Open research issues on Computational Techniques for Financial Applications

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Abstract - We present in the following the state of the art for computational techniques for financial applications both from the methodological and applicative points of view. The techniques are applied to a variety of applicative domains (economic growth, financial assets, agriculture output, inventory in supply chains) to illustrate the extension of the research area.

Keywords - computational techniques for financial systems, modeling timeseries, financial assets.

Introduction

The format of special issues hosted in WSEAS Transactions on Systems is well proved and continues to develop over time [1-16]. The main aim of this special issue "Computational techniques for financial applications" is the presentation of state of the art contributions in the field originating from our community of authors. The hosted works explore the following topics:

1) Chinese economic growth is examined under the constraint of energy-saving policy and future scenarios are discussed [17];

2) corporate private placements are examined under the lenses of long-term shareholder wealth [18];

3) alternative regression models to assess the effects of covariates in output oriented DEA scores related to agricultural research production in Brazil [19];

4) scaling factors fine-tuning fuzzy logic control approach to optimize inventory supply chains [20];

5) methodology to compare bonds, stocks and mixed funds in the light of wealth creation [21].

Conclusions

Finally before diving into the collected research works [17-21], let us remember the reader that WSEAS Transactions on Systems has broad spectre of Special Issues, e.g. [1-16]. This is has the objective of creating an active and contributing research community around the journal and to present their latest efforts which have achieved wide interest among its members. As a reader of the journal you are invited to take inspiration by the presented papers and to consider to submit your future works to the journal itself.
Enjoy your reading!

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The effects of Private placement on long-term shareholder wealth: empirical evidence from Chinese listed firms

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Abstract: - Cumulative abnormal return (CAR) is estimated as long-term shareholder wealth of private placement, and we propose empirical evidence of the effect of private placement on long-term shareholder wealth. Private placement of listed firms has significantly positive effect on long-term shareholder wealth. Cumulative abnormal return are positively related with offer type of private placement at the confidence of 95% level, and long-term shareholder wealth of private placement subscribed by non-cash assets is better than cash assets, cumulative abnormal returns of private placement are negatively related with the size of total assets and offer type at the significance of 95% level. On the basis of our empirical evidence, we propose the following advices, such as encouraging the subscription of stock shares of private placement, strengthening prominent assets quality of private placement, strengthening supervision and punishment of inner information transaction, and planning industry layout of corporate private placement etc.

Key-Words: - private placement; cumulative abnormal return; shareholder wealth; offer type; listed firms

1 Introduction

Private equity placement, also known as non-pubic offering is defined that listed firms issue stocks to the specific objects using non-public offering. Private equity placement is a flexible and resilient financing way, it had become one of the most important ways of equity refinancing for listed firms in China. Initial Public offering and private equity placement are the most important ways for listed firms to issue new shares. Since 2005, refinancing ways of listed firms had undergone a significant change with the completion of equity-split reform, the refinancing appetite of listed firms had shifted private equity placement from initial public offering and new equity-matching ways. Private equity placement, also known as non-pubic offering is defined that listed firms issue stocks to the specific objects using non-public offering. Private equity placement is an important and growing part of the worldwide capital markets, those business groups dominate private-sector industrial activity in economies such as American, Brazil, Chile, Hong Kong, India, Indonesia, Malaysia, Pakistan, South Africa, South Korea and Taiwan etc.

Compared with other refinancing ways, private equity placement has three unparalleled advantages: Firstly, based on keeping constant expansion pressures of current stock markets and avoiding secondary market shock. Listed firms can raise sufficient external capitals from equity-controlled shareholders, institutional investors and strategic investors using private equity placement. Secondly equity-controlled shareholders can pour quality assets into listed firms through private equity placement and higher-quality stock assets are introduced into capital market, which are helpful to reducing re-investment time and future related party transactions, enhancing sustainable profitability and

independence of listed firms. Thirdly regulatory section need lower information disclosure of private equity placement and implement easy audit procedures, which are helpful to saving financing costs and time and protecting commercial secrets of listed firms, than saving government regulatory resources.

Private equity placement is a flexible and resilient financing way, it had become one of the most important ways of equity refinancing for listed firms in China. Based on private placement ways, private placement objects are divided into three types in China: first objects are larger controlling shareholders, actual controlled-shareholders and related strategic shareholders, this object of private placement is to acquire the superiorly physical assets of related parties and to achieve the overall public offering of business groups. Second objects are institution investors in order to introduce strategic cooperators outside, such as securities investment fund corporate, trust investment corporate, insurance corporate, qualified foreign institution investors and other institution investors. Third objects are institution investors and larger controlling shareholders.

Early foreign scholars find private equity placement has a positive announcement effects on average abnormal stock returns [1-6]. Wruck (1989) examine that stock public offering has a significantly negative announcement on average abnormal stock returns, while private equity placement has a significant positive announcement on average abnormal stock returns [1]. Cross-sectional empirical analysis indicates that firm value change at the announcement of private placement is strongly correlated with the change in ownership concentration. Hertzel and Smith (1993) find that price discounts of private placement reflect information costs borne by private investors and abnormal returns reflect favorable information about firm value, information effects appear to be relatively more important than ownership effects for the smaller firms [2]. Hertzel and Rees (1998) propose that private equity placement conveys favorable new information to investors and that the information reflects the changes of future earnings [3]. Hertzel, Lemmon and Linck et al. (2002) propose that private equity placement experiences positive announcements effects and negative post-announcement on stock price [4]. Tang, Chun and Tong (2002) examine positive announcement effect of seasoned equity issues in Singapore, and they find that higher abnormal returns for firm undertaken larger issues, this issue size reflects the magnitude of favorable news on the issuing firms' earning prospects [5]. Cronpvist and Nilsson (2005) suggest that private placements are often made to passive investors, thereby helping management solidify their control of the firm [6]. Price discounts of private placement, stock-price reactions, post-placement activities of the purchasers, and large blocks of stock favor managerial entrenchment as the explanation for many private placements. Private equity placement provides favorable market information, introduces institution investors and strategic investors with a strong incentive and monitoring ability to supervise firms managers and larger controlling shareholders, reduce agency cost of managers, accordingly private placement can improve market reaction of stock returns and firms' financial performance.

However private equity placement firms typically experience negative long-run performance following the placements in Singapore and New Zealand. Hertzel et.al (2002) find that the mean three- year buy-and-hold abnormal return after private equity placement reduces -23.78%, this pattern is caused by over-optimism investors about the firm prospects at the announcement of private placement sale. Since private investors appear to be overly optimistic about the potential performance improved in the future [4]. If they feel disappointed that such an improvement fails to materialize, there is little direct evidence on the overly optimistic expectations explanation for this underperformance. Chen et al. (2002) examine institutional characteristics and the wealth effects of private equity placements in Singapore, their findings show that private placements in Singapore generally result in a negative wealth effect and a reduction in ownership concentration, at high levels of ownership concentration, the relation between abnormal returns and changes in ownership concentration is significantly negative, market reacts less favorably to placements in which management ownership falls below 50%, but more favorably to issues to single investors[7]. Barclay et al. (2007) suggests that private placements are often made to passive investors, and placement price discounts, stock-price reactions, the post-placement activities of the purchasers, large blocks of stock favor managerial entrenchment as the explanation for many private placements [8]. The above scholars consider that private equity placement in Singapore and New Zealand cannot be sold to directors and related controlling shareholders, this issuing way of private placement will reduce firms' ownership concentration, and the dilution of share-holding ratio of original controlling shareholders and firms managers will transmit a negative market signal,

accordingly these signals lead to a negative announcement and wealth effects.

The central question of private equity placement is how to determine the issue price of private placement. Rational issue price and price discount are directly related to the vital interests between old and new shareholders, and are related to the successful implement of private placement program. Reasonable pricing of private placement is reflected by price discount level of private placement. Kaplan and Schoar (2005) investigates the performance and capital inflows of private equity partnerships, their results show that better performing partnerships are more likely to raise follow-on funds and larger funds, and top performing partnerships grow proportionally less than average performers [9]. Krohmer, Lauterbach and Calanog (2009) examine the investment performance and the varying motivation of private equity firms, and they find that staging has a positive effect on investment returns in the beginning of the investment decisions, however staging appears to be negatively associated with returns when used prior to the exit decision [10]. Huang and Chan (2012) propose that outside blockholders arising from private equity placement have a significantly positive effect on operation performance of listed firms with poor corporate governance [11]. Wilson et al. (2012) find that listed firms in U.K. backed buyouts by private equity portfolio fund achieved superior economic and financial performance in the period before and during the recent global recession, relative to comparable firms that did not experience such transactions, listed firms imply positive differentials of 5–15% in productivity and approximately 3–5% in profitability for buyout firms, relative to non-buyout firms [12]. Franzoni, Nowak and Phalippou (2012) find that when diversification benefits provided by private equity may be lower than anticipated investment returns, private equity suffers from significant exposure to the same liquidity risk factor, their empirical results show the link between private equity returns and overall market liquidity occurs via a funding liquidity channel [13]. Minardi et al. (2013) verify that Private equity (PE) backed IPOs have higher average CAR than non-PE backed IPOs in both periods, PE investment has a positive relation to CAR for IPOs issued in 2004–2006, however PE backed IPOs issued during 2007–2008 were not a significant relation [14]. Cumming and Zambelli (2013) investigates the impact of excessive regulation on private equity (PE) returns and firm performance, their results show that extreme regulation and prohibition reduces the quality of capital and fund involvement for value-added investors such as PE funds, extreme regulation reduces not only the supply of capital, but also PE returns and firm performance, as well as the likelihood of an IPO exit [15].

Lin et al. (2013) examine that financial analysts do tend to make over-optimistic forecasts at the time of private equity placements, such over-optimistic forecasts can lead to investors erroneously overstating the value of placement firms, resulting in subsequent revisions of their valuations over time, and long-run performance of private equity placement has a negative correlation with over-optimistic forecasts of financial analysts [16]. Private equity placement is helpful for listed firms to introduce strategic investors to achieve overall public offering and financial restructuring, to extend the industrial chain of listed firms, to reduce related-party transactions and similar competition with business groups, to enhance the larger controlling shareholders and strengthen firms operation supervision, accordingly these factors prompt and improve long-term performance and stock market reaction of listed firms.

The existing literatures provide much direct evidence on the relationship between overvaluation and earning management. Goh et al. (1999) examine that earnings forecast revisions by analysts subsequent to the announcement of private equity placements, their empirical results show that analysts make significant upward revisions to their forecasts for current-year earnings, these forecast revisions are significantly related to announcement-period abnormal returns, and private equity placements convey favorable information about future earnings [17]. Beuselinck, Deloof and Manigart (2009) examine the relation between private equity (PE) investors' involvement and their portfolio firms' earnings quality, PE involvement increases a firm's willingness to recognize losses more timely compared with industry, size and life-cycle [18]. Chen et al. (2010) propose that issuing firms of private placement overstate their earnings in the quarter preceding private equity placement announcements and sophisticated investors do not ask for a fair discount when purchasing the shares of the private issuing firms [19]. Hsu et al. (2011) find that firms have incentives to engage in earnings management before the announcement date of private equity offerings, and management tended to manage reported earnings upward when the private placement was subscribed by non-insiders; whereas management tended to downward manage earnings when the private placement was subscribed by insiders [20]. Earning management can boost

earnings relative to cash flows, can make private equity placement overprices, however earning management can also be used to induce undervaluation. Adams et al. (2009) find that managers of mutual use discretionary choices to reduce reported earnings prior to the demutualization to help justify a lower initial valuation for demutualizing firms [21]. Chang et al. (2012) propose a general model of futures options valuation under the term structure of stochastic multi factors, their empirical results show term structure of stochastic multi-factors has a significant effect on futures options valuation for CO_2 emissions allowances, and estimate the theoretical futures options valuation by using historical market information [22]. Chang et al. (2012) find that term structure of stochastic multi-factors has a significant effect on futures options valuation for CO_2 emission allowances, and estimate the theoretical futures options valuation by using historical market information [23]. Wang, Huang and Chang (2013) use panel data of weekly corporate bond yields and the fixed effect model with variable intercept [24]. The factors which affect corporate bond spread mainly include bond market complex index, stock market complex index, CPI, bond idiosyncratic volatility and stock idiosyncratic volatility. Chang (2013) propose the market behavior of convenience yields and examine the options feature of convenience yields for emission allowances, their empirical evidence show market participants can flexibly adjust portfolio policies of emission allowances assets and achieve extra market arbitrage revenues through exchanging emission allowances assets between spot and futures [25]. Li (2008) presents that American options can be exercised at any time during their lifetime, and addresses the optimal stopping time of several kinds of American call options [26]. Shao and Wang (2010) consider the statistical properties of chain reaction of stock indices, the theory of interacting systems and statistical physics are applied to describe and study the fluctuations of two stock indices in a stock market, and the properties of the interacting reaction of the two indices are investigated in the present paper [27]. Athina's (2012) intention of this research is to understand the behavior of the Cyprus Stock Market, his empirical findings of FTSE/CySE 20 show that return distribution takes the shape of a Gaussian distribution at 345 days and the tails appear to become less heavy for less frequent series [28]. Petr (2012) applies several prototype generation classifiers to predict the trend of the NASDAQ Composite index and demonstrates that prototype generation classifiers outperform support vector machines and neural networks considering the hit ratio of correctly predicted trend directions [29]. Neri (2012) proposes an introduction to the special issue on computational techniques for trading systems, time series forecasting, stock market modeling, and financial assets modelling [30]. Neri (2012) discusses a computational simulation technique based on agent based modeling and learning to closely approximate the SP500 and DJIA indexes over many periods and under several experimental set ups [31]. Listed firms have a strong incentive to earning management before private equity placement, and the ways of earning management is significantly related with private placement objects, share-holding ratio owned by larger controlling shareholders and market reaction of new stock of private placement. Larger controlling shareholders enhance positive earning management before private equity placement in order to improve financial performance of listed firms, and then have a more strong motivation to increase private placement price, the final goal of earning management is to wealth tunneling or propping for larger controlling shareholders.

Interests tunneling between equity-controlled shareholders and minority shareholders are a hot topic in the field of corporate governance. Johnson and Porta et.al (1999) refer to the transfer of resources out of a company to its controlling shareholder [32]. They proposal that wealth tunneling comes in two forms: First, a equity-controlled shareholder can simply transfer resources from the firm for his own benefit through self-dealing transactions, including outright theft or fraud, asset sales and contracts such as transfer pricing advantageous to the controlling shareholders, excessive executive compensation, loan guarantees, expropriation of corporate opportunity. Second, the controlling shareholders can increase their shares of the firm without transferring any assets through dilutive shares issues, minority freeze-outs, insider trading, creeping acquisitions, or other financial transactions that discriminate against minorities. Bae, Kang and Kim (2002) examine whether firms belonging to Korean business groups benefit from acquisitions they make or whether such acquisitions provide a way for controlling shareholders to increase their wealth by increasing the value of other group firms [33]. While minority shareholders of a chaebol-affiliated firm making an acquisition lose, these controlling shareholders of listed firm on average benefits because the acquisition enhances the value of other firms in the group. Bertrand, Mehta and Mullainathan (2002) propose a general methodology

to measure the extent of tunneling activities, propagate of earnings shocks across firms within a group, expropriate by minority shareholders through tunneling resources from firms with low cash rights [34]. Kim (2009) find that wealth tunneling will occur in low-cash-flow-right firms, but not in high-cash-flow- right firms, to provide support to poorly performing firms [35]. Liu and Lu (2007) examines the relation between earnings management and corporate governance in China introducing a tunneling perspective, their empirical results demonstrate that firms with higher corporate governance levels have lower levels of earnings management, listed firms have strong incentives to manage earnings in order to meet certain return on equity (ROE) thresholds, and earnings management is the most conspicuous[36]. Cheung, Rau and Stouraitis (2006) propose that firms announcing connected transactions earn significantly negative excess returns, significantly lower than firms announcing similar arm's length transactions, and then their results show that limited evidence that firms undertaking connected transactions trade at discounted valuations prior to the expropriation [37]. Dow and McGuire (2009) find evidence of profit tunneling of more weakly affiliated keiretsu firms during strong economic times, the motivation behind strengthened affiliation appears primarily linked to the goal of overcoming financial constraints by accessing the internal capital market of the business group [38]. Peng, Wei and Yang (2011) employ connected transaction data from China to test the implications of Friedman et al. (2003)' model, and find that all of the transaction types in our sample can be used for tunneling or propping depending on different financial situations of the firms, political connection is negatively associated with the announcement effect[39]. Riyanto and Toolsema (2008) links existence of the pyramidal ownership structure to tunneling and propping, their empirical results show that tunneling alone cannot justify the pyramidal structure unless outside investors are myopic, since rational outside investors anticipate tunneling and adjust their willingness-to-pay for the firm's shares [40].Francisco (2009) examine a 6-year sample of controller-dominated, concentrated ownership firms in Chile, his results show that group-affiliated companies, controllers' presence on the board of directors is associated with a strong negative relation between chair and board compensation and controllers' cash-flow rights, controllers of group-affiliated companies prefer to increase chair and board compensation rather than dividends as their cash-flow rights decrease [41].Hájek and Neri(2013), Azzouzi and Neri(2013), Bojkovic and Neri(2013) propose an introduction of spessial issue on computational techniques for trading systems, time series forecasting, stock market modeling, financial assets modeling, advanced control of energy systems, advanced control methods: Theory and application and recent methods on physical polluting agents and environment modeling and simulation [42-46].

Those scholars at home and abroad pay much attention on announcement effects, wealth tunneling or propping stock market reaction and earning management, however few scholar in China pay little attention on long-run shareholders wealth of listed firms after private equity placement, subscribing ways from different private placement objects and firms size are significantly related with long-run shareholding wealth after private placement.

The remainder of our paper is organized as follows. Section 2 presents theoretical analysis anpothesis development. Section 3 shows data source. Section 4 analyses variables definition and model development. Section 5 proposes empirical evidence of the effect of private equity on long-term shareholders wealth. Section 6 provides a brief conclusion.

2. Theoretical analysis and hypothesis development

Private equity placement involve strict constrains in private placement objects and placement shares circulation, placement objects such equity-controlled shareholders, institutional investors and strategic investors seek additional interests compensation for market risks and internal motivation loss. Profitability and shareholder wealth are important factors for listed firms to select private equity and public issuing ways. Corporate governance structure and ownership structure in Chinese capital markets environment have greater divergent, financing ways of listed firms is affected by private equity policy.

Hypothesis 1: Private equity of listed firms has a positive effect on long-term shareholder wealth.

Based on signal delivering theory, inner investors capturing more information deliver related information to outer investors in firms' decision-making process, outer investors who receive related decision information will make reasonable analysis and judgment, and then improve their investment decision. Main private equity object have minority controlling shareholders, related shareholders and

institutional investors, minority larger shareholders and related shareholders can direct and indirect join in operating process of listed firms and understand future development strategy, institutional investors have strong incentive to acquire operating information of listed firms, and then make scientific and corrective investment decision and value judgment. Minority larger shareholders and related shareholders subscribe private equity stock, and transmit positive information for outer investors. Market value of listed firms is seriously undervalued, and this firm has better development potentiality and future profitability, outer investors have strong investment confidence and actively buy stock form secondary stock markets, and then enhance stock prices. On the basis of supervision effect theory, institutional investors have strong incentive to supervise managers and incline agency costs between managers and shareholders, and then increase firms' market value. In brief, listed firms present private equity placement shares, when larger shareholders, related shareholders and institution investors subscribe private palcement shares, main information is transferred. Market value of listed firms is seriouly undervalue, these firms have good future and own most protential investment projects, and their profitability exhibit an increasing trend. Outer investors receive good signals, insrease stock shares , and then promote stock price increasing.

Hypothesis 2: long-term shareholders wealth of private equity subscribed by non-cash ways is better than private equity subscribed by cash ways.

Based on subscription ways, private equity way in China have non-cash subscription and cash subscription. If institution investors pour cash into listed firms and subscribe private placement shares, listed firms invest excellent projects and control shareholders' equity using these cash, and achieve predominant assets and increase their profitability. When minority controlling shareholders and related shareholders pour their predominant assets into listed firms, those original assets may achieve market circulation and reduce law risk and market risk in the operating process. Merged superior assets of related shareholders, listed firms reduce external dependence and improve production and business independence, strengthen the ability of controlling central assets and technology, and then achieve scale affects of corporate development and improve long-run market value of listed firms. Related shareholders may strengthen managers' supervisions, incline agency costs and unnecessary loss with an increase of share-holding ratio. In brief, larger shareholders increase holding-shares ratio using private placement, and pour excellent assets, market value of listed firms have an increasing trend. As a result, we propose long-term shareholder wealth of private placement subscribed non-cash ways has better increasing speed than private equity subscribed by cash ways

3 Data source

Private placement is the most important way for listed firms to refinance equity after share-split reform. In order to examine the effects of private placement on long-run shareholders wealth, we select 324 firms issued private placement as empirical data samples in Chinese Shanghai and Shenzhen exchange platform from June 6, 2006 to June 6, 2010. Data samples are sourced from CSMAR Solution platform in Shenzhen, CNINF Solution platform and GENIUS Finance platform. We filter and delete those data samples in order to feasibility and correctness of empirical evidence. Firstly, we choose private equity sample of Share A for different pricing method among share A , B and H. Secondly, we delete listed firms in finance and assurance industry, their capital source and operating scope have greater difference compared with listed firms in other industries. Thirdly, if listed firms carried out more than twice private placement in the data-covering period, we choose first private placement as sample events. Fourthly, we filter private placement events with data-missing and individually extreme variable. Fifthly, listed firms may not disclose greater events such as shareholders meeting, the broad announcement, annual reporting and bonus plan etc, those events have significant impact on stock price. Sixthly, listed firms carry out private placement without refinance behavior such as rationed shares, convertible bonds etc, those refinancing behaviors have significant effect on stock price.

4 Variables definition and model development

Institution investors pay much attention on long-term development and firms' performance, they can strengthen the constraints of agency behavior for firm managers in order to maintain self-interests. Institution investors have sufficient ability and strong motivation to prevent larger controlling shareholders invade firms interests and to urge senior managers diligence. When institution investors subscribe stock shares after private equity placement, firm managers wish reduce behavior constraints from institution investors. Accordingly

when institution investors subscribe certain stock shares, larger controlling shareholders wish make a higher private placement price in order to decrease shares ratio of institution investors.

When greater price discount subscribed by larger controlling shareholders and institution investors have two wealth effects [17]: firstly, wealth tunneling effect is a way that larger controlling shareholders can transfer wealth from minority shareholders through subscribing greater price discount of private equity placement. Secondly, wealth dilution effect is a way that earnings per share of larger controlling shareholders reduce for equity dilution after private equity placement. From the above analysis theory, larger controlling shareholders have many interests coordination with minority shareholders. Whether wealth transferring effect or wealth dilutting effects is decided by net equity difference between original holding-share ratio and subscribing-share ratio of larger controlling shareholders.Wealth transferring-effect is significant with an increase of original share-holding ratio, while wealth diluting-effect is significant with an increase of subscribing-share ratio.

