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Editorial*

Importance of information value issues in finance and economics can hardly be overestimated. Information is reflected (or not) in market prices; price itself could be used to predict major turmoils in economy; information use (or misuse) determines asset managers performance (or underperformance); market participants use information about central banks' actions and econometric links between major macroeconomic variables to form their expectations about inflation and exchange rates; investment bankers use information about firm's past fundamentals to hypothesize on its future value; local firms can learn from actions of multinational enterprises – i.e. copy information – to increase productivity, etc. Coincidence or not, but each paper in the current, 7th, issue of *Review of Business and Economic Studies* is somehow related to various aspects of the information impact on performance of firms, markets, its actors, and economy as a whole. And this is the reason why we've chosen to dedicate infographics on the second page of the cover to the topic of stock market information flows impact on each other. The model, outputs of which are visualized by Valery Barmin, allows to capture some aspects of information sharing regime changes as a result of crises. In fact, during major economic turmoils, regional information sets (i.e. sets that are supposed to be relevant only for regional stocks) become more globalized, market participants are sharing the same news flow. We can hypothesize, that under extreme uncertainty traders (probably, irrationally) are looking for any additional information piece, which could shed light on future. In turn, that leads to spontaneous coordination of market participants, which makes assets co-move together in times of financial turmoil. Further, we can observe some signs of habit formation: there is some evidence, though weak, that when situation stabilizes, information flow sharing decreases, but general patterns sustain, leading to more co-movement between assets.

Assets co-movement, especially during crises, brings its own risks, creating huge obstacle to diversification. Quality of diversification is obviously one of the most disputable topics in modern quantitative finance. Boris Valilyev's piece "Using Intrinsic Time in Portfolio Optimization" in current issue of our journal contributes to the field in two important ways. He uses mixture of distribution hypothesis to obtain nearly-normal returns, which then can be used to calculate historical estimates of market returns. His approach assumes applying concept of intrinsic time, which became well-known since seminal work by Clark, published in 1973 in *Econometrica*[1]. Boris Vasilyev deforms return series timescale across volume domain. By doing that he obtains series, that are slightly asynchronous in time domain, but instead synchronous in volume domain. According to mixture of distribution hypothesis, volume could be regarded as proxy for information arrival process, and information is regarded as the sum of all the forces, that drive prices. Returns are almost normal, but can we use asynchronous returns when building portfolio, which assumes simultaneity in trading? Boris Vasilyev offers his own solution to the problem; and by doing it, he, at the same time, develops his own way of covariance matrices robust estimation, which has solid ground in economic science. Empirical analysis performed by Vasilyev shows, that raw estimates of covariance matrices, obtained through this procedure, appear to be superior in terms of diagonality even to shrinked estimates. Efficiency frontiers built with these estimates strongly dominate frontiers build using all traditional approaches. This is definitely a breakthrough in portfolio management science.

Another important and disputable issue in finance is what part of information set is reflected in prices. Ta Cong in his paper "Is There a Dividend Month Premium? Evidence from Japan" discusses, how stock market responds to news about firm's dividend distribution decisions. Although he uses standard approach of building with-dividends and without-dividends portfolios and regressing its returns in CAPM, Fama-French and Carhart models, his findings contradict to previous evidence. He postulates regional differences in market reaction to dividend announcements. Dividend payers have always been regarded as value companies, paying to investor a premium over growth firms; but on Japanese market, as Ta Cong shows, dividend payers have negative premium over dividend non-payers. In fact, this means that information about dividends have negative value to investors in Japanese market – a puzzling finding.

The paper "Analysis of Investors' Strategies Using Backtesting and DEA Model" by Dina Nasretdinova, Darya Milovidova and Kristina Michailova approaches issues of firm fundamentals relevance from completely different angle. They analyse stock market public strategies of 30 investment "gurus", as they were popularized in their books. These strategies use

*От редакции.

[1] Clark, P.K. (1973), "A Subordinated Stochastic Process Model with Finite Variance for Speculative Prices", *Econometrica*, 41, 135–155.

various sets of fundamentals to build portfolios of stocks. Common sense would suggest that this information has no value at all, since strategies were made public long ago, and all possible excess profits could easily be wiped by rational arbitragers.

Approach of Nasretdinova, Milovidova and Mikhailova assumes using simulation of trades of famous market forecasters, inferred from description of their strategies; their goal is to determine, which strategy of information set usage (if any) is superior to others. Instead of relying to one of the classic parametric approaches (like regressing returns in CAPM/Fama-French/Carhart, as in Ta Cong's paper), they use data envelopment analysis to determine strategies' relative superiority in multi-criterial KPI-like sense. Authors have found, that some strategies do demonstrate sustainable superiority in performance, and, moreover, these strategies could be exposed either to value or growth risks, or even both; hence not information set itself, but the strategy of its usage contributes to performance. We can mention at least one seminal paper, which supports that result from different point of view, namely series of papers by Brinson, Hood and Beebower on importance of investment policy of funds[2].

Nurlana Batyrbekova in her paper "Using Elliott Wave Theory Predictions as Inputs in Equilibrium Portfolio Models With Views" uses approach, similar to the one taken by authors of previous piece. She studies, whether market revelations of one of the Elliott Wave Theory proponents, Robert Prechter, do have some real value for predicting the market. Conceptually, she paves the way of Brown, Goetzmann, and Kumar[3], who used to backtest predictions of Dow Theory proponent, William Peter Hamilton. Further, she augments their approach with Bayesian portfolio decision using Black-Litterman portfolio optimization framework. She finds that while overly concentrated, high-risk portfolios are underperforming the benchmark, combining predictions with diversification beats both the benchmark and diversified portfolios without Prechter's simulated views. Hence, Prechter's market ruminations, despite all the haziness and adhocism inherent to Elliott Wave Theory, could bring some value to market participants.

Oleg Karapaev further contributes to information value issues in the following way. In his paper, "Some Stylized Facts about Analyst Errors", he questions possible reasons of low accuracy of broker sell-side recommendations. Brokers are supposed to use all relevant information, be it publicly available or insider, to estimate future stock prices and market fundamentals; they use the latter to build discounted cash flows models, and to infer fair price from it. Sometimes brokers fail to forecast prices; sometimes they fail to forecast fundamentals as well. Possible questions here could be: is there some significant difference in forecast errors for fundamentals as compared to prices? If so, the reason of error could be in denominator of DCF model, i.e. in discount term, which incorporates time-varying risks perception. Further, are there some differences in errors across industries or investment styles? In other words, can we say that some fundamentals are harder to predict due to specific uncertainties of the industry or business model or firm lifecycle period? Do errors of consensus forecast depend upon the number of brokers covering the stock? This is a sketch of a grand research programme, and Oleg Karapaev in his paper formulates just some stylized facts and makes first attempt of conceptualization.

Le Thu Trang takes completely different angle in "Productivity Spillovers from Foreign Direct Investment in Vietnam", researching how information about best practices in industry affects firm productivity and hence – economic growth. She applies classic approach – total factor productivity estimation through data envelopment analysis, with subsequent regression of panel of various factors to TFP – to Vietnamese data, and contributes to evidences of positive impact of foreign direct investments by multinational corporations on local industries.

Finally, we close the 7th issue of *ROBES* with paper "Exchange Rate Management in Vietnam for Sustaining Stable and Long-Term Economic Growth" by Nguyen Hai An. His findings are complementary to results of Le Thu Trang. Nguyen Hai An builds macroeconometric model linking inflation and trade balance with exchange rate, price for credit, and money supply. Author finds that while currency depreciation impacts inflation, information about exchange rate alone could not explain trade balance change. Hence, policy advice could be inferred, that government should focus on stabilizing exchange rate to make inflation more predictable for firms, and on enhancing the quality of exported goods to improve firms competitiveness. Probably, that could be achieved, among other measures, by creating stimuli for multinational enterprises to be more active in direct investments to industries.

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[2] Gary P. Brinson, L. Randolph Hood, and Gilbert L. Beebower, "Determinants of Portfolio Performance," *Financial Analysts Journal* (1995): 133–138.

[3] Stephen J Brown, William N. Goetzmann, and Alok Kumar, "The Dow Theory: William Peter Hamilton's Track Record Reconsidered," *The Journal of Finance* 53, no. 4 (1998): 1311–1333.

Using Intrinsic Time in Portfolio Optimization*

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Abstract. The concept of intrinsic time was introduced in Mandelbrot's paper circa 1963 and further developed in discussion paper by Muller *et al.* (1993). As reported by Didenko *et al.* (2014), there are some evidences that sampling price series in volume domain results in almost normal returns, which could help to overcome some common issues in portfolio optimisation. First, we briefly survey flaws of classic approach to portfolio optimisation, then we test for statistical properties of intrinsic-time sampled return series, theorize on how intrinsic time could help in handling issues of portfolio optimisation, and then empirically test our guesses. We show that using intrinsic time helps in overcoming such flaws of Modern Portfolio Theory as poor diversification and reliance on normality of returns.

