silver, platinum and palladium, are classified as the commodities asset class in Anikin (1988), Figuerola-Ferretti, McCrorie (2016). The precious metals synthesis, application, and industrial consumption in the economy of the scale and the scope has been studied in Hourwich (1902, 1903). The precious metals valuation in the economy of the scale and the scope has been studied in Goodman (1956), Crowson (1987), Kaufmann, Winters (1989), Aggarwal, Lucey (2007). The precious metals prices dependences on various oscillating economic variables such as the industrial consumption in the real sector of the economy of the scale and the scope have been researched in Fama, French (1988), Labys, Achouch, Terraza (1999). The precious metals prices
dependences on various fluctuating financial variables such as the foreign currencies exchange rate in the finances have been researched in Crowson (1987). The precious metals prices dependencies on some other commodities such as the diamonds have been researched in Rand Kwong Yew Low, Yiran Yao, Faff (2016). The precious metals forward/spot exchange rates dynamics has been studied in Hammoudeh, Yuan, McAleer, Thompson (2009), Aggarwal, Lucey, O'Connor (2014). The investment into the precious metals by buying the physical precious metal or by investing into the precious metals funds or by occurring the precious metals mining companies stocks has been researched in Jaffee (1989), Demidova-Menzel; Heidorn (August 2007b). The precious metals safe haven and hedging properties for the private/institutional investors have been researched in Worthington, Pahlavani (2007), Rand Kwong Yew Low, Yiran Yao, Faff (2016).

Completing a comprehensive review of academic literature, we can evidently argue that the precious metals exchanges have been established to facilitate the precious metals trade in the economies of the scales and scopes on the national/global scales. There are the following main precious metals exchanges in the World in Sephton, Cochrane (1990), Demidova-Menzel, Heidorn (August 2007):

1. The Commodity Exchange (COMEX);
2. The New York Mercantile Exchange (NYMEX);
3. The Chicago Board of Trade (CBOT);
4. The London Metal Exchange (LME).

6.8 Intellectual property exchange as investment medium.

Finally, ensuring a consistency in our research discussion, we would like to say a few words on the intellectual property exchange, which can be undoubtedly classified as one of the perspective investment mediums in the capital markets in the finances.

We believe that the creation of the intellectual property exchanges will further facilitate the intellectual property selling, buying, licensing by the inventors, the IP rights holders, the entrepreneurs, the interested firms around the World. In our opinion the intellectual property exchanges will be established in the clusters with the hi-tech and financial firms mainly.

Looking forward, we would like to make a research comment that the digital currencies exchange can be considered as one of the perspective investment mediums for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. At this time, the Bitcoin and the Ethereum digital currencies began to be valued/traded/exchanged at the digital currencies exchanges in the global capital markets.

In Chapter 6, we focused on the investment mediums for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. So far, we have gained a reasonably comprehensive knowledge on the investment products, vehicles, and mediums destined for application in the global capital markets.

In Chapter 7, we will tackle the research problem on the financial risk calculation, estimation and mitigation techniques in the process of the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.
Chapter 7

Financial risk of investment portfolio at financial capital investment in capital markets

A modern prosperous society can be accurately characterized by an existing level of investment attractiveness of its economy of the scale and the scope. The financial capital would be invested by the investor into the investment products with an application of the investment vehicles in the investment medium in the case, if the investor’s expectation to get the high return-on-investment could be realized at a high probability level in the selected economy of the scale and the scope. The probability can be calculated by the investor, taking into an account the macro-/micro- economic variables in the frames of the modern investment portfolio theory during the wealth management process in the finances in Ledenyov D O, Ledenyov V O (2013a).

Fig. 31 shows a hypothetical investment portfolio with the diversified asset classes for the financial capital investment in the capital markets in the economies of the scales and scopes in the short and long time periods, which must be created by the investor with the goal to get an increased return premium.

Fig. 31. Hypothetical investment portfolio with diversified asset classes for financial capital investment in capital markets in economies of scale and scope in short and long time periods.
Typically, the investors create an investment portfolio with the diversified assets classes to minimize all the existing financial, economic, political risks as well as to maximize the return on the financial capital investment in the capital markets in the economies of the scales and the scopes in the short and long time periods. The investment portfolio building during the wealth management process can be regarded as a quite challenging task, because the financial capital flows in the open, non-linear and complex diffusion-type financial systems with the positive or negative feedback loop mechanisms, resulting in the assets prices fluctuations in view of the macro-/micro- economic variables oscillations in the economies of the scales and the scopes in Mosekilde (1996, 1996-1997), Beinhocker (2006), Mandelbrot (2004).

The Modern Portfolio Theory (MPT) is based on a fundamental concept that the price changes by the different interrelated investment assets must be taken into an account in the process of the investment portfolio building in Markowitz (1952, 1956, 1959, 1987). In other words, Markowitz (1952) proposed that the investment portfolio’s risk depends on the variance of the investment portfolio’s expected return premium.

The Modern Portfolio Theory (MPT) introduces an idea of the Efficient Frontier (EF) in the finances in Markowitz (1952, 1956, 1959, 1987). Let us assume that we have a set of the selected investment assets, then, the maximum portfolio returns are limited by the upper concave boundary in the case of the increasing risk magnitude. A dependence between the investment return premium and the investment risk is represented by the concave curve, which is concavely increasing with the risk factors growth in Markowitz (1952, 1956, 1959, 1987), Shiryaev (1998a, b), Hull (2005-2006, 2010, 2012), Mitra (2009), Ledenyov D O, Ledenyov V O (2013a).

Let us define the weighted expected return of a portfolio \( R_p \) as in Mitra (2009)

\[
R_p = \sum_{i=1}^{N} w_i \mu_i,
\]

then the portfolio’s variance \( \sigma_p^2 \) can be written as

\[
\sigma_p^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} \sigma_{ij} w_i w_j,
\]

where

- \( N \) is the number of assets in a portfolio;
- \( i, j \) are the asset indices and \( i, j \in \{1, \ldots, N\} \);
- \( w_i \) is the asset weight, subject to the constraints:

\[
0 \leq w_i \leq 1,
\]

\[
\sum_{i=1}^{N} w_i = 1;
\]
• $\sigma_{ij}$ is the covariance of asset $i$ with asset $j$;
• $\mu_i$ is the expected return for asset $i$.

Speaking clearly, Markowitz (1952) considers the two characteristics of capital $X_i(b)$:

1. $EX_i(b)$ is the mathematical expectation;
2. $DX_i(b)$ is the dispersion.

In agreement with the mean variance analysis by Markowitz (1952), the investment portfolios with a set of points $(EX_i(b), \sqrt{DX_i(b)})$ between the point $\alpha$ and the point $\beta$ on the efficient frontier curve have the maximum mean value of capital at the minimum value of dispersion in Fig. 32.


Let us list the main research findings in the Modern Portfolio Theory (MPT) in the finances in the chronological order:


2. Tobin (1958) introduced the Tobin's mutual fund theorem, stating that the investment portfolio’s assets allocation problem can be viewed as a decision to allocate between the riskless asset and the risky portfolio. Tobin (1958) showed that the efficient frontier becomes a straight line in the presence of a risk-free asset;

3. Mandelbrot (1963) investigated the scaling properties of the certain speculative prices changes;

4. Fama (1963) discussed the Mandelbrot’s research proposals and the stable Paretian hypothesis;

5. Sharpe (1964) summarized the research results by Markowitz (1952) and Tobin (1958) by introducing the Separation Theorem, in which the process of investment choice has the two possible phases:
   1) The choice of a unique optimum combination of risky assets; and
   2) The separate choice, concerning an allocation of funds between such a combination of a risky assets and a single riskless asset;


7. Engle (2003, 2006) analyzed and summarized all the important research findings in the Modern Portfolio Theory (MPT) in Markowitz (1952), Tobin (1958), Sharpe (1964);

8. Demidova-Menzel; Heidorn (August 2007) briefly described the limitations in the case of application of a standard deviation of the investment returns as an investment portfolio risk measure in the Modern Portfolio Theory (MPT). A main criticism is in the fact that a standard deviation of the investment returns as an investment portfolio risk measure in the MPT is assumed to be described by the bell-shaped Gauss distribution, but the real observed deviations of the investment returns for the certain investment asset classes in the investment
portfolio can be better characterized by the different types of statistical distributions. For example, the real observed deviations of the investment returns in the case of the commodity asset class in the investment portfolio can be accurately characterized by a right skewed distribution instead of a normal distribution. Therefore, an application of the standard deviation of the investment returns as an investment portfolio risk measure in the Modern Portfolio Theory (MPT) is limited by a set of the certain investment assets classes only;

9. Hassine, Roncalli (2013) analyzed and summarized all the research findings in the Modern Portfolio Theory (MPT) in the Markowitz (1952), Tobin (1958), Sharpe (1964);


Going to the next point, let us discuss some important investment portfolio theories in the finances in details. The Capital Asset Pricing Model (CAPM) theory has been introduced with the purpose to accurately determine the expected return premiums on the selected assets in the investment portfolio during the financial capital investment in the capital markets in the economies of the scales and the scopes in Sharpe (1964), Lintner (1965), Mossin (1966).

The CAPM main idea is that, in the investment portfolio, the numerous investment products (the investment asset classes/the investment instruments) with the various associated market risks can generate the different expected return premiums during the financial capital investment in the capital markets in the economies of the scales and the scopes. In the CAPM theory, all the investors have both the similar objectives and the same accumulated information in Sharpe (1964), Lintner (1965), Mossin (1966), Engle (2003, 2006). The Capital Asset Pricing Model (CAPM) theory applications have been researched in Sharpe (1965, 1966, 1968, 1992, 1994), Sharpe, Alexander, Bailey (1999). The dynamic Consumption CAPM (CCAPM) theory has been proposed to extend the static Capital Asset Pricing Model (CAPM) theory by providing a theoretical framework to evaluate the market portfolio dynamically in Merton (1973).


\[ R_a = R_f + \beta (R_m - R_f) + \epsilon, \]

where
• $R_a$ is the expected return of an asset;
• $R_f$ is the risk-free rate of return;
• $R_m$ is the expected market return;
• $\epsilon$ is the error term;
• the systematic risk with respect to the tangency portfolio $\beta = \frac{\sigma_{am}}{\sigma_{mm}}$;
• $\sigma_{am}$ is the market and asset’s covariance;
• $\sigma_{mm}$ is the market’s variance.

The Sharpe ratio attempts to provide the portfolio risk measure in terms of the quality of the portfolio’s return at its given level of risk. The Sharpe ratio is a return-to-risk measure in the frames of the Capital Asset Pricing Model (CAPM) theory in Sharpe (1966), Mitra (2009):

\[
S = \frac{R_p - R_f}{\sigma_p}
\]

where $\sigma_p$ is the portfolio return’s standard deviation.

The tangency investment portfolio is an investment portfolio that maximizes the Sharpe ratio as shown on the efficient frontier from the mutual fund theorem in Sharpe, Alexander, Bailey (1999). The maximum Sharpe ratio of the investment portfolio is situated on the efficient frontier in Hassine, Roncalli (2013).

The modified version of the Sharpe ratio can be written as in Fung and Hsieh in (1999b, 2000b), Mitra (2009)

\[
\text{Modified Sharpe Ratio} = \frac{R_p}{\sigma_p}.
\]

The Jensen’s alpha is essentially an intercept of the regression of the excess returns on the risk factors, such as the Fama-French three factors in Jensen (1968), Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences (2013). It can be interpreted as the portfolio risk measure to quantify the portfolio return premiums above that predicted by CAPM in Jensen (1968), Economic Sciences Prize Committee of Royal Swedish Academy of Sciences (2013), Mitra (2009):

\[
\alpha = R_p - \left[ R_f + \beta_p \left( R_m - R_f \right) \right].
\]

The Treynor ratio can be interpreted as the “quality” of portfolio return for a given level of risk, but the risk is measured on a CAPM theory basis and written as in Mitra (2009):

\[
\text{Treynor Ratio} = \frac{R_p - R_f}{\beta_p}
\]
The Fama, French Three Factor Model with the two new factors: 1) the book-to-market value; and 2) the price-earnings ratio for the listed companies, aiming to predict the expected return premiums in Fama, French (1993), Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences (2013). The three factor model accounts for these higher premiums in the following equation in Fama, French (1993), Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences (2013), Mitra (2009):

$$R_{\alpha} = R_f + \beta_{\rho1}(R_m - R_f) + \beta_{\rho2}SMB + \beta_{\rho3}HML + \epsilon,$$

where

- SMB is the difference in return for small and large sized companies;
- HML is the difference in return for high book to market value and low book to market value companies;
- $\beta_{\rho1}$, $\beta_{\rho2}$, $\beta_{\rho3}$ are regression gradients (slopes).

The Sharpe’s Asset Class Factor Model has been proposed for the return premium measurement, which is a weighted average of a small number of asset classes instead of a weighted average of a large number of individual asset returns, in the cases of the mutual/hedge funds in Sharpe (1992), Fung, Hsieh (1997), Mitra (2009). The Sharpe’s Asset Class Factor Model can be expressed as in Sharpe (1992), Fung, Hsieh (1997), Mitra (2009):

$$R_p = \sum_k w_k F_k + \epsilon,$$

where

- $w_k = \sum_j x_j \lambda_j$;
- $\epsilon = \sum_j x_j \epsilon_j$;
- $j$ is the asset class;
- $k$ is the total number of asset classes;
- $x_j$ is the weighting of asset class $j$;
- $\lambda_j$ is the factor loading for asset $j$ (change in fund return/change in asset $j$ return);
- $\epsilon_j$ is the error term for asset $j$.

Going to the next topic, as we know the investment portfolio can be created by investing the different investment products (the investment asset classes) with the help of the different investment vehicles in the different investment mediums in the capital markets in the economies of the scales and the scopes. For example, the investment portfolio can include the publicly traded shares of the public company’s stock. In this case, the investor / firm’s owner(s) may be
interested to understand: How can the financial institution / public company / firm manage all the risks, and calculate the cost of capital, and compute the cost of equity?

In the practical case of the financial institution / company’s risk management, the risk can be mitigated, going from the principles of diversification, hedging and total risk measurements. An actual risk management concept is reflected in the Economic Capital and Credit Modeling theories in which the dependence between the total risk and the investment return premium is derived in Ideas At Work (2006), Ledenyov D O, Ledenyov V O (2012d):

1. Cost of Capital is calculated using the Weighted Average Cost of Capital (WACC) model, which includes the following financial variables and ratios: Levered Beta, Debt/Total Capitalization, Tax Rate, Unlevered Beta, Targeted Capital Structure, Risk Free Rate, Market Risk Premium, Spread over Risk Free Rate. The Weighted Average Cost of Capital (WACC) is the weighted average of the marginal costs of all sources of capital. The formula for estimating WACC is as follows in Schnoor (2006):

\[
WACC = K_d (1 - T)D/V + K_e E/V + K_p P/V
\]

where:
- \( K_d \) = the pre-Tax Cost of Debt;
- \( T \) = the Marginal Tax Rate of the entity being valued;
- \( D/V \) = the Long-term target Net Debt to Total Capitalization;
- \( K_e \) = the market-determined Cost of Equity Capital;
- \( E/V \) = the Long-term target Market Value of Equity to Total Capitalization;
- \( K_p \) = the Cost of Traditional Preferred Stock;
- \( P/V \) = the Long-term target Market Value of Preferred Stock to Total Capitalization.

2. Cost of Equity is calculated using the Capital Asset Pricing Model (CAPM), which includes the following financial variables and ratios: Beta = Firm Specific Risk / Market Risk, Cost of Equity = Risk Free Rate + Beta, Multifactor Models of Asset Returns. In CAPM theory in Jarrow (1988), Lintner (1965), Sharpe (1964), Sharpe, Alexander, Bailey (1999), the beta is a measure of risk: a measure of stock price volatility relative to the overall benchmark market index. The beta changes from 0 to 2 (beta=0, risk=0; beta=1, then risk=average market risk (a stock moves up or down in the same proportion as the overall market); beta=2, then risk=well above average market risk). The company’s Cost of Equity, \( K_e \), is calculated using the Capital Asset Pricing Model (CAPM) in Schnoor (2006):

\[
K_e = R_f + \beta' \left( market \ risk \ premium \right)
\]
where: • $K_e$ = the market-determined Cost of Equity Capital;

• $R_f$ = the Risk Free Rate;

• $\beta$ = the company’s beta. The beta is a measure of stock price volatility relative to the overall benchmark market index. In other words, the beta is the price volatility of a financial instrument relative to the price volatility of a market or index as a whole. Beta is most commonly used with respect to equities. A high-beta instrument is riskier than a low-beta instrument. If the stock moves up or down in the same proportion as the overall market, it has a Beta of 1.0. A stock with Beta of 1.2 is considered riskier than the overall market. Higgins (2007) states that the beta can also be considered as an angle of incline:

$$\beta = \frac{P_{jm}y_i}{y_m}$$

where:

• $P_{jm}$ is the non-diversified risk.

Continuing our discussion on the risk factors, let us consider all the existing risks in the finances in the details. We would like to draw attention to the fact that there are many types of risk, which have to be taken to an account by the investor at the investment process in the capital markets in the finances. Let us distinguish the two big classes of risks in the finances:

1. The microeconomic risks:
   1) the business plan risk,
   2) the financial credit risk,
   3) the financial transaction risk,
   4) the business operation risk,
   5) the business management risk,
   6) the business revenue generation risk;

2. The macroeconomic risks:
   1) the local/global market risk,
   2) the central bank interest rate risk,
   3) the financial liquidity risk,
   4) the foreign exchange risk,
   5) the environmental risk,
   6) the geopolitical risk.

Fig. 33 shows the financial, economic and political risks, which have to be accounted by investor in the process of creation of the hypothetical investment portfolio with diversified...
investment asset classes for the financial capital investment in the capital markets in short and long time periods.

**Fig. 33.** Financial, economic, social and political risks to account at creation of hypothetical investment portfolio with diversified asset classes for financial capital investment in capital markets in economies of scale and scope in short and long time periods.

As we can see, there are many different categories of risk, which have to be taken to an account by an investor during the investment process in the capital markets in the finances. In the finances, the Basel III capital requirements have been formulated in Basel Committee on Banking Supervision (2006, 2009), Bernanke (2009a, b, c, d, e), Ledenyov V O, Ledenyov D O (2012d). In addition, it makes sense to note that many advanced models to account for the numerous risk factors and calculate the total risk magnitude in the capital markets in the finances have been developed. However, one of the interesting points to understand is that most these theoretical models have been created to operate with the positive interest rates and they have not been developed to work properly in the case of the negative interest rates, which are normally set
by the central banks. The negative interest rates are present in Japan and some other countries presently in Higuchi (2016).

Let us write the the investment portfolio total risk computing algorithm as a dial in the Swiss watch, including the microeconomic risks: the business plan risk, the financial credit risk, the financial transaction risk, the business operation risk, the business management risk, the business revenue generation risk; as well as the macroeconomic risks: the local/global market risk, the central bank interest rate risk, the financial liquidity risk, the foreign exchange risk, the environmental risk, the geopolitical risk.

Fig. 34 demonstrates the investment portfolio total risk computing algorithm as a dial in the Swiss watch.

![Fig. 34. Investment portfolio total risk computing algorithm as dial in Swiss watch.](image)

In the computer science, it is a commonly accepted practice to create a block scheme of the computing algorithm. Thus, let us write the the investment portfolio total risk computing algorithm as a block scheme, including the microeconomic risks such as the business plan risk, the financial credit risk, the financial transaction risk, the business operation risk, the business
management risk, the business revenue generation risk, as well as the macroeconomic risks such as the local/global market risk, the central bank interest rate risk, the financial liquidity risk, the foreign exchange risk, the environmental risk, the geopolitical risk.

Fig. 35 presents a block scheme of the investment portfolio total risk computing algorithm.

![Block scheme of investment portfolio total risk computing algorithm](image-url)

**Fig. 35.** Block scheme of investment portfolio total risk computing algorithm.
Continuing our discussion on the investment portfolio, let us assume that we make the financial capital investment in the publicly traded shares of the company’s stock. Then, let us remind again that the electromagnetic signal processing theory in which the electromagnetic signal can be accurately characterized by the multiple measured parameters such as the amplitude, frequency, period and phase has been developed in the electrical, electronic and computer engineering sciences in Ledenyov D O, Ledenyov V O (2015a).

The investment product/asset value in the investment portfolio changes over the time, because of the macro-/micro-economic variables oscillations, including the demand/supply fluctuations. In a general case, it is a well accepted practice to characterize the investment asset value changes by the the continuous-time signals, corresponding to the Value of Share 1 (t), Value of Share 2 (t), and Value of Share 1 (t). Let us illustrate the concept by performing the spectrum analysis of the three continuous-time signals by the three fluctuating selected shares’ values over the certain time period $S_1(t)$, $S_2(t)$, $S_3(t)$. The Value of Share 1 (t) and the Value of Share 2 (t) are correlated in the time; the Values of Shares 1, 2 (t) and the Value of Share 3 (t) are uncorrelated in the time.

Fig. 36 shows the correlated and uncorrelated continuous-time oscillations of the three selected shares values over the certain time period $S_1(t)$, $S_2(t)$, $S_3(t)$. The Value of Share 1 (t) and the Value of Share 2 (t) are correlated in the time; the Values of Shares 1, 2 (t) and the Value of Share 3 (t) are uncorrelated in the time.

![Fig. 36. Correlated and uncorrelated continuous-time oscillations of three selected shares values in time $S_1(t)$, $S_2(t)$, $S_3(t)$.](image-url)
Thus, the correlated and uncorrelated investment assets can be included in the investment portfolio during the financial capital investment in the capital markets in the economies of the scales and the scopes. However, we would like to stress that the investment assets values in the time domain change abruptly in the capital markets in the economies of the scales and the scopes. The sharp disruptive events of various nature, including the technological, economical, financial, social, political disruptions, may have the multiple (in)direct instant impacts on the investment assets prices changes in the time domain.

We would like to propose the Ledenyov discrete-time investment assets values oscillations theory in the investment portfolio in the finances. We think that the dynamics of fluctuations of the investment assets’ values in the investment portfolio in the capital markets in the economies of the scales and the scopes in the time domain has a discrete nature. Therefore, the investment assets values oscillations can be accurately approximated by the discrete-time digital signals in Oppenheim, Schafer (1989), Simon, Hinedi, Lindsey (1995), Proakis, Manolakis (1996), Prisch (1998), Wanhammar (1999), Sklar (2001), Rice (2008), Ledenyov D O, Ledenyov V O (2015a).

Fig. 37 illustrates the correlated and uncorrelated discrete-time oscillations of the three selected shares values over the certain time period $S_1(t)$, $S_2(t)$, $S_3(t)$. The Value of Share 1 ($t$) and the Value of Share 2 ($t$) are correlated in the time; the Values of Shares 1, 2 ($t$) and the Value of Share 3 ($t$) are uncorrelated in the time.

![Correlated and uncorrelated discrete-time oscillations of three selected shares values in time $S_1(t)$, $S_2(t)$, $S_3(t)$](image-url)

**Fig. 37.** Correlated and uncorrelated discrete-time oscillations of three selected shares values in time $S_1(t)$, $S_2(t)$, $S_3(t)$. 

160

Fig. 38 illustrates the correlated and uncorrelated complex discrete-time oscillations of the three selected shares values over the certain time period $S_1(t)$, $S_2(t)$, $S_3(t)$. The Value of Share 1 ($t$) and the Value of Share 2 ($t$) are correlated in the time; the Values of Shares 1, 2 ($t$) and the Value of Share 3 ($t$) are uncorrelated in the time.

**Fig. 38.** Ledenyov correlated and uncorrelated complex discrete-time oscillations of three selected shares values in time $S_1(t)$, $S_2(t)$, $S_3(t)$. 
Going to the next point, let us say that the Ledenyov correlated and uncorrelated complex discrete-time oscillations of the shares values in the investment portfolio depend on the instantly changing macro-/micro-economic variables in the capital markets in the economies of the scales and the scopes over the selected time period. For example, the GDP(t), GNP(t), GIP(t), PPP(t) fluctuations in the economies of the scales and the scopes in the time domain may cause the correlated and uncorrelated complex discrete-time oscillations of the shares values in the investment portfolio.

Fig. 39 pictures the old theoretical conception to describe the GDP(t), GNP(t), PPP(t) fluctuations in the economy of the scale and the scope by the on the continuous-time waves. The Juglar economic cycle, Kondratiev economic cycle, Kitchin economic cycle, Kuznets economic cycle in the form of the continuous-time waves with the different amplitudes, frequencies, periods and phases can be seen in Juglar (1862), Kondratieff (1922, 1925, 1926, 1928, 1935, 1984, 2002), Kitchin (1923), Kuznets (1973a, b).

![Continuous-time waves of GDP(t)/GNP(t)/PPP(t) fluctuations in economy of scale and scope.](image)

**Fig. 39.** Continuous-time waves of GDP(t)/GNP(t)/PPP(t) fluctuations in economy of scale and scope.
Recently, the new theory on the Ledenyov discrete-time digital waves of GDP(t)/GNP(t)/GIP(t)/PPP(t) fluctuations in the economy of the scale and the scope has been proposed in Ledenyov D O, Ledenyov V O (2015d, e, f), Ledenyov D O, Ledenyov V O (2016r), Ledenyov V O, Ledenyov D O (2016s). In our opinion, there are the Ledenyov complex discrete-time digital waves with the different amplitudes, frequencies, periods, phases proposed in Ledenyov D O, Ledenyov V O (2015d, e, f, 2016r, s), which more accurately characterize the economic output fluctuations comparing to the Juglar continuous-time wave in Juglar (1862), the Kondratieff continuous-time wave in Kondratieff (1922, 1925, 1926, 1928, 1935, 1984, 2002), the Kitchin continuous-time wave in Kitchin (1923), the Kuznets continuous-time wave in Kuznets (1973a,b).

In Fig. 39, we would like to illustrate the new theoretical conception on the Ledenyov discrete-time waves of the GDP(t)/GNP(t)/GIP(t)/PPP(t) fluctuations with the four types of the waves:

1. The simple discrete-time digital wave, Wave 1 (W1);
2. The complex discrete-time digital wave, Wave 2 (W2);
3. The complex discrete-time digital wave with multiple distortions, Wave 3 (W3);
4. The complex discrete-time digital wave with the multiple distortions, which is transmitted in the form of the bursts, Wave 4 (W4).

We think that the Ledenyov complex discrete-time digital waves may have the complex wave forms with the different amplitudes, frequencies, periods, phases as in case of the complex discrete-time digital wave with the multiple distortions (see Wave 3 (W3), Wave (W4) in Fig. 38). We believe that the Ledenyov complex discrete-time digital waves can finely approximate the long, medium and short fluctuations of the economic output in the economies of the scales and the scopes.

In the case of the long/medium/short waves of the economic output fluctuations, we think that there are the Ledenyov complex discrete-time digital waves, which are propagated in the form of the transmitted bursts of the complex discrete-time digital signals similar to the transmitted bursts of the spread spectrum signals in Dixon (1976), Viterbi (May 1979), Pickholtz, Milstein (May 1982), Simon, Omura, Scholtz, Levitt (1985, 1994), Simon, Moher (2008), Rappaport (January 2010), Miao, Zander, Sung, Slimane (2016). Speaking more clearly, during the spectral analysis of the economic output fluctuations in the economics, the long/medium/short Ledenyov complex discrete-time digital waves of the economic output fluctuations may be present in the form of transmitted complex discrete-time digital signal bursts.
Fig. 40 presents the Ledenyov discrete-time waves of GDP(t)/GNP(t)/PPP(t) fluctuations in the economy of the scale and scope. The simple discrete-time digital wave is denoted as Wave 1 (W1), the complex discrete-time digital wave is marked as Wave 2 (W2), the complex discrete-time digital wave with the multiple distortions is presented as Wave 3 (W3), the complex discrete-time digital wave with the multiple distortions, which is transmitted in the form of the bursts, is shown as Wave 4 (W4).

![Diagram of Ledenyov discrete-time digital economic output waves in economy of scale and scope in time.]

**Fig. 40.** Ledenyov discrete-time digital economic output waves in economy of scale and scope in time.

Let take a close look on the Ledenyov complex discrete-time digital economic output wave, aiming to understand the its nature, generation techniques and econophysical properties.

Fig. 41 shows the Ledenyov discrete-time digital economic output wave, which is generated by the complex high order digital modulations techniques with an application of the disruptive financial/economic/social/political innovations and propagated in the form of the signal bursts in the economy of the scale and the scope. The Ledenyov discrete-time digital economic output wave can be distorted by various economic financial technological political events in the economy of the scale and the scope.
Fig. 41. Ledenyov discrete-time digital economic output wave, which is generated by complex high order digital modulations techniques with application of disruptive financial/economic/social/political innovations and propagated in form of bursts.

For example, the Chinese civilization economy of the scale and the scope with 4000 years of history can be accurately characterized by the Ledenyov long complex discrete-time digital wave, propagating in the form of the discrete-time signal bursts over the centuries. We can assume that, at a certain time period, there was a signal burst with the complex discrete-time digital signal, corresponding to the intensive development stage with the disruptive events such as the inventions of the paper, writing, arithmetic. At the subsequent time period, there was no a signal burst with the complex discrete-time digital signals, because of the destruction phase in the Chinese economy of the scale and the scope. At the next time periods, the complex discrete-time digital signal, corresponding to the intensive development stage with the disruptive events such as the globalization, the growing international trade, the new innovative technologies inventions in the electronics, the new innovative industries creation was observed again and again. We can consider the Roman civilization as another possible example to illustrate the Ledenyov long complex discrete-time digital wave, propagating in the form of the signal bursts over the centuries.
Now, let us formulate the Ledenyov investment assets theorem: The investment assets can sharply/instantly/discretely correlate/uncorrelate in the investment portfolio during the financial capital investment in the capital markets in the economies of the scales and the scopes in the short and long time periods, depending on the various financial/economic variables fluctuations caused by the disruptive financial/economic/social/political innovations.

This is an important theorem, because there is a principal distinction between:

1) The investment assets, which are approximated by the continuous-time signals with the slow correlation/uncorrelation properties on the one side, and

2) The investment assets, which are approximated by the discrete-time digital signals with the ultrafast correlation/uncorrelation properties on the other side.

In general, it means that the investment portfolio managers must use the Ledenyov complex discrete-time digital signals processing theory to analyze the spectrum of the investment assets signals, calculating the total risk of the investment portfolio and the total stability of the investment portfolio.

Going to the next point, we would like to say a few words about the well known modern theoretical and practical approaches to model the market volatility and evaluate the risk of the investment portfolio in Barone-Adesi, Giannopoulos, Vosper (1999); McNeil, Frey (2000).

We would like to focus our attention on the three broad categories of existing models:

1. The parametric models:
   
   1) The risk metrics: The basic concept of the Value-at-Risk (VaR) in the investment portfolio has been introduced in JP Morgan (1994), Mitra (2009). The VaR has become the standard measure to quantify the risk in the finances. It evaluates the value-at-risk by the “variance-covariance method” (the delta-normal method), assuming that the standardized residuals are normally distributed, but that is not a case in the real-life investment scenarios in Manganelli, Engle (2001);

   2) The generalized autoregressive conditional heteroskedasticity (GARCH): It models the financial and economic variables (the interest rates and the equity prices), applying the big observation window on the sequential events, using the weighted averages and giving more weight to the recent events and less weight to the distant events in the time domain in Bollerslev (1986). It performs the Monte Carlo simulation with the stochastic differential equations (SDE) in Engle (1982a, 2003). It evaluates the difference, using an Exponentially Weighted Moving Average in the Integrated GARCH model in Engle (1982a, 2003):

   $\sigma_t^2 = \lambda \sigma_{t-1}^2 + (1 - \lambda) y_{t-1}^2$

   \[\sigma_t^2 = \lambda \sigma_{t-1}^2 + (1 - \lambda) y_{t-1}^2\]
with $\lambda$ usually set equal to 0.94 or 0.97.

2. The nonparametric models:
   1) The historical simulation: It uses the rolling observation windows of sequential events over the selected time periods to estimate the investment portfolio return premiums. Aiming to compute the Value-at-Risk (VaR) the next time period, the rolling observation window has to be moved forward by one observation, and then the entire procedure must be repeated.

   2) The hybrid model: It applies the historical simulation and the GARCH model;

3. The semi-parametric models:
   1) The extreme value theory in Mitra (2009);

   2) The conditional autoregressive value at risk (CAViaR): It uses the GARCH model with some improvements and computes directly the quantile of the distribution in Engle, Manganelli (1999), Manganelli, Engle (2001);


Considering the next topic in our discussion, let us discuss the problem on the stability of the investment portfolio. From our previous considerations, we know that the investment portfolio must be built, using the diversified asset classes to increase the investment return premium and to reduce the total risk on the invested financial capital in the capital markets at the same time, because there is a certain inter-dependence between:

1. The expected investment return premium on the invested financial capital in the investment portfolio with the diversified asset classes in the capital markets in the short and long time periods from one side, and

2. The macro-/micro- economic/financial risk factors associated with the invested financial capital in the investment portfolio with the diversified asset classes in the capital markets in the short and long time periods from other side.

However, let us point to an interesting scientific observation that the investment portfolio, perfectly optimized from the risk point of view, can also be qualified as the investment portfolio, which is inherently unstable from the stability point of view.

For example, let us assume that we have conducted the financial engineering process and the risk mitigation process, designing an investment portfolio with the diversified asset classes to reduce the total risk magnitude. This investment portfolio is expected to deliver an increased investment return premium in the capital markets in the short and long time periods. However, let us explain that:

1. The any selected pair of assets in the investment portfolio may be un-correlated (stable), reducing the total risk magnitude of the investment portfolio; or

2. The any selected pair of assets in the investment portfolio may be correlated (unstable), decreasing the total stability magnitude of the investment portfolio at the same time.

In other words, the investment portfolio may have the low total risk magnitude, but it can be inherently unstable at the same time. Therefore, in this case, the investor may not be able to obtain the increased investment return premium on the invested financial capital in the investment portfolio with the diversified asset classes in the capital markets in the short and long time periods, because the investment portfolio is inherently unstable in Ledenyov D O, Ledenyov V O (2013a).
Therefore, the highly performing investment portfolio with the diversified asset classes in the capital markets in the short and long time periods can be created by doing the following two things in Ledenyov D O, Ledenyov V O (2013a):

1. The optimization of the investment portfolio in terms of its total risk factors decrease;

2. The optimization of the investment portfolio in terms of its stability magnitude increase.

We propose the Ledenyov investment portfolio stability theorem in the finances in Ledenyov D O, Ledenyov V O (2013a): The investment portfolio is considered to be stable in the case, when any pair of the randomly selected assets is stable, satisfying the Lyapunov stability criteria: The two randomly selected assets must have the two close trajectories at the start and continue to have the two close trajectories always in Lyapunov (1892, 1966, 1992).

It is necessary to understand that the problem on the stability of the investment portfolio can be considered as the frames of the discrete system stability theory in the nonlinear dynamic chaos science in Kuznetsov, Leonov (2005). Therefore, we propose to use the dynamic regimes modeling on the bifurcation diagram, based on the nonlinear dynamic chaos theory, with the purpose to make the accurate characterization of the dynamic properties of the combining risky investments in the investment portfolio, namely to precisely characterize the stability of investment portfolio in Ledenyov D O, Ledenyov V O (2013a).


Continuing our research discussion on the investment portfolio stability, let us note that Shiriyaev (1998a, b) reviewed the nonlinear chaotic models, highlighting a well known fact that the diffusion-type financial systems can be characterized as the chaotic diffusion-type financial
systems or the deterministic nonlinear diffusion-type financial systems. Shiryaev (1998a, b) considered the nonlinear dynamic diffusion-type financial system, which can be described by the logistic equation

\[ x_n = \lambda x_{n-1} (1 - x_{n-1}), \quad n \geq 1, \quad 0 < x_0 < 1, \]

where the nonlinear dynamic diffusion-type financial system has a number of the stable and unstable states at the increase of parameter \( \lambda \), resulting in the transition to the chaos state at the parameter \( \lambda = 3.6 \).

Shiryaev (1998) noted that the below expression is true in the case of all the parabolic systems, where \( F = 4.669201 \) is the Feigenbaum number

\[ \frac{\lambda_k - \lambda_{k-1}}{\lambda_{k+1} - \lambda_k} \to F, \quad k \to \infty. \]

Fig. 42 shows the 3D bifurcation diagram for the accurate characterization of dynamic properties of the combining risky investments in an investment portfolio in the nonlinear dynamic financial system, obtained in Matlab in Ledenyov D O, Ledenyov V O (2013a).

![3D bifurcation diagram](image)

**Fig. 42.** 3D bifurcation diagram for accurate characterization of dynamic properties of combining risky investments in investment portfolio in nonlinear dynamic financial system, created in Matlab (after Ledenyov D O, Ledenyov V O (2013a)).
We completed the above computer simulation with the aim to obtain the 3D bifurcation diagram to illustrate the dynamic properties of the combining risky investments in the investment portfolio in the nonlinear dynamic financial system in the time domain Ledenyov D O, Ledenyov V O (2013a).

In Chapter 8, we will consider the research problem on the quantum winning virtuous investment strategies creation and execution for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.
Chapter 8

Quantum strategies of investment portfolio at financial capital investment in capital markets

A financial process of the financial capital investment in the capital markets in the economies of the scale and the scope includes, at least, the eight main stages. All these phases must be clearly distinguished, fully understood and finely processed by the prospective investors:

1. The financial investment capital allocation;
2. The financial investment strategy creation;
3. The optimal investment opportunity finding;
4. The financial investment risk evaluation;
5. The financial investment capital investing;
6. The increased return premium generation;
7. The increased financial capital collection;
8. The financial investment capital increase.

We would like to take a more detailed unbiased view on the process of the investment strategy creation in this chapter, integrating all the modern scientific discoveries in the natural/social sciences with the aim to find an optimal investment strategy in the course of our discussion on the topic of research interest.

In a century of competition between the globalization trend and the protectionism trend in Wolf (2004), we believe that the technological, social, and political disruptive innovations may create or destroy the investment opportunities in the economies of the scales and the scopes around the World instantly. Therefore, the problem on the creation of the optimal investment strategy in the capital markets can be considered as one of the central problems in the finances.

Let us begin our research thinking on the quantum winning virtuous investment strategy creation by elegantly comparing all the important scientific topics in the finances with the shining high quality diamonds of the white, yellow, pink, red, black colors. Highlighting an undisputable unquestionable importance of the quantum winning virtuous investment strategy creation process, we would like to make a persuasive philosophical statement that the fundamental strategy theory could be conditionally classified as a crystallly clear pink diamond of highest quality, shining brightly, colorfully and attractively in a spectrum of illuminating lights.
of the finances, economics and business administration sciences in Ledenyov V O, Ledenyov D O (2016s).

Indeed, the research topic on the quantum winning virtuous investment strategy creation generates a considerable scientific interest among the authoritative strategy thinkers, experts and professors in the globally integrated World in Ledenyov V O, Ledenyov D O (2016s). Of course, the research on the quantum winning virtuous investment strategy creation is in a state of constant progressive development through a chain of the scientific evolutionary visions transformations in the best minds of the leading strategy thinkers, experts and professors in Ledenyov V O, Ledenyov D O (2016s).

