Some thoughts on accurate characterization of stock market indexes trends in conditions of nonlinear capital flows during electronic trading at stock exchanges in global capital markets

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Abstract – This research represents some thoughts on the accurate characterization of the stock market indexes trends in the conditions of the nonlinear capital flows at the stock exchanges in the global capital markets. We make our original research proposal that the nonlinear capital flows in the process of the electronic trading can originate the nonlinear changes of the stock market indexes at the stock exchanges in the global capital markets. We suggest that the econophysics techniques can be used to precisely characterize the nonlinearities in the finances. We performed the research of the nonlinearities in Matlab, researching: 1) the ideal dependence of the stock market index over the time, 2) the linear dependence of the stock market index over the time, 3) the quadratic dependence of the stock market index over the time, 2) the exponential dependence of the stock market index over the time. We researched the following indexes: 1) The Dow Jones Industrial Average (DJIA) index; 2) The Standard and Poor's 500 (S&P 500) index; 3) The NYSE Composite index; 4) The Hong Kong Hang Seng index; 5) The Shanghai Composite index; 6) The Financial Times Securities Exchange (FTSE100) index; 7) The Deutscher Aktienindex (DAX) index; 8) The Nikkei 225 Stock Average index over the certain time periods. The selected time periods were: 6 months; 12 months; 24 months. We assumed that, in every considered case, there are the complex changes of the company valuation, foreign exchange rates, interest rates, prices of strategic commodities over the specified time period. We found that there are the nonlinearities in the characteristic dependences of the stock exchanges indexes on the time. Our research results are in a good agreement with the research findings in Abhyankar, Copeland, Wong (1995, 1997), however the multiple evidences of quantum chaos were found in the researched stock market indexes dependences for the first time.

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Keywords: stock exchange, stock indexes trends analysis, nonlinear capital flows at stock exchanges, financial securities market, global capital market, share price volatility, foreign exchange rates, interest rates, prices of strategic commodities, return on investments, equity premium, investment portfolio, econophysics, econometrics, integrative thinking.

Introduction

The *Amsterdam Stock Exchange* is 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)*. In the seventeenth century, the *Britain* succeeded the *Netherlands,* throwing in the age of 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 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 financial 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).* Presently, the *LSE* remains the world's most innovative stock exchange, which operates in the global capital market in *Neal (2005)*. The *Paris Stock Exchange* 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)*. The *New York Stock Exchange (NSYE)* conducts its operations since *1817* in *Shiryaev (1998a)*. The *Tokyo Stock Exchange* was founded in *1878* in *Hamao, Hoshi, Okazaki (2005)*. In our time, there are many innovative stock exchanges, which are governed by the various organizational rules, including the *Amsterdam, London, Melbourne, Frankfurt, Paris, Frankfurt, New York, Toronto, Tokyo, Shanghai and Hong Kong* stock exchanges in *Hart, Moore (1996), Goetzmann, Ibbotson, Peng (2000), Le Bris, Hautcoeur (2011).* 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 the different investment strategies at the stock exchanges,

which can be characterized by the *Return-on-Investment (ROI)* in *Lowenfeld (1907, 1910)*, *Gregory, Harris, Michou (2001)*. Today, the competition among the various stock exchanges for both the public companies and 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, in *Di Noia (2001)*. For example, the *Amsterdam Stock Exchange* merged with the *Brussels Stock Exchange* and the *Paris Stock Exchange* to establish the *Euronext* in *2000*.

This article continues a series of our research articles on *the nonlinearities in the finances* in *Ledenyov V O, Ledenyov D O (2012a, b)*, *Ledenyov D O, Ledenyov V O (2012c, d)*, *Ledenyov D O, Ledenyov V O (2013a, b, c, d, e)*, discussing the topics on the accurate characterization of the stock market indexes trends in the conditions of the nonlinear capital flows during the electronic trading at the stock exchanges in the global capital markets.

Accurate characterization of stock market indexes trends in conditions of nonlinear capital flows during electronic trading at stock exchanges in global capital markets

The principles of economics are closely interconnected with **the concept of the capital** and **the concept of the interest rates**, which represent the centric scientific problems in the finances in *Menger (1871)*, *von Böhm-Bawerk (1884, 1889, 1921)*. *Hirsch (1896, 1985)* provides the definitions of the following important financial terms:

1. **Capital** comprises all wealth produced for the ultimate purpose of satisfying some want or desire, but actually employed in adding to the productiveness of future labor.

2. **Wealth** comprises all matter the potential utility of which has been partly or fully developed by labour.

3. **Interest** is the share of *Wealth*, which the owners of *Capital* can claim for permitting it to be used in the production of *Wealth*.

The capital can be invested in the valuable financial papers such as the **stock** in *Lowenfeld (1907, 1910)*. *Bachelier (1900)* proposed the first mathematical description of the **stock price**, using the *linear Brownian motion model* in the conditions of the *(B, S)-market*, where *B* is the *bank account*, *S* is the *stock price* as described in *Shiryaev (1998a, b)*

$$B = \left(B_t \right)_{t \leq T}$$

$$S = \left(S_t \right)_{t \leq T}$$

$$S_t = S_0 + \mu\, t + \sigma W_t, \quad t \leq T.$$

In addition, *Bachelier (1900)* derived a number of formulas to evaluate the option prices, which can be summarized as the *Bachelier* formula for the rational value $\mathbb{C}_T = \mathbb{C}\left(f_T; P \right)$ of the *European call option* with the payment function $f_T = \left(S_T - K \right)^+$ in *Shiryaev (1998b)*

$$\mathbb{C}_T = \left(S_0 - K \right) \Phi\left(\frac{S_0 - K}{\sigma T^{1/2}} \right) + \sigma T^{1/2} \varphi\left(\frac{S_0 - K}{\sigma T^{1/2}} \right)$$

$$where \quad \varphi(x) = \frac{1}{(2\pi)^{1/2}} e^{-\frac{x^2}{2}}, \quad \Phi(x) = \int_{-\infty}^{x} \varphi(y)\,dy.$$

$$\mathbb{C}_T = \sigma \left(\frac{T}{2\pi} \right)^{1/2} \quad at \quad S_0 = K.$$

Fisher (1922) analyzed and summarized some interesting facts about the *stock index numbers*, conducting a first serious study of their varieties, tests, and reliability. *Hautcoeur (2006) described* the early history of the stock market indexes at the *Paris Stock Exchange* in *France*.

Presently, there are a big number of the *stock exchange indexes* in *Shiryaev (1998a)*

1. The *Dow Jones Industrial Average* (*DJIA*) index;

2. The *Standard and Poor's 500* (*S&P 500*) index;

3. The *NYSE Composite* index;

4. The *AMEX Market Value* index;

5. The *Hong Kong Hang Seng* index;

6. The *Shanghai Composite* index;

7. The *Financial Times Securities Exchange* (*FTSE100*) index;

8. The *Deutscher Aktienindex (DAX)* index;

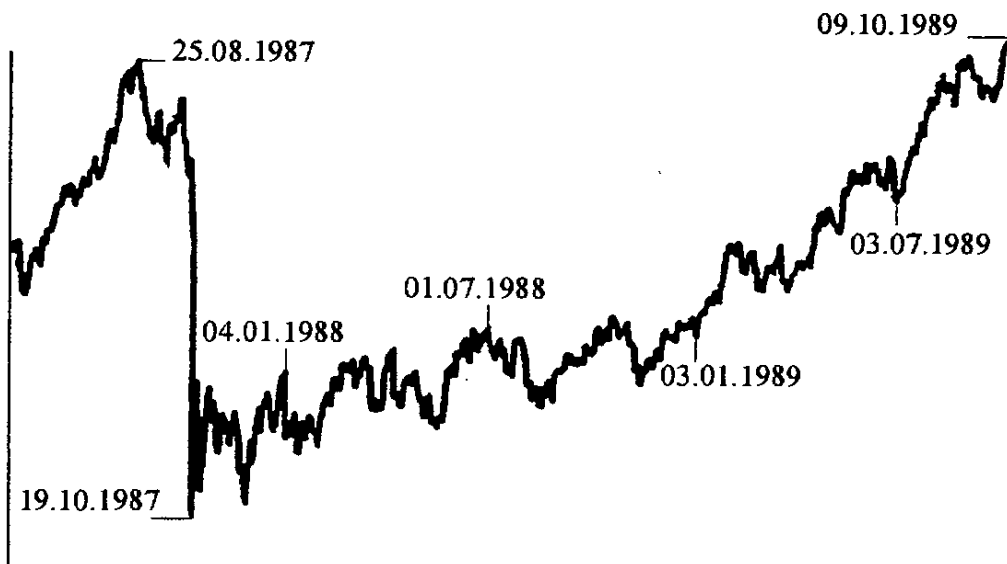9. The *Nikkei 225 Stock Average* index.

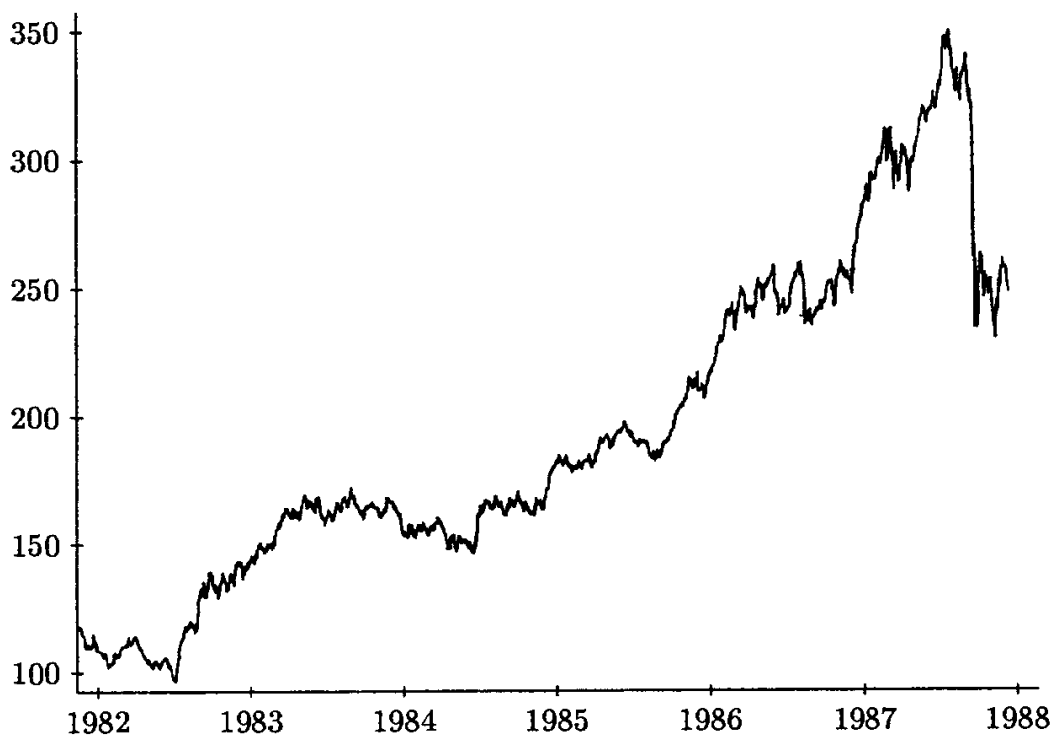**Fig. 1.** *Dependence of Dow Jones Industrial Average (DJIA) index on time (after Shiryaev (1998a)).*