Аннотация. Концепция внутреннего времени была введена в работе Mandelbrot 1963 года и далее развита в докладе Muller с соавторами (1993). Недавнее исследование Диденко с соавторами (2014) предоставило ряд свидетельств о том, что свертка ценовых рядов по объемам приводит к квази-нормальности доходностей активов. Этот феномен можно использовать в портфельной оптимизации. Наша работа начинается с краткого обзора основных проблем современной портфельной теории. Далее мы тестируем нормальность рядов при различных параметрах свертки по объемам и эмпирически тестируем пригодность такой свертки в портфельной оптимизации. Наши результаты показывают, что свертка по объемам позволяет преодолеть такие недостатки СПТ, как слабая диверсификация и предположение о нормальности доходностей.

Key words: Intrinsic time, modern portfolio theory, portfolio optimisation, returns normality.

INTRODUCTION

Soon after the publication of "Portfolio Selection" by Harry Markowitz (1952) that is mostly referred to as a seminal work for modern portfolio theory based on mean-variance analysis (referred herein after to as "MVO"), it became evident that the original method presented therein resulted in low-diversified and unstable portfolios leading to overtrading and excessive risks. Along with increasing the number of assets in optimization universe these drawbacks even aggravated, and that most probably motivated Markowitz to introduce initial linear constraints to the process which were described in his work (1956) published several years later and gave ground to numerous modifications and developments to the MVO process ever since.

OVERTRADING

With respect to MVO excessive trading activity is mainly stemmed from frequent portfolio rebalancing that leads to placing additional open or close market orders to meet new assets allocation. A major cause of such instability is a combination of factors comprising unavoidable presence of estimation errors within input data from one hand, and high sensitivity of MVO to even minor changes in inputs, from the other. Hypothetically, if input data would be free of such errors inside, the optimization would definitely provide efficient or optimal portfolio composition. In reality the inputs are statistical estimates derived from or generated on the basis of historical data and bear some portion of disturbance inside. Michaud (1986) posited such inaccuracy results in overinvestment in some securities or assets and underinvestment in others. For example, with two assets like A and B, such as A's true expected return is slightly lower than that of B, but standard deviation is slightly higher, and provided both assets returns have identical correlations with the returns for each of the other assets the portfolio universe, asset B is preferred among these two, and if the inputs are free

* Использование внутреннего времени ценовых рядов в портфельной оптимизации.

of estimation error, it dominates A. But if such errors resides the input data, asset A may have an estimated expected return that is higher, and an estimated standard deviation hat is lower than that of B. In this case, portfolio optimization will erroneously assign a higher weight for A than for B. Moreover, estimation error may fluctuate around zero over time, and having the same true expected values for A and B in future, the optimizer may generate the opposite result affected by changing estimation error that will lead to dramatic rebalancing of portfolio.

High MVO sensitivity to a minor change in the data for input can therefore lead to a dramatic change in overall portfolio composition. Thus, an update that bears a slight change in expected return or standard deviation for one asset can result in radical portfolio reconstruction, rebalancing weight not only for this particular asset, but reallocating all the assets from the universe under consideration. Such potential recomposition results in excessive trading on the portfolio deemed necessary to meet new allocations each time the inputs change.

Overtrading is usually associated with two main problems such as increased possibility of capital loss and excessive transaction costs. First mainly results from overinvestment in few assets that is evident for low-diversified concentrated portfolios. The inputs for MVO are always estimates that may be quite far from the true values in future. Thus, if the market turns against the investor, low portfolio diversification, i. e. allocation into fewer assets, will increase potential losses. In this case if the investor utilizes the leverage the losses are even magnified and may exceed investor's capital. Another issue is transaction costs. They are often fixed, and in total therefore dependant on the number of trades executed. Frequent assets re-allocation results in higher transaction costs that harmfully affect the return of the portfolio and hence overall profitability of the investment.

The problem of excessive turnover and overinvestment in fewer assets can be settled by introduction of specific constraints into MVO process. These may limit minimum and maximum weights for one asset (or class of assets) and/or preset minimum number of assets to be included in the portfolio to ensure proper level of its diversification.

Transaction costs may be reduced by composition of more stable portfolios. For example, Lummer *et al.* (1994) proposed for this purpose to use sensitivity analysis allowing to diminish dramatic changes in recommended portfolio due to minor changes in inputs. This method implies selecting an efficient portfolio and then altering the MVO inputs to construct a set of portfolios with new inputs, and then to examine how close they are to the initial efficient one. The goal is to find a set of asset weights that will be close to efficient proportion under several different sets of plausible inputs. On the other hand, expected benefit from any reallocation advised by MVO can be assessed with respect to relevant transaction costs necessary for its execution.

EXPECTED RETURNS

Yet another question for MVO is that the theory implies expected returns as an input. They cannot be known directly from the market, but only estimated commonly on the basis of its past data, that leads to unstable portfolio weights. MVO would generate a perfect solution if the inputs would be true expected returns and the variance matrix. In reality the estimates of expected returns mostly consist of noise and estimates of the variance matrixes are very noisy too. Scherer (2002) noted that "mean-variance optimization is too powerful tool for the quality of our data".

The main problem is to estimate expected returns with sufficient accuracy. There are several main methods published to resolve this issue. For example, Black and Litterman (1992) proposed to estimate the expected returns by combining Capital Asset Pricing Model (CAPM) equilibrium and subjective investor views. However, investor's assumptions for the market must be also specified with numbers for both the expected returns and the uncertainty that may be considered as a drawback for this approach. Another way is the Arbitrage Pricing Theory (APT) that was described by Ross (1976) and was intended to model returns of the assets (for the discrete time) as a linear combination of independent factors. The APT constructs expected returns as statistical estimates to fit historical data that in turn may also lead to unstable allocations.

Another empirical way of expected returns estimation is to apply for consensus forecasts of professionals participating in market activity. Informational vendors (such as Bloomberg) provide this opportunity to its subscribers. However, the experience proves their expectations are usually drop far from true values, at least as far as single assets predicts are concerned. Meanwhile, the empirical expectations with respect to cumulative indexes prove to be much more accurate. This allows to use a single index model as an instrument of expected return estimations using index estimation as the only macroeconomic parameter to influence particular asset expected return. Multifactor models are not that simplified and imply regression analysis based on several factors such as, for example, indexes by various industry sectors. They are more detailed in assessment of expected returns

than single index models as consider any stock dependence not on general index, but on the index of corresponding sector. However, multifactor models also provide quite rough estimations within wide confidence intervals.

Following MVO routine, once input parameters have been estimated, it performs optimization assuming all inputs are certain and estimation errors are introduced into the process of allocation. Various approaches exist to stabilize the optimization results with respect to estimation errors, which can be distinguished in two main ways.

The first approach implies to reduce the estimation errors of the input parameters via econometric methods. For example, to reduce the impact of noise estimation Michaud (1998) used the resampling method. The idea behind it is that real returns are very noisy. As the optimization procedure is very unstable depending on small changes in inputs, the portfolio should be optimized over sets of similar return series that are randomly generated following some preset parameters. On average, noise should be evened out. Thus, starting with original return series, some new series are generated with small amounts of noise to the original series. Then MVO procedure runs over all series and eventually results in a set of different optimal portfolios composed for a same expected returns level. The average over all optimal portfolios is expected to be more stable with respect to errors in the input data.

The second way is to shrink directly the weights in portfolio using bounds, penalties for the objective function or regularization of input parameters. Jagannathan and Ma (2003) showed that imposing constraints on the mean-variance optimization can be interpreted as a modification of the covariance matrix. In particular, lower (upper) bounds decrease (increase) the variances of asset returns. Thus, constraints imposed on weights can reduce the degree of freedom of the optimization, and the allocation remains then within certain intervals. But the correction of estimation errors proved to be such difficult task that some studies were devoted to show that heuristic allocations perform even better than MVO-generated ones with respect to Sharpe ratio. For example, DeMiguel *et al.* (2009) assessed the performances of 14 different portfolio models and the equally-weighted portfolio on different datasets and come to conclusion that detailed and sophisticated models did not produce a better optimization than the naïve equally-weighted portfolio.

As a result, Lindberg (2009) mentioned one more way to deal with the problem of expected returns estimation that is simply ignoring them. This method is stemmed from the classical 1/n strategy, which simply puts 1/n of the investor's capital in each of n available assets. No doubt, this strategy should be well diversified. However, covariation between different assets may refrain this from being the case, and as it is possible to obtain rather good estimates of covariations between assets returns, this information can be also used in portfolio construction. Later, Fernholz (2002) has proposed to consider expected returns as dependant on ranks. These ranks can be established, for example, based on the market capital distribution. Thus, rank 1 can be assigned to the asset with the highest market capitalization, rank 2 to the next highest, and so far. A paper by Almgren and Chriss (2005) presented a portfolio optimization method which utilized such ordering information instead of expected returns. It uses information about the order of the expected returns as the MVO inputs instead of the very estimates. This approach also benefits from extended use of covariance information.

NORMALITY OF RETURNS

Assets returns follow some statistical distribution and its form is an issue of highest importance for financial modeling in general and MVO in particular. Basic assumptions on market prices behavior are required to perform a testing of asset pricing models, to optimize portfolios by computation of risk/return efficient frontiers, to assess derivatives and determine the hedging strategy over time, as well as to measure and manage financial risks. However, neither economic nor statistical theory appears to succeed in determination of exact type of returns distribution. Thus, distributions used in empirical and theoretical research are commonly derived from an assumption or estimation of data used. The overall belief adopted in finances is that this is the normal (Gaussian) distribution.