Considering the strategy theory advancements, we can distinguish the following new theoretical approaches in the fundamental strategy theory in Ledenyov V O, Ledenyov D O (2016s):

1. The classical philosophical views on the fundamental strategy theory, which consider the continuous-time processes in the economies of the scales and scopes in the mechanical devices disruption century in Chandler (1962, 1998; 1977, 1993; 1994; 2001; 2005);

2. The analogue philosophical views on the fundamental strategy theory, which deal with the continuous-time processes in the analogue creative economies of the scales and scopes in the analogue devices disruption century in Ledenyov D O, Ledenyov V O (2015b);

3. The digital philosophical views on the fundamental strategy theory, which deal with the discrete-time processes in the digital creative economies of the scales and scopes in the digital devices disruption century in Ledenyov D O, Ledenyov V O (2015b);


Of course, there are some other original scientific approaches, which can be certainly used to improve the fundamental strategy theory in the frames of the finances, economics, business administration, econophysics, psychology sciences during the scientific learning process. They have been researched, to a certain extent, during an intensive research process with an application of the accumulated knowledge base in the frames of the finances, economics, business administration, econophysics, psychology sciences in Chandler (1962, 1998; 1977, 1993; 1994; 2001; 2005), Chandler, Daems (1980), Andrews (1971a, b, 1980, 1981a, b, 1984), Rumelt (1974, 1982), Porter (1979, 1980, 1982a, b, 1983, 1985, 1987a, b, 1991, 1994a, b, 1996a, b, 1997, 2001a, b, 2008, December 2013), Porter, Harrigan (1981), Porter, Salter (1982),
In these circumstances, the most striking fact to be mentioned is that the fundamental strategy theory learning curve during the strategy knowledge accumulation process in the finance, economics, business administration, econophysics, psychology sciences in the time scale may exhibit, at least, the three possible dependences:

1. The linear dependence, when the level of strategy knowledge increases linearly in the selected time period (it can be realized in real life at the short time periods only);

2. The exponential dependence, when the level of strategy knowledge increases exponentially and steadily in the selected time period (it can be observed in real life over the long time periods);

3. The S-type nonlinear dependence, when the level of strategy knowledge increases nonlinearly in the selected time period, namely the strategy knowledge accumulation or destruction processes in the selected time period may have place (it can be observed in real life over the long time periods).

Fig. 43 presents the fundamental strategy theory learning curve as a linear dependence of the strategy knowledge accumulation on the time in the simplest possible case. In addition, Fig. 43 shows that the fundamental strategy theory learning curve can also be represented as the
exponential dependence or the S-type nonlinear dependence of the strategy knowledge accumulation/destruction processes on the time in more complex cases to account for the nonlinear data gaining/losing by the financial investors during the strategy knowledge accumulation process in the long term perspectives.

Fig. 43. Dependence of strategy knowledge accumulation/learning on time: 1) Linear, 2) Exponential, 3) S-type nonlinear.

Now, let us introduce the Ledenyov multidimensional strategy space with XYZ coordinates. In this case, we can represent the strategy as a Ledenyov strategy vector, which points to a certain direction in the XYZ multidimensional strategy space. In other words, we propose to think about the strategy vector as the strategy vector of action, which is directed toward the certain direction in the XYZ multidimensional strategy space. Speaking clearly, we can set our strategic goal to reach an increased return premium on the financial investments in the capital markets by drawing the strategy vector with the direction to the certain point in the XYZ multidimensional strategy space. Then, we could say that a real implementation of the created strategy would require an application of the well defined practical actions toward the completion of our outlined strategic goal. This geometric representation of the strategy in the
terms of the Ledenyov strategy vector in the Ledenyov multidimensional strategy space with the XYZ coordinates will be quite useful during the forthcoming discussion on the complex multivector strategies definition, meaning, creation and their practical implementation in real life situations in the finances.

Fig. 44 represents the strategy as the Ledenyov strategy vector of action, which points to the certain direction in the Ledenyov multidimensional strategy space with XYZ coordinates.

**Fig. 44.** Ledenyov strategy vector in Ledenyov multidimensional strategy space with XYZ coordinates.

Moving forward, let us say that we can think about the complex strategy, employing the complex strategy concept in the cases, when the complex strategy may include a big number of the Ledenyov strategy vectors with the discretely changing directions in the Ledenyov multidimensional strategy space in the time domain. For example, let us illustrate the complex strategy concept by assuming that we would like to move from point A to point B by the Rolls Royce automobile, using an existing highways network on our European continent. First of all, we must create the simple strategy of our automobile movement from the point A to the point B by drawing the automobile movement vector from the point A to the point B on the map. Let us imagine that there are many natural barriers, including the mountains, hills, valleys, rivers between the point A and point B, hence in this case, we would be forced to drive towards the
slightly different directions to reach the final destination point on our travelling way. Therefore, we must create the Ledenyov complex strategy vector for our automobile movement from point A to point B by drawing the multiple automobile movement vectors with the slightly different directions between the point A and the point B on the map. In other words, the complex strategy may include a number of the strategy vectors, changing in the Ledenyov XYZ multidimensional strategy space over the time.

Fig. 45 demonstrates the complex strategy concept in which the Ledenyov complex multivector strategy includes a number of the Ledenyov strategy vectors, changing in the Ledenyov XYZ multidimensional strategy space over the time.

![Diagram](image)

**Fig. 45.** Ledenyov complex multivector strategy as number of Ledenyov strategy vectors in Ledenyov multidimensional strategy space with XYZ coordinates, changing in the space – time domains.

Obviously, in the finances, the Ledenyov complex multivector strategy can be efficiently frequently used to reach the pre-determined strategic goals by the private and institutional investors during the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.
For instance, the Ledenyov complex multivector strategies can be formulated and executed to reach the certain return premium target level or the certain profitability target level or the certain net income target level at the financial institutions, investment funds, investment boutiques, etc. There may be a number of the financial/economic/political factors, which must be taken to an account in the process of the Ledenyov complex multivector strategy creation by the investors at the financial institutions for a number of possible applications at various social/financial/economic settings in the selected time periods.

Fig. 46 shows the geometric representation of the Ledenyov parallel complex multivector strategy and Ledenyov sequential complex multivector strategy in the Ledenyov multidimensional strategy space with XY coordinates, changing in the space – time domains.

Fig. 46. Geometric representation of Ledenyov parallel complex multivector strategy and Ledenyov sequential complex multivector strategy in Ledenyov multidimensional strategy space with XY coordinates, changing in space – time domains.

Going from the modern scientific findings and our research understanding, we prefer to divide all the Ledenyov complex multivector strategies in the two specific categories:

1. The Ledenyov parallel complex multivector strategies;
2. The Ledenyov sequential complex multivector strategies.

For example, in one case, the investor may pursue the Ledenyov parallel complex multivector strategies at the same time period by investing the financial capital in the diversified investment products, using various unrelated investment vehicles in the investment mediums in
the capital market over the selected limited time. In this case, let us assume that investor will execute the investment strategies in parallel.

In other case, the investor can pursue the Ledenyov sequential complex multivector strategy at the same time period by investing the financial capital in the preferable investment products, using various unrelated investment vehicles in the investment mediums in the capital market at the selected limited time period. In this case, let us assume that investor will alter the investment strategies sequentially.

However, in the real life situation, the investor can also pursue the Ledenyov mixed parallel-sequential complex multivector strategies:

1. by investing the financial capital in the diversified investment products, using various unrelated investment vehicles in the investment mediums in the capital market over the selected limited time in parallel; as well as

2. by changing sequentially the investment strategies during the financial capital in the preferable investment products, using various unrelated investment vehicles in the investment mediums in the capital market at various time moments.

Fig. 47 shows the geometric representation of the Ledenyov mixed parallel-sequential complex multivector strategies in the Ledenyov multidimensional strategy space, changing in space – time domains.

![Geometric representation of Ledenyov mixed parallel-sequential complex multivector strategies](image)

**Fig. 47.** Geometric representation of Ledenyov mixed parallel-sequential complex multivector strategies in Ledenyov multidimensional strategy space with XY coordinates, changing in space – time domains.
In a big number of cases, the Ledenyov complex multivector strategies can be used in the game theory applications in Cournot (1838, 1897), Edgeworth (1881), von Neumann (1928, 1959), von Neumann, Morgerstern (1944).

Fig. 48 shows the decision tree, which can be used to make the strategic decisions on the complex multivector strategies in the frames of the game theory in Fudenberg, Tirole (1991).

![Decision tree in game theory](image)

**Fig. 48. Decision tree in game theory.**

We think that the investor’s decision (the economic agent’s decision) to change the direction of the strategy vector in the multidimensional strategy space during the strategic operation is forced/encouraged by the strategic analysis of the numerous (un)related factors and (un)objective reasons in the frames of the (non)cooperative games in the economic environment within the limited information dataset at the selected time periods as researched in the finances, economics and business administration sciences. However, in our opinion, the game theory may have a number of theoretical limitations. One of the most notable limitation is the only use of the inductive logic, the deductive logic, and in some cases, the abductive logic during the decision making process with an application of the decision trees in the strategic games analysis in Cournot (1838, 1897), Edgeworth (1881), von Neumann J (1928, 1959), von Neumann, Morgerstern (1944), Hayek (September 1945), Nash (1950a,b, c, 1951, 1953), Shapley (1953), Williams (1954), Simon (1955), Luce, Raiffa (1957, 1989), Shubik (1953a, b, c, 1954, 1955, 1956, 1958a, b, c, 1959, 1975, 1981, 1987, 1988, July 12 2000, May 2001), Brewer, Shubik (1979), Shubik, Levitan (1980), Tucker, Luce (editors) (1959), Blackett (1962), Farquharson (1969), Morse, Kimball (1970), Arrow (1971), Howard (1971), Alchian, Demsetz (December 1972), Maynard Smith, Price (1973), Maynard Smith (1974, 1982), Aumann, Shapley (1974), Harsanyi (1974), Selten (1975, 1988), Selten, Harsanyi (1988), Jensen, Meckling (October 1976,


At this point of our research discussion, let us precisely define the quantum logic (the probability logic), the inductive logic, the deductive logic, the abductive logic in Ledenyov D O, Ledenyov V O (2015n, s):

1. The Ledenyov quantum logic (the probability logic) – the logic of what may occur – reasons through computing of events probabilities distributions. Quantum logic allows a and b to be realized, depending on a and b events probabilities distributions equal to square of the Schrödinger’s wave function in Ledenyov D O, Ledenyov V O (2015n, s).

2. The 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.
3. The 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.

4. The 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 \( b \).

Applying our innovative scientific thinking, we propose the Quantum Thinking Process (QTP) algorithm, which can be considered as the “computing kernel” to make the logic decisions in the case of the decision making process by the investors during the financial capital investment in the diversified investment products by means of various investment vehicles in the different investment mediums in the capital markets in the economies of the scales and scopes. Thus, let us list the main distinctive features of the Quantum Thinking Process (QTP) algorithm:

1. The parallel application of the inductive logic, deductive logic, abductive logic;
2. The subsequent application of the Ledenyov quantum (probabilistic) logic;
3. The highly sophisticated decision making technique to select the best decision during the decision making process.

Fig. 49 shows the block scheme of the Ledenyov quantum thinking process algorithm.
The Ledenyov Quantum Thinking Process (LQTP) algorithm is an integral part of the Ledenyov Quantum Winning Virtuous Strategy Search (LQWVSS) algorithm. Let us formulate the Ledenyov Quantum Winning Virtuous Strategy Search Algorithm:


1. to get an increased return premium during the financial capital investment in the capital markets in the short and long time periods;

2. to make a positive financial impact in the society in the frames of the socially responsible investment (SRI) that integrates the social, environmental, and ethical considerations into the investment decision making process at the financial capital investment in the capital markets in the short and long time periods in Waddock, Graves, (1994), Arora, Gangopadhyay (1995), Sparkes (1998, 2004, 2008), Johnson, Greening (1999), Lyndenburg (2002), Cox,

3. to share a part of the increased investment return premium on the realization of the shared value principles initiatives, aiming to reduce an inequality between all the modern society members and to improve a quality of life of all the developed society members in Porter, Kramer (December 2006).

We can illustrate the Ledenyov quantum winning virtuous strategy search algorithm by drawing the action stages on an imagined dial in the Swiss mechanical watch. We prefer to place the described actions in the positions of the hours, ranging from 1 to 12, on an imagined dial of the Swiss mechanical watch. Then, let us assume that the arrow will switch clockwise from 1 to 12 at an imagined dial in the Swiss mechanical watch. This way, we can illustrate the 12 most significant activities to create the quantum winning virtuous investment strategy in the finances.

Fig. 50 illustrates the Ledenyov quantum winning virtuous strategy search algorithm as a set of the strategic actions, shown on an imagined dial of the Swiss mechanical watch.

**Fig. 50.** Ledenyov quantum winning virtuous strategy search algorithm as a set of strategic actions on imagined dial of Swiss mechanical watch.
Making a step forward, let us create a block scheme of the Ledenyov quantum winning virtuous strategy search algorithm as it is commonly accepted in the financial engineering science and the computer science. In other words, we will simply represent a set of the strategic actions on an imagined dial of the Swiss mechanical watch in the form of the block scheme.

Fig. 51 depicts the block scheme of the Ledenyov quantum winning virtuous strategy search (LQWVSS) algorithm.

Fig. 51. Block scheme of Ledenyov quantum winning virtuous strategy search algorithm.
Let us move ahead with the consideration of a practical realization and application of the Ledenyov Quantum Winning Virtuous Strategy Search (LQWVSS) algorithm, discussing the concrete practical meaning of every action block in the above block scheme:


7. The application of the quantum thinking process with the inductive, deductive, abductive logics: The investor has to apply the inductive logic, the deductive logic and the abductive logic to make his/her decision on a set of strategic choices such as the optimal available investment choices on the financial capital investment in the capital markets in Ledenyov V O, Ledenyov D O (2016s), Martin (1998-1999, 2005-2006);

8. The application of the quantum thinking process with the quantum (probabilistic) logic: The investor has to apply the quantum (probabilistic) logic to make his/her decision on a set of strategic choices such as the optimal available investment choices on the financial capital investment in the capital markets in Ledenyov V O, Ledenyov D O (2016s);


10. The creation of the quantum winning virtuous strategy: The investor has to create the quantum winning virtuous strategy by placing the strategy vector toward the direction of the optimal strategic choice among a set of strategic choices such as the optimal available investment choices on the financial capital investment in the capital markets in Ledenyov V O, Ledenyov D O (2016s);

11. The implementation of the quantum winning virtuous strategy: The investor has to execute the quantum winning virtuous strategy by completing all the activities to reach the goal(s), which are set by the strategy vector as far as the financial capital investment in the capital markets in concerned in Ledenyov V O, Ledenyov D O (2016s);

12. The result achievement and desire satisfaction: The investor has to evaluate the obtained result against the initial goals as far as the financial capital investment in the capital markets in concerned, satisfying the initially expressed investment desire in Ledenyov V O, Ledenyov D O (2016s).
Finally, we would like to make a concluding remark that Ledenyov Quantum Winning Virtuous Strategy Search (LQWVSS) algorithm can be implemented in the form of the software program and executed at the high performance computing systems to numerically solve the challenging research problem on the investment strategy creation and execution during a process of the financial capital investment in the global capital markets.

Conclusion

The financial capital investment as a research subject in the finances has always been treated similarly to a “newly discovered star” in the finances galaxy, attracting a considerable research interest and originating original thoughts by the economists, financiers, philosophers, thinkers and scientists over the recent centuries. The great scientific minds tried to explore and understand the capital origination, accumulation and distribution principles in the financial systems in the economies of the scales and scopes in various social economical political settings and systems at the different historical time periods in the World in Joseph Penso de la Vega (1668, 1996), Mortimer (1765), Smith (1776, 2008), Ricardo (1817, 1821), Bentham (1839), Mill (1862), Marx (1867, 1893, October 1994), Bagehot (1873, 1897), George (1879, 1881, 2009), von Böhm-Bawerk (1884, 1889, 1921), Hirsch (1896), Bachelier (1900), Slutsky (1910), von Mises (1912), Keynes (1930 1934, 1936), Schumpeter (1939), Obstfeld, Rogoff (1996), Krugman, Wells (2005), Stiglitz (2005, 2016), Piketty (August 2013), Dodd (2014).

Undoubtedly, the financial capital investment in the capital markets in the finances has been considered as a financial conundrum with a big number of the changing financial variables and the unanswered questions by the economists, financiers, investors, philosophers, thinkers and scientists over the centuries, who attempted to formulate, re-think and solve the problem on the financial capital investment in the nonlinear diffusion-type financial systems from the social and natural sciences perspectives over the years in Markowitz (1959, 1987), Fabozzi, Markowitz (editors), Cootner (1964), Merton (1992), Shiryaev (1998a, b), Hull (2010, 2012a, b).

Of course, as we know, the nature of the processes of the financial capital origination, accumulation and distribution has been comprehensively studied and understood, to some degree, highlighting the unequal fragmented capital distributions in the form of increasing financial capital gaps between the different social hierarchy layers in various countries in Stiglitz (2015), Piketty (August 2013, August 15 2014). A general expressed opinion is that this inequality in the financial capital distributions appears due to a number of factors, including the ineffective economic policies introduction by the governments, the increased investment return premium generation by the successful market agents, and the low level of capital gains taxation by the tax authorities in the conditions of the nonlinear diffusion-type financial system, because of various existing economic/social/political reasons in the economies of the scales and the scopes.

This book represents the three decades of multidisciplinary research excellence by the authors in the finances, econometrics and econophysics. Indeed, we decided to discuss a
challenging problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, keeping in mind the fact that a serious progress has been achieved in the finances, econometrics and econophysics sciences, for instance: a) the origination of the numerous groundbreaking financial innovations in the capital markets in the finances, b) the creation of the sophisticated theoretical financial capital investment models and theories in the econometrics/econophysics sciences, c) the development of the innovative theoretical financial capital investment models and theories in the quantum econophysics science, and d) the introduction of the advanced theoretical financial capital investment models and theories in the discrete and stochastic mathematics science.

Chapter 1 discusses briefly the history of creation of the financial capital markets, the evolution of the financial capital markets and the present state of the financial capital markets in Asia, Europe and North America from the ancient time to the present time, going from the academic literature perspective. The main historical facts to emphasis are:

1. The introduction of the money to the first financial system in the ancient time of the Song dynasty and the Yuan Dynasty in mainland China;
2. The significant historical scientific role by the Austrian school of economic and financial thinking toward the creation of the fundamental theory on the modern global financial system operation;
3. The considerable impact by the Chicago school of the economic and financial thinking toward the creation of the modern global financial system in the global capital market.

Chapter 2 formulates a problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

The main research findings to keep in mind are:

1. The investment as an act of allocation of the financial capital in order to gain the profit in the form of the increased return premium, advantage or interest;
2. The fact that the problem on the investment of the financial capital in the capital markets can only be solved, introducing a number of the financial and economic variables to characterize the financial capital in the differential equations in the advanced theoretical models in various sciences;
3. The axiom that the financial capital investment in the capital markets can be accurately characterized by measuring and analyzing the statistical distributions of the discrete-time financial/economic events by the oscillating financial/economic variables in the finances, economics, and econometrics sciences.
4. The proposition that the financial capital investment in the capital markets can be precisely described by measuring and researching the signals by the oscillating financial/economic variables in the finances, economics, and econophysics sciences;

5. The suggestion to characterize the financial capital investment in the capital markets by registering and studying the scaling properties of the discrete-time events by the oscillating financial/economic variables in the finances, economics and econophysics sciences.

Chapter 3 solves a problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

The main innovative research proposals to summarize are:

1. The innovative proposition to use the multilayered approach during the consideration of the investment problem, characterizing the different layers of the investment process;

2. The proposed investment problem solution, applying the investment process algorithm with the different embedded investment layers;

3. The definition and list of the possible investment products in the capital markets;

4. The definition and list of the possible investment vehicles in the capital markets;

5. The definition and list of the possible investment mediums in the capital markets.

Chapter 4 focused on the investment products for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

The main innovative research outcomes to pay attention are:

1. The land as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;

2. The real estate as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;

3. The commodity as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;

4. The bond as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;

5. The firm’s stock and the stock options as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;

6. The financial security as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;
7. The foreign currency as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;

8. The intellectual property as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods;

9. The bitcoin as an investment product for financial capital investment in capital markets with aim to get increased return premium in short and long time periods.

Chapter 5 considered the investment vehicles for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

The main innovative research analysis results to remember are:

1. The investment bank as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

2. The investment fund as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

3. The hedge fund as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

4. The pension fund as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

5. The mutual fund as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

6. The venture capital fund as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

7. The angel investor as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

8. The investment boutique as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;
9. The private investment office as an investment vehicle for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

**Chapter 6** defined the investment mediums for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

The main innovative research proposals to memorize are:

1. The land exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

2. The real estate exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

3. The stock exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

4. The foreign currencies exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

5. The financial securities exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

6. The precious metals exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

7. The intellectual property exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods;

8. The digital currencies exchange as an investment medium for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

**Chapter 7** introduced the financial risk calculation and mitigation techniques during the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.
The main innovative scientific findings to think about are:

1. The modern portfolio theory (MPT) in Markowitz (1952, 1956, 1959, 1987);

2. The efficient frontier (EF) theoretical conception in the Modern Portfolio Theory (MPT) in Markowitz (1952, 1956, 1959, 1987) and its limitations in the real-life practical applications;

3. The investment portfolio accurate characterization by both 1) the total risk value, which is a sum of all the risks of the selected assets in Markowitz (1952, 1956, 1959, 1987) and 2) the total stability magnitude, which is a sum of all the stabilities of the selected assets in Ledenyov D O, Ledenyov V O (2013a);

4. The representation of the asset classes in the investment portfolio as the electronic signals, which can be characterized by the correlated and uncorrelated complex discrete-time digital oscillations with the certain amplitudes, frequencies, periods, and phases. The spectrum analysis with an aim to minimize the total risk, to maximize the stability of the investment portfolio, and to create the efficient optimized investment portfolio;

5. The Ledenyov investment assets theorem on the ultrafast (un)correlation properties of the investment assets in the investment portfolio;

6. The Ledenyov investment portfolio stability theorem on the stability of the investment portfolio;

7. The Ledenyov discrete-time digital short/medium/long waves of the economic output fluctuations in the economies of the scales and the scopes;

8. The Ledenyov bursts with the discrete-time digital waves to characterize the economic output fluctuations in the economies of the scales and the scopes at the very long observation time periods;

9. The most important research result is that the diversification of the investment portfolio must be conducted across all the investment products, the investment vehicles, the investment mediums at the same time (The early research findings focused on the diversification among the investment products/asset classes/instruments only);

10. The final comment is that an efficient optimized investment portfolio includes the carefully selected diversified investment products, investment vehicles and investment mediums for the financial capital investment in the capital markets in the economies of scale and the scope in the short and long time periods, aiming to decrease the total risk of the investment portfolio, to increase the total stability of the investment portfolio and to get the increased return premium in Ledenyov D O, Ledenyov V O (2013a).
Chapter 8 proposed the new research approaches to the quantum winning virtuous strategies creation and execution with the use of the quantum logic, inductive logic, deductive logic and abductive logic during the capital investment in the capital markets in the short and long time periods.

The main innovative research ideas to memorize are:

1. The conceptual design of the Ledenyov Quantum Winning Virtuous Strategy Search (QWVSS) algorithm with the use of the quantum logic, inductive logic, deductive logic and abductive logic for the capital investment in the capital markets in the short and long time periods;

2. The conceptual design of the Ledenyov Quantum Thinking Process (QTP) algorithm with the use of the quantum logic, inductive logic, deductive logic and abductive logic for the capital investment in the capital markets in the short and long time periods;

3. The definition of the Ledenyov quantum logic (the probability logic) for the decision making in frames of Ledenyov Quantum Winning Virtuous Strategy Search (QWVSS) algorithm for the capital investment in the capital markets in the short and long time periods;

4. The theoretical conception on the strategy vector in the multidimensional strategy space in frames of the fundamental theory on the complex strategy in the multidimensional strategy space.

We conclude by saying that this book discussed some aspects of the complex problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. It explained how the investment process works, opening the unlimited opportunities for the individual and institutional investors towards the private/institutional wealth accumulation, the optimal wealth management and the social prosperity building on a global scale.
Acknowledgement

Our sincere gratitude goes to all our colleagues-researchers, including the professors from the leading universities, the academics from the national academies of sciences, the researchers from the big multinational corporations and small startups, the subject experts from the professional consulting firms, the governmental officials from the government agencies, the financiers from the central banks, the analysts from the analytic “think tanks”, the policy makers from the management consulting firms, and the senior executives from the international financial organizations for presenting us with the multiple wonderful global opportunities to deliver our invited speeches, public lectures, research talks, scientific presentations on the subject of our research interest during the expert level seminars, scientific symposiums, international conferences, and business meetings in the Eastern and Western Europe, North America, East Asia, Middle East, and Australia over the last 27 years.

Traditionally, we like to conduct the Q&A sessions after the invited lectures, hence we thank all the young inquisitive researchers, talented graduate students and their experienced professors from the leading universities for a big number of interesting questions during the questions and answers (Q&A) sessions after our presentations. We do consider all the questions as quite useful and encouraging, because the new groundbreaking innovative research ideas originate in our minds in the process of debate frequently. The multiple research inputs by the academicians, practitioners, subject experts allowed us to think differently on the multi-dimensional scientific problems and encouraged us to work intensively and persistently toward the research book completion this year.

We gratefully acknowledge the insightful thoughtful ideas on the subject of our research interest, expressed by Dr. Ben Shalom Bernanke, former Chairman of the Board of Governors of the Federal Reserve System in an electronic copy of his Ph. D. Thesis: “Long-term commitments, dynamic optimization, and the business cycle” as well as the copies his innovative 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. Of course, the modern science evolves steadily and consistently, hence our understanding on the nature of the business cycles changes accordingly from the continues-time wave to the discrete-time digital waves of the economic output fluctuations in the time domain.

We are very grateful to Prof. Robert F. Engle III, Department of Finance, New York University in New York, USA for his scientific visionary statements, interesting discussions and comprehensive research data on the Stratonovich – Kalman – Bucy filtering algorithm, in
particular, the thoughtful discussion on the derivation of the probability density function as a sum of its predictive or conditional densities in the case the state-space model in Engle (2006) has to be mentioned. We absolutely agree with Prof. Robert F. Engle III wise research opinion that the modern finances can certainly be researched with an application of the digital signal processing techniques in the electronics science.

Speaking about the electronics and economics sciences, one of the interesting historical facts can be mentioned. Namely, the Danish school of scientific thinking in the analogues signals processing at Technical University of Denmark, Lyngby, Denmark as well as the Swedish school of scientific thinking on the digital signals processing at Linköping University, Sweden have had a considerable impact on the first author’s scientific vision formation in the natural and social sciences. Scandinavian period in the first author’s research work can be regarded as a most fruitful, because it allowed to make the innovative research in the electronics and economics sciences in parallel in 1995, 1996-1997. As Prof. Lars Wanhammar, Linköping University likes to state: “the signal processing is fundamental to the information processing, and includes various method of the information extraction”, which may be used to make the assumptions in the electronics, finances, economics sciences.

It is a real privilege for the second author to deliver his personal cordial thanks to Prof. Janina E. Mazierska, Electrical and Computer Engineering Department, James Cook University in Townsville in Australia, who helped the second author to cultivate the logical scientific thinking to tackle the complex scientific problems on the analogue and digital signal processing, the accurate measurements of physical parameters, the nature of the nonlinearities in the microwave superconductivity, applying the interdisciplinary scientific knowledge since 2000.

We found that the integrative thinking is a quite useful theoretical approach to solve the financial engineering problems, hence we sincere thank Profs. Roger L. Martin, the Rotman School of Management at the University of Toronto in Toronto, Canada for the numerous long-hours scientific discussions on the strategy, integrative thinking and financial engineering in the electronic trading laboratory at the Rotman School of Management at U of T in Toronto, Canada in 1998-1999 and 2005-2006. Of course, our private discussions included a number of generals topics such as the wine, music and tennis.

We appreciate Prof. John C. Hull for the useful exchanges by the research opinions on the financial derivatives during our innovative research at the electronic trading laboratory at the Rotman School of Management at U of T in Toronto, Canada in 1998-1999 and 2005-2006, which proved to be increasingly important for the optimized computer algorithms creation, the software programs writing, and the computer modeling.
The important groundbreaking research results on the creative disruption and evolutionary economics, obtained by Prof. Joseph Alois Schumpeter at the University of Vienna in Austria in 1905 – 1908, University of Czernowitz in Ukraine in 1909 – 1911, University of Graz in Austria in 1912 – 1914, University of Bonn in Germany in 1925 – 1932, Harvard University in the USA in 1932 – 1950, had a considerable enigmatic influence on the presented research opinions by the authors. Let us repeat that the first author’s visit to University of Czernowitz in Ukraine in March 2015 is just a clear confirmation of the above statements.

As we all know, the ideas on the creative destruction have been further researched by Prof. Clayton M. Christensen, Kim B. Clark University Professor of Business Administration, Harvard Business School, Harvard University and some other notable scientists, hence we studied and absorbed the modern research approaches and findings on the creative destruction before making our innovative scientific vision. Let us say that Prof. Clayton M. Christensen presented the very Scandinavian approach to the understanding of the research problem on the creative disruption and evolutionary economics in his lecture notes, research articles and numerous books. It is nice to see that Prof. Clayton M. Christensen continues to be very active in the field of his research interest, making his business foresights, writing his new research books, lecturing at Harvard Business School, and conducting the executive program in the summer time.

The authors would like to explain that the quantum strategy represents a new research subject for a big number of the leading research institutions and universities, hence we sincerely acknowledge an enormous interest to our innovative research on the quantum strategy application in the finances from the side of Prof. Michael E. Porter, Founding Director, Strategy Institute, Harvard Business School, Harvard University, USA. It is wonderful to see that Prof. Michael E. Porter, Founding Director, Strategy Institute, Harvard Business School, Harvard University finds the enough time to write his numerous research articles and books despite of his heavy administrative work load at the Strategy Institute, Harvard Business School, Harvard University. We are very grateful to Prof. Michael E. Porter, Bishop William Lawrence University Professor, Harvard University, who is considered by the authors as a father of the modern business strategy, for his valuable personal efforts and time to write and discuss a number of his interesting informative research articles and books as well as to create the lecture notes, providing us with his professional expertise, exceptional quality professional advices and wise opinions in the field of competitive strategy in the 21st century. In fact, Prof. Michael E. Porter is regarded by the authors as a “guiding star” in the strategy science galaxy.

Our Swiss watches collecting lifestyle, encouraged the second author to visit the Patek Philippe museum in Genève, Switzerland in 2016, resulting in an interesting research proposition
to present the quantum strategy search algorithm in the form of an imagined dial in the Swiss mechanical time-pieces. Indeed, we found that the international students, professors and executives in the business administration education programs at various complexity levels can memorize the information on the Ledenyov Quantum Winning Virtuous Strategy Search (LQWVSS) algorithm, presented in the form of an imagined dial in the Swiss mechanical time-pieces, much more better, comparing to the generally accepted block-schemes, which may better suit the needs by the students enrolled in the computer science education programs.

One of the most important lessons, which we learned in the processes of our education and research at the universities over the years is that the innovative groundbreaking research ideas matter a lot in the modern society. The innovative research ideas lead to the “quantum leaps” in the social-scientific-economic-financial progress in the developed countries. Fortunately, we obtained the multidisciplinary knowledge, completing the university degrees in the Radio-Physics and Electronics at V.N. Karazin Kharkiv National University in Kharkiv, Ukraine in 1993 and 1999. Therefore, we would like to share an opinion that all our discoveries have been made due to the multi-disciplinary knowledge application, which is considered by the authors as a key factor on the way toward the modern society building.

Continuing our research discussion, let us explain the origins of some innovative research ideas, which are presented in this book in the finances:

1. We think that the multiple layers research analysis approach can be successfully applied to research the different investment layers in a process of capital investment in the capital markets in the finances science, including the investment product, vehicle, medium layers, in analogy to the complex hetero-junction structures research in the electronics;

2. The research on the analogue/digital signals processing in the electronics engineering science allowed us to formulate the Ledenyov discrete-time digital business cycles theory in which the discrete-time disruptive innovations can sharply change the economic output waveform in the economics science;

3. The research on the quantum transitions by the quantum objects in the atom in the quantum physics facilitated the creation of the discrete-time quantum business cycles theoretical model in the frames of the quantum macroeconomics theory and the quantum microeconomics theory in the economics science. In this case, we not only consider the discrete-time digital waveform of the economic output fluctuations, but study the discrete-time transition phenomena and its quantum properties, focusing on the number of disruptive events and their economic properties during the transition from the one level of the economic output to the another level of the economic output in the economy of the scale and the scope as explained in the book;
4. The research on the time division duplex (TDD) / frequency division duplex (FDD) direct sequence spread spectrum (DSSS) wireless communication devices and the Code Division Multiple Access (CDMA) wireless communication devices in the electrical and computer engineering science made it possible to formulate the theory on the Ledenyov long complex discrete-time digital wave, propagating in the form of the transmitted discrete-time spread spectrum signal bursts in the economy of the scale and the scope in the economics science. In this case, the every transmitted signal burst contains the Ledenyov discrete-time digital wave of GDP(t)/GNP(t)/PPP(t) fluctuations, which is modulated by the disruptive technological/social/political innovations in the economy of the scale and the scope in the scale-time domains. There may be the time periods, when the discrete-time spread spectrum signal bursts are present (the intensive economic development phase) or they are absent (the economic stagnation/downturn/crisis phase).

5. As we know the financial capital investment can be done into such an investment product as the foreign currencies, which are constantly traded in the FX markets in the finances. The research on the microwave signals generation/propagation/attenuation/processing in the electronics allowed us to propose an interesting idea on a possibility of realization of the ultra high frequency (UHF) electronic trading in the FX markets in the finances;

6. The foreign currencies exchange indexes in the foreign currencies exchange markets can fluctuate instantly. In this case, the research on the discrete-time digital signals in the digital signal processing theory in the electronics science gave us an opportunity to make a suggestion on a possibility of realization of the nonlinear signal filtering of the foreign currencies exchange indexes, using the Stratonovich-Kalman-Bucy filter and the particle filter in the Stratonovich-Kalman-Bucy nonlinear signals filtering theory in the finances;

7. The hedge fund is a well known investment vehicle in the modern finances. Thus, the research on the discrete-time digital signals in the digital signal processing theory in the electrical and computer engineering science allowed us to suggest that the tracking of the hedge fund’s investment strategies by various investment funds can be efficiently done, using the Stratonovich-Kalman-Bucy nonlinear signals filtering theory in the finances;

8. The research on the analogue signal processing theory and the digital signal processing theory in the electronics science encouraged us to formulate the Ledenyov investment assets theorem in the finances science;

9. The research on the stability in the mathematics science and the complex systems stability in the electrical and computer engineering science allowed us to introduce the Ledenyov investment portfolio stability theorem in the finances science;
10. The research on the quantum random number generators on the magnetic flux qubits (1024 QRNG_MFQ chipset) in the quantum physics helped us to better understand the random fluctuations of the financial variables in the finances;

11. The theoretical conception on the quantum money in the finances was proposed as a result of our intensive research work in the quantum physics, superconductivity, optics and low temperature physics sciences over the recent decades;

12. A recent invention of the quantum logic for an application in the decision making theory in the business administration, law making, finances, and economics sciences is a result of our intensive research work in the quantum physics over 25 years.

It worth to comment that the scientific thinking school in Bunyakovsky (1825a, b, c, 1846), who was born in Town of Bar, Region of Vinnysia, Ukraine; influenced the authors’ strategic scientific vision creation and helped to develop the authors’ tactical approaches to the scientific problems solutions in the case of the problem on the forecast in the capital markets.

Speaking about Kharkiv, we can say that Prof. Niels Bohr, Copenhagen University, Denmark visit to Kharkov, Ukraine in 1933 led to the creation of the econophysics science, and the second author’s visits to Roskilde, Lyngby, Denmark and Copenhagen, Denmark in 1995, 1996-1997 resulted in the new quantum theories formulation in the econophysics science.

The authors acknowledge the multiple scientific discussions on the econophysics and the quantum mechanics with Oleg P. Ledenyov in Kharkiv, Ukraine over the recent decades. Our farther, Oleg P. Ledenyov, researched the absorption phenomena, including the absorption of the electromagnetic signals in the high pure metals / superconductors at the ultrasonic frequencies at the low temperatures; the absorption of the electromagnetic signals in the superconductor crystals/thin films at the ultra high frequencies at the low temperatures; the absorption of the electromagnetic signals in the quantum liquids such as the liquid Helium at the ultra high frequencies at the low temperatures; and the absorption of the chemical elements and their isotopes in the soft condensed matter in the physics in Kharkiv, Ukraine for the five decades. Therefore, it was interesting for us to make the advanced research on the absorption of information by the investors during the financial capital investment in the capital markets in the economics and the finances.

The first author thanks for a wonderful opportunity to deliver the invited research seminar, answer the multiple research questions, and make an exchange by the innovative research opinions on the nonlinear signals processing at Electrical and Computer Engineering Department, James Cook University, Townsville, Australia in April, 2016.
Looking forward, we can see an existence of a serious contradiction in the minds of the reputable economists in the economics science. The problem is that all the classic theories in the economics and finances sciences are based on an assumption that the financial and economic processes in the economies of the scales and the scopes can be classified as the continuous-time processes. The fact is that a big number of the economists created the outdated economic theories dealing with the continuous-time financial and economic processes in the economies of the scales and the scopes. However, presently, we came to an understanding that all the financial and economic processes in the economies of the scales and the scopes are the discrete-time digital processes. Therefore, it is necessary to recognize a profoundly important fact that a new way of thinking and a new mentality must be applied to understand and accurately characterize the discrete-time digital processes in the economies of the scale and the scope in the frequency/scale/time domains. In this context, we formulated our new innovative theories in the economics and finances sciences.

Finally, the authors thank a senior management team at The Mathworks for the license and kind permission to get a remote access to the software libraries with the different implementations of the digital signal processing algorithm, including the Stratonovich – Kalman-Bucy filtering algorithm, as well as the bifurcation algorithms in the Matlab, at the Mathworks servers in the USA.

It is not conceivable to write this book without the multiple useful research inputs from and encouragements by many brilliant people, who are not listed in the acknowledgement, because of various reasons. Indeed, playing the tennis at the tennis courts or the golf at the golf play grounds with our respected research collaborators, business partners, family friends in various countries around the World, we have already conducted many thousands of thoughtful discussions on the topics of our research interest, hence we would like to thank all our global Friends for their brilliant ideas, interesting opinions, numerous comments, wise suggestions and shared experiences on the subject of our research interest in the economics, finances, and econophysics.
References:

Economics science history, finance science history:

4. Ricardo D 1817, 1821 On the principles of political economy and taxation 3rd edition John Murray Albemarle Street London UK.
16. Bachelier L 1914 Le jeu, la chance et le hazard Bibliothèque de Philosophie scientifique Ernest Flammarion Paris France
   http://gallica.bnf.fr/ark:/12148/bpt6k61926m .
28. Slutsky E E 1915 Sulla teoria sel bilancio del consumatore Giornale degli economisti e rivista di statistica 51 no 1 pp 1 – 26 Italy.
30. von Mises L 1912 The theory of money and credit Ludwig von Mises Institute Auburn Alabama USA
31. Keynes J M 1919 The economic consequences of the peace Macmillan London UK.
32. Keynes J M 1930 The applied theory of money: A treatise on money vol 2 Macmillan London UK.
33. Keynes J M 1934 A treatise on money Macmillan London UK.
34. Keynes J M 1936 The general theory of employment, interest and money Macmillan Cambridge University Press Cambridge UK.
38. Fisher I 1930 The theory of interest Macmillan Company New York USA.
43. Ellis H, Metzler L (editors) 1949 Readings in the theory of international trade Blakiston Philadelphia USA.
44. Friedman M (editor) 1953 Essays in positive economics Chicago University Press Chicago USA.
47. Olson M 1965 The logic of collective action Harvard University Press Cambridge Massachusetts USA.
51. Minsky H P 2015 Minsky archive The Levy Economics Institute of Bard College Blithewood
Bard College Annandale-on-Hudson New York USA
http://www.bard.edu/library/archive/minsky/.