Fig. 2. *Dependence of Standard and Poor's 500 (S&P 500) index over time,* $S = (S_n)$, *(after Shiryaev (1998a)).*
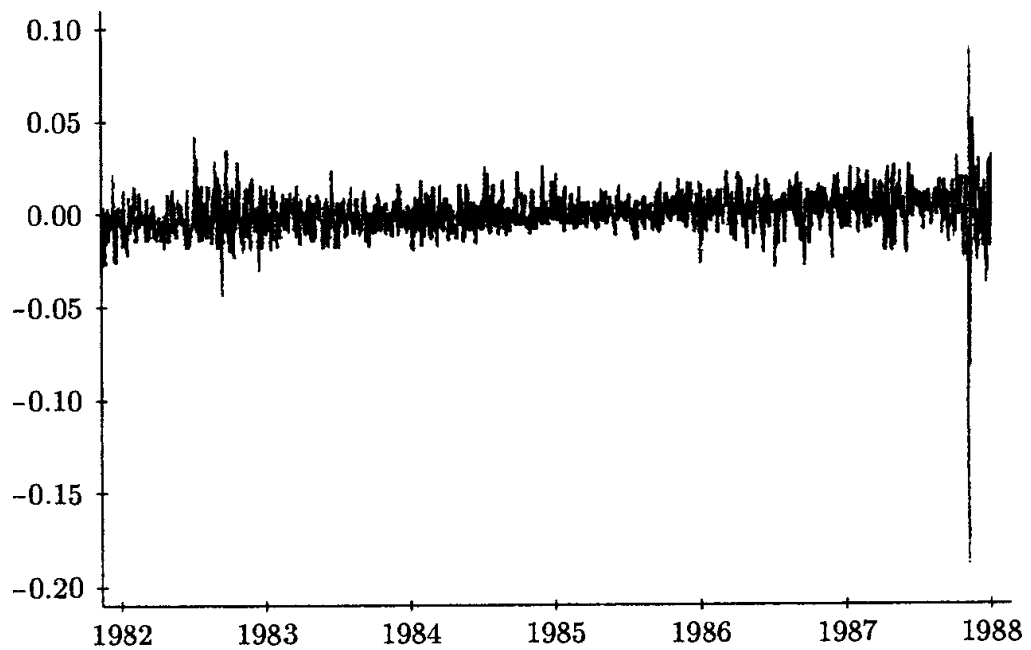
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Fig. 3. *Dependence of Standard and Poor's 500 (S&P 500) index over time,* $h = h_n = \ln \dfrac{S_n}{S_{n-1}}$,

(after Shiryaev (1998a)).

We would like to add that the *stock market indexes* demonstrate a certain dependences on the following important factors:

    1) The *company valuation*;

    2) The *foreign exchange rates*;

    3) The *interest rates*; and

    4) The *prices of strategic commodities*.

    Let us consider the dependences of the *stock market indexes on the company valuation, foreign exchange rates, interest rates and prices of strategic commodities comprehensively.*

Dependence of stock market indexes on company valuation

    Researching the dependence of the stock market indexes on the company valuation, let us begin with the consideration of the ***company valuation techniques,*** which are frequently used for the company's *stock price* valuation. The company valuation is performed in the following cases in *Schnoor (2006)*

    1. *Public Equity Offerings*: How much is a company or division worth in the public markets?

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2. *Debt Offerings*: What is the underlying value of the business or assets against which debt is being issued?

3. *Mergers and Acquisitions*: How much is the target company worth? What is the value of potential synergies?

4. *Divestitures*: How much can a company or division be sold for?

5. *Public Defense*: Is the company undervalued or overvalued in the event of a hostile bid?

6. *Fairness of opinions*: Is the price offered for a company or division fair from a financial point of view?

7. *Research*: Should the firm's clients buy, hold or sell positions in a particular security?

The **Valuation Methodologies** include in *Schnoor (2006)*:

1. *Publicly Traded Company Analysis Methodology*:
   a) Public market valuation,
   b) Value is based on market trading multiples of comparable companies,
   c) Can be regarded as a market's shortcut to a Discounted Cash Flow (DCF),
   d) This methodology does not usually reflect an M&A control premium.

2. *Comparable Transactions Analysis Methodology*:
   a) Focused on change of control situations,
   b) Value is based on multiples paid for the comparable companies in sale transactions,
   c) This methodology includes a control premium.

3. *Discounted Cash Flow Analysis Methodology*:
   a) Represents the intrinsic value of a business,
   b) Requires a detailed financial forecast (usually five to ten years),
   c) Usually the most detailed and intensive methodology to prepare.

4. *Leveraged Buyout Analysis Methodology*:
   a) Variation on a Discounted Cash Flow (DCF) analysis with different assumptions,
   b) Represents the value to a financial / LBO buyer,
   c) Value is based on the Free Cash Flows, Debt Repayment and Return on Investment (*ROI*).

5. *Other Methodologies*:
   a) Liquidation Analysis,
   b) Break up Analysis,

c)   Greenfield / "Cost to Build" Analysis.

The two most common *Measures of Company Value* are in *Schnoor (2006)*

1. *Equity Value*

    a)   Represents the value attributed to the common shareholders of the business

    b)   It is the value remaining after all debt and preferred stock obligations have been satisfied,

    c)   Often called **Market Capitalization,**

    d)   **Market Capitalization** = Diluted Shares O/S x Current Share Price.

2. *Enterprise Value*

    a)   Sometimes referred to as "**Firm Value,**"

    b)   Represents the market value of all capital invested in a business,

    c)   Theoretically, debt and preferred securities should be valued at market, but this is often impractical,

    d)   **Enterprise Value** = Market Capitalization + Net Debt + Preferred Equity + Minority Interest – Long Term Investments,

    e)   Net Debt = Short Term Debt + Long Term Debt + Capitalized Leases – (Cash + Cash Equivalents).

The Tab. 1 illustrates the **Minority Interest** and **Investments** situations in Company A and its three subsidiaries in *Schnoor (2006)*:

	Subsidiary X	Subsidiary Y	Subsidiary Z
Ownership Percentage	100%	30%	75%
Accounting method	Consolidation	Equity Method	Consolidation
Does Subsidiary appear as a Long Term Investment on the Balance Sheet?	No	Yes	No
Does the ownership create Minority Interest on the Balance Sheet?	No	No	Yes

Amount of Minority Interest	0%	0%	25%
Percent of EBITDA included in Company A's EBITDA	100%	0%	100%
Value of Subsidiary Included in Company A's Market Value	100%	30%	75%
Are the previous two rows consistent?	Yes	No	No
Possible adjustments to Reconcile	Not Required	Add 30% of Sub. Y's EBITDA to Co. A's EBITDA **or** reduce Co. A's Market Value by the value of Sub Y	Subtract 25% of Sub. Z's EBITDA from Co. A's EBITDA or increase Co. A's market Value by the value of sub. Z that is not owned
Decision Making criteria	Does Co. A have control over the respective subsidiary?	Does Co. A have control over the respective subsidiary?	Does Co. A have control over the respective subsidiary?
Typical Convention to resolve	None Required	No, so reduce Co. A's Market Value by the value of Sub. Y	Yes, increase Co. A's Market Value by the value of Sub. Z that is not owned

Tab. 1. *Minority Interest and Investments Situations in Company A and its Three Subsidiaries (after Schnoor (2006)).*

The **Equity Value** and **Enterprise Value** can be represented as in *Schnoor (2006)*:

1. Market Basis: **Enterprise Value = Net Debt + Equity Value**,

2. Book Basis: **Assets = Liabilities + Shareholders Equity.**

The **Equity Value Multiples** in *Schnoor (2006)*:

1. Certain ratios or values apply to equity holders only – **Net Income**, **Cash Flow**, and **Book Value,**

2. Since these values are after debt, multiples applied to these values are based only on the value of the equity,

3. Some relevant equity value multiples are:

   a) **Price /Earnings** (P/E),

   b) **Price / Book Value,**

   c) **Price / Cash Flow.**

The **Enterprise Value Multiples** in *Schnoor (2006)***:**

1. Certain ratios or values apply to all capital providers (including debt and equity) – **Revenues**, **EBITDA**, **EBIT,**

2. These values are before the cost of debt, so the relevant multiples should be based on Enterprise Value,

3. Some relevant Enterprise value multiples are:

   a) Enterprise Value / Sales,

   b) Enterprise Value / EBITDA.

The main difference between **Equity Value** and **Enterprise Value** and their respective resolves around the treatment of debt in Tab. 2 in *Schnoor (2006)*.

Equity Value or Enterprise Value

Ratio Denominator	Has Interest been subtracted?	Numerator
Book Value	Yes	Equity Value
Net Income	Yes	Equity Value
Cash Flow	Yes	Equity Value
Revenue	No	Enterprise Value
EBITDA	No	Enterprise Value
EBIT	No	Enterprise Value

Tab. 2. *Equity Value or Enterprise Value (after Schnoor (2006)).*

The **Publicly Traded Comparable Company Analysis** overview in *Schnoor (2006)*:

1. The analysis of publicly traded comparable companies usually consists of a comparison of several companies operating and trading statistics,
2. The exact ratios and values will vary from industry to industry,
3. There is no perfect, consistent template that can be used for any company,
4. Depending on the particular situation, multiples can be calculated in different ways:
   a) Valuation,
   b) Credit Analysis / Liquidity,
   c) Restructuring,
5. Each company has to be analyzed carefully to find adjustments and subtleties,
6. In addition, every senior banker may have preferences for specific ratios or calculations.

The **Pros and Cons of Comparables** are summarized in the Tab. 3 in *Schnoor (2006)*:

PROS	CONS
Provides a benchmark to value a company by referring to other similar public companies	Does not account for "control premiums" nor potential synergies realized in an acquisition
Calculates valuation multiples based on current market conditions	May not reflect fundamental value in thinly traded, small capitalization or poorly followed stocks
Takes into account industry trends and growth prospects	For many companies, there are few, if any, good comparable companies
Provides insight into key valuation multiples for an industry	Does not explain market inefficiencies
Serves as a reliable value indicator for a minority investment	

Tab. 3. *Pros and Cons of Comparables (after Schnoor (2006)).*

The key to choosing appropriate comparables or compiling useful trading comparables is to first identify companies that are considered comparable based on the following criteria's in *Schnoor (2006)*:

1. **Operational Criteria's**:
   a) Industry,
   b) Products,
   c) Distribution Channels,
   d) Customers,
   e) Seasonality,
   f) Cyclicality,
   g) Geographic Location.