Although returns normality is the standard in financial modeling, some alternatives have been also considered mainly due to evidence that the Gaussian distribution tends to underestimate the weight of the extreme returns contained in the distribution tails as well as the returns fallen around the mean. For example, Longin (2005) noted that during the stock market crashes (such as in 2008) daily market drops can exceed 20% that can hardly be explained within normality universe. In response, several other distributions have been proposed by the scholars, who tried to apply them, however without evident success: a mixture of Gaussian distributions, stable Paretian distributions, Student t-distributions and the class of ARCH processes. Main shortcoming of all these alternatives is that they are not nested and their adequacy

therefore cannot be directly compared, for example, by a likelihood ratio test.

On the other hand, MVO's intended outcome is to find an optimal portfolio that means to maximize investor's utility function. In case this utility function is not quadratic, but generally represented with any upward concave form, expected utility function should depend on the portfolio return's values only. Such distributions must be the two-parameter ones, i. e. should be fully explained by their first two moments — mean and variance, which are also implied to express the higher order moments, e. g. skewness and kurtosis. Several distributions, such as the normal, lognormal, or gamma ones satisfy this criterion well. However, with respect to the problem of portfolio optimization, the distribution in question should also satisfy one more criterion. Portfolio optimization deals with a universe of assets (or other portfolios), and an investor selects which assets to include into portfolio. Thus, all portfolios composed by combination of individual assets must also follow some distribution that can be fully explained by their means and variances. The distribution therefore must comply with a criterion that both individual assets' returns distribution should depend on just their mean and variance, and the distribution of returns of a portfolio (combination) of these assets meets the same requirement. The only distribution that is suitable to comply with it and has finite variance is the normal Gaussian one.

As a result, the paradigm in finance is that MVO can be successfully applied only provided asset returns follow the normal distribution that is determined by its two first moments, means of returns and their variances. The third and fourth moments of distribution, that are, in particular, the skewness and kurtosis can be also theoretically added to the utility to reflect and explain a non-normality of returns, but it is believed that skewness is close to impossible to predict and the predictability of kurtosis is considerably limited, either.

INTRINSIC TIME

MVO is intended to answer a very natural question: if the exact parameters are known, which portfolio maximizes the expected return for pre-specified level of risk, or which portfolio minimizes the risk for pre-specified rate of expected return? This would be all the investor would need to have an optimal portfolio and be happy enough with it. However, among others, the issues described above bring some bitter stuff into reality. "Exact parameters" that are needed *ad hoc*, proved to be uncertain, noisy and lead the optimizer to unstable results with underestimated risks.

However, it becomes evident the main problem for all these issues is that asset returns are not normally distributed. This is a reason why the investor cannot accurately estimate expected returns, has problems with unstable solutions, rebalancing, and hence with overtrading and other bad things. Realized returns values refrains the investor from a clear view of true normal distribution that exists in the market, but is hidden by noise. It is widely assumed that this is the way things are, and for the purpose of this work, in particular, it is implied as a true.

Based on inherent normality of returns distribution, most of the scholars propose various approaches how to adjust realized market returns to suit Gaussian framework by introducing new parameters that make the models more and more complicated. At some extent, it becomes evident that many of such sophisticated models perform worse than simplest naïve portfolios, and hence are discarded. But one point remains unchanged: the source data is taken from the market and then is converted into returns addressed for statistical manipulations.

On the other hand, it is known that the proximity of returns distribution to Gaussian normality is not stable over different time intervals and commonly increases with decrease of the frequency. For example, the distribution of monthly returns is closer to the normal one than that of days, hours or minutes. The cause is deemed to be that the higher time intervals have relatively lower proportion of noise within the returns, but anyway it is obvious the proximity of returns distribution to the normal on depends on time. It flows constantly by seconds, minutes, etc. And it is also obvious, but not for the market! One minute at the middle of trading day is not the same as one minute right before it is being closed. Hence, a question: how can one consider all time spans during the day in the same manner? This understanding may explain (at least partially) the non-normality that all involved have got accustomed to observe.

Next question is what can be used to measure this difference in the same intervals of time, or to tick market intrinsic time clock. Volatility is usually higher during periods of active trading (when our time should go "faster") and, conversely, is lower over non-active trading ones (when our time goes "slower"). But it is not so easy to estimate it independently, and its value represents the situation non-equally depending on volumes traded, that seems itself to be much more interesting to implement. Traded volumes can generally reflect the level of market activity and this parameter is usually available as provided among common market data.

The bars can be now formed as based not on astronomic time interval expiration (end of second,

minute, hour, etc.), but when the traded volume achieves certain pre-set value since last closed bar formed by the same method. It can be considered as market intrinsic time. Such time dimension — cumulative volume bar (referred hereinafter to as "CVB"), will not coincide with astronomic time, but is expected to better reflect the nature and the mood of the market. The CVB returns are expected to achieve closer proximity to normal distribution as much of usual noise may prove to be in fact the messed data of neighbor conventional (astronomic timed) bars, that is going to disappear in case of CVB accounting for market activity.

CVB approach as market intrinsic time can potentially provide a better solution for all of above described issues. And the most interesting is that it may allow to use MVO it its original form, without complicated modifications and add-ons. More stable portfolios avoid overtrading, expected returns have lower estimation errors as returns distribution is close to the normal one, realized returns noise is diminished.

CVB PROXIMITY TO NORMAL DISTRIBUTION

Although the data generated by the market is believed to be normally distributed, it is full of noise that prevents investors from gaining benefits associated with this normality. The proportion of such disturbances, however, in overall price movements tends to decrease along with increasing of time intervals size taken for consideration. It mainly results from the magnitude of the market swings that are evidently bigger within less frequent intervals, while the noise component rises slower and steadily fades out. The returns for yearly intervals are much closer to normally distributed data than the returns for minute frequency. Higher intervals, however, cannot often be useful enough for active trading and this makes it clear that normalization of more frequent data would be a matter of the highest interest for investors. As the returns derived from CVB are believed to be closer to normal distributed data than the regular ones (based on conventional astronomic time bars — referred hereinafter to as "conventional returns"), we have conducted a comparison of both types.

CVB concept posits that the bar is closed not with a tick of a clock as usual, but when the volume of trades for particular asset achieved certain preset value. Thus, such intrinsic time is individual for every asset as particular trading volumes are believed impossible to coincide across the market. To fulfill an experiment we have taken one minute data for a period of one year 2013 for top ten assets of Russian stock market[1] and have compared the proximity to normal distribution for the returns generated by conventional bars data and CVBs.

CVB composition is performed as iterations for trading volumes increasing from 100,000 to 40,000,000 with a step of 100,000. For every asset, one minute bars volumes from original source data files are added up until the sum achieves the value of current iteration. Then the current CVB is considered as closed, and the loop starts the same routine for next CVB. Any next iteration obviously produces less bars than the previous one as it collects more conventional bars to achieve increased target volume, i. e. generates higher intervals that may itself bring the results closer to normality. To offset this influence and to assess the contribution of the very CVB concert rather than the benefit of a scale, we also generate conventional bars of similar range. When any iteration if finished, it brings the finite number of CVBs generated. Dividing original source data file length by this number we can obtain the number of conventional bars in the interval that corresponds to one newly generated CVB. Then we compose new conventional bars dataset relevant to this particular

[1] Data is available at: http: //www. finam. ru/analysis/profile041CA00007/, [accessed 25 February 2015].

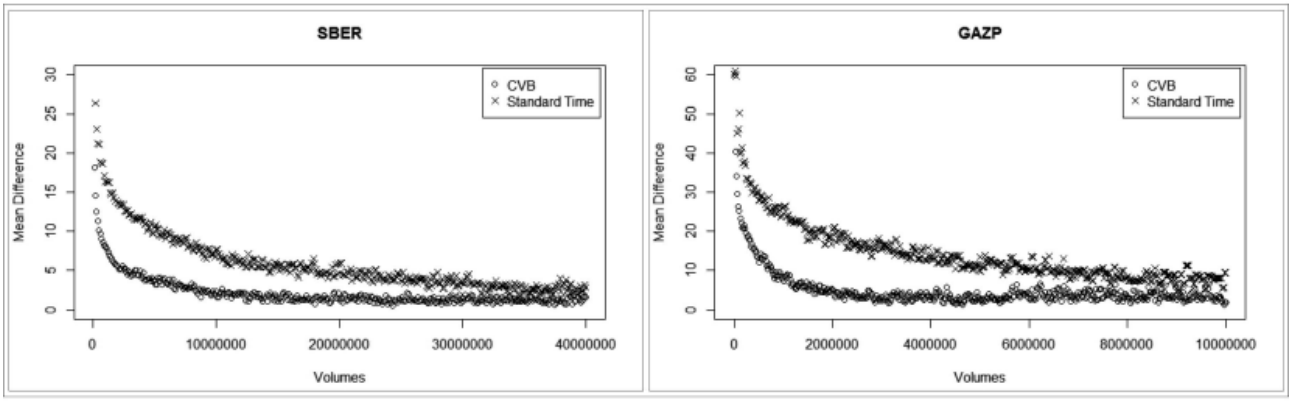

Figure 1. Deviation of observed returns from normally distributed data.