59. Foray D, Freeman Ch (editors) 1993 Technology and the wealth of nations Stanford
University Press Stanford California USA.


62. Scornick-Gerstein F May, 1996 Private communications on land value taxation theory by
Henry George Royal Automobile Club London UK.

63. Scornick-Gerstein F 1999 The future of taxation: The failure of the poll tax in the UK

64. Landes D S 1969 The unbound Prometheus: Technological change and industrial
development in Western Europe from 1750 to the present Cambridge University Press
Cambridge UK.

65. Landes D S May 1990 Why are we so rich and they so poor American Econ Review 80 2

and Some are So Poor W W Norton & Company Inc; Little, Brown and Company; Abacus

67. Wolf M 2004 Why globalization works Yale Nota Bene, Yale University Press New Haven,


70. Stiglitz J E 2015 The great divide Public Lecture on 19.05.2015 London School of Economics and Political Science London UK

71. Stiglitz J E 2016 The Euro: How a common currency threatens the future of Europe

72. Morris D, Heathcote J 2007 The price and quantity of residential land in the United States


http://piketty.pse.ens.fr/en/capital21c2,


**Juglar economic cycle theory in economics:**


**Kondratiev economic cycle theory in economics:**
85. Kondratieff N D 1922 The world economy and its trends during and after war *Regional branch of state publishing house* Vologda Russian Federation.
86. Kondratieff N D 1925 The big cycles of conjuncture *The problems of conjuncture* 1 (1) pp 28 – 79.


90. Kondratieff N D 1984 The Long wave cycle *Richardson & Snyder* New York USA.
98. Kuczynski Th 1978 Spectral analysis and cluster analysis as mathematical methods for the periodization of historical processes: Kondratieff cycles – Appearance or reality?


103. Van Duijn J J 1983 The long wave in economic life Allen and Unwin Boston MA USA.
112. Wallerstein I 1984 Economic cycles and socialist policies Futures 16 (6) pp 579 – 585.

116. Freeman C, Louçã F 2001 As time goes by: From the industrial revolutions to the information revolution Oxford University Press Oxford UK.

117. Goldstein J 1988 Long cycles: Prosperity and war in the modern age Yale University Press New Haven CT USA.


123. Tylecote A 1992 The long wave in the world economy Routledge London UK.


128. Perez C 2002 Technological revolutions and financial capital – The dynamics of bubbles and golden ages Edward Elgar Cheltenhem UK.


Kitchin economic cycle theory in economics:


Kuznets economic cycle theory in economics:

138. Kuznets S 1924 Economic system of Dr. Schumpeter M. Sc. Thesis under Prof. Wesley Clair Mitchell Columbia University NY USA.

139. Kuznets S 1930 Secular movements in production and prices Ph. D. Thesis under Prof. Wesley Clair Mitchell Columbia University NY USA.

140. Kuznets S 1930 Secular movements in production and prices. Their nature and their bearing upon cyclical fluctuations Houghton Mifflin Boston USA.


146. Kuznets S 1968 Toward a theory of economic growth, with reflections on the economic growth of modern nations.

147. Kuznets S 1971 Economic growth of nations: Total output and production structure.


161. Wikipedia 2015b Simon Kuznets Economist *Wikipedia* USA
Ledenyov economic cycle theory in economics:

http://mpra.ub.uni-muenchen.de/63565/ ,

http://mpra.ub.uni-muenchen.de/64368/ ,

http://mpra.ub.uni-muenchen.de/64755/ ,

165. Ledenyov D O, Ledenyov V O 2016r Precise measurement of macroeconomic variables in time domain using three dimensional wave diagrams MPRA Paper no 69609 Munich University Munich Germany, SSRN Paper no SSRN-id2733607 Social Sciences Research Network New York USA pp 1 – 52
http://mpra.ub.uni-muenchen.de/69609/ ,

www.lap-publishing.com ,
http://mpra.ub.uni-muenchen.de/72286/ ,

Accurate characterization of properties of economic cycles in economics:


197. Jourdon Ph 2008 La monnaie unique Europeenne et son lien au developpement economique et social coordonne: une analyse cliometrique *Thèse Universite Montpellier* France.


The Wall Street Journal New York USA.
Federal Reserve Bank of St Louis
http://research.stlouisfed.org/fred
211. Desai M, King St, Goodhart Ch 2015 Hubris: Why economists failed to predict the crisis
and how to avoid the next one Public Lecture on 27.05.2015 London School of Economics
and Political Science London UK
http://media.rawvoice.com/lse_publiclecturesandevents/richmedia.lse.ac.uk/publiclecturesan
devts/20150527_1830_hubris.mp4
212. Wikipedia 2015c Business cycle Wikipedia California USA

Disruptive technological and social innovations in economics and finances:
213. Schumpeter J A 1911; 1939, 1961 Theorie der wirtschaftlichen entwicklung: The theory
of economic development: An inquiry into profits, capital, credit, interest and the business
cycle Redvers Opie (translator) OUP New York USA.
History vol 7 pp 149 – 159.
216. Solow R H August 1957 Technical change and the aggregate production function Review
217. Christensen C M June 16, 1977 Fatal attraction: The dangers of too much technology
Computerworld Leadership Series pp 3 – 11.
218. Christensen C M Fall 1992a Exploring the limits of the technology S-curve, Part 1:
Component Technologies Production and Operations Management 1 pp 334 – 357.
219. Christensen C M Fall 1992b Exploring the limits of the technology S-curve, Part 2:
the wave Harvard Business Review 73 no 1 pp 43 – 53.
221. Bower J L, Christensen C M 1997 Disruptive technologies: Catching the wave in Seeing
MA USA.
222. Christensen C M 1997 The innovator's dilemma: When new technologies cause great
firms to fail Harvard Business School Press Boston MA USA.


233. Christensen C M 1999b Impact of disruptive technologies in telecommunications in Bringing PC economies to the telecommunications industry *PulsePoint Communications*.


238. Christensen C M, Craig Th, Hart S March April 2001 The great disruption *Foreign Affairs 80* no 2.


250. Shah Ch D, Brennan T A, Christensen C M April 2003 Interventional radiology: Disrupting invasive medicine.

251. Christensen C M March April 2003 Beyond the innovator's dilemma *Strategy & Innovation 1* no 1.


222


262. Dyer J H, Gregersen H B, Christensen C M 2011 The innovator's DNA: Mastering the five skills of disruptive innovators *Harvard Business Press* Boston MA USA.


267. Christensen C M 2015 Disruptive strategy *Course for Senior Executives* Harvard Business School Harvard University Cambridge USA.


272. Dobbs R, Woetzel J, Flanders St 2015 No ordinary disruption: The four global forces breaking all the trends Public Lecture on 08.06.2015 London School of Economics and Political Science London UK http://media.rawvoice.com/lse_publiclecturesandevents/ri@gmail.com/publiclecturesandevents/20150608_1830_noOrdinaryDisruption.mp4 .


Metal coins, paper money, electronic money, network money, electronic cash, digital cash, bitcoin, electronic payments, debit cards, credit cards, stored value cards, smart cards (electronic purses) in finances:


276. Del Mar A 1894 History of money in ancient countries New-York USA.


278. Keynes J M 1936 The general theory of employment, interest, and money Harcourt Brace Jovanovich New York USA.


284. Tobin J 1963 Commercial banks as creators of money in Banking and monetary studies Carson D (editor) Irwin Homewood IL USA pp 408 – 419.


293. Rousseas St W 1972 Monetary theory Enopf New York USA.


297. Hayek F A 1978 Denationalization of money: The argument refined The Institute of Economic Affairs London UK.


305. White L H 1989 Competition and currencies New York University Press NY USA.

306. White L H (editor) 1993 Free banking vols 1, 2, 3 E Elgar Publishing Aldershot Hants UK.


312. Suhr D 1989 The capitalistic cost-benefit structure of money: An analysis of money’s structural non-neutrality and its effects on the economy Springer Berlin Heidelberg New York USA.

Revue des Etudes Anciennes 91 pp 87 – 94.

315. Goodhart Ch 1989 Money, information, and uncertainty Macmillan London UK.

316. Goodhart Ch 2000 Can central banks survive the IT revolution? International Finance
vol 3 no 2 pp 189 – 209.

317. Kennedy M 1989 Interest and inflation free money: How to create an exchange medium
that works for everyone Permakultur Institute e.V.

318. Whitesell W 1989 The demand for currency versus debitable accounts Journal of Money,
Credit and Banking 21 (2) pp 246 – 251.

319. Whitesell W 1992 Deposit banks and the market for payment media Journal of Money,
Credit and Banking 24 (4) pp 484 – 496.

320. Howgego Ch J 1990 Why did ancient states strike coins? The Numismatic Chronicle 150
pp 1 – 25.

321. Karwiese St 1991 The Artemisian hoard and the first coins of Ephesus Revue Belge de

322. Selgin G A, White L W December 1994 How would the invisible hand handle money?

323. Bauer P W October 1 1995 Making payments in cyberspace Economic Commentary
Federal Reserve Bank of Cleveland USA.

324. Crede A 1995 Electronic commerce and the banking industry: The requirement and
opportunities for new payment systems using the Internet Journal of Computer Mediated
Communication vol 1/3

325. Duca J V, Whitesell W C 1995 Credit cards and money demand: A cross-sectional study
Journal of Money, Credit and Banking 27 (2) pp 604 – 623.

cross-country analysis Journal of Money, Credit and Banking vol 28 no 4 part 2 pp 914 –
939.

327. Humphrey D B 2004 Replacement of cash by cards in US consumer payments Journal of
Economics and Business 56 pp 211 – 225.

Federal Reserve Bank of Richmond USA pp 10 – 18.

Hawaii USA.


www.bis.org/publ/index.htm.

Bank for International Settlements (BIS) 2004 Survey of developments in electronic money and Internet and mobile payments *Committee on Payment and Settlement Systems Bank for International Settlements* Basel Switzerland
www.bis.org/publ/index.htm.

Bernkopf M 1996 Electronic cash and monetary policy *First Monday Munksgaard International Publishers* Copenhagen Denmark
http://www.firstmonday.dk.


Dorn J A (editor) 1996 The future of money in the information age *Cato Institute* Washington DC USA.


Lynch D, Lundquist L 1996 Digital money: The new era of Internet commerce *John Willey and Sons Inc* New York USA.


US Treasury September 1996 An introduction to electronic money issues *US Treasury* USA.

Berentsen A 1997a Digital money, liquidity, and monetary policy *First Monday Munksgaard International Publishers* Copenhagen Denmark

Berentsen A 1997b Supervision and regulation of network banks *First Monday Munksgaard International Publishers* Copenhagen Denmark


362. McKnight L, Bailey J (editors) 1997 Internet economics MIT Press Cambridge MA USA.

363. Neuman C, Medvinsky G 1997 Internet payment services in Internet economics McKnight L, Bailey J (editors) MIT Press Cambridge MA USA.


380. Orr B July 1999a At last Internet banking takes off ABA Banking Journal p 36.

381. Orr B July 1999b E-banks or E-branches? Both are in play as early adopters make them work ABA Banking Journal pp 32 – 34.


390. Workshop October 20 – 21 2000 The analysis of new electronic payments systems based on Carl Menger’s institutional theory of the origin of money Workshop Vienna Austria.


394. Beck H 2001 Banking is essential, banks are not. The future of financial intermediation in the age of the Internet Netnomics vol 3 pp 7 – 22.


404. Davies G 2002 A history of money from ancient times to the present day 3rd edition University of Wales Press Cardiff UK.


http://www.imes.boj.or.jp .

www.capco.com ,


Central banks, federal reserve banks, federal reserve system in finances: 


410. Bernanke B S 2004 The great moderation


413. Bernanke B S 2007 The financial accelerator and the credit channel *Speech at The Credit Channel of Monetary Policy in the Twenty-first Century Conference* Federal Reserve Bank of Atlanta Georgia USA.

414. Bernanke B S 2009a The crisis and the policy response *Federal Reserve* USA.


http://www.bis.org/review/r091119a.pdf.


http://www.bis.org/review/r091013a.pdf.


http://www.bis.org/review/r091006a.pdf.


http://richmedia.lse.ac.uk/publicLecturesAndEvents/20090113_1300_policyResponsesToTheFinancialCrisis.mp3.

419. Bernanke B S 2010a Monetary policy and the housing bubble *Annual Meeting of the American Economic Association* Atlanta Georgia USA.

420. Bernanke B S 2010b Causes of the recent financial and economic crisis testimony before the Financial Crisis Inquiry Commission Washington USA


422. Bernanke B S 2012b Monetary policy since the onset of the crisis *The Changing Policy Landscape symposium* sponsored by the Federal Reserve Bank of Kansas City Jackson Hole Wyoming USA


430. Taylor J B 1999 Monetary policy rules *University of Chicago Press* Chicago USA.

431. Ferguson R W Jr 2003 Rules and flexibility in monetary policy *Remarks at the University of Georgia* Athens Georgia USA


http://mpra.ub.uni-muenchen.de/50235/ ,


Stock exchange history, stock exchange operation principles, company valuation, company stock emission, company stock valuation by market, company stock valuation by rating agencies in economics and finances:

441. Courtois A 1855 Des opérations de bourse Paris France.
444. Lowenfeld H 1907 The investment of trust funds in the safest and most productive manner Effingham Wilson London UK.
446. Fisher I 1922 The making of index numbers. A study of their varieties, tests, and reliability New York USA.
467. Munro J H 2003 The medieval origins of the 'Financial Revolution': usury, rentes, and negotiability The International History Review XXV 3 ISSN 0707-5332 pp 505 – 756 Munich University Munich Germany
http://mpra.ub.uni-muenchen.de/10925/.


472. Schnoor I 2005-2006 Private communications on business valuation methodologies Rotman School of Management University of Toronto Canada.


474. Bartram S M, Bodnar G M 2009 Crossing the lines: The conditional relation between exchange rate exposure and stock returns in emerging and developed markets MPRA Paper No. 14018 Munich University Munich Germany pp 1 – 43
http://mpra.ub.uni-muenchen.de/14018/.


http://mpra.ub.uni-muenchen.de/9679/ .

http://www.economics.stir.ac.uk .

496. Thai-Ha Le, Youngho Chang 2011a The impact of oil price fluctuations on stock markets in developed and emerging economies MPRA Paper No. 31936 Munich University Germany
http://mpra.ub.uni-muenchen.de/31936/ .

497. Thai-Ha Le, Youngho Chang 2011b Dynamic relationships between the price of oil, gold and financial variables in Japan: A bounds testing approach MPRA Paper No. 33030 Munich University Germany pp 1 – 30
http://mpra.ub.uni-muenchen.de/33030/ .


Investment capital, investment portfolio, investment portfolio risk management in finances:

521. Markowitz H M 1956 The optimization of a quadratic function subject to linear constraints Naval Research Logistics Quarterly vol 3.
523. Markowitz H M 1987 Mean-variance analysis in portfolio choice and capital markets Basil Blackwell USA.


545. du Toit J, Peskir G, Shiryaev A N 2007 Predicting the last zero of Brownian motion with drift Cornell University NY USA pp 1-17

559. Cootner P 1964 The random character of stock prices MIT Press Cambridge USA.

248
595. Sharpe W 1992 Asset allocation: Management style and performance measurement

   *Journal of Portfolio Management* 18 no 2 pp 7 – 19.


   USA.


618. Merton R C 1993b Optimal investment strategies for university endowment funds in Clotfelter C, Rothschild M editors Studies of supply and demand in higher education University of Chicago Press Chicago USA.


653. Bernanke B S 2007 The financial accelerator and the credit channel *Speech at The Credit Channel of Monetary Policy in the Twenty-first Century Conference* Federal Reserve Bank of Atlanta Georgia USA.
654. Bernanke B S 2009a The crisis and the policy response *Federal Reserve* USA.
http://www.bis.org/review/r091013a.pdf.

http://www.bis.org/review/r091006a.pdf.

http://richmedia.lse.ac.uk/publicLecturesAndEvents/20090113_1300_policyResponsesToTheFinancialCrisis.mp3.

659. Bernanke B S 2010a Monetary policy and the housing bubble Annual Meeting of the American Economic Association Atlanta Georgia USA.

660. Bernanke B S 2010b Causes of the recent financial and economic crisis testimony before the Financial Crisis Inquiry Commission Washington USA


666. Bernanke B S 2013d A century of U.S. central banking: Goals, frameworks, accountability The first 100 years of the Federal Reserve: The policy record, lessons learned,
and prospects for the future conference sponsored by the National Bureau of Economic Research Cambridge Massachusetts USA.

http://media.rawvoice.com/lse_publiclecturesandevents/richmedia.lse.ac.uk/publiclecturesandevents/20130325_1715_whatShouldEconomistsAndPolicymakersLearn.mp4 ;


743. Engle R, Ishida I 2002 Forecasting variance of variance: The square-root, the affine, and the CEV Garch models Department of Finance Working Papers New York University NY USA.
www.nobel.se .


757. Engle R F 2006a Private communications on the modern portfolio, risk management and nonlinear dynamic chaos theories in finances *Rotman School of Management* University of Toronto Ontario Canada.

758. Engle R F 2006b Private communications on the Stratonovich – Kalman – Bucy filtering algorithm *Rotman School of Management* University of Toronto Canada.


787. Higuchi K 2016 Private communication on the interest rates setting by the Bank of Japan V. N. Karazin Kharkiv National University Kharkiv Ukraine.

*Land investment, land valuation, land ownership, land exchange, financial capital investment product, financial capital investment medium in finances:*

788. Ricardo D 1817, 1821 On the principles of political economy and taxation 3rd edition *John Murray* Albemarle Street London UK.


834. Głuszak M 2008 Land acquisition in development projects: Investment value and risk SRE-Discussion 2008/06 Department of Socioeconomics Institute for Multilevel Governance and Development Vienna University of Economics and Business Vienna Austria pp 1 – 16.


Fund for Agricultural Development, Food and Agriculture Organization London, Rome UK, Italy.


Malashchuk O 2014 The land use ranking by the degree of investment attractiveness Balanced Nature Using 5 (3) pp 116 – 120.


Busha D 2015 Land market infrastructure development as a basic prerequisite for improving the investment attractiveness of lands Ukrainian Journal Ekonomist issue 3 pp 21 – 25.


Bochco O 2016 Increasing the level of investment attractiveness of land resources in Lviv region Balanced Nature Using 4 (2) pp 43 – 47.

Commodity investment, commodity valuation, commodity derivatives, commodity futures, commodities exchange, financial capital investment product, financial capital investment medium in finances:


871. Working H 1960 Speculation on hedging markets *Food Research Institute Series* 1 pp 185 – 220.


960. Hamilton J D 1996 This is what happened to the oil-price macroeconomy relationship Journal of Monetary Economics 38 pp 215 – 220.


964. Hamilton J, Jing Wu 2013a Effects of index-fund investing on commodity futures prices Working Paper University of California San Diego USA.


976. Schneeweis T, Spurgin R 1997 Energy based investment products and investor asset allocation. *Center for International Securities and Derivatives Markets (CISDM) Isenberg School of Management* University of Massachusetts USA.


www.elsevier.com/locate/agecon.

1004. Till H Fall 2000a Passive strategies in the commodity futures markets *Derivatives Quarterly* pp 49 – 54.

1005. Till H September 2000b Systematic returns in commodity futures *Commodities Now* pp 75 – 79.


1010. Cochrane J H 2001 Asset pricing *Princeton University Press* Princeton NJ USA.


1015. Richards T J, Padilla L August 5 - 8 2001 Commodity R&D, patenting and promotion

*Selected Paper Presented at AAEA Annual Meetings* pp 1 – 21.

1016. Barsky R B, Kilian L May 2002 Do we really know that oil caused the great stagflation?


www.elsevier.com/locate/agecon.


*Journal of Regulatory Economics* 24 (1) pp 5 – 33.


*ABP Working Paper*


1027. Weiser S 2003 The strategic case for commodities in portfolio diversification

*Commodities Now* pp 7 – 11.


1037. Erb C, Harvey C May 2005 The tactical and strategic value of commodity futures NBER Working Papers no 11222 USA.


1044. Pulvermacher K March 2005a What are commodities?

1045. Pulvermacher K 2005b Commodity returns and the economic cycle

1046. Taylor S J 2005 Asset price dynamics: Volatility and prediction Princeton University
Press Princeton USA.

1047. Brown S P January February 2006 The commodity question: Can adding commodities to

1048. Bryant H L, Bessler D A, Haigh M. S 2006 Causality in futures markets Journal of

1049. Campbell P, Orskaug B-E, Williams R Spring 2006 The forward market for oil The Bank

1050. Feldman, B Till H 2006 Separating the wheat from the chaff: Backwardation as the long-
term driver of commodity futures performance; evidence from soy, corn, and wheat futures
from 1950 to 2004 EDHEC Risk and Asset Management Research Centre Nice France.

1051. Frankel J 2006 The effect of monetary policy on real commodity prices NBER Working
Paper #12713 National Bureau of Economic Research USA, in Asset Prices and Monetary
Policy John Campbell (editor) University of Chicago Press Chicago USA.

1052. Fusaro, P, Vasey G September 2006 Energy & environmental funds continuing to offer

1053. Holmes D 2006 A financial feast: A-la-carte commodity investing Alchemy issue 43 The

1054. McNee A July 2006 Investors slake commodities thirst with structured products The
Banker pp 40 – 42.

1055. Upperman F 2006 Positions of traders Wiley Hoboken NJ USA.

1056. Blanchard O J, Gali J 2007 The macroeconomic effects of oil shocks: Why are the 2000s
so different from the 1970s? NBER Working Paper 13368 National Bureau of Economic
Research USA.

1057. Demidova-Menzel N; Heidorn Th August 2007 Commodities in asset management
Working Paper Series Frankfurt School of Finance and Management no 81 Frankfurt
Germany pp 1 – 67
http://nbn-resolving.de/urn:nbn:de:101:1-20080827282 ,
http://hdl.handle.net/10419/27848 ,
www.frankfurt-school.de.


1069. Bhardwaj G, Gorton G, Rouwenhorst K G 2008 Fooling some of the people all of the time: The inefficient performance of commodity trading advisors *Yale ICF Working paper 08-21* Yale University USA.


1117. Aulerich N M, Irwin S H, Garcia P 2010 The price impact of index funds in commodity futures markets: Evidence from the CFTC’s daily large trader reporting system Working Paper Department of Agricultural and Consumer Economics University of Illinois at Urbana- Champaign USA.


1132. Nissanke M December 2010 Commodity markets and excess volatility: Sources and strategies to reduce adverse development impacts *CFC Conference* University of London Brussels Belgium.


1139. Cárdenas M, Ramírez S, Tuzemen D December 2011 Commodity dependence and fiscal capacity *RWP 11-08* Federal Reserve Bank of Kansas City USA.


1145. Ghosh J 2011 Implications of regulating commodity derivatives markets in the USA and EU *PSL Quarterly Review* vol 64 no 258 pp 287 – 304.


1154. Yiuman Tse, Williams M December 20  2011 Does index speculation impact commodity prices? An intraday futures analysis *WP # 007FIN-257-2011* Department of Finance University of Texas San Antonio Texas USA pp 1 – 44.


https://mpra.ub.uni-muenchen.de/35670/.

1161. Girardi D October 9 2012 Do financial investors affect the price of wheat? CRESME University of Siena Italy, MPRA Paper no 40285 Munich University Munich Germany pp 1 – 32
https://mpra.ub.uni-muenchen.de/40285/.


1179. Fattouh B, Kilian L, Mahadeva L 2013 The role of speculation in oil markets: What have we learned so far? The Energy Journal 34(3) pp 7 – 33.


1206. Babbage Ch 1832 On the economy of machinery and manufacturers Charles Knight 13 Pall Mall East London UK.
Precious metal investment, precious metal valuation, precious metals exchange, financial capital investment product, financial capital investment medium in finances:

http://dx.doi.org/10.1086/250881 ,
http://www.journals.uchicago.edu/doi/10.1086/250881 .

http://dx.doi.org/10.1086/250987 ,
http://www.journals.uchicago.edu/doi/10.1086/250987 .


1212. Burke W June 4 1982 Not-so-precious metal FRBSF Economic Letter issue jun4 pp 1 – 4


http://dx.doi.org/10.1142/9789814566926_0010.


1238. Qiang Y 1998 World metal prices: A database *Discussion Paper 98.03* Department of Economics University of Western Australia.


http://nbn-resolving.de/urn:nbn:de:101:1-20080827282 ,
http://hdl.handle.net/10419/27848 ,
www.frankfurt-school.de.

1276. Demidova-Menzel N; Heidorn Th August 2007b Gold in the investment portfolio Working Paper no 87 Frankfurt School of Finance and Management Frankfurt Germany pp 1 – 50


1280. Tully E, Lucey B 2007 A power GARCH examination of the gold market Research in International Business and Finance 21 (2) pp 316 – 325.


1285. Roberts M C 2009 Duration and characteristics of metal price cycles Resources Policy 34 (3) pp 87 – 102.


299


1315. Yermilova M 2012 Possible scenarios for the world monetary system development in conditions of returning to using of precious metals Ukrainian Journal Ekonomist 10 pp 4 – 7.

1316. Caporin M, Ranaldo A, Velo G G 2013 Stylized facts and dynamic modeling of high-frequency data on precious metals Working Paper on Finance no 1318 School of Finance University of St Gallen Switzerland pp 1 – 40


1322. Öztek M F, Ocal N 2013 Financial crises, financialization of commodity markets and correlation of agricultural commodity index with precious metal index and S&P500 ERC Working Paper no 1302 ERC - Economic Research Center Middle East Technical University Turkey


1323. Reboredo J C 2013a Is gold a hedge or safe haven against oil price movements? Resources Policy 38 (2) pp 130 – 137.


1330. Smales L A 2013 News sentiment in the gold futures market *Social Science Research Network* NY USA


https://hal.archives-ouvertes.fr/hal-01010516/document .


https://mpra.ub.uni-muenchen.de/53229/1/MPRA_paper_53229.pdf .


Bildirici M, Türkmen N 2015 Nonlinear causality between oil and precious metals *Resources Policy* 46 (P2) pp 202 – 211.

Bosch D, Pradkhan E 2015 The impact of speculation on precious metals futures markets *Resources Policy* 44 (C) pp 118 – 134.


http://ncid.unav.edu/download/file/fid/590.


Real estate investment, real estate valuation, real estate exchange financial capital investment product, financial capital investment medium in finances:


1386. Hartzell D J, Mengden A August 27 1986 Real estate investment trusts - Are they stocks or real estate? *Salomon Brothers Real Estate Research* USA.


1393. Haight G T, Fort D A 1987 REITs, new opportunities in real estate investment trust securities *Probus Publishing* Chicago Illinois USA.


1439. Jun Han, Youguo Liang 1995 The historical performance of real estate investment trusts  

1440. Mueller G R Spring 1995 Understanding real estate’s physical and financial cycles  

1441. Barkham R J, Ward C W R, Henry O T 1996 The inflation-hedging characteristics of  


1443. Han J 1996 Targeting markets is popular: A survey of pension real estate investment  
advisors *Real Estate Finance* **13** (1) pp 66 – 75.

1444. Newell G 1996 The inflation-hedging characteristics of Australian commercial property:  


1446. Seck D 1996 The substitutability of real estate assets *Real Estate Economics* **24** (1)  
pp 75 – 95.


Hill* Boston MA USA.

Economic Papers no 272* Australia–Japan Research Centre Research School of Pacific and  
Asian Studies The Australian National University Canberra Australia ISBN 0 86413 216 6  
pp 1 – 53.

inflation-hedging characteristics of UK real estate *Journal of Real Estate Finance and  
Economics* vol **15** no 1 pp 59 – 76.

1452. Mei J, Saunders A 1997 Have U.S. financial institutions' real estate investments exhibited  

1453. Redman A L, Manakyan H, Liano K 1997 Real estate investment trusts and calendar  

1454. Ball M, Lizieri C, MacGregor B N 1998 The economics of commercial property markets  
*Routledge* London UK.


1457. Martens C-P 1998 Real estate investment in Germany *5th European Real Estate Society Conference* Maastricht The Netherlands.


1464. Lee St 2001 The risk of investing in the real estate markets of the Asian region *Working Paper of Department of Land Management no 6* University of Reading UK.

1465. Lee St 2005 Gauging the investment potential of international real estate markets *Working Paper of Department of Real Estate and Planning no 19* University of Reading UK.

1466. Lee St 2006a The impact of country risk on international real estate returns *Working Paper of Department of Real Estate and Planning no 10* University of Reading UK.

1467. Lee St 2006b The impact of exchanges rates on international real estate portfolio allocation *Working Paper of Department of Real Estate and Planning no 4* University of Reading UK.


1471. Deqing Diane Li, Yung K 2004 Short interests in real estate investment trusts
International Real Estate Review 7 (1) pp 56 – 70.

1472. Engelberts R, Suarez J L 2004 The real estate industry in The Netherlands Working

1473. Hoskin N, Higgins D, Cardew R Spring 2004 Macroeconomic variables and real estate

1474. Loo Lee Sim, Xing Quan Zhang, Jieming Zhu 2004 Globalization and real estate
investment in Beijing 11th European Real Estate Society Conference Milano Italy.

1475. Pi-Ying, Lai Peddy 2004 The competitiveness of real estate industry in Taiwan 11th
European Real Estate Society Conference Milano Italy.

1476. Hardin W G, Liano K, Gow-Cheng Huang 2005 Real estate investment trusts and
calendar anomalies: Revisited International Real Estate Review 8 (1) pp 83 – 94.

1477. Laposa S, Lizieri C April 13 – 16 2005 Real estate capital flows and transitional
economies Conference Paper ARES Meeting Santa Fe NM USA.

1478. Holsapple E J, Ozawa T, Olienyk J 2006 Foreign “direct” and “portfolio” investment in


in Central/South America and Africa Journal of Real Estate Portfolio Management 12 (3)
pp 261 – 276.

2008 Developing real estate markets in transition economies UN Intergovernmental
Conference Paper RICS Research Foundation.

estate research Journal Real Estate Research 30 (1) pp 91 – 124.

1483. Lambie-Hanson L Fall 2008 Addressing the prevalence of real estate investments in the
new markets tax credit program Working Paper 2008-04 Federal Reserve Bank of San
Francisco California USA pp 1 – 43
http://frbsf.org/cdinvestments/.

1484. Minye Zhang, Yongheng Deng July 9 2008 The relationship between stock returns and
the past performance of hotel real estate industry in the U.S.: Is hotel real estate prone to
overinvestment? School of Policy, Planning, and Development USC California USA
pp 1 – 52.


http://hdl.handle.net/10086/27541.


Private and public firms theories in economics and finances:


1507. Ohlin B 1933 Interregional and international trade Harvard University Press Cambridge Massachusetts USA.


1513. Barnard C I 1949 The entrepreneur and formal organization Change and the Entrepreneur. Harvard University Press Cambridge MA USA.


1528. Fogel R 1964 Railroads and American economic growth: Essays in econometric history *Johns Hopkins Press* Baltimore USA.

1529. Williamson O E 1964 The economics of discretionary behavior: Managerial objectives in a theory of the firm *Prentice-Hall* Englewood Cliffs NJ USA.


1534. Williamson O E 1996 The mechanisms of governance *Oxford University Press* New York USA.


1539. Stigler G 1968 The organization of industry *Richard Irwin Inc* Homewood USA.


1550. Hirschman A O 1970 Exit, voice, and loyalty: Responses to decline in firms, organizations, and states *Harvard University Press* Cambridge MA USA.


1574. Pfeffer J 1982 Organizations and organization theory *Ballinger Publishing Company* USA.


318


1596. Tirole J 2006 The theory of corporate finance *Princeton University Press* Princeton USA.


Public company investment, public company initial public offering valuation by rating agency/open market, stock exchange, financial capital investment product, financial capital investment medium in finances:


1665. Dretske F 1983 The flow of information MIT Press Cambridge Massachusetts USA.


1699. Ritter J R (editor) 2005 Introduction to recent developments in corporate finance in *Recent developments in corporate finance* vols 1, 2 *Edward Elgar Publishing* Northampton MA.


1713. Ritter J R, Vismara S, Paleari S 2012 Europe's second markets for small companies
   European Financial Management 18 (3) pp 352 – 388.

1714. Ritter J R 2013 Re-energizing the IPO market Chapter 4 pp 123 – 145 in Restructuring to

1715. Ritter J R, Xiaohui Gao, Zhongyan Zhu 2013 Where have all the IPOs gone? 48 (6)
   Journal of Financial and Quantitative Analysis.

   Chapter 1 pp 11 - 34 in Handbook of research on IPOs Levis M, Vismara S (editors)
   Edward Elgar Publishing Cheltenham UK.

1717. Myers S C, Majluf N S 1984 Corporate financing and investment decisions when firms
   have information that investors do not have Journal of Financial Economics 13
   pp 187 – 22.

   pp 1315 – 1336.

   Economics 17 (2) pp 223 – 249.

1720. Amihud Y, Mendelson H, Uno J 1999 Number of shareholders and stock prices:

1721. Amihud Y, Hauser S, Kirsh A 2001 Allocations, adverse selection and cascades in IPOs:
   Evidence from Israel Working Paper.

1722. Amihud Y, Hauser S, Kirsh A 2003 Allocations, adverse selection and cascades in IPOs:

1723. Beatty R P, Ritter J R 1986 Investment banking, reputation, and the underpricing of

   of executive compensation, ownership, and board structure in initial public offerings

1725. Beatty R P, Welch I 1996 Issuer expenses and legal liability in initial public offerings

1726. Booth J, Smith R 1986 Capital raising, underwriting and the certification hypothesis

1727. Ridder A 1986 Access to the stock market - An empirical study on the efficiency of the
   British and the Swedish primary markets Casion Press Stockholm Sweden.


1837. Gerstein F S 1995 Private communications on the IPO underpricing, long term performance and emerging issues markets Copenhagen Denmark


1887. Ehrhardt O 1997 Börseneinführungen von aktien am deutschen kapitalmark Wiesbaden Germany.


1956. Field L C 1999 Control considerations of newly public firms: The implementation of anti-takeover provisions and dual class shares before the IPO *Working Paper* Pennsylvania State University USA.

1958. Field L C, Sheehan D P 2001 Underpricing in IPOs: Control, monitoring, or liquidity? 
\textit{Unpublished Penn State Working Paper} USA.


2036. Derrien F, Kecskés A 2006 The initial public offerings of listed firms *Journal of Finance*.


2042. Hahn T, Ligon J A 2004 Liquidity and initial public offering underpricing *College of Business and Economics* University of Idaho USA.


Killian L, Smith K, Smith W 2001 IPOs for everyone: The 12 secrets of investing in IPOs John Wiley & Sons Indiana USA.

Lowry M, Schwert G W 2001 Biases in the IPO pricing process Working Paper Penn State University USA.


Sentis P 2002 Initial public offerings: the good, the bad and the liars Working Paper University of Montpellier France.


2081. Cheng L T W, Mak B S C, Chan K C 2002 Strategic share allocation, information content of pre-listing characteristics, listing-day trading activities, and under-pricings of IPOs Working Paper Hong Kong Polytechnic University Hong Kong P R China.


2105. Xie F 2002 The endogeneity of IPOs being underwritten by prestigious underwriters SSRN: 352160.


2107. Barondes R D R, Nyce C, Sanger G C 2003 Law firm prestige and performance in IPOs: Underwriters’ counsel as gatekeeper or turnstile Contracting and Organizations Research Institute University of Missouri Columbia Missouri USA.


http://mpra.ub.uni-muenchen.de/7260/ .


2119. Hoberg G 2003 Strategic underwriting in initial public offerings Yale University Working Paper USA.


2126. Lemmens G 2003, 2007 The choice of the investment bank when going public Catholic University of Leuven Belgium MPRA Paper no 4692 Munich University Munich Germany pp 1 – 95 http://mpra.ub.uni-muenchen.de/4692/.


2140. Van der Goot T 2003 Risk, the quality of intermediaries and legal liability in the Netherlands IPO market International Review of Law & Economics 23 (2) pp 121 – 140.


2158. Hahn T, Ligon J A 2004 Liquidity and initial public offering underpricing *Working Paper* College of Business and Economics University of Idaho University of Alabama USA.


2160. Hoberg G 2004 Strategic underwriting in initial public offers *Yale ICF Working Paper no 04-07* Yale University USA.


2168. Lubig D 2004 Underpricing und langfristige performance der IPOs am neuen markt *Frankfurt am Main* Germany.


2174. Pollock T G, Chen G, Jackson E M, Hambrick D 2005 Symbolic certification or substantive resources? Over tallying the signalling value of IPOs’ prestigious affiliates in *Academy of Management Annual Meeting* Honolulu HI USA.

2175. Pritsker M 2004 Large investors: Implications for equilibrium asset returns, shock absorption and liquidity *The Federal Reserve Board USA*.


<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Journal/Book, Volume, Issue</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>2181.</td>
<td>Rice D T 2004 The nanotech IPO Nanotechnology L and Bus 1</td>
<td></td>
<td>315 – 322.</td>
</tr>
<tr>
<td>2182.</td>
<td>Rice D T 2006 When the nanotech company goes public: Using the electronic Dutch</td>
<td>Nanotechnology L and Bus 3</td>
<td>185 – 188.</td>
</tr>
<tr>
<td></td>
<td>auction</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>markets: Evidence from France, Germany and the UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2186.</td>
<td>Serve S 2004 The operating performance of French IPO firms</td>
<td>THEMU Universite de</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cergy-Pontoise Cedex France</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2188.</td>
<td>Alti A 2006 How persistent is the impact of market timing on capital structure</td>
<td>Journal of Finance 61</td>
<td>1681 – 1710.</td>
</tr>
<tr>
<td></td>
<td>Spanish capital market</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>markets to forecast market capitalization prior to an initial public offering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>equity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>information production, and underwriter competition</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The evidence for Switzerland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2197.</td>
<td>Forestieri G 2005 Corporate and investment banking</td>
<td>Egea Milan Italy.</td>
<td></td>
</tr>
</tbody>
</table>


2208. LiCalzi M, Pavan A 2005 Tilting the supply schedule to enhance competition in uniform price auctions European Economic Review 49 pp 227 – 250.


2223. Damodaran A 2006 Damodaran on valuation John Wiley and Sons New York USA.


2241. Leite T 2007 Adverse selection, public information and underpricing in IPOs Journal of Corporate Finance.
2252. Farina V 2008 Network embeddedness, specialization choices and performance in investment banking industry University of Rome Tor Vergata Italy MPRA Paper no 11701 Munich University Munich Germany pp 1 – 26 http://mpra.ub.uni-muenchen.de/11701/.
2256. Khurshed A, Pande A, Singh A 2008 Subscription patterns, offer prices and the underpricing of IPOs

2257. Khurshed A, Paleari S, Pande A, Vismara S 2011 Grading, transparent books and initial public offerings


2261. Yongyuan Qiao 2008 Analysis into IPO underpricing and clustering in Hong Kong equity market School of Economics and Finance University of St Andrews UK MPRA Paper no 7876 Munich University Munich Germany pp 1 – 28
http://mpra.ub.uni-muenchen.de/7876/.