This paper chooses that cumulative abnormal return (CAR) estimate long-term stock prices of private equity. Offer type defines that market investors select the type of subscribing stock shares in private equity, 1 denotes subscribed using non-cash assets, 0 denotes subscribed using cash assets. Financial leverage (LEV) defines asset-liability ratio of private equity at the previous year-end, listed firms with greater asset-liability ratio reduce agent costs between shareholders and creditors and offset tax and own better financial leverage, market investors believe that greater asset-liability ratio can improve market value of listed firms and inner managers deliver active market signals. Firms' asset size define the nature logarithm of total book value of firms' assets at the previous year-end, market investors can gain more extra market information with an increase of assets size and then decrease information asymmetry and agent costs. Relative size of private equity defines that the ratio of total share quantity of private equity divided by total share quantity owned by listed firms. Listed firms with higher shares quantity of private equity imply greater uncertainty of financial performance in the future, and market investors spend greater information collecting costs. Returns of net assets (ROE) define the ratio of profit after tax divided by net assets at the previous year-end. Book-market value ratio (BM) defines book value of total assets divided by their market value at the previous year-end. Based on the above theoretical analysis, we propose the following model.

$$CAR = \alpha_0 + \alpha_1 Offertype + \alpha_2 Size + \alpha_3 Rsize + \alpha_4 Lev + \alpha_5 Roe + \alpha_6 Bm \quad (1)$$

Where α_0 is the intercept term, $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$ are the coefficients of variables offertype, size, rsize, lev, roe and bm.With an increase of holding-share ratio owned by controlling shareholders and institution investors, lager controlling shareholders and institution investors cannot be restrained by other circulating-stock shareholders in the process of management decisions. In the emerging capital market, market scheme scarcity, share-split problems and inadequate supervision can bring about absonant interests between larger controlling shareholders, institution investors and minority shareholders. From the theoretical analysis, the interests of controlling shareholders and institution investors are closely associated with stock prices of listed firms, accordingly larger controlling shareholders, institution investors and minority shareholders have joint interests. Due to stronger-controlled condition of larger controlling shareholders and institution investors, they have stronger motivation to invade interests of minority shareholders. It is possible for larger controlling shareholders and institution investors to meet self-interest and invade interests of minority shareholders through greater price-discounts of private equity placement.

Share-holding ratio owned by institution investors are diluted and firm wealth owned by institution investors is transferred away by larger controlling shareholders. Accordingly larger controlling shareholders can transfer firm wealth from those institution investors and circulating shareholders outside. When institution investors subscribe overall private placement shares, compared with other two way of subscribing private placement shares, institution investors can attain the greatest wealth-transferring effects from the controlling shareholders and minority shareholders outside. Firm wealth transferring effects owned by larger controlling shareholders exhibit an increasing trend with an increase of price discount ratio and holding-share ratio subscribed by controlling shareholders. In the event of larger controlling shareholders and institution investors participation, wealth transferring effects are closely related with the

greater price discount ratio of private placement and the larger difference between share-subscribing ratio after private placement and original share-holding ratio owned by controlling shareholders and institution investors. Larger controlling shareholders and institution investors have greater incentive to transfer firm wealth through private equity placement with an increase of the degree of interest deviation among larger controlling shareholders, institution investors and minority shareholders outside.

5 empirical evidence of the effect of private placement on long-term shareholder wealth

5.1 Statistical analysis of long-term shareholders wealth

Seen from the table 1, the mean of CAR12 and CAR36 of private placement are 0.157104 and 0.423603, and the mean of CAR12 is less than the mean of CAR36, those results exhibit that private placement issued by listed firms has positive impact with long-term shareholder wealth. The standard deviation of CAR12 and CAR36 are 0.374586 and 0.538203, those results show that private placement lead to larger shareholder wealth, and stock volatility of VAR12 is greater than CAR36. those empirical evidences support hypothesis 1.

Table 1: statistical analysis of cumulative abnormal return of corporate private placement

varriables	CAR12	CAR36
mean	0.157104	0.423603
maximum	1.646904	2.049960
minimum	-0.697936	-0.651652
Standard deviation	0.374586	0.538203
samples	324	324

Note: CAR12 denotes cumulative abnormal return of corporate private placement from previous 1 to 12 months. CAR36 denotes cumulative abnormal return of corporate private placement from previous 1 to 36 months.

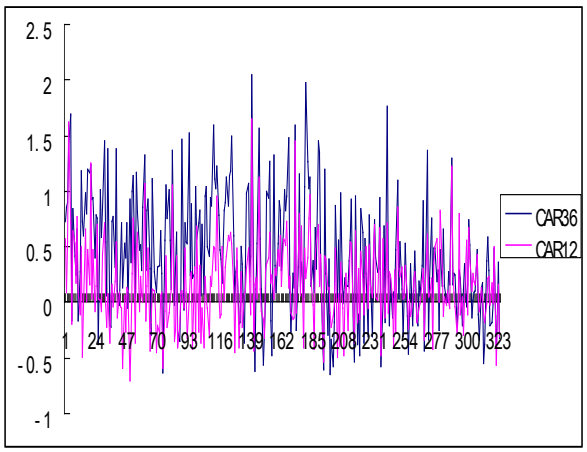

Fig.1 cumulative abnormal return

5.2 The effect of private placement on long-term shareholder wealth

Seen from the table 2, the offer type of private placement are positively related with CAR12 and CAR36, their related coefficients exhibit significant at the confidence of 95% level, those results show that long-term shareholder wealth of private placement subscribed by non-cash assets is better than cash assets, and this empirical evidence supports hypothesis 2. Compared with the offer type of cash assets, the offer type of non-cash assets can pure excellent assets into listed firms, can reduce the problems of related transaction and similar competition. If merged assets are significantly related with upstream and downstream industry of listed firms, listed firms can reduce outer dependence and improve firms' competitive ability. Listed firms poured prominent assets by controlling shareholders can enhance continuable profitability and their long-run market values, those signals can improve long-term shareholders wealth. Cumulative abnormal returns of private placement are negatively related with the size of total assets and offer type at the significance of 95% level, cumulative abnormal return of private placement incline with an increase of assets size and offer type size, and the incline of CAR36 is greater than CAR12.

Table 2: empirical evidence of the effect of private placement on long-term shareholder wealth

Variables	CAR12	CAR36
α_0	1.660507^{***}	3.495082^{***}
	(4.0020)	(5.9299)
α_1	0.055319^{**}	0.022532^{**}
	(2.1465)	(2.3287)
α_2	-0.069111^{***}	-0.139023^{***}
	(-3.6704)	(-5.1976)

α_3	-0.086306**	-0.187890**
	(-2.5842)	(-1.8954)
α_4	-0.059273*	-0.084195*
	(-1.7390)	(-1.7390)
α_5	-0.022883	0.071667
	(-0.3593)	(0.7921)
α_6	-0.017744	0.035432
	(-0.3021)	(0.4246)

Note: **** , ** , * denote the confidence 99% , 95% and 90% level, the number in the parentheses is t statistic values.*

In the emerging capital market, market scheme scarcity, share-split problems and inadequate supervision can bring about absonant interests between larger controlling shareholders, institution investors and minority shareholders. From the theoretical analysis, the interests of controlling shareholders and institution investors are closely associated with stock prices of listed firms, accordingly larger controlling shareholders, institution investors and minority shareholders have joint interests. Due to stronger-controlled condition of larger controlling shareholders and institution investors, they have stronger motivation to invade interests of minority shareholders. It is possible for larger controlling shareholders and institution investors to meet self-interest and invade interests of minority shareholders through greater price-discounts of private equity placement.

6 conclusion and policy advice

This article present the cumulative abnormal return (CAR) is estimated as long-term shareholder wealth of private placement, and we propose empirical evidence of the effect of private placement on long-term shareholder wealth. Private placement of listed firms has significant impact on long-term shareholder wealth. Based on asymmetric information theory and signal delivery theory, outer investors believe that private placement decided by corporate managerial level exhibit strong development potential and profitability, meanwhile controlling shareholders can capture inner favorable information. Those investors subscribe the stock share of private placement, those signals exhibit that these firms owner excellent market value and investment returns. Cumulative abnormal return are positively related with offer type of private placement at the confidence of 95% level, and those results support hypothesis 1. Minority larger shareholders subscribe private equity sshares, this firm has better development potentiality and future profitability, outer investors actively buy stock form secondary stock markets, and then enhance stock prices. Institutional investors have strong incentive to supervise managers and incline agency costs between managers and shareholders, and then increase firms' market value.

Long-term shareholder wealth of private placement subscribed by non-cash assets is better than cash assets, cumulative abnormal returns of private placement are negatively related with the size of total assets and offer type at the significance of 95% level. The offer type of non-cash assets can pure excellent assets into listed firms, and merged assets are significantly related with upstream and downstream industry, listed firms can reduce outer dependence and improve firms' competitive ability. Minority controlling shareholders pour their predominant assets into listed firms, reduce law risk and market risk in the operating process, incline external dependence and improve production and business independence, strengthen the ability of controlling central assets and technology, and improve long-run market value of listed firms.

On the basis of our empirical evidence, we propose the several following advices. Firstly, our government should encourage that minority controlling shareholders subscribe stock shares of private placement and pour excellent assets into listed firms. Listed firms can enhance long-run market value and strengthen competitive ability and then improve long-term shareholder wealth. Secondly, our government should strengthen prominent assets quality of private placement, should propose profitability forecast and related compensation system, broaden public medals and administrations supervise poured assets quality. Thirdly, our administration should strengthen supervision and punishment of inner information transaction and related information disclosure. Stock exchange platform, supervision institution and intermediary service organizations strengthen inner information supervision, enhance punishment efficiency and improve information disclosure quality. Fourthly, our government should reasonably plan industry layout of corporate private placement..

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The Environmental Kuznets Curve Effects of Energy Intensity and Emission Intensity on Optimizing Chinese Emission-reduction under the Constraint of Energy-saving Policy

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Abstract: - Using Environmental Kuznets Curve theory, this article examines the EKC effect of economic growth, energy intensity and carbon emission intensity on total quantity of carbon emission under the constraint of energy-saving policy. Optimizing energy-consuming structure and decreasing energy-consuming intensity can incline carbon emissions intensity and slow down the increasing speed of carbon emissions quantity. GDP per population and carbon emission intensity have significantly inverted U-shape EKC effect on carbon emission quantity at the confidence of 95% level from 2006 to 2015, accordingly optimizing energy-consuming structure and reducing energy intensity are helpful to incline carbon emission intensity and total quantity growth of carbon emission in eleventh-five and twelfth-five periods under the constraint of energy-saving and emission-reduction policy. However planning target of carbon emission intensity faces greater challenges and risks in the future, Chinese government should introduce a serial of energy-saving and emission-reduction advices and policies in the future.

Key-Words: - Environmental Kuznets Curve; energy-consuming structure; energy intensity; carbon emission intensity; energy-saving; emission-reduction;

1 Introduction

Based on BP world energy statistical yearbook in 2013, total quantity of Chinese energy consumption account for 20% of global energy consumption in 2012, China had been become the largest energy-consuming country and second carbon emission country. Coal-consuming quantity account for 68.4% of total quantity of Chinese energy consumption in 2012, energy-consuming structure is unreasonable, energy efficiency is relatively lower, energy-consuming structure with over-dependent coal resources cannot turn around in the short term. Accordingly a larger number fossil energy utilization cause serious damage of ecological environment, resource-environment pressure is ever-increasingly growing. Since 2006, Chinese government had carried out mandatory energy-saving and emission-reduction responsibility system using energy development planning and comprehensive programs of energy-saving and emission-reduction in the eleventh-five and twelfth-five period, strengthen government and corporate responsibility using the constraint of energy-saving and emission-reduction policy.

Since an inverted U-type relationship between economic development and environmental degradation by Grossman and Krueger [1], this relationship means that the lower degree of economic development causes less environmental pollutions, environmental degradation is serious with an quick increase of initial economic growth, and then environmental problems will be gradually improve with higher developed degree of economic growth. Environmental Kuznets Curve (EKC) suggests the relationship between economic growth and environmental degradation taking the forms of an inverted U-type, and then sufficient economic development will solve environmental degradation and natural resource exhaustion problems in both developed and underdeveloped nations. Bruyn (1997) find evidence for structural changes of economic growth as an important determinant of the impressive reductions in SO2 emissions of developed economies during the 1980s [2]. Unruh and Moomaw (1998) imply that national income levels determine pollution levels using the EKC hypothesis, and historical economic growth can forecast pollution trajectories of individual country

[3]. Dijkgraaf and Vollebrgh (2005) cast an inverted-U relationship between per capita GDP and environmental pollution, CO_2 emission-reduction is difficult due to the overall Environmental Kuzents Curve [4]. Verbeke and Clercq (2006) posits an inverse U-shaped relation between environmental pollution and national income with a Monte Carlo investigation of an transited Environmental Kuznets type [5]. He (2008) discusses the validity of the Environmental Kuznets Curve (EKC) hypothesis for the case of Chinese industrial SO2 emissions, his result show the decreasing trend in per capital emissions may well not be enough to bring about an immediate reduction in terms of total quantity of industrial SO_2 emissions and SO_2 emissions density [6]. Brajer, Mead and Xiao (2008) find some support for the typical inverted-U-shaped relationship and an N-shaped cubic configuration between economic growth and environmental degradation [7]. Diao et al (2009) develop regression modes for investigating the inverted-U relationship between economic growth and environmental quality in China using Environmental Kuznets Curve (EKC) theory [8]. Miah et al. (2010) examine the effect of economic development processes on environmental changes using Environmental Kuznets Curve (EKC) hypothesis [9].

The EKC literatures shift the main issue from natural resource exhaustion and environmental degradation and economic growth to overcome necessarily environmental deterioration and pollution. Appropriate economic growth and environmental regulation policies have played an important role in the developed and underdeveloped countries.

However a large parts of empirical evidence attempt to examine the significance of other factors than economic growth that may lead to an EKC-pattern. Lindmark (2002) examines the inverted-U trajectory of Swedish CO_2 emissions associated with technology, industrial structural changes, economic growth and fuel price, and suggests higher sustained-growth rates was associated with less technological and industrial structural changes relating to CO_2 emissions quantity than those periods with lower growth rates [10]. Lantz and Feng (2006) investigate that gross domestic product per capita (GDP/capita), population and technological change have the important impact on CO_2 emissions, their results show that GDP per capital is not an inverted U-shaped relationship with population, a U-shaped relationship with technology progress [11]. Harris et al. (2009) test the validity of the EKC effect using the ecological footprint, which is a more comprehensive measure of environmental degradation [12]. Kijima et al.(2011) find that expected level of overall pollutions exhibit a inverted V-shaped or an N-shaped pattern with an increase of economic growth [13]. Park and Lee (2011) investigate a relationship between economic development and air pollution at the regional level, their results show potential existence of U-shaped and N-shaped curves, and the region-specific coefficients are enormously heterogeneous across regions [14]. Thompson (2012) determines the effect of water abundance on an EKC for water pollution using Environmental Kuznets Curve theory, and water abundance greatly affects the turning point of an EKC [15]. Lin et al. (2013) verify that the initial goals of the government on energy conservation and emission reduction could not be achieved through improving energy efficiency alone, but need to be supplemented with relevant energy pricing reforms [16]. The above studies examine the other underlying factors that may drive such an EKC relationship, such as the distribution of income, international trade, structure changes, technical progress, energy efficiency improvement, governance and consumer preferences [17-18]. Chang and Wang (2012) propose a new N-factor affine term structure model for CO2 futures price and estimate parameters in the new affine model by using the Kalman filter technique, their results CO2 futures price follow significant mean-reversion process, and the estimated coefficients of mean-reversion speed, market risk premium, volatility and their correlation among state variables are almost significant [19]. Chang, et al.(2012) develop the general model of the futures options valuation under the term structure of stochastic multi-factors, suggest the futures options function carry information about the volatility and adjustment speed of arbitrary multi factors, the correlation among multi-factors, and the time to maturity of futures and options contract [20]. Chang (2013) propose the market behavior of convenience yields and examine the options feature of convenience yields for emission allowances, his empirical evidences show that when the convenience yields are call or put options, market participants can flexibly adjust portfolio policies of emission allowances assets, and then achieve extra market arbitrage revenues through exchanging emission allowances assets between spot and futures [21]. Chang (2013) proposes the empirical evidence of the effects of ownership and capital structure on environmental information disclosure, his empirical results show that state legal-person ownership, non-state ownership, ownership concentration, financial

leverage, long-term debts and short-term debts have significantly positive impacts on environmental information disclosure [22]. Neri (2010) describes how the software agent paradigm can be a powerful and versatile simulation tool to model and study complex systems, and software agents allow to approximate the behavior of complex systems under several scenario conditions [23]. Neri (2012) discusses a computational simulation technique based on agent based modeling and learning to closely approximate the SP500 and DJIA indexes over many periods and under several experimental set ups [24]. Neri (2012) presents an introduction to the special issue on computational techniques for trading systems, time series forecasting, stock market modeling, and financial assets modeling [25]. Yu and Zhou (2010) adopts stochastic frontier analysis to measure R&D efficiency and its impacts on Chinese high- tech industry in 2001- 2007 with provincial panel data, Institutional environment, the size of firms, and the expense on digestion and adoption of technology have a positive impact on R&D efficiency of high- tech industries [26]. Zhang and Wang (2010) use provincial panel data to examine the relationship between economic growth and air pollutants, the inverted- U relation results from government regulations rather than the endogenous mechanism [27]. Yao (2012) finds that the environmental performance appraisal system towards local governments is implemented to resolve the soft constraints of environmental regulation in the long run In order to break political connection buffer effect between the local government and some regulated firms [28]. Cheng and Wang (2014) present a vector auto regression model of energy consumption , technological progress and economic growth is established and the dynamic relationships between them are empirically analyzed with the econometric method of the cointegration test , Granger causality test , impulse response function and variance decomposition [29]. Hájek and Neri (2013), Azzouzi and Neri (2013), Bojkovic and Neri(2013), Pekař and Neri(2013), Guarnaccia and Neri(2013) propose an introduction to the special issue on computational techniques for trading systems, time series forecasting, stock market modeling, financial assets modeling, advanced control of energy systems, interactive multimedia systems, and advanced control methods: Theory and application [30-34].Energy consumption structure, energy intensity, energy efficiency and energy-saving policy have important role in economic growth and emission target control.

The above literatures pay much attention on crucial factors such as economic growth, population, technology progress, industrial structure changes etc using an inverted-U and N-type EKC theory. Especially this article has two major contribution: firstly those literatures have not take full account for the inverted-U type EKC effect of energy intensity, energy- consuming structure and carbon emission intensity on environmental degradation. Secondly the constraint of energy-saving regulation policy has a significant impact on energy efficience and energy intensity and emission intensity. Since 2006, Chinese government proposes specific constricted targets in energy consumption structure, energy intensity, energy efficiency and carbon emission intensity. This paper presents energy efficiency, energy-consuming quantity and carbon emission intensity have significant effects on emission-reduction target on the constraint of energy-saving policy, and then propose reasonable advices on energy planning and environmental regulation policies for further energy-saving policy.

The remainder of our paper is organized as follows. Section 2 presents Environmental Kuznets Curve theory. Section 3 describes the source of data samples and constraint energy-saving and emission-reduction indicators. Section 4 proposes co-integration and Granger causality tests. Section 5 presents the statistical results of EKC effect of economic growth, energy intensity and carbon emission intensity on carbon emission quantity under the constraint of energy-saving policy. Section 6 provides a brief conclusion and a serial of resonable advices.

2 Environmental Kuznets Curve (EKC) estimation

According to the EKC-hypothesis, further economic growth can improve environmental degradation after an economy has reached an adequate level of economic growth [17]. In the early stages of economic growth, there is an abundance of natural resource stock and a limited generation of wastes and greenhouse emissions due to limited economic growth. There occurs a significant depletion of natural resource and wastes accumulate with an quick increase of economic growth and industrialization. During this stage, there is a positive relationship between economic growth and environmental degradation. Industrial structure optimization, technology improvement, energy efficiency and information diffusion can reduce environmental degradation with further economic

growth. The early studies test the EKC-hypothesis using the following general model.

$$y_t = \beta_0 + \beta_1 x_t + \beta_2 x_t^2 + \beta_3 z_{it} + \beta_4 z_{it}^2 + \varepsilon_t \quad (1)$$

In equation (1), y is the dependent variable of environmental degradation, which denotes the logarithm of total quantity of carbon emission, the lower carbon emissions mean the better environmental quality. x is the independent variable of economic growth which denotes the logarithm of GDP per population. z_i reflects other variables that may affect y. β_0 is the constant term, β_i is the estimated coefficients, ε is the error term. Based on equation (1), we can examine multi-shapes relationship between economic growth and carbon emission quantity. When $\beta_1 = \beta_2 = 0$, x and y has no relationship. When $\beta_1 > 0, \beta_2 = 0$, x and y exist increasing linear relationship, while $\beta_1 < 0, \beta_2 = 0$, x and y exist inclining linear relationship. When $\beta_1 \le 0, \beta_2 > 0$, x and y exist U-shape curve relationship, while $\beta_1 \ge 0, \beta_2 < 0$, x and y exist inverted U-shape curve relationship.

3 Data Source and Constraint Indicators

3.1 Data Source

In order to examine the EKC effects of energy efficiency, energy consumption structure and carbon emission intensity on carbon emission quantity, we choose that data samples on GDP, population, energy-consuming quantity and their consumption structure are sourced from China Statistical Yearbook. Actual GDP per population is estimated by retailed price index in 2005. Estimated methodology and data samples are sourced from Inter-government Panel on Climate Change, CO_2 emission coefficient of coal is 2.7942 tons per ton of standard coal energy (TCE), CO_2 emission coefficient of oil is 2.1494 tons per TCE, CO_2 emission coefficient of natural gas is 1.6443 tons per TCE, CO_2 emission quantity per year is estimated in the equation (2)

$$C_t = \sum_{i=1}^{3} E_{it} \times \eta_i \quad (2)$$

Where i =1,2,3 denote coal, oil and natural gas, C denote total quantity of CO_2 emission, E_i denote consuming quantity of fossil energy i, η_i denote CO_2 emission coefficients of energy i. Based on equation (2), total quantity of CO_2 emission is 14.38 one hundred million tons in 1978, and total quantity of CO_2 emission is 85.03 one hundred million tons in 2012. In the figure 1, total quantity of CO_2 emission exhibit an increasing trend from 1978 to 2012.

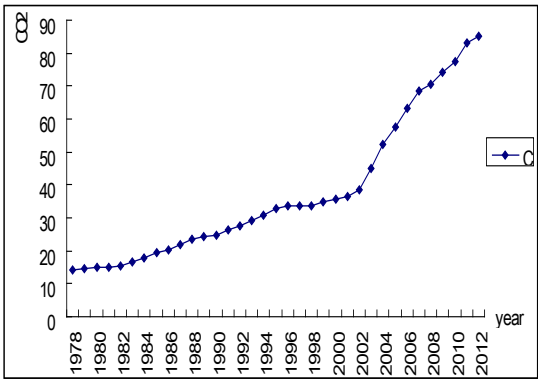

Figure 1. Total quantity of CO_2 emission (100 million tons)

3.2 Constraint Indicators of Energy-saving and Emission-reduction Planning

Based on twelfth-five energy planning in China and comprehensive program of energy-saving and emission-reduction policy, Chinese state council proposes some constraint target of energy-saving and emission-reduction in twelfth-five period. Compared with 0.9350 tons TCE per ten thousand Yuan in 2010, energy intensity will attain 0.7854 tons TCE per ten thousand Yuan in 2015, reduce 16% than energy intensity in 2010, and incline 32% than energy intensity1.2761 tons TCE per ten thousand Yuan in 2005. Chinese economic growth will reduce 6700 million tons TCE in twelfth-five period. Energy consumption structure will optimize, the ratio of non-fossil energy counted underlying energy consumption quantity will increase 2.8% than its ratio 8.6% in 2010, the consumption ratio of natural gas counted underlying energy consumption will enhance 3.1% than its ratio 4.4% in 2010, coal consumption ratio will incline 3.0% than its ratio 68.0% in 2010, oil consumption ratio will incline 2.9% than its ratio 19.0% in 2010. Carbon emission intensity will attain 1.8477 tons per ten thousand Yuan, and will reduce 17% than emission intensity 2.2261 tons per ten thousand Yuan in 2010.