CVB set and compare proximity to normally distributed data with the same mean and standard deviation for both generated datasets.

Figure 1 presents the results for common shares of GAZP (Gazprom) and SBER (Sberbank). Other assets examined provide similar pictures. Deviation from normal distribution diminishes with interval rise for returns based on both conventional bars and CVBs, but the latter present higher rate and gets times lower in the left part of the charts. By the end of iterations the conventional returns row tends to reach CVB ones, although CVBs still provide lower values within the range of observation.

As a result we may posit that CVB approach allows obtaining returns that are closer to normally distributed than the conventional bars. This advantage becomes specifically evident on smaller time intervals, but proceeds even further, although not that dramatically. The application of CVB may encounter some complexities stemmed from the fact that every asset now exists in the market at its own time. But this problem may be solved for practical purposes of optimization as described below.

PORTFOLIO OPTIMIZATION USING CVB

Portfolio Theory by Harry Markowitz gives ground to numerous mean-variance optimizers most of which attempt to improve the method and to bypass its known drawbacks as described above. Thus, we believe it is interesting to compare portfolio optimization by original mean-variance analysis performed on conventional and CVB based data, as CVB brings no modification to optimization process itself, but just rearranges the data to input. For this purpose we take one minute interval data (also provided by Finam) for a period from June 2008 till end of December 2014 for top ten Russian stocks. The start date was taken that as one of the participants (particularly HYDR — Rushydro) was listed just at the end of May 2008, and we have no data for processing beyond this point. The portfolio is intended to be rebalanced on a weekly or monthly basis.

Here we encounter a problem rising from individual CVB time for each participant of our universe to optimize. Going common way we cannot rebalance the portfolio based on CVB as the bars of all participating assets close differently, and there is no conventional uniform cut-off time. This issue can be solved by several means, but we use one as follows. As CVB is intended to arrange the data in a more natural way, there is no difference which direction such a composition goes to. In other words, returning back to the Figure 1 above, CVB construction performed from the last data point backward to the first one would produce the same result in the chart. Thus, we can perform portfolio optimization at any point of conventional time if constructing CVB row backward from this point.

Similar to the way we used in the experiment on proximity to normal distribution, at every point of portfolio optimization we imitate conventional row by CVBs one to compare with the most suitable. For example, if we perform monthly optimization for the point X of conventional data and use therefore X months of previous data, we adjust CVB dataset accordingly. Particularly, we derive total trading volume for each asset for whole the period till point X, and then we divide it by X — the number of months taken for optimization. It results in the value of average volume per month which becomes a target volume for CVB composition. It is definitely the easiest way that does not take into account, for example, global changes in volumes across all periods that may be significant for Russian market and can be introduced by averages, but we leave it out of this research for the sake of simplicity. Once we have the target value for volume, we can construct CVBs starting from X point. The number of CVBs is also X that is the last point of both conventional and CVB datasets that are now equally sized and ready for input to the optimizer.

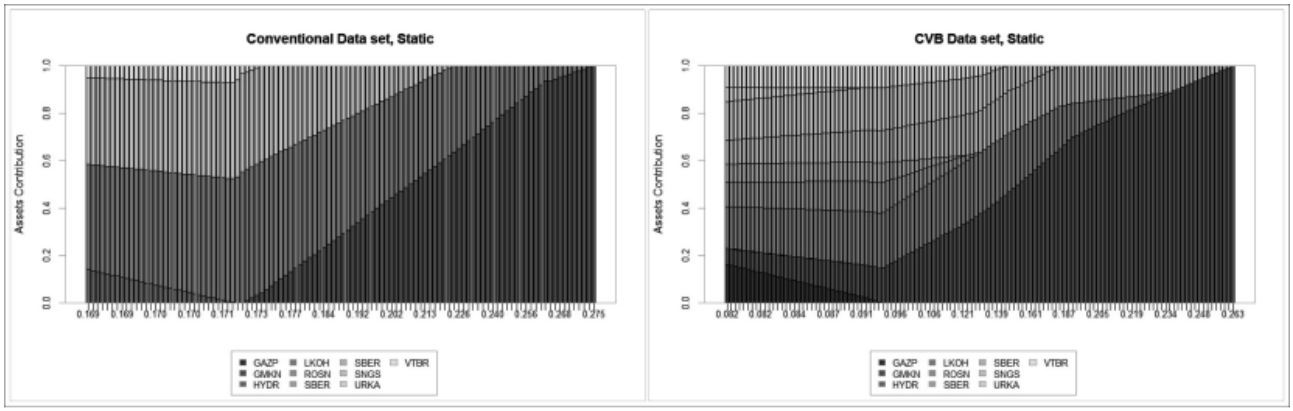

Figure 2. Static Transition Maps.

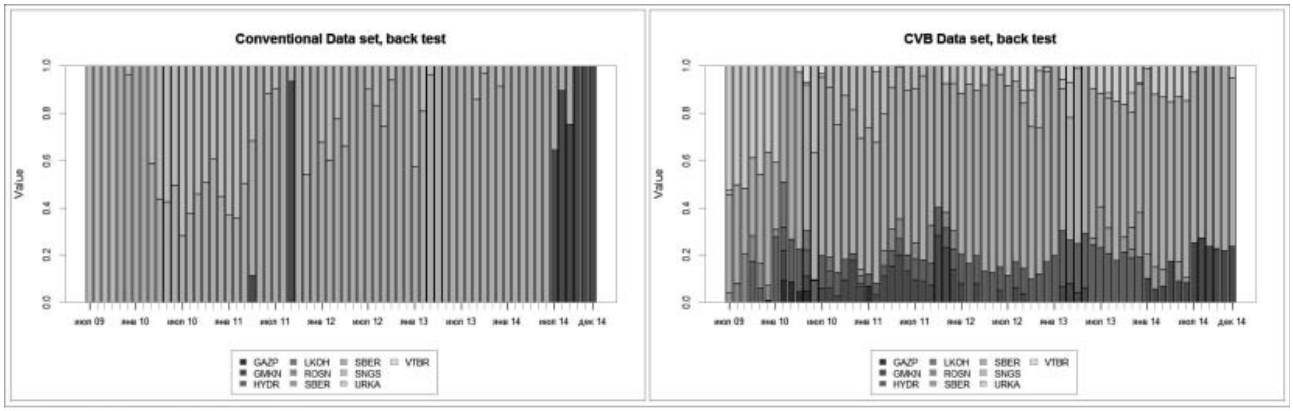

Figure 3. Back test transition maps.

Optimization results are interesting in comparison of static and historical portfolio composition for both data samples. Figure 2 shows static transition maps for the date of 30 December 2014. Left map refers to conventional bars based portfolios, while the right map — to CVBs-based ones. Each map represents a hundred portfolios sitting of efficiency frontier and sorted by return (or risk) from the lowest to the highest. X-axis is labeled with expected portfolio risk, while Y-axis represents the weights of participating stocks.

CVB-based efficient portfolios are evidently more diversified and contain eight-nine assets until the middle of the map, while portfolios composed on the basis of conventional data sample consist of only four assets with domination of two of them in the beginning — LKOH (Lukoil) and SNGS (Surgutneftegas). GMKN (GMK Norilskiy Nikel) dominates both maps most risky/profitable portfolios rightwards. Higher level diversification leads to lowering of portfolio risk that is particularly demonstrated by these charts. Starting level of risk 0.169 for conventional bars based frontier is achieved by CVB-based one only in the right half of its map. As concentrated portfolios are considered as one of the known shortcomings to Markowitz optimization, considerably higher diversification of CVB-based effective portfolios may demonstrate CVB's obvious advantage over conventional data sampling.

Figure 3 represents transition maps of optimal Sharpe portfolios for the whole period from 2008 to the end of 2014 for both data sampling methods with monthly rebalancing. For each time point all generated efficient portfolios are compared by their Sharpe ratios calculated as a quotient of division of portfolio expected (excess) return by its expected risk. Then, the best portfolio is included in this map each time. The charts display similar peculiarity as the static maps. CVB-based portfolios are at least twice better diversified over the whole period under consideration. The assets participating in the portfolios in the left map are included in respective port-

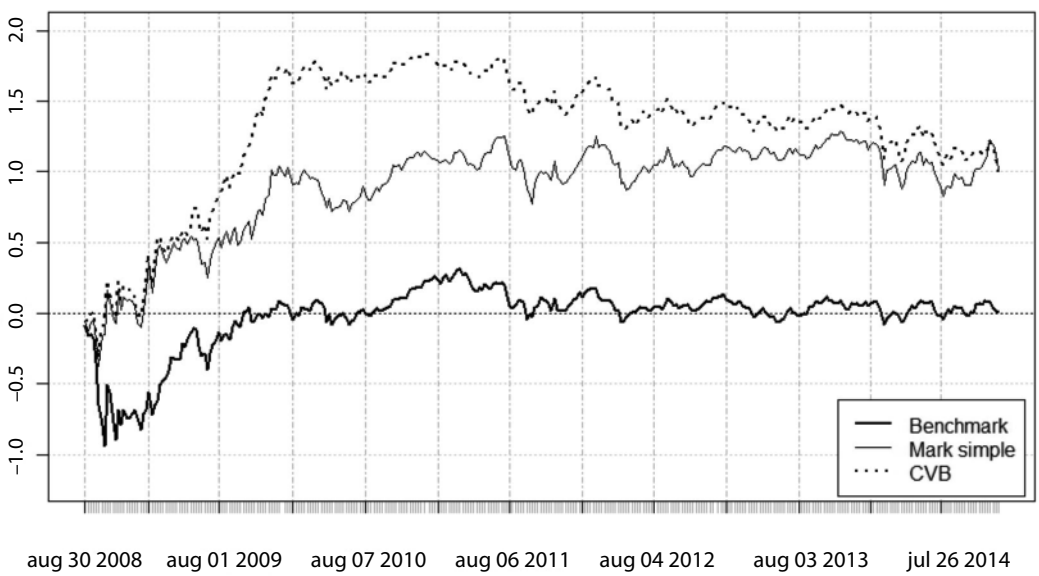

Figure 4. Optimization performance.

folios represented in the right chart, but also added with some other assets ignored by conventional data based optimization.