2279. Hussinger K 2010 Absorptive capacity and post-acquisition inventor productivity *Katholieke Universiteit Leuven Belgium Centre for European Economic Research (ZEW) Mannheim Germany ZEW Discussion Papers no 10-066 Leibniz Information Centre for Economics Germany pp 1 – 32
http://hdl.handle.net/10419/41435 ,


http://mpra.ub.uni-muenchen.de/21737/.


2284. Pennacchio L 2013 The causal effect of venture capital backing on the underpricing of Italian IPOs University of Napoli "Federico II" Italy MPRA Paper no 48695 Munich University Munich Germany pp 1 – 44
http://mpra.ub.uni-muenchen.de/48695/.


2287. Yao-Min Chiang, Hirshleifer D, Yiming Qian, Sherman A 2010 Learning to fail? Evidence from frequent IPO investors Department of Finance National Chengchi University Taipei Taiwan, The Paul Merage School of Business University of California Irvine California USA, Department of Finance University of Iowa USA, Department of Finance DePaul University Chicago Illinois USA MPRA Paper no 25231 Munich University Munich Germany pp 1 – 40
http://mpra.ub.uni-muenchen.de/25231/.


Ferretti R, Meles A 2011 Underpricing, wealth loss for pre-existing shareholders and the cost of going public: The role of private equity backing in Italian IPOs *Venture Capital* **13** pp 23 – 47.

Adesoye A B, Atanda A A-M 2012 Monetary policy and share pricing business in Nigeria *Department of Economics* Olabisi Onabanjo University Nigeria *MPRA Paper no 35846* Munich University Munich Germany pp 1 – 20

Boissin R 2012 Orphan versus non-orphan IPOs: The difference analyst coverage makes

*MPRA Paper no 41584* Munich University Munich Germany pp 1 – 31

Cumming D J, Hass L H, Schweizer D 2012 The fast track IPO – Success factors for taking firms public with SPACs

http://ssrn.com/abstract=2144892 ,
http://dx.doi.org/10.2139/ssrn.2144892 .

Datar V, Emm E, Ince U 2012 Going public through the back door: A comparative analysis of SPACs and IPOs *Banking and Finance Review* **4** (1).


Rodrigues U, Stegemoller M A 2012 What all-cash companies tell us about IPOs and acquisitions SSRN

http://ssrn.com/abstract=2101830 ,
http://dx.doi.org/10.2139/ssrn.2101830 .


http://mpra.ub.uni-muenchen.de/48106/ .


2301. Lakicevic M, Shachmurove Y, Vulanovic M 2013 Institutional changes of SPACs University of Montenegro, City College City University of New York, Western New England University MPRA Paper no 44181 Munich University Munich Germany pp 1 – 35 http://mpra.ub.uni-muenchen.de/44181/.

Private company investment, private company valuation, venture capital investment, venture capital fund, angel capital investment, financial capital investment product, financial capital investment medium in finances:


2310. Stiglitz J E 2013 Five years in limbo Columbia University 3022 Broadway NY USA http://www8.gsb.columbia.edu/chazen/globalinsights/node/218/Five%20Years%20in%20Limbo#.
2311. Kirzner I 1973 Competition and entrepreneurship *University of Chicago Press* Chicago USA.


2339. Stedler H 1987 Venture capital und geregelter freiverkehr: Eine empirische studie Frankfurt am Main Germany.


2341. Clark R 1988 Venture capital in Britain, America, and Japan Croom Helm London UK.

2343. Eisinger P 1993 State venture capitalism, state politics, and world of high risk investment *Economic Development Quarterly* 7 (2) pp 131 – 140.


2396. Gompers P, Lerner J 1999d The venture capital cycle *MIT Press* Cambridge Massachusetts USA.


2422. Lerner J, Moore D, Shepherd S 2005 A study of New Zealand's venture capital market
and implications for public policy A report to the Ministry of Research, Science and
2423. Lerner J, Schoar A, Wongsunwai W 2007 Smart institutions, foolish choices? The limited
2424. Lerner J 2008, 2009 Boulevard of broken dreams: Why public efforts to boost
entrepreneurship and venture capital have failed Princeton University Press Princeton USA.
2425. Lerner J, Sorensen M, Strömberg P 2009 What drives private equity activity and success
globally in Gurung A, Lerner J (editors) Globalization of alternative investments Working
Papers vol 2 The global economic impact of private equity report 2009 World Economic
and unsuccessful venture capital expansion Working Paper 15102 National Bureau of
Economic Research Cambridge MA USA
Swedish Entrepreneurship Forum pp 1 – 31, Industrial and Corporate Change 22 (1)
pp 153 – 182.
2428. Puri M 1994 The long-term default performance of bank underwritten security issues
2429. Puri M 1996 Commercial banks in investment banking: Conflict of interest or
century Irwin Burr Ridge IL USA.
2432. Anton J, Yao D 1995 Start-ups, spin-offs, and internal projects Journal of Law,
2434. Fiet J O 1995 Risk avoidance strategies in venture capital markets Journal of
Management Studies 32 (4) pp 551 – 574.
2435. Hart O 1995 Firms, contracts, and financial structure Oxford University Press UK.


2493. Wright M, Robbie K 1998 Venture capital and private equity: A review and synthesis


2496. Bliss R 1999 A venture capital model for transitioning economies: The case of Poland


2498. Gilson R 1999 The legal infrastructure of high technology industrial districts: Silicon
   Valley Route 128, and covenants not to compete *York University Law Review* **74**
   pp 575 – 629.

2499. Gilson R, Schizer D 2003 Understanding venture capital structure: A tax explanation for

2500. Gulati R, Gargiulo M 1999 Where do inter-organizational networks come from?
   *American Journal of Sociology* vol **104** (5) pp 1439 – 1493 *University of Chicago Press*
   Chicago USA.

2501. Hamao Y, Packer F, Ritter J R 1999 Institutional affiliation and the role of venture
   capital: Evidence from initial public offerings in Japan *Marshall School of Business
   University of Southern California Capital Markets Department Federal Reserve Bank of New
   York Warrington College of Business Administration University of Florida USA* pp 1 – 50.

2502. Leopold G 1999 Venture capital - das eigenkapitalgeschäft mit kleinen und mittleren
   unternehmen *Deutsches Steuerrecht* **37** pp 470 – 476.

   pp 255 – 274.

   USA.

2505. Baygan G, Freudenberg M 2000 The internationalization of venture capital activity in
   OECD countries: Implications for measurement and policy *OECD Science, Technology and
   http://dx.doi.org/10.1787/084236411045 .

2506. Baygan G 2003 Venture capital policies in Korea *OECD Science, Technology and
and Industry Organization for Economic Co-operation and Development pp 1 – 21


2512. Cumming D J, MacIntosh J G 2002a Crowding out private equity: Canadian evidence Working Paper University of Alberta and University of Toronto

2513. Cumming D J, MacIntosh J G 2002b A cross-country comparison of full and partial venture capital exits Journal of Banking and Finance


382


2545. Lee J 2000 Challenges of Korean technology-based ventures and governmental policies in the emergent-technology sector *Technovation* **20**.

2546. Lehtonen S 2000 Venture capitalist’s exit vehicles and their effects on perceived utility. Allocation of rewards and contract structure *PhD Dissertation no 89 Swedish School of Economics and Business Administration Helsingfors Sweden.*


2554. Engel D 2001a Höheres beschäftigungswachstum durch venture capital? ZEW Discussion Paper no 01-34 Mannheim Germany.

2555. Engel D 2001b Die identifizierung VC-finanziert er unternehmen in den ZEW Gründungspanels Unveröffentlichtes Manuskript Mannheim Germany.


2578. Shachmurove Y 2007b Geography and industry meets venture capital *Departments of Economics The City College of the City University of New York University of Pennsylvania* USA pp 1 – 34


2619. Gawlik R, Teczke J 2003 Spin of enterprises as a financing solution for the innovative clients of science and technology parks *MPRA Paper no 45224* Munich University Munich Germany pp 1 – 7
http://mpra.ub.uni-muenchen.de/45224/.


2621. Hirukawa M, Ueda M 2003 Venture capital and productivity *University of Wisconsin-Madison* USA.


http://hdl.handle.net/10419/23962 , 
ftp://ftp.zew.de/pub/zew-docs/dp/dp0282.pdf , 
www.econstor.eu.


2629. Schmidt D, Wahrenburg M 2003 Contractual relations between European - VC funds and investors: The impact of reputation and bargaining power on contractual design *RICAFE Working Paper 12*
http://ww.lse.ac.uk/ricafe.


http://www.ecb.int ,

Da Rin M, Hege M U, Llobet G, Walz U 2005 The law and finance of venture capital financing in Europe: Findings from the RICAFE research project MPRA Paper no 39552 Munich University Munich Germany pp 1 – 30
http://mpra.ub.uni-muenchen.de/39552/ .


De Clercq D, Dimov D 2010 Doing it not alone. Antecedents, dynamics, and outcomes of venture capital syndication Venture capital pp 221 – 242 John Wiley & Sons Inc USA.


2671. Dushnitsky G, Lenox M J 2006 When does corporate venture capital create firm value? 


2689. Zook M A 2005 The geography of the Internet industry: Venture capital, dotcoms, and local knowledge Blackwell Publishing Malden MA USA.

2690. Antonelli C, Teubal M 2006 Venture capitalism as a mechanism for knowledge governance Working paper series no 4 Department of Economics Università di Torino Italy.


2710. Tirole J 2006 The theory of corporate finance *Princeton University Press* New Jersey USA.


2721. de Bettignies J-E 2008 Financing the entrepreneurial venture Management Science 54 pp 151 – 166.


2762. Aberman J 2009 The decline of the United States venture capital industry: What the federal government should do about it *Amplifier Ventures* Washington DC USA.


2790. Inci E, Barlo M 2010 Banks versus venture capital when the venture capitalist values private benefits of control MPRA Paper no 25566 Munich University Munich Germany pp 1 – 43 http://mpra.ub.uni-muenchen.de/25566/.


2796. Metrick A, Yasuda A 2010b Venture capital and the finance of innovation *John Wiley and Sons Inc* NY USA.


2829. Pennacchio L 2013 The causal effect of venture capital backing on the underpricing of Italian IPOs MPRA Paper no 48695 Munich University Munich Germany pp 1 – 44 http://mpra.ub.uni-muenchen.de/48695/ .
2830. Stuetzer M, Obschonka M, Schmitt-Rodermund E 2013 Balanced skills among nascent entrepreneurs *MPRA Paper no 48641* Munich University Munich Germany pp 1 – 39 http://mpra.ub.uni-muenchen.de/48641/ ; http://www.springerlink.com/content/e73m7tc8j33411/.


*Firm's stock option investment, traded stock options, employee/executive stock options, equity options in finances:*


http://www.journals.uchicago.edu/doi/10.1086/258885 .


2838. Lewellen W G 1968 Stock options Chapter in *Executive Compensation in Large Industrial Corporations* National Bureau of Economic Research Inc USA pp 46 – 69


2843. Merton R C 1997 Continuous-time finance *Blackwell Publishers* USA.


2858. Hull J 1997 Options, futures, and other derivative securities 3rd edition *Prentice Hall* New Jersey USA.


2889. Chicago Board Options Exchange 1996 CBOE constitution and rules: The official constitution and rules of the Chicago Board Options Exchange Inc *Commerce Clearing House* Chicago IL USA.


2904. Lee J H, Nayar N 2000 Can the American option sell for less than the matched European option? Working Paper University of Oklahoma Norman USA.


2915. Bodie Z, Kaplan R S, Merton R C March 2003 For the last time: Stock options are an expense *Harvard Business Review*.


2945. Campbell D Winter 2007 Options on the outs *Econ Focus* pages 16 – 22


http://dx.doi.org/10.1142/9789812770851_0009.

2949. Ni S X, Pan J, Poteshman A M 2008 Volatility information trading in the option market

Finance 9 (2) pp 188 – 199.

2951. Cuny Ch J, Martin G S, Puthenpurackal J J 2009 Stock options and total payout Journal
of Financial and Quantitative Analysis 44 (2) pp 391 – 410.


2953. Chen Y-R, Bong Soo Lee 2010 A dynamic analysis of executive stock options:
Determinants and consequences Journal of Corporate Finance 16 (1) pp 88 – 103.

2954. Engle R, Neri B 2010 The impact of hedging costs on the bid and ask spread in the
options market Working Paper New York University NY USA.

2955. Hallock K F, Olson C A 2010 New data for answering old questions regarding employee

2956. Babenko I, Lemmon M, Tserlukevich Y 2011 Employee stock options and investment

2957. Børsum Ø 2011 Employee stock options Memorandum no 11/2010 Department of
Economics Oslo University Oslo Norway pp 1 – 37

2958. Schürhoff N, Ziegler A 2011 Variance risk, financial intermediation, and the cross-
section of expected option returns Working Paper University of Lausanne, University of
Zurich Switzerland.

Finance and Accounting 36 (3) pp 459 – 490.


2961. Korn O, Paschke C, Uhrig-Homburg M 2012 Robust stock option plans Review of
Quantitative Finance and Accounting 39 (1) pp 77 – 103.

Institute of Economy Trade and Industry (RIETI) Japan pp 1 – 31


https://www.econstor.eu/bitstream/10419/146777/1/869413082.pdf,
http://hdl.handle.net/10419/146777 .

**Bond investment, bond valuation, financial securities investment, financial securities exchange, financial capital investment product, financial capital investment medium in finances:**


http://www.nber.org/books/hick57-1 .


3005. Tucker J F Fall 1989 Junk bonds for individual investors: Key characteristics and comparisons with other investments Cross Sections pp 1 – 4.


3021. Canterbery E R 2000 The sacred college of bonds and money Chapter 4 in Wall Street
capitalism: The theory of the bondholding class World Scientific Publishing Co Pte Ltd pp 47
– 63.
3023. Landen C 2000 Bond pricing in a hidden Markov model of the short rate Finance and
3024. Campbell J Y, Viceira L M 2001 Who should buy long-term bonds? The American
3025. Campbell J Y, Taksler G B 2003 equity volatility and corporate bond yields Journal of
Finance 58 pp 2321 – 2349.
3026. Elliott R J, Van Der Hoek J 2001 Stochastic flows and forward measure Finance and
Stochastics 5 (4) pp 511 – 525.
3027. Elliott R J, Nishide K 2013 Pricing of discount bonds with a Markov switching regime
KIER Working Paper no 859 Institute of Economic Research Kyoto University Kyoto Japan
pp 1 – 18.
3028. Schultz P 2001 Corporate bond trading costs: A peek behind the curtain Journal of
Finance 56 pp 677 – 698.
3029. Livingston M, Zhou L 2002 The impact of rule 144A debt offerings upon bond yields and
3030. Livingston M, Zhou L 2010 Split bond ratings and information opacity premiums
(1) pp 129 – 146.
Income 13 (4) pp 57 – 72.
pp 138 – 160.
bonds Discussion Paper no 2005-95 Center for Economic Research Tilburg University The
3035. Pu Shen 2005 How long is a long-term investment? Economic Review First Quarter 2005


3055. Webb A 2009 The case for investing in bonds during retirement issues in brief Center for Retirement Research Boston College Boston USA http://crr.bc.edu/briefs/the-case-for-investing-in-bonds-during-retirement/.


3069. Zhiguo He, Milbradt K January 13 2012 Endogenous liquidity and defaultable bonds Booth School of Business University of Chicago, MIT Sloan School of Management Cambridge USA pp 1 – 58.


Credit derivative investment, credit derivative pricing, credit derivatives exchange, financial capital investment product, financial capital investment medium in finances:
3079. Knight F 1921 Risk, uncertainty and profit Houghton Mifflin New York USA.


3124. Hull J, White A 2005a The valuation of correlation-dependent credit derivatives using a structural model *Joseph L Rotman School of Management* University of Toronto Canada.


3141. Das S 1998b Credit-linked structured notes in Credit derivatives: Trading and management of credit and default risk Das S (editor) *John Willey & Sons Inc* Singapore.


3161. Duffie D 1996a Dynamic asset pricing theory Princeton University Press Princeton USA.
3164. Duffie D, Singleton K 1999 Simulating correlated defaults *Graduate School of Business*
Stanford University California USA.

3165. Duffie D, Pan J, Singleton J November 2000 Transform analysis and asset pricing for
affine jump diffusions *Econometrica* 68 (6) pp 1343 – 1376.

3166. Duffie D, Gârleanu N G 2001 Risk and valuation of collateralized debt obligations
*Working Paper* Graduate School of Business Stanford University, *Financial Analysts*
*Journal* 57 (1) pp 41 – 59.

3167. Duffie D, Lando D 2001 Term structures of credit spreads with incomplete accounting

3168. Duffie D, Singleton K 2002 Credit risk: Pricing, measurement, and management
*Princeton University Press* Princeton NJ USA.

3169. Duffie D, Gârleanu N 2003 Risk and valuation of collateralized debt obligations
*Graduate School of Business* Stanford University Stanford USA.

3170. Duffie D, Filipovic D, Schachermayer W 2003 Affine processes and applications in

3171. Duffie D July 2008 Innovations in credit risk transfer: Implications for financial stability


securitizations *Journal of Lending and Credit Risk Management* vol 78 no 11 pp 14 – 34.

3174. Neal R S May 1996 Credit derivatives: New financial instruments for controlling credit
risk *Economic Review* Second Quarter Federal Reserve Bank of Kansas City Kansas USA pp
15 – 27.

3175. Neal R S, Rolph D S 1999 An introduction to credit derivatives in Handbook of Credit
3 – 24.

3176. Reoch R, Masters B March 1996 Credit derivatives: Structures and applications

3177. Schönbucher P J August 1996 The term structure of defaultable bond prices *Discussion*
*Paper B-384* University of Bonn SFB 303.

3178. Schönbucher P J Term structure modelling of defaultable bonds *The Review of*
*Derivatives Studies* Special Issue: Credit Risk 2 (2/3) pp 161 – 192.

3179. Schönbucher P J Fall 1999 Credit risk modelling and credit derivatives *Ph D Thesis*
Faculty of Economics University of Bonn Germany.
3180. Schönbucher P J 2000a Pricing of credit risk and credit risk derivatives Bonn Graduate School of Economics Department of Economics University of Bonn Germany.


3186. Freixas X, Rochet J-C 1997 Microeconomics of banking MIT Press Cambridge MA USA.


http://nbn-resolving.de/urn:nbn:de:hebis:30-9462 ,
http://hdl.handle.net/10419/78086 .


3210. Tavakoli J 2001 Credit derivatives and synthetic structures: A guide to instruments and applications John Wiley and Sons Inc New York USA.

3211. Tavakoli J M 2003 Collateralized debt obligations and structured finance John Wiley and Sons Inc Hoboken New Jersey USA.


3216. Heidorn T 1999 Kreditderivate *Hochschul* Frankfurt am Main Germany.


3221. Rappoport P 1999 Valuing credit fundamentals: Rock bottom spreads *JP Morgan Research* USA.


3232. Müller F 2000 Kreditderivate und risikomanagement Bankakademie-Verlag GmbH Frankfurt am Main Germany.


3239. Craddock M, Platen E June 28 2001 Benchmark pricing of credit derivatives under a standard market model Department of Mathematical Sciences School of Finance and Economics University of Technology Sydney Australia pp 1 – 27.


3242. Giesecke K 2001 Default compensator, incomplete information, and the term structure of credit spreads Department of Economics der Humboldt-Universität Berlin Germany.


3245. Giesecke K, Weber St 2003 Cyclical correlations, credit contagion, and portfolio losses Cornell University, Technische Universität Berlin Ithaca, Berlin USA, Germany.

3246. Giesecke K 2004 Credit risk modeling and valuation: An introduction Cornell University Ithaca USA.


http://www.fame.ch .


433


Fage P November 24 2003 Hedging with credit default swaps Credit Suisse First Boston Emerging Markets Sovereign Strategy Focus.


Galiani S 2003 Copula functions and their application in pricing and risk managing multi-name credit derivative products M Sc Thesis King’s College London UK.

Grundke P 2003 Modellierung und bewertung von kreditrisiken Ph D Dissertation Universität zu Köln Der Deutsche Universitätsverlag Wiesbaden Germany.

Haas F June 2003 Towards a 'market continuum'? Structural models and interaction between credit and equity markets Banque de France Financial Stability Review no 2.


Packer F, Suthiphongchai C December 2003 Sovereign credit default swaps BIS Quarterly Review USA.

Schmidt Th 2003 Credit risk modeling with random fields Inaugural-Dissertation zur Erlangung des Doktorgrades an den Naturwissenschaftlichen Fachbereichen (Mathematik) der Justus-Liebig-Universität Gießen Germany.


3320. Pausch Th, Schweimayer G March 2004 Hedging with credit derivatives and its strategic role in banking competition Beitrag nr 260 Faculty of Business Administration and Economics University of Augsburg Germany pp 1 – 39.


3325. Verdier P-H 2004 Credit derivatives and the sovereign debt restructuring process Harvard Law School Harvard University USA.

3326. Zhu H 2004 An empirical comparison of credit spreads between the bond market and the credit default swap market BIS Working Papers no 160 BIS Switzerland.


Bomfim A N 2005 Understanding credit derivatives and related instruments Elsevier Academic Press San Diego USA.


Brigo D, Pallavicini A, Torresetti R June 2007 CDO calibration with the dynamical generalized Poisson loss model Risk Magazine.


3371. Skinner F 2005 Pricing and hedging interest and credit risk sensitive instruments Elsevier Butterworth-Heinemann Burlington Massachusetts USA.


3377. Cremers H 2006 Bankcontrolling und risiko in Vorlesungsskript des Sommersemesters 2006 im Bachelor-Studiengang der HfB Business School of Finance and Management Frankfurt am Main Germany.


http://nbn-resolving.de/urn:nbn:de:101:1-20080827273 ,
http://hdl.handle.net/10419/27847 .


http://nbn-resolving.de/urn:nbn:de:101:1-20090826287 ,
http://hdl.handle.net/10419/27932 .


http://nbn-resolving.de/urn:nbn:de:101:1-20090826290 ,
http://hdl.handle.net/10419/27933 .


3383. Felsenheimer J, Gisdakis Ph, Zaiser M 2006b Active credit portfolio management – A practical guide to credit risk management strategies Wiley Verlag Weinheim Germany.

3384. Geithner T F May 16 2006 Implications of growth in credit derivatives for financial stability Remarks at New York University Stern School of Business Third Credit Risk Conference New York USA.

3385. Gikhman I July 2006 Some critical comments on credit risk modeling MPRA Paper no 1451 Munich University Germany pp 1 – 7
http://mpra.ub.uni-muenchen.de/1451/.

http://mpra.ub.uni-muenchen.de/7078/.

http://mpra.ub.uni-muenchen.de/34511/.

3388. Goderis B, Marsh I W, Castello J V, Wagner W 2006 Bank behavior with access to credit risk transfer markets SSRN USA


3394. Ludovici A November December 2006 The application of neural networks to the pricing of credit derivatives Rivista Di Politica Economica pp 187 – 221.


3397. McDonald R L 2006 Derivatives markets 2nd edition Addison Wesley Boston USA.


3402. Partnoy F, Skeel D 2006 The promises and perils of credit derivatives School of Law Legal Studies Research Paper no 07-74 University of San Diego San Diego USA.


3419. Fathi A, Nader N 2007 Copula based simulation procedures for pricing basket credit derivatives Faculty of Business and Economics University of Sfax Tunisia, MPRA Paper no 6014 Munich University Germany pp 1 – 31 http://mpra.ub.uni-muenchen.de/6014/ .


3422. Henrard M 2009 The irony in the derivative discounting part II: The Crisis Working Paper Social Science Research Network NY USA
3432. Rajan A, McDermott G 2007 The structured credit handbook Wiley Finance New Jersey USA.
3434. Summer Ch 2007 Credit risk – Advanced models Skriptum des Fachbereichs Bankbetriebslehre der Wirtschaftsuniversität Wien Austria.
3436. Thompson J R 2007 Credit risk transfer: To sell or to insure? Working Paper 1131 Queen’s University Kingston Ontario Canada.
3437. Truslow D March 22 2007 Effectiveness of credit risk management in allocating risk Remarks at Federal Reserve Bank of Richmond 2007 Credit Market Symposium Charlotte NC USA.
3453. O’Kane D 2008 Modelling single-name and multi-name credit derivatives Wiley Finance Series John Wiley and Sons Inc NY USA.


3473. Rey N November 20 2009 Credit derivatives: instruments of hedging and factors of instability. The example of “Credit Default Swaps” on French reference entities CEPN University of Paris 13 France hal-00433883 version 1 pp 1 – 27.


3483. Tsui L K 2010 Exact numerical algorithm for n-th order derivative of a single variable function Working Paper University of Pittsburgh USA.
3484. Tsui L K May 18 2010 Multi-factor bottom-up model for pricing credit derivatives Department of Mathematics University of Pittsburgh USA, MPRA Paper no 23090 Munich University Germany pp 1 – 43 http://mpra.ub.uni-muenchen.de/23090/.


Ojo M April 30 2012 Bailouts and longer term refinancing operations (LTROs): When temporary cures generate longer term economic concerns Covenant University, MPRA Paper no 38483 Munich University Germany pp 1 – 32 http://mpra.ub.uni-muenchen.de/38483/.


Avino D, Lazar E 2012 Rethinking capital structure arbitrage ICMA Centre University of Reading Henley School of Business UK, MPRA Paper no 42850 Munich University Germany pp 1 – 28 http://mpra.ub.uni-muenchen.de/42850/.

Heller D, Vause N 2012 Collateral requirements for mandatory central clearing of over-the-counter derivatives BIS Working Papers no 373 Switzerland.


Foreign currencies investment, foreign currencies exchange rates valuation, ultra high frequency electronic trading, foreign currencies exchange, financial capital investment product, financial capital investment medium in finances:

3504. Ellis H, Metzler L (editors) 1949 Readings in the theory of international trade Blakiston Philadelphia USA.

3505. Machlup F 1949 The theory of foreign exchanges in Readings in the theory of international trade Ellis H, Metzler L (editors) Blakiston Philadelphia USA.

3506. Robinson J 1949 The foreign exchanges in Readings in the theory of international trade Ellis H, Metzler L (editors) Blakiston Philadelphia USA.

3507. Friedman M 1953 The case for flexible exchange rates in Essay in positive economics University of Chicago Press Chicago USA.

3508. Friedman M (editor) 1953 Essays in positive economics Chicago University Press Chicago USA.


3516. Shiryaev A N 1967 Two problems of sequential analysis *Cybernetics* 3 pp 63 – 69.


3521. Shiryaev A N 1988 Probability *Springer-Verlag* Berlin Heidelberg Germany.


3534. Peskir G, Shiryaev A N 2006 Optimal stopping and free-boundary problems *Lectures in Mathematics* ETH Zürich *Birkhäuser* Switzerland MR2256030


3537. du Toit J, Peskir G, Shiryaev A N 2007 Predicting the last zero of Brownian motion with drift Cornell University NY USA pp 1-17


3543. Gapeev P V, Shiryaev A N 2010 Bayesian quickest detection problems for some diffusion processes Cornell University NY USA pp 1 – 25

3544. Karatzas I, Shiryaev A N, Shkolnikov M 2011 The one-sided Tanaka equation with drift Cornell University NY USA

3545. Shiryaev A N, Zhitlukhin M V 2012 Optimal stopping problems for a Brownian motion with a disorder on a finite interval Cornell University NY USA pp 1 – 10


3561. Arrow K 1970 Essays in the theory of risk bearing *Markham* Chicago USA.
3566. Newbold P, Granger C W J 1974 Experience with forecasting univariate time series and
the combination of forecasts Journal of the Royal Statistical Society 137 pp 131 – 165.
3567. Fleming J M 1975 Floating exchange rates, asymmetrical intervention and the
3568. Shapiro A C 1975 Exchange rate changes, inflation, and the value of the multinational
corporation
to September 1975 Federal Reserve Board International Finance Discussion Paper no 123
Federal Reserve Board USA.
3570. Dornbusch R 1976 Expectations and exchange rate dynamics Journal of Political
Economy 84 (6) pp 1161 – 1176.
pp 93 – 106.
3572. Frankel J A 1976 A monetary approach to the exchange rate: Doctrinal aspects and
3573. Frankel J A 1979 On the mark: A theory of floating exchange rates based on real interest
3574. Frankel J A 1982a In search of the exchange risk premium: A six currency test assuming
3575. Frankel J A 1982b A test of perfect substitutability in the foreign exchange market
3576. Frankel J A (editor) 1983 Exchange rate and international macroeconomics University of
Chicago Press Chicago USA.
3577. Frankel J A, Froot K 1987 Using survey data to test standard propositions regarding
3578. Frankel J A, Froot K 1990a Chartists, fundamentalists, and trading in the foreign
3579. Frankel J A, Froot K 1990b Chartists, fundamentalists, and the demand for dollars in
Private behavior and government policy in interdependent economies Courakis A, Taylor M
P Clarendon Oxford UK.
3580. Frankel J A, Froot K 1990c Exchange rate forecasting techniques, survey data, and
implications for the foreign exchange market Working Paper no 3470 National Bureau of
Economic Research Cambridge Massachusetts USA.


3583. Frankel J A (editor) 1993 On exchange rates *MIT Press* Cambridge MA USA.


3596. Mussa M 1979 Empirical regularities in the behaviour of exchange rates and theories of the foreign exchange market in Brunner K, Meltzer A H (editors) Policies for employment,

3597. Mussa M 1981 The role of official intervention Group of Thirty New York NY USA.


3603. Clark, Logue, Sweeney (editors) 1977 The effects of exchange rate adjustment Department of the Treasury Washington DC USA.


3612. Huang R, Stoll H 1997 The components of the bid-ask spread: A general approach

3613. Stoll H R 1998 Reconsidering the affirmative obligation of market-makers Financial
Analysts Journal 54 (5) pp 72 – 82.

3614. Stoll H R, Schenzler Ch 2005 Trades outside the quotes: Reporting delay, trading option,


3616. Blanchard O 1979 Speculative bubbles, crashes, and rational expectations Economics

3617. Brunner K, Meltzer A H (editors) 1979 Policies for employment, prices and exchange
Company Elsevier Amsterdam The Netherlands.

3618. Deardorff A 1979 One way arbitrage and its implications for the foreign exchange

3619. Goodman S 1979 Foreign exchange rate forecasting techniques: Implications for business

3620. Aliber R (October) 1980 The integration of the offshore and domestic banking system

Chicago USA.

3622. Allen P, Kenen P 1980 Asset markets, exchange rates, and economic integration
Cambridge University Press New York USA.


3624. Amihud Y, Ho T, Schwartz R (editors) 1985 Market making and the changing structure
of the securities industry Lexington Massachusetts USA.

3625. Amihud Y 1994a Evidence on exchange rates and valuation of equity shares in Exchange
rates and corporate finance Amihud Y, Levich R M (editors) Business One Irwin Homewood
IL USA.

3626. Amihud Y 1994b Exchange rates and the valuation of equity shares in Exchange rates
and corporate performance Amihud Y, Levich R M (editors) Irwin New York USA
pp 49 – 59.


3644. Loosignian A M 1981 Foreign exchange futures *Dow Jones - Irwin* Homewood IL USA.

3645. Mussa M 1981 The role of official intervention *Group of Thirty* New York NY USA.


3647. Stigum M 1990 The money market *Dow Jones - Irwin* Homewood IL USA.


3653. Bigman D, Taya T (editors) 1983 Exchange rate and trade instability *Ballinger* Cambridge Massachusetts USA.


3684. Engel Ch M, West K (May) 2004a Accounting for exchange rate variability in present value models when the discount factor is near one *American Economic Review* **94** pp 118 – 125.


3687. Engel Ch M, Mark N, West K D 2007 Exchange rate models are not as bad as you think *NBER Working Paper* NBER USA.


3708. Levich R M 1985 Empirical studies of exchange rates: Price behaviour, rate
determination and market efficiency in Handbook of international economics Jones R W,
Kenen P B (editors) vol 2 North-Holland Publishing Company Amsterdam The Netherlands.
3709. McInish T H, Wood R A 1985 An analysis of transactions data for the Toronto Stock
3710. Dominguez K M 1986 Are foreign exchange forecasts rational? New evidence from
3711. Dominguez K M 1990 Market responses to coordinated central bank intervention
3712. Dominguez K M 1992 Exchange rate efficiency and the behavior of international asset
markets Garland New York USA.
3713. Dominguez K M 1993 Does central bank intervention increase the volatility of foreign
MA USA.
3714. Dominguez K M, Frankel J 1993a Does foreign-exchange intervention matter? The
for International Economics Washington DC USA.
assessment in On exchange rates Frankel J A (editor) MIT Press Cambridge MA USA.
3717. Dominguez K M 1998 Central bank intervention and exchange rate volatility Journal of
3718. Dominguez K M 2003a The market microstructure of central bank intervention Journal
3719. Dominguez K M 2003b Foreign exchange intervention: Did it work in the 1990s? in
Dollar overvaluation and the World economy Bergsten C F, Williamson J (editors) Institute
for International Economics Washington DC USA.
3720. Bollerslev T 1986 Generalized autoregressive conditional heteroskedasticity Journal of
Econometrics 21 pp 307 – 328.
3722. Baillie R, Bollerslev T 1990 Intra-day and inter market volatility in foreign exchange


466
3751. Lyons R K 1986 Tests of the foreign exchange risk premium using the expected second moments implied by option pricing International Finance Discussion Papers 290 Board of Governors of the Federal Reserve System USA.
Lyons R K (March) 1988 Tests of the foreign exchange risk premium using the expected second moments implied by option pricing *Journal of International Money and Finance Elsevier* 7 (1) pp 91 – 108.


Lyons R 1993a Information intermediation in the microstructure of the foreign exchange market *NBER Working Paper* #3889 Berkeley Business School USA.


Fan M, Lyons R (July) 2001 Customer-dealer trading in the foreign exchange market Typescript UC Berkeley USA.


Lyons R K 2003 Explaining and forecasting exchange rates with order flows Economie Internationale CEPII research center issue 96 pp 107 – 127.


3819. Sager M, Taylor M P 2005 Order flow and exchange rate movements Typescript University of Warwick UK.


3855. Humpage O 1989 On the effectiveness of exchange market intervention Federal Reserve Bank of Cleveland USA.


3859. Van Hagen J 1989 Monetary targeting with exchange rate constraints: The Bundesbank in the 1980s Federal Reserve Bank of St Louis USA.


3926. Curcio R, Goodhart Ch 1992 When support / resistance levels are broken, can profits be made? Evidence from the foreign exchange market *Discussion Paper no 142* Financial Markets Group London School of Economics London UK.


3952. Zhou B 1992a High frequency data and volatility in foreign exchange rates Manuscript Department of Finance Sloan School of Management MIT Cambridge MA USA.

3953. Zhou B 1992b Forecasting foreign exchange rates subject to de-volatilization Working Paper no 3510 Sloan School of Management Massachusetts Institute of Technology Cambridge MA USA.


4017. Hansch O, Naik N, Viswanathan S (November) 1994 Trading profits, inventory control and market share in a competitive dealer market Typescript Duke University USA.


4030. Slezak S 1994 A theory of the dynamics of security returns around market closures

4031. Szpiro G G 1994 Exchange rate speculation and chaos inducing intervention *Journal of

   rice differences of equivalent assets *Mathematical Finance* **4** (2) pp 205 – 221.

4033. Walsh E J 1994 Operating income, exchange rate changes, and the value of the firm: An

4034. Wei, Sh-J (May) 1994 Anticipations of foreign exchange volatility and bid-ask spreads
   USA.

4035. Watanabe T 1992 The signaling effect of foreign exchange intervention: The case of
   Japan *Bank of Japan* Tokyo Japan.

4036. Watanabe T, Harada K 2004 Effects of the Bank of Japan’s intervention on yen/dollar
   exchange rate volatility *Journal of the Japanese and International Economies*.

4037. Watanabe T, Yabu T (June) 2007 The great intervention and massive money injection:
   Hitotsubashi University Japan.

   Brookfield VT USA*.

4039. Chiang T, Jiang C 1995 Foreign exchange returns over short and long horizons

   pp 445 – 479.

4041. Ederington L, Lee J 1995 The short-run dynamics of price adjustment to new information

4042. Evertsz C J G 1995 Self - similarity of high - frequency USD/DEM exchange rates
   *Proceedings of the First International Conference on High Frequency Data in Finance
   (HFDF-1)* vol 3 Research Institute for Applied Economics Olsen & Associates Zürich
   Switzerland.

4043. Faruqee H 1995 Long-run determinants of the real exchange rate: A stock-flow


4063. Carlson J A, Osler C L (March) 1999 Determinants of currency risk premiums Federal Reserve Bank of New York Staff Reports Series no 70.


4072. Osler C L, Vandrovych V 2009 Hedge funds and the origins of private information in currency markets Typescript Brandeis University.

4073. Osler C L, Yusim R 2009 Intraday dynamics of foreign-exchange spreads Typescript Brandeis University.


4078. Peiers B (October) 1995 Informed traders, intervention, and price leadership: A deeper view of the microstructure of the foreign exchange market University California Los Angeles California USA.


4081. Schwartz R (editor) 1995 Global equity markets: Technological, competitive, and regulatory challenges Irwin Homewood Illinois USA.


4106. Tsang Sh-K 1996 A study of the linked exchange rate system and policy options for Hong Kong *Hong Kong Policy Research Institute* Hong Kong P R China.


4108. Tsang Sh-K, Sin Ch-Y, Cheng Y-Sh 1999 The robustness of Hong Kong’s linked exchange rate system as a currency board arrangement *The 54th European Meeting of the Econometric Society* Hong Kong P R China.

4109. Tsang Sh-K 1999a A study of the linked exchange rate system and policy options for Hong Kong *Hong Kong Policy Research Institute Ltd* Hong Kong P R China.


4111. Tsang Sh-K, Yue Ma 2002 Currency substitution and speculative attacks on a currency board system *Journal of International Money and Finance* 21 (1) pp 53 – 78.


Copejans M, Domowitz I 1997 The performance of an automated trading market in an illiquid environment *Working Paper* Duke University, Northwestern University USA.


Evans M D D (November) 1997 The microstructure of foreign exchange dynamics *Typescript* Georgetown University USA.


4145. Evans M D D, Lyons R K 2009 Forecasting exchange rate fundamentals with order flow Working Paper Georgetown University USA.


4149. Fleming M, Remolona E 1999 Price formation and liquidity in the US treasury market

4150. Fleming M (September) 2002 Price discovery in the US treasury market: The impact of
order flow and liquidity on the yield curve Typescript New York Federal Reserve Bank New
York USA.


4153. Goldberg L, Tenorio R 1997 Strategic trading in a two-sided foreign exchange auction


4155. Harris J, Schultz P 1997 The importance of firm quotes and rapid executions: Evidence

4156. Hartmann P 1997 The currency denomination of international trade after European
Monetary Union Typescript European Central Bank.

4157. Hartmann Ph 1998 Do Reuters spreads reflect currencies’ differences in global trading

4158. Hartmann P 1998 Currency competition and foreign exchange markets: The dollar, the
yen, and the euro Cambridge University Press Cambridge UK.

4159. Hartmann P 1999 Trading volumes and transaction costs in the foreign exchange market:

4160. Hung J 1997 Intervention strategies and exchange rate volatility: A noise trading

4161. Kirilenko A 1997 Endogenous trading arrangements in emerging foreign exchange
markets Typescript International Monetary Fund USA.