2. **Financial Criteria's:**
   a) Size,
   b) Leverage,
   c) Profit Margins,
   d) Growth Prospects,
   e) Shareholder Base,
   f) Risk Profile.

The **Sources for Identifying Comparable Companies** include in *Schnoor (2006)*:
1. SIC Code Screens,
2. Equity Research,
3. 1—K/Annual Report,
4. Proxy Statement,
5. Other Bankers,
6. Client.

The **Time Period** in a comparable analysis depends on the company, industry, and practices of different groups. Forecast multiples are generally more important than historical multiples, because investors pay for future earnings. However, historical data is usually more complete, and is often relied upon as well in *Schnoor (2006)*:
1. **LFY-1**: Latest fiscal year minus one
2. **LFY**: Latest fiscal year
3. **LTM**: Last twelve months

4. **LFY+1**: Forecast for the next fiscal year

5. **LFY+2**: Forecast for the year after next

The **Time Period Adjustments**: LTM Income Statement and Cash Flow Statement values are calculated as follows in *Schnoor (2006)*:

LTM = Fiscal Year Ended 12/31/2005 – Q1 Ended 3/31/2005 + Q1 Ended 3/31/2006

In future periods, if the companies don't all have the same year end, forecasts should be calendarized to make them comparable:

1. If Company A has a September 30 year end, and all its peers have a December 31 year end, Company A's forecast should be calendarized

2. Earnings per Share estimates for Company A are as follows:

   a) Fiscal 2006: $1.59

   b) Fiscal 2007: $1.86

3. Calendar 2006 EPS = (3/4 *1.59 + ¼ * 1.86) = $1.66

The **Income Statement Items** include in Tab. 4 in *Schnoor (2006)*:

Income Statement and Cash Flow Items

Item	Comments
Revenues	1. Should only include revenue from the sale of the company's goods and services 2. Exclude interest and other income 3. If a company reports **Gross** and **Net Revenue**, use **Net Revenue**
EBITDA	1. The most common performance measure among investment bankers 2. Serves as a pre-tax proxy for cash flow generated from operations 3. **EBITDA** and **EBIT** multiples attempt to normalize for differences in companies capital structures

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	4. The comparable analysis model calculates **EBITDA** by adding **EBIT** and **D&A**
Depreciation and Amortization	1. Includes depreciation for **PP&E**, goodwill amortization, and items such as depletion for mining companies 2. Do not include amortization of debt issuance costs as these figures are typically included in interest expense
EBIT	1. Must exclude special charges, non-recurring items and discontinued operations
Earnings per Share	1. Usually looked at after preferred dividends and extraordinary items 2. Needs to be adjusted after-tax for any non-recurring items 3. Used for the calculation of **Price/Earnings** multiples
Cash Flow	**1. Net Income + Deferred Taxes + D&A + Other non-cash items** 2. Measure of cash generated by a company after leverage and taxes, but generally before working capital items 3. A closer approximation of the cash generated by a company's operations

Tab. 4. *Income Statement and Cash Flow Items (after Schnoor (2006)).*

The **Balance Sheet Items** include Tab. 5 in *Schnoor (2006)*:

Balance Sheet Items

Balance Sheet Items	Comments
Cash and Marketable Securities	1. Includes cash and cash equivalents 2. Check for any long-term investments in marketable securities
Short-Term Debt	1. Includes notes payable, commercial paper, linesof credit, bank overdrafts, current portion of long-term debt and capital leases
Long-Term Debt	1. Includes long-term debt and capitalized lease obligations
Minority Interest	1. Includes the minority interest as it appears on the balance sheet 2. Represents the portion of earnings that are attributable to shareholders owning less than 50% of a subsidiary
Preferred Shares	1. Includes Preferred Stock on the company's balance sheet that has debt-like characteristics
Convertible Securities	1. If the security is in the money, treat as equity 2. If the security is out of money, treat as debt
Common Equity	1. Includes common stock, paid-in capital and retained earnings 2. Do not confuse with shareholders' equity, which generally includes preferred stock – confirm your group's definition of these categories
Shareholders' Equity	1. Includes the Common Equity described above, plus the book value of preferred stock that is considered equity

Tab. 5. Balance Sheet Items (after Schnoor (2006)).

The **Shares Outstanding Values** used in **Comparable Company Analysis**. The following are the **Shares Outstanding Values** that are required in the comparable company analysis model in Tab. 6 in *Schnoor (2006)*:

Shares Outstanding Definitions

Shares Outstanding Category	Comments
Basic Shares Outstanding as of Comp date	1. Represents the total number of shares issued and outstanding as of the comp date 2. Start with the **Basic Shares Outstanding** as of the latest balance sheet date and check press releases to see if any shares have been issued or redeemed since the last balance sheet date 3. Used to calculate the company's market capitalization
Fully Diluted Shares Outstanding as of the Comp Date	1. This number is calculated in the comp model 2. The basic shares outstanding is added together with the total number of in-the-money options to arrive at this value
LTM Weighted Average Fully Diluted Shares Outstanding	1. This number is typically found in the notes to the financial statements 2. Used to calculate **Earnings per Share** and **Cash Flow per Share**

Tab. 6. Shares Outstanding Definitions (after Schnoor (2006)).

The **Performance Ratios** include the following profitability ratios, which are often used when analyzing a company in Tab. 7 in *Schnoor (2006)*:

Profitability Ratios

Profitability Ratio	Definition
Return on Equity	ROE = Net Income / Common Equity
Gross Margin	Gross Margin = Gross Profit / Net Sales
EBITDA Margin	EBITDA Margin = EBITDA / NET Sales
EBIT Margin	EBIT Margin = EBIT / Net Sales
Net Income Margin	NI Margin = Net Income / Net Sales

Tab. 7. Profitability Ratios (after Schnoor (2006)).

The **Valuation Ratios** include the following ratios, which are often used when analyzing a company in Tab. 8 in *Schnoor (2006)*:

Valuation Ratios

Valuation Ratio	Definition
Price / Earnings (P/E)	P/E = Current Share Price / Fully Diluted EPS
Price / Cash Flow	P/CF = Current Share Price / (F/D) Operating CFPS
Price / Book Value	P/BV = Current Share Price / Book Value per Share
Enterprise Value / Revenue	EV/Rev = Enterprise Value / Revenue
Enterprise Value / EBITDA	EV / EBITDA = Enterprise Value / EBITDA
Enterprise Value / EBIT	EV/EBIT = Enterprise Value / EBIT

Tab. 8. Valuation Ratios (after Schnoor (2006)).

The **Credit Ratios** include the following ratios, which are often used to assess a company's debt capacity, and may also provide insight into a company's trading performance in Tab. 9 in *Schnoor (2006)*:

Credit Ratios

Credit Ratios	Definition
Net Debt / Total Cap (Book)	Debt / Cap (Book) = Net Debt / Capitalization (Book)
Net Debt / Total Cap (Market)	Debt / Cap (Market) = Net Debt / Capitalization (Market)
EBITDA / Interest	EBITDA / Interest = EBITDA / Interest Expense
(EBITDA – CAPEX) / Interest	(EBITDA – CAPEX) / Interest = (EBITDA – CAPEX) / Interest
Total Debt / EBITDA	Debt / EBITDA = Total Debt / EBITDA

Tab. 9. Credit Ratios (after Schnoor (2006)).

Adjusting for the Operating Leases: When calculating **Credit Ratios**, you may need to capitalize a company's operating leases to make the company comparable with its peers in *Schnoor (2006)*:

1. An **Operating Lease** is a lease for which the lessee acquires the property for only small portion of its useful life.
2. A **Capital Lease** is a lease that meets one or more of the following criteria, and as such is classified as a purchase:
   a) The lease term is greater than 75% of the property's estimated economic life
   b) The lease contains an option to purchase the property for less than fair market value
   c) Ownership of the property is transferred to the lessee at the end of the lease term
   d) The present value of the lease payments exceeds 90% of the fair market value of the property
3. An Operating Lease would be capitalized as follows:

a) The operating lease expense (which can be found in the notes to the financial statements) would usually be multiplied by a ratio of 6.0x – 8.0x

b) This capitalized value would get added to the company's debt

c) The operating lease expense would then be subtracted from the company's costs to arrive at a higher EBITDA

d) This adjustment is not normally done, when calculating trading multiples

Adjusting for the Securitizations: It may also be necessary to adjust for any securitized assets in *Schnoor (2006)*:

1. If a company has securitized some assets, you may need to add these assets back to the balance sheet
   a) This value can be found in the notes to the financial statements
   b) Add the assets back to the appropriate working capital item
   c) Subtract the corresponding amount from the cash line (or add the corresponding amount to the company's debt)
2. These adjustments are made for comparison purposes so that you are comparing companies on an apples-to-apples basis.

The **Important Reminders**, when preparing **Comparable Company Analysis** in *Schnoor (2006)*:

1. Eliminate non-recurring items that are recorded before NI:
   a) Restructuring Charges / one-time write offs
   b) Gains or losses on the sale of assets
   c) Read all footnotes and MD&A carefully to find these items
2. Tax-effect all adjustments:
   a) Check *MD&A* and footnotes for actual tax impact, if available
   b) If not available, use the company's marginal tax rate
3. D&A may be buried in COGS or SG&A, so look at the Cash Flow Statement
4. Make sure to understand the company's pension liability
5. Double check all calculations = perform reality checks
6. Use most current financials to check historical data
7. Include Marketable Securities in Cash
8. Subtract Long-Term Investments when calculating Enterprise Value
9. Calendarize earnings estimates

The **Analytical Trouble Shooting**: Read all disclosures carefully and be prepared to adjust for the following types of occurrences in *Schnoor (2006)*:

1. Stock splits, Dividends and Repurchases
2. Non-calendar year ends (EPS estimates)
3. Cash (Long-term investments)
4. Recent acquisitions and divestitures – pro forma numbers
5. Changes in earnings estimates
6. Differences in accounting treatment
7. Non-recurring items
8. Recent debt or equity offerings
9. Temporary sector reactions
10. Take-over activity among competitors
11. Conversion of convertible securities since the last reporting period
12. Differences in international accounting treatment.

Let us consider the *Comparable Transactions Analysis* in *Schnoor (2006):*

1. The ***Comparable Transactions Analysis*** provides some information on the transactions, which are completed in the same industry as the company being valued

2. *The **Comparable Transaction Multiples*** provide insight into:
   a) ***Premiums***, which are paid by the acquirers to gain a control over the target companies, and
   b) ***Potential for synergies***.

3. The ***Comparable Transaction Multiples*** preparation, may require the consideration of the following data:
   1. The ***industry of the company*** being valued, in order to properly screen transactions,
   2. The ***time frame of specific transactions*** – typically you want transactions that have been consummated in the past few years,
   3. The ***status of past transactions***:
      a) Successfully completed transaction,
      b) Pending transaction,
      c) Terminated transaction,
      d) Consideration: Cash vs. Stock exchange,
      e) Hostile vs. Friendly bids.