Back test conducted for both types of data sampling methods also allows comparing their real performance in the market. The results are demonstrated in the Figure 4.

Both sets of portfolios outperform the benchmark that is calculated as cumulative return of assets market capitalization. CVB-based portfolios perform better than conventional data based ones in the beginning, but depreciate in the second part of the graph. This may result from initial assumption that target volumes for CVB step is constant over the period, or that CVB works better in the bull market that has taken place in Russia from second half of 2008 till the mid of 2011.

CONCLUSION

CVB approach to data sampling proved to have a real effect on portfolios composition using even pure, standard tools of optimization. It brings more diversified portfolios and can provide results outperforming that of generated on the basis of conventionally sampled data. As CVB approach is not an optimization tool itself, it can be easily introduced to any of existing optimization techniques to enhance their positive features.

Based on experiments to approach normally distributed series, it is believed that CVB can demonstrate better performance on smaller intervals. Thus, there are two main directions to evolve the research. First, to apply CVB to more frequent rebalancing, for example, on daily or even lower basis, where common portfolio optimization is not traditionally used. And the second direction is to try CVB on more developed and vigorous markets such as that of USA. Both these developments will allow tuning the method and improving its performance for future application.

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Is There a Dividend Month Premium? Evidence from Japan*

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Abstract. Defined by Hartzmark and Solomon (2012), dividend month premium is misvaluation of stocks in the months when companies are predicted to pay dividends. Following Hartzmark and Solomon methodology, this paper examines market reactions to Japanese companies in the dividend months. Portfolios consisting of companies with a predicted dividend and all other companies were formed and regressed under the CAPM, the Fama-French 3 factor and the 4 factor models. In a data sample consisting of 2263 Japanese companies from January 1991 to October 2014, no statistically significant abnormal returns were found in predicted dividend portfolio. Nonetheless, this study recorded significant negative abnormal returns of dividend paying companies with respect to non-dividend payers.

Аннотация. По определению Hartzmark и Solomon (2012), премия дивидендного месяца – это ошибочное ценообразование акций в месяцах, в которых ожидается выплата дивидендов. Следуя методологии Hartzmark and Solomon, данная статья исследует рыночную реакцию на японские компании в дивидендных месяцах. Портфели, состоящие из акций компаний с ожидаемым дивидендом и остальных компаний, были сформированы и регрессированы в соответствии с двух-(CAPM), трех-(Fama-French), четырехфакторной (Carhart) моделями. В выборке из 2263 японских компаний в период с января 1991 года по октябрь 2014 года не были найдены статистически важные аномальные доходности в портфеле ожидаемых дивидендов. Тем не менее в данном исследовании были замечены статистически важные негативные аномальные доходности дивидендных компаний по отношению к недивидендным компаниям.

Keywords: Dividends, mispricing, market efficiency, price pressure.

1. INTRODUCTION

Traditional theoretical models in finance are built under the assumption of perfect financial markets with perfect liquidity and without transaction costs. Perfect or efficient markets are those that are able to incorporate instantaneously all publicly available information. In that sense, research on stock price reactions to corporate distributions play a prominent role, as they can examine real-world efficiency of capital markets. Not only are dividend announcements public corporate events, they are also of highly predictable and regular character and thus, as Jensen (1978) pointed out, profitable trading strategies based on that set of information should not exist. Moreover, as Miller and Modigliani (1961) stated, the dividend payout policy of a company is irrelevant to its investors, thus should not affect overall earnings of stocks.

However, an expanding body of research has documented empirical evidence of market inefficiencies, including abnormal returns around dividend announcement and ex dividend dates. To start with, Charest (1978) found asymmetrical stock market responses to announcement of dividend increases and decreases, which could presuppose arbitrage opportunities. Kalay and Lowenstein (1985) recorded a positive net dividend announcement effect. Following these papers, Eades, Hess and Kim (1985) documented similar market reactions to dividend announcement and in addition discovered an ex-dividend period effect. Moreover, they found no evidence of risk increases around declaration dates.

Shefrin and Statman (1984) introduced behavioral reasons behind managerial decisions on dividend policies and explained investors' preference towards cash dividends. Extending Shefrin and Statman's (1984) behavioral theory, Baker and Wurgler (2004 a & b) developed a theory of catering, which proposed that investors' sentiments and psychology are drivers for dividend demand. Market participants may prefer dividends, as they are a guaranteed source of revenue,

* Существует ли премия дивидендного месяца? Пример из Японии

and hence would buy dividend-paying stocks before ex-date and sell after. This would result in positive abnormal returns of subsequent stocks prior ex-date and negative abnormal returns after the ex-date.

Under the same intuition of dividend-paying stocks overpricing, Hartzmark and Solomon (2012) documented instances of market mispricing of US stocks in months when dividend is predicted. The authors presented evidence of high positive abnormal returns in predicted dividend months and argued this anomaly is unlikely to be explained by systemic risk. In addition, recorded anomalies are nearly as big as value premiums, but have lower standard deviations. Consistent with price pressure theory, Haltzmark and Solomon marked returns before ex-dividend dates and subsequent reversals after ex-dividend dates correlate with liquidity, and are higher in times of market stress and high volatility. Moreover, they argue that the dividend month premium is not driven by earnings announcement or seasonality effects.

Following Hartzmark and Solomon (2012), this paper is aimed at finding evidence of market inefficiencies with respect to corporate distribution events. Using a similar methodology applied on Japanese stock market, this study came to different results. To start, no return patterns with respect to dividend companies were identified. What is more, no evidence of abnormal returns of dividend paying companies was found. In contrary, in the sample of this research, dividend-paying companies had lower average returns than companies without a dividend. That led to the discovery of a dividend discount on the Japanese stock market, as a portfolio that goes long on companies with predicted dividend and short on all other companies has a significant negative abnormal return of -0.69% with respect to a 4 factor model. By isolating earnings announcements effects, the performance of the difference portfolio did not change, as it had significant negative abnormal return of –0,78%.

As most research on dividends were done on the US stock market, this paper contributes to the literature by exploring new instances of market inefficiencies, by examining market responses to dividend payments of companies listed on Tokyo Stock Exchange. The remainder of the paper is structured as follows. Section 2 describes the hypotheses. Section 3 discusses the data. Section 4 presents the main results of the paper, and section 5 concludes.

2. HYPOTHESES

The perfect capital market, or complete market, can be clearly defined through several essential properties. Firstly, there are no information asymmetries, meaning that all data is freely available to everyone. Furthermore, close substitutes to securities are available, and exercising the arbitrage strategy has no cost. All these characteristics allow a defense of the main property of a perfect capital market – the demand for stocks is horizontal, i.e. the price of a security is not dependent on the number of it being bought or sold on the market. Consider the example of an investor who operates at this type of market and decides to buy a large quantity of a certain stock. This bid would be fulfilled at a spread market price since any other price would result in an arbitrage opportunity. From the side of a market player performing the arbitrage, the situation can be described as an arbitrageur selling short the desired (by the investor) amount of the stock, and then buying the same amount of close substitutes, therefore performing the profit as a difference of an actual market price and the price that the investor was willing to pay. However, other arbitrageurs would also identify the opportunity and perform the same transactions, hence driving the asking price of the stock to converge with the spread market price and thus making the arbitrage profits converge to zero.

The most prominent alternative hypothesis related to corporate distributions, as in Hartzmark and Solomon (2008), states that returns are high due to the foreseeable price pressure preceding the dividend payment. In the course of this period of time, the supply-demand model of the dividend-paying shares is mostly explained by two factors – investors whose trading model is built around the dividends themselves, and secondly, by the market makers and arbitrageurs who are trying to benefit from the short-term price fluctuations. For example, those investors who get utility from dividends are more prone to buy the shares of firms that are going to pay dividends sooner (assuming positive interest rates). Therefore, these investors are more interested in buying (or not selling) the stock right before the dividend payments rather than immediately after. Nevertheless, this does not automatically mean that the same set of investors are buying the securities just before the payment day, and selling immediately after. It may be the case that investors are just going long for the same stocks they already were aiming to buy, and taking the opportunity to make the transaction prior to the ex-day (or postponing the projected sales until the payment day). If the supply provided by arbitrageurs and market makers is not enough to meet the demand by dividend-seeking investors, the situation of an excess demand for the dividend-paying shares will occur, thus bringing the price up to the new equilibrium. To summarize, we can state that the existence of a demand for dividends themselves (in other words – the desire of some investors to pay for dividends) stays behind the phenomenon of changes in supply and demand of dividend-paying assets.