4162. Lamoureux C, Schnitzlein C 1997 When it’s not the only game in town: The effect of

4163. Madhavan A, Smidt S 1991 A Bayesian model of intraday specialist pricing Journal of

4164. Madhavan A, Smidt S 1993 An analysis of changes in specialist inventories and


4170. Madhavan A (March) 2000 Market microstructure: A survey University of Southern California USA.


4172. Madhavan A (October) 2000 In search of liquidity in the internet era 9th Annual Financial Markets Conference of the Federal Reserve Bank of Atlanta USA.


4174. Montiel P J 1997 Exchange rate policy and macroeconomic management tin ASEAN countries in macroeconomic issues facing ASEAN countries International Monetary Fund Washington USA.


4177. Reiss P, Werner I (February) 1997 Interdealer trading: Evidence from London Stanford Graduate School of Business Research Paper no 1430 University of Stanford California USA.


4182. Wei S, Kim J (November) 1997 The big players in the foreign exchange market: Do they trade on information or noise? *NBER Working Paper* 6256 NBER USA.

4183. Werner I (September) 1997 A double auction model of interdealer trading *Research Paper no 1454* Stanford University California USA.


4186. Abrams R K, Beato P 1998 The prudential regulation and management of foreign exchange risk *International Monetary Fund* Washington DC USA.


4190. Bjønnes G H, Rime D (March) 2001 FX trading live! Dealer behavior and trading systems in foreign exchange markets *Typescript* Norwegian School of Management University of Oslo Norway

www.uio.no/~dagfinri.


4195. Blennerhasset M, Bowman R G 1998 A change in market microstructure: The switch to
electronic screen trading on the New Zealand stock exchange *Journal of International


4197. Caramazza F, Aziz J 1998 Fixed or flexible? Getting the exchange rate right in the 1990s
IMF Washington USA

4198. Chang Y, Taylor S 1998 Intraday effects of foreign exchange intervention by the Bank of


4200. Chow E H, Chen H L 1998 The determinants of foreign exchange rate exposure:

4201. Clark P B, Macdonald R 1998 Exchange rates and economic fundamentals: A
methodological comparison of BEERS and FEERS *IMF Working Paper* WP/98/67 IMF
USA.

4202. Covrig V, Melvin M 1998, 2002 Asymmetric information and price discovery in the FX
market: Does Tokyo know more about the yen? *Typescript* Arizona State University, *Journal

from high frequency data *Typescript* University of Toronto Canada.

experience *Typescript* Board of Governors of the Federal Reserve System USA.

4205. Fleming J, Kirby C, Ostdiek B 1998 Information and volatility linkages in the stock,

insider trading *Working Paper* Loyola University of Chicago University of Florida USA.

4207. George E 1998 Exchange rates: An intractable aspect of monetary policy *Bank of


4209. Hau H 1998 Competitive entry and endogenous risk in the foreign exchange market


4225. Mende A, Menkhoff L (March) 2003 Different counterparties, different foreign exchange trading? The perspective of a median bank.


4281. Rigobon R (September) 1999 On the measurement of the international propagation of shocks NBER Working Paper 7354 NBER USA.

4282. Saar G (July) 1999 Demand uncertainty and the information content of order flow Typescript Johnson School Cornell University NY USA.


4284. Scalia A (August) 2004 Is foreign exchange intervention effective? Some micro-analytical evidence from Central Europe Typescript Bank of Italy Rome Italy.


4295. Carlson J (August) 2002 One minute in the life of the DM/$: Public information in an electronic market *Typescript* Purdue University USA.


4300. Fujiwara I (June) 2000 Liquidity and leverage risk in the Dollar/Yen market *Typescript* Nuffield College Oxford UK.


4314. McCallum B (April) 2000 Theoretical analysis regarding a zero lower bound on nominal interest rates *NBER Working Paper no 7677* NBER USA.


4343. Duarte M, Stockman A (July) 2001 Rational speculation and exchange rates NBER Working Paper 8362 NBER USA.


4355. Sinn H, Westermann F (July) 2001 Why has the euro been falling? An investigation into the determinants of the exchange rate NBER Working Paper 8352 NBER USA.


4359. Aguiar M (March) 2002 Informed speculation and the choice of exchange rate regime *Typescript* University of Chicago USA.


4363. Chari A 2006 Heterogeneous market making in foreign exchange markets: Evidence from individual bank responses to central bank interventions *Journal of Money, Credit, and Banking*.


4384. Kaul A, Mehrotra V (June) 2002 Ticker or trade? How prices adjust in international markets Typescript University of Alberta Edmonton Alberta Canada.


4394. Carpenter A, Wang J (January) 2003 Sources of private information in FX trading Typescript University of New South Wales Sydney Australia.


4407. Mathisen J 2003 Estimation of the equilibrium real exchange rate for Malawi *IMF Working papers 03/104* IMF USA.


4413. Wright J H 2003 Bayesian model averaging and exchange rate forecasts *International Finance Discussion Papers no 779* Board of Governors of the Federal Reserve System USA.


4470. Charlebois M, Sapp St 2006 Temporal patterns in foreign exchange returns and options
Richard Ivey School of Business University of Western Ontario Canada.

Monetary Authority Quarterly Bulletin 49.

4472. Gilbert C, Rijken H 2006 How is futures trading affected by the move to a computerized
trading system? Lessons from the LIFFE FTSE 100 contract Journal of Business Finance

4473. Jeon J, Oh Y, Yang D Y 2006 Financial market integration in East Asia: Regional or
global Asian Economic Papers 5 (1) pp 73 – 89.

4474. Escribano A, Pascual R 2006 Asymmetries in bid and ask responses to innovations in the

4475. Kaul A, Sapp S 2006 Y2K fears and safe haven trading of the US dollar Journal of


4477. Kim S, Lee J W, Shin K 2006 Regional and global financial integration in East Asia
Working Paper Series 0602 Institute of Economic Research Korea University South Korea.

4478. Kočenda E, Valachy J 2006 Exchange rate volatility and regime change: Visegrad
comparison Journal of Comparative Economics 34 (4) pp 727 – 753.


4480. Kočenda E, Poghosyan T 2009 Macroeconomic sources of foreign exchange risk in new

4481. LeBaron B 2006 Agent-based computational finance vol 2 Tesfatsion L, Judd K L

4482. Mende A 2006 09/11 on the USD/EUR foreign exchange market Applied Financial
Economics 16 (3) pp 213 – 222.

4483. Mende A, Menkhoff L 2006 Profits and speculation in intra-day foreign exchange trading

4484. Muller A, Verschoor W F C 2006 Foreign exchange risk exposure: Survey and

4485. Norouzzadeh P, Rahmani B A 2006 Multifractal de-trended fluctuation description of


4509. Fung L, Yu I W 2007 Assessing the credibility of the convertibility zone of the Hong Kong dollar Working Paper 19/2007 Hong Kong Monetary Authority Hong Kong P R China.

4510. Genberg H, He D, Leung F 2007 Recent performance of the Hong Kong dollar linked exchange rate system Research Note 02/2007 Hong Kong Monetary Authority Hong Kong P R China.

4511. Genberg H, He D, Leung F 2007 The ‘Three refinements’ of the Hong Kong dollar linked exchange rate system two years on Hong Kong Monetary Authority Quarterly Bulletin 51 pp 5 – 11.

4513. Hong Kong Monetary Authority (December) 2007 The foreign exchange and derivatives markets in Hong Kong Hong Kong Monetary Authority Quarterly Bulletin Hong Kong P R China.


4521. Van Wincoop E, Tille C 2007 International capital flows NBER Working Paper 33 NBER USA.


Brunnermeier M K, Nagel S, Pedersen L H 2008 Carry trades and currency crashes *NBER Macroeconomics Annual 2008* NBER USA.


Lien K 2008 Day trading and swing trading the currency market: Technical and fundamental strategies to profit from market moves *John Wiley and Sons* New York USA.


4547. Adrian T, Etula E, Shin H S 2009 Risk appetite and exchange rates Staff Report no 361 Reserve Bank of New York NY USA.


4559. Hattori M, Shin H S 2009 Yen carry trade and the subprime crisis IMF Staff Papers IMF USA.


4567. Serban A F (November) 2009 Combining mean reversion and momentum trading strategies in foreign exchange markets Department of Economics West Virginia University USA pp 1 – 30.


4578. Diamond R (April 4) 2011 Banks’ profits could take hit in fight over forex fees Pensions and Investments.


4583. Plantin G, Shin H H 2011 Carry trades, monetary policy and speculative dynamics Princeton University USA.


Intellectual property investment, intellectual property exchange in finances:


4599. Penrose E T 1951 The economics of the international patent system John Hopkins University Press Baltimore MD USA.


4610. Taylor C, Silberston Z A 1973 The economic impact of the patent system *Cambridge University Press* Cambridge UK.


4619. Mackaay E 1985a De hersenschim als rustig bezit - Moet Alle informatie voorwerp van eigendom zijn? (The chimera as peaceful possession - Must all information be the object of a property right?) *Computerrecht* pp 12 – 16.


4622. Mackaay E 1989 Les droits intellectuels - Entre propriété et monopole (Intellectual property rights - Between property and monopoly *Journal des Économistes et des Études Humaines* 1.)


4641. David P A 1985 New technology, diffusion, public policy and industrial competitiveness center for economic policy research Stanford University California USA.


4682. Besen St M, Kirby Sh N 1989b Compensating creators of intellectual property: Collectives that collect Rand Corporation no R-3751-MF.


Scotchmer S 2001 The political economy of intellectual property treaties Working Paper no E01-305 Institute of Business and Economic Research University of California at Berkeley California USA.


536
4762. Lasinski M J 2002 Valuation of intellectual property assets in mergers and acquisitions in
Intellectual Property Assets in Mergers and Acquisitions Bryer L, Simensky M (editors) John
Wiley and Sons Inc USA.

4763. Maskus K E 2000a Intellectual property rights in the global economy The Institute for
International Economics Washington DC USA.


4765. Deli Yang 2003 The development of intellectual property in China World Patent
Information 25 (2) pp 131 – 142.

from David K. Levine pp 1 – 60

Primer for identifying and determining value The American Bar Association Chicago USA.

4768. Anson W, Noble D, Samala J 2014 IP valuation: What methods are used to value
intellectual property and intangible assets? Licensing Journal 34 (2).


4770. Ramello G 2005 Intellectual property and the markets of ideas Review of Network

damages John Willey and Sons Inc NY USA.

DOI: http://dx.doi.org/10.4337/9781847201522, 

(4) pp 323 – 326.

4774. Kamiyama Sh, Sheehan J, Martínez C 2006 Valuation and exploitation of intellectual
property OECD Science, Technology and Industry Working Paper no 2006/5 OECD
Publishing Paris France.

for Development Economics Delhi School of Economics India pp 1 – 16


Bittelmeyer C 2007 Patente und finanzierung am kapitalmarkt *Deutsche Universitätsverlag* Wiesbaden Germany.


Parr R 2007 Royalty rates for licensing intellectual property *John Willey and Sons Inc* NY USA.


Ruder D S 2008 Strategies for investing in intellectual property *Beard Books* Washington USA.

Kite S 2009 Intellectual property may soon be traded as its own asset class’ *Securities Industry News* 8 (3).


4798. George A 2012 Constructing intellectual property *Cambridge University Press* New York USA.


4801. Frey C B 2013 Intellectual property rights and the financing of technological innovation *Edward Elgar Publishing* Cheltenham Massachusetts USA.


**Investment bank, financial capital investment vehicle in finances:**


4825. Grant K C 1999 Internet investment banking and corporate debt issuance Journal of Applied Corporate Finance 12 (2) pp 4-4.


4830. Perez C 2002 Technological revolutions and financial capital Elgar Cheltenham UK.


Sirri E 2004 Investment banks, scope, and unavoidable conflicts of interest Economic Review issue Q 4 pp 23 – 35.


Brambilla C, Piluso G 2008 Italian investment and merchant banking up to 1914: Hybridising international models and practices Discussion Paper no 69 Dipartimento di Economia e Management (DEM) University of Pisa Italy pp 1 – 42.


http://mpra.ub.uni-muenchen.de/31649/.
4849. Bonin H 2014 From history to present: Investment banking at stake HAL.

Hedge fund, financial capital investment vehicle in finances:


Cochrane J H 2001 Asset pricing Princeton University Press USA.

Brooks C, Kat H M 2001 The statistical properties of hedge fund index returns and their implications for investors Journal of Alternative Investments vol 5 no 3 pp 26 – 44.


Kat H M 2003 10 things that investors should know about hedge funds Institutional Investor pp 72 – 81.


Kat H M 2010 Things that investors should know about hedge funds Institutional Investor pp 72 – 81.


4948. Popova I, Morton D P, Popova E 2003 Optimal hedge fund allocation with asymmetric preferences and distributions Technical Report University of Texas at Austin Texas USA.


4969. Lhabitant F S 2004 Hedge funds with quantitative insights *John Wiley & Sons Inc* USA.


550


4982. Hodder J E, Jackwerth J C 2005 Incentive contracts and hedge fund management Finance Department School of Business University of Wisconsin-Madison USA; Department of Economics University of Konstanz Germany pp 1 – 34.


4999. Ding B, Shawky H A 2006 The performance of hedge fund strategies and the asymmetry of return distributions Center for Institutional Investment Management Working Paper Department of Finance School of Business University at Albany USA.


5004. Billio M, Getmansky M, Pelizzon L 2007 Dynamic risk exposure in hedge funds working paper University of Massachusetts Amherst MA USA.


5029. Takahashi A, Yamamoto K 2008 Hedge fund replication *CIRJE-F-592* Graduate School of Economics University of Tokyo Japan pp 1 – 32 http://www.e.u-tokyo.ac.jp/cirje/research/03research02dp.html.


5053. Ben Dor B A, Eisenthal-Berkovitz Y, Xu J 2012 A quantitative framework for analyzing the performance of an individual hedge fund vs its peers Barclays Research UK.


5072. Schnoor I 2005-2006 Private communications on risk management Rotman School of Management University of Toronto Canada.


**Pension fund investment, financial capital investment vehicle in finances:**


5103. Warshawsky M J 1987 The funding of private pension plans *Staff Studies Paper no 155* Board of Governors of the Federal Reserve System USA.


Sinn H-W 2000 Why a funded pension system is useful and why it is not useful International Tax and Public Finance 7 pp 389 – 410.


http://eprints.lse.ac.uk/24942/.

5133. Besley T, Prat A 2003 Pension funds governance and the choice between defined Benefit and defined contribution plans *CEPR Discussion Paper no 3955*.


http://eprints.lse.ac.uk/24519/.


5149. Perotti E, Schwienbacher A 2007 The political origin of pension funding *CEPR Discussion Paper no 6100* CEPR


**Mutual fund, financial capital investment vehicle in finances:**


5218. James E, Ferrier G, Smalhout J, Vittas D 1999 Mutual funds and institutional investments: What is the most efficient way to set up individual accounts in a social security system? NBER Working Paper no 7049 NBER USA.


5226. Wermers R 2003 Is money really “smart”? New evidence on the relation between mutual fund flows and performance persistence Department of Finance University of Maryland USA.


5229. Teo M, Woo Sung-Jun 2001 Persistence in style-adjusted mutual fund returns Manuscript Harvard University Cambridge USA.


5233. Pastor L, Stamburgh R 2002 Mutual fund performance and seemingly unrelated assets
13 (12) pp 869 – 876.
5235. Berk J B, Green R C 2004 Mutual fund flows and performance in rational markets
really pick stocks? New evidence from a bootstrap analysis Discussion Paper INSEAD.
5237. Mahoney P 2004 Manager-investor conflicts in mutual funds Journal of Economic
Perspectives 18 (2) pp 161 – 182.
5238. Mamaysky H, Spiegel M, Zhang H 2004 Improved forecasting of mutual fund alphas and
betas’ ICF Working Paper 04-23 Yale School of Management Yale University USA.
5240. Prather L, Bertin W J, Henker Th 2004 Mutual fund characteristics, managerial attributes,
5241. Anderson S C, Ahmed P 2005 Mutual funds: Fifty years of research findings Chapter 3 in
Mutual Fund Fees and Expenses Springer pp 57 – 69.
5242. Barber B, Odean T, Zheng L 2005 Out of sight, out of mind: The effects of expenses on
mutual fund flows Journal of Business 78 pp 2095 – 2120.
5243. Bollen N P B, Busse J A 2005 Short-term persistence in mutual fund performance Review of
Financial Studies.
5246. Kacperczyk M, Sialm C, Zheng L 2008 Unobserved actions of mutual funds Review of
Financial Studies 21 pp 2379 – 2416.
Money Macro and Finance (MMF) Research Group Conference pp 1 – 50
5248. Raychaudhuri A 2005 Persistence in the Indian mutual fund market The IUP Journal of


Meschke F 2007 An empirical examination of mutual fund boards SSRN Paper 676901 SSRN USA.


www.comisef.eu .


**Angel investor, business angel, financial investment vehicle in finances:**


5316. Landström H 2007 Handbook of research on venture capital Edward Elgar Publishing Cheltenham UK Northampton MA USA.

5317. Landström H, Mason C (editors) 2012 Handbook of research on venture capital: Volume 2 Edward Elgar Publishing Cheltenham UK Northampton MA USA.

http://dx.doi.org/10.4337/9781783471720.00005 ,

http://dx.doi.org/10.4337/9781783471720 ,
http://www.e-elgar.com/shop/isbn/9781783471713 ,


http://dx.doi.org/10.4337/9781783471720.00007 ,


5341. Lerner J 2009 Boulevard of broken dreams *Princeton University Press* Princeton NJ USA.


5368. Sohl J E 2012 The changing nature of the angel market in Handbook of Research on Venture Capital Edward Elgar Publishing UK.
5370. Jossi F July 2005 Angels we have heard on high Fedgazette pp 11 – 13.
5377. Vance D E 2005 Raising capital Springer New York USA.


5385. Mercil St 2006 Organizing angel investment to benefit angels, companies, and communities Community Development Investment Review Federal Reserve Bank of san Francisco 2 (3) pp 43 – 49 www.frbsf.org/cdinvestments,


5392. Clark C 2008 The impact of entrepreneurs' oral "pitch" presentation skills on business angels' initial screening investment decision Venture Capital 10 (3) pp 257 – 279.


http://dx.doi.org/10.1080/13691061003643276.


http://dx.doi.org/10.4337/9781783471720.00022,


http://dx.doi.org/10.4337/9781783471720.00012,


http://dx.doi.org/10.4337/9781783471720.00021 ,


http://dx.doi.org/10.1142/9789814733816_0007,

http://dx.doi.org/10.1142/9789814733816_0012,

http://dx.doi.org/10.1142/9789814733816_0016,

http://dx.doi.org/10.1142/9789814733816_0011,


http://dx.doi.org/10.1142/9789814733816_0019,

http://dx.doi.org/10.1142/9789814733816_0010,


http://dx.doi.org/10.1142/9789814733816_0020 ,

http://dx.doi.org/10.1142/9789814733816_0017 ,

http://dx.doi.org/10.1142/9789814733816_0003 ,

http://dx.doi.org/10.1142/9789814733816_0013 ,

http://dx.doi.org/10.4337/9781783471720.00016 ,

http://dx.doi.org/10.1142/9789814733816_0009 ,


Investment boutique firm, investment boutique bank, financial capital investment vehicle in finances:


5482. Weihong Song Wei Jie, Lei Zhou 2013 The value of “boutique” financial advisors in mergers and acquisitions Journal of Corporate Finance 20 (C) pp 94 – 114.
Goodhart Ch, Schoenmaker D March 2016 The United States dominates global
investment banking: Does it matter for Europe? *Policy Contributions Bruegel* issue 2016/06
pp 1 – 14

Thomson Reuters 2016 Global investment banking review full year 2015 *Thomson
Reuters Deals Business Intelligence* New York USA.

Wikipedia 2016 Boutique investment bank Wikipedia Inc

**Probability theory, statistics theory, Brownian movement theory, diffusion theory and chaos
theory in econometrics, econophysics and physics:**

Huygens 1657 *De ratiociniis in aleae ludo* (On calculations in games of chance).

Bernoulli J 1713 *Ars conjectandi* (The art of guessing).

Bernoulli D 1738, 1954 *Specimen theoria novae de mensura sortis* Commentarii
*Academiae Scientiarum Imperialis Petropolitanae* Petropoli vol 5 pp 175 – 192; Exposition
of a new theory on the measurements of risk Sommer L (translator) *Econometrica* vol 22
pp 23 – 36.

De Moivre 1730 *Miscellanea analytica supplementum* (The analytic method).

De Laplace 1812 *Théorie analytique des probabilités* Paris France.

Bunyakovsky V Ya 1825 *Heat propagation in solids Ph D Thesis* under
Prof. Augustin -Louis Cauchy supervision *École Polytechnique* Paris France.

Bunyakovsky V Ya 1846 *Foundations of the mathematical theory of probability
St. Petersburg* Russian Federation.

Connor J J, Robertson E F July 2000 Viktor Yakovlevich Bunyakovsky (December 16,
1804 - December 12, 1889) *School of Mathematics and Statistics* University of St Andrews
Scotland UK
http://www-history.mcs.st-andrews.ac.uk/Biographies/Bunyakovsky.html.

V Ya Bunyakovsky International Conference (August 20 - 21) 2004 Private
communications with conference participants on V Ya Bunyakovsky’s mathematical theory
of probability and its applications in econophysics and econometrics during tour to Town of
Bar Vinnytsia Region Ukraine V Ya Bunyakovsky International Conference Institute of
Mathematics of National Academy of Sciences of Ukraine (NASU) Kyiv Ukraine
www.imath.kiev.ua/~syta/bunyak.


5497. Chebyshev P L 1846 An experience in the elementary analysis of the probability theory Crelle’s Journal fur die Reine und Angewandte Mathematik.


5504. Markov A A 1906 Extension of law of big numbers on variables, depending from each other Izvestiya Fiziko-Matematicheskogo Obschestva pri Kazanskom Universitete 2nd series vol 15 (94) pp 135 – 156 Russian Federation.


5518. Kolmogorov A N 1947 The contribution of Russian science to the development of probability theory *Uchenye Zapiski Moskovskogo Universiteta* no 91.


5534. Mandelbrot B B 1967a The variation of some other speculative prices *Journal of Business* vol 40 pp 393 – 413.


5544. Mandelbrot B B 1977 Fractals: Form, chance and dimension W H Freeman San Francisco USA.
5545. Mandelbrot B B 1982 The fractal geometry of nature W H Freeman San Francisco USA.
5548. Gnedenko B V, Khinchin A Ya 1961 An elementary introduction to the theory of probability Freeman San Francisco USA.
5553. Lamperti J 1966 Probability Benjamin New York USA.
5559. Breiman L 1968 Probability Addison-Wesley Reading MA USA.
history statistics and probability Kendall M G, Plackett R L (editors) 2 pp 347 – 382 London
UK.
Association 64 pp 316 – 323.
USA.
San Francisco California USA.
The Netherlands.
5569. Andreev A F February 1976 Diffusion in quantum crystals Uspekhi Fizicheskikh Nauk
(UFN) vol 118 (2) pp 251 – 271.
Basel-Stuttgart Switzerland-Germany.
York USA.
92210254–0 pp 1 – 496.
University Press Oxford New York UK USA.
York USA.
York USA.
5577. Pagan A 1984 Econometric issues in the analysis of regressions with generated regressors
USA.
5579. Taylor S 1986 Modeling financial time series *John Willey and Sons Inc* New York USA.
5580. Tong H 1986 Nonlinear time series *Oxford University Press* Oxford UK.
5588. Pesaran M H, Potter S M (editors) 1993 Nonlinear dynamics, chaos and econometrics *John Willey and Sons Inc* New York USA.
5591. Peters E E 1994 Fractal market analysis: Applying chaos theory to investment and economics *John Willey and Sons Inc* New York USA.
5592. Enders W 1995 Applied econometric time series *John Willey and Sons Inc* New York USA.
5597. Moore G E 2003 No exponential is forever – but we can delay forever *ISSCC*. 

597


5604. Hasem P M, Pesaran B 1997 Working with Microfit 4.0: Interactive econometric analysis *Oxford University Press* Oxford UK.


5612. Hayashi F 2000 Econometrics *Princeton University Press* Princeton NJ USA.


5622. Ledenyov V O, Ledenyov D O, Ledenyov O P 2006, 2012 Features of oxygen and its vacancies diffusion in superconducting composition YBa$_2$Cu$_3$O$_{7-\delta}$ near to magnetic quantum lines Problems of Atomic Science and Technology vol 15 no 1 pp 76 – 82 ISSN 1562-6016, Cornell University NY USA


5624. Wilson 2016 Non Western mathematics Public Lecture London School of Economics and Political Science London UK

Quantum diffusion in physics, econophysics and finances:


**Stability of investment portfolio in nonlinear dynamics, mathematics and finances:**


5630. Kolmogorov A N 1940 Wienerische spiralen und einige andere interessante kurven im Hilbertschen raum *DAN USSR* vol 26 no 2 pp 115 – 118.


5652. Feigenbaum M J 1980 The transition to aperiodic behaviour in turbulent systems Communications Mathematical Physics vol 77 no 1 pp 65 – 86.


Strogatz S 1994 Nonlinear dynamics and chaos *Addison Wesley* NY USA.


Mosekilde E 1996-1997 Private communications on quantum chaos *Department of Physics* Technical University of Denmark Lyngby Copenhagen Denmark.


Sauer T et al 1996 Chaos: An introduction to dynamic systems *Springer Verlag* NY USA.


5678. Saratov group of theoretical nonlinear dynamics 2012 Information on the logistic equation.


Wiener filtering theory, Pugachev filtering theory, Stratonovich optimal nonlinear filtering theory, Stratonovich-Kalman-Bucy filtering algorithm, Stratonovich-Kalman-Bucy filter, particle filter in econometrics, econophysics, electrical and computer engineering:


5683. Wiener N 1949 The extrapolation, interpolation and smoothing of stationary time series John Wiley & Sons Inc New York NY USA.


5702. Pugachev V S 1980b Finite distributions of processes, defined by stochastic differential equations, and extrapolation of these processes *DAN USSR* vol 251 no 1 pp 40 – 43.


Newton G C Jr, Gould L A, Kaiser J F 1957 Analytical design of linear feedback controls
*John Wiley & Sons Inc* New York USA.


Rytov S M 1957 Development of theory of nonlinear oscillations in the USSR *Radio-
Technique and Electronics* no 11 pp 1435 – 1450.

Cramer H 1957 Mathematical methods of statistics *Princeton University Press* Princeton
NJ USA.

Bellman R E, Glicksberg I, Gross O A 1958 Some aspects of the mathematical theory of
control processes *RAND Report R-313* pp 1 – 244.

Blum M 1958 Recursion formulas for growing memory digital filters *Trans IRE Prof

Darlington S 1958 Linear least-squares smoothing and prediction with applications *Bell

Davenport W B Jr, Root W L 1958 An introduction to the theory of random signals and

Sherman S 1958 Non-mean-square error criteria *Trans IRE Prof Group on Information
Theory* **IT-4** pp 125 – 126.

Shinbrot M 1958 Optimization of time-varying linear systems with nonstationary inputs
*Trans ASME* vol **80** pp 457 – 462.

USA.

Kalman R E, Koepcke R W 1958 Optimal synthesis of linear sampling control systems

Kalman R E, Koepcke R W 1959 The role of digital computers in the dynamic
optimization of chemical reactors *Proceedings of the Western Joint Computer Conference*

Kalman R E, Bertram J E 1958 General synthesis procedure for computer control of
single and multi-loop linear systems *Transactions of the AIEE* vol **77** II pp 602 – 609.

Kalman R E, Bertram J E 1959 A unified approach to the theory of sampling systems
*Journal of the Franklin Institute* vol **267** pp 405 – 436.

Kalman R E 1960a On the general theory of control systems *Proceedings of the First
International Conference on Automatic Control* Moscow USSR.


5750. Stratonovich R L 1959a Optimum nonlinear systems which bring about a separation of a signal with constant parameters from noise *Radiofizika* 2 (6) pp 892 – 901.


5781. Wright-Patterson Air Forces Base (AFB) 1970 – 2016 Full extended complemented digital collection of technical research reports and research seminars minutes Wright-Patterson Air Forces Base (AFB) Ohio USA.


5786. Maybeck P S 1974 Applied optimal estimation—Kalman filter design and implementation Air Force Institute of Technology Wright-Patterson Air Forces Base (AFB) Ohio USA.


5808. Lewis F 1986 Optimal estimation John Wiley & Sons Inc USA.


5826. Tanizaki H 1993 Non-linear filters: Estimation and applications Lecture Notes in economics and mathematical systems Springer Verlag Germany.
5828. Bar-Shalom, Xiao-Rong Li 1993 Estimation and tracking: Principles, techniques and software Artech House Boston USA.
5837. Hayes M H 1996 Statistical digital signal processing and modeling John Wiley and Sons Inc USA.
5839. Haykin S (editor) 2001 Kalman filtering and neural networks Wiley Inter-Science USA.
5840. Fuller W A 1996 Introduction to statistical time series John Wiley & Sons Inc USA.


5844. Krelle W 1997 How to deal with unobservable variables in economics *Discussion Paper no B 414 Bonn University* Germany.


5847. Mantegna R N, Stanley H E 1999 Introduction to Econophysics *Cambridge University Press* Cambridge UK.


5856. Welch G, Bishop G 2001 An introduction to the Kalman filter Department of Computer Science University of North Carolina at Chapel Hill Chapel Hill USA.


5894. Theoret R, and Racicot F - E 2010 Forecasting stochastic volatility using the Kalman filter: an application to Canadian interest rates and price-earnings ratio MPRA Paper no 35911 Munich University Munich Germany http://mpra.ub.uni-muenchen.de/35911/.


5901. Hang Qian 2012 A flexible state space model and its applications MPRA Paper No 38455 Munich University Munich Germany pp 1 - 27 http://mpra.ub.uni-muenchen.de/38455/.


Continuous time signals, analog signals, discrete time signals, digital signals, spectrum of signals in digital signal processing, physics and electronics engineering:

5908. Maxwell J C 1890 Introductory lecture on experimental physics in Scientific papers of J C Maxwell Niven W D (editor) vols 1, 2 Cambridge UK.

5910. Walsh J L 1923b A property of Haar’s system of orthogonal functions Math Ann 90 p 3845.


5921. Fountain T 1987 Processor arrays, architecture and applications Academic Press London UK.


5941. Wikipedia 2015f Continuous wave Wikipedia Inc USA
Time Division Duplex/Frequency Division Duplex spread spectrum burst communications, UMTS/WCDMA/LTE wireless communications, WCDMA optical communications, digital signal processing in telecommunications, electronics engineering, and physics:

5942. Wikipedia 2015g Discrete-time signal *Wikipedia Inc* USA

5943. Wikipedia 2015h Hadamard code *Wikipedia USA*

5944. Wikipedia 2016i Polarization *Wikipedia USA*

5945. Wikipedia 2016j Circular polarization *Wikipedia USA*

5946. Wikipedia 2016k In phase and quadrature components *Wikipedia USA*

5947. Wikipedia 2016l Constellation diagram *Wikipedia USA*

5948. Matlab 2014 IQ diagram *MathSoft California USA.*

5949. Ledenyov D O, Ledenyov V O 2015a Nonlinearities in microwave superconductivity 8th edition *Cornell University NY USA* pp 1 – 923


Quantum physics, electronics, mechanics:


622
5967. Planck M 1914 The theory of heat radiation 2nd edition *P Blakiston's Son & Co*
   http://openlibrary.org/books/OL7154661M.


http://adsabs.harvard.edu/abs/1943NW.....31..153P,
https://dx.doi.org/10.1007%2FBF01475738.

5970. Einstein A 1905 Zur Elektrodynamik bewegter Körper On the electrodynamics of moving bodies *Annalen der Physik* Berlin Germany (in German) **322** (10) pp 891 – 921
http://onlinelibrary.wiley.com/doi/10.1002/andp.19053221004/pdf,
http://adsabs.harvard.edu/abs/1905AnP...322..891E),
http://dx.doi.org/10.1002%2Fandp.19053221004.

5971. Einstein A 1917 Zur Quantentheorie der Strahlung On the quantum mechanics of radiation *Physikalische Zeitschrift* (in German) **18** pp 121 – 128
http://adsabs.harvard.edu/abs/1917PhyZ...18..121E.

http://echo.mpiwg-berlin.mpg.de/MPIWG:DRQK5WYB.

http://journals.aps.org/pr/pdf/10.1103/PhysRev.47.777,
http://adsabs.harvard.edu/abs/1935PhRv...47..777E,
https://dx.doi.org/10.1103%2FPhysRev.47.777.


http://www.cond-mat.physik.uni-mainz.de/~oettel/ws10/bks_PhilMag_47_785_1924.pdf,
https://dx.doi.org/10.1080%2F14786442408565262.
5977. de Broglie L 1926 Ondes et mouvements Waves and motions Gauthier-Villars Paris France.
5978. de Broglie L 1927 Rapport au 5e Conseil de Physique Solvay Brussels Belgium.
5979. de Broglie L 1928 La mécanique ondulatoire Wave mechanics Gauthier-Villars Paris France.
https://www.worldcat.org/oclc/1871779.
5981. Compton A; Allison S K 1935 X-Rays in theory and experiment D Van Nostrand Company Inc New York USA
https://www.worldcat.org/oclc/853654.
5982. Schrödinger E 1926 Quantisierung als Eigenwertproblem Annalen der Phys 384 (4) pp 273 – 376
http://adsabs.harvard.edu/abs/1926AnP...384..361S,
https://dx.doi.org/10.1002%2Fandp.19263840404.
5983. Fermi E 1934 Radioattività indotta da bombardamento di neutroni La Ricerca scientifica 1 (5) p 283 (in Italian)
http://adsabs.harvard.edu/abs/1934RSPSA.146..483F,
https://dx.doi.org/10.1098%2Frspsa.1934.0168.
5985. Townes Ch 1939 Concentration of the heavy isotope of carbon and measurement of its nuclear spin PhD thesis Caltech California USA
http://thesis.library.caltech.edu/4202/.
5987. Gordon J, Zeiger H, Townes Ch 1955 The maser — new type of microwave amplifier, frequency standard, and spectrometer Physical Review 99 (4) p 1264
http://adsabs.harvard.edu/abs/1955PhRv...99.1264G,
5988. Shimoda K, Wang T, Townes Ch 1956 Further aspects of the theory of the maser
   Physical Review 102 (5) p 1308
   http://adsabs.harvard.edu/abs/1956PhRv..102.1308S ,
   https://dx.doi.org/10.1103%2FPhysRev.102.1308 .
5989. Townes Ch H 1964 Nobel Prize in Physics Stockholm Sweden
5990. Townes Ch H 1966 Obtaining of coherent radiation with help of atoms and molecules
   Uspekhi Fizicheskih Nauk (UFN) vol 88 no 3.
5991. Townes Ch H 1969 Quantum electronics and technical progress Uspekhi Fizicheskih
   Nauk (UFN) vol 98 no 5.
5992. Townes Ch 1995 Making waves American Institute of Physics Press New York USA
5993. Townes Ch 1999 How the laser happened: Adventures of a scientist Oxford University
   pp 1 – 404.
5995. Blokhintsev D I 1954 Development of first nuclear reactor for nuclear power plant
   Moscow Russian Federation.
5997. Prokhorov A M, Basov N G 1955 Molecular generator and amplifier Uspekhi Fizicheskih
   Nauk (UFN) vol 57 no 3 pp 485 – 501.
   Physics JETP 16 1489.
5999. Prokhorov A M 1964 Nobel Prize in Physics Stockholm Sweden
6000. Prokhorov A M Quantum electronics 1965 Uspekhi Fizicheskih Nauk (UFN) vol 85 no 4
6001. Karlov N V, Prokhorov A M 1976 Laser’s separation of isotopes Uspekhi Fizicheskih
   Nauk (UFN) vol 118 no 4 pp 583 – 609.
6002. Prokhorov A M 1979 To 25th anniversary of laser Uspekhi Fizicheskih Nauk (UFN)
   vol 128 no 3.
http://www.springer-sbm.de/index.php?id=121&L=0 .


6007. Schawlow A, Townes Ch 1958 Infrared and optical masers Physical Review 112 (6) p 1940
http://dx.doi.org/10.1103%2FPhysRev.112.1940 ,


6009. Schawlow A 1964 Nobel Prize in Physics Stockholm Sweden


6025. Mygind J 1997 Private communications on the new sources of noise in the single electron transistors *Department of Physics* Technical University of Denmark Lyngby Denmark.


**Wave function in Schrödinger quantum mechanical wave equation in quantum mechanics:**


6033. Schrödinger E 1926b An undulatory theory of the mechanics of atoms and molecules


Bibcode:1926PhRv...28.1049S

https://dx.doi.org/10.1103%2FPhysRev.28.1049,

http://adsabs.harvard.edu/abs/1926PhRv...28.1049S.


6036. Einstein A 1917 Zur Quantentheorie der Strahlung On the quantum mechanics of radiation *Physikalische Zeitschrift* (in German) 18 pp 121 – 128

http://adsabs.harvard.edu/abs/1917PhyZ...18..121E.


http://journals.aps.org/pr/pdf/10.1103/PhysRev.47.777,

http://adsabs.harvard.edu/abs/1935PhRv...47..777E,

https://dx.doi.org/10.1103%2FPhysRev.47.777.


Artificial intelligence, electronics engineering and computer science:


**Deoxyribonucleic acid (DNA), digital DNA of economy of scale and scope in biology economics and finances:**


6090. Kol'tsov N K December 12, 1927 The physical-chemical basis of morphology 3rd All-Union Meeting of Zoologist, Anatomists, and Histologists Leningrad USSR.


**Strategy theory in management, business administration, psychology, and mathematics:**


6111. Andrews K R 1971a The concept of corporate strategy Richard D Irwin Homewood USA.


6125. Porter M E 1983 Analyzing competitors: Predicting competitor behavior and formulating offensive and defensive strategy in Policy, strategy, and implementation Leontiades M (editor) Random House USA.


6129. Porter M E May 1987a The state of strategic thinking Economist London UK.


Porter M E December 1996b Tradeoffs, activity systems, and the theory of competitive strategy *Unpublished Work* Harvard University USA.


Porter M E 2001b The technological dimension of competitive strategy in Research on technological innovation, management and policy vol 7 Burgelman R A, Chesbrough H (editors) *JAI Press* Greenwich CT USA.


Porter M E January 2008 The five competitive forces that shape strategy *Special Issue on HBS Centennial* *Harvard Business Review* 86 (1) http://hbr.org/2008/01/the-five-competitive-forces-that-shape-strategy/ar/1 .


6154. Yelle L E 1979 The learning curve: Historical review and comprehensive survey *Decision Sciences* 10 (2) pp 302 – 328.

6155. Schelling Th C 1980 The strategy of conflict *Harvard University Press* Cambridge USA.


6175. Yip G 1992 Total global strategy: Managing for worldwide competitive advantage *Prentice Hall* NY USA.


6183. McKiernan P 1997 Strategy past, strategy futures *Long range planning* vol 30 no 5 p 792.


6188. Moldoveanu M, Martin R L 2001 Agency theory and the design of efficient governance mechanisms Joint Committee on Corporate Governance Meeting Rotman School of Management University of Toronto Ontario Canada pp 1 – 57.