The attention has to be paid to the following **Transaction Issues** in *Schnoor (2006)*:

1. Two types of transaction multiples are usually calculated:
   a) **Financial Multiples** (Enterprise Value / LTM EBITDA)
   b) **Industry Specific** Multiples (Enterprise value / annual Production)
2. Comparable transaction analysis provides insight into the M&A activity in a specific industry
   a) Activity relative to the overall market
   b) Who is buying, and what are they buying?
   c) What kinds of premiums are buyers paying?
3. Provides an understanding of the events surrounding specific transactions:
   a) Hotly contested transactions
   b) Privately- negotiated friendly deals
   c) Major transactions that impact an entire industry
   d) Timing of transactions relative to specific business cycles

The **Sourcing Precedent Transactions**: The following sources can be used to identify appropriate comparable transactions in *Schnoor (2006)*:

1. M&A Databases – SDC, Internal databases
2. Previous analysis prepared by specific industry groups
3. Industry periodicals and news articles
4. Acquisitions footnotes in the annual reports of public companies
5. Tender offer documents
6. Equity research analysts
7. Senior investment bankers
8. Client

The Use of Comparable Transaction Multiples (Comparables) to Derive Value in *Schnoor (2006)*:

1. The first stage is to calculate the relevant multiples for each comparable company
2. Then, to determine which multiples or range of multiples justify a reasonable benchmark for valuing the specific target
3. Analyze the results to decide which companies are most comparable:
   a) Exclude outlying multiples

b) Test for reasonableness and use common sense

4. Look at mean and median multiples, mean excluding high and low multiples, and multiples of specific companies that may be most relevant

5. Use judgement to determine, which ratios are most relevant given the company and the nature of its industry

The following table contains **Comparable Trading Multiples** for sample companies, which will be used to value a target company in Tab. 10 in *Schnoor (2006)*:

Comparable Trading Multiples

	Price 07/10/06	Mkt. Cap. (US$MM)	EV (US$MM)	Debt/ Total Cap.	EV/ EBITDA 2005	EV/ EBITDA LTM	EV/ EBITDA 2006E	P/BV LTM
Company 1	$14.05	$2,679	$4,467	40%	11.2x	11.1x	10.9x	0.9x
Company 2	$11.05	$2,024	$3,218	37%	16.7x	12.0x	9.5x	1.3x
Company 3	$9.40	$706	$1,301	46%	8.0x	6.0x	4.8x	0.7x
Company 4	$33.50	$1,887	$3,840	51%	11.8x	9.0x	6.7x	1.6x
Company 5	$42.50	$4,062	$7,394	45%	11.5x	11.5x	8.0x	1.3x
Company 6	57.63	$11,467	$20,018	43%	9.7x	9.7x	5.5x	2.5x
Average				**44%**	**11.5**	**9.9x**	**7.6x**	**1.4x**
Average Excluding Hi & Low				**43%**	**11.0x**	**10.3x**	**7.4x**	**1.3x**

Tab. 10. Comparable Trading Multiples (after Schnoor (2006)).

The following table contains **Comparable Transaction Multiples** for sample transactions which will be used to value a target company in Tab. 11 in *Schnoor (2006)*:

Comparable Transaction Multiples

Date	Acquirer	Target	EV Paid (US$MM)	Target's Capacity (000units)	LTM EBITDA (US$MM)	EV per Unit (US$/unit)	EV per EBITDA
2005	Company A	Company B	$995	885	$80	$1,124	12.4x
2004	Company C	Company D	$594	440	$52	$1,350	11.4x
2003	Company E	Company F	$882	875	$91	$1,008	9.7x
2002	Company G	Company H	$3,875	2,463	$291	$1,573	13.3x
2002	Company I	Company J	$450	250	$31	$1,800	14.5x
	Median					**$1,350**	**12.4x**
	Mean					**$1,371**	**12.3x**
	Mean Excluding Hi & Low					**$1,349**	**12.4x**

Tab. 11. *Comparable Transaction Multiples (after Schnoor (2006)).*

The following table uses the **Comparable Trading Multiples** and **Comparable Transaction Multiples** from the previous pages to value a sample target company in Tab. 12 in *Schnoor (2006)*:

Summary Value Table

Methodology	Target Company's Values	Multiple Range	Value (US$ Millions)
Trading Multiples LTM EBITDA 2006E EBITDA	 $88 (US$/MM) $102 (US$/MM)	 9.5x – 10.5x 7.0x – 8.0xx	 9.5x88=836 – 924 7.0x102=714 – 816
Summary Enterprise Values			(836+714)/2=**$775** -**$870**
Transaction Multiples LTM EBITDA Annual Capacity	 $88 (US$/MM) 600 (000 units)	 12.0x – 12.5x $1,300-$1,400	 12x88=1,056 – 1,100 1,300x600=780 – 840
Summary Enterprise Values			**$918 - $970**
Summary Enterprise Value Range Less: Net Debt Equity Value SharesOutstanding(MM)			**$847 - $920** $250 847-250=$597 - $670 55.7
Equity Value perShare			597/55.7=**$10.70 -$12.00**

Tab. 12. *Summary Value Table (after Schnoor (2006)).*

The **Important Considerations** have to be taken to the account during the above calculations see the **Summary Value Table** in *Schnoor (2006)*:

1. Multiply the **Operating Results** of the company to be valued by relevant comparable company **Multiples**:

   a) Use a few time periods – i.e. LTM, forecast years

   b) Select relevant multiple ranges for each period

2. Convert derived **Equity Values** to **Enterprise Values** by adding the target's ne debt

a) Net Income / EPS multiples

b) Book Value Multiples

3.   Convert derived **Enterprise Values** to **Equity Values** by subtracting the target's net debt

a) Sales Multiples

b) EBITDA Multiples

4.   A range of values, **Value Range**, is usually calculated based on high, mean and low summary multiples.

Finally, let us summarize some important definitions of used terms:

1. Consolidated income statement: revenues (include product sales, contract research, royalty and interest income); Earnings Before Interest, Income Taxes, Depreciation and Amortization (EBITDA), depreciation and amortization, EBIT, earnings per share, cash flow from operating, investing, financing activities;

2. Consolidated balance sheet: total assets, total liabilities, total equity, net assets, cash and marketable securities, short term debt, long term debt, minority interest, preferred shares, convertible securities, common equity, shareholder equity;

3. Consolidated statement of recognized income and expense: currency translation on foreign currency net investments, amounts charged to hedging reserve, actuarial gains/losses on pension schemes, current tax on items taken directly to equity, deferred tax on items taken directly to equity, net income recognized directly in equity, profit, total recognized income and expense;

4. Reconciliation of underlying earnings per share: profit, preference dividends, net financing credit, market value movements on derivatives, amortization of assets;

5. Performance ratios: return on equity, profit margin (it represents after-tax income as percentage of revenues), gross margin, EBITDA margin, EBIT margin, net income margin;

6. Valuation ratios: price / earnings, price cash / flow, price / book value, enterprise value / revenue, enterprise value / EBITDA, enterprise value / EBIT;

7. Credit ratios: net debt / total capitalization (book), net debt / total capitalization (market), EBITDA / interest, EBITDA – CAPEX / Interest, total debt / EBITDA;

8. Other ratios: consumer financial obligations ratio measures all consumer credits, including credit cards, auto loans, durable goods payment plans (published by *Federal Reserve*); mortgage financial obligations ratio measures mortgage debt as a share of personal disposable income.

Dependence of stock market indexes on exchange rates

Researching **the dependence of the stock market indexes on the exchange rates**, *Bartram, Bodnar (2009)* investigated the impact by the exchange rate risk on the stock indexes returns, arguing that the return premium is directly related to the size and sign of the subsequent exchange rate change and suggesting that the fluctuations in the exchange rates represent a source of time-variation in the currency risk premia. *Bartram, Bodnar (2009)* write: "A fundamental issue in modern global finance is the degree to which exchange rate fluctuations influence firms' stock returns. Of course changes in exchange rates can affect stock returns either by altering firms' expected cash flows or the cost of capital used to discount these cash flows."

Fig. 4 shows the predicted relation between foreign exchange rate exposure and stock returns, and Figs. 5 and 6 present the actual relation between the exchange rate exposure and the stock returns for all the firms and in *Bartram, Bodnar (2009)*.

Tab. 13 provides the descriptive sample statistics in *Bartram, Bodnar (2009)*.
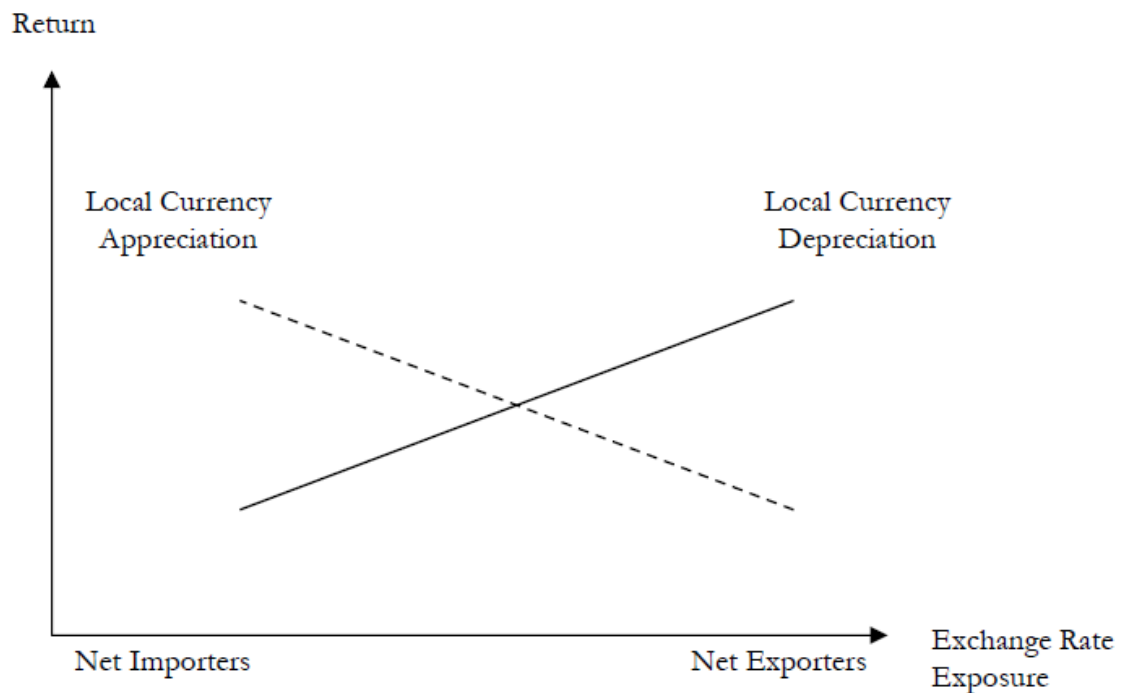
Fig. 4. *Predicted relation between foreign exchange rate exposure and stock returns (after Bartram, Bodnar (2009)).*
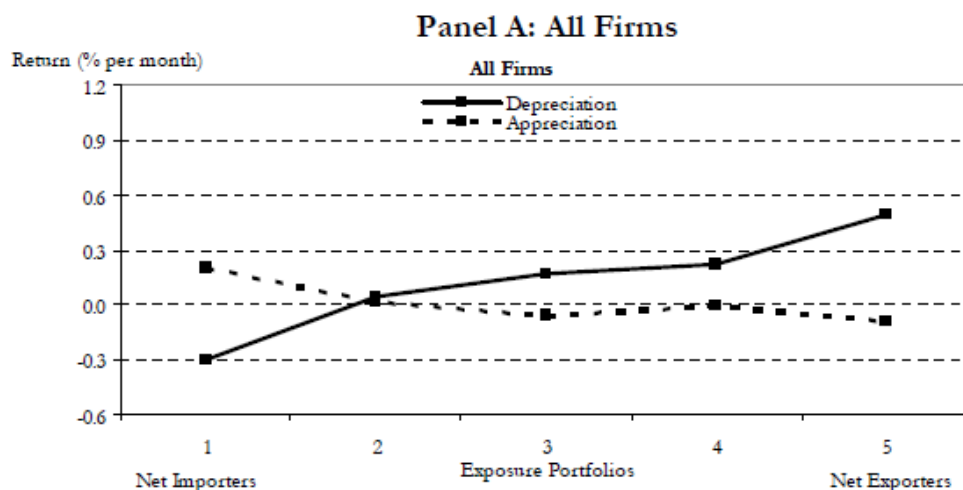
Panel A: All Firms