3. DATA DESCRIPTION

The data on monthly returns were derived from monthly stock prices extracted from Bloomberg, while data on dividends was collected from Datastream. Monthly return data runs from January 1991 to October 2014. Historical prices were adjusted to reflect regular quarterly, semiannual, annual cash distribution, also stock splits, consolidations, spin-offs, stock dividends and rights offerings. For this study only stocks listed on the Tokyo Stock Exchange were used. Only common stocks of Japanese companies were considered and thus, ADRs, various ownership units, REITs, and stocks of companies incorporated outside Japan, were excluded. Besides, stocks were excluded that were listed after January 2004 and those that have prices below 200 Japanese yen as of October 2014. Also stocks that did not contain data on dividends were not included in the final sample.

For dividend payments, only ordinary cash dividends paid in Japanese yen were considered. As the purpose of this study is to examine market reaction to regular and predictable events, abnormal and non-recurring dividends were excluded. 23.75% of dividend observations are annual, 75.97% are semi-annual and 0.28% quarterly.

4. METHODOLOGY AND RESULTS

PREDICTED DIVIDEND MONTH AND RAW RETURNS

In this section, we are trying to find any patterns in raw returns of dividend paying stocks in the months of expected dividend. As pointed out by Bernheim (1991), firms are usually persistent in their dividend policy, meaning that companies which pay semiannual dividends or annual dividends, as it is in our case, will most likely distribute cash to shareholders every six or twelve months. Hartzmark and Solomon (2012) introduce the term "predicted dividend" on the notion that future dividend payments time can be forecasted by past corporate distributions. In other words, if a firm paid annual dividends 12 months ago, or semi-annual dividends 6 and 12 months ago it will have a "predicted dividend" in the current month.

As Eades, Hess and Kim (1986) and Hartzmark and Solomon (2012) noted, dividend announcements have a predictable component, thereby market reactions to these corporate events should have a more consistent nature and evidences of market inefficiencies, if they exist, would have a more reliable interpretation. Using these argumentations, raw returns of dividend paying companies were sorted with respect to their dividend month in order to find some pattern in dividend payers' pricing.

Table A presents the monthly stock returns of companies according to the timing of the past dividend payments, using monthly data from January 1991 to December 2011. Table A examines the average returns of dividend payment in the current month based on payment of dividends in previous months. In Table A, averages are taken over all firm/month combinations. Months lagged indicates a company had a dividend lagged the indicated number of months in the past.

Table A presents mean and standard deviation of returns following dividend payment. Similar to Haltzmark and Solomon (2013), we observe highest average returns 3, 9 and 12 months after the dividend payment (1.98%, 1.58% and 1.40%, respectively). However, as this study used different sample companies, which pay annual or biannual dividends, these findings have different implications. If a dividend premium existed, we would observe highest mean returns 6 and 12 months after the dividend. What is more, there is no evidence of lower risk during dividend months, or higher risk in months preceding predicted dividend, as indicated by standard deviation.

According to Baker and Wurgler (2003), dividend premium is the difference in average market-to-book ratios between dividend payers and non-dividend payers. Using the concept of predicted dividend, portfolios with a strategy of exploiting possible dividend payers' mispricings were formed. Thus in this study, under the term dividend premium, we understand the differences in performance of companies that have a predicted dividend and companies that are predicted not to pay dividends.

Table B shows the distribution of returns of formed portfolios. The results are contradicting to the

Table A. Raw returns with respect to dividend month.

Months since dividend payment	Returns in Current Month Given Dividend Payment N Months Ago	
	Mean return	Standard deviation
1	0.17	10.84
2	0.19	11.69
3	1.98	10.90
4	0.76	10.33
5	-0.05	10.50
6	0.38	10.93
7	-0.23	10.86
8	-0.56	11.48
9	1.52	12.84
10	1.08	10.62
11	0.47	10.65
12	1.40	10.86

findings of Hartzmark and Solomon (2013): instead of a dividend premium, some evidence of a dividend discount can be seen. The portfolio compiled of predicted dividend payers has mean return of 0.02% and standard deviation of 5.36%. Months without a predicted dividend have an average return of 0.44% and a standard deviation of 5.84%. Even after eliminating outliers1, the predicted dividend portfolio still has a lower return than a portfolio consisting of all other companies.

ABNORMAL RETURNS IN DIVIDEND MONTHS

As it was observed, the dividend portfolio has a lower volatility than the portfolio of all other companies, so according to central asset pricing theory, lower returns of dividend-paying companies are costs associated with lower risks that are important to investors. Shiller (1981) noted that dividends tend to have less fluctuations than stock prices. Using behavioral arguments of Baker and Wugler (2004) and Li and Lie (2006), it can be suggested that dividends can be perceived as a safer asset that is more robust to systematic risk.

Following Hartzmark and Solomon (2012), portfolios of predicted payers, predicted non-payers and their difference, are tested with respect to standard asset pricing models. Returns of above-mentioned portfolios are regressed under the CAPM, the Fama-French 3 factor model and the Carhart 4 factor model:

$$R_{PredDiv,t} - R_f = \alpha + \beta_{Mkt\text{-}Rf} * R_{Mkt\text{-}Rf,t} + \varepsilon_t \quad (1)$$

$$R_{PredDiv,t} - R_f = \alpha + \beta_{Mkt\text{-}Rf} * R_{Mkt\text{-}Rf,t} + м_{SMB} * R_{SMB,t} + \beta_{HML} * R_{HML,t} + \varepsilon_t \quad (2)$$

$$R_{PredDiv,t} - R_f = \alpha + \beta_{Mkt\text{-}Rf} * R_{Mkt\text{-}Rf,t} + \beta_{SMB} * R_{SMB,t} + \beta_{HML} * R_{HML,t} + \beta_{UMD} * R_{UMD,t} + \varepsilon_t \quad (3)$$

Table C represents the results of regressions with respect to excessive market return factors. The long portfolio is an equal-weighted average return of companies that are predicted to issue dividend in the current month. The short portfolio is an equal-weighted average return of companies that are not predicted to pay dividends. The difference is a portfolio that goes long on companies that have predicted dividend and goes short on companies that are not supposed to pay dividend in the current month.

Table C.1 presents the results of regressions of Japanese monthly stock returns based on predicted dividend payment. Portfolios of stock returns are formed based predicted dividend payments, which are then used for regressions of excess portfolio returns on a CAPM model (excess market returns only), 3 factor regressions (excess market returns, SMB, and HML), 4 factor regressions (excess market returns, SMB, HML and UMD). Portfolios are equally weighted. A predicted dividend month has a semi-annual dividend 6 or 12 months ago, or an annual dividend 12 months ago. Stocks with monthly dividends in the previous 12 months are excluded from the analysis. For the short portfolios, "All Other Companies" contains all companies not included in the long portfolio. Regressions are run on returns derived from monthly prices of TSE common shares, from January 1991 to October 2014. The top number is the coefficient, the lower number in parentheses is the t-statistic, and *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively.

The portfolio of dividend payers has negative abnormal returns of -0.22% under the CAPM model, -0.29% under Fama French 3 factor model, and -0.21% under the 4 factor model. The portfolio of all other companies on the other

[1] The distribution of the second portfolio looks skewed to the right, so a suggestion would be that outliers on the right tail could have affected the mean return of the portfolio. Outliers were all the returns bigger than 15% or smaller than –15%.

Table B. Returns based on predicted dividends.

	Mean return	standard deviation	1%	5%	10%	median	90%	95%	99%
[1] Predicted dividend	0.02	5.36	−13.99	−8.10	−6.30	−.25	6.67	9.80	13.77
[2] All other companies	0.44	5.84	−15.35	−8.56	−6.32	0.20	7.39	9.91	18.02
[3] Predicted dividend w/o outliers	−0.03	5.06	−13.52	−8.07	−6.28	−0.28	5.98	9.61	12.86
[4] All other companies w/o outliers	0.37	5.24	−12.43	−8.06	−5.95	0.20	7.01	9.21	13.52
Portfolio Long [1] Short [2]	−0.41	2.37	−7.57	−4.65	−3.21	−0.36	2.06	3.06	4.56
Portfolio Long [3] Short [4]	−0.42	2.08	−6.64	−3.91	−3.03	−0.40	2.10	3.06	4.42

Table C.1. Factor Loadings from Fama French 4 Factor Difference Portfolios.
Long Predicted Dividend, Short All Other Companies.

	CAPM Alpha	3-Factor Alpha	4-Factor Alpha	MktRf	SMB	HML	UMD
Long	−0.22 (−1.03)	−0.29 (−1.53)	−0.21 (−1.10)	0.58*** (17.25)	0.58*** (10.25)	0.17*** (2.42)	−0.022 (−0.51)
Short	0.21 (0.97)	0.11 (0.66)	0.20 (1.20)	0.69*** (23.21)	0.66*** (13.19)	0.24 (4.04)	−0.08 (−2.25)
Difference	−0.69*** (−5.27)	−0.65*** (−7.81)	−0.68*** (−4.97)	−0.10*** (−4.68)	−0.07** (−1.81)	−0.08* (−1.65)	0.06 (−1.59)

hand has positive abnormal returns of 0.21% under the CAPM model, 0.11% under Fama French 3 factor model and 0.20% under the 4 factor model. However, these results turned out to be statistically insignificant and therefore it is not sufficient to say that companies with predicted dividends underperform the market. More importantly, betas for MktRF, SMB and HML factors are positive and significant, which suggest that the negative return of the predicted dividend portfolio is not achieved with reduction to systemic risks.