Table 1 constraint index of energy-saving and emission-reduction in China

variable	*2010*	*2015*	*target*	*attribute*
CI	2.2261	1.8477	-17%	constraint

EI	0.9350	0.7854	-16%	constraint
ECQ	32.5	40	23.1%	forecast
RNFE	8.6%	11.4%	2.8%	constraint
RC	68.0%	65.0%	-3.0%	forecast
RO	19.0%	16.1%	-2.9%	forecast
RG	4.4%	7.5%	3.1%	forecast

Note: 1. CI denotes carbon emission intensity, EI denotes energy consumption intensity, ECQ denotes energy-consuming quantity, RNFE denotes consuming ratio of non-fossil energy,RC denotes consuming ratio of coal, RO denotes consuming ratio of oil, RG denotes consuming ratio of natural gas.
2.Measured unit of emission intensity is denoted by tons per ten thousand Yuan, measured unit of energy intensity is denoted by tons TCE per ten thousand Yuan, measured unit of energy-consuming quantity is denoted by 100 million tons.
3. Data source are from twelfth-five energy planning in China and comprehensive program of twelfth-five energy-saving and emission-reduction policy, GDP is adjusted according to constant price index in 2005.

4 Granger Causality Test

In the table 2, the statistical value of ADF test of emission quantity, GDP per population, energy intensity and carbon emission intensity is greater than -2.6210 at the confidence of 90% level, those variables are non-stationary. The statistical values of first-difference ADF test of each variable are less than -2.9640 at the confidence 95% level, those variables are stationary at the condition of first-difference ADF test. Empirical evidence of ADF test show that GDP, energy intensity, carbon emission intensity and carbon emission quantity can not exhibit long-run co-integration relationship, as a result, Chinese government carry out appropriate energy-saving and emission-reduction policy which has obvious impact on economic growth.

Table 2. The test results of Augmented Dickey-Fuller unit root

variables	*level*	*1st difference*
y	-0.5326	-2.9722**
x	-0.1147	-302112**
EI	-0.6930	-4.0850***
CI	-0.4365	-4.2260***

Note: ***,**,* denote the significance of 99%, 95%, 90% level, unit root test is estimated by ADF model with intercept term and lag=2, the critical statistical results of ADF test are -3.6701 , -2.9640 and -2.6210 at the significance of 99%, 95%, 90% level.

Table 3 Empirical evidence of Granger causality test of each vairiables

variables	*Lag*	*t-statistical value*	*p-value*
$x \to y$	2	3.9414	0.035
$y \to x$	2	0.2434	0.786
$EI \to y$	2	4.1924	0.029
$y \to EI$	2	2.5842	0.099
$CI \to y$	2	4.2888	0.027
$y \to CI$	2	2.4661	0.109

Note: $x \to y$ denotes x does not Granger cause y, $y \to x$ denotes y does not Granger cause x, the following variables are similarly defined.

In the table 3, the t-statistical value of Granger $x \to y$, $EI \to y$ and $CI \to y$ are 3.9414, 4.1924 and 4.2888, their p-values are 0.035, 0.029 and 0.027, those Granger causality test significantly refuse initial hypothesis at the significance of 95% level, those empirical results show that GDP per population, energy intensity and carbon emission intensity have causal impacts with carbon emission quantity, historical data of GDP per population, energy intensity and carbon emission intensity can predict short-term trend of carbon emission quantity. the p-value of Granger $y \to x$, $y \to EI$ and $y \to CI$ are 0.786, 0.099 and 0.109, those Granger causality test accept initial hypothesis at the confidence of 95% level, those empirical results can not support their Granger causality relationship. Accordingly GDP per population, energy intensity and carbon emission intensity have single-directionally causal relationship with carbon emission quantity. Since 2005, carbon emission quantity in China have structural change, carbon emission quantity and GDP per population do not have long-term co-integration relationship, however sample data before 2006 pay little role to predict further carbon emission quantity.

5 EKC Effects Estimation under the Constraint of Energy-saving Policy

5.1 Discrete EKC Model

Assumed GDP per population at intial period is GDP_0 , growth ratio of GDP at period t is

g_t , GDP_T at period T is equal to $GDP_T = GDP_0 \times \prod_{t=1}^{T}(1+g_t)$. Assumed population quantity at intial period is P_0, natural growth ratio of population at period t T is k_t ,population quantity at period T is equal to $P_T = P_0 \times \prod_{t=1}^{T}(1+k_t)$. Assumed X_0, X_T are GDP per population at intial period and period T, accordingly

$$X_T = X_0 \times \prod_{t=1}^{T}\frac{1+g_t}{1+k_t} \quad (3)$$

Assumed Q_0 is total quantity of energy consumption at intial period, Q_T is total quantity of energy-consuming planning at period T, l_t is increasing ratio of energy consuming quantity at period t.

$$l_t = \sqrt[T]{\frac{Q_T}{Q_0}} - 1 \quad (4)$$

Total quantity of energy consumption at period t is equal to $Q_t = Q_0 \times (1+l_t)^t$. Assumed q_c, q_o, q_g are consuming ratio of fossil fuel coal, oil and natural gas, r_c, r_o, r_g are inclining ratio of fossil fuel coal, oil and natural gas, and their incling ratio is similarly defined as equation (4). Assumed Q_t is total quantity of energy consumption at period t, total quantity of carbon emission at period t is equal to

$$C_t = 2.7942 Q_t q_{ct}(1-r_{ct}) + 2.1494 Q_t q_{ot}(1-r_{ot}) + 1.6443 Q_t q_{gt}(1-r_{gt}) \quad (5)$$

Energy-consuming intensity is equal to $EI_t = \frac{Q_t}{GDP_t}$, carbon emission intensity is equal to $CI_t = \frac{C_t}{GDP_t}$. Environmental problems will improve with an increase of economic growth, we believe that Environmental Kuznets Curve can achieve a turning piont.

5.2 Target Analysis of Carbon Emission Intensity and Energy Intensity

Chinese government smoothly attain planning target of carbon emission in twelfth-five period, there are two ways. One way is to enhance energy usage efficiency and incline energy-consuming intensity per GDP, another way is to optimize energy consumption structure, especially reduce coal-energy-consuming ratio in underlying energy consumption, and improve consuming ratio of renewable energy. Based on the constrained planning target of energy-saving policy in twelfth-five period, if planning growth ratio of GDP per year is 7.5%, total quantity and structure of energy consuming can attain according to planning target in twelfth-five period, energy-consuming intensity in 2015 is 0.8606 tons TCE per ten thousand Yuan. Compared with energy intensity 0.9350 tons TCE per ten thousand Yuan in 2010, energy intensity reduces 3.921% and it is much less than inclining ratio of planning target 16% in twelfth-five period. Carbon emission intensity in 2015 is 1.9670 tons per ten thousand Yuan, compared with carbon emission intensity 2.2261 tons per ten thousand Yuan, carbon emission intensity reduces 11.64% and it is less than inclining ratio of carbon intensity 17% in twelfth-five period.

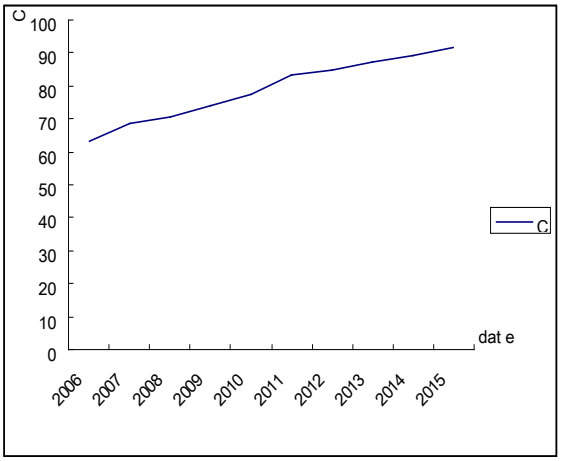

Figure 2. Total quantity of carbon emission (100million tons)

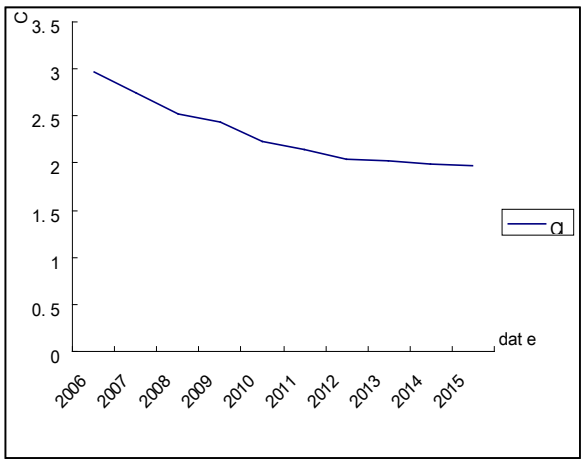

Figure 3. Carbon emission intensity (CI)

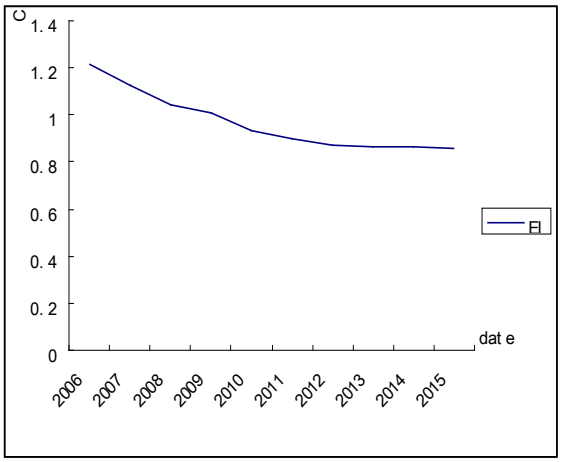

Figure 4. Energy-consuming intensity (EI)

Table 4. Target analysis of carbon emission intensity and energy intensity under the constraint of energy-saving policy

Variable	*2010*	*2015*	*Target achievement*
Carbon intensity	2.2261	1.9670	11.64%
Energy intensity	0.9350	0.8606	3.92%

Note: GDP is estimated according to constant price index in 2005.

5.3 EKC Effect Estimation under the Constraint of Energy-saving Policy

Chinese government has set constrained target responsibility of energy-saving and emission-reduction policy and strengthens government and enterprises responsibility, push government and enterprises improve energy efficiency and reduce energy intensity, optimize energy-consuming structure and than incline carbon emission intensity. In order to examine the EKC effect of energy intensity, GDP per population and carbon emission intensity on total quantity of carbon emission, we propose the following equation (6).

$$y_t = \beta_0 + \beta_1 x_t + \beta_2 x_t^2 + \beta_3 ei_t + \beta_4 ei_t^2 + \beta_5 ci_t + \beta_6 ci_t^2 \quad (6)$$

Where ei denotes energy-consuming intensity, ci denotes carbon emission intensity, β_0 is intercept term, $\beta_1 - \beta_6$ are the coefficients of each variables. Because Chinese government has carried out the constraint of energy-saving policy, we choose data samples from 2006 to 2015, and examine the EKC effect of energy intensity, GDP per population and carbon emission intensity on carbon emission quantity under the constraint of energy-saving policy. The regression results are as following table 5.

Table 5. EKC effect estimation under the constraint of energy-saving policy

variables	*1978-2005*	*2006-2015*
β_0	-15.5985***	-75.1483***
	(-9.9205)	(-6.1691)
β_1	2.8545***	14.9605***
	(11.5950)	(6.0846)
β_2	-0.0953*	-0.6921***
	(-1.9092)	(-5.7157)
β_3	0.6904	1.8803**
	(0.8728)	(3.2385)
β_4	0.7389	3.2658**
	(1.4552)	(2.1502)
β_5	1.4481	5.4811**
	(0.9832)	(3.2168)
β_6	-0.6047	-3.1752**
	(-1.2984)	(-2.7414)
R^2	0.9996	0.9999

Note:1. GDP values are adjusted as the constant price in 2005, energy intensity and carbon emission intensity are estimated as the constant price in 2005.
2. ***,**,* denote the significance of 99%, 95%, 90% level, the number in the parentheses are t statistic values.

In the table 5, the related coefficients among total quantity of carbon emission, GDP per population and squared GDP per population from 1978 to 2005 are 2.8545 and -0.0953 at the confidence of 90% level, t-statistical values are larger than 1, GDP per population have an inverted U-shaped EKC effect on carbon emission quantity at the confidence of 90% level from 1978 to 2005. The related coefficients among carbon emission

quantity, carbon intensity and squared carbon intensity are 1.4481 and -0.6047, t-statistical values are less than 1, carbon emission intensities have a non-significantly inverted U-shaped EKC effect on carbon emission quantity from 1978 to 2005. The related coefficients among Carbon emission quantity, GDP per population and squared GDP per population are 14.9605 and -0.6921 at the confidence of 99% level from 2006 to 2015, those results show that GDP per population have a significantly inverted U-shaped EKC effect on carbon emission quantity at the confidence of 99% level from 2006 to 2015. The related coefficients among carbon emission quantity, carbon intensity and squared carbon intensity are 5.4811 and -3.1752 at the confidence of 95% level, and carbon emission intensity has a significantly inverted U-shaped EKC effect on carbon emission quantity at the confidence of 95% level from 2006 to 2015. The related coefficients among carbon emission quantity, energy intensity and squared energy intensity are 1.8803 and 3.2558 at the significance of 95% level from 2006 to 2015. Those empirical evidences show that Chinese government encourage enterprises to enhance investment of energy-saving and emission-reduction projects using the constraint of energy-saving policy, promote energy-saving technology implication, implement energy-saving and emission-reduction management practices, those activities are helpful to reduce carbon emission quantity. Optimizing energy-consuming structure and reducing energy intensity are helpful to incline carbon emission intensity and total quantity growth of carbon emission.

6 Conclusion

Using Environmental Kuznets Curve theory, this article examines the EKC effect of economic growth, energy intensity and carbon emission intensity on total quantity of carbon emissions under the constraint of energy-saving policy. Economic growth, energy-consuming intensity and carbon emission intensity can not exhibit long-term co-integration relationship and single-directionally causal relationship with total quantity of carbon emission. Energy-saving policy implemented by Chinese government has not significant effect on economic growth, and we can predict future short-run trend of carbon emission quantity. Based on the constrained planning target of energy-saving policy in twelfth-five period, if planning growth ratio of GDP per year is 7.5%, energy-consuming intensity in 2015 forecasts 0.8606 tons TCE per ten thousand Yuan and reduces 3.921% in 2015 using discrete EKC model, as a result energy intensity will not achieve constraint indicators of energy-saving planning in twelfth-five period. Carbon emission intensity in 2015 forecasts 1.9670 tons per ten thousand Yuan and reduces 11.64% in 2015 using discrete EKC model, accordingly carbon emission intensity will not attain constraint indicators of emission-reduction planning in twelfth-five period. GDP per population have an inverted U-shaped EKC effect on carbon emission quantity at the confidence of 90% level from 1978 to 2005, while carbon emission intensities have an non-significantly inverted U-shaped EKC effect on carbon emission quantity from 1978 to 2005. Those empirical evidences exhibit energy-consuming structure, energy intensity and emission intensity have non-significant impact on inclining speed of carbon emission intensity from 1978 to 2005. GDP per population and carbon emission intensity have significantly inverted U-shape EKC effect on carbon emission quantity at the confidence of 95% level from 2006 to 2015, accordingly optimizing energy-consuming structure and reducing energy intensity are helpful to incline carbon emission intensity and total quantity growth of carbon emission in eleventh-five and twelfth-five periods on the constraint of energy-saving and emission-reduction policy. Energy-saving and emission-reduction policy have a significant impact on eerngy efficience and emission reduction. Under the constraint of energy-saving and emission-reduction policy, optimizing energy-consuming structure, especially optimizing coal-consuming structure, inclining energy intensity and total quantity of energy consumption, and then carbon emission intensity reduces and environmental degradation improves with an increase of economic growth.

However planning target of carbon emission intensity faces greater challenges and risks in the future, Chinese government should introduce a serial of energy-saving and emission-reduction advices and policies. Firstly, government should establish government-guided, market-driven, enterprise -led regulation schemes of energy saving and emission-reduction, actively promote those regulation schemes implication and then achieve long-run emission reduction effect using market scheme. Secondly, government should improve constrained-indicators system of energy-saving and emission-reduction, improve market trade scheme and supervising assessment system, establish information communication and punishment mechanism of energy-saving and emission-reduction and then strengthen enterprises environmental responsibility and enhance environmental benefits of energy-saving enterprises.

Thirdly, our government should take an effective ways to optimize energy-consuming structure incline, reduce consuming-ratio of fossil fuels and increase consuming-ratio of renewable energy, control total quantity of energy consumption, drive carbon emission intensity incline and decrease the rising speed of carbon emission quantity. Fourthly, government should promote renewable energy technology implication, encourage enterprises to increase investment of energy-saving and emission-reduction projects using fiscal tax and subsidy instruments and market mechanism, and then effectively promote energy-saving management practices. Fifthly, government should introduce emission trade scheme and interests-oriented incentives, foster energy-saving and emission-reduction finance services markets, establish target responsibility and marketization of energy-saving and emission-reduction and then significantly reduce carbon emission intensity and total quantity of carbon emission.

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Mutual Funds Investment Strategies

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Abstract: - The main purpose of this market survey was to compare bond, stock and mixed funds domiciled in the United States and selected countries of the European Union using of modern methods to give proof to people, that it is possible to increase their personal wealth by this way of the investment, which is now possible in the transition economies too. However, not everyone here knows the inherent risks involved in investing or how to strike a correct balance between risk taking and making a profit. In such situation, there is a possibility to ask professionals or consultants for their choice of what they believe to be the best investment alternative(s) or to determine own strategies in selecting risk level and attempt to find the best investment alternatives. In this paper the strategy based on the large collections of historical data sets (6,385 calculations were made) is shown.
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Key-Words: - Mutual funds, investment, bond, stock

1 Introduction

The mutual funds are a portfolio of multiple company´s stocks, picked and managed by a professional fund manager (Mincher, 2007).

Over the past decade American investors increasingly have turned to mutual funds to save for retirement and other financial goals (Kyiosaki, 2011). Mutual funds can offer the advantages of diversification and professional management. However, as with other investment choices, investing in mutual funds involves risk. And fees and taxes will diminish the fund's returns. It pays to understand both the upsides and the downsides of mutual fund investing and how to choose products that match your goals and tolerance for risk (http://www.sec.gov/investor/pubs/inwsmf.htm).
Money market mutual funds offer a convenient parking place for cash reserves when an investor is not quite ready to make an investment or is anticipating a near-term cash outlay for a non-investment purpose. Money market mutual funds offer ultimate safety and liquidity. This means that investors will have an expected sum of cash at the very moment that they need it (http://www.investopedia.com/articles/mutualfund/04/081104.asp). By Rose, Marquis (2009) the household – individuals and families – are the dominated holders of corporate stocks, followed by pensions funds, mutual funds and insurance companies.

The brutal collapse of financial markets a few years ago and some specific problems of transformed economics – e.g. promotion of idea that huge profit could be recognised before being realized by churning non-liquid assets (Gregoriou, 2010) - are the reasons for poor confidence in them. However, this was not the end of mutual funds because they remain a viable investment vehicle for many people although they should be very cautious. In truth, mutual funds are still the best way to achieve long-term financial goals for many of us. But we need to collect more information from long-term periods and hope that, after the passage of time, they will be stable once again. By Kiyosaki (2011) - there is no such thing as a safe investment. There are only smart investors. By Valach (2010) is obtaining of update and true information for making a decision more and more difficult. It is necessary to calculate all information available in the market (Ingersoll,

1987). But there exists one unpredictable risk – political (Kohout, 2005), which is more expected in some countries. They are not convenient for the investment.

One of the advantages of mutual funds is that they are diversified, what is one of most important reasons for the investment of our money (Escalda, Vaz, 1998). There are many such funds worldwide that offer many a numerous variety of benefits and risks and which, when combined with the approach a client chooses, they can offer a very good profit result even in difficult times for investing. Due to the short history of these investments in the Czech Republic, the comparison of funds of the Czech Republic with those of foreign funds was chosen. Specifically, the performance of Czech, American and European funds was compared. During this process 6,385 calculations were made. For this reason a decision to find some new method how to do calculations more easy and exact was made. The new method which offers more easy way to the optimal and easier strategy of investing while avoiding lot of calculation and mistakes was found in the co-operation of two universities in the Czech Republic.

Information technologies play a key role in industry and in the development of the transition economies as a whole. The requirements of the application sphere and foreign investors are connected with the rapid growth of IT technologies, yet science and research have not responded adequately to this newly emerging situation. Additionally, the growing complexity of the tasks solved in the application sphere – in industry and society – brings a growing need to create a modern computer infrastructure based on high-powered supercomputers, including the development of related scientific disciplines. The lack of a supercomputer centres represents a key competitive disadvantage of the Czech Republic. The IT4Innovations Centre of Excellence in Ostrava (http://www.it4i.cz/en/index.php) solves this problem in the present time and responds to these needs, representing a tool for the integration and development of IT research. The infrastructure created by the IT4Innovations will thus not only work as a high-quality partner for the application sphere, but will also motivate industry to develop new and innovative products and solutions based on the effective use of these modern technologies.

Economic and financial modelling, that is included in the Numerical Modelling for Engineering research area, creates one of the basic exact tools for economic and financial decision-making, analysis, and prediction. A specific feature for these models is that there are extensive dimensions, and extensive data is necessary to be processed. In addition, it concerns dynamic models for risks, uncertainty, and flexibility (Martiník, 2012).

The above-mentioned implies that model applications are demanding on computing technology from the point of view of the quantity of processed and stored data as well as computations range and speed. Thus it is necessary and it is also the application precondition to dispose of performing computing technology. It looks to be a good way for the new research not only in the field of finance in the Czech Republic.

The heading of each section should be printed in small, 14pt, left justified, bold, Times New Roman. You must use numbers 1, 2, 3, … for the sections' numbering and not Latin numbering (I, II, III, …)

2 Problem Formulation

Mutual funds are good financial instruments if you know how to use them to your advantage. The first decision one has to consider is **timing**. Time plays a very important role because mutual funds are usually not short term investments but rather long term investments for the reason that one has to expect the possibility of changes in the market in the long term. It is also necessary to keep them long enough to ride out business cycles as they will occur. This means holding them at least 5 years but it is probably better to keep them 10 to 20 years. As one can see, investing in mutual funds is rather similar to investing in real estate, Benz (2005).

The second step is to obtain enough **information** to decide which funds to choose. It is necessary to obtain reliable data in order to select the best funds in the market, both foreign and domestic.

The third step is **to reduce the risk,** with the help of diversification.