Fig. 5. *Actual relation between exchange rate exposure and stock returns for all firms (after Bartram, Bodnar (2009)).*
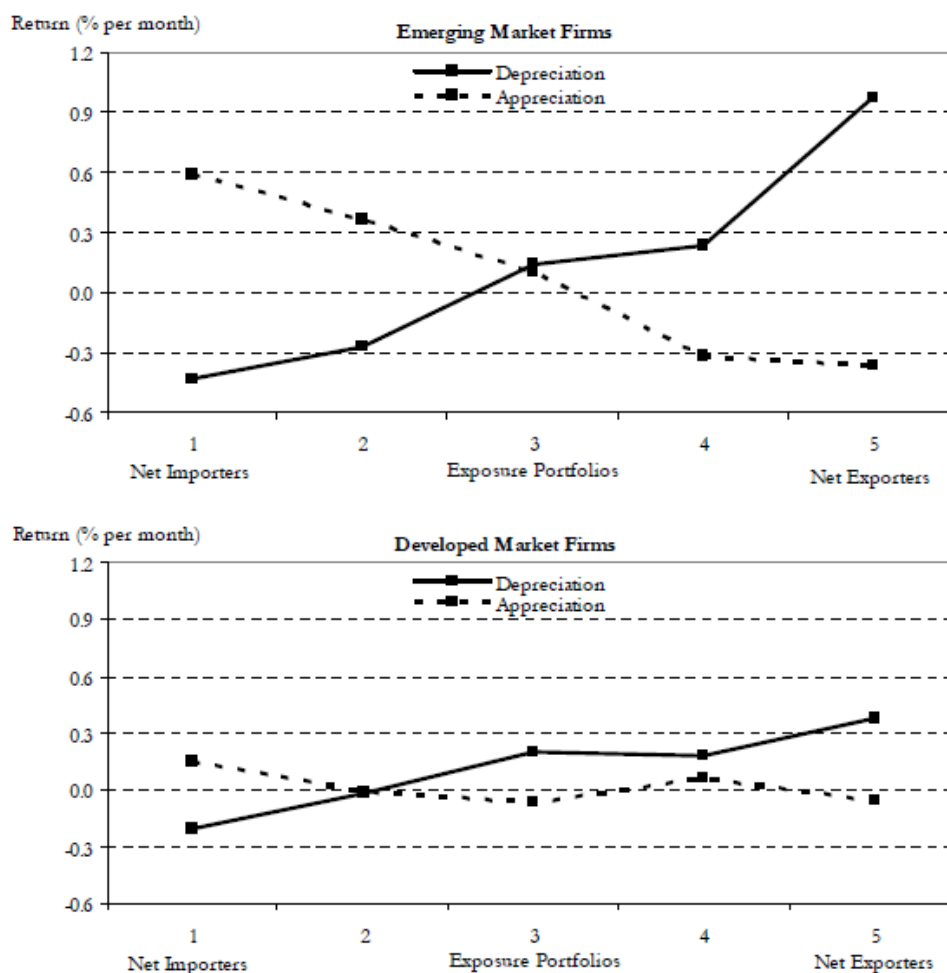

Fig. 6. *Actual relation between exchange rate exposure and stock returns for emerging and developed market firms (after Bartram, Bodnar (2009)).*

	N	Percentage positive	negative	Mean	Median	Std. Dev.	Skewness	Kurtosis	Minimum	Maximum
Panel A: All firms (37 countries)										
All Periods										
Stock returns	591,949	55.6	44.4	0.86	0.71	11.70	-0.01	5.06	-63.68	65.48
Market indices	591,949	61.0	39.0	0.80	1.30	5.67	-0.30	5.56	-50.16	57.96
Exchange rates	591,949	51.8	48.2	0.08	0.01	2.50	3.36	71.75	-29.53	64.47
Local Currency Depreciation										
Stock returns	306,863	56.4	43.6	0.97	0.84	11.61	-0.04	5.09	-63.68	65.48
Market indices	306,863	61.1	38.9	0.88	1.30	5.65	-0.28	8.04	-50.16	57.96
Exchange rates	306,863	100.0		1.49	0.92	2.28	9.61	165.02	0.00	64.47
Local Currency Appreciation										
Stock returns	285,086	54.8	45.2	0.73	0.57	11.80	0.03	5.03	-63.68	65.48
Market indices	285,086	60.9	39.1	0.71	1.30	5.70	-0.32	3.00	-36.20	42.89
Exchange rates	285,086		100.0	-1.44	-0.97	1.73	-4.25	31.00	-29.53	-0.01

	N	Percentage positive	negative	Mean	Median	Std. Dev.	Skewness	Kurtosis	Minimum	Maximum
Panel B: Emerging market firms (14 countries)										
All Periods										
Stock returns	92,351	56.3	43.7	1.16	0.49	14.32	0.15	3.70	-63.68	65.48
Market indices	92,351	58.7	41.3	1.17	1.48	8.59	-0.05	4.28	-50.16	57.96
Exchange rates	92,351	52.3	47.7	0.44	0.08	4.42	4.07	42.82	-29.53	64.47
Local Currency Depreciation										
Stock returns	48,334	52.8	47.2	-0.04	0.00	14.80	0.00	3.46	-63.68	65.48
Market indices	48,334	52.8	47.2	0.06	0.36	9.24	-0.01	4.82	-50.16	57.96
Exchange rates	48,334	100.0		2.57	1.25	4.71	6.05	49.40	0.00	64.47
Local Currency Appreciation										
Stock returns	44,017	60.2	39.8	2.49	1.41	13.65	0.43	3.93	-63.68	65.48
Market indices	44,017	65.1	34.9	2.37	2.44	7.63	0.09	2.61	-36.20	42.89
Exchange rates	44,017		100.0	-1.90	-1.23	2.50	-4.10	24.76	-29.53	-0.01
Panel C: Developed market firms (23 countries)										
All Periods										
Stock returns	499,598	55.5	44.5	0.80	0.74	11.15	-0.08	5.21	-63.68	65.48
Market indices	499,598	61.4	38.6	0.73	1.30	4.95	-0.56	2.29	-34.50	34.52
Exchange rates	499,598	51.7	48.3	0.02	0.00	1.95	-0.77	7.70	-15.22	8.71
Local Currency Depreciation										
Stock returns	258,529	57.1	42.9	1.16	1.02	10.90	-0.01	5.24	-63.68	65.48
Market indices	258,529	62.7	37.3	1.03	1.41	4.66	-0.28	2.50	-32.71	34.52
Exchange rates	258,529	100.0		1.29	0.86	1.33	1.83	4.29	0.00	8.71
Local Currency Appreciation										
Stock returns	241,069	53.8	46.2	0.41	0.44	11.40	-0.14	5.16	-63.68	65.48
Market indices	241,069	60.1	39.9	0.41	1.13	5.22	-0.74	1.94	-34.50	22.24
Exchange rates	241,069		100.0	-1.35	-0.92	1.54	-3.71	23.24	-15.22	-0.01

Tab. 13. *Descriptive sample statistics: number of observations (N), percentage of positive and negative observations, mean, median, standard deviation, skewness, kurtosis, maximum and minimum values of all variables used in the analysis (after Bartram, Bodnar (2009)).*

Completing the comprehensive research on the relation between the foreign exchange rate exposures and the stock returns, based on a large sample of non-financial firms from the *37* countries around the world, including the *United States*, *Bartram, Bodnar (2009)* state that the *exchange rate exposure* is an important, systematic variable in the return generating process. *Bartram, Bodnar (2009)* write*: "Given the increasing trend of globalization of business activities, these results have important implications for asset pricing, corporate finance and risk management. They suggest that investors should be cognizant of the fact that exchange rates are an important risk factor for firms and that this risk factor translates into non-trivial conditional return premia in most cases."*

Alagidede, Panagiotidis, Xu Zhang (2010) investigated the nature of the causal linkage between the stock markets and the foreign exchange markets in *Australia, Canada, Japan, Switzerland*, and *UK* from *1992:1* to *2005:12*. *Alagidede, Panagiotidis, Xu Zhang (2010)* conducted the *co-integration tests* and found no evidence of a long-run relationship between the variables. Also, *Alagidede, Panagiotidis, Xu Zhang (2010)* carried the three variations of the *Granger causality test* and found the causality from the exchange rates to the stock prices for *Canada, Switzerland*, and *United Kingdom*; the weak causality in the other direction was found only for the *Switzerland*. The *Hiemstra-Jones test* was used to examine a possible nonlinear causality and the results indicated the causality from the stock prices to the exchange rates in *Japan* and the weak causality of the reverse direction in *Switzerland* in *Alagidede, Panagiotidis, Xu Zhang (2010)*.

Tabak (2006) researched the relationship between stock prices and exchange rates. *Tabak (2006)* found that there is no long term relationship, but there is a linear *Granger* causality from stock prices to exchange rates in accordance with the portfolio approach: the stock prices lead the exchange rates with the negative correlation. In addition, *Tabak (2006)* found that there is a nonlinear *Granger* causality from exchange rates to stock prices in agreement with the traditional approach: the exchange rates lead the stock prices in *Granger (1969)*.