What is striking is that, contrary to Hartzmark and Solomon (2012), "between companies" difference portfolio have significant negative returns. Dividend payers with respect to non-dividend payers return -0.69% under CAPM (t-statistic -5.27), -0.65% under the Fama French 3 factor model (t-statistic -7.81) and -0.68% (t-statistic -4.97). Even after eliminating outliers in returns of companies predicted dividend and all other companies, the results are nearly the same. What is more, the abnormal returns of the difference portfolio do not associate with any systemic risks. Factor loadings on market and value risks are -0.10 and -0.07 with t-statistic of -4.68 and -1.74 respectively. While companies in dividend months have less systemic risks than other companies, the difference is small.

EARNINGS ANNOUNCEMENTS EFFECT

As Charest (1978) found evidence of net positive earnings announcement effect on stock prices, it is essential to isolate market responses only to dividend events. In the sample of this study, companies in most cases do not pay dividends in the same month when earnings reports are issued. That could cause a skew in the returns of the long-short portfolio, as during earning announcement months the short position in non-dividend payers would have excess returns due to the earnings effect. That is why we examine stock returns of dividend payers and non-dividend payers in months without financial reporting. Using the same method as above, the portfolio of companies with predicted dividend and the portfolio of companies without a predicted dividend both in non-earnings months are regressed under the 4 factor model.

Table D presents the results of the 4 factor regressions of Japanese monthly stock returns based on predicted dividend payment. Portfolios of stock returns are formed based predicted dividend payments, which are then used for regressions of excess portfolio returns on 4 factor regressions (excess market returns, SMB, HML and UMD). Portfolios are equally weighted. A predicted dividend month has a semi-annual dividend 6 or 12 months ago, or an annual dividend 12 months ago. Stocks with monthly dividends in the previous 12 months are excluded from the analysis. For the short portfolios, "All Other Companies" contains all companies not included in the long portfolio. Non-earnings months indicate a month that a company did not report earnings. Regressions are run on returns derived from monthly prices of TSE common shares, from January 1991 to October 2014. The top number is the coefficient, the lower number in parentheses is the t-statistic, and *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively.

Table D.1 returns the betas for the returns of mentioned portfolios. Excluding earnings months from the regression does not change the results. The difference portfolio still has a negative abnormal return of -0.78% with t-statistic of -4.92. It can be inferred

Table D. Factor Loadings from 4 Factor Difference Portfolios in Non-Earnings Months.
Long Predicted Dividend, Short All Other Companies

	4-Factor Alpha	MktRf	SMB	HML	UMD
Long	−0.34 (−1.10)	0.58*** (13.25)	0.58*** (8.06)	0.20*** (2.66)	−0.01 (0.25)
Short	0.25 (1.20)	0.71*** (18.21)	0.66*** (10.59)	0.27 (3.93)	−0.06 (−1.45)
Difference	−0.78*** (−4.92)	−0.12*** (−4.20)	−0.08** (−1.70)	−0.07 (−1.28)	0.08 (2.08)

Table C.2. Factor Loadings from Fama French 4 Factor Difference Portfolios With Outlier Returns Excluded

	CAPM Alpha	3-Factor Alpha	4-Factor Alpha	MktRf	SMB	HML	UMD
Long	−0.22 (−1.03)	−0.29 (−1.53)	−0.21 (−1.10)	0.58*** (17.25)	0.58*** (10.25)	0.17 (2.42)	−0.022 (−0.51)
Short	0.21 (0.97)	0.11 (0.66)	0.20 (1.20)	0.69*** (23.21)	0.66*** (13.19)	0.24 (4.04)	−0.08 (−2.25)
Difference	−0.69*** (−5.88)	−0.66*** (−5.68)	−0.68*** (−5.84)	−0.10*** (−4.68)	−0.07** (−1.74)	−0.05 (−1.25)	0.04 (1.59)

that dividend premium (discount) has its own nature and is not largely affected by earnings news.

5. CONCLUSION

Stock market responses to public corporate events, such as dividend announcements, have been a very popular subject of research. However, most of past studies were focused on stock markets of common law countries, such as the USA and the UK. This paper focuses on stock market responses to corporate distribution events of companies listed on Tokyo Stock Exchange.

At first, monthly returns of dividend-paying companies were sorted with respect to month, when the latest dividend payment occurred. Unlike Harztmark and Solomon (2013), no prominent returns pattern of companies with predicted dividend were found. Then portfolios of dividend payers and non-dividend payers were formed. First glance on raw returns of these portfolios pointed out to suggestion that Japanese stock market reacts differently from US stock market.

In order to examine market efficiency, respected portfolios were regressed under the CAPM, the Fama-French 3 factor and Carhart 4 factor models. Separately portfolio of companies with predicted dividend and portfolio of all other companies did not have statistically significant abnormal returns. Nonetheless, the difference portfolio that goes long on dividend payers and short on non-dividend payers showed statistically significant return with negative sign. Even after eliminating the effect of outliers and earnings announcement effect, neither significance, nor size of abnormal returns were reduced. The results of this paper not only record instances of market inefficiency, but also contradict findings of past research on dividend month premium. It is important to note that the purpose of this paper is to find evidences of abnormal market reactions. Further studies analyzing larger samples could give better understanding of these phenomena.

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APPENDIX

Table C.2 presents the results of regressions of Japanese monthly stock returns based on predicted dividend payment. Portfolios of stock returns are formed based predicted dividend payments, which are then used for regressions of excess portfolio returns on a CAPM model (excess market returns only), 3 factor regressions (excess market returns, SMB, and HML), 4 factor regressions (excess market returns, SMB, HML and UMD). Portfolios are equally weighted. A predicted dividend month has a semi-annual dividend 6 or 12 months ago, or an annual dividend 12 months ago. Stocks with monthly dividends in the previous 12 months are excluded from the analysis. For the short portfolios, "All Other Companies" contains all companies not included in the long portfolio. Outliers were all the returns bigger than 15% or smaller than -15%. Regressions are run on returns derived from monthly prices of TSE common shares, from January 1991 to October 2014. The top number is the coefficient, the lower number in parentheses is the t-statistic, and *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively.

Analysis of Investors' Strategies Using Backtesting and DEA Model*

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Abstract. This paper analyzes the efficiency of the rules described by famous "investment gurus". We backtested 30 strategies over the period of 20 years using monthly data from USA stock market and scored their comparative characteristics using DEA model. Although strategies vary in historical performance, 11 strategies managed to beat benchmarks over the long term. Most efficient strategies according to DEA appear to be Graham, Lian, Zweig, Siegel strategies.

Аннотация. Статья анализирует эффективность правил, на которых основаны стратегии профессионалов в сфере инвестиций. Мы провели бэктест 30 стратегий за 20 лет, используя месячные данные американского фондового рынка и DEA-модель, оценили их сравнительные характеристики. Хотя стратегии и варьируются исторически, 11 стратегий превзошли эталонный индекс в долгосрочном периоде. Наиболее эффективными стратегиями, согласно DEA, являются стратегии Грэхема, Льяна, Цвейга и Сигеля.

Key words: DEA model, backtesting, strategy, benchmark, return, risk, DEA-score.

INTRODUCTION

Technical analysis and technical trading rules draw a lot of attention for last several decades just because of simplicity of making historical backtests. While many non-professional investors and almost all professionals are using fundamental analysis as their primary tool for long-term investments, little has been done so far to question empirically performance of fundamental trading rules. How these rules performed in the past, relative to each other and to the benchmark? Do "investment gurus" really add value with their strategies, or they just monetize on bestsellers, describing it? In our research we examine this question by formalizing fundamental trading rules, or "screens", and then performing historical backtest. Further we develop and apply DEA methodology to select rules that are most efficient based on wide variety of efficiency measures, as many investors use different approaches to select best screening rules.

Our results could be interpreted two-ways. If there is significant divergence between results reported or observed in reality and results obtained in backtest, it may mean that either the author is not telling the whole truth about his stock selection methodology, or his stock picking skill is weaker than his marketing team. Results from DEA also proves this paradox. 5 strategies out of 30 were inefficient.

STOCK SCREENING

While there are two basic fundamental investing styles: growth and value, many of stock screening strategies have both a value and a growth component. One of the most ineffectual aspects of choosing a stock investment strategy is the historical performance. The historical performance often assessed by backtesting.

Stock screening, i.e. applying sets of filter rules to fundamental parameters of wide universe of equities

* Анализ стратегий инвесторов с помощью использования бэктеста и DEA-модели.

to select stocks in portfolio has been widely applied by practitioners.

Many sets of filters have been proposed. However, some of them apply rules and philosophies that contradict each other.