For all of these decisions, it is necessary to understand the **performance** of a fund and the **risk** for that investment (Steigauf, 2003). The financial markets have been very uncertain especially the last five years. What is the difference between risk and uncertainty? While it might seem like a same term, it is not quite so. Risk can be quantified, which means that there is a measurable probability of

possible outcomes. The probabilities of outcomes can be attained either by deduction or induction. For example economists induce probability distributions from stock market returns from the history of past returns.

Contrary to risk, uncertainty is not quantifiable. In this situation the world is not well charted. Our world view might be insufficient or the way world operates might change, so that the past observation become obsolete. Typically, when making an investment decision, both risk and uncertainty are present. Given that risk is quantifiable, most of literature on the subject if financial markets, deals predominantly with risk, but not with uncertainty. Complete ignorance of uncertainty may result in poor investment.

The financial markets are very important object taught now at different schools. They are e.g. one of part of the lessons at high schools (Dvořáková, 2011) and universities in the Czech Republic. The topics of investing in mutual funds are the part of standards of Ministry (2011) of Education, Youth and Sports of the Czech Republic in the System of building of financial literacy at schools too.

2.1 Indicators showing the performance and risk

Performance indicators

The fund performance should be compared within the same category of funds. For example, there is big difference between funds that focus on stocks and those that focus on bonds. It is also better to do the comparison within a long time period because the data is less affected by cyclical bull and bear markets if a longer period is chosen. It is necessary to know if fund costs and expenses such as management salaries, advertising, operating costs, duties and taxes etc. are deducted before the publishing of return results. If not, it might be that the profit will shrink because of these "invisible" costs, and the fund might not be such an optimal choice (Lack, 2011).

Risks indicators

Time is the most important indicator (Steigauf, 2003). Time is very important in any financial activity and the longer the time period often means the greater the risk. It works the same way in mutual funds. An investor, that chooses mutual funds, usualy looks at mutual funds as long-term investment. The price of mutual funds is determined once-per day. The only time it would make sense to follow the price movements much closer would be if there is a situation, when one tries to find a perfect moment to enter particular mutual fund.

The **risk** (Benz, 2005) can be further influenced by the interest rate and, of course, by changes in monetary market if some foreign currency is used. There is, more or less, only one risk-free investment – state bonds provided they are issued in some relatively safe country, but in this case it is not possible to talk about investment in mutual funds. However we should underline the adjective "safe" because….How we can define a "safe country" nowadays?

Measurement of turnover. It may not appear very relevant to cost, but if a particular fund trades its securities often, there are transaction fees applied which increases the cost of the fund and lowers its net profit.

Management and its changes. When there is a long time period associated with the favourable performance of a particular fund and the good performance was a result of good management, a change in management can cause certain problems.

William J. O´Neil (2002) author of the book "How to Make Money in Stocks" suggests a different approach. His method of making money with mutual funds is based on his strategy, "CAN SLIM", which has to do with choosing the right growth stock based on indicators that show significant growth, e.g.: growing earnings per share, growing sales, being a leader in the industry or sector, and correctly timing the investment. When it comes to mutual funds, O'Neal (2002) suggests that the only type of fund worth investing in is a U.S. based growth stock fund. He also suggests that the minimal time for investment should be at least 15 years, and that the fund must be one of the top performers in the growth fund group.

The main purpose of this market survey was to compare bond, stock and mixed funds domiciled in the United States and selected countries of the European Union with the using of modern methods to give proof to people how it is possible to increase their personal wealth by this way of the investment. This research was so much specific

and unique, that there is not any other for the comparing of it. The period being monitored was 2007 – 2012, which was impacted by the current financial crisis. However a longer period is necessary to minimise all the side effects.

2.2 Methodology

The investment companies from the United States are: Fidelity Investments, Vanguard Group, Morgan Stanley, and American Funds. All of these companies manage certain mutual funds. The data was collected from web pages in www.finance.yahoo.com and verified on www.morningstar.com. Prices were adjusted for dividends and operating costs.

In the Czech Republic, the following investment companies and their funds were chosen: Investiční společnost České spořitelny a.s. (ISČS), Investiční kapitálová společnost Komerční banky a.s., ČSOB Investiční společnost a.s., ČP Invest a.s.

German mutual funds work under the management of the Deutsche Bank AG and the prices were acquired from their web page.

French funds are managed by the group BNP Paribas. Historical prices were mostly acquired from the official web pages of this bank, which the exception of one particular fund found in the pages www.conseq.cz.

British funds are managed by the group Barclays PLC. Prices were acquired from their official web page.

The last funds analysed are globally based. These funds are members of the investment group Franklin Templeton. They are specifically stock funds: FT Asian Growth Fund and FT Latin American Fund. These stock funds were added because they were recommended by investment-consultant based on web pages www.investicni-konzultant.cz, which offer advice on mutual fund investments. These two funds were specifically offered as a good investment opportunity at http://www.investicni-konzultant.cz.

The funds are measured with respect to absolute profit/loss without the consideration of risk, the standard deviation of a five-year period recalculated to one year to emphasise the risk, beta coefficient, the Sharpe ratio, the Treynor ratio and the coefficient of variation (by the way described in Levy, Marshall, 1991).

The purpose of all these calculations is to discover if a certain fund could be considered a good investment when taking risk into consideration.

The calculations are performed in the following manner by (www.morningstar, www.finance-management.cz)

1. **Profitability of funds** – arithmetic and geometric means. The arithmetic mean is calculated on a monthly basis and was used as the average return of a fund in the Sharpe and Treynor ratios.
2. **Standard deviation s_x** is the rate of variableness as the standard rate of total risk of individual assets and portfolios:

$$s_x = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

   where $n \in \boldsymbol{N}$ is the number of values x_i in the set of data for $1 \leq i \leq n$ ($\boldsymbol{N}$ denotes the set of all natural numbers), x_i is taken as random values from a data set, x is the arithmetic mean of the values x_i for $1 \leq i \leq n$.
3. **Beta coefficient** – for this indicator it is necessary to have the broader market data. Beta measures the systematic risk. There are many benchmarks used such as the general market, e.g. the S&P 500 or EuroStoxx 50. The logic was to find a benchmark that is the most related to the assets of a certain fund. Beta shows changes in the value of a fund, if the market (the benchmark) would change. If the value of the coefficient is 1 then the fund will change in the exact same proportion as the market. Beta coefficient is calculated using the coefficient of co-variation between a particular fund and a relative market, divided by the coefficient of determination R^2
4. **Coefficient of determination R^2** - shows the percentage of changes that can be explained by the changes in the market (the benchmark). The Coefficient of determination was used as a supporting indication for Beta coefficient. It shows what percentage of changes in the fund's performance are determined by the compared benchmark (the market). The higher the coefficient of determination, the

more reliable is the coefficient Beta as a value of likely variation. For example, if the Coefficient of determination has a low value, this means that the fund does not correlate very well with the market compared, and could be a good choice if one wants to diversify portfolio further. The higher the coefficient of determination, the more we can rely on the beta:

$$R^2 = \sigma_i / r_i$$

where σ_i is the standard deviation of assets I for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$, r_i is the average of profitability of assets I for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$.

5. **Sharpe ratio *SR*** - calculated by dividing the excess average return by the standard deviation of a certain fund.

$$SR = (r_i - r^*) / \sigma_i$$

where r_i is the average profitability of assets i for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$, r^* is the risk-free rate of profitability and σ_i is the standard deviation of profitability of assets i for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$.

6. **Treynor ratio *TR*** - calculated similarly to the Sharpe ratio of a fund but instead of using the standard deviation, the excess return is divided by the beta, (i.e. the market risk).

$$TR = (r_i - r^*) / Beta_i$$

where r_i is the average profitability of assets i for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$, r^* is the risk-free rate of profitability and σ_i and $Beta_i$ is the beta coefficient of assets I for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$.

7. **Coefficient of Variation *CV***

$$CV = \sigma_i / R_i$$

where σ_i is standard deviation of profitability of assets i for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$, and R_i is the average profitability of assets i for $1 \leq i \leq n$, where $n \in \boldsymbol{N}$.

To obtain these results, it was necessary to make more than 6,500 calculations and to accept risk of some mistakes in such way or to ask somebody to help us with some PC programmes.

3 Problem Solution

Figures and Tables are enclosed as enclosure.

The Figure 1 shows an example of a bar graph which was made for all types of mutual funds (by www.investing-in-mutual-funds), (i.e. stock funds, mixed funds and bond funds). Figure 1 shows the performance results of all stock funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank, Franklin Templeton Asia, Franklin Templeton.

It is clear that the best results are shown by the American fund, Morgan Stanley. The calculation of all coefficients and ratios were done for all types of funds. In total, there were 18 tables and 18 graphs.

The following figure (Figure 2) shows the performance results of all bond funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank..

The performance of the bond funds was calculated using the same formula as for the stock funds. The best performance is shown by the investment company Vanguard Group. The only fund that showed loss was the Barclays British fund.

The following figure (Figure 3) shows the performance results of all mixed funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.

The performance of the mixed funds was calculated using the same formula as for the other two types of funds. Mixed funds are composed mainly of stocks and bonds, and also sometimes other types of securities. The best performance is shown by the investment company Morgan Stanley. The worst performing mixed fund in the time period analysed was a Czech fund of the ČSOB. The Performance of the European mixed funds altogether lagged behind their American counterparts. The only European fund that showed profit was a Czech fund of the ISČS.

The following figure (Figure 4) shows the standard deviation of all stock funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank, Franklin Templeton Asia, Franklin Templeton Latin (the same position as in the figure but the picture is too small for detailed reading).

The standard deviation is used to determine the individual risk of each fund (also known as volatility). In this case, the standard deviation was calculated using the monthly net asset value and converted to yearly bases. The global funds of the company Franklin Templeton are the riskiest funds

to invest in. These two funds invest predominantly in China and Latin America. It is necessary to point out that the standard deviation of the Czech investment companies is not publicised anywhere and has to be calculated from the net asset value in order to evaluate it. The least individual risk is associated with the ČP Invest investment company.

The following figure (Figure 5) shows the standard deviation of all bond funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.

The standard deviation for the bond funds was calculated in the same way as for the stock funds. The riskiest of the bond funds is the fund of the company ČP Invest. The least risky is the fund of the company ČSOB.

The following figure (Figure 6) shows the standard deviation of all mixed funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.

The standard deviation for the bond funds was calculated in the same way as for the stock and bond funds. The biggest individual risk is associated with the fund of Fidelity Investments. The least risky mixed fund is the fund of the ISČS.

The following figure (Figure 7) shows the beta coefficient of all stock funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank, Franklin Templeton Asia, Franklin Templeton Latin (the same position as in the figure but the picture is too small for detailed reading).

The results of the beta coefficient comparison were quite different for each fund. The financial markets were very turbulent during this time period. The biggest systematic (market) risk is associated with the Morgan Stanley fund. This means that if the market moves up 1 %, this particular fund will move up 1.12 %.

The following figure below (Figure 8) shows the beta coefficient of all bond funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank

The biggest systematic (market) risk is associated with the Vanguard Group bond fund. The beta coefficient is 2,075. The funds of the companies Barclays and ISČS show negative beta coefficient, and this means that they are negatively correlated with the broad market. They move the opposite direction to the broader market movement.

The following figure (Figure 9) shows the beta coefficient of all mixed funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.

Based on the graph above, the funds based in the United States have a greater beta coefficient. The fund of Fidelity Investments has the greatest beta, closest to 1. This means that this fund moves nearly perfectly with the market. The European funds are not correlated very much with the broader market.

The following figure (Figure 10) shows the coefficient of variation of all stock funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank, Franklin Templeton Asia, Franklin Templeton Latin (the same position as in the figure but the picture is too small for detailed reading).

The coefficient of variation can be interpreted as units of risk per a unit of profit. This means that the lower the coefficient, the better the results. If the profits were in fact negative, the results could not be interpreted. This is the case with all the funds where there is a zero instead of a number of units of risk per unit of profit. According to the graph above, the best results were shown by the Morgan Stanley stock fund.

The following figure (Figure 11) shows the coefficient of variation of all bond funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.

Based on the graph above, the best results are shown by the Vanguard bond fund, which has the lowest coefficient of variation. The only bond fund that did not yield any profit is the Barclays bond fund.

The following figure (Figure 12) shows the coefficient of variation of all mixed funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.

Based on the graph above, the best results are shown by the ISČS mixed fund, based in the Czech Republic. This is the only fund of the European mixed funds that had positive average profits.

The following figure (Figure 13) shows the Sharpe ratio of all stock funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank, Franklin Templeton Asia, Franklin Templeton Latin.

The Sharpe ratio is negative for all of the funds in this time frame. This would means that based on this graph, the risk associated with investment is too great and it would be wiser to invest in the risk-free asset. This time period was affected by the

economic crisis the most. The collapse of the stock markets is the immediate cause of such bad results for all of the stock funds. The American stock funds showed slightly better results than the European funds. The fund of the company Morgan Stanley has the highest Sharpe ratio.
The following figure (Figure 14) shows the Sharpe ratio of all bond funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.
The Sharpe ratio is negative for all of the bond funds in this time period. This means that based on this graph, it would be safer to invest in a risk-free asset. The fund of the Czech company ČSOB has the worst Sharpe ratio. The best performing bond funds are the two funds based in the United States: Vanguard Group and Fidelity Investments.
The following figure (Figure 15) shows the Sharpe ratio of all mixed funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.
The Sharpe ratio is negative for all of the mixed funds in this time period. This is the same case as with stock and bond funds. Based on this graph, it a risk-free asset seems like a better investment. The funds based in the United States are again performing slightly better than their European counterparts. The fund of the company Fidelity Investments has the best ratio, while the worst Sharpe ratio is found in the French fund of BNP Paribas.
The following figure (Figure 16) shows the Treynor ratio of all stock funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank, Franklin Templeton Asia, Franklin Templeton Latin
Based on the negative Treynor ratios of all stock funds in this time period, it would make more sense to invest in a risk-free asset. The cause of ratios being negative in this time frame is the low average profits of each fund. Also the market risk, which is used to calculate the Treynor ratio, was been very high in the current period. The best performing stock fund is Morgan Stanley. The worst investment would have been into the ČP Invest stock fund during this time period.
The following figure (Figure 17) shows the Treynor ratio of all bond funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.
The Treynor ratios of the bond funds conclude in similar results as the stock funds in this time period. It is necessary to exclude the funds Barclays and ISČS. These funds are negatively correlated to the broader markets, so their Treynor ratios are positive. However this is not a result of average profits exceeding the risk, the profits are actually negative, thus resulting in a positive number, when a negative average profits are divided by the negative beta coefficient. The best ratio is shown by the bond fund of the company Vanguard Group. The worst performing fund in this time frame is the BNP Paribas.
The following figure below (Figure 18) shows the Treynor ratio of all mixed funds, i.e. American, Vanguard, Morgan Stanley, Fidelity, ČP Invest, ČSOB, IKS KB, ISČS, Barclays, BNP Paribas, Deutsche Bank.
Based on the graph above, it is clear that the best results are shown by the funds based in the United States. The best one of these funds is the mixed fund of the company Fidelity Investments. The fund BNP Paribas has the lowest Treynor ratio, which makes it the worst fund to invest in, when considering the market risk relative to average profit. American funds seemed to be superior in the comparison of all categories. The reason is probably because of their long history, knowledge, and experience in the practice of such business.

4 Conclusion

The main purpose of this market survey was to compare bond, stock and mixed funds domiciled in the United States and selected countries of the European Union. Modern portfolio indicators were used as the main scale for comparison purposes. Standard deviation and profitability were used as the supporting indicators.

The period being monitored was during 2007 – 2012 which was impacted by the current financial crisis. However, a longer period is necessary to minimise all the side effects and to help mitigate the disposition of showing better results by fund a find's management. The importance of this can be demonstrated by the sample used in comparing official results of the Czech ISČS stock fund, published on the web site which showed a profit percentage of 140 % in 2011. However, when we calculate the same fund during a 3 year period, it was much less (60-64 %).

This research demonstrates the superior profitability of stock funds in comparison with other funds, but they also have a higher risk for the investor as well. In addition, the results of this analysis prove that financial consultants in the Czech Republic, usually, only calculate the profit of funds with no respect to

risk and with no consideration, either, to market risk or to individual (fund) risk. We would recommend that any potential well educated investor, to do their own calculation by the ratios and coefficients as demonstrated in this paper. (We agree with Kiyosaki´s statement, that investor should be in this time well educated.)

As was mentioned before, the best comparison is made when using of longer time period. A time period chosen in our analysis was not really long enough. This paper can be a good base for some following research. During this process 6,385 calculations were made. For this reason is strictly recommended to use a new computer method which offers more easy way to the optimisation of strategy of investing while avoiding lot of calculation and mistakes.

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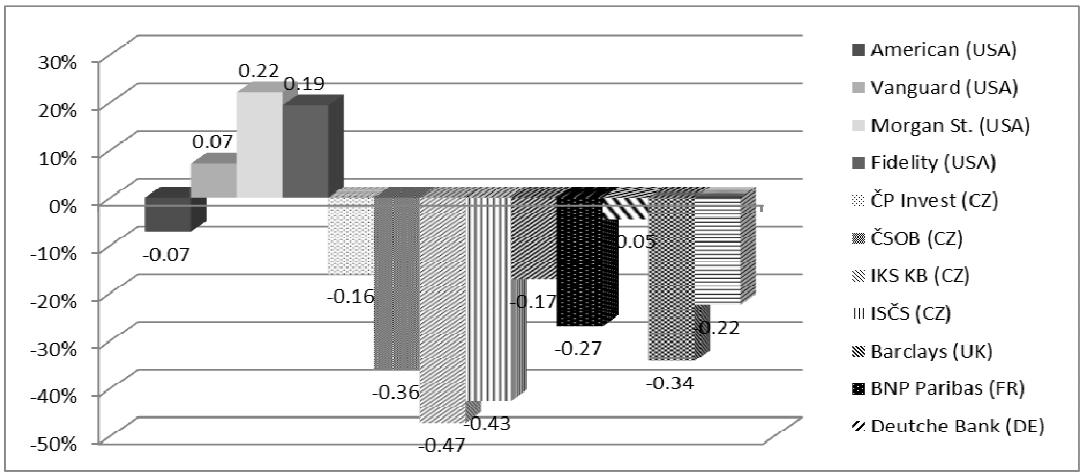

Figure 1. Performance of stock funds in 2007 – 2012.

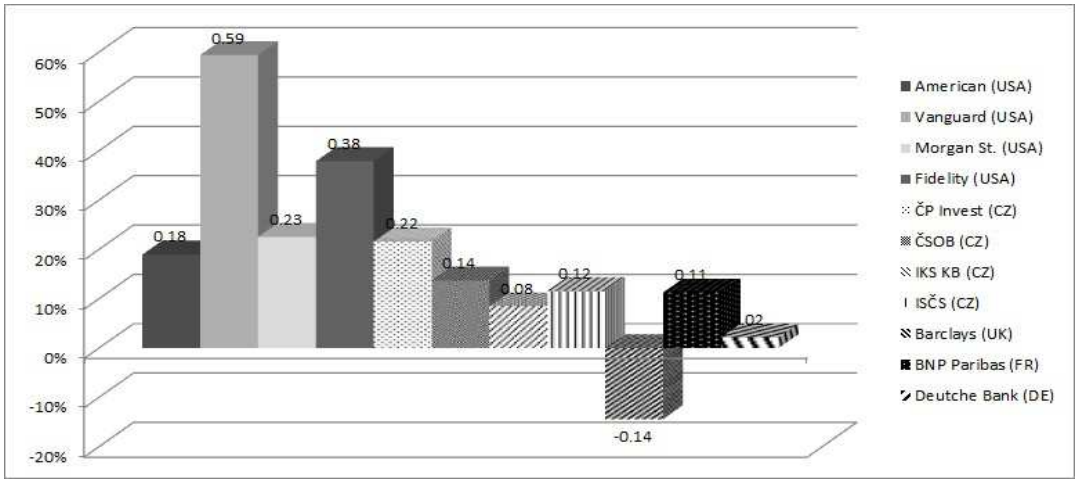

Figure 2. Performance of bond funds in 2007 – 2012.

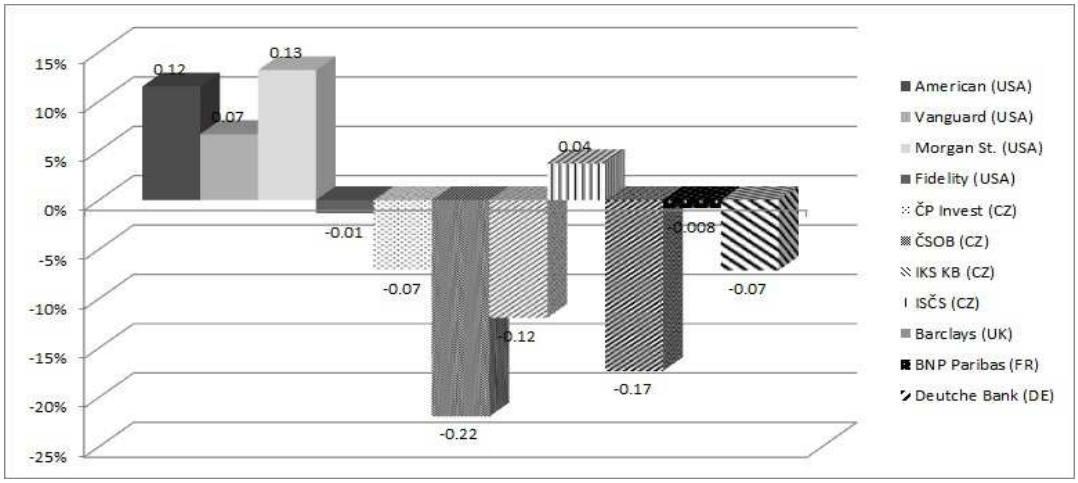

Figure 3. Performance of mixed funds in 2007 – 2012.

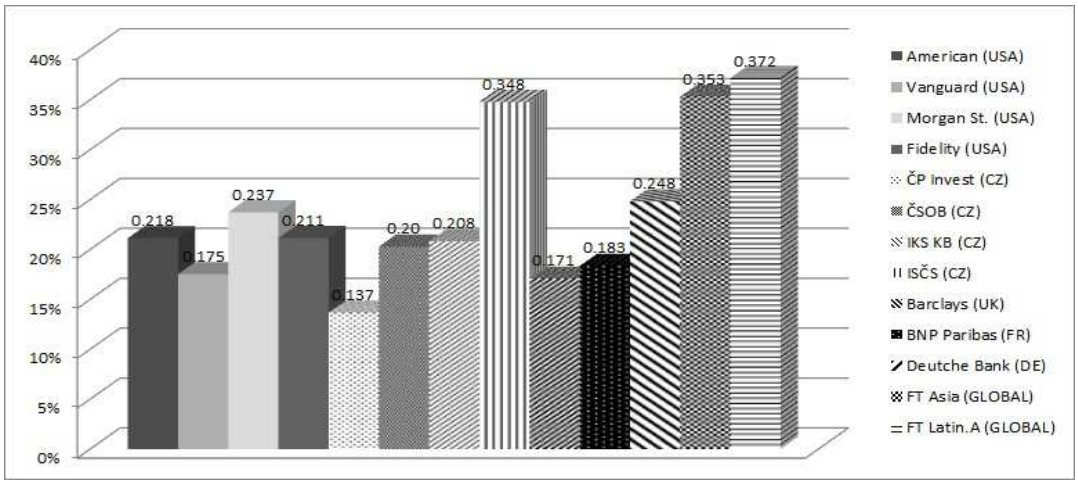

Figure 4. The standard deviation of stock funds in 2007 – 2012.