6191. Martin R L 2007 Designing the thinker Rotman Magazine Rotman School of Management University of Toronto Ontario Canada pp 4 – 8.


6202. Drejer A 2002 Strategic management and core competencies 1st edition Quorum Books Westport Connecticut USA.
www.blueoceanstrategy.com,
https://smart.ly/blue-ocean-strategy/.
6214. Murphy T, Galunic Ch 2007 Leading in the age of talent wars INSEAD Leader-casts INSEAD France.


6219. Sull D 2007d Closing the gap between strategy and execution: The strategy loop in action Public Lecture London School of Economics and Political Science London UK.

6220. Sull D 2008 An iterative approach to the strategy Public Lecture London School of Economics and Political Science London UK.


6222. Samuels R 2008 Japan's grand strategy Public Lecture on 13.10.2008 London School of Economics and Political Science London UK
http://www.lse.ac.uk/collections/LSEPublicLecturesAndEvents/events/2008/20080819t1316z001.htm
http://richmedia.lse.ac.uk/publicLecturesAndEvents/20081013_1830_japansGrandStrategy.mp3

6223. Chamberlain G P 2010 Understanding strategy Create Space Charleston South Carolina USA.


Game theory in strategy, management, business administration, psychology, and mathematics:


6234. Edgeworth F Y 1881 Mathematical psychics Kegan Paul London UK.


6249. Shubik M 1953c The role of game theory in economics *Kyklos* 7 (2) p 21.

6250. Shubik M 1954 Readings in game theory and political behavior *Doubleday* New York USA.


6257. Shubik M 1975 Games for society, business and war *Elsevier* Amsterdam The Netherlands.

6258. Brewer G, Shubik M 1979 The war game *Harvard University Press* Cambridge USA.

6259. Shubik M, Levitan R 1980 Market structure and behavior *Harvard University Press* Cambridge USA.


6261. Shubik M 1987 A game-theoretic approach to political economy *MIT Press* Cambridge MA USA.


6267. Blackett P M S 1962 Studies of war *Oliver and Boyd* Edinborough Scotland UK.


6269. Morse P E, Kimball G E 1970 Methods of operations research *Peninsula Publishing* Los Altos California USA.


6293. Fudenberg D, Tirole J 1993 Game theory *MIT Press* Cambridge Massachusetts USA.


6314. Leonard R 2010 Von Neumann, Morgenstern, and the creation of game theory

6315. Papayoanou P 2010 Game theory for business Probabilistic Publishing

6316. Julmi Ch 2012 Introduction to game theory BookBooN Copenhagen Denmark

6317. Brandenburger A 2014 The language of game theory: Putting epistemics into the
mathematics of games World Scientific Series in Economic Theory 5 World Scientific

6318. McCain R A 2014 Game theory: A nontechnical introduction to the analysis of strategy

6319. RAND Corporation 2016 Digital archive of publications RAND Corporation USA.

Selected research papers in macroeconomics, microeconomics and nanoeconomics:

6320. Ledenyov V O, Ledenyov D O 2012a Shaping the international financial system in
century of globalization Cornell University NY USA pp 1 – 20

6321. Ledenyov V O, Ledenyov D O 2012b Designing the new architecture of international
financial system in era of great changes by globalization Cornell University NY USA
pp 1 – 18

6322. Ledenyov D O, Ledenyov V O 2012a On the new central bank strategy toward monetary
and financial instabilities management in finances: econophysical analysis of nonlinear
dynamical financial systems Cornell University NY USA pp 1 – 8

6323. Ledenyov D O, Ledenyov V O 2012b On the risk management with application of
econophysics analysis in central banks and financial institutions Cornell University NY USA
pp 1 – 10

6324. Ledenyov D O, Ledenyov V O 2013a On the optimal allocation of assets in investment
portfolio with application of modern portfolio management and nonlinear dynamic chaos
theories in investment, commercial and central banks Cornell University NY USA pp 1 – 34

financial and economic systems Cornell University NY USA pp 1 – 27


6332. Ledenyov D O, Ledenyov V O 2013i Venture capital optimal investment portfolio strategies selection in diffusion - type financial systems in global capital markets with
nonlinearities MPRA Paper no 51903 Munich University Munich Germany pp 1 – 81,
SSRN Paper no SSRN-id2592989 Social Sciences Research Network New York USA
http://mpra.ub.uni-muenchen.de/51903/ ,

6333. Ledenyov D O, Ledenyov V O 2014a Mergers and acquisitions transactions strategies in
diffusion - type financial systems in highly volatile global capital markets with nonlinearities
MPRA Paper no 61946 Munich University Munich Germany, SSRN Paper no
SSRN-id2561300 Social Sciences Research Network New York USA pp 1 – 160
http://mpra.ub.uni-muenchen.de/61946/ ,

6334. Ledenyov D O, Ledenyov V O 2014b Strategies on initial public offering of company
equity at stock exchanges in imperfect highly volatile global capital markets with induced
nonlinearities MPRA Paper no 53780 Munich University Munich Germany, SSRN Paper no
SSRN-id2577767 Social Sciences Research Network New York USA pp 1 – 138
http://mpra.ub.uni-muenchen.de/53780/ ,

6335. Ledenyov D O, Ledenyov V O 2014c On the winning virtuous strategies for ultra high
frequency electronic trading in foreign currencies exchange markets MPRA Paper no 61863
Munich University Munich Germany, SSRN Paper no SSRN-id2560297 Social Sciences
Research Network New York USA pp 1 – 175
http://mpra.ub.uni-muenchen.de/61863/ ,

6336. Ledenyov D O, Ledenyov V O 2014d On the fundamentals of winning virtuous strategies
creation toward leveraged buyout transactions implementation during private equity
investment in conditions of resonant absorption of discrete information in diffusion - type
financial system with induced nonlinearities MPRA Paper no 61805 Munich University
Munich Germany pp 1 – 161, SSRN Paper no SSRN-id2559168 Social Sciences Research
Network New York USA
http://mpra.ub.uni-muenchen.de/61805/ ,

6337. Ledenyov D O, Ledenyov V O 2014e MicroFX foreign currencies ultra high frequencies
trading software platform with embedded optimized Stratonovich – Kalman - Bucy filtering
algorithm, particle filtering algorithm, macroeconomic analysis algorithm, market
microstructure analysis algorithm, order flow analysis algorithm, comparative analysis
algorithm, and artificial intelligence algorithm for near-real-time decision making / instant switching on / between optimal trading strategies ECE James Cook University Townsville Australia, Kharkov Ukraine.

6338. Ledenyov D O, Ledenyov V O 2014f MicroLBO software program with the embedded optimized near-real-time artificial intelligence algorithm to create winning virtuous strategies toward leveraged buyout transactions implementation and to compute direct/reverse leverage buyout transaction default probability number for selected public/private companies during private equity investment in conditions of resonant absorption of discrete information in diffusion - type financial system with induced nonlinearities ECE James Cook University Townsville Australia, Kharkov Ukraine.

6339. Ledenyov D O, Ledenyov V O 2015a Nonlinearities in microwave superconductivity 8th edition Cornell University NY USA pp 1 – 923


http://mpra.ub.uni-muenchen.de/61681/ ,


http://mpra.ub.uni-muenchen.de/63380/ ,


http://mpra.ub.uni-muenchen.de/63565/ ,


http://mpra.ub.uni-muenchen.de/64368/ ,


6350. Ledenyov D O, Ledenyov V O 2015l Wave function method to forecast foreign currencies exchange rates at ultra high frequency electronic trading in foreign currencies
6351. Ledenyov D O, Ledenyov V O 2015m Quantum money MPRA Paper no 67982 Munich University Munich Germany, SSRN Paper no SSRN-id2693128 Social Sciences Research Network New York USA pp 1 – 70
http://mpra.ub.uni-muenchen.de/67982/ ,

http://mpra.ub.uni-muenchen.de/68404/ ,

http://mpra.ub.uni-muenchen.de/68730/ ,

http://mpra.ub.uni-muenchen.de/68960/ ,

http://mpra.ub.uni-muenchen.de/69405/ ,

6356. Ledenyov D O, Ledenyov V O 2016r Precise measurement of macroeconomic variables in time domain using three dimensional wave diagrams MPRA Paper no 69609 Munich University Munich Germany, SSRN Paper no SSRN-id2733607 Social Sciences Research Network New York USA pp 1 – 52
http://mpra.ub.uni-muenchen.de/69609/ ,


6359. Ledenyov D O, Ledenyov V O 2015t MicroID software program with the embedded optimized near-real-time artificial intelligence algorithm to create the winning virtuous business strategies and to predict the director’s election / appointment in the boards of directors in the firms, taking to the consideration both the director’s technical characteristics and the interconnecting interlocking director’s network parameters in conditions of the resonant absorption of discrete information in diffusion - type financial economic system with induced nonlinearities ECE James Cook University Townsville Australia, Kharkov Ukraine.

6360. Ledenyov D O, Ledenyov V O 2015u MicroITF operation system and software programs: 1) the operation system to control the firm operation by means of the information resources near-real-time processing in the modern firms in the case of the diffusion - type financial economic system with the induced nonlinearities; 2) the software program to accurately characterize the director’s performance by means of a) the filtering of the generated/transmitted/received information by the director into the separate virtual channels, depending on the information content, and b) the measurement of the levels of signals in every virtual channel with the generated/transmitted/received information by the director, in the overlapping interconnecting interlocking directors networks in the boards of directors in the firms during the Quality of Service (QoS) measurements process; and 3) the software program to create the winning virtuous business strategies by the interlocking interconnecting directors in the boards of directors in the modern firms in the case of the
diffusion-type financial economic system with the induced nonlinearities, using the patented recursive artificial intelligence algorithm ECE James Cook University Townsville Australia, Kharkov Ukraine.

6361. Ledenyov D O, Ledenyov V O 2015v MicroIMF software program: the MicroIMF software program to make the computer modeling of 1) the interactions between the information money fields of one cyclic oscillation and the information money fields of other cyclic oscillation(s) in the nonlinear dynamic economic system, 2) the interactions between the information money fields of cyclic oscillation and the nonlinear dynamic economic system itself, and 3) the density distributions of the information money fields by different cyclic oscillations (the economic continuous waves) in the nonlinear dynamic economic system ECE James Cook University Townsville Australia, Kharkov Ukraine.

6362. Ledenyov D O, Ledenyov V O 2015w MicroSA software program 1) to perform the spectrum analysis of the cyclic oscillations of the economic variables in the nonlinear dynamic economic system, including the discrete-time signals and the continuous-time signals; 2) to make the computer modeling and to forecast the business cycles for a) the central banks with the purpose to make the strategic decisions on the monetary policies, financial stability policies, and b) the commercial/investment banks with the aim to make the business decisions on the minimum capital allocation, countercyclical capital buffer creation, and capital investments ECE James Cook University Townsville Australia, Kharkov Ukraine.

6363. Ledenyov D O, Ledenyov V O 2015x DNACode software program 1) to model the Digital DNA’s complex knowledge base structure for the selected economy of the scale and scope in the case of the G20 nations; 2) to accurately forecast the generation/propagation of the Ledenyov discrete time digital waves of GIP(t)/GDP(t)/GNP(t)/PPP(t) (the discrete-time digital business cycles of GIP(t)/GDP(t)/GNP(t)/PPP(t)) in the G20 economies of the scales and scopes) ECE James Cook University Townsville Australia, Kharkov Ukraine.

6364. Ledenyov D O, Ledenyov V O 2016y MacroSoft software program, which creates the proposed three dimensional (3D) wave diagram to accurately characterize and to finely display the GIP(t), GDP(t), GNP(t), PPP(t) dependences for the G7 economies of the scales and scopes in the time domain for the two possible cases: 1) the continuous-time waves of GIP(t), GDP(t), GNP(t), PPP(t), and 2) the discrete-time waves of GIP(t), GDP(t), GNP(t), PPP(t).
List of Figures:

Chapter 1:
1. Fig. 1. New wealth creation synthesis process with three objects: Matter, Labour and Capital.................................................................9
2. Fig. 2. Money definition.................................................................10
3. Fig. 3. Money types in financial system.............................................13
4. Fig. 4. Means of value payment in financial system .........................13
5. Fig. 5. Money design evolution in financial system in time...............17

Chapter 2:
1. Fig. 6. Financial variables to characterize investment of financial capital in capital markets..............................................................22
2. Fig. 7. Gauss normal distribution of probability of occurring events.............23
3. Fig. 8. Illustration of the valuable financial papers prices evolution estimation with the probability theory in the mathematics in Bachelier (1900, 1914, 1937, 19 May 1941). The three Gauss normal distributions of the probabilities of the valuable financial papers prices at various time periods of 1, 5, 10 years are depicted......................................................23
4. Fig. 9. Classification of signals by oscillating financial variables in finances.............25
5. Fig. 10. Continuous-time signal by oscillating financial variables in finances................26
6. Fig. 11. Discrete-time signal by oscillating financial variables in finances...............26
7. Fig. 12. Continuous-time signal filter in finances.......................................26
8. Fig. 13. Discrete-time signal filter in finances...........................................26
9. Fig. 14. Fractal in form of Cantor set.................................................28
10. Fig. 15. Fractal in form of Koch snowflake........................................28
11. Fig. 16. Quantum diffusion of money at cross-sections of Feynman paths in capital markets.................................................................31

Chapter 3:
1. Fig. 17. Sciences to solve problem on investment of financial capital in capital markets.................................................................33
2. Fig. 18. Multilayered theoretical modeling to find solution of problem on investment of financial capital in capital markets.................................................................34
3. Fig. 19. Block scheme of investment process.............................................35
4. Fig. 20. Investment star planetary system in finances galaxy..........................36
5. Fig. 21. Investment products in capital markets………………………………………………37
6. Fig. 22. Investment vehicles in capital markets……………………………………………38
7. Fig. 23. Investment mediums in capital markets……………………………………………39

Chapter 4:
1. Fig. 24. Investment products in capital markets in finances………………………………40

Chapter 5:
1. Fig. 25. Investment vehicles in capital markets in finances……………………………81
2. Fig. 26. Private equity investment scheme………………………………………………84
3. Fig. 27. Dependence of investment return premiums on different investment strategies by hedge fund over selected time period………………………………………………………90
4. Fig. 28. Venture capital organization scheme……………………………………………103
5. Fig. 29. Venture capital investment process scheme………………………………………106

Chapter 6:
1. Fig. 30. Investment mediums in capital markets in finances……………………………116

Chapter 7:
1. Fig. 31. Hypothetical investment portfolio with diversified asset classes for financial capital investment in capital markets in economies of scale and scope in short and long time periods ………………………………………………………………………………………………………147
3. Fig. 33. Financial, economic, social and political risks to account at creation of hypothetical investment portfolio with diversified asset classes for financial capital investment in capital markets in economies of scale and scope in short and long time periods…………………………………………….156
4. Fig. 34. Investment portfolio total risk computing algorithm as dial in Swiss watch………157
5. Fig. 35. Block scheme of investment portfolio total risk computing algorithm……………158
6. Fig. 36. Correlated and uncorrelated continuous-time oscillations of three selected shares values in time………………………………………………………………………………………………159
7. Fig. 37. Ledenyov correlated and uncorrelated discrete-time oscillations of three selected shares values in time……………………………………………………………………………………………160
8. **Fig. 38.** Correlated and uncorrelated complex discrete-time oscillations of three selected shares values in time $S_1(t), S_2(t), S_3(t)$……………………………………………………………………………….161

9. **Fig. 39.** Continuous-time waves of GDP(t)/GNP(t)/PPP(t) fluctuations in economy of scale and scope………………………………………………………………………………….162

10. **Fig. 40.** Ledenyov discrete-time digital economic output waves in economy of scale and scope in time……………………………………………………………………………….164

11. **Fig. 41.** Ledenyov discrete-time digital economic output wave, which is generated by complex high order digital modulations techniques with application of disruptive financial/economic/social/political innovations and propagated in form of bursts……………….165

12. **Fig. 42.** 3D bifurcation diagram for accurate characterization of dynamic properties of combining risky investments in investment portfolio in nonlinear dynamic financial system (after Ledenyov D O, Ledenyov V O (2013a))………………………………………………………………………………170

**Chapter 8:**

1. **Fig. 43.** Dependence of strategy knowledge accumulation/learning on time: 1) Linear, 2) Exponential, 3) S-type nonlinear………………………………………………………………………………….176

2. **Fig. 44.** Ledenyov strategy vector in Ledenyov multidimensional strategy space with XYZ coordinates………………………………………………………………………………….177

3. **Fig. 45.** Ledenyov complex multivector strategy as number of Ledenyov strategy vectors in Ledenyov multidimensional strategy space with XYZ coordinates, changing in the space – time domains………………………………………………………………………………….178

4. **Fig. 46.** Geometric representation of Ledenyov parallel complex multivector strategy and Ledenyov sequential complex multivector strategy in Ledenyov multidimensional strategy space with XY coordinates, changing in space – time domains………………………………………………………………………………….179

5. **Fig. 47.** Geometric representation of Ledenyov mixed parallel-sequential complex multivector strategies in Ledenyov multidimensional strategy space with XY coordinates, changing in space – time domains………………………………………………………………………………….180

6. **Fig. 48.** Decision tree in game theory…………………………………………………………………………………………………………………………………..182

7. **Fig. 49.** Block scheme of Ledenyov quantum thinking process algorithm………………………………………………………………………………………………184

8. **Fig. 50.** Ledenyov quantum winning virtuous strategy search algorithm as a set of strategic actions on imagined dial of Swiss mechanical watch………………………………………………………………………………….186

9. **Fig. 51.** Block scheme of Ledenyov quantum winning virtuous strategy search algorithm………………………………………………………………………………………………187
List of Tables:

Chapter 1:
N/A

Chapter 2:
N/A

Chapter 3:
N/A

Chapter 4:
N/A

Chapter 5:
1. Tab. 1. Financial parameters to characterize private equity fund…………………………84

Chapter 6:
N/A

Chapter 7:
N/A

Chapter 8:
N/A
Accuracy of measurement of capital, 11
Algorithm, 157
  investment portfolio total risk computing, 157
  Ledenyov quantum thinking process (LQTP), 184, 185
  Ledenyov quantum winning virtuous strategy search (LQWVSS), 185 - 189
American Research and Development (ARD) fund, 98
Alpha, 152
Antique/modern, 80
  art(s), 80
  exchange, 80
Artificial intelligence, 191
Asset classes (investment), 40 - 80
  Automated reasoning process, 191
Bank(s), 11, 12
  central, 11, 12
  commercial, 82
  investment, 82
Basel III capital requirements, 156
Bayesian filters, 85
Bell-shaped distribution, 23, 24, 151
Beta, 154, 155
Bifurcation diagram, 170
Bitcoin blockchains, 12
Blockchain technology, 12
Brownian motion, 23, 24, 28
Business angel network(s) (BAN), 112
Business cycle(s), 18
  Juglar, 18
  Kitchin, 18
  Kuznets, 18
  Kondratiev, 18
  Ledenyov, 18
Buy-and-Hold Abnormal Returns (BHAR), 56
Cantor set, 28
Capital, 9
  accumulation, 9
  accuracy of measurement, 11
  definition, 9
  distribution, 11
  financial, 9
  flow(s), 11
  investment(s), 8, 9
  market(s), 9
  origin, 9
  value, 9
Capital Asset Pricing Model (CAPM), 151
  dynamic consumption (CCAMP), 151
  static (CAMP), 151
  theory, 151
Capital market(s), 11
  debt, 11
  equity, 11
Central bank(s), 11, 12
  Bank of Amsterdam, 11
  Bank of England, 11
  functional task(s), 11
  operations, 11, 12
  Sveriges Riksbank, 11
Chaos science, 27
Chicago Board Options Exchange (CBOE), 63, 64, 127
Chipset(s), 17
  quantum memory on magnetic vortices knots, 17
  quantum random number generator on magnetic flux qubits (1024 QRNG_MFQ), 17
Classification of signals by oscillating financial variables in finances, 25
  continuous-time, 25
  discrete-time, 25
Commodity, 44
Commodity exchanges, 139
  Commodity Exchange (COMEX), 139
  New York Mercantile Exchange (NYMEX), 139
  Chicago Board of Trade (CBOT), 139
  Tokyo Commodity Exchange (TCE), 139
  Tokyo Grain Exchange (TGE), 139
Complex, 161, 178
  discrete-time signal(s), 161
  strategy as number of strategy vectors, 178
  complex strategy concept, 177
Computing, 169, 170, 184
kernel, 184
modeling, 169, 170
Correlated/uncorrelated complex discrete -
time oscillation of share value in time, 161
Correlated/uncorrelated continuous -
time oscillation of share value in time, 159
Correlated/uncorrelated discrete -
time oscillation of share value in time, 160
Cost of capital, 154
Cost of equity, 154
Cournot-Nash non-cooperative equilibria, 181
Credit modeling theory, 154
Cryptocurrencies, 12
Bitcoin, 12
Ethereum, 12
Decision tree in game theory, 182
Derivatives, 65
credit, 65
equity, 66
other, 66
Diffusion of money (quantum), 29, 30
Diffusion-type financial systems, 148
Digital DNA(s), 31, 630
Digital signals processing theory, 166
Digital signal processor(s) (DSP), 15
Discounted Cash Flow (DCF), 54
Dynasties in mainland China, 10
Song, 10
Yuan, 10
Disruptive technological economical
financial social political innovations, 160, 166, 220
Earnings before interest taxation
depreciation amortization (EBITDA), 21, 52
Economic cycle(s), 18
Juglar, 18
Kitchin, 18
Kuznets, 18
Kondratiev, 18
Ledenyov, 18
Economic capital theory, 154
Economic development burst(s), 165
Economy of scale and scope, 9
Efficient frontier, 148, 149
Electromagnetic signals processing theory, 159
Electronic money, 16, 17
European business angel network(s)
(EBAN), 112
Exchange(s), 116
commodities, 139
financial securities, 135
foreign currencies, 116,
intellectual property, 144
land, 117
precious metals, 142
real estate, 118
stock, 119
Expected return premium in CAPM, 151
Factors (new) in Fama, French three factor
model, 153
book-to-market value, 153
price-earnings ratio for listed companies,
153.
Fama-French three factor model, 152, 153
Feynman, 29, 30
path(s), 29, 30
path integrals method, 29, 30
Field programmable gate array(s) (FPGA), 15
Finances, 9
Financial, 8, 9, 192
capital, 8, 9
capital gap, 192
capital investment, 192
resources, 8, 9
security(s), 65
transaction(s), 8, 9
Financial securities exchanges types, 135
listed derivatives exchange(s), 135
over-the-counter (OTC) derivatives exchange(s), 135
Firm, 50
Foreign currencies, 69, 70
exchange rate, 69, 70
Formulation of, 20
problem on financial capital investment,
20
Fourier spectral analysis, 28
Fractal(s), 27
Functional tasks by central bank, 12
financial liquidity provision, 12
financial liquidity regulation, 12
Fund(s), 83, 87, 94, 96, 98
aggressive, 83
alpha, 83
covered call, 83
focus, 83
hedge, 87
index, 83
investment, 83
mezzanine, 83
mutual, 83, 96
pension, 83, 94
private equity, 83
sovereign wealth, 83
special situations, 83
venture capital, 98

Game theory, 181, 182
Gauss normal distribution, 23, 24, 151
Geometric representation of strategy, 177
Globalization, 174

Harvard Business School, 98
Harvard University, 98
Hedge fund, 85, 87, 89
investment return, 87
portfolio return, 89
replication products, 85
Hedge fund organization model(s), 91
traditional investment bank, 91
inside-only hedge fund, 91
straddling hedge fund, 91
straddling “feeder” fund of funds, 91
stand-alone outside hedge fund, 91
outside “feeder” fund of funds, 91
Hedge fund dynamic leveraging trading strategies, 91, 92
Convertible arbitrage, 91
Distressed securities, 91
Diversified debt, 92
Emerging markets, 92
Equity market neutral, 91
Event driven, 91
Fixed income arbitrage, 92
Fund of funds, 92
Global macro, 92
Long/short equity hedge, 91
Managed futures, 92
Merger arbitrage, 92
Multi-strategy, 92
Relative value arbitrage, 92
History of, 9
capital markets, 9
Hypothetical investment portfolio, 147

Increased return on investment, 8
Increased return premium, 8
Inequality, 192
Information communication technologies (ICT), 15
Initial public offering process (IPO), 53
Instruments (investment), 40 - 80
Integrated circuit, 15
Intellectual property, 78, 144
Interest rates by central bank, 156
negative, 156
positive, 156
Internet, 12
Investment (in/of), 9, 36, 147,
capital market(s), 9
financial resource(s), 9
portfolio, 147
portfolio total risk computing algorithm, 157
process, 35
star planetary system in finances galaxy, 36
Investment mediums (by name), 116, 117, 119, 127, 135, 139, 142, 144
land exchange, 117
real estate exchange, 118
stock exchange, 119
foreign currencies exchange, 127
financial securities exchange, 135
commodities exchange, 139
precious metal exchange, 142
intellectual property exchange, 144
Investment products (by name), 40, 41, 44, 49, 50, 65, 69, 78
land, 41
real estate, 42
commodity, 44
bond, 49
company stock and stock option, 50
financial security, 65
foreign currency, 69
intellectual property, 78
Investment vehicle(s) (by name), 81, 82, 83, 87, 94, 96, 98, 114, 115
investment bank, 82
investment fund, 83
hedge fund, 87
pension fund, 94
mutual fund, 96
real, 38
venture capital fund, 98
angel investor, 111
investment boutique, 114
private investment office, 114, 115
virtual, 38
Initial Public Offering (IPO) underpricing, 55, 101

Jensen’s alpha, 152

Koch snowflake, 28

Land, 41, 117
Latest Technology Evolution (LTE), 15
Ledenyov, 14, 52, 16, 160, 161, 164, 165, 166, 169, 178, 184, 185, 204, 216
business cycle(s), 18
complex multivector strategy, 178
complex strategy vector, 178
constant, 52
correlated/uncorrelated complex discrete-time oscillations of selected shares values in time, 161
correlated/uncorrelated simple discrete-time oscillations of selected shares values in time, 160
discrete time digital economic cycle theory in economics (publications), 216
discrete-time digital economic output wave(s), 164, 165
discrete-time digital waves of GDP(t)/GNP(t)/GIP(t)/PPP(t), 163
discrete-time investment assets values oscillations theory, 151, 160
distribution of number of excited firms’ business processes of certain value at selected level (state) in economy of scale and scope, 52
economic cycle(s), 18
investment assets theorem, 166
investment portfolio stability theory/theorem, 151, 169
mixed parallel-sequential complex multivector strategy, 180
multidimensional strategy space with XY / XYZ coordinates, 177, 178, 179
origins of underpricing and long term underperformance effects theory, 55
parallel complex multivector strategy, 179
quantum diffusion money theory, 29, 30
quantum econophysical wave equation, 71
quantum (probabilistic) logic, 183, 184
quantum money (q-money), 16
quantum random number generator on magnetic flux qubits, 17, 204
quantum theory on dual nature of money, 14
quantum thinking process algorithm (LQTP), 184
quantum winning virtuous strategy search algorithm (LQWVSS), 185
sequential complex multivector strategy, 179
strategy vector, 177, 178
Logic(s), 183, 184
Inductive, 183
Deductive, 183
Abductive, 184
Ledenyov Quantum (Probabilistic), 184
Lyapunov, 169
exponent, 169
stability criteria, 169

Marconi seminar, 17
Markowitz’s efficient frontier (MEF), 149
Massachusetts Institute of Technology, 98
Matlab, 170
Mean(s) of value payments, 10, 13
bit coins, 13
electronic money, 13
metal coins, 13
network money, 13
paper checks, 13
paper currencies, 13
payment orders, 13
Medium (investment), 10, 116 - 146
Medium of exchange, 10, 116 - 146
Metal(s), 142
precious, 142
noble, 142
Modeling, 169, 170
Modern portfolio theory (MPT), 148
Money, 10, 11, 13
design, 11
design evolution, 11
bit coins, 13
electronic money, 13
metal coins, 13
network money, 13
paper checks, 13
paper currencies, 13
payment orders, 13
sorts of, 10
types of, 10
Multi-fractals, 27, 28
theory, 27, 28
Mutual fund theorem, 152

New wealth, 9
creation, 9
synthesis, 9
Nonlinear diffusion-type financial system, 89, 98, 192
Nonlinearities, 98

Object oriented software program(s), 15
Optimization algorithm(s), 90
probabilistic global search Lausanne (PGSL), 90
multilevel coordinate search (MCS), 90
Matlab direct search, 90
Matlab simulated annealing, 90
Matlab genetic, 90
Options, 62, 63, 64, 65, 66, 127
stock options, 62
employee’s / executive’s compensation
stock options, 62
equity options, 63, 66

Paretian hypothesis, 150
Particle filter, 85
Planck quantum theory of light, 16
Policies by central bank, 12
financial stability policy, 12
monetary stability policy, 12
Political economy science, 9
Precious metals, 142
exchange, 142
Precious metals exchanges, 143
Chicago Board of Trade (CBOT), 143
Commodity Exchange (COMEX), 143
London Metal Exchange (LME), 143
New York Mercantile Exchange (NYMEX), 143
Private investment office, 114, 115
Probability theory, 23
Product(s) (investment), 40 - 80

Quantitative easing policies in finances, 19
Quantum winning virtuous investment strategies search algorithm, 173, 186, 187
as dial in Swiss watch, 186
block scheme, 187
Quantum, 16, 17, 173, 184
data communication protocol(s), 16
diffusion of money, 29, 30
logic, 184
money, 16
processor(s), 16
random number generator(s), 16
theory of firm, 51
thinking process algorithm, 184
winning virtuous investment strategies algorithm, 173
wireless/wireline/optical/space communication networks, 16

Real estate, 118
exchange, 118
private homes, 118
business shops, 118
business centers, 118
trade markets, 118
public buildings, 118
cathedrals, 118
Real-time operation system(s), 15
Return on investment, 8
Return premium on investment, 8
Risk(s), 155
macroeconomic, 155
microeconomic, 155

SBIR program, 99
Schrödinger wave function, 29, 30
Science(s), 23, 24
computer, 33
econometrics, 23, 24, 33
economics, 33
econophysics, 23, 24, 33
finance, 33
mathematics, 33
physics, 33
psychology, 33

Shares, 50
Shared value principle(s), 186
Sharpe, 152, 153
asset class factor model, 153
ratio, 152
Signals by oscillating financial variables, 27
continuous time, 27
discrete-time, 27
Silicon Valley, 100
Socially responsible investment (SRI), 185
Software program(s), 15, 191
Solution of, 35
problem on financial capital investment, 35
Spread spectrum signal, 163
Stability (of), 169
investment portfolio, 169
Lyapunov criteria, 169
Standard deviation of return, 169
Startup investment stages, 104, 105
Beta, 104
Development, 104
Profitable, 105
Restart, 105
Shipping, 104
Start-up, 104
Stock exchange(s), 119
Amsterdam Stock Exchange, 119
Brussels Stock Exchange (BSE), 121
London Stock Exchange (LSE), 120
New York Stock Exchange (NYSE), 120
Paris Stock Exchange (PSE), 120
Tokyo Stock Exchange (TSE), 121
Stratonovich, 602
optimal nonlinear filtering theory, 85, 86, 602
Stratonovich-Kalman-Bucy, 71, 85, 86, 602
algorithm, 71, 85, 86, 602
filter, 71, 85, 86, 602
Strategy, 91, 173 – 191
dynamic leveraging trading, 91
quantum winning virtuous investment, 173 – 191
Swiss mechanical watch, 186
Synchronous optical network (SONET), 15
System, 11
financial, 11
monetary, 11
Tangency investment portfolio, 152
Theorem, 152
investment assets, 166
investment portfolio stability, 169
mutual fund, 152
Theory of, 9, 14, 50, 104, 147, 173
capital, 9
corporate finance, 104
credit modeling, 154
discrete-time events scaling, 27
digital signals processing, 166
dual nature of money (quantum), 14
economic capital, 154
firm, 50, 51
game, 181
investment(s), 147
modern portfolio, 148
multi-fractals, 28
origins of underpricing and long term underperformance effects, 55
quantum winning virtuous investment strategies search, 173
risk calculation, 147
Time period(s), 8
long, 8
short, 8
Tobin's mutual fund theorem, 150
Transistors made of, 15
Gallium Arsenide (GaAr), 15
Germanium Nitride (GeN), 15
Silicon Carbide (SiC), 15
Treibnor ratio, 152
Underpricing of initial public offering of company equity, 55
Unicorn, 98
Universal mobile telecommunication system (UMTS), 15
Value payments exchange process, 10
Valuable financial papers price(s), 28
Vehicles (investment), 81 - 115
Venture capital (VC), 98 - 110
firm(s), 98
fund(s), 98 - 110
investment(s) in Africa, 102
investment(s) in Asia, 101 - 102
investment(s) in Canada, 100 - 101
investment(s) in Europe, 101
investment(s) in the USA, 98 - 100
investment process scheme, 106
Venture Capital financing stages, 104
Seed financing, 104
Start-up financing, 104
Expansion financing, 104
Venture capital organization structure, 102, 103
General Partners (GPs), 102
Limited Partners (LPs), 102
Startup company, 103
Venture capital, 103
Venture capital firm, 103
Venture capital fund, 103
Venture capital industry, 103
Venture capitalist, 103
Very large scale integrated (VLSI) circuits, 15
Volatile nature of capital markets, 20

Wealth, 9
  creation, 9
  management, 9, 98
  new, 9
  synthesis, 9
Weighted average cost of capital (WACC) model, 154
Wideband code division multiple access (WCDMA), 15
Wiener filtering theory, 602
Authors Index

Abdulai, 42, 117, 118
Abel, 46, 140
Aberman, 100, 110
Abers, 183
Abhyankar, 75, 132
Abid, 68, 138, 139
Abken, 64
Aboody, 64
Abor, 83
Abrahamsson, 111
Abrams, 75, 132
Abreu, 76, 133, 172
Acconcia, 56, 62, 127
Acemoglu, 77, 134
Acharya, 48, 68, 138, 142, 168, 172
Achouch, 47, 140, 143, 144
Ackermann, 93
Adair, 44, 119
Adam, 69, 95, 139
Adams, 47, 48, 98, 141, 142
Adebiyi, 77, 134
Adelman, 78, 145
Adelstein, 79, 145
Adesoye, 54, 62, 127
Adkins, 95
Adler, 71, 129
Adlington, 44, 119
Admati, 72, 108, 130
Adrangi, 46, 47, 141, 144
Adrian, 77, 93
Aernoudt, 109, 113
Affleck-Graves, 55, 56, 57, 58, 123
Agbeyegbe, 143
Aggarwal, 54, 55, 58, 67, 93, 94, 98, 114, 123, 143
Aghion, 108, 110
Agrawal, 137
Aguirar, 76, 133
Agyei-Ampomah, 144
Ahmed, 96, 97
Ahya, 79, 146
Aitken, 76, 134
Aizenman, 110
Akalbua, 42, 117
Akaike, 85
Akerlof, 57, 66, 71, 107, 122, 128, 136, 188
Akgiray, 143
Akhiezer, 183

Akrum, 76, 77, 133, 134
Akutsu, 25
Albanese, 67, 137
Alberola, 75, 132
Albrecht, 68, 138
Alchian, 181, 182
Aldatmaz, 64
Alderson, 50
Aldrich, 94
Alexander, 46, 64, 68, 77, 79, 93, 134, 139, 140, 145, 151, 152, 154, 169, 171, 175
Alfonsi, 68, 138
Alfonso, 167, 172
Al-Hassan, 144
Aliber, 71, 75, 76, 128, 133
All, 144
Allayannis, 76, 133
Allen, 55, 58, 67, 68, 71, 72, 73, 109, 122, 128, 129, 130, 137, 138
Allerdice, 97
Allison, 183
Almeida, 60, 124
Almekinders, 74, 131
Alqatawni, 102, 111
Alquist, 48, 141
Al-Sharkas, 93
Al-Shubiri, 63, 64
Alvi, 61, 126
Altman, 49, 66, 136
Altuntas, 114
Alvarez, 12, 56, 126
Alves, 97
Amati, 114
Amato, 67, 137
Amatucci, 113, 114
Ambarish, 49
Ambrose, 43, 119
Amenc, 93
Amerise, 91, 94
Ametrano, 69, 139
Amihud, 54, 58, 67, 71, 122, 128, 137
Amin, 93
Amis, 113
Amir, 107, 108, 109
Ammer, 68, 73, 131, 138
An, 54, 62, 64, 126
Anand, 61, 83, 126, 174, 185, 188, 189, 190
Ancel, 43, 119