In the *econometrics*, there are many mathematical tests, which are applied to research the possible interconnections between the *stock prices* and the *exchange rates*: *1)* stationarity test, *2) Augmented Dickey and Fuller (ADF) unit root test* in *Dickey, Fuller (1981), 3) Phillips-Perron (PP) test* in *Phillips (1987), Phillips, Perron (1988), 4) Johansen co-integration test* in *Johansen (1988), Johansen, Juselius (1990), 5) Granger causality test* in *Granger (1969)* and many others.

Hartmann, Pierdzioch (2006) proposed that there are the nonlinear links between the stock returns and the exchange rate oscillations.

The influences by the exchange rate risk on the stock indexes returns have also been researched in a classic research work by *Granger (1969)*, and by other researchers in *Aggarwal (1981), Soenen, Hennigar (1988), Giovannini, Jorion (1989), Jorion (1991), Loudon (1993), Bailey, Chung (1995), Prasad, Rajan (1995), Ajayi, Mougoue (1996), Issam, Abdalla, Murinde (1997), Yu Q (1997), Chow, Lee, Solt (1997), Choi, Hiraki, Takezawa (1998), Ajayi, Friedman, Mehdian (1998), Granger, Huang, Yang (2000), Nieh, Lee (2001), Stavarek (2004), Kolari, Moorman, Sorescu (2005), Phylaktis, Ravazzolo (2005).*

Dependence of stock market indexes on interest rates

We would like to emphasis that the *interest rates* fluctuating changes may have a considerable influence on the *stock market indexes*.

Hyde (2007) researched the sensitivity of stock returns at the industry level to market, exchange rate and interest rate shocks in the four major *European* economies: *France, Germany, Italy and the UK. Hyde (2007)* writes: "According to financial theory changes in exchange rates and interest rates should affect the value of the firm." *Hyde (2007)* concludes: "This study clearly establishes that industries in *France, Germany, Italy* and the *UK* face significant market and exchange rate risks; and industries in *France* and *Germany* face significant interest rate risk."

Tabak (2006) writes: "Finally, nonlinearities in government monetary policies may be another factor, which would explain nonlinearities in the relationship between stock and exchange rate prices. Figure 7 presents the official short term interest rate in the Brazilian economy during the period in analysis. As we can see, there have been many jumps in these interest rates, mainly in the period before the devaluation, which intended to reduce capital outflows and maintain a certain level of international reserves."
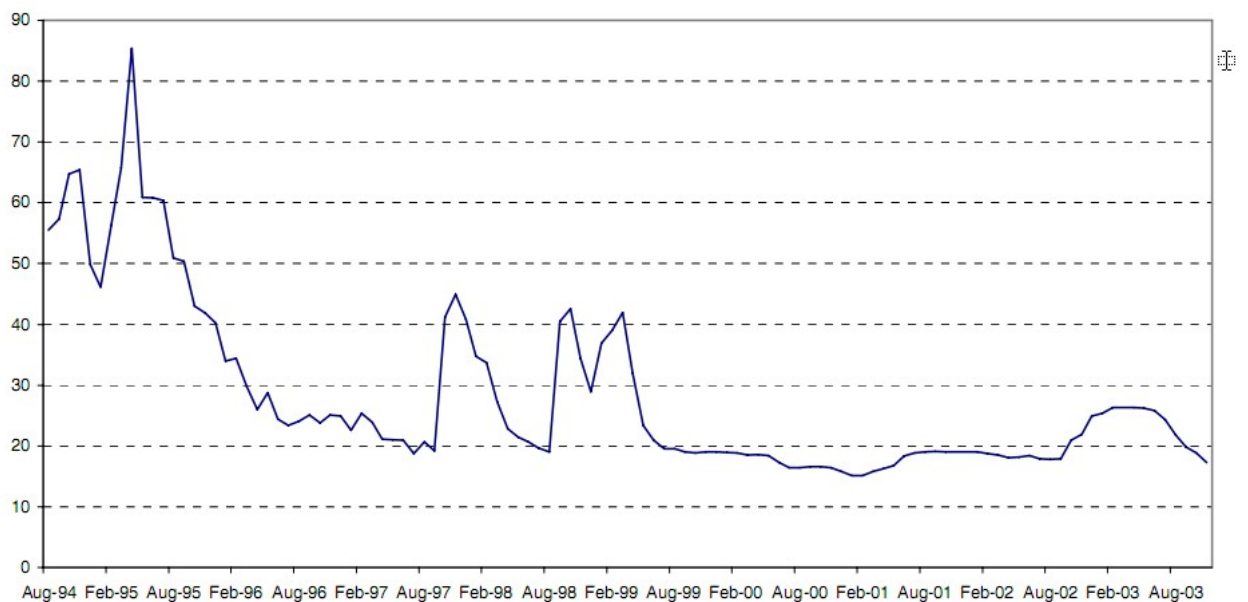
Fig. 7. *Official interest rates in Brazil (after Tabak (2006))*

Dependence of stock market indexes on strategic commodities

Considering ***the dependence of the stock market indexes on the strategic commodities***, *Thai-Ha Le and Youngho Chang (2011a, b)* researched the relationships between the oil price, the gold price and the financial variables, including the interest rates, exchange rates and stock prices, in a major oil-consuming and gold-holding country such as *Japan. Thai-Ha Le, Youngho Chang (2011b)* analyzed the early research findings in *Hamilton (1983)*, *Gisser, Goodwin (1986)*, *Fortune (1987)*, *Mork (1989)*, *Sjaastad, Scacciallani (1996)*, *Chan, Faff (1998)*, *Cai, Cheung, Wong (2001)*, *Guo, Kliesen (2005)*, *Basher, Sadorsky (2006)*, *Sjaastad (2008)*, *Park, Ratti (2008)*, *Breitenfellner, Crespo (2008)*, *Kilian, Park (2009)*, *Wang M L, Wang C P, Huang (2010)*, *Lizardo, Mollick (2010)*, presenting the correlation matrix. *Thai-Ha Le, Youngho Chang (2011b)* write: "The choice of financial variables are made based on the theoretical macroeconomic basis that *interest rate* is a variable that captures the monetary policy instrument, *exchange rate* is an important transmission channel in an open economy, and *stock market* is an indicator of the health of an economy." *Thai-Ha Le and Youngho Chang (2011b)* conclude by making the following statements: "Our results suggest that in the long run, gold price and the *Japanese* stock price have significantly positive impacts on the *Japanese* interest rate. This implies that rises in the price of gold and stock could help form expectations of increasing inflation over time, which eventually leads to an increase in interest rate in the long run. In the meantime, higher inflation is often thought to associate with the depreciation of the domestic currency (i.e. the *Japanese* yen) against major currencies." As it can be seen from the article, *Thai-Ha Le and Youngho Chang (2011b)* believe that the realization of investment strategies towards the increasing investments in the gold and oil strategic commodities along with the investments in the stocks can stabilize the investment portfolios, which are formed by the investors at the *Japanese* stock exchanges in the long term perspectives.

Fig. 8 shows the *Japan's* oil consumption by year (*1980-2010*), and Fig. 9 represents the Japan's gold reserves (*1950-2011*) *in Thai-Ha Le and Youngho Chang (2011b).*

Tab. 14 includes the descriptive statistics of series, and Tab. 15 presents the correlation matrix (in log level) *in Thai-Ha Le and Youngho Chang (2011b).*
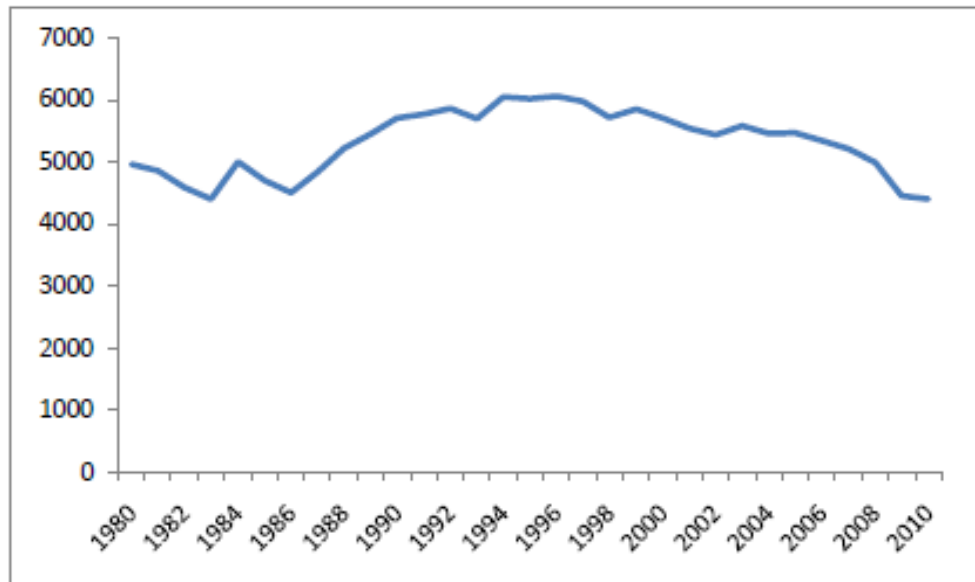
Fig. 8. *Japan's oil consumption by year (1980-2010) (after Thai-Ha Le and Youngho Chang (2011)).*
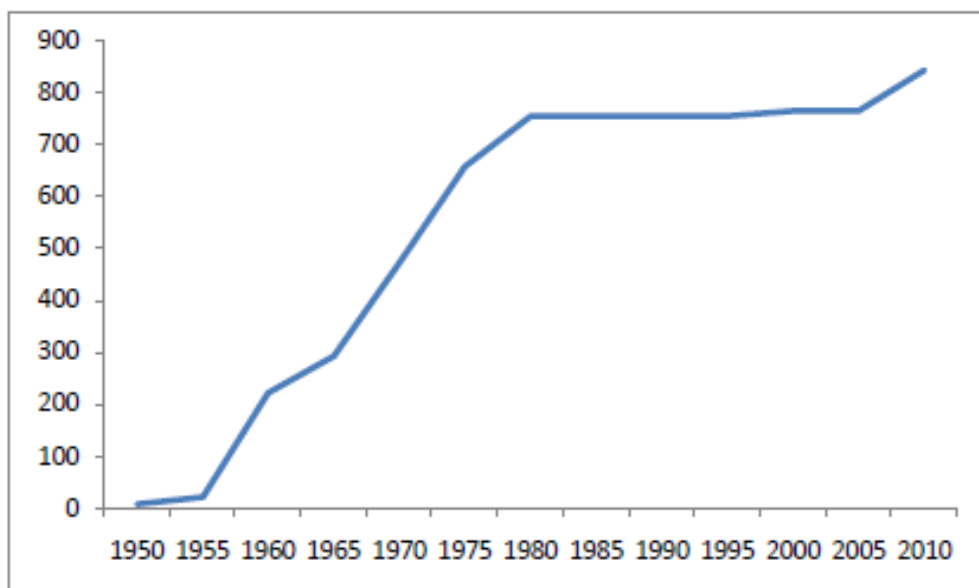
Fig. 9. *Japan's Gold Reserves (1950-2011) (after Thai-Ha Le and Youngho Chang (2011)).*