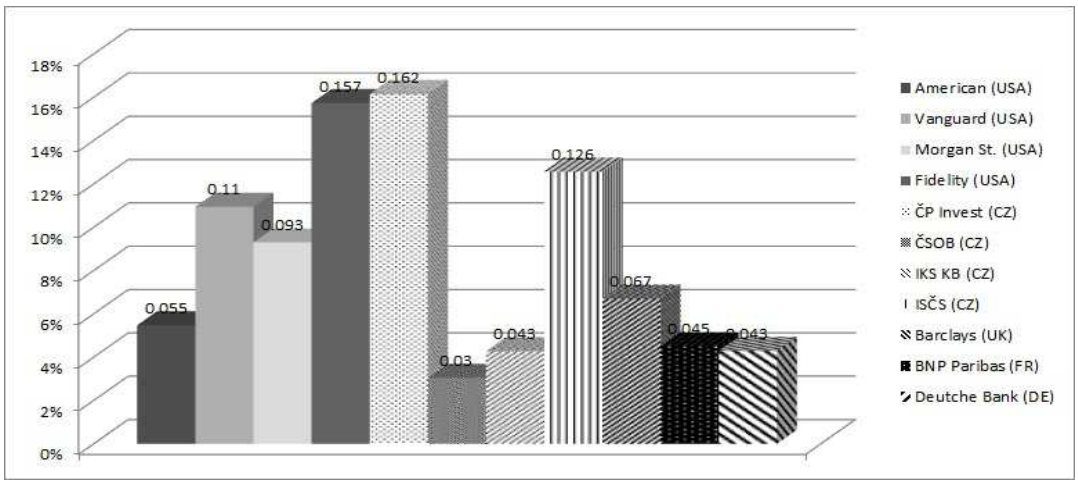

Figure 5. The standard deviation of bond funds in 2007 – 2012.

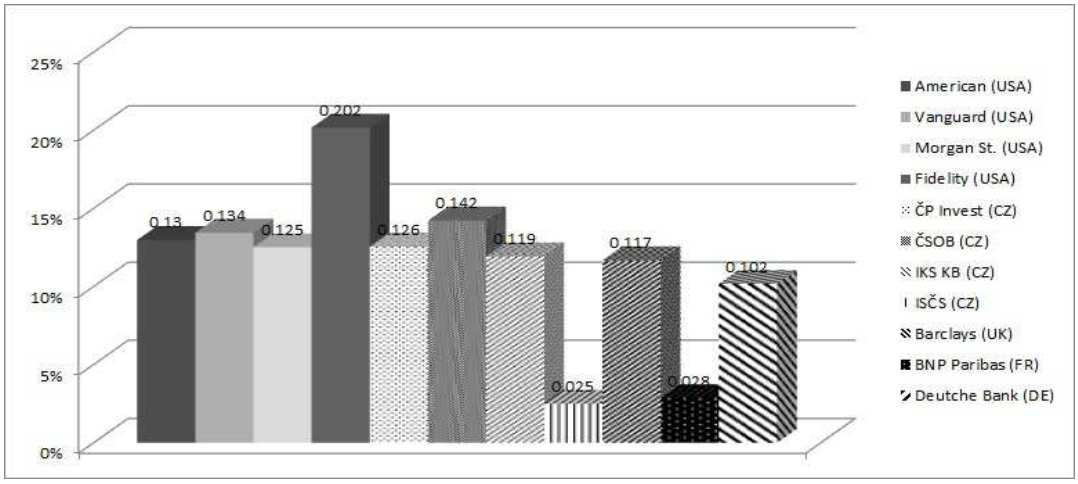

Figure 6. The standard deviation of mixed funds in 2007 – 2012.

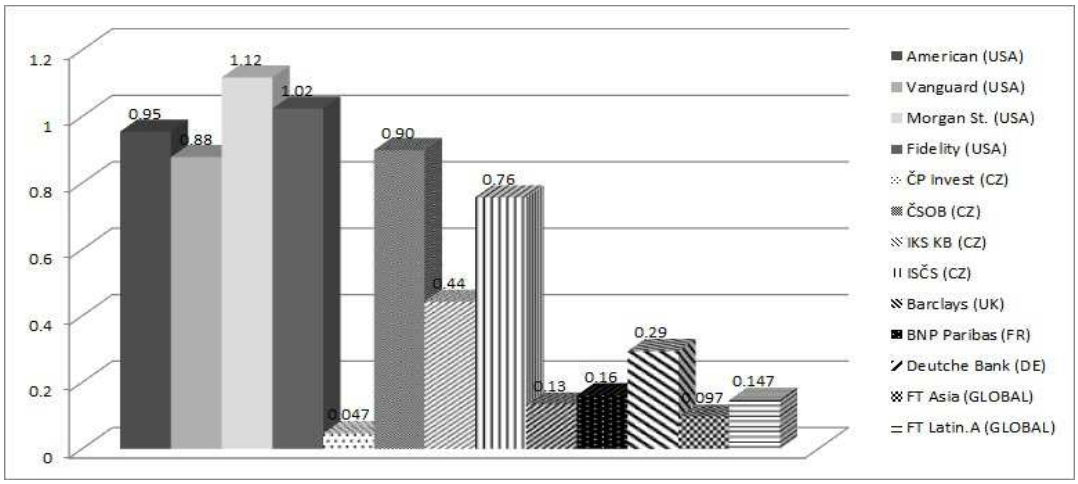

Figure 7. The coefficient beta of stock funds in 2007 – 2012.

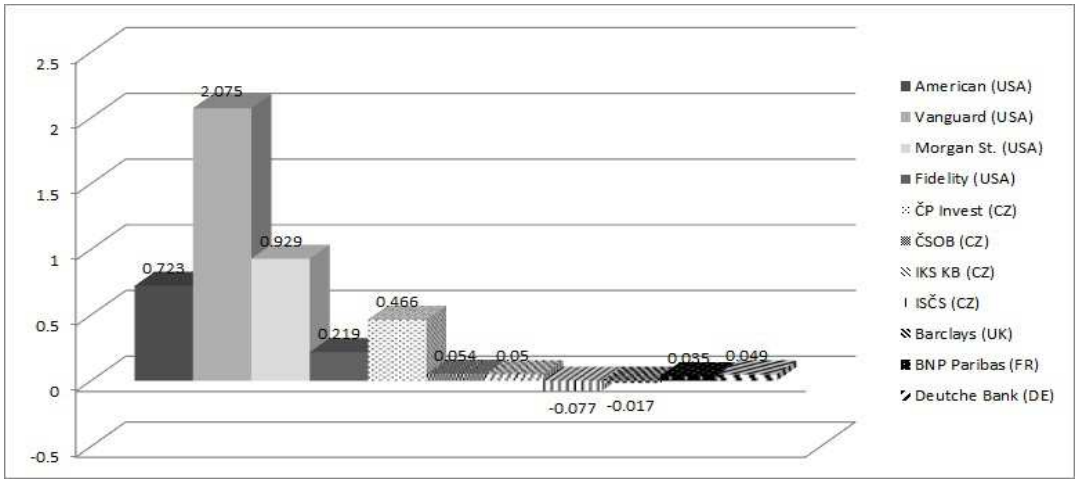

Figure 8. The beta coefficient of bond funds in 2007 – 2012.

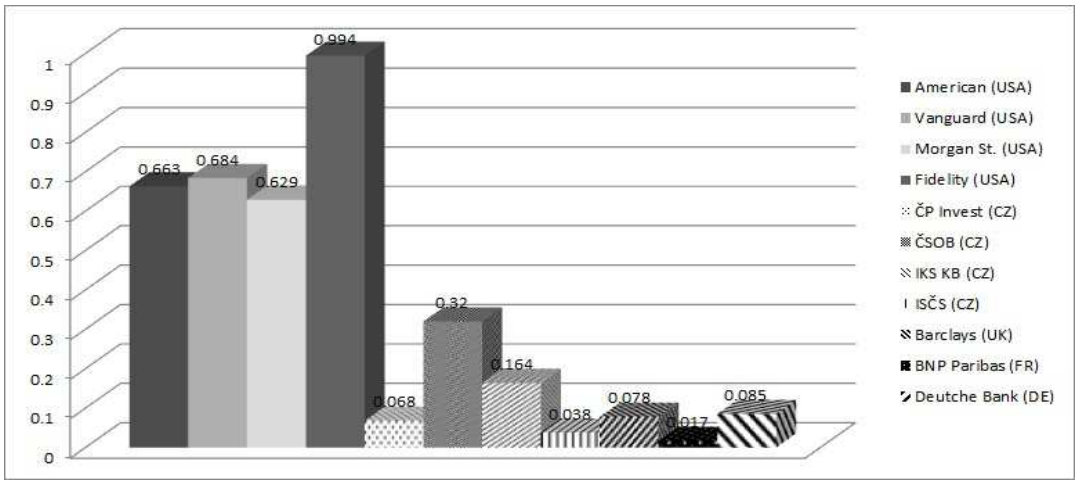

Figure 9. The beta coefficient of mixed funds in 2007 – 2012.

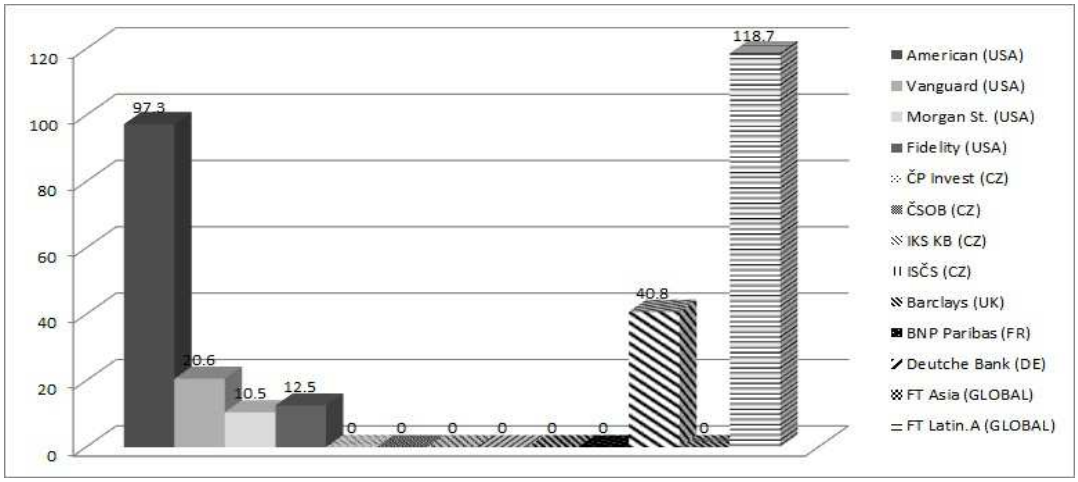

Figure 10. The coefficient of variation of stock funds in 2007 – 2012.

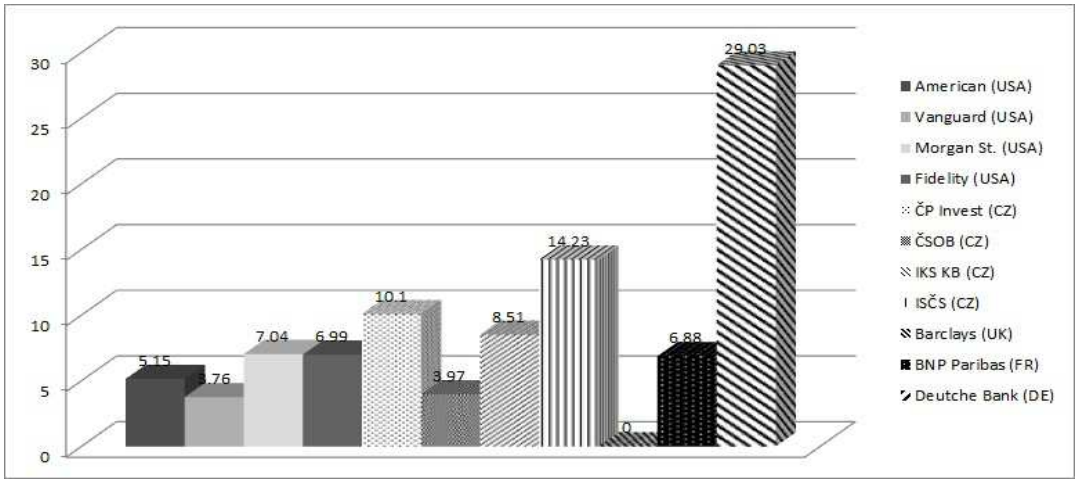

Figure 11. The coefficient of variation of bond funds in 2007 – 2012.

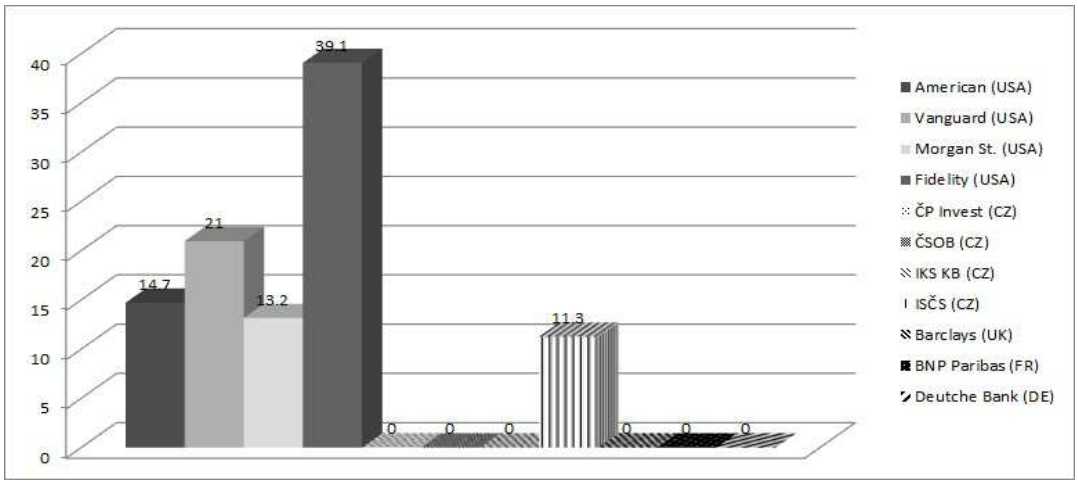

Figure 12. The coefficient of variation of mixed funds in 2007 – 2012.

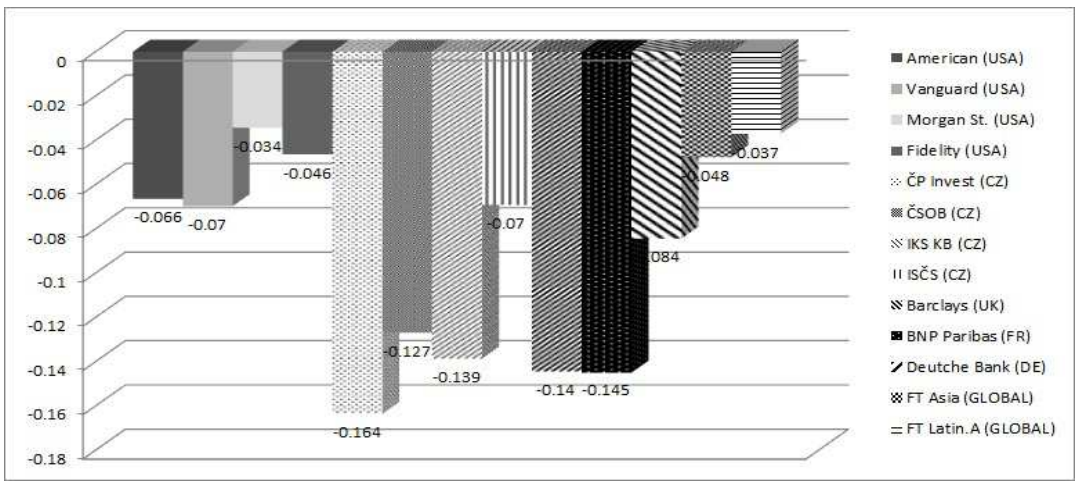

Figure 13. Sharpe ratio of all stock funds in 2007 – 2012.

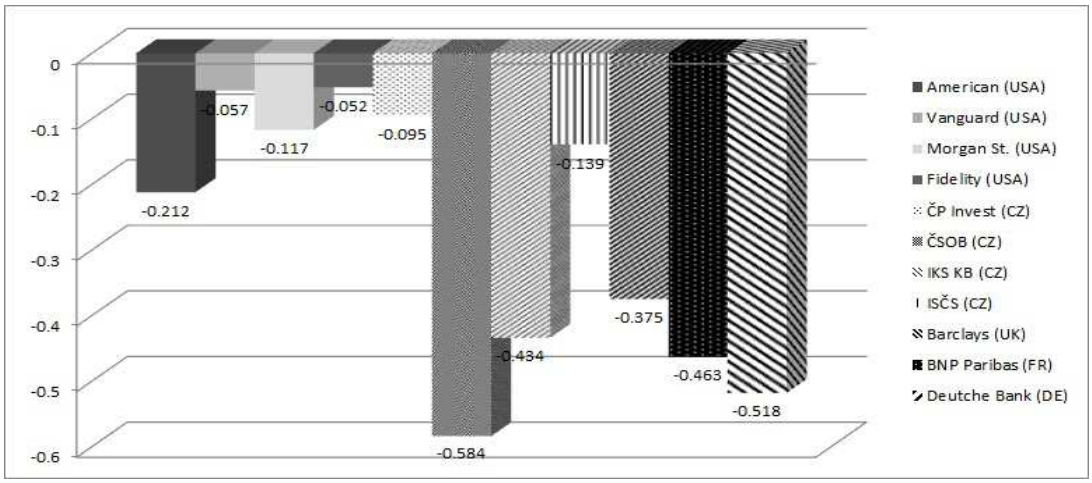

Figure 14. The Sharpe ratio of bond funds in the period 2007 – 2012.

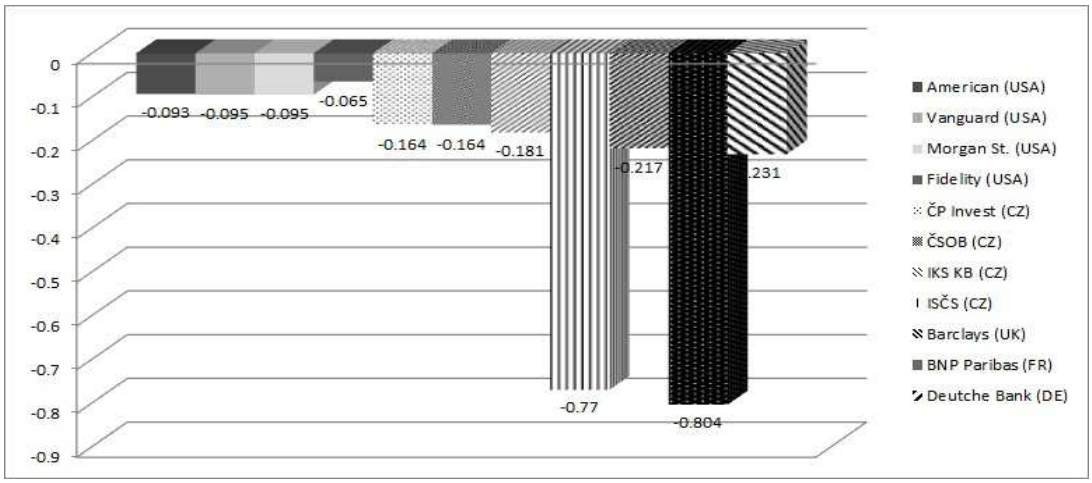

Figure 15. The Sharpe ratio of mixed funds in 2007 – 2012.

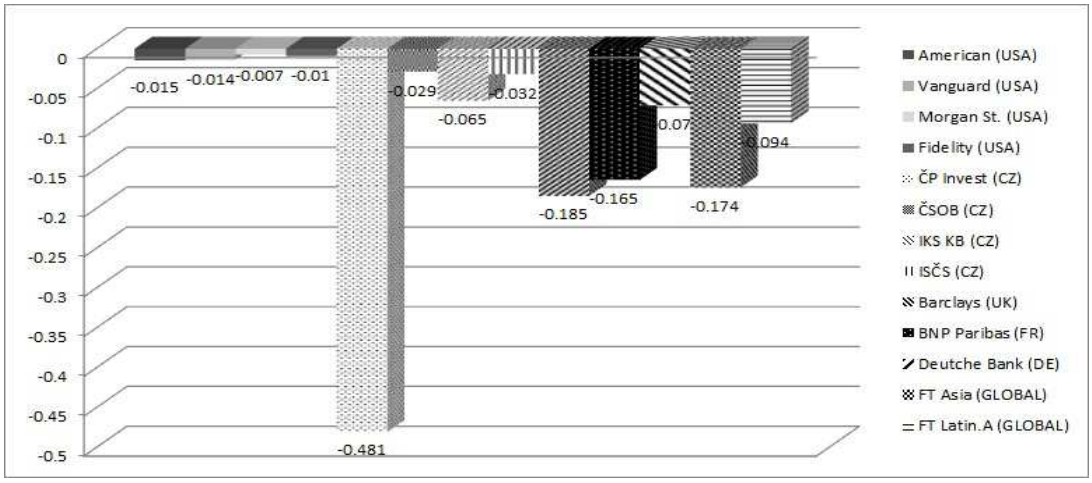

Figure 16. The Treynor ratio of stock funds in the period 2007 – 2012.

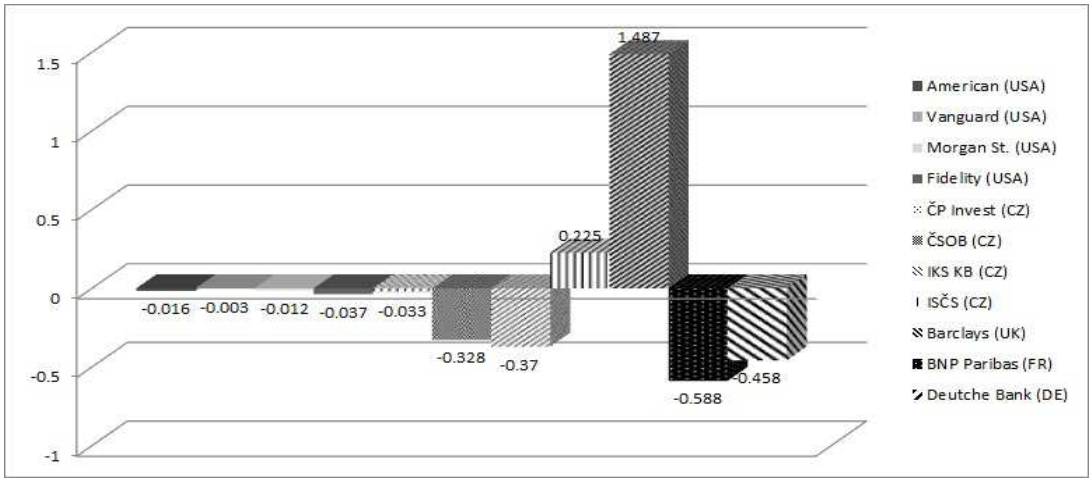

Figure 17. The Treynor ratio of bond funds in 2007 - 2011.