666
Andersen, 72, 79, 129, 146
Anderson, 11, 44, 76, 86, 96, 97, 119, 133
Andreasen, 86
Andreev, 29
Andreossi-O'Callaghan, 144
Andrew, 74, 131
Andrews, 42, 117, 174
Ang, 64, 94, 95
Angelini, 67, 137
Anghelache, 48, 50, 142
Anikin, 72, 79
Ansoff, 175
Anson, 79, 93, 146
Ansotegui, 59, 124
Anton, 108
Antonakakis, 144
Anthony, 75, 132
Antolin, 95
Anton, 108
Antonelli, 110
Antweiler, 109
Anwar, 76, 134
Anzuini, 48, 141
Aoki, 79, 145, 146
Aoyama, 18, 19, 25
Apergis, 144
Appelhoff, 111
Arai, 79
Arbatli, 48, 142
Arbulu, 120
Arcas, 59, 124
Archer, 49
Archibald, 59, 124
Arditti, 97
Arenius, 113
Arezki, 42, 117, 118
Arikawa, 56, 62, 102
Arkebauer, 59, 124
Arikawa, 111, 126
Arjalies, 186
Armada, 97
Arnold, 62, 64, 126
Arnold, 25, 57
Arnsdorf, 69, 139
Arora, 185
Arosio, 56, 60, 124
Aroui, 144
Arping, 67, 137
Arrow, 71, 78, 128, 145, 181, 182
Arugaslan, 56, 61, 126
Arulampalam, 86
Arvantis, 67, 137
Asabere, 43, 118
Asako, 42, 117
Asbell, 80, 146
Ashcraft, 68, 138
Ashford, 79, 145
Ashish, 114
Ashta, 114
Asness, 93
Asquith, 49, 56, 59, 124
Astakhov, 169
Atanda, 54, 62, 127
Ates, 77, 134
Athans, 86
Atienza, 114
Atkins, 183
Attié, 48, 141
Au, 114
Aubry, 95
Audretsch, 98, 109
Auer, 144
Aulerich, 48, 141, 142
Aumann, 181, 182
Aunon-Nerin, 67, 137
Ausloos, 28, 75, 133
Ausseme, 54, 56, 57, 59, 60, 123, 124, 126
Ausubel, 59, 124
Auto, 113
Avdeitchikova, 114
Avino, 69, 139
Avnimelech, 110
Avramov, 89
Aye, 144
Aziz, 75, 132
Azman-Saini, 93
Baba, 68, 77, 93, 135, 138
Babbage, 50
Babbel, 49
Babbs, 86
Babenko, 63, 64
Bacchetta, 76, 77, 133, 134, 135, 188
Bachelier, 18, 23, 24, 171
Bachmeier, 47, 141
Bachurinskaya, 44, 119
Back, 58, 123
Backus, 71, 129
Beine, 76, 133
Beinhocker, 148
Beitel, 68, 138
Bekaert, 73, 130
Bellhouse, 181, 183
Bellman, 85
Ben David, 181, 183
Benedikt, 78, 79, 146
Bengtsson, 110
Benhabib, 46, 140
Benjamin, 113
Benninga, 61, 126
Benson, 111
Benston, 57, 122
Bentham, 9
Bently, 78, 80, 146
Benveniste, 58, 60, 83, 108, 122, 125
Benyamini, 79, 146
Berestetsky, 183
Berg, 61, 126
Bergemann, 108, 109, 110
Berger, 66, 77, 108, 134, 136
Berglöf, 108
Bergman, 64
Bergsten, 76, 133
Bergstresser, 95, 97
Berk, 11, 97, 98, 110
Berkeley, 62, 126
Berkman, 60, 124
Berle, 50
Berlin, 66, 136
Bernardo, 60, 125
Bennanke, 12, 25, 46, 140, 156
Bernheim, 58, 95, 122
Bernile, 110
Berry, 44, 74, 119, 131
Bers, 44, 119
Bertin, 96
Bertola, 73, 130
Bertoni, 102
Bertram, 25, 85, 169
Bertin, 97
Bertzins, 83
Besanko, 175, 185, 188, 189, 190
Besen, 79, 145, 146
Besley, 95
Bessembinder, 46, 50, 74, 131, 140
Bessler, 47, 141
Bessy, 79, 146
Betker, 50
Bhansali, 77, 134
Bhanumurthy, 76, 134
Bharat, 109
Bhardwaj, 47, 141
Bhatia, 113
Bhattacharya, 73, 74, 130, 132
Bhidé, 108
Bhojraj, 98
Biais, 60, 73, 125, 130
Bianchetti, 69, 139
Bicchieri, 181, 182
Bielecki, 67, 68, 137, 138
Bienz, 111
Bierman, 50, 63, 181, 183
Bierwag, 49
Bigman, 71, 129
Bignasca, 86
Bildirici, 144
Billio, 94
Bilson, 71, 72, 129
Binay, 61, 125
Bing Han, 64
Binmore, 60, 124
Bin Yu, 98
Birley, 108
Bishop, 56, 60, 86, 125
Bittelmeyer, 79, 146
Bizjak, 64
Bjønnes, 75, 132, 188, 189, 190
Black, 49, 51, 59, 63, 66, 67, 71, 73, 95, 102, 108, 124, 128, 130, 136, 171
Blackett, 181
Blair, 78, 79, 146
Blake, 95, 97
Blakeney, 79, 146
Blanchard, 46, 47, 48, 71, 128, 140, 141
Blanco, 67, 68, 137, 138
Blank, 46, 140
Blazenko, 44, 66, 119, 136
Bleaney, 46, 140
Blennerhasset, 75, 132
Bliss, 64, 89, 109, 171
Block, 100, 102, 108, 110
Blokhintsev, 183
Blomeyer, 64
Blondell, 57, 60, 125
Bloomfield, 79, 145
Blum, 85
Blume, 49, 71, 89, 128
Blundell-Wignall, 83
Bochco, 42, 118
Bode, 85
Bulow, 83
Brockwell, 86
Broll, 67, 137
Brooks, 47, 62, 93, 127, 114, 141, 144
Brophy, 94, 108
Brorsen, 46, 47, 140
Broto, 86
Broughman, 110
Brounen, 44, 60, 119, 125
Brusseau, 74, 79, 131, 146
Brown, 47, 57, 59, 63, 68, 76, 79, 86, 90, 92, 93, 95, 86, 97, 122, 124, 133, 134, 141, 145
Broye, 60, 125
Broz, 77, 134
Bru, 23
Bruder, 94
Brueggeman, 43, 44, 46, 118, 119, 140
Brunetti, 47, 141, 143
Brunner, 71, 73, 128, 131
Brunnermeier, 76, 77, 93, 133, 134, 135, 172
Bruno, 106, 107, 108
Brush, 23
Bruton, 108, 113
Bryant, 47, 141
Bryer, 80
Bryson, 67, 85, 137
Bubák, 77, 135
Buchanan, 80, 146
Buckland, 57, 122
Bucy, 25, 85
Buddhavarapu Sailesh Ramamurtie, 64
Budhiraja, 86
Bulow, 60, 64, 95, 125
Bunde, 76
Burdett, 72, 129
Borghof, 57, 61, 67, 137
Burjack, 144
Burns, 43
Burnside, 77, 134
Bunde, 28, 133, 169
Bunyakovsky, 23
Buraschi, 69, 139
Borghof, 125
Burke, 143
Burnham, 73, 130
Burns, 25, 118, 167, 172
Burnside, 77, 134
Burrell, 49, 78, 80, 146
Burrowes, 61, 126
Burstein, 76, 133
Burtschell, 68, 138
Busaba, 58, 60, 122, 125
Busha, 42, 118
Bushnell, 47, 140
Busse, 97
Butler, 42, 61, 117, 126
Butlin, 11
Büyükşahin, 47, 141
Bygrave, 108, 109
Byström, 68, 138
Caballero, 47, 141
Cable, 109
Caetano, 62, 127
Caglar, 69, 139
Caglayan, 93
Caglio, 62, 127
Caines, 86
Cairns, 95
Cajueiro, 77, 134
Cakici, 64
Calanog, 110
Calice, 69, 139
Callier, 71, 128
Callmann, 78, 145
Calomiris, 64, 110
Calvo-Gonzalez, 48, 141
Câmara, 64
Cameron, 18, 175
Camerer, 181, 183
Campa, 77, 134
Campbell, 18, 47, 49, 50, 63, 64, 73, 74, 89, 110, 130, 132, 141, 171, 172, 175, 185
Campolieti, 67, 137
Cangiano, 95
Canlin Li, 64
Canova, 72, 129
Canterbery, 49
Cantner, 111
Canto, 77, 134
Cao, 64, 74, 77, 94, 132, 134
Capie, 11, 144
Capocci, 93, 151
Caporin, 144
Capozza, 42, 117
Cappé, 86
Cappiello, 167, 172
Căpușan, 28, 78, 135
Caramazza, 75, 132
Cottarelli, 95
Cotter, 54, 58, 123, 146
Cottier, 78, 79, 80, 146
Cotula, 42, 117
Coudert, 69, 139
Coughenour, 46, 140
Courakis, 73, 130
Cournot, 181, 182
Courtault, 23
Courtney, 69, 139
Courtois, 120
Cousseran, 68, 138
Coval, 64, 76, 133
Coveney, 113
Covin, 60, 125
Covrig, 75, 76, 132, 133, 188
Cowen, 97
Cowles, 171
Cowling, 57, 61, 95, 111, 125
Cox, 46, 49, 51, 63, 66, 71, 128, 136, 140, 185
Craddock, 67, 137
Craig, 64
Cramton, 59, 124
Crawford, 10, 11
Creal, 86
Cremer, 47, 141
Cremers, 68, 93, 98, 138
Crépel, 23
Crepey, 68, 138
Creti, 48, 142
Crew, 51
Crick, 31
Crifo, 186
Cristescu, 77, 134
Crockett, 77, 135
Cronon, 136
Croushore, 76, 133
Crowson, 143
Cséna, 69, 139
Cu, 111
Cubeddu, 95
Cuche, 86
Cuddington, 144
Cule, 95
Cullen, 143
Cumming, 62, 67, 100, 101, 110, 127, 137, 185
Cunat, 44, 119
Cuny, 64
Curcio, 43, 72, 73, 119, 130
Curley, 57, 122
Curto, 69, 139
Cuthbertson, 97
Cvijanovic, 44, 119
Cyr, 51
Czarnecki, 74, 131
Dacorogna, 70, 73, 74, 76, 130, 131, 133
Daems, 174
Dahl, 74, 131
Dahlgren, 64
Dahliquist, 95
Dahm, 31
Daily, 60, 125
Daines, 60, 125
Dalton, 60, 125
Dan, 79, 145
Damodaran, 54, 62, 126
Daniel, 59, 97, 124
Danielsen, 60, 125
Danielsson, 76, 93, 133
Danker, 74, 131
D'Arcy, 44, 119
Da Rin, 102, 105, 106, 109, 110
Dark, 57, 58, 60, 82, 122, 125
Darlington, 85
Darné, 144
Darvas, 86
Das, 62, 96, 111, 126, 129, 136
Da Silveira, 63, 64
Daskalakis, 48, 142
Datar, 62, 127
Datta, 54, 59, 123
Dave, 70, 73, 130
Davenport, 85
David, 79, 145
Davidson, 18, 110, 111, 185
Davies, 10, 11
Davila, 109
Davis, 23, 67, 79, 85, 86, 89, 95, 109, 121, 137, 145, 171, 174
Davydenko, 68, 138
Dawid, 110
Dawson, 64
De Alba, 86
Dean, 108
Deardorff, 71, 79, 128, 145
Deaton, 46, 140
Deb, 62, 94, 127
De Bettignies, 109, 110
D'Mello, 60, 124
Dobrikat, 59, 123
Dobronogov, 95
Doctor, 69, 139
Dodd, 10, 11, 18, 137
Dodge, 74, 131
Doeswijk, 61, 125
Dolado, 18, 185
Dollinger, 114
Dolvin, 61, 126
Domanski, 47, 141
Domeneh, 42, 118
Domínguez, 72, 73, 76, 129, 131, 133
Domowitz, 72, 73, 74, 129, 130, 132
Donohue, 73, 130
Doob, 85
Dooley, 71, 72, 128, 129, 130
Doran, 62, 86, 126
Dornbusch, 71, 128
Dossani, 109
Dos Santos, 62, 127
Dötz, 68, 138
Douc, 86
Doucet, 86
Dougall, 49
Doukas, 76, 133
Doyne, 76, 133
Dragon Yongjun Tang, 97
Draho, 60, 124
Drake, 55, 58, 123
Dramani, 86
Dranove, 175, 185, 188, 189, 190
Draper, 95, 144
Dreher, 77, 134
Dreherdo, 56, 62, 126
Drehmann, 25
Dreier, 78, 80, 146
Drejer, 175, 185, 188, 189, 190
Drellichman, 144
Dretske, 57, 122
Driessen, 98
Drobetz, 57, 61, 126
Droms, 97
Drucker, 68, 138
Drut, 50
Drzik, 67, 137
D’Souza, 76, 133
Du, 48, 109, 141
Duarte, 76, 133
DuCharme, 56, 60, 77, 125, 134
Dudzinski, 109
Dukeker, 64, 77, 134
Duffee, 66
Duffie, 47, 66, 67, 136, 137, 140
Duffner, 110
Dufty, 79, 146
Dukas, 74, 131
Dukes, 98
Dumas, 71, 74, 129, 131
Dunbar, 57, 60, 61, 124, 125
Dunne, 67, 76, 78, 134, 135, 137
Dupriez, 25
Duque, 60, 124
Durbin, 18, 86, 185
Dürckáková, 78, 135
Durnev, 61, 126
Dürr, 68, 138
Durré, 77, 134
Dusak, 46, 140
Dushnitsky, 110, 111
Dussollier, 78, 80, 146
Du Toit, 171
Dutta, 181, 183
Duxbury, 113
Duysters, 111
Dwight, 83
Dworkin, 79, 146
Dwyer, 48, 74, 113, 131, 142
Dyson, 95

Eagleeye, 47, 141
Easley, 59, 63, 64, 74, 123, 131, 167, 172, 188
Easterbrook, 79, 145
Easton, 60, 125
Eaton, 42, 95, 117
Eberhart, 64
Eberle, 171
Eberly, 46, 140
Ebrahim, 75, 133
Ebrahimijam, 86
Echevarría, 117
Eckardt, 97, 110
Eckbo, 57, 60, 124
Echevarría, 42
Economic Sciences Prize Committee of
Royal Swedish Academy of Sciences, 152, 153
Eddelbuttel, 75, 132
Edelen, 76, 133, 188
Edelstein, 44, 119
Ederington, 47, 49, 73, 74, 131, 141
Edgeworth, 181, 182
Edin, 73, 131
Edison, 73, 75, 130, 132
Edmans, 83
Edwards, 46, 50, 66, 67, 71, 73, 93, 129, 130, 136, 138, 140
Egan, 109
Egstrup, 77, 134
Ehrhardt, 57, 59, 60, 123, 124
Ehrlich, 114
Eichenbaum, 77, 134
Eichengreen, 72, 75, 77, 93, 130, 133, 134
Eichholtz, 60, 125
Einstein, 23, 183
Eisberg, 183
Eisele, 98
Eisenhardt, 110
Eisinger, 108
Eisele, 109
Elango, 108
El-Bachir, 68, 138
El Bied, 93
Elder, 43, 48, 119, 141, 144
Eling, 93
Elizalde, 69, 139
Eller, 67, 138
Elliott, 50
Ellis, 18, 60, 69, 71, 124, 127, 128
Ellison, 97, 108
Ellul, 56, 61, 62, 110, 125, 126
El-Shagi, 77, 134
Elston, 56, 62, 101, 111, 127
Elton, 67, 97, 137
Elvin, 42, 117
Elyasiani, 73, 130
Embrechts, 67, 74, 132, 137
Emerson, 12
Emm, 62, 127
Emmrich, 144
Enge, 86
Engel, 71, 72, 101, 109, 110, 129
Engelberts, 44, 119
Engle, 64, 72, 86, 129, 150, 151, 166, 167, 168, 171, 172
English, 98
Ennew, 108
Ennis, 93
Epley, 43, 118
Erb, 47, 141
Erdal, 58, 122
Ericsson, 67, 138
Erikson, 111
Erkan, 83
Ernst, 110
Ervin, 42, 117
Escribano, 77, 134, 144, 188
Estapé-Dubreuil, 114
Estey, 43, 118
Etheridge, 23
Etingson, 64
Etula, 48, 77, 135, 141
EBAN (European Business Angel Network), 113
European Central Bank, 16
Evans, 72, 74, 94, 95, 98, 129, 132, 134, 175, 188
Evenson, 79, 145
Everts, 109
Everts, 74, 131
Ewing, 144
Exley, 95
Eychenne, 94
Fabozzi, 47, 50, 65, 67, 68, 95, 97, 137, 138, 141
Fabregat, 59, 124
Fabrizio, 60, 124
Factor, 144
Faff, 93, 143, 144, 145
Fage, 67, 137
Fakton, 42, 117
Falconer, 86
Falk, 108
Falkenbach, 44, 119
Fall, 118
Fallick, 110
Fama, 11, 46, 51, 57, 66, 71, 89, 97, 122, 128, 136, 140, 143, 150, 151, 153, 171
Fan, 72, 129
Farhi, 47, 141
Farhmeir, 86
Farina, 62, 126, 188
Farquharson, 181
Farragher, 43, 119
Farrar, 97
Farrell, 44, 79, 113, 145
Farstrup, 77, 134
Faruqee, 74, 75, 131, 132
Fatemi, 74, 131
Fathi, 68, 138
Fattouh, 48, 142
Freeman, 113
Freihube, 75, 132
Freixas, 49, 67, 137
French, 46, 57, 64, 71, 72, 89, 122, 128, 129, 140, 143, 151, 153, 171, 188
Freudenberg, 109
Frey, 80, 146, 166
Fried, 107, 108, 110
Frieden, 77, 134
Friedlan, 58, 123
Friedman, 11, 18, 43, 71, 85, 95, 118, 128
Fries, 69, 139
Frino, 74, 76, 131, 134
Frömmel, 75, 132
Froot, 66, 71, 73, 128, Froot, 130, 136
Frost, 66, 136
Frühwirth-Schnatter, 86
Fudenberg, 79, 145, 181, 182, 183
Fuertes, 48, 141
Fuji, 69, 139
Fujiwara, 18, 19, 25, 75, 133
 Fukuda, 78, 135
Fulgieri, 58, 82, 110, 123
Fuller, 86
Fulop, 68, 138
Fung, 54, 59, 76, 77, 87, 90, 91, 93, 124, 134, 135, 153
Fusaro, 47, 141
Füss, 47, 94, 141

Gabor, 15
Gagnon, 74, 77, 131, 134
Gajewski, 54, 56, 57, 62, 126
Galai, 71, 129, 188
Galati, 76, 133
Galbraith, 11, 18, 185
Gale, 67, 137
Galeano, 93
Galev, 83, 109
Gali, 47, 48, 141
Galiani, 67, 137
Gallardo, 67
Galindo, 183
Gallacher, 98
Gallais-Hamonno, 120
Gallardo, 77, 135
Gallese, 107
Galli, 71, 85, 86, 128
Gallini, 79, 145, 146
Gallo, 72, 129, 167, 168, 172
Gamerman, 86
Gamow, 31

Gande, 59, 123
Gandolfo, 169
Gangjee, 78, 80, 146
Gangopadhyay, 185
Ganor, 61, 126
Gans, 109
Gao, 56, 57, 60, 61, 125, 126
Gaon, 93
Gapeev, 171
Garbade, 46, 140
Garbaravičius, 93
Garber, 73, 131
Garcia, 48, 67, 94, 138, 141, 142
Gardner, 48, 142, 167, 171
Garfinkel, 75, 132
Gargiulo, 109
Gârleanu, 64, 66, 137
Garman, 71, 128, 129
Garner, 72, 129
Garon, 95
Gasmi, 47, 48, 141, 142
Gaspar, 97
Gateche, 61, 126
Gatto, 97
Gau, 43, 118
Gauder, 44, 119
Gauvin, 67, 137
Gavetti, 175, 185, 188, 189, 190
Gavin, 48, 141
Gawlik, 109
Gawron, 93
Gay, 98
Gazdar, 111
Ge, 110
Gebhardt, 110
Gebreselasie, 76, 134
Géczy, 56, 59, 67, 123, 137
Geeen, 46, 140
Géhin, 93
Gehrig, 75, 132
Geithner, 68, 138
Geltner, 43, 118
Geman, 93
Genberg, 76, 77, 134
Gendron, 98
Gençay, 76, 77, 133, 135
Georg, 73, 130
George, 25, 42, 64, 75, 80, 111, 132, 146
Georges, 120
Gerke, 57, 60, 109, 125
Gerlach, 72, 77, 129, 134
Grasso, 50
Graversen, 171
Graves, 185
Gray, 79, 94, 114, 146
Grebler, 43, 118
Grebioli, 169
Greco, 95
Green, 50, 64, 97, 110, 114, 181, 183
Greenaway, 47, 140
Greene, 18, 185
Greening, 185
Greenspan, 68, 75, 133, 138
Greenwald, 107
Greer, 47, 140, 141
Gregg, 59, 123
Gregoriou, 93
Gregory, 67, 68, 69, 121, 137, 138, 139
Gregson, 114
Grepperud, 42, 117
Gresse, 54, 56, 57, 62, 126
Gressis, 97
Grigelionis, 171
Griffin, 76, 133
Griffith, 61, 126
Griffiths, 18, 43, 56, 73, 78, 80, 86, 119, 146, 183, 185
Grill, 67, 137
Grilli, 110
Grimaldi, 73, 130
Grimble, 86
Grimes, 48, 73, 131, 142
Grinblatt, 58, 97, 98, 122
Grindley, 79
Grisom, 43, 118
Groh, 44, 111, 119
Grohs, 101, 109
Gross, 85
Grossman, 71, 74, 79, 128, 131, 145, 146, 188
Grover, 44, 119
Gruben, 79, 146
Gruber, 48, 67, 97, 137, 142
Gruber J, 68, 138
Gruber W, 68, 138
Grullon, 61, 83, 126
Grünbichler, 74, 131
Grundke, 67, 137
Grundy, 64
Gruss, 48, 142
G20 Study Group on Commodities, 48, 142
Guay, 64
Guelllec, 80, 146
Guembel, 76, 133
Gueyie, 93
Guillaume, 71, 73, 130
Gulamhussen, 83
Gulati, 61, 109, 125
Gulde, 75, 132
Gulko, 93
Gunay, 62, 126
Güntay, 50
Gunther, 114
Guo, 60, 62, 125, 126, 127
Gupta, 93, 94, 108, 109, 144
Gurdgiev, 144
Guthner, 108
Guzhvin, 42, 117
Gvazdaitytė, 102, 111
Gyger, 93
Gyourko, 43, 46, 118, 140
Haas, 62, 67, 74, 93, 127, 131, 137
Haberman, 95, 109
Habib, 56, 60, 125
Ha-Chin Yi, 60, 125
Hacihasanoglu, 144
Hacioglu, 83
Hackbarth, 50
Hadass, 56, 62, 126
Hahm, 76, 134
Hahn, 56, 60, 61, 125, 126
Haigh, 47, 141
Haight, 43, 118
Hailu, 48, 141
Haines, 113
Hakamada, 93
Hakkio, 72, 129
Hale, 62, 126
Haleh, 86
Hall, 63, 64, 72, 76, 79, 108, 110, 111, 114, 115, 128, 130, 133, 146
Hall H, 77, 134
Hall L, 77, 134
Halliday, 183
Halloch, 64
Halperin, 69, 139
Halttunen, 71, 128
Hamao, 57, 109, 122
Hambrick, 61, 126, 174, 188
Hamilton, 18, 43, 47, 71, 118, 129, 140, 185
Hammoudeh, 143, 144
Hamon, 73, 130
Havrilesky, 74, 131
Hay, 79, 109, 113, 145
Hayashi, 18, 47, 141, 185
Hayek, 11, 18, 181, 182
Hayes, 48, 86, 141
Haykin, 86
Haynie, 111
Hayt, 75, 132
Hazama, 44, 119
Hazen, 59, 123
Hazlitt, 18
He, 48, 58, 75, 77, 123, 132, 134, 135, 141
Head, 95
Heald, 79, 145
Heaney, 60, 124
Heath, 47, 63, 64, 66, 77, 135, 136, 141
Heathcote, 42
Heaton, 60, 79, 89, 125, 145, 171
Hebner, 58, 97, 123
Heckinger, 135, 136, 139
Hedge Fund Working Group and Hedge Fund Standards Board, 94
Hedges, 93
Hédon, 114
Heerink, 42, 118
Hegde, 55, 58, 123
Hege, 108, 109, 110
Heidorn, 45, 47, 67, 93, 94, 137, 139, 141,
143, 144, 150
Heimer, 78, 135
Heinrich, 68, 138
Hekman, 43, 118
Helfat, 25
Heller, 69, 139
Hellmann, 102, 109, 110, 114
Hellwig, 66, 71, 128, 136, 188
Helmantel, 61, 126
Helpman, 75, 79, 132, 145
Helwege, 59, 124
Hemmes, 61, 125
Hemmings, 95
Hendershott, 43, 118
Henderson, 48, 71, 74, 128, 131, 142
Hendricks, 97, 181, 183
Hendry, 18, 167, 171, 172, 185
Henke, 67, 137
Henker, 96, 97
Hennings, 42, 117
Henrard, 68, 138
Henry, 44, 72, 119, 128, 130
Henschel, 67, 137
Han, 44, 109, 119
Hand, 110, 183
Hang Qian, 86
Haniotis, 48, 141
Hanka, 59, 124
Hanley, 55, 58, 123
Hanouna, 66, 136
Hansch, 74, 75, 131, 132
Hansen, 57, 60, 71, 73, 77, 89, 122, 125,
128, 129, 130, 134, 171, 181, 183
Hanson, 50
Han-Suck Song, 98
Hao, 61, 126
Harada, 74, 131
Hardin, 44, 119
Hardle, 18, 185
Hardouvelis, 72, 129, 130
Harikumar, 56, 61, 126
Haritchabale, 109
Harjoto, 186
Harlow, 90, 92
Harrigan, 174, 185, 188, 189, 190
Harrington, 181, 183
Harris, 47, 50, 61, 72, 73, 75, 108, 121, 126,
129, 131, 132, 141
Harrison, 95, 111, 113, 114
Harsanyi, 181, 182
Hart, 51, 72, 108, 121, 129, 175
Harte, 28
Hartmann, 75, 132
Hartzell, 43, 118
Hartzmark, 46, 140
Harvey, 47, 64, 73, 86, 130, 141
Hasan, 56, 60, 109, 125
Hasanbodzin, 94
Hasbrouck, 58, 66, 72, 122, 129, 136
Hasem, 75, 132
Hashimoto, 72, 129
Hashitsume, 169
Haslem, 97
Hassine, 94, 149, 151, 152, 172
Hatch, 64
Hatem, 143
Hattori, 66, 77, 135, 137
Hau, 72, 75, 76, 77, 78, 129, 132, 134, 135
Haubrich, 64
Hauser, 58, 122
Hautcoeur, 120, 121
Havlina, 86
Havlín, 28, 76, 133, 169
Havrilesky, 74, 131
Hsiu-Lang Chen, 97
Hsu, 62, 109, 110, 111, 127
Hsuan-Chi Chen, 98
Hu, 58, 123
Huang, 59, 67, 71, 73, 76, 123, 128, 130, 133, 137
Huault, 68, 138
Hubbard, 64
Huber, 93
Hübner, 69, 93, 139, 151
Huddart, 63, 64
Hudson, 28, 78, 80, 114, 146
Huff, 174
Hüfner, 75, 133
Hughes, 55, 58, 79, 123, 145
Hui, 56, 59, 76, 77, 124, 134
Huismann, 73, 130
Hui-Wen Koo, 42, 118
Hull, 63, 64, 66, 136, 148, 172, 185
Humpage, 72, 75, 76, 130, 132, 133
Humphreys, 48, 142, 144
Hung, 75, 132
Hung-Gay Fung, 50, 144
Hunter, 50
Hurdzeu, 48, 142
Hurt, 61, 78, 126, 145
Hurtt, 64
Hurwitz, 79, 145
Hussinger, 62, 127, 188
Husson, 58, 122
Hutchison, 76, 133
Hutt, 108
Hüttemann, 67, 137
Hutton, 57, 59, 123
Hyvaj, 114
Huyghebaert, 61, 125
Hwang, 58, 86, 122
Hyde, 109
Hyder, 66, 137
Hyfte, 108
Hyfte, 108
Hyland, 48, 142
Hytinen, 109

III, 43, 78, 79, 118, 119, 146
Iannucci, 42, 118
Ibarra-Ramirez, 50
Ibbotson, 43, 49, 57, 90, 92, 93, 94, 118, 121, 122
Iben, 49
Ibrahim, 113
Ideas at Work, 154

Idzorek, 94
Ielpo, 48, 142
Ikäheimo, 98
Ikeda, 18, 25
Ikenberry, 64
Illinski, 18, 19, 185
Imadédine, 56, 62, 102, 111, 127
Imbierowicz, 69, 139
Impavido, 95
In, 68, 138
Inada, 25, 68, 138
Inamura, 48, 142
Ince, 62, 127
Inci, 102, 111
Inderst, 95, 109, 110
Ineichen, 93
Ingersoll, 71, 74, 93, 129, 131
Inghelbrecht, 54, 125, 126
Ing-Haw Cheng, 48, 142
Inghelbrecht, 54, 60, 62
Inmoo Lee, 63
Inoue, 42, 77, 117, 134
Instefjord, 68, 138
Int-Veen, 67, 137
Investopedia, 63, 65
Ioannidis, 69, 139
Ireland, 175, 185, 188, 189, 190
Irvine, 97
Irwin, 47, 48, 140, 141, 142
Isaacs, 181, 183
Isaksson, 106, 108, 110
Isard, 71, 72, 74, 75, 129, 131, 132, 133
Ishida, 167, 172
Iskandar-Datta, 54, 59, 123
Issler, 144, 167, 172
Ito, 24, 72, 86, 129, 130, 167, 171, 172, 188
Ivanov, 111
Iversen, 73, 131
Ivkovic, 97
Iwasaki, 77, 135
Iwata, 42
Iyetomi, 18, 19, 25
Izzo, 93