	Gold price	Oil price	Stock price	Exchange rate	Interest rate
Level					
Mean	54537.52	3938.171	115.3462	118.7690	1.846506
Std. dev.	21545.53	2397.475	34.46711	18.98073	2.415065
Skewness	0.981081	1.551602	0.780172	0.739332	1.176576
Kurtosis	3.047719	4.878465	3.443337	4.261368	3.141187
Jarque-Bera	48.47549	165.5778	33.10954	47.53349	69.92888
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	302	302	302	302	302
Log					
Mean	10.83652	8.131502	4.705064	4.764884	-1.358454
Std. dev.	0.367199	0.519025	0.292862	0.156310	2.874324
Skewness	0.449856	0.645148	0.063841	0.177786	-0.697807
Kurtosis	2.148535	2.584738	2.550319	3.290633	2.333622
Jarque-Bera	19.30881	23.11944	2.749650	2.653821	29.99711
Probability	0.000064	0.000010	0.252884	0.265296	0.000000
Observations	302	302	302	302	301
First difference of log					
Mean	0.001255	0.001818	-0.000289	-0.002943	-0.013366
Std. dev.	0.037407	0.086545	0.049947	0.027620	0.360691
Skewness	0.040842	-0.647030	-0.479338	-0.412149	1.369446
Kurtosis	4.013493	6.594339	4.683407	3.532176	17.92842
Jarque-Bera	12.96608	183.0314	47.06787	12.07358	2869.891
Probability	0.001529	0.000000	0.000000	0.002389	0.000000
Observations	301	301	301	301	299

Tab. 14. *Descriptive statistics of series (after Thai-Ha Le and Youngho Chang (2011)).*

	Gold price	Oil price	Stock price	Exchange rate	Interest rate
Gold price	1.000000				
Oil price	0.694998	1.000000			
Stock price	-0.021031	-0.239504	1.000000		
Exchange rate	-0.032640	-0.230694	0.473171	1.000000	
Interest rate	0.197579	-0.343101	0.597658	0.373778	1.000000

Tab. 15. *Correlation matrix (in log level) (after Thai-Ha Le and Youngho Chang (2011)).*

Impact by nonlinear capital flows on stock exchange indexes

During the investment decision making process the investors calculate the following capital market ratios such as the *dividend yield*, *payment ratio*, *re-investment ratio* and *stop ratio* as proposed in *Łuniewska (2007)*

1) *Dividend Yield*

$$\text{Dividend Yield} = \frac{\text{Dividend}}{\text{Price of Share}} \cdot 100$$

2) *Stop Ratio*

$$WZ = \frac{\text{Profit- Dividend}}{\text{Profit}}$$

3) *Payment Ratio*

$$WR = \text{Capital ProfitgStop Return},$$

$$\text{Capital Profit} = \frac{\text{Increment Net}}{\text{Company Capital}}$$

4) *Re-Investment Ratio*

$$WW = \frac{\text{Dividend Per One Share}}{\text{Profit Per One Share}}.$$

However, the *capital markets* are highly volatile. "Volatility is a measure of uncertainty of the financial time series data or possible risk that is commonly faced by investors in stock trading," as noted in *Situngkir, Surya (2004)* The *stock exchange, foreign exchange and bond markets* are highly volatile in *Busch, Christensen, Nielsen (2009)*. The capital markets are characterized by the high volatility, because of the oscillating nature of the financial time series in *Schwert (1989)*. *Gencay, Selcuk, Whitcher (2008)* noted that the fundamental properties of *volatility dynamics* are the *volatility clustering* (conditional heteroscedasticity) and the *long memory* (slowly decaying autocorrelation), and proposed that there is an asymmetric volatility dependence across the different time horizons.

The *volatility forecasting* is a complicated computing intensive process, which uses a number of financial variables, highly parallel computing algorithms and sophisticated theoretical models with the aim to accurately characterize the *volatility dynamics*. The information on the *volatility dynamics* makes it possible to predict and optimize the *Return-on-Investment (ROI)* of

an investment portfolio in *Busch, Christensen, Nielsen (2009), Ledenyov D O, Ledenyov V O (2013e), Ledenyov D O, Ledenyov V O (2013a)*. The *Return-on-Investment (ROI)* of a hypothetical global equity index investment portfolio depends on a number of factors, including the *stock exchange returns* in the conditions of different *GDP* economic regimes in *Égert, Koubaa (2004), Kavkler, Festić (2011), Ledenyov D O, Ledenyov V O (2013e), Ledenyov D O, Ledenyov V O (2013a), Elton, Gruber (1995)*. The stocks prices changes at the different stock exchanges can have the certain correlations. *Utsugi, Ino, Oshikawa (2003)* analyzed the cross correlations at the global stock exchanges in the financial markets, applying the *random matrix theory*, with the purpose to predict the stock prices at the global stock exchanges. Thus, we come to the understanding that the investors prefer to build the highly diversified investment portfolios with many uncorrelated assets, aiming to mitigate the various types of financial risks in *Statman (1987)*.

It is a well known fact that the *financial systems* can be regarded as the *diffusion systems*, which can be characterized by the drift and diffusion coefficients in *Bernanke (1979), Shiryaev (1998a)*. *Xiaohong Chen, Hansen, Carrasco (2009)* state: "Nonlinearities in the drift and diffusion coefficients influence temporal dependence in scalar diffusion models." *Barnett, Yijun He (2000)* state that there are multiple evidences on the presence of the nonlinearities in the financial data. The nonlinearities can originate, because of various reasons such as the *information shocks*, connected with the change of the liquidity levels in the financial system, bankruptcies of companies, natural disasters, etc. There are many **econophysical tests** to detect and classify the nonlinearities in the finances:

1) The **correlation dimension test**, which approximates the *Hausdorf* dimension of fractal attractors. The basic idea is that of replacing the box-counting algorithm, necessary to compute the fractal dimension, with the measurement of correlations between points of a long time series on the attractor in *Grassberger, Procaccia (1983), Barnett, Yijun He (2000)*;

2) The **BDT test**, which tests the null hypothesis of whiteness against an unspecified alternative, using a nonparametric technique, in *Brock, Dechert, LeBaron, Scheinkman (1996), Barnett, Yijun He (2000)*;

3) The **Hinich bi-spectrum test**, which tests the null hypothesis that the skewness function is flat, and hence it is a test of lack of third order nonlinear dependence in *Hinich (1982), Barnett, Yijun He (2000)*.

4) The **NEGM test**, which applies a regression method, involving the use of neural network models, to test for a positivity of presence of the dominant *Lyapunov* exponent; hence, this way, it is possible to detect the sensitive dependence on the initial conditions, which is a

fundamental characteristic of chaos in *Nychka, Ellner, Gallant, and McCaffrey (1992), Barnett, Yijun He (2000)*.

5) The ***White test***, when the time series is fitted by a single hidden-layer feed-forward neural network, which is used to determine whether any nonlinear structure remains in the residuals of an autoregressive (*AR*) process fitted to the same time series in *White's (1989), Barnett, Yijun He (2000)*.

6) The ***Kaplan test***, which is a test of the linear stochastic process against the general nonlinearity. In the case of chaos, a time series plot of the output of a chaotic system may be very difficult to distinguish visually from a stochastic process. However, plots of the solution paths in phase space (x_{t+1} plotted against x_t and lagged values of x_t) often reveal deterministic structure that was not evident in a plot of x_t versus t in *Kaplan (1994), Barnett, Yijun He (2000)*.

We can see that there is an increasing necessity to research the various types of nonlinearities, and take them into an account as explained in *Van Dijk, Franses, Lucas (1996)*: "Much recent research in both theoretical and applied time series analysis has focused on nonlinear features of economic variables." The modeling of nonlinearities is an important mathematical problem in both the *econophysics* and the *econometrics in Hull (2005-2006), Martin (1998-1999, 2005-2006)*. *Bullard, Butler (1993)* write: "The main benefit of nonlinear dynamic modeling is that it is possible to consider reasonable and simple economic models that never converge to a steady state; even deterministic versions can display endogenous fluctuations." *Bullard, Butler (1993)* add: "The study of nonlinear dynamic models and deterministic chaos offers several lessons to econometricians. If forecasting is a goal of economic modeling, the possible existence of significant nonlinearity in the data suggests standard linear models may provide misleading results. In the case of chaos, the precision of a forecast when there is only a very small error in the initial conditions worsens exponentially over time." *Bullard, Butler (1993)* conclude: "Nonlinear models provide a rigorous concept for the notion of an inherently unstable economy." The *nonlinearities* in the finances have also been researched in *Wolf, Swift, Swinney, Vastano (1985)*, *Tsay (1986)*, *Kelsey (1988)*, *Baumol, Benhabib (1989)*, *Brock, Malliaris (1989)*, *Tong (1990)*, *Brock (1990)*, *Scheinkman (1990)*, *Decoster, Mitchell (1991)*, *Granger, Terasvirta (1993)*, *Bullard, Butler (1993)*, *Ramsey , Rothman (1994)*, *Abhyankar, Copeland, Wong (1995, 1997)*, *Van Dijk, Franses, Lucas (1996)*, *Ghashghaie, Breymann, Peinke, Talkner, Dodge (1996)*, *Barnett, Gallant, Hinich, Jungeilges, Kaplan (1997)*, *Wymer (1997)*, *Agnon, Golan, Shearer (1999)*, *Ahn, Gao (1999)*, *Barnett, Yijun He (2000)*, *Barnett, Serletis (2000)*, *Kim, Morley, Piger (2002)*, *Kim, Osborn, Sensier (2002)*, *Kim (2003)*, *Blake, Kapetanious (2003)*, *Cuaresma (2003)*, *Dahl, Gonz´alez-Rivera (2003)*,

Chortareas, Kapetanious, Uctum (2003), Kesriyeli, Osborn, Sensier (2004), Bond, Harrison, O'Brien (2005), Dahl, Gonz´alez-Rivera, Qin (2005), Chappell, Panagiotidis (2005), Sarno, Valeufe, Leon (2006), Bond, Harrison, Hession, O'Brien (2006), De Veirman (2007), Jaiswal, Niraj (2007), Marmer (2008), Xiaohong Chen, Hansen, Carrasco (2009), Mussoa, Straccaa, van Dijk (2009), Serletis, Malliaris, Hinich, Gogas (2010), Panagiotidis (2010), Wanfeng Yan, Woodard, Sornette (2010).