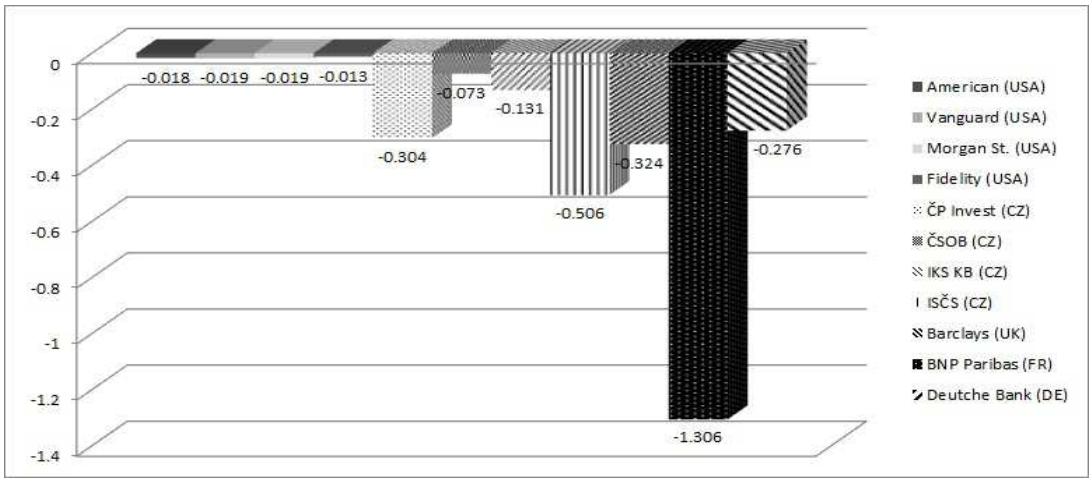

Figure 18. The Treynor ratio of mixed funds in the period 2007 - 2012.

Optimization of a Vendor Managed Inventory Supply Chain Based on Complex Fuzzy Control Theory

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Abstract: This paper recommends a scaling factors fine-tuning fuzzy logic control approach to optimize the dynamic performance of one typical vendor managed inventory supply chain with automatic pipeline, inventory and order based production control system(VMI-APIOBPCS), based on complex fuzzy control theory. The first thing is to embed a dual-input single-output fuzzy logic controller into the system based on the classic control engineering model. Then, the fuzzy inputs are given different weights by the way of scaling factors in order to optimize the system further. This methodology can make good use of managers' experience accumulated in perennial practice and the managers' rational estimation of different circumstances. Lastly, the simulation results show that, this method can improve the dynamic performance of VMI-APIOBPCS, especially the inventory dynamic behaviors.

Key–Words: VMI-APIOBPCS, fuzzy logic controller, scaling factors, dynamic performance

1 Introduction

With the progress of the information technology the urge of mutual benefit, orgnizations (suppliers, manufacturers, distributors, wholesalers, retailers) in supply chain accommodate their strategies to this new collaborative work tendency[1]. The operational pattern of VMI come into being at the opportune historic moment. As one of the most prevalent integrated styles, the implementation of its effective control is pressing to build modern manufacturing system. However, owning to the intrinsic complexity and turbulent market changes, the effective controlling became unrealistic[2, 4]. Many factors, such as forecast error, the block of information delivery, demand change etc., always result into unexpected overstock and incremental of overall running cost[3, 5, 6, 7, 8, 12].

Those problems, existed in VMI system, are severe in other classic production and inventory control system[11], likewise, which have been discussed heatedly both in practical management and academic field for decades. Early in 1982, Towill adopted control engineering method to optimize the IOBPCS (inventory and order based production control system) by setting the proportion of inventory adjust time(Ti) and production delay(Tp) and the proportion of demand forecast smoothing time(Ta) and production delay(Tp), respectively[3]. Later, GA was employed to optimize three control parameters (Ta, Tw, Ti) of APIOBPCS, based on stability and robustness of system, and especially, considered the work in progress(WIP) adjust time (Tw) in the optimization, a beginning of taking the production and inventory control system as an whole picture[5]. S.M.Disney, based on the research achievement in 2000, synthesized six parameters (Ta, Tw, Ti, Tq, G, W) of VMI-APIOBPCS and made an simulation optimization[6]. The centralized management method, VMI was adopted in this paper to make the manufacturer of APIOBPCS pay more attention to the integrated benefit, thus the distributor's forecast smoothing time (Tq), the proportion of Distributors Safety Stock and Average consumption (G) and Ratio of production adaptation to inventory cost (W) were considered. In conclusion, the optimization methods mentioned above simply adopted mathematical arithmetic, only reached an ideal combination of control parameters in the mathematical sense.

Although, we researched production-inventory system all-around by the classic control engineering method and came up with numerous of optimization outcomes[19, 20, 21, 23, 28], many supply chains, reported worldwide, still suffered from bad supply chain performance[7]. This situation reminds us to give deep thought about this research angle.

Actually, many researchers investigated this issue in different points. White utilized proportion-integration-differentiation (PID) controller to optimize the IOPBCS, and greatly reduced the inventory

level[16]. B. Samanta combined PID controller with fuzzy logic controller to optimize an inventory control system[18]. At last, the system is capable of preserving the final system inventory level at the desired level in spite of variations in demand. However, the PID controller is not welcomed in the production-inventory research field for its congenital drawback that its corresponding hard wares is not existed in virtual production-inventory systems[7].

As regards to the control of inventory and production system, a kind of complex social economic system, the element of social sciences is requisite. As the Figure1 informs us, one critical parameter can be connected with another three or four ones, and mostly are determined by managers based on the relevantly internal and external factors, such as consumer loyalty, long term profits.

The VMI-APIOBPCS model was rebuilt by fuzzy difference equations, then genetic algorithms (GA) was adopted to search optimal parameters of fuzzy VMI-APIOBPCS model[9]. In final, bullwhip effect was reduced and the overall performance was bettered. Yohanes Kristianto cleverly inserted the fuzzy logic controller with dual-input and one-output into VMI supply chain system, and lastly an ANOVA test , set to assess the assumptions, verified that the inventory response is effectively improved. This method can not only imitate the human thinking, but also absorbed managers' experience[14]. However, with the turbulent change of modern market and the management environment, the original experience may not be completely adaptable to the new surroundings.Fuzzy logic controller is kind of artificial intelligence and its implementation relies on complex computer techniques. As Filippo Neri said in [10], this kind of model can carry information about the volatility and the correlation among multi-factors, which enables the modern supply chain to be more flexible and accurate.

In view of above drawbacks and requirements, this paper inserts the fuzzy logic controller into the classic VMI-APIOBPCS model built in control engineering[6].But here the continuous-time version is considered. The potential fuzzy logic controller is connected with a more complex system than VMI with the expectation of extensive revenue. Then different weights are exerted on the dual fuzzy inputs further to enable the experience to suit the present surroundings.

The remaining parts of this paper proceeds as follows: section 2 includes the VMI-APIOBPCS model and introduces the related parameters should be fuzzy; introduces the complex fuzzy control theory and the fuzzy inference system applied in this paper and its optimization; the introduction of objection function. Section 3 shows us the simulation results and corresponding analysis. In section 4, the conclusions are made.

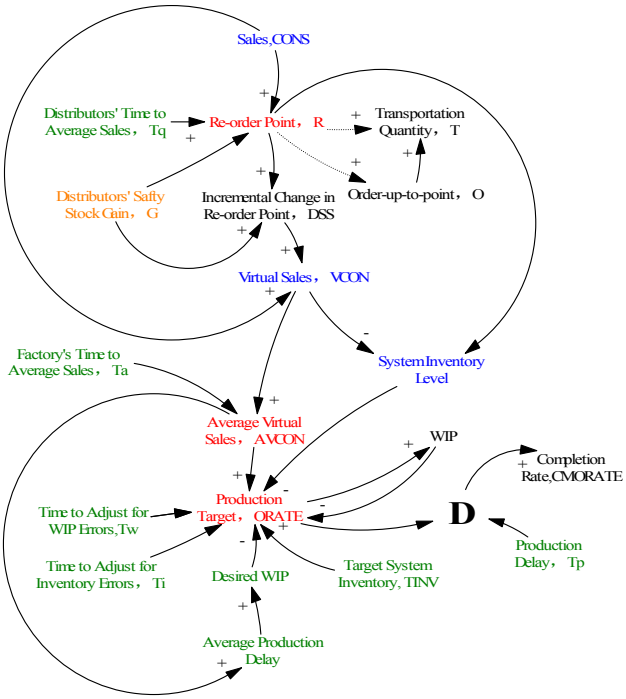

Figure 1: Causal loop diagram of VMI-APIOBPCS

2 Fuzzy VMI-APIOBPCS Control Model

2.1 Construction of VMI-APIOBPCS Model

In 1961, Forrester firstly adopted industrial dynamics (equals to system dynamics) in the research of production and inventory control system. After that, Towill expanded the model into the form of IOBPCS, moreover, carried out a string of optimizations of the system dynamic performance. Simon continuingly expanded the model into the more complex form of APIOBPCS with taking WIP into consideration[32]. And the VMI-APIOBPCS is the combination of VMI supply chain and APIOBPCS, which is displayed in Figure1, in which the variables are classified by different color: words colored green are control parameters in the system: words colored red are parameters been controlled; words colored blue are parameters based on observation or recording; words colored orange are the control parameters limited by consumer loyalty. Overall, the model of VMI-APIOBPCS synthesizes the multi-aspect interactions.

In VMI-APIOBPCS, distributors provide inventory information and data of sales to the supplier. Meanwhile, both of them reach a consensus in terms

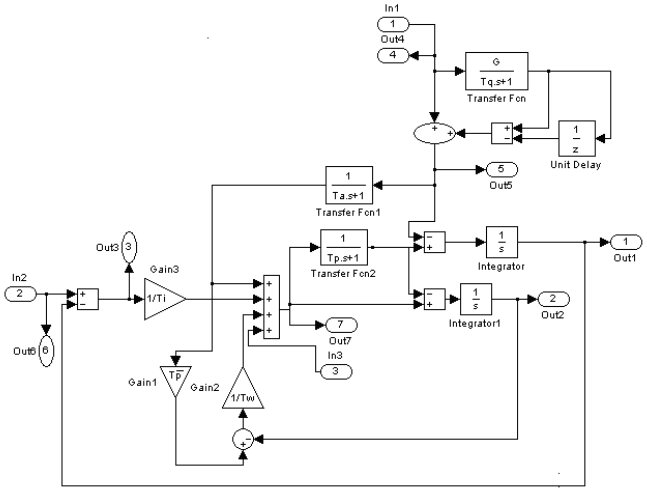

Figure 2: Block diagram of VMI-APIOBPCS

of Reorder-point, in order to avoid excess inventory. While the inventory level of distributors below the Reorder-point, the supplier will supply the proper production automatically. Then, the manufacturer of the VMI supply chain will execute the function of APIOBPCS such that makes new production plan or distribution plan according to its inventory level.

Six parts are included in this system: 1) distributors' demand forecasting policy; 2) factory's demand forecasting policy; 3) the set of system inventory target; 5) the feedback loop of WIP; 6) production delay. We concluded them into two classes: demand forecasting policy and inventory policy. We can distinctly read the above knowledge in Figure 2(All the ins and outs in the above block diagram mean the connections with other subsystem that will be expressed in the following parts).

All in all, VMI-APIOBPCS, as an integrated management model, effectively slims down the supply chain system, smoothes the information and motivates the agile production.

2.1.1 Demand Forecasting Policy

We use exponential smoothing to predict the demand quantities of distributors and factory. For the sake of convenience, the sample time Δt is set for 1 in this continuous-time model.

According to [20], we can obtain the relationship between the factory's demand forecasting constant α_a and factory's time to average sales: $\alpha_a = 1/(1+Ta)$. For same argument, as to distributors, the relationship is: $\alpha_q = 1/(1+Tq)$. Forecast error ε is a stochastic variable, with mean zero. At last, the initial input of the whole system is consumer consumption such that market demand

$$CONS_t = \begin{cases} 0 & if \quad t < 0 \\ 1 & if \quad t \geq 0 \end{cases}$$

.

2.1.2 Inventory Policy

In this paper, $TINV_t = 0$[3, 6]. Tp is a parameter beyond of control , restricted to manufacturing facility, product type, efficiency of production and so on[3], and in this paper we set $Tp = 4$. From the Figure2, we can obtain that the ORATE is decided by factory's demand forecasting, product of inventory deviation and $(1/Ti)$, product of WIP deviation and $(1/Tw)$. As to Ti, Tq is decided by α_i, α_a, such that $\alpha_i = 1/(1+Ti)$, $\alpha_a = 1/(1+Tw)$[14]. $T\bar{p}$ is the estimate of the average production delay, and $T\bar{p} = 4$. G is the proportion of distributors' safety stock between average consumption, reflecting the consumer service level.

2.1.3 Optimization of Parameters

Towill built the IOBPCS model, and acquired the optimal parameters by analyzing the sensitivity of the control parameters. Disney optimized the control variables (Ta, Ti, Tw, Tq, G, W) by simulation, and the results were assessed by $ITAE$ (Product of Time and Absolute Error)[6]. Darya Kastsian adopted normal vector method to optimized the control parameter (Ta, Ti, Tw, Tq), based on the stability and robustness of system[33].

Kuo Ping Lin combined fuzzy mathematics and GA to obtain optimal dynamic performance of VMI-APIOBPCS [9]. Yohanes Kristianto pointed out there is a drawback for the forecast changed can unilaterally decided the smoothing constant. The decision support system should take more errors or inevitable deviations[14].

Disney obtained strict optimal parameters (Ta, Ti, Tw), based on the stability and robustness of system, then, analyzed the impact of change of single control parameter on the dynamic inventory response and received that the change of Ti incurred maximum variation of the dynamic inventory level[5]. To discern the indication of the fuzzy logic controller optimization more distinctly, we just choose Ti as our optimization parameter.

Furthermore, in order to make a more pragmatic optimization, we additionally select two deviations as the fuzzy inputs. According to [14], we select demand change and the difference between inventory level and demand as inputs.

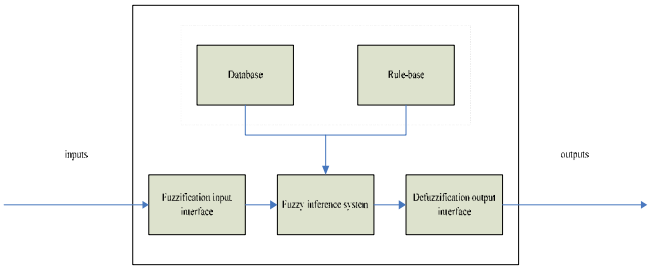

Figure 3: Fuzzy logic controller

2.2 Complex Fuzzy Control Theory

The variables of complex system always have no definite relationships in mathematical sense, even are impossible to quantitative analysis with diverse assumptions[13, 15]. Traditional control theory is confined. In contrast, fuzzy control can make good use of experts' knowledge and experience, relying on fuzzy inference and decision-making to realize the control of complex system, especially the complex social economic system with nonlinear lumped or distributed parameter [29, 30, 17].

The human factors in decision-making mainly include attitude to risk, intuition, experiences, or the combination of some of them. Those factors can directly act on the result of decision-making[1, 31]. In practical, managers can accumulate lot of experience that the management can receive excellent performance. If we can apply the experience in the future management, we can get good work.

In conclusion, fuzzy control can make good use of this experience, which can be an ideal method to investigate complex production-inventory issues.

2.2.1 Fuzzy Logic Controller

Fuzzy logic controller is the core of fuzzy control, including fuzzification input interface, fuzzy inference system (database, rule-base), defuzzification output interface.

1) Fuzzification input interface

Input variables should be fuzzified, then can be available to fuzzification input interface. As regards to fuzzification, we need to determine the fuzzy scale, which is inadvisable to be divided neither too raritas or too compact, otherwise, it is apt to induce bad consequence of information distortion. Besides, defuzzification should be in accordance with the membership function that is general in several forms such as straight lines, triangular, trapezoids, haversine, exponential[22]. And we adopt the simple and effective triangular one as our membership function,

Linguistic scale	input $\Delta(\delta,\varepsilon)$	Smoothing constant(α)
Very High (VH)	$0.75 \leq \Delta \leq \infty$	0.5;1;1
High (H)	$0.51 \leq \Delta \leq 0.74$	0.25;0.75;1
Medium (M)	$0.26 \leq \Delta \leq 0.50$	0.25;0.5;0.75
Low (L)	$0.05 \leq \Delta \leq 0.25$	0;0.25;0.75
Very Low (VL)	$\Delta \leq 0.04$	0;0;0.5

Table 1: Membership function

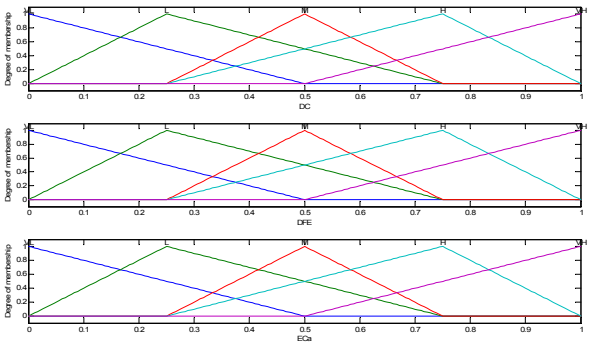

Figure 4: Membership function

which is expressed in Table1. We can understand it by Figure4 more intuitively.

In this paper, the two input variables are demand change (δ_t) and deviation between system level and demand(ε_t). $\delta_t = D_t - D_{t-1}$, $\varepsilon_t = AINV_t - CONS_t$. ε_t can be produced by system itself in the simulation. Besides we assume $\delta_t = 0.2$ such that the demand change of system is 0.2 (Actually, the demand change is a stochastic variable, which is dependent on season, promotion, product life cycle and so on. Here we assume it as a constant just for simplifying simulation process).

2) Database

Database stores all the membership functions that are used in input and output, providing data to the inference system. In this paper, the membership functions of inputs and output are in form of Figure4, collaboratively.

Finally, the combination of database and rule-base produces the fuzzy inference system, which is illustrated by Figure5. After a series of fuzzy operations, all the rules can form the fuzzy rule curved surface, like Figure6.

In Figure4 and Figure6, ECa means smoothing constant α_i; DEF means ε; DC means δ.

3) Rule-base

The Rule-base of fuzzy logic controller is based on experts' knowledge and frontline workers' experience accumulated for long time, expressed as a lan-

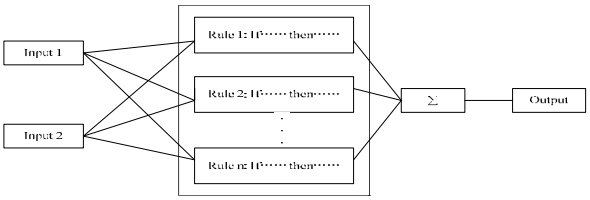

Figure 5: Fuzzy inference system

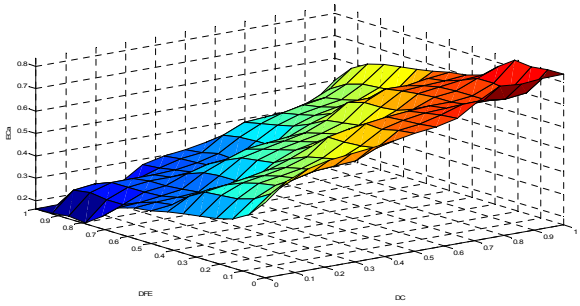

Figure 6: Fuzzy rule camber

guage form of human intuitive inference. In general, we use 'If-then' as the rule that should be translated to enable the inference rule to be quantified. The rule-base of this paper is shown in Table2.

Finally, the combination of database and rule-base produces the fuzzy inference system, which is illustrated by Figure5. After a series of fuzzy operations, all the rules can form the fuzzy rule curved surface, like Figure6.

4) Defuzzification output interface

Defuzzification output interface can transform the fuzzy outputs into the normal form the control system can identify and accept. In this paper, we adopt the frequently-used centroid calculation, known as the center of gravity of area defuzzification (the explicit process, which is carried out in the fuzzy logic controller (FLC in Figure7, is in [14]). After defuzzification, we get the smoothing constant α_i, consequently converted though a series mathematical calculations into the form of Ti based on $\alpha_i = 1/(1+Ti)$. The

		ε				
		VH	H	M	L	VL
δ	VL	VL	VL	L	L	M
	L	VL	L	L	M	H
	M	L	L	M	H	H
	H	L	M	H	H	VH
	VH	M	H	H	VH	VH

Table 2: Rule-base

subsystem of the calculations in simulink is displayed in Figure7.

2.2.2 Optimization of Fuzzy Logic Controller

Generally, in the simple fuzzy logic controller, all inputs have the same influence on the fuzzy logic controller such that we rigidly follow the original experts' experience. However, this natural extraction of experts' a priori knowledge is not always easy or possible to realize[37], for some of the experience may not be suitable for present situation due to uncertainties. In this paper, after exerting different weights on the inputs by scaling factors, managers can flexibly master the inputs to be better for the control[24, 25, 26].

μ, δ and ε are the fuzzy variable of their own discourse domain, so the control table of the simple fuzzy logic controller can be expressed by the following analysis formula.

$$\mu = \langle(\delta + \varepsilon) \div 2\rangle \tag{1}$$

In order to enable the fuzzy logic controller to suit for different surroundings, we need to expand the control table to have more space to be revised. In this paper, we expand (1) into

$$\mu = \langle K1 \times \delta + K2 \times \varepsilon\rangle \tag{2}$$

$K1$, $K2$ $\in$(0,1). $K1$, $K2$ are independent from each other, used to regulate the degree of impact of inputs on fuzzy control. In other words, we consider the scaling factors $K1$,$K2$ as the subjective weights of inputs given by managers in different situations. Meantime, we assume $K1+K2 = 1$, $K1$, $K2$ $\in$(0,1). Then we can adjust the scaling factors to find the optimal result.

2.3 Evaluation of Fuzzy VMI-APIOBPCS Control System

The complex of production-inventory system directly makes its evaluation intractable, for it is involved in versatile factors, such as dynamic response time, errors, deviations etc.. But in this paper, we have only one goal for evaluation of the system control–minimum cost. According to this criterion, we can draw up the objective function.