Jackson, 49, 61, 126
Jackwerth, 93, 94
Jacob, 54, 62, 79, 127, 146
Jacobs, 64, 67, 109, 138
Jacobson, 11
Jacobsson, 109
Jacoby, 50
Jocod, 171
Jacquillat, 54, 57, 58, 73, 122, 130
Jaeger, 93, 94
Jaffee, 44, 57, 64, 66, 83, 98, 107, 119, 122, 136, 140, 143
Jagannathan, 46, 56, 62, 61, 89, 93, 126, 127, 140, 171
Jain, 58, 60, 61, 108, 109, 123, 124, 126, 144
Jakobsen, 57, 60, 125
James, 56, 59, 62, 66, 78, 97, 123, 126, 135, 136
Jang, 86
Jankowitz, 69, 139
Jankowitz, 108
Jans, 97
Jansen, 93
Janska, 50
Japan Institute of Intellectual Property, 79, 146
Jarnecic, 76, 134
Jarrow, 64, 66, 136, 154
Jasiak, 70, 74, 131
Jaskiewicz, 57, 61, 126
Javaheri, 85, 86
Jayanthi, 77, 134
Jayaraman, 72, 129
Jazwinski, 85
Jeanblanc, 68, 138
Jeanne, 75, 76, 133
Jean Yu, 62, 127
Jeffrey, 113, 181, 182
Jegadeesh, 58, 97, 111, 123, 172
Jelic, 61, 125
Jen, 97
Jeng, 109
Jenkins, 18, 185
Jenkinson, 59, 60, 124, 125
Jennings, 64
Jensen, 47, 51, 57, 89, 97, 107, 112, 113, 122, 140, 144, 152, 171, 181, 182
Jeon, 77, 134
Jerrett, 144
Jiang, 97, 126, 131, 134, 135
Jieming Zhu, 119
Jing Chi, 98
Jingjing Yang, 98
Jin-Li Hu, 97
Jin Zhang, 98
Jirnyi, 127
Jittrapanun, 114
Jo, 48, 111, 142, 186
Joachain, 183
Jobst, 67, 137
Joe, 67, 137
Joëts, 49, 142
Jog, 55, 58, 62, 123, 126
Johan, 100, 109, 185
Johanssen, 73, 130
Johnson, 12, 42, 44, 47, 55, 58, 64, 68, 95, 114, 119, 122, 138, 140, 144, 175, 185
Johnson Matthey Plc, 47, 141
Joûts, 48, 142
Jones, 56, 59, 60, 61, 72, 74, 102, 110, 124, 125, 126, 129, 131, 174, 185, 188, 189, 190
Joo-Ho Sung, 95
Jordan, 56, 60, 125
Jorde, 79, 145
Jorion, 64, 68, 73, 93, 130, 138, 172
Jortzik, 68, 138
Joseph, 85
Joseph Penso de la Vega, 9, 11, 18, 20, 31, 120
Josephson, 29
Joshi, 68, 76, 133, 138
Jossi, 113
Jot Yau, 50
Jourdon, 25
Jovanovic, 48, 110, 142
Joy, 97
JP Morgan, 166
Judd, 77, 79, 145
Judge, 18, 185
Jaffee, 46
Judd, 134
Juglar, 25, 162, 163
Julier, 86
Jumli, 181, 183
July, 119
Jungbacker, 86
Jun Han, 43, 119
Juselius, 68, 73, 130, 138
Juvenal, 48, 142
Kabanov, 23
Kabus, 110
Kacperczyk, 97
Kadanoff, 169
Kaeck, 69, 139
Kagan, 10, 11
Kahle, 57, 61, 125
Kahn, 59, 124
Khoylian, 108
Khursched, 54, 55, 56, 57, 59, 61, 62, 124, 125, 126
Kiefer, 59, 74, 123, 131, 188
Kieschnick, 56, 59, 61, 124, 126
Kiff, 67, 137
Kilian, 47, 48, 77, 134, 141
Killeen, 72, 75, 77, 129, 132, 134
Killian, 60, 125, 142
Kim, 25, 28, 43, 54, 55, 57, 58, 60, 61, 62, 67, 68, 73, 75, 76, 77, 97, 111, 118, 122, 123, 124, 125, 126, 130, 132, 133, 134, 138, 144
Kimata, 48, 142
Kimball, 181, 182
Kimmel, 78, 79, 146
Kimura, 48, 142
Kincaid, 75, 132
King, 11, 25, 76, 93, 133
Kini, 58, 60, 61, 108, 109, 123, 124, 126
Kirby, 75, 79, 132, 145
Kirchner, 48, 142
Kirilenko, 48, 75, 109, 132, 142
Kirsch, 113
Kirsh, 58, 113, 122
Kirzner, 98, 107
Kisling, 93
Kiss, 56, 61, 125
Kisselev, 76, 133
Kitasaka, 42
Kitchin, 25, 162, 163
Kite, 78, 79, 146
Kitsabunnarat, 61, 125
Kiyam, 56, 60, 124
Kiyotaki, 42, 73, 117, 131
Kizys, 144
Klaassen, 67, 137
Klausner, 60, 125
Kleidon, 74, 131
Kleiman, 43, 59, 118, 119, 124
Klein, 73, 130, 131
Kleinknecht, 25
Kleinow, 95
Klemkosky, 63, 97
Klemperer, 60, 79, 124, 125, 145
Klepper, 110
Kleshchelski, 77, 134
Klimontovich, 169
Kloosterman, 109
Klueppelberg, 74, 132
Knight, 66, 108, 136
Knockaert, 110
Knüpfer, 62, 98, 126
Knyphausen-Aufeß, 113
Kocagil, 47, 140
Kočenda, 77, 134, 135
Koch, 47, 140, 144
Kodres, 93
Koedijk, 73, 130
Koehler, 98
Koepcke, 25, 85
Kogan, 47, 141
Kogut, 59, 123
Koh, 54, 58, 122
Koh F C C, 109
Koh W T H, 109
Kohers, 60, 125
Kohlhagen, 71, 129
Kojiten, 50
Kolb, 46, 140
Kolmogorov, 169
Kolokolova, 94
Kolos, 48, 141
Koltsov, 31
Kon, 78, 97, 135
Kondratieff, 25, 162, 163
Kong, 97
Konikov, 68, 138
Konrad, 86
Kooli, 54, 57, 59, 61, 93, 123, 126
Kõõmägi, 106, 110
Koop, 185
Koopman, 18, 86, 185
Kopecky, 73, 130
Kopsch, 98
Korn, 64, 65
Korniotis, 48, 141
Korteweg, 111
Kortian, 76, 133
Kortum, 99, 102, 108
Koscielny-Bunde, 28, 76, 133
Koski, 109
Koskie, 60, 124
Kosowski, 93, 97
Kostakos, 48, 142
Kotha, 110
Kothari, 57, 58, 59, 64, 67, 97, 123, 137
Kotler, 185
Kotlikoff, 95
Kou, 69, 139
Kouri, 71, 128
Koutmos, 76, 133, 188
Lieser, 44, 119
Lifshits, 183
Light, 95
Ligon, 56, 60, 61, 125, 126
Ligterink, 74, 131
Lijun Bo, 69, 139
Lilien, 86, 167, 171
Liljeblom, 50
Lim, 44, 55, 57, 58, 77, 111, 119, 123, 134
Lin, 72, 74, 85, 109, 129, 131, 167, 171, 172
Linario, 50
Lindley, 77, 135
Lindsey, 15, 25, 32, 102, 109, 110, 160, 161
Lindskog, 67, 137
Ling, 98
Lingelbach, 102, 110, 114
Ling-Ni Boon, 48, 142
Linneman, 43, 46, 118, 140
Lins, 42, 117
Lintner, 151, 154, 171
Linton O, 93
Lin Wen-Ling, 72, 129
Lipson, 61, 74, 126, 131
Lipton, 69, 139
Litterman, 49, 75, 86, 89, 132, 171
Litvak, 110
Litvin, 86
Litzenberger, 47, 97, 140
Litzka, 114
Liu, 28, 43, 47, 48, 58, 69, 77, 78, 83, 111, 114, 118, 119, 123, 135, 139, 141
Livada, 110
Livdan, 47, 141
Livingston, 50, 97
Li Wang, 48, 142
Lixandru, 48, 142
Lizieri, 44, 119
Lizondo, 72, 130
Ljung, 86
Ljungqvist, 54, 56, 57, 59, 60, 83, 110, 122, 124, 125
Llewellyn, 79, 146
Llobet, 110
Lo, 18, 73, 74, 76, 77, 93, 94, 130, 132, 133, 134, 135, 185
Locho, 93
Lochstier, 48, 142
Locke, 74, 131
Lockett, 109
Lockwood, 97
Lode Li, 51
Löffler, 60, 124
Loeffl, 50
Logue, 54, 57, 61, 71, 122, 125, 128
Lombardi, 48, 141, 142
London Bullion Market Association (LBMA), 144
Long, 63
Longstaff, 47, 64, 66, 74, 131, 136, 141
Loo Lee Sim, 44, 119
Lopesko, 72, 129
Loosignian, 71, 129
Lopes, 86
Lopez, 67, 75, 132, 137
Lopez-de-Silanes, 54, 59, 123, 124
Loretan, 75, 132
Lorino, 175
Louche, 185
Loughran, 55, 57, 58, 60, 61, 108, 122, 123, 125
Louis, 86
Loury, 78, 145
Love, 43, 72, 75, 76, 118, 130, 133
Lovell, 46, 140
Lovenfeld, 121
Lowry, 54, 56, 59, 60, 125, 124
Lu, 28, 68, 78, 109, 110, 135, 138
Luati, 86
Lubig, 56, 57, 61, 126
Lucas, 58, 65, 67, 68, 98, 107, 122, 137, 138
Luce, 181, 182
Lucey, 68, 138, 143, 144
Lucena, 62, 127
Luchs, 175
Ludovici, 138
Luenberger, 115
Luft, 64
Ludovici, 68
Lui, 75, 118, 132
Lukas, 91, 93
Luke Chan, 143
Lummer, 47, 140
Lunde, 77, 134, 167, 172
Luo, 76, 133
Lusht, 43, 118
Lutkepol, 18, 185
Luukkonen, 102, 110
Luzi, 42, 118
Lyandres, 62, 110, 127
Lyapunov, 169
Lynch, 97
Lydenberg, 185
Lyndenburg, 185
Lyon, 57, 59, 60, 123, 124
Lyons, 72, 74, 77, 129, 132, 134, 188
Lyrio, 74, 132
Ma, 28, 46, 76, 77, 78, 133, 134, 135, 140
Maberly, 64
Mabro, 47, 140
Macarty, 113
Macaulay, 49
MacBeth, 63, 66, 89, 136, 171
MacDonald, 72, 74, 75, 129, 131, 132
Macey, 75, 133
MacFarlane, 43, 119
MacGarvie, 110
MacGregor, 44, 47, 119, 140
Machlup, 69, 71, 127, 128
MacIntosh, 95, 100, 109, 119
Mack, 97
Mackaay, 78, 145
MacKenzie, 67, 137, 144
MacKinlay, 18, 73, 74, 130, 132, 185
MacKinnon, 18, 185
MacMillan, 108
Macminn, 64
MacQueen, 79, 146
Macrae, 74, 131
Madan, 64, 68, 138
Maddison, 120
Madhavan, 72, 75, 130, 132
Madrigal, 74, 131
Maenhout, 98
Mager, 60, 125
Maghakian, 67, 138
Mahadeva, 48, 142
Mahanti, 68, 139
Mahapatra, 98
Mahieu, 73, 74, 130, 131
Mahoney, 97, 110
Mahtani, 67, 137
Maier, 71, 72, 93, 128, 129
Maillard, 94
Maizels, 46, 140
Majluf, 57, 122
Mak, 56, 60, 125
Makarov, 93
Mäkelä, 110
Maksimov, 44, 119
Maksimovic, 60, 125
Malackowski, 79, 146
Malakhov, 93
Malashchuk, 42, 118
Malhotra, 97
Malik, 144
Malkiel, 93, 97
Mallo, 76, 133
Malloy, 61, 97, 126
Malphrus, 12
Malvey, 59, 124
Mamaysky, 97
Manakyan, 44, 119
Manaster, 58, 122
Mancini, 78, 135, 167, 172
Mandava, 171
Mandelbrot, 27, 28, 148, 150, 171
Mandelker, 82
Mandel’shtam, 113
Manganelli, 166, 167, 172
Manhong Mannie Liu, 111, 114
Manigart, 56, 61, 108, 113, 125
Mankiw, 46, 140
Mann, 67, 110, 114, 137
Manne, 51
Manning, 68, 138
Mano, 51
Manolakis, 15, 25, 32, 86, 160, 161
Mansfield, 79, 145
Mansi, 98
Månsson, 113
Mansur, 144
Mantegna, 19, 70, 74, 131
Manzon, 64
Mao, 57, 60, 125
Mapa, 86
March, 51, 137, 138
Marchetti, 25
Marcucci, 167, 172
Marcus, 94, 95, 138
Marietta-Westberg, 62, 127
Marin, 95
Marinescu, 68, 138
Maringer, 98
Marion, 73, 130
Marisetty, 62, 127
Margrabe, 63
Margulis, 113
Mark, 72, 74, 129, 131
Markopoulos, 144
Markov, 23
Markova, 113
Markowitz, 148, 149, 150, 151, 171
Marks, 75, 133
Maurer, 77, 135, 188
Markus, 67
Marriott, 109
Marris, 51
Marsch, 67, 137
Marsh, 68, 73, 74, 77, 78, 131, 134, 135, 138
Marshall, 48, 50, 142
Marston, 59, 71, 75, 124, 129, 132
Martel, 100, 109
Martellini, 93
Martens, 44, 75, 119, 132
Martimort, 61, 125
Martin, 43, 64, 67, 68, 76, 93, 118, 133, 137, 138, 175, 185, 188, 189, 190
Martin Young, 98
Martinetti, 94
Martínez, 79, 146
Marx, 9, 10, 11, 75, 109, 133
Marzo, 78, 135
Mas-Colell, 64, 181, 183
Mashal, 67, 137
Maskell, 86
Maskin, 58, 122
Maskus, 79, 146
Mason, 71, 111, 112, 113, 128
Massa, 61, 83, 97, 98, 126
Massib, 74, 131
Masson, 71
Master, 67, 137
Masters, 66, 137
Masulis, 58, 60, 73, 111, 123, 124, 130
Matallín-Sáez, 98
Mate, 143
Mathews, 110
Mathieson, 72, 93, 130, 133
Mathisen, 75, 76, 133
Mathur, 75, 132
Matisko, 86
Matos, 97
Matsui, 73, 131
Matsumura, 73, 131
Matarrocci, 93
Mattia, 69, 139
Matusik, 110
Matutes, 79, 146
Matyska, 44, 47, 119, 140
Mauer, 54, 58, 76, 111, 123, 133
Maug, 110
Maula, 109, 110, 113
Maurer, 78, 135
Maxwell, 24, 26, 50, 114
May, 111, 114, 169
Maybeck, 85, 86
Mayer, 48, 110, 141
Mayers, 73, 130
Mayhew, 61, 126
Maynard Smith, 181, 182
Mayordomo, 69, 139
Mazouz, 144
Mazurek, 50
Mazuy, 97
McAfee, 58, 122
McAleer, 143, 144
McAllister, 66, 136
McAlum, 43, 119
McCahery, 56, 57, 61, 125
McCain, 181, 183
McCallum, 76, 133
McCalman, 79, 146
McCarthy, 79, 95
McCarty, 146
McConnell, 25
McClimony, 55, 59, 123
McCorry, 74, 131
McCoy, 80, 146
McCran, 76, 133
McCracken, 142, 144
McCue, 43, 118
McCurdy, 75, 132
McDermott, 47, 68, 80, 139, 140, 144, 146
McDonald, 49, 54, 55, 57, 58, 59, 122, 138
McDonough, 82
McEnally, 93
McFarlane, 42, 117
McGlue, 109
McGowen, 43, 118
McGrattan, 76, 133
McGreel, 44, 119
McGroarty, 144
McGuire, 77, 94, 135
McInish, 61, 72, 74, 126, 129, 131
McIntosh, 43, 118
McKelvie, 111
McKenzie, 95
McKiernan, 175
McKinnon, 11, 71, 128
McLeod, 97
McMahan, 43, 118
McMahon, 183
McMillan, 58, 87, 94, 110, 122
McMurray, 64
Mitchell, 25, 46, 67, 77, 95, 110, 134, 137, 140, 144
Mithal, 66, 136
Mitra, 87, 91, 94, 148, 149, 151, 152, 153, 166
Mitsel, 95
Mitteness, 114
Miville, 75, 132
Mizrach, 77, 134
Mkandawire, 78, 135
Mlambo, 86
Mohan, 57, 59, 124
Mohanty, 143
Moharana, 98
Moher, 161, 163
Mok, 56, 59, 124
Mole, 75, 132
Moldoveanu, 175, 185, 188, 189, 190
Montagnani, 80, 146
Montgomery, 76, 133, 174, 175, 185, 188, 189, 190
Monticini, 77, 134
Montiel, 75, 132
Mooney K, 43, 118
Mooney S, 43, 118
Morales, 144
Morck, 61, 76, 95, 126, 133
Morellc, 50
Morey, 97, 98
Morgan, 47, 49, 69, 120, 139, 140
Morgenegg, 70, 73, 130
Morgenstern, 181, 182
Morikawa, 64
Morkholm, 10, 11
Morley, 86
Morovic, 109
Moroz, 10, 11
Morrell, 186
Morris, 42
Morrison, 60, 67, 68, 82, 83, 114, 115, 125, 138
Morrow, 67, 137
Morse, 181, 182
Mortensen, 68, 138
Mortimer, 9, 11, 18, 20, 31
Morton, 66, 93, 136
Mosakowski, 110
Mosekilde, 27, 74, 148, 169
Moser, 67, 137
Moshirian, 44, 68, 119, 138
Moskowitz, 109
Mossin, 151, 171
Mossinghoff, 79, 145
Motohashi, 102, 110
Motta, 62, 126
Mottis, 186
Mou, 48, 142
Moulines, 86
Mountain, 143
Moutos, 95
Mrsik, 102, 111
Mudambi, 56, 57, 59, 124
Mueller, 43, 119, 133
Muennich, 110
Müller, 67, 69, 70, 73, 74, 76, 77, 108, 109, 110, 111, 130, 131, 134, 135, 137
Mullett, 114
Mullins, 49
Mumey, 42, 117
Munck, 114
Munnell, 95
Munro, 120
Munro-Faure, 44, 119
Murase, 42, 117
Murnieks, 114
Murphy, 48, 51, 63, 64, 141
Murray, 102, 109, 110, 111
Murthi, 95
Muscarella, 55, 58, 108, 122
Musser, 71, 128
Mustafa, 167, 172
Musto, 97
Mutafoglu, 144
Muthig, 67, 137
Muto, 48, 142
Muzyka, 55, 57, 58, 108, 123
Myers, 57, 59, 122, 123
Myerson, 57, 122, 181, 183
Mykhailovska, 46, 48, 142
Nader, 68, 138
Nagayasu, 75, 76, 132, 134
Nagel, 77, 93, 134, 135, 172
Nagrel, 70, 73, 131
<table>
<thead>
<tr>
<th>Author</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nahata</td>
<td>110, 111</td>
</tr>
<tr>
<td>Nahum</td>
<td>94</td>
</tr>
<tr>
<td>Naidu</td>
<td>74, 131</td>
</tr>
<tr>
<td>Naifar</td>
<td>68, 138, 139</td>
</tr>
<tr>
<td>Naik</td>
<td>74, 75, 90, 93, 110, 131, 132, 133</td>
</tr>
<tr>
<td>Nakayama</td>
<td>25</td>
</tr>
<tr>
<td>Naldi</td>
<td>67, 137</td>
</tr>
<tr>
<td>Nanda</td>
<td>54, 58, 59, 73, 97, 111, 123, 124, 130</td>
</tr>
<tr>
<td>Nandy</td>
<td>58</td>
</tr>
<tr>
<td>Nanthakumaran</td>
<td>44, 47, 119, 140</td>
</tr>
<tr>
<td>Naranjo</td>
<td>76, 133</td>
</tr>
<tr>
<td>Narasimha</td>
<td>108</td>
</tr>
<tr>
<td>Narayan</td>
<td>49</td>
</tr>
<tr>
<td>Nascent</td>
<td>111</td>
</tr>
<tr>
<td>Nash</td>
<td>181, 182</td>
</tr>
<tr>
<td>Nashikkar</td>
<td>68, 139</td>
</tr>
<tr>
<td>Nason</td>
<td>73, 130</td>
</tr>
<tr>
<td>National Bank of Poland</td>
<td>76, 134</td>
</tr>
<tr>
<td>Navarro</td>
<td>167, 172</td>
</tr>
<tr>
<td>Nayar</td>
<td>64</td>
</tr>
<tr>
<td>Ng</td>
<td>75, 76, 77, 132, 167, 171, 172</td>
</tr>
<tr>
<td>Nguyen</td>
<td>48, 68</td>
</tr>
<tr>
<td>Neal</td>
<td>66, 73, 120, 121, 130, 137</td>
</tr>
<tr>
<td>Neely</td>
<td>75, 76, 77, 97, 132, 134</td>
</tr>
<tr>
<td>Nefedova</td>
<td>98</td>
</tr>
<tr>
<td>Neher</td>
<td>109</td>
</tr>
<tr>
<td>Neira</td>
<td>114</td>
</tr>
<tr>
<td>Neis</td>
<td>66, 136</td>
</tr>
<tr>
<td>Nelken</td>
<td>67, 137</td>
</tr>
<tr>
<td>Nelson</td>
<td>25, 60, 72, 79, 86, 124, 129, 145, 167, 171</td>
</tr>
<tr>
<td>Neri</td>
<td>64</td>
</tr>
<tr>
<td>Nési</td>
<td>68, 138</td>
</tr>
<tr>
<td>Neske</td>
<td>68, 138</td>
</tr>
<tr>
<td>Neuberger</td>
<td>66, 75, 95, 133, 136</td>
</tr>
<tr>
<td>Neuhäuser</td>
<td>57, 61, 125</td>
</tr>
<tr>
<td>Neumann</td>
<td>61, 126</td>
</tr>
<tr>
<td>Neus</td>
<td>110</td>
</tr>
<tr>
<td>Nevermann</td>
<td>108</td>
</tr>
<tr>
<td>Neves</td>
<td>76, 133</td>
</tr>
<tr>
<td>Newbery</td>
<td>46, 78, 140, 145</td>
</tr>
<tr>
<td>Newbold</td>
<td>18, 71, 128, 185</td>
</tr>
<tr>
<td>Newell</td>
<td>43, 44, 119</td>
</tr>
<tr>
<td>Newey</td>
<td>72, 129, 130</td>
</tr>
<tr>
<td>Newsome</td>
<td>77, 134</td>
</tr>
<tr>
<td>Newton</td>
<td>85</td>
</tr>
<tr>
<td>Ng</td>
<td>73, 98, 130, 133, 134</td>
</tr>
<tr>
<td>Nguyen</td>
<td>138, 142, 144</td>
</tr>
<tr>
<td>Nguyen-Thi-Thanh Huyen</td>
<td>93</td>
</tr>
<tr>
<td>Ni</td>
<td>64</td>
</tr>
<tr>
<td>Nicholas</td>
<td>114</td>
</tr>
<tr>
<td>Nicodano</td>
<td>102, 105, 106, 110</td>
</tr>
<tr>
<td>Nicolò</td>
<td>68, 138</td>
</tr>
<tr>
<td>Nielsen</td>
<td>109, 110</td>
</tr>
<tr>
<td>Nielson</td>
<td>46, 140</td>
</tr>
<tr>
<td>Nieuwland</td>
<td>74, 131</td>
</tr>
<tr>
<td>Nieuwoudt</td>
<td>42, 117</td>
</tr>
<tr>
<td>Nightingale</td>
<td>78, 135</td>
</tr>
<tr>
<td>Nijman</td>
<td>47, 50, 74, 131, 140</td>
</tr>
<tr>
<td>Nikulchev</td>
<td>169</td>
</tr>
<tr>
<td>Nimalendran</td>
<td>73, 75, 76, 130, 132, 133</td>
</tr>
<tr>
<td>Nishide</td>
<td>50</td>
</tr>
<tr>
<td>Nishikawa</td>
<td>98</td>
</tr>
<tr>
<td>Nissanké</td>
<td>48, 141, 142</td>
</tr>
<tr>
<td>Nitzsche</td>
<td>97</td>
</tr>
<tr>
<td>Noble</td>
<td>79, 146</td>
</tr>
<tr>
<td>Noe</td>
<td>61, 126</td>
</tr>
<tr>
<td>Nofsinger</td>
<td>59, 61, 95, 124, 125</td>
</tr>
<tr>
<td>Nolte I</td>
<td>77, 135</td>
</tr>
<tr>
<td>Nolte S</td>
<td>77, 135</td>
</tr>
<tr>
<td>Norbäck</td>
<td>111</td>
</tr>
<tr>
<td>Norden</td>
<td>68, 138</td>
</tr>
<tr>
<td>Nordhaus</td>
<td>78, 145</td>
</tr>
<tr>
<td>Norli</td>
<td>57, 60, 124</td>
</tr>
<tr>
<td>Norouzzadeh</td>
<td>28, 77, 134</td>
</tr>
<tr>
<td>North</td>
<td>57, 62, 126</td>
</tr>
<tr>
<td>Nounis</td>
<td>56, 61, 125, 126</td>
</tr>
<tr>
<td>Novotný</td>
<td>49, 142, 144</td>
</tr>
<tr>
<td>Novikov</td>
<td>93, 171</td>
</tr>
<tr>
<td>Nowman</td>
<td>86</td>
</tr>
<tr>
<td>Nunes</td>
<td>69, 139</td>
</tr>
<tr>
<td>Nwin-Anefo Fru Asaba</td>
<td>144</td>
</tr>
<tr>
<td>Nyborg</td>
<td>56, 58, 59, 61, 123, 126</td>
</tr>
<tr>
<td>Nyce</td>
<td>57, 61, 125</td>
</tr>
<tr>
<td>Obadan</td>
<td>76, 133</td>
</tr>
<tr>
<td>Obradović</td>
<td>90, 94</td>
</tr>
<tr>
<td>Obschonka</td>
<td>111</td>
</tr>
<tr>
<td>Obstfeld</td>
<td>71, 73, 74, 129, 130, 131</td>
</tr>
<tr>
<td>Ocal</td>
<td>144</td>
</tr>
<tr>
<td>Ochoa</td>
<td>86</td>
</tr>
<tr>
<td>O’Connell</td>
<td>47, 141</td>
</tr>
<tr>
<td>O’Connor</td>
<td>77, 134, 143, 144</td>
</tr>
<tr>
<td>Odean</td>
<td>57, 59, 97, 123</td>
</tr>
<tr>
<td>O’Donnell</td>
<td>82</td>
</tr>
<tr>
<td>Odusami</td>
<td>144</td>
</tr>
<tr>
<td>OECD</td>
<td>114</td>
</tr>
<tr>
<td>Oesterhelweg</td>
<td>73, 131</td>
</tr>
<tr>
<td>Oesterle</td>
<td>109</td>
</tr>
<tr>
<td>Ofek</td>
<td>61, 76, 125, 133</td>
</tr>
<tr>
<td>Office of Career Services</td>
<td>115</td>
</tr>
</tbody>
</table>
Phillips, 42, 117
Phipps, 42, 117
Phylaktis, 78, 135
Piazzi, 50
Pichler, 54, 60, 62, 125, 126
Pickholtz, 161, 163
Pictet, 70, 73, 74, 76, 130, 131, 133
Pierantoni, 50
Pierdzioch, 145
Pierse, 86
Piggott, 94, 95
Piketty, 10, 11
Pilipovic, 47, 140
Pilote, 50
Piluso, 83, 91, 94
Pindyck, 46, 47, 140
Pines, 93
Pinheiro, 83
Pintado, 110
Pirrong, 74, 121, 131
Pis, 67
Pis, 78
Pis, 135
Plesoianu, 28, 78, 135
Podolsky, 183
Poghosyan, 77, 134
Poh-Kam Wong, 114
Polach, 49, 142, 144
Politis, 114
Polk, 172
Pollet, 111
Pollock, 61, 126
Polonchek, 108
Pommet, 101, 102, 111
Pons-Sanz, 56, 61, 126
Pontecorvo, 82
Pool, 94
Poon, 54, 59, 124
Poonawala, 71, 128
Pope, 74, 131
Popova, 64
Popova E, 93
Popova I, 93
Popper, 74, 76, 132, 133
Porchia F, 69, 139
Porchia P, 69, 139
Porter, 97, 174, 185, 186, 188, 189, 190
Portes, 67, 72, 75, 130, 132, 137
Posthaus, 68, 138
Posthuma, 93
Poterba, 97, 108
Poteshman, 63, 64
Pottage, 78, 80, 146
Potter, 18, 185
Potters, 19
Pound, 171
Poundstone, 181, 183
Poudyal, 62, 126
Pound, 89
Poveda-Fuentes, 57, 62, 126
Powell, 57, 60, 86, 124, 125
Poyiadjis, 86
Pozdena, 82
Prabhala, 58, 110, 123
Pradkhan, 144, 145
Prager, 78, 145
Prahalad, 175
Prasad, 74, 113, 131
Prat, 95
Prather, 96, 97
Prato, 67, 137
Predescu, 66, 68, 136, 138
Prescott, 25, 86
Preston, 113
Prewysz-Kwinto, 50
Price, 10, 11, 181, 182
Priest, 79, 145
Priestley, 86
Primiceri, 86
Prisch, 15, 25, 32, 160, 161
Pritsch, 68, 138
Pritscher, 56, 61, 126
Proakis, 15, 25, 32, 86, 160, 161
Proietti, 86
Proimos, 110
Prokopczuk, 86
Protopopov, 114
Protter, 64
Prowse, 109, 113
Rosser, 19
Rossetto, 54, 62, 110, 126
Rossi, 48, 86, 95, 141, 144
Rotemberg, 46
Roten, 60, 125
Roth, 42, 117
Röthig, 47, 141
Rothbard, 18
Rothenberg, 140, 185
Rothschild, 167, 171, 172
Rottke, 44, 119
Rouah, 93
Roubini, 76, 133
Roulac, 43, 118
Roure, 113, 114
Rousslang, 79, 145
Routledge, 47, 48, 140, 141
Rouwenhorst, 47, 48, 97, 141, 142
Roy, 60, 125
Roza, 114
Rozeff, 74, 131
Rozek, 79, 145
Ruback, 51
Rübel, 77, 134
Rubens, 43, 46, 118, 140
Rubenstein, 112, 113
Rubin, 86
Rubinstein, 46, 63, 64, 72, 129, 140, 181, 183
Rubinton, 83
Rubio-Ramirez, 86
Ruder, 79, 146
Rudolph, 67, 136, 137
Rue, 175
Ruenzi, 97
Ruffini, 135, 136, 139
Ruhnka, 108
Ruiz, 59, 86, 124
Rukstad, 174, 185, 188, 189, 190
Rule, 67, 137
Rumelt, 174
Rushing, 79, 145
Russel, 66, 136
Russell, 72, 98, 107, 129, 167, 168, 172
Russu, 42, 118
Rüther, 80, 146
Rutkowski, 67, 68, 137, 138
Ruud, 55, 58, 123
Ryan, 76, 133
Rydén, 86
Rydqvist, 55, 56, 58, 123
Rylov, 183
Rystrom, 43, 118
Rytov, 85
Saadouni, 59, 124
Saar, 75, 133
Sacală, 48, 142
Sachs, 47, 140
Sack, 77, 134
Sadka, 75, 93, 94, 132
Sadler, 175, 185, 188, 189, 190
Sadorsky, 48, 142
Sagaly, 43, 118
Sager, 72, 77, 110, 129, 134
Saha, 93
Sahay, 76, 134
Sahlman, 58, 64, 102, 108, 122
Sahminan, 77, 134
Sahoo, 62, 127
Sakakibara, 79, 146, 174, 185, 188, 189, 190
Salandro, 72, 130
Salmond, 86
Saloner, 79, 145
Salop, 79, 145
Salter, 108, 174, 185, 188, 189, 190
Saltuk, 69, 139
Saly, 63, 64
Samala, 79, 146
Samiei, 73, 76, 130, 133
Samila, 98, 102, 111
Samuels, 175
Samuelson, 23, 25, 79, 111, 145, 171
Sandberg, 108
Sander, 106, 110
Sanders, 43, 47, 54, 118, 126, 140
Sandner, 100, 102, 110
Sandoval, 86
Sands, 183
Sanger, 57, 61, 74, 125, 131
Sang Hoon Kang, 144
San Jose, 113, 114
Sanohdontree, 96, 98
Santioni, 50
Santos, 48, 50, 62, 68, 114, 126, 138, 142, 144
Sapienza, 108, 113
Sapp, 77, 134, 135
Sapusek, 57, 60, 124
Sarasvathy, 113
Saratov group of theoretical nonlinear dynamics, 169
Schiff, 144
Sargent, 61, 89, 171
Şargu, 69, 139
Sari, 144
Sarig, 59, 61, 124, 126
Sarín, 136
Sarkar, 75, 132
Sarno, 72, 74, 76, 77, 78, 129, 132, 133, 134, 135
Sato, 18, 19, 76, 133
Saturnino, 62, 127
Satyanarayan, 47, 140
Sau, 102, 104, 110
Sauer, 169
Saunders, 44, 59, 67, 72, 119, 123, 129, 137
Sautner, 64
Savaser, 74, 131
Scacciaiavillani, 144
Scalia, 75, 133
Scarláti, 77, 134
Schachermayer, 66, 109, 137
Schaefer, 68, 138
Schåck, 108
Schäfer, 15, 25, 32, 64, 78, 135, 160, 161
Schankerman, 79, 145, 146
Schatt, 60, 125
Scheffler, 109
Scheela, 114
Schefczyk, 109
Scheicher, 64
Scheinikman, 89, 171
Schenek, 56, 60, 125
Schendel, 174
Schenone, 61, 126
Schenzler, 71, 128
Scherer, 48, 78, 141, 145, 172
Scherlter, 109
Schiereck, 44, 56, 57, 61, 75, 119, 125, 126, 132
Schiff, 79, 146, 183
Schizer, 109
Schlottmann, 68, 138
Schmelting, 75, 189, 190, 132
Schmidt, 67, 73, 108, 109, 110, 131, 137
Schmitt, 78, 80, 146
Schmitt-Rodermund, 111
Schmitz, 46, 140
Schnadt, 11
Schneeweis, 47, 93, 140
Schneider, 50
Schnid, 68, 138
Schnidrig, 70, 74, 131
Schnitkey, 42, 117
Schnitzlein, 75, 132
Schnoor, 154, 172
Schoar, 99, 108, 109, 111, 113
Schoenholtz, 89, 171
Schoenmaker, 115
Scholes, 51, 63, 66, 71, 128, 136, 171, 175
Scholtens, 185
Scholtz, 63, 161, 163
Scholz, 93
Schönbucher, 67, 137
Schoors, 110
Schorfeide, 167, 172
Schotman, 74, 131
Schrand, 67, 137
Schremp, 57, 61, 125
Schrödinger, 183
Schubert, 64
Schuchman, 78, 145
Schurermann, 93
Schuhmacher, 93
Schulmeister, 72, 129
Schultz, 50, 54, 55, 57, 58, 60, 61, 62, 67, 68, 75, 123, 124, 126, 132, 137, 139
Schumacher, 98
Schumpeter, 18, 25, 185
Schürhoff, 50, 64
Schuster, 61, 125
Schwaller, 86
Schwartz, 11, 46, 47, 49, 66, 70, 71, 72, 74, 76, 86, 90, 93, 128, 130, 131, 133, 136, 140
Schweiger, 108
Schweis, 79, 146
Schweinmayer, 67, 68, 137, 138
Schweizer, 44, 42, 119, 127
Schwenk, 174
Schwert, 54, 60, 89, 125, 171
Schwienbacher, 95, 100, 101, 109, 110, 113, 114
Scotchmer, 79, 145, 146
Scott, 47, 63, 64, 97, 140
Scott–Quinn, 67, 74, 131, 137
Searle, 80, 146
Sebastian, 93
Sebastião, 77, 135
Seck, 44, 119
Sedzro, 93
Sefcik, 56, 60, 125
Segerstrom, 79, 145
Szymanowska, 42, 117
Susmel, 167, 172
Sussman, 76, 82, 133
Sussmuth, 25
Suthiphongchai, 67, 137
Suzuki, 42, 117
Svensson, 44, 73, 119, 130
Swaminathan, 56, 60, 61, 76, 125, 126, 133
Swanson, 143
Swart, 102, 109
Sway, 72, 129
Sweeney, 43, 71, 72, 75, 118, 128, 129, 132
Sweeting, 95
Swierzbinski, 60, 124
Swinkels, 77, 135, 188
Swinnen, 46, 47, 140
Swiss National Bank, 25
Syacutekora, 44, 119
Sykes, 108
Sylvain, 10, 11
Symanski, 72, 74, 129, 131
Szabo, 50
Szado, 94
Szakmary, 75, 132
Szentes, 110
Szpiro, 74, 131
Szreder, 42, 118
Szymanowska, 47, 140

Tabak, 77, 134
Tachibana, 42, 117
Ta-Chung Liu, 167, 171
Tadic, 86
Täg, 108
Taggart, 95
Taha, 97
Takahashi, 69, 85, 87, 93, 94, 139
Takezawa, 75, 132
Taksler, 50
Talay, 185
Talkner, 74
Tallau, 64
Tam, 77, 134
Tanaka, 109
Tang, 90, 97, 141
Tanizaki, 86
Tanner, 74, 131
Tang, 68, 94
Tardos, 181
Taschini, 48
Talay, 18

Talkner, 131
Tallau, 63
Tang, 48, 139
Taniguchi, 25
Tapper, 80, 146
Tardos, 183
Tarondeau, 175
Taschini, 142
Tashiro, 113
Tatsaronis, 93
Tavakko, 74, 131
Tavakoli, 67, 137
Tavares, 68, 138
Taya, 71, 129
Taylor A, 77, 134
Taylor C, 79
Taylor D, 71, 129
Taylor G S, 43,
Taylor H M, 27, 28
Taylor J B, 77, 134
Taylor M P, 77, 134
Taylor S J, 18, 46, 47, 56, 57, 59, 60, 61, 63,
64, 72, 73, 74, 75, 76, 93, 108, 117, 118,
132, 123, 124, 125, 126, 129, 130, 132, 133,
140, 141, 144, 145, 185
Te, 86
Tebroke, 61, 126
Teczke, 109
Teece, 79, 146, 175, 188, 189, 190
Teijl, 79, 145
Teiletche, 94
Telser, 46, 51, 140
Templeman, 78, 79, 146
Tenorio, 75, 132
Teo, 93, 97
Tepper, 95
Terada, 77, 135
Teräsvirta, 18, 185
Ter Horst, 93
Terraza, 47, 140, 143, 144
Teschl, 183
Tefsatsion, 77, 134
Teubal, 110
Thakor, 55, 58, 62, 108, 123, 126
Thaler, 58, 122
Thapar, 90, 94
Theissen, 75, 132, 133
Theoh, 56, 57, 59, 124
Theoret, 86
Thesmar, 44, 119
Thibodeau, 43, 118
Uechi, 25
Ueda, 50, 109, 110
Uesugi, 44, 119
Ugolini, 144
Uhlir, 55, 58, 122
Uhlmann, 86
Uhrig-Homburg, 64
Ujihara, 46, 140
Upperman, 47, 141
US Air Forces Office of Scientific Research, 85
US General Accounting Office, 76, 133
US President’s Working Group on Financial Markets, 93
US Treasury, 16
Utsunomiya, 64
Uzawa, 25

Vacca, 75, 133
Vadivasova, 169
Vahid, 76, 133, 167, 172
Vaissié, 93
Vakarchuk, 183
Valachi, 77, 134
Valente, 74, 132
Valta, 50
Van, 102
Van Auken, 110
Van Binsbergen, 98
Van Boening, 73, 130
Van Bommel, 60, 61, 125, 126
Van Caenegem, 79, 146
Vance, 113
Vandelouise, 143
Van Den Berg, 42, 118
Van Der Geest, 56, 57, 60, 125
Van Der Goot, 54, 61, 125, 126
Van Der Heijden, 42, 118
Van Der Hoek, 50
Van Der Kr Pasmans, 42, 118
Van Der Panne, 25
Van Der Post, 42, 117
Van der Sluis, 93
Van Der Wel, 86
Van Der Zwaan, 60, 125
Van Deventer, 102, 110
Van De Vrande, 111
Van Dijk, 77, 135, 188
Vandervloecht, 74, 131
Van Frederiks, 56, 57, 60, 125
Van Hagen, 72, 130
Vanhaezebroeck, 111
Van Horne, 18, 185
Van Hulle, 61, 125
Van Ierland, 42, 118
Van Inwegen, 94
Van Kervel, 74, 131
Van Loan, 86
Van Ness, 27, 28
Van Nieuwbergh, 97
Van Norden, 77, 134
Van Osnabrugge, 111, 113
Van Pottelsbergen, 110
Van Robays, 48, 142
Vanthoor, 74, 131
Van Wesep, 64
Van Willigenburg, 86
Van Wincoop, 76, 77, 133, 134, 135, 188
Varadi, 48, 142
Varangis, 47, 140
Varga, 69, 86, 139
Varian, 75, 133
Varma, 49
Vasey, 47, 141
Vasiljevic, 42, 118
Vasisht, 48, 142
Vaubel, 77, 134
Vause, 69, 139
Vayanos, 60, 75, 125, 133
Vaysburd, 68, 138
Vecchiato, 68, 138
Veenman, 42, 117
Vega, 48, 72, 75, 129, 132, 141
Velasco, 48, 142
Vêlayoudom Marimoutou, 144
Veld, 47, 140
Veldkamp, 97
Velo, 144
Velucchi, 168, 172
Venditti, 142
Venegas, 86
Venekamp, 61, 125
Venditti, 48
Verbeek, 93
Wendt, 113
Weithers, 113
Wasserman, 109
Watanabe, 74, 131
Watkins, 144
Watson, 25, 31, 86, 167, 168, 171, 172
Weber, 143
Wetzel, 113
Weaver, 59, 124
Webb, 43, 44, 46, 50, 58, 118, 119, 123, 140, 181, 183
Weber, 57, 61, 64, 67, 68, 94, 122, 126, 137, 138
Wedge, 97
Weersink, 48, 141
Wehn, 68, 138
Wei, 50, 56, 57, 59, 60, 65, 68, 74, 75, 77, 108, 123, 125, 131, 132, 134, 138, 144
Weihong Song, 115
Wei Jie, 115
Weinbaum, 98
Weinberg, 63
Weiner, 47, 64, 141
Weinstein, 57, 58, 73, 122, 123, 130
Weisang, 84, 85, 94, 86
Weisbach, 62, 97, 126
Weiser, 47, 141
Weismann, 93
Weiss, 58, 66, 98, 104, 107, 108, 122, 136
Weiss-Hanley, 62, 127
Weithers, 68, 139
Wei Xiong, 48, 141, 142
Wei Xueqi, 114
Welch, 54, 56, 57, 58, 59, 60, 86, 122, 123, 124, 125, 175
Weller, 74, 132
Wells, 18, 86, 109, 135, 136, 139, 174, 185, 188, 189, 190
Welzel, 67, 137
Wendt, 43, 118
Werker, 50
Werners, 89, 95, 97
Werner, 42, 68, 75, 117, 132, 138
Wernerfelt, 51
West, 42, 72, 89, 117, 129, 130, 171
Westerhoff, 76, 134
Westerholm, 60, 124
Westerfield, 64
Westerlund, 144
Westermann, 76, 133
Weston, 61, 83, 126
Westphal, 113
Wetzel, 111, 113
Weymouth, 77, 134
Whaley, 46, 63, 64, 74, 131, 140
Wheaton, 43, 118, 119
Whinston, 58, 64, 79, 122, 145, 181, 183
Whitcomb, 71, 128
White, 12, 63, 66, 72, 73, 76, 79, 97, 114, 121, 129, 131, 133, 136, 145, 167, 172
Whitehouse, 95
Whitelaw, 77, 135
Whitesell, 11
Whittaker, 66, 136
Whittingham, 49
Whittington, 175
Whittred, 59, 124
Wickramanayake, 93
Wiener, 24, 85
Wigderson, 181, 183
Wikipedia, 25, 31, 115, 149
Wilder, 64, 67, 137
Wilhelm, 54, 58, 59, 60, 82, 83, 114, 115, 122, 123, 124, 125
Wilhelmsson, 98
Willenborg, 61, 126
Williams, 11, 46, 47, 48, 58, 69, 123, 139, 140, 141, 142, 181, 182, 185
Williamson, 51, 68, 71, 73, 76, 128, 130, 133, 138
Willis, 12
Willner, 85, 108
Wilson, 57, 67, 80, 108, 111, 113, 122, 137, 146
Wiltbank, 113
Wiltschaw, 42, 117
Wimmer, 68, 138
Winkelmann, 75
Winklevass, 95
Winschel, 86
Winter, 79, 145, 175, 185, 188, 189, 190
Winters, 143
Winton, 50, 59, 66, 110, 124, 136
Wise, 95
Witkin, 114
Witt, 110
Wittner, 43, 118
Wohar, 74, 132
Wohl, 59, 124
Wohlever, 97
Wolfke, 111
Wolf, 68, 74, 75, 132, 139
Wolfenzon, 58, 122
Wolff. 49, 72, 130, 131
Wolinsky, 72, 73, 129, 131
Womack, 55, 56, 58, 59, 60, 61, 123, 124, 125
Wong, 43, 48, 56, 57, 60, 73, 76, 77, 102, 110, 113, 118, 124, 125, 131, 133, 134, 141, 144
Wong E, 77, 134
Wong J, 77, 134
Wongchoti, 61, 126
Wongsunwai, 99, 108
Wongswan, 77, 134
Wood, 56, 62, 72, 126, 129, 144
Woodford, 11, 77, 134
Woodward, 48, 110, 111, 141
Wooldridge, 167, 171
Woo Sung-Jun, 97
Working, 46, 66, 136, 140
Workman, 86
Worthington, 47, 76, 133, 141, 143, 144
Worzala, 43, 119
Wrampelmeyer, 78, 135
Wren-Lewis, 75, 132
Wright-Patterson Air Forces Base, 85
Wu, 47, 62, 68, 69, 74, 78, 127, 131, 135, 138, 139, 140, 167, 172
Wurgler, 59, 124
Würtz, 70, 74, 131
Wurtzbach, 43, 118
Wu Zhenyu, 114
Wylie, 43, 118

Xia, 49, 86
Xiangkang Yin, 64
Xianlei Ma, 42, 118
Xiaoping Shi, 42, 118
Xiaoqing Eleanor Xu, 144
Xiao-Rong Li, 86
Xiaoyun Yu, 83
Xie, 61, 111, 125
Xing Quan Zhang, 44, 119
Xiong, 48, 72, 86, 94, 129, 141
Xu, 49, 67, 137
Xuemin Yan, 61, 125
Xuereb, 175
Xuewei Yang, 69, 139

Yabu, 74, 131
Yadav, 64, 74, 75, 131, 133
Yafeh, 110
Yakovenko, 19
Yamaguchi, 76, 133
Yamaoka, 42, 117
Yamamoto, 84, 85, 87, 93, 94
Yamori, 45, 48, 139, 141
Yan, 58, 60, 61, 68, 75, 76, 97, 123, 125, 126, 133, 139
Yang, 46, 47, 56, 62, 64, 69, 77, 79, 101, 111, 127, 134, 139, 140, 146
Yany, 48, 142
Yao, 75, 108, 132
Yao-Min Chiang, 62, 127
Yap, 86
Yaron, 47, 89, 141, 171
Yasuda, 111
Yasuharu Iwata, 117
Ye, 64
Yehuda, 98
Yelle, 174
Yeoman, 10, 11
Yeomans, 57, 122
Yermilova, 144
Yermo, 95
Yerramilli, 110
Yeung, 61, 76, 114, 126, 134
Yigit, 77, 134
Yildirak, 69, 139
Yildirim, 66, 69, 136, 139
Yiming Qian, 62, 127
Yin, 76, 133
Ying Jiao, 69, 139
Yiran Yao, 143, 145
Yi Tan, 114
Yitshaki, 111
Yiu, 76, 78, 133, 135
Yiuman Tse, 48, 142
Yizhu Wang, 62, 127
Yoffie, 174, 185, 188, 189, 190
Yogo, 48, 142
Yongheng Deng, 44, 119
Yongyuan Qiao, 56, 62, 126
Yoo, 167, 171
Yoon, 28, 76, 134
Yorke, 169
Yormark, 43, 118
Yosha, 109
Yoshida, 42, 117
Yoshikawa, 25
Yoshimaru, 47, 140
About Authors

Dimitri O. Ledenyov graduated from Department of Radio-Physics and Electronics at V. N. Karazin Kharkiv National University in Kharkiv, Ukraine in 1994 - 1999. Dimitri makes the research on the financial capital investment in the global capital markets in the economics and finances. He conducts the research on the microwave superconductivity at James Cook University in Townsville, Queensland, Australia in 2000 - 2017. He authored the numerous research papers, reviews and books in the social and natural sciences. He participated in a big number of the international conferences, symposiums, forums, seminars and business meetings around the World.

Viktor O. Ledenyov graduated from Department of Radio-Physics and Electronics at V. N. Karazin Kharkiv National University in Kharkiv, Ukraine in 1988 - 1993. Viktor makes the research on the financial capital investment in the global capital markets in the economics and finances. He conducts the research on the microwave superconductivity, the condensed matter physics, the telecommunications, the quantum computing at a number of the research institutions and universities in Europe and in North America in 1993 – 2017. He authored the numerous research papers, reviews and books in the social and natural sciences. He participated in a big number of the international conferences, symposiums, forums, seminars and business meetings around the World.
Investment in Capital Markets creates a strategic vision on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods. The book is written with a main goal to explain the pros and cons of the financial capital investment in the capital markets, discussing the sophisticated investment concepts and techniques in the simple understandable readable general format language. We would like to highlight the three interesting facts about the book: 1. It is centered on the consideration of the modern investment products, the investment vehicles and the investment mediums for the financial capital investment in the capital markets; 2. It is focused on the financial risk calculation and mitigation techniques for the financial capital investment in the financial capital markets. 3. It is aimed to describe the quantum winning virtuous investment strategies creation and execution techniques during the financial capital investment in the capital markets. The investors, financiers, economists, financial analysts, financial traders, financial advisers, lawmakers, policy analysts, subject experts, professors, and students will certainly enjoy a breathtaking splendid learning journey with the explained new ideas, established concepts and outlined future prospects toward the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

Key Features:

∗ Discovers the capital markets history from the ancient time to the present time.

∗ Formulates the general problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

∗ Solves the problem on the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods, using a number of the investment products, investment vehicles and investment mediums.

∗ Explains the theoretical fundamentals of the modern investment products, investment vehicles and investment mediums for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

∗ Debates the practical applications of the modern investment products, investment vehicles and investment mediums for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

∗ Considers the modern financial risk calculation techniques during the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

∗ Outlines the problem on the quantum winning virtuous investment strategies creation and execution during the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

∗ Presents the algorithm for the quantum winning virtuous investment strategies creation and execution during the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.

∗ Discusses the practical perspectives on the limitless opportunities for the financial capital investment in the capital markets with the aim to get an increased return premium in the short and long time periods.