In Figs. 10, 11, 12 the examples of the nonlinearities in the cases of *Hong Kong Hang Seng Index, S & P 500 Index, Shanghai Composite Index* are shown in *Wanfeng Yan, Woodard, Sornette (2010).*
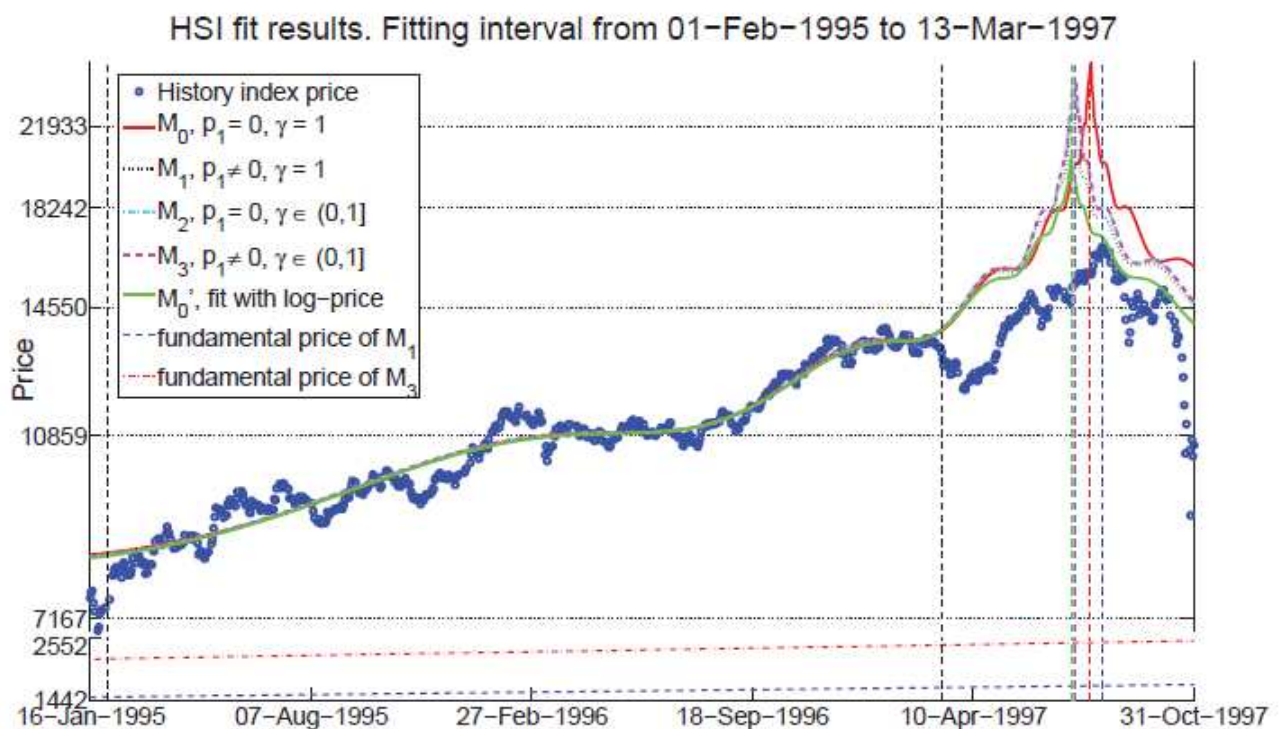
Fig. 10. *Nonlinearities in case of Hong Kong Hang Seng Index*
(after Wanfeng Yan, Woodard, Sornette (2010).
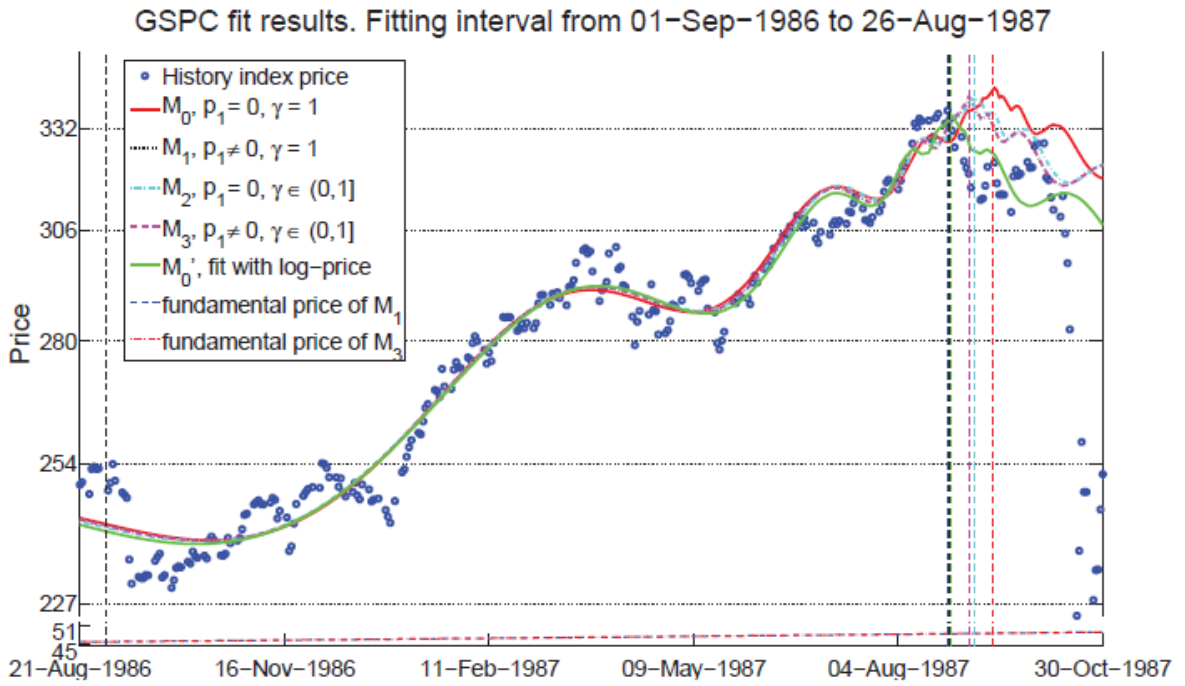
Fig. 11. *Nonlinearities in case of S & P 500 Index*

(after Wanfeng Yan, Woodard, Sornette (2010).
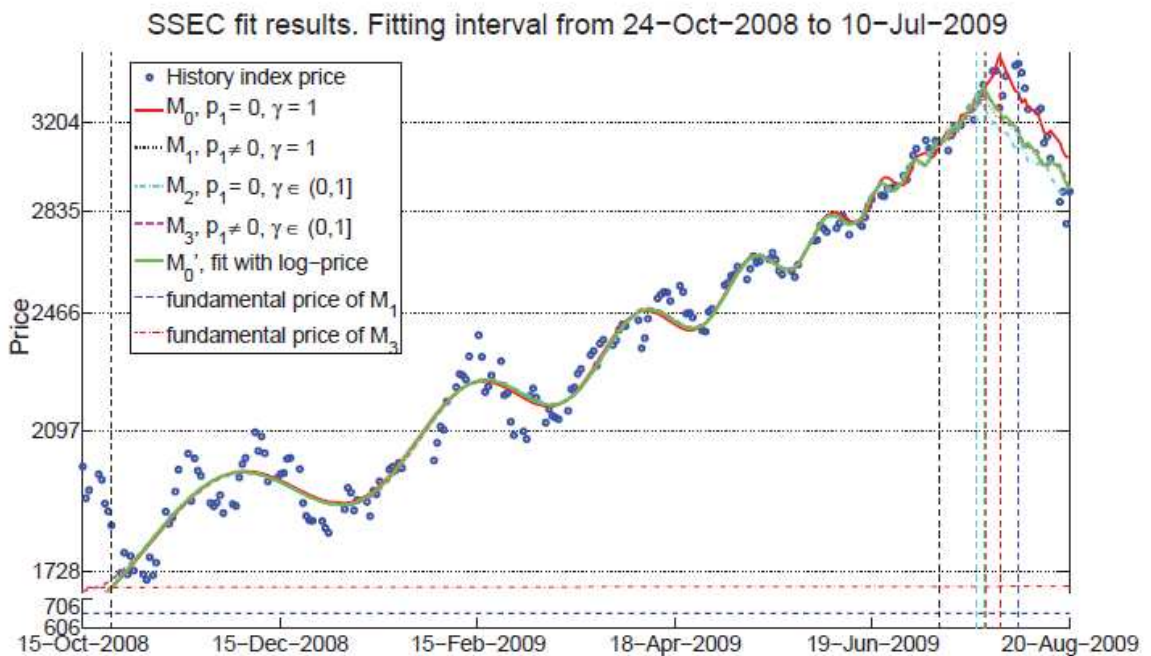
Fig. 12. *Nonlinearities in case of Shanghai Composite Index*

(after Wanfeng Yan, Woodard, Sornette (2010).

We make our original research proposal that the *nonlinear capital flows* in the process of the *electronic trading* can originate the nonlinear changes of the stock market indexes at the stock exchanges in the global capital markets. Applying *the integrative thinking principles* to the problem on *the stock market indexes trends analysis*, we suggest that the *econophysics* techniques can be used to precisely characterize the *nonlinearities* in the finances. In our representation, *the nonlinear capital flows* depend on the following characteristics dependences *1) the dependence of the company valuation on the time; 2) the dependence of the foreign exchange rates on the time*; *3) the dependence of the interest rates on the time*; and *4) the dependence of the prices of strategic commodities on the time*. We performed the research of the *nonlinearities* in *Matlab*, researching: *1) the ideal dependence of the stock market index over the time, 2) the linear dependence of the stock market index over the time, 3) the quadratic dependence of the stock market index over the time, 2) the exponential dependence of the stock market index over the time*. We researched the following indexes: *1)* The *Dow Jones Industrial Average* (*DJIA*) index; *2)* The *Standard and Poor's 500* (*S&P 500*) index; *3)* The *NYSE Composite* index; *4)* The *Hong Kong Hang Seng* index; *5)* The *Shanghai Composite* index; *6)* The *Financial Times Securities Exchange* (*FTSE100*) index; *7)* The *Deutscher Aktienindex (DAX)* index; *8)* The *Nikkei 225 Stock Average* index over the certain time periods. The selected time periods were: *6* months; *12* months; *24* months. We assumed that, in every considered case, there are the changes of the *company valuation, foreign exchange rates, interest rates, prices of strategic commodities* over the *specified time period*. We found that there are the *nonlinearities* in the characteristic dependences of the *stock exchanges indexes* on the time. Our research results are in a good agreement with the research findings in *Abhyankar, Copeland, Wong (1995, 1997)*, however the multiple evidences of the *quantum chaos* were found for the first time. In our opinion, the developed software program on the nonlinearities in the finances in *Matlab* will help us to make the accurate characterizations of the stock market indexes trends, facilitating the optimal investment decisions making during the electronic trading at the stock exchanges in the global capital markets.

Conclusion

We make our original research proposal that the *nonlinear capital flows* in the process of the *electronic trading* can originate the nonlinear changes of the stock market indexes at the stock exchanges in the global capital markets. We developed a software program, which can detect the nonlinearities and quantum chaos in the stock market indexes dependences over the

selected time period and predict their behavior with the certain accuracy in the short and long time perspectives. In our opinion, the nonlinearities and quantum chaos have to be taken to the consideration during the accurate characterization of stock markets indexes trends by the private and institutional investors during the investment decision making process at the global stock exchanges.

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