Towill evaluated the IOBPCS by

$$P.I. = \int_0^\infty ((COMRATE)^2 + \mu^2 (INV.DEV)^2) dt$$

, $COMRATE$ means completion rate, INV.DEV means deviation between inventory and inventory tar-

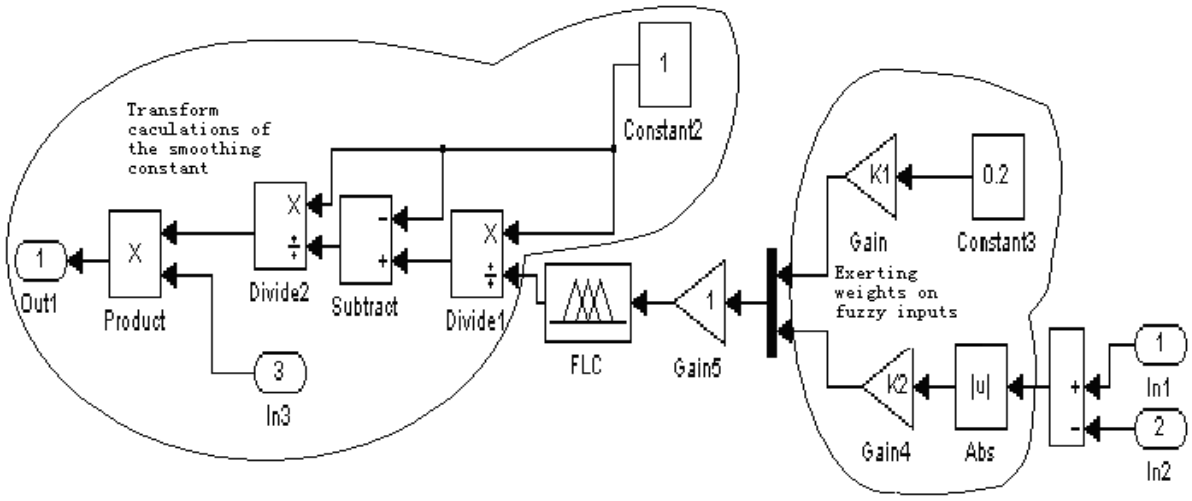

Figure 7: Subsystem of transform calculations and scaling factors

get, μ means the weight coefficient[3]. Disney designed a comprehensive objective function

$$SCORE = \frac{1}{\sqrt{ITAE^2 + \omega_N^2 + PR^2 + WIPR^2 + SV^2}}$$

, ω_N is the noise of $ORATE$, meaning 'bullwhip effect' in management, PR means robustness to production lead-time variations, $WIPR$ means robustness to pipeline level information fidelity, SV means systems selectivity), based on the stability and robustness for APIOBPCS [5]. Disney concisely adopted

$$SCORE = K \times VR_{ORATE} + VR_{AINV}$$

as the objective function of DE-APIOBPCS(a special situation of APIOBPCS, in which Ti equals to Tw).

Based on the deep thoughts about the features of VMI-APIOBPCS, we adopted three dimensions Euclidean distance as the form of objective function. The minimum value of the objective function is the best. The objective function is equation(3).

$$D = \sqrt{VR^2 W + {ITAE_{AINV}}^2 + {ITAE_{VCON}}^2} \quad (3)$$

In (3), $VR = \left[\frac{\int_0^{ts}(ORATE(t))^2dt}{\int_0^{ts}(CONS(t))^2dt}\right]^2$, $ITAE_{AINV} = \frac{\int_0^{ts}|E_{AINV}|tdt}{a}$, $ITAE_{VCON} = \frac{\int_0^{ts}|E_{VCON}|tdt}{b}$ (t_s means the moment the system response becomes stable). In the following phase, the three parts of the objective will be interpreted explicitly.

1) $VR = \left[\frac{\int_0^{ts}(ORATE(t))^2dt}{\int_0^{ts}(CONS(t))^2dt}\right]^2$

In this paper, VR is made to be the measurement of bullwhip effect, which is obviously different from the expression $\omega_N = \int_0^{\pi}|ORATE(\omega)|^2d\omega$ in related works [3, 5].

In this paper, all the simulations are operated in time domain in which the tradition expression is refractory. Here, in order to gain precise data, we create a new form of metric for bullwhip effect strictly based on the definition of bullwhip effect (a tendency for small changes in end-consumer demand to be amplified as one moves further up the supply chain[8]. In communication engineering, $W' = \int_{-\infty}^{\infty}(f(t))^2dt$ means the total power of signal (equals to the spectral density estimate). Naturally, $W' = \int_0^{t_0}(f(t))^2dt$ (t_0 means particular moment) means the power of signal in a period of time. $O = \int_0^{ts}(ORATE(t))^2dt$ represents the total variations of order rate from the beginning of response to the last stability. The same argument, $I = \int_0^{ts}(CONS(t))^2dt$ represents for the total variations of consumer consumption from the beginning of response to the last stability. Then $VR = O/I$. So $VR = \left[\frac{\int_0^{ts}(ORATE(t))^2dt}{\int_0^{ts}(CONS(t))^2dt}\right]^2$ can be competent for the measurement of bullwhip effect. Its calculation subsystem is in the Figure8.

2) $ITAE_{AINV} = \frac{\int_0^{ts}|E_{AINV}|tdt}{a}$, $ITAE_{VCON} = \frac{\int_0^{ts}|E_{VCON}|tdt}{b}$

As to the meaning of $|E_{AINV}|$, $|E_{VCON}|$, we can refer to [6].

But the meaning of a, b is different. The function of a, b in $ITAE_{AINV}$, $ITAE_{VCON}$ is to simplify the value to the same order of magnitude. However, the coefficients inevitably change the proportion between

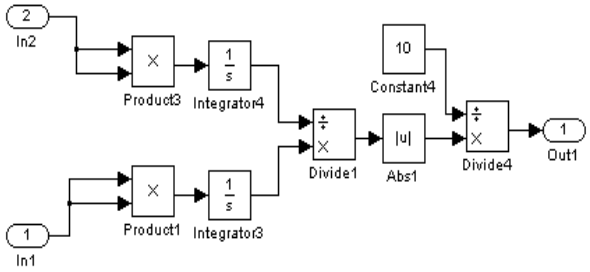

Figure 8: Subsystem of calculating VR

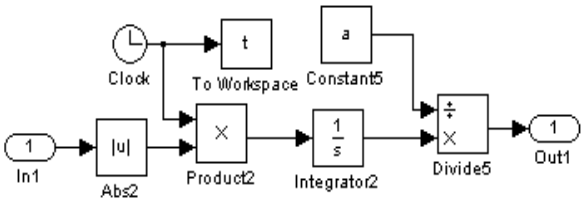

Figure 9: Subsystem of calculating ITAE

$ITAE_{AINV}$ and $ITAE_{VCON}$ in the objective function. The subsystem of calculating $ITAE$ in simulink is displayed in Figure 9.

When $a = 250$, the value of the subsystem is $ITAE$ for inventory response , noted as $ITAEainv$; When $a = 10$, the value of the subsystem is $ITAE$ for virtual demand, noted as $ITAEvcon$.

At last, the above three subsystems are assembled together to be the system of objective function, which is expressed in Figure10.

3 Simulation Results and Analysis

In this paper, the simulation was implemented in the simulink of matlab7.0.1. The block diagram is shown in Figure 11.

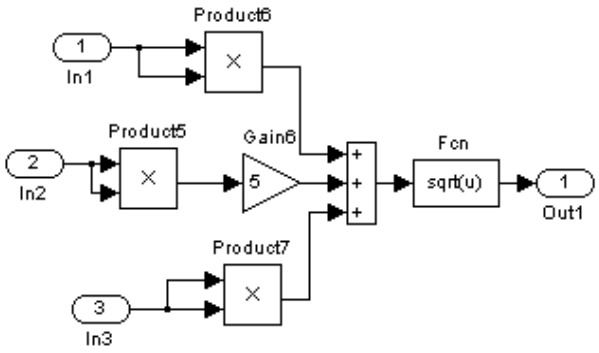

Figure 10: Subsystem of objective function

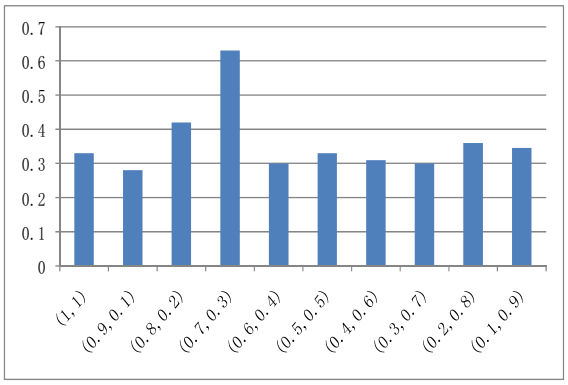

Figure 12: Fine regulating function of scaling factors

We selected nine groups data of the control parameters in simulation and every group is simulated in the conditions with and without FLC . Besides, under the condition with FLC, the fuzzy input variables are given nine different weights ($K1 = 0.9$, $K2 = 0.1$; $K1 = 0.8$, $K2 = 0.2$; $K1 = 0.7$, $K2 = 0.3$; $K1 = 0.6$, $K2 = 0.4$; $K1 = 0.5$, $K2 = 0.5$; $K1 = 0.4$, $K2 = 0.6$; $K1 = 0.3$, $K2 = 0.7$; $K1 = 0.2$, $K2 = 0.8$; $K1 = 0.1$, $K2 = 0.9$). Take the simplicity of human thinking into consideration, we just choose the simple and intuitive numbers as the weights given to the fuzzy inputs.

3.1 Overall Dynamic Performance Comparison

In Table3, we can find that the values of objective function with FLC are obviously smaller than that without FLC. And after the regulation of scaling factors, the performance is further optimized. From Figure 13, the overall dynamic performances in the three different conditions are compared. The value of D without FLC is about three times larger than that with FLC . Figure 14 shows the effect of fine-tuning of the scaling factors on the performance of the whole system.

The distinct comparisons are the strongest evidence of optimizing quality. After the connection with fuzzy logic controller, the dynamic performance of VMI-APIOBPCS is greatly optimized. Although, the scaling factor cannot change the performance obviously, the fine-tuning can enable the managers to flexibly manipulate the business activities, so as to preserve the maximum profit in spite of disturbances.

3.2 Management Insights

In this paper, the fuzzy logic controller is applied to optimize the dynamic performance of VMI-

Value of control parameters	With FLC	Without FLC		
(Ta, Ti, Tq, Tw, G, W)	D	D(without Sf)	D(with Sf)	Optimal Sf
(6, 7, 6, 42, 1, 1)	4.05	1.33	1.28	$K1 = 0.9$,$K2 = 0.1$
(2, 16, 3, 35, 4, 0.2)	6.09	3.25	3.15	$K1 = 0.9$, $K2 = 0.1$
(3, 3, 2, 4, 1, 0.05)	1.10	0.65	0.64	$K1 = 0.9$, $K2 = 0.1$
(7, 12, 6, 63, 2, 5)	9.00	2.48	2.46	$K1 = 0.9$, $K2 = 0.1$
(1, 5, 1, 5, 2, 0.01)	1.21	1.02	0.96	$K1 = 0.9$, $K2 = 0.1$
(10, 20, 6, 63, 4, 20)	27.89	4.80	4.79	$K1 = 0.6$, $K2 = 0.4$
(7, 27, 6, 63, 8, 5)	28.95	9.55	9.48	$K1 = 0.7$, $K2 = 0.3$
(14, 27, 2, 63, 16, 1)	37.53	10.78	10.36	$K1 = 0.4$, $K2 = 0.6$
(30, 26, 3, 35, 32, 1)	135.24	26.00	24.65	$K1 = 0.8$, $K2 = 0.2$

♢ Sf is the abbreviation of Scaling factor

♢ All the value of control parameters are recommended settings in[3].

Table 3: Performance comparison

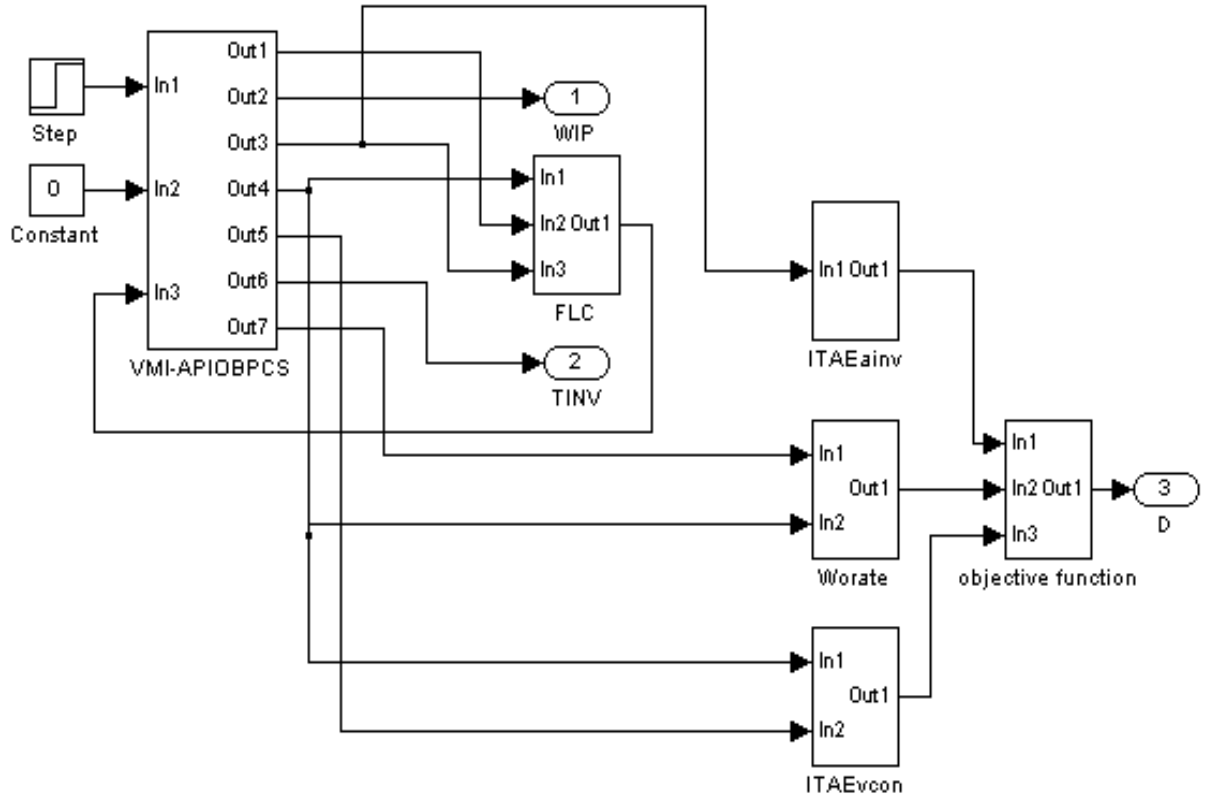

Figure 11: Block diagram of simulation

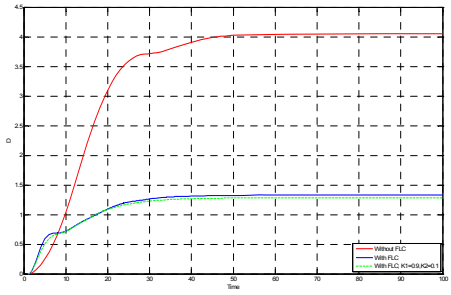

Figure 13: Overall dynamic performance

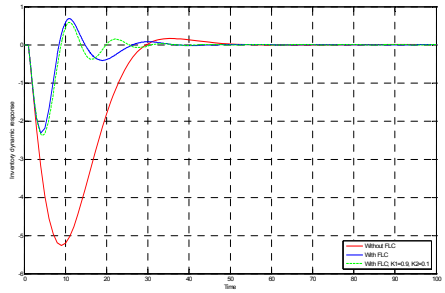

Figure 14: Comparison of inventory response

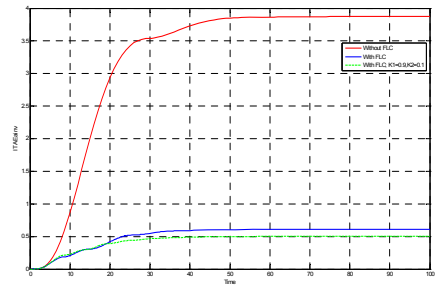

Figure 15: Comparison of ITAEainv

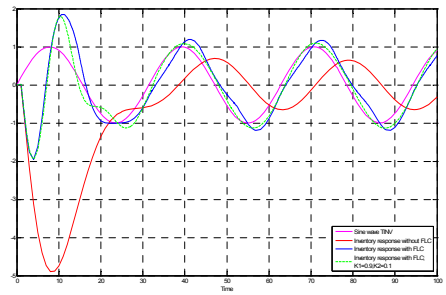

Figure 16: The ability to follow TINV

APIOBPCS model, furthermore, the fuzzy input variables are given different weights to adjust the knowledge in the new surroundings. After the investigation, we can reach the several important conclusions about innovations in this paper:

With the application human intelligence in the model, we can get new results that the fuzzy controller can greatly optimize the integrated performance of VMI-APIOBPCS. The scaling factors can tune the system performance finely, which makes the system optimization flexible to different new surroundings.

The dual-input, single input fuzzy logic controller can take demand and deviation between the inventory level and demand into consideration to make a more rational decision.

What's more, an auxiliary benefit, the inventory dynamic performance is largely improved. It is profitable for the inventory control.

After the conclusions, several points of management insight are obtained:

In the practice of forecasting, we should take more factors, both direct and indirect, into consideration according to the feature of our own business.

Production-inventory system is complex social economic system, in which human being play irreplaceable roles. Therefore, in the designing of optimization method, the unique thinking pattern needs to be taken into account.

In the process of management, we not only absorb the lessons but also conclude the precious experience. And we need to ponder how use the experience in the future work. This is the ideal of fuzzy control in this paper, meanwhile, the philosophy of learning organization[41].

When we adopt control engineering to research or optimize the production-inventory system, we should assess the practicability and whether it is proper for the control of production-inventory system, for it instinctively differently from the system like electronic and mechanical system[38, 39].

In a word, fuzzy control, as one kind of artificial intelligence, can imitate the way of human thinking, exploit experts' knowledge and experience, and renew the knowledge constantly. It is greatly significant to improve operational performance, reduce management cost, and elevate the flexibility[34, 40].

4 Conclusion

In this paper, the novel artificial intelligence–fuzzy control is adopted to optimize the production-inventory system. The simulation results verify that the overall dynamic performance is greatly improved

and the inventory dynamic response is obviously improved. Fuzzy control can imitate thinking of human beings and make good use of experts' knowledge and experience to avoid the turbulent fluctuations in inventory dynamic changes.

By the way, further research can adopt optimization algorithm, liking GA, to initiatively search the optimal scaling factors, or investigate the effect of other variables on the determination of control parameters. Besides, the excellent inventory response may lay much pressure on the production, and this can be further researched. The relationship between the optimal performance and scaling factors can also be explored.

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Assessing the Significance of Covariates in Output Oriented Data Envelopment Analysis with Two Stage Regression Models

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Abstract - We propose alternative regression models to assess the effects of covariates in output oriented DEA scores. We use probability choice models combined with specifications related to the gamma and to the truncated normal families of distributions. These specifications imply different two stage regression models and alternative quasi maximum likelihood estimators. We apply these methods to assess the significance of technical effects – type of unit, processes improvement and technology impact – affecting DEA efficiency scores computed to agricultural research production in Brazil, measured through Embrapa. We favor models taking into account the whole sample of efficiency scores and not only the inefficient units. In our application we conclude that type of unit and processes improvement are significant effects, with the latter effect negatively associated to the efficiency of the units classified into the type of unit considered more efficient.

Key-words - Data envelopment analysis; Fractional regression models; Second stage DEA regressions; Bootstrap; Contextual variables; Agricultural research.

1. Introduction

In many applications of DEA one is faced with a setting where the main objective is to assess the significance of contextual variables in the efficiency measures. Similar settings will appear in Sytems and Control Theory. See [1] [2] [3] [4] [5] [6] [7] [8] [9]. Descriptive and parametric inferences are available for this purpose. An instance of the former is the work of [10]. Typical approaches for the latter are based on two stage regressions. Some criticism to the two stage regressions can be seen in the literature in the works of [11] [12], who establish the conditions under which it is valid. Basically it is assumed that the contextual variables are exogenous to the production process. Correlation between DEA measurements of different units and endogeneity of contextual variables may invalidate the statistical analysis. [13] [14] also discuss the problem.

Our objective in this article is the assessment of the influence of the contextual variables type of unit (product, thematic or ecoregional oriented), processes improvement and impact of technology on the DEA efficiency measurements, computed as performance measures for the Brazilian Agricultural Research Corporation (Embrapa) research centers. This is a DEA VRS model with a single pooled output measure and three inputs – personnel expenses, operational costs, and capital depreciation. For this purpose we use the fractional regression model, as proposed by [15][16].

Our discussion proceeds as follows. In Section 2, we present the state of the art on fractional regression models. In Section 3, we summarize the Embrapa production model. This is the case study in which the proposed approach will be applied. In Section 4, we describe the family of probability distributions we use in our regressions. Section 5 is on our statistical findings and discusses the proposed models regarding our case study. In Section 6, we summarize our conclusions.

2. State of the art

The fractional regression to assess the effect of covariates in a context where DEA scores are treated as descriptive measures of the relative technical efficiency of the sampled DMUs are proposed in [15] [16] These authors propose the use of flexible families of probability distributions to describe the response behavior of performance measures with values in the interval $(0,1]$ and apply their specifications to agricultural data. They consider one and two part models that can be used with quasi maximum likelihood, nonlinear least squares and maximum likelihood estimation. In the two part model, firstly a binary choice model

is fit by maximum likelihood to all units. The contextual variables affect the expected response (choice of being efficient) through a distribution function evaluated on a linear construct. The second part fits a nonlinear mean with values in $(0,1)$ for the inefficient units. The dependence on the contextual variables in this instance is obtained via a monotonic function of another linear construct.

The two stage approach of [11] assumes that DEA scores measure efficiency relative to an estimated frontier, the true value of which is unobserved. This implies that estimates of efficiency from DEA models are subject to uncertainty because of sampling variation [15]. From an empirical point of view, the statistical analysis of the two part fractional regression and the two stage approach of [11] are similar. They assume a truncated normal distribution for the inefficient units and propose bootstrap estimation of the model parameters. The same idea can be used in the fractional regression. The difference is that the two stage regression does not take into account efficient DMUs. In this context, unity efficiency is viewed more as a natural consequence of the way DEA scores are defined than as informative as why units become efficient.

Motivated by the results of [11] [15] [16] [17], here we propose a model for the analysis of two stage regressions where the response is output oriented with values in $[1,+\infty)$. Our contribution to this literature is threefold. Firstly, our approach combines a choice model with probability distributions with support in $[1,+\infty)$. It extends the work of [17] on quasi maximum likelihood involving the Bernoulli log-likelihood function, allowing responses greater than one. Secondly, we use the gamma and the truncated normal families to define regression models to fit mean efficiency response encompassing the whole sample. We thus avoid the two part model. Finally, we compare the results of some of these distinct approaches in a context of interest in it involving the assessment of technical effects in a real case study.

Other recent approaches on the two-stage regressions subject can be seen in [18] [19] [20] [21] [22], among others. Modelling in other contexts can be seen in [23] [24] [25] [26] [27] [28] [29] [30].

3. Embrapa's Production Model

Embrapa's research system comprises 42 research centers (DMUs) spread all over the country. Input and output variables have been defined from a set of performance indicators known to the company since 1991.

The set of production variables monitored by Embrapa, as considered here, comprises one output and a three dimensional input vector. The analysis is performed on a yearly basis. Here we restrict attention to 2009. Dynamic specifications are studied in [31] [32].

The input side of Embrapa's production process is composed of three factors: personnel, operational costs (consumption materials, travel and services less income from production projects), and capital measured by depreciation.

The output indicator is a pooled index of four categories: Scientific Production; Production of Technical Publications; Development of Technologies, Products, and Processes; Diffusion of Technologies and Image.

Inputs and output are indexes of complex computations that can be appreciated elsewhere. See [31] [32] [33] for more details.

Embrapa's production system is being monitored since 1996 for 37 research centers. Measures of efficiency and productivity are calculated and used for several managerial objectives. One of the most important is the negotiation of production goals with the individual research units. A proper management of the production system as a whole requires the identification of good practices and the implementation of actions with a view to improve overall performance and reduce variability in efficiency among research units.

Parallel to this endeavor is the identification of non-production variables that may affect positively or negatively the system. It is of managerial interest to detect controllable attributes causing the observed best practices.

Several attempts are in course in Embrapa to evaluate the effects of contextual variables in production efficiency. It is worth to mention [31] [32] [34] [35]. Here we analyze the effect of three exogenous covariates: process improvement (*PRO*), impact of technologies (*IMP*), and type of a research center. *PRO* and *IMP* are considered continuous scores. Type is a categorical variable. The construct *IMP* is a score computed by Embrapa's administration reflecting perceptions regarding the quality of the reports on impact of the technologies developed by the research centers; it's about form and contents of the reports, and not about the importance of the technologies under concern. On the other hand, *PRO* is a value intended to measure the successful implementation

of changes on some administrative processes. These processes are selected by local Embrapa's administration. Type is an exogenous classification based on the research focus of each unit. There are three types: units or research centers that focus their research on agricultural products (*PRODUCT*), research centers focusing on agricultural specific themes (*THEMATIC*), and research centers focused on agricultural research pertaining to issues related to environment and ecological aspects (*ECOLOGICAL*). We assume that all contextual variables satisfy the separability assumption of [1].

The data on production (inputs – X1, X2, X3 – and output – Y), the DEA output oriented efficiencies under variable returns to scale (EFF), and contextual variables are shown in Table 1. The year of analysis is 2009.

4. DEA, Contextual Variables and Statistical Models

Consider a production process with *n* production units, the Decision Making Units (DMUs). Each DMU uses variable quantities of *s* inputs to produce a single output *y*. Denote by $Y=(y_1,...,y_n)$ the $1\times n$ output vector, and by $X=(x_1,...,x_n)$ the $s\times n$ input matrix. Notice that the element $y_j>0$ is the output of DMU *r* and $x_j\geq 0$, with at least one component strictly positive, is the $s\times 1$ vector of inputs used by DMU *j* to produce y_r.

For each DMU *j* the DEA measure of efficiency ϕ_r^* is the solution of the linear programming problem $\max_{\phi,\lambda}\phi$ subject to $\sum_r \lambda_r y_r \geq \phi\, y_j$ and $\sum_r \lambda_r x_r \leq x_j$, $\sum_r \lambda_r = 1$, $\lambda=(\lambda_1,...,\lambda_n)\geq 0$.

Our objective is to assess the effect of a vector of contextual variables on the DEA efficiency scores. In this context, in [5 15] it is considered a two part model for responses in the interval $(0,1]$. Basically, they assume that contextual variables may affect differently efficient and inefficient DMUs. They argue that a two part model should be used for modelling DEA scores. The first part of such model comprises a standard binary choice model that governs the probability of observing an efficient DMU. They suggest the use of the whole sample to estimate the model $\text{Prob}(\phi_j^*=1\mid z_j)=F(z_j'\beta)$, where *z* is the vector of contextual variables, β is an unknown parameter vector, and F is a known probability distribution function. Typical choices for *F* are the logistic and the standard normal distributions. Other possibilities may be seen in [5]. For the second part of the model they assume the specification $E(\phi_j^*\mid z_j)=G(z_j'\theta)$, presented in [7 17], for the DEA scores in the interval $(0,1)$.

It is important to emphasize here that quasi maximum likelihood methods may not be used to compute standard errors for any of the previous approaches. The existing correlation among the DEA scores precludes the assumption of independent observations necessary for the validity of the asymptotic assumptions for quasi maximum likelihood and nonlinear least squares.

Motivated by the families of gamma and truncated normal distributions, we begin proposing two specifications for the mean efficiency with estimation based on the whole sample, when efficiency scores are output oriented and greater than or equal to one. Firstly, we specify the mean efficiency as the mean of a random variable of the form 1+H, where H has the gamma distribution with location parameter *p* and scale parameter $\lambda_j^{-1}=\exp(z_j'\theta)$. Here z_j, again, is the observation of the vector of contextual variables for the inefficient DMU *j*. The parameters θ are unknown. Secondly, another flexible family much used in stochastic frontier analysis is given by the truncated normal distribution. The corresponding mean in this case is given by $z_j'\theta+\sigma\phi((1-z_j'\theta)/\sigma)/(1-\Phi((1-z_j'\theta)/\sigma))$, where $\phi(.)$ and $\Phi(.)$ are the density and the distribution functions of the standard normal. This expression is the mean of the random variable $z_j'\theta+u_j$, where u_j is the $N(0,\sigma^2)$ truncated at $1-z_j'\theta$.

As in [15], we see possible that contextual variables and corresponding parameters may differ for efficient and inefficient units. In both cases the mean response for the efficiency measure will be a monotonic function of the linear construct $z'\theta$. In a joint model, as we propose, this more general assumption will not be parsimonious, creating convergence problems in nonlinear estimation. The separate Bernoulli type regression of [15] will demand many efficient units for a reasonable assessment of the corresponding covariates.

Table 1. Production data, efficiency measurements and contextual variables.

	X1	X2	X3	Y	EFF	*PRO*	*IMP*	Type
DMU1	1.9491	2.31	2.7117	1.5779	1.1725	71.38	1.42	*THEMATIC*
DMU2	0.9475	0.7801	0.6516	0.8873	2.0851	45.88	4.27	*PRODUCT*
DMU3	0.6054	0.6833	0.7612	1.5432	1.1989	88.38	3.53	*THEMATIC*
DMU4	1.3058	1.1456	1.1190	0.5541	3.3389	72.79	4.20	*PRODUCT*
DMU5	1.0482	1.1079	1.1601	1.3029	1.4201	88.88	2.86	*THEMATIC*
DMU6	0.6746	0.8532	0.6409	0.7294	2.5368	58.50	3.86	*PRODUCT*
DMU7	0.4377	0.5439	1.0545	1.8501	1.0000	58.42	2.22	*THEMATIC*
DMU8	1.021	0.7785	0.7123	1.0453	1.7699	80.68	4.61	*PRODUCT*
DMU9	0.9175	0.9185	1.8102	0.7664	2.4143	80.92	3.94	*PRODUCT*
DMU10	1.3485	0.9039	1.5332	0.7837	2.3607	95.13	4.10	*PRODUCT*
DMU11	0.9720	1.0944	1.0455	0.7466	2.4777	85.88	3.75	*PRODUCT*
DMU12	1.0433	0.7983	1.0437	1.0598	1.7458	57.75	4.10	*THEMATIC*
DMU13	1.0481	1.0375	0.7269	1.2256	1.5094	70.04	4.91	*PRODUCT*
DMU14	1.4299	1.4462	1.4492	1.0583	1.7483	81.88	4.07	*PRODUCT*
DMU15	0.9104	0.7062	0.7744	1.0922	1.6938	73.63	3.32	*THEMATIC*
DMU16	0.8805	0.838	0.9973	0.6600	2.8027	79.48	4.54	*PRODUCT*
DMU17	1.3737	1.7809	1.5852	1.1443	1.6168	47.43	4.72	*PRODUCT*
DMU18	1.0264	0.9054	0.9540	0.9172	2.0169	76.50	4.47	*PRODUCT*
DMU19	0.5765	0.5647	0.6141	1.8501	1.0000	92.25	4.96	*THEMATIC*
DMU20	0.6892	0.9250	1.0699	0.7055	2.6226	76.38	4.02	*PRODUCT*
DMU21	1.2903	1.1155	0.8306	0.5272	3.5088	73.38	3.91	*ECOLOGICAL*
DMU22	1.7702	1.7286	1.5338	0.5682	3.2563	85.38	4.22	*ECOLOGICAL*
DMU23	1.6006	1.715	1.8198	1.1389	1.6244	84.08	3.16	*ECOLOGICAL*
DMU24	0.7749	1.194	0.673	0.6848	2.7012	85.40	3.84	*ECOLOGICAL*
DMU25	0.5078	0.4727	0.2901	0.4944	1.0000	73.00	1.41	*ECOLOGICAL*
DMU26	0.7037	0.5547	0.4159	1.1163	1.0000	0.00	3.10	*ECOLOGICAL*
DMU27	0.6122	0.5341	0.6379	1.4728	1.1955	50.17	3.73	*ECOLOGICAL*
DMU28	1.1706	1.0919	0.8334	0.5575	3.3190	2.50	1.77	*ECOLOGICAL*
DMU29	0.6368	0.7740	0.5731	0.6497	2.6490	73.88	4.51	*ECOLOGICAL*
DMU30	0.7758	0.5738	0.6142	0.8509	2.1744	86.54	4.85	*ECOLOGICAL*
DMU31	1.0206	0.9173	0.6094	1.2273	1.4954	95.50	2.71	*ECOLOGICAL*
DMU32	1.3446	1.3243	1.1444	0.6782	2.7278	65.14	4.32	*ECOLOGICAL*
DMU33	2.3904	2.1439	1.5218	0.8324	2.2227	83.13	4.32	*ECOLOGICAL*
DMU34	0.6753	0.6457	0.7747	0.9863	1.8758	83.80	4.35	*PRODUCT*
DMU35	0.4118	0.4548	0.5033	1.5013	1.0000	18.88	4.67	*PRODUCT*
DMU36	0.7590	0.8277	1.0633	1.8501	1.0000	90.25	3.04	*THEMATIC*
DMU37	0.350	0.8103	0.7465	0.7627	1.0000	0.00	4.26	*THEMATIC*

Source: Author's calculations based on Embrapa's research units data.

Thus, imposing similar effects of the covariates in all DMUs, we have the two following nonlinear regressions to be estimated using the complete sample:

(1) Gamma assumption

$$E\left(\phi_j^* \mid z_j\right)=\left[1+p\exp\left(z_j'\theta\right)\right]\left[1-F\left(z_j'\beta\right)\right]+F\left(z_j'\beta\right)$$

(2) Truncated Normal assumption

$$E\left(\phi_j^* \mid z_j\right)=\left[z_j'\theta+\sigma\frac{\phi\left(\left(1-z_j'\theta\right)/\sigma\right)}{1-\Phi\left(\left(1-z_j'\theta\right)/\sigma\right)}\right]\left[1-F\left(z_j'\beta\right)\right]+F\left(z_j'\beta\right)$$

Another possibility to evaluate the effect of contextual variables z_j for technical efficiency measurements ϕ_j^* in the interval $[1,+\infty)$, mimicking the work of [17] for general truncated distributions, is to assume the following log likelihood functions for the efficiency response. For the gamma distribution we have

$$l(\beta,\theta,p)=\eta\left(\sum_{\phi_j^*=1}\log F\left(z_j'\beta\right)\right)+(1-\eta)\begin{pmatrix}p\log\left(\lambda_j\right)+(p-1)\log\left(\phi_j^*-1\right)\\ \sum_{\phi_j^*>1}-\lambda_j\left(\phi_j^*-1\right)-\log\Gamma(p)\\ +\log\left(1-F\left(z_j'\beta\right)\right)\end{pmatrix},$$

where η is the indicator of an efficient DMU. For the truncated normal, we have

$$l(\beta,\theta,\sigma)=\eta\left(\sum_{\phi_j^*=1}\log F\left(z_j'\beta\right)\right)+(1-\eta)\begin{pmatrix}\log g\left(\phi_j^*,z_j'\theta,\sigma^2\right)\\ \sum_{\phi_j^*>1}-\log\left(1-Q\left(1,z_j'\theta,\sigma^2\right)\right)\\ +\log\left(1-F\left(z_j'\beta\right)\right)\end{pmatrix},$$

where g is the density function of the normal $N\left(z_j'\theta,\sigma^2\right)$ and Q *is* the corresponding distribution function.

In applications under exogeneity of the contextual variables all the models above may be estimated by quasi maximum likelihood or nonlinear least squares. Our choice is the nonlinear least squares, with standard errors and confidence intervals computed using nonparametric bootstrap based on centered residuals or not. These order of ideas represent new contributions and are clearly distinct from the proposals of [15], including the work of [17].

We believe that additional information on the contextual variables is gained considering the whole sample of efficiency scores. In our application the data do not support different parameterizations for efficient and inefficient units jointly, as we have a small sample. Therefore, we assume $\theta=\beta$. In other words, our assumption is that contextual variables affect the response equally on efficient and on inefficient DMUs. A difficulty that arises with the representations (1) e (2) is that the mean, in general, is no longer a monotone function of the linear construct $z'\theta$.

Restricting attention only to inefficient units, using maximum likelihood and assuming the truncated normal or the gamma distributions, the results will be equivalent to the two stage analysis proposed by [1].

5. Statistical Results

For the data of Table 1 we assume that the linear construct

$$\mu=\beta_0+\beta_1 PRO+\beta_2 IMP+\beta_3 PRODUCT+\beta_4 THEMATIC$$

affects expected efficiency according to one of the models discussed above. *PRODUCT* and *THEMATIC* are dummy variables.

The gamma specification with nonlinear least squares estimation better fits the data (best correlation between predicted and observed efficiency scores). The separate mean specifications do not produce stable nonlinear least squares results. Maximum likelihood for the inefficient units under the gamma and the truncated normal are stable and leads to similar statistical results.

We begin our discussion with the two part analysis, as proposed by [15], using maximum likelihood methods and the bootstrap Algorithm #1 of [11], which assumes the truncated normal specification to compute standard errors and confidence intervals for the model, based on 5,000 replications. Table 2 shows results of the choice model with the probit assumption.

We see that only marginally the set of contextual variables is significant. *PRO* acts reducing the probability of being efficient and *THEMATIC* has an increasing effect. The analysis of [1] is shown in Table 3 (results with the gamma distribution are basically the same). Only type of unit is significant at the 5% level.

Table 4 shows the statistical results for the joint estimation of the specification (1) using nonlinear least squares. Correlation between predicted and observed values is 0.692. Nonlinear least squares did not converge for (2). The bootstrap (nonparametric) results are based on

5,000 replications. Fig.1 illustrates the bootstrap distributions.

One can see in Table 4 that Type and *PRO* are significant effects. The model is more informative regarding the effect of the contextual variables on efficiency. Fig.2 shows the derivative of the expected mean response as a function of the linear construct μ. We see that the mean response increases or decreases depending on the level of the contextual variables. The same behavior is observed with the marginal effect of *PRO*. The negative value of *THEMATIC* is in the direction of more efficiency. For *PRO* is more difficult to disentangle the marginal effect. For all thematic centers, which are the more efficient, *PRO* has a positive effect. For the other types the response will decrease with the level of μ.

We see that processes improvement has not been adequate for benchmark units and do not lead to overall improvement for the less efficient units. The impact of technologies on efficiency, as actually measured, is not statistically important. Appropriate presentation of reports will not lead to more efficiency in production. Managers should look more carefully into production and costs profiles and into processes actually carried out within benchmarks units that could indeed lead to the increase of overall performance.

Table 2. Results of the choice model with the probit specification.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	37.893	37.814
SC	39.504	45.868
-2 Log L	35.893	27.814

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	8.0798	4	0.0887
Score	7.4800	4	0.1126
Wald	6.4687	4	0.1668

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	1.4009	1.6314	0.7373	0.3905
PRO	1	-0.0282	0.0179	2.4646	0.1164
IMP	1	-0.1006	0.2944	0.1168	0.7326
PRODUCT	1	-0.8279	0.8624	0.9214	0.3371
THEMATIC	1	0.9818	0.6213	2.4972	0.1140

Source: Author's calculations.

Table 3. Results of the truncated normal specification for the inefficient units.

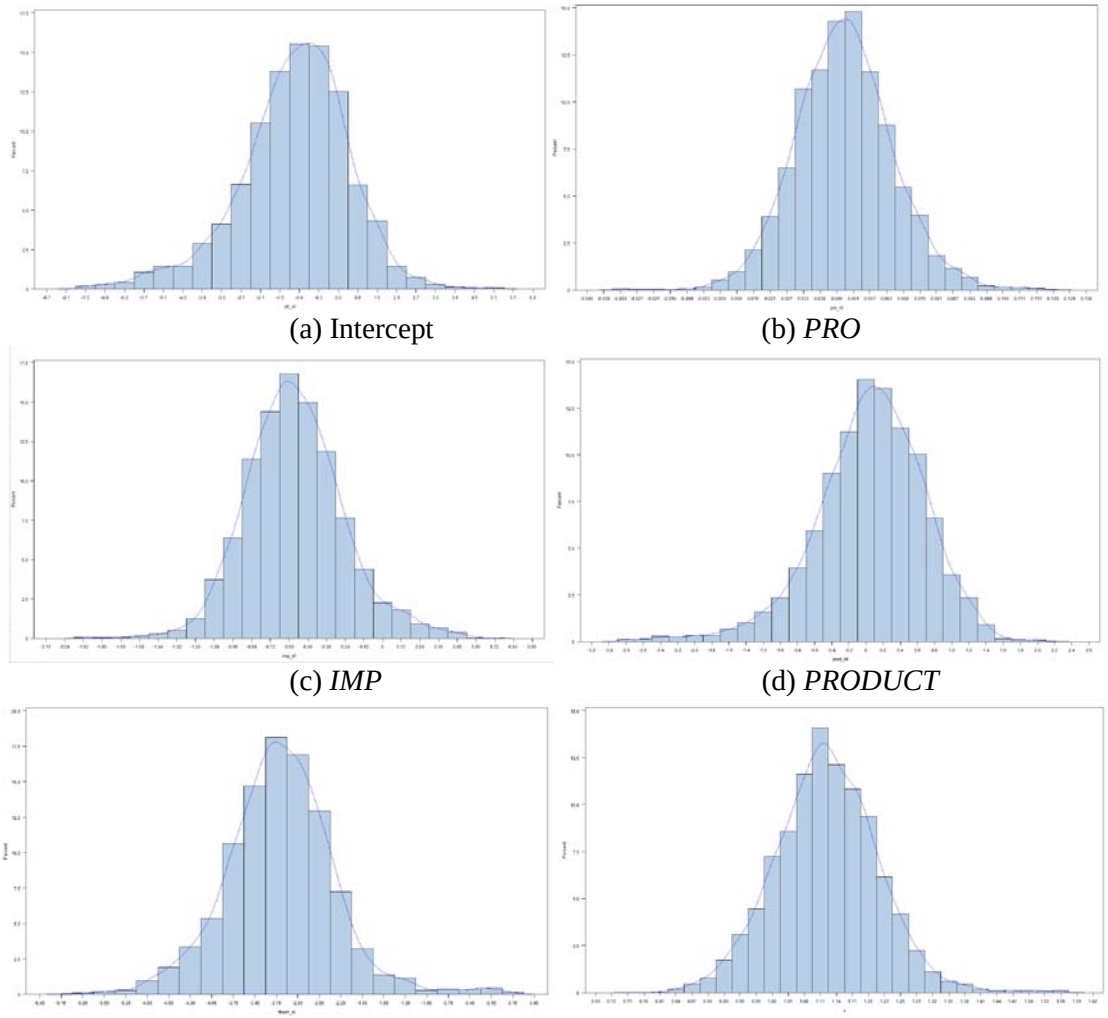
Parameter	Estimate	Bootstrap Standard Error	DF	t Value	95% Bootstrap Percentile Confidence Interval	
Intercept	2.4618	1.1369	30	2,1654	0.0308	4.5015
PRO	0.0008	0.0101	30	0,0816	-0.0181	0.0225
IMP	-0.0278	0.2076	30	-0,1340	-0.4411	0.4126
PRODUCT	-0.2265	0.2917	30	-0,7765	-0.7991	0.3632
THEMATIC	-1.6402	0.6780	30	-2,4192	-3.3985	-0.6399
sigma	0.6423	0.1067	30	6,0197	0.3968	0.8267

Source: Author's calculations

Table 4. Nonlinear least squares for $E\left(\phi_j^* \mid z_j\right)=\left[1+p\exp\left(z_j'\theta\right)\right]\left[1-F\left(z_j'\beta\right)\right]+F\left(z_j'\beta\right)$.

Parameter	Estimate	Bootstrap Standard Error	95% Bootstrap Percentile Confidence Interval	
Intercept	-1.0188	0.7098	-5.2688	1.9396
PRO	0.0528	0.0176	0.0137	0.0852
IMP	-0.6738	0.3174	-1.1485	0.1667
PRODUCT	0.0770	0.6443	-1.4742	1.2034
THEMATIC	-4.1007	0.7654	-4.6618	-1.4163
v (p=exp(v))	1.0673	0.0968	0.9292	1.3139

Source: Author's calculations



(a) Intercept (b) *PRO*

(c) *IMP* (d) *PRODUCT*

(e) *THEMATIC* (f) v

Fig.1. Bootstrap distributions (Source: Author's calculations).

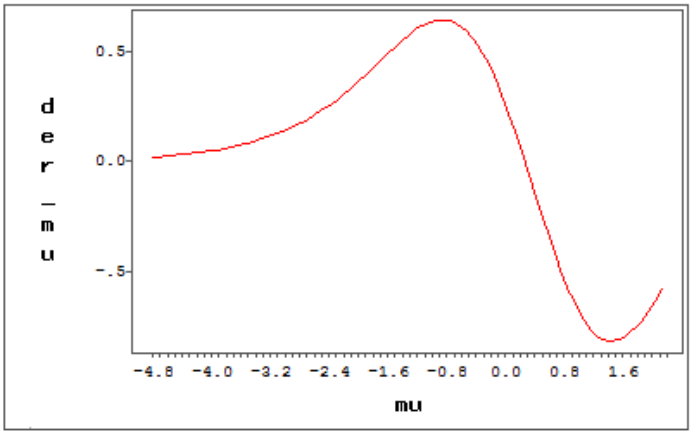


Fig.2. Derivative of the expected mean response as a function of the linear construct μ (Source: Author's calculations).

6. Summary and Conclusions

We propose and fit a new family of probability distributions for DEA output oriented measures of efficiency as an extension of fractional regression models for responses outside the $(0,1)$ interval. The objective of the analysis was to study the effect of contextual variables in the DEA performance measure computed for Embrapa's research centers.

The models considered allow for the dependence on a vector of contextual variables via a linear construct. As in fractional regression, the models combine two parts. These are a choice model explaining the expectation of being efficient, and a flexible family describing the expected mean behavior of the inefficient firms. These are motivated by the gamma and the truncated normal distributions.

The separate analysis for efficient and inefficient units seem to provide support for the two stage regression of [11], since we do not detect significant effects in the choice model related to the efficient units. For the inefficient units both approaches lead to the same results when we fit the data using maximum likelihood under the assumptions of the gamma or the truncated normal.

Combination of the two part models estimated via nonlinear least squares and bootstrap leads to different conclusions regarding the marginal effects of the contextual variables. The impression is that the inclusion of efficient units adds relevant information to the statistical analysis. This point is particularly important for the instrumentalist approach, where we look at efficiency measurements more as measures of performance than as realizations associated with a true unknown production process.

We conclude that the joint regression approach is more informative. The set of contextual variables studied in Embrapa's application is defined by PRO – Process improvement, IMP - impact of technologies and Type (Product, Thematic and Ecoregional). Type and PRO are statistically significant. The type category Thematic includes the more efficient units. The response effect to PRO varies with the expected mean efficiency level and is positively associated with performance for the Thematic research centers.

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