We have used strategies of B. Graham, D. Dreman, J. Neff, W. Buffett, P. Lynch, K. Fisher, M.Zweig, J. O'Shaughnessy, J. Greenblatt, J. Piotroski, I. Kahn, A. Nutt, W&E Schloss, J. O'Neil, and others in our research to backtest it and estimate its weaknesses and strengths.

All strategies were backtested over the 20 years period (1993-2013) with monthly rebalancing. Screening universe was comprised of all members of Russell 3000 Index, NASDAQ Composite Index, S&P 1500 Composite Index. Performance of almost all strategies (except strategies with "absolute income") were recorded against benchmark.

We considered strategies by their performance.

Lian's strategy focuses on early growth industries or fallen angels out of favor sectors. Its screen returned 6947,94% *vs* S&P 500 returned 419.83% which beats the benchmark. The mean active return is around 16% which is the best result among other strategies. Sharpe ratio is also high which shows us that this strategy is not risky. Lian's symmetric return distribution function has high kurtosis. It also has fat tails, mostly in positive end of distribution curve showing that strategy has a lot of profitable deals (Figure 1).

Further research of profitable strategies showed **Fisher's strategy** for technology industry. Portfolio returned 1635.86%. Fisher started to trade since 2002. The strategy has been growing steadily, but from 2003 to 2007 there was a period of stagnation, i.e. the strategy had no income. During the crisis, the strategy has fallen relatively deep. But it has recovered quickly. Sharp ratio indicated positive value. However, the standard deviation was high. Hence, we can claim that the strategy has a high risk. It is obvious from the FisherTech strategy's return distribution function that it implies unexpected figures. Kurtosis is sharp and extremely high. It has long positive and negative tails, however, skewness is positive, which proves the high profit of this strategy. Figure 2 represents the full information.

Nevertheless, another growth screen based on his approach did not beat benchmark. Fisher screen has delivered a return of 19.26%. Thus, this strategy doesn't work. Moreover, the value of Sharpe ratio is 0,06, which is the lowest compared to rest of strategies. Furthermore, the skewness has high negative value.

According to **Browne's Screen**, which is represented by Figure 3, this portfolio returned 1412.14%. Thus, the strategy beats the benchmark. It has a high value of Sharpe ratio. Moreover, it has standard deviation of 22,39 which is not the highest value comparing to other strategies. Brown's strategy has symmetric return distribution function. However, it has fatter positive tail. Therefore, it makes strategy profitable.

Another relevant example of profit-making strategy is **Piotroski's** method which focuses on the stocks whose B/M ratios were in the top 20 percent of the market. He wanted a firm's ROA to be positive. Piotroski's portfolio returned 970.43%. Screen beat the benchmark. During the crisis the maximum of drawdown was reached. This strategy has recovered quickly and continued stable growth. The Sharpe ratio is relatively low. In addition, it has the highest standard deviation among all strategies. Piotroski's

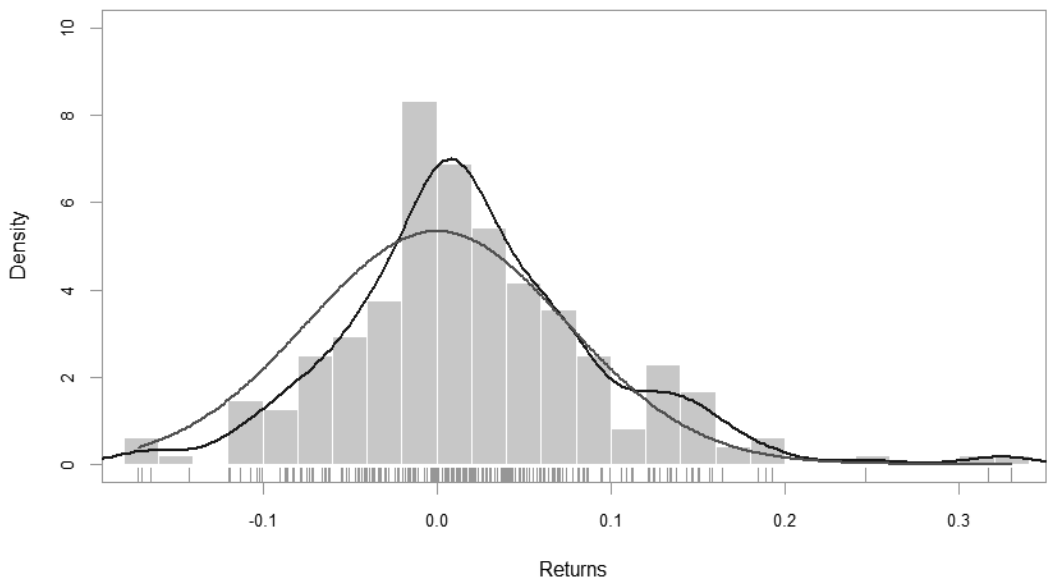


Figure 1. Return distribution function. Lian's strategy.

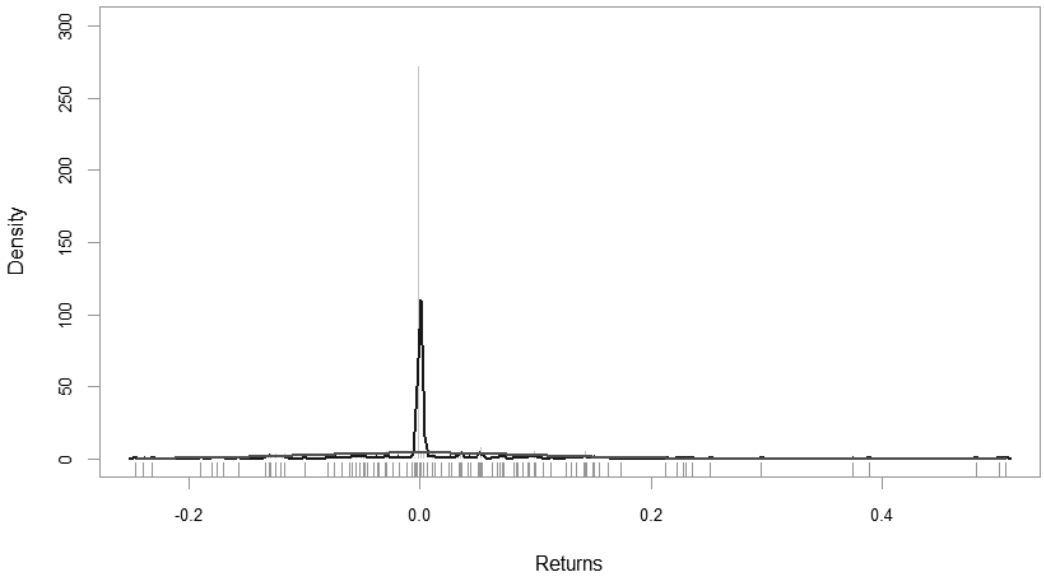


Figure 2. Return distribution function. Fisher's strategy.

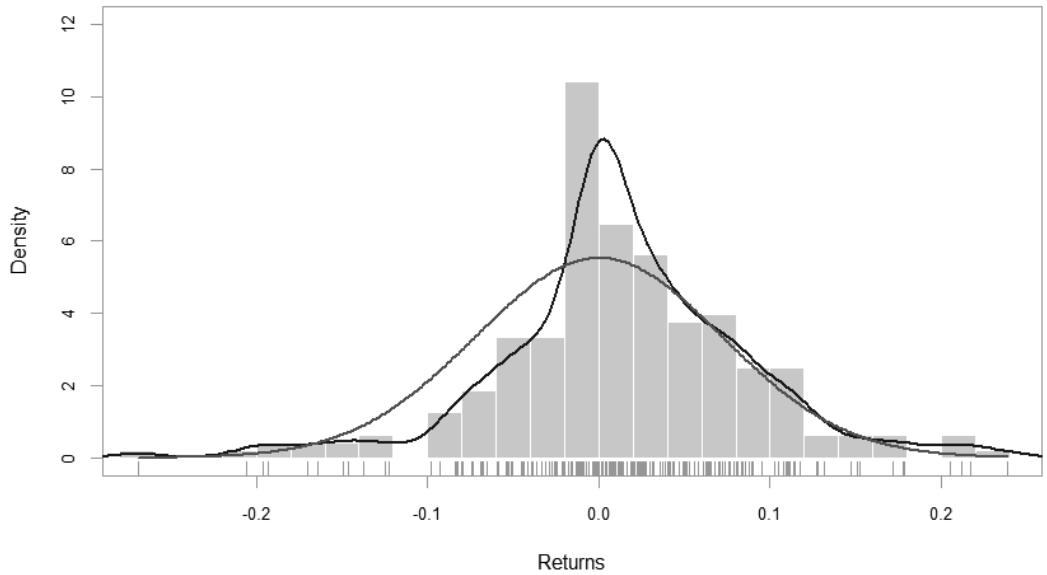


Figure 3. Return distribution function. Browne's strategy.

strategy shows symmetric return distribution function. Slightly left-skewed, but tail in positive, end is fatter which brings high return figures (see Figure 4).

Graham's screen returned 940.64%. During times of crisis market was shrinking much faster than the strategy did. While the market was slowly recovering, Graham's strategy returns were steadily growing. On average, strategy selects 15 stocks with moderate turnover ratio. This strategy is not very risky which is proved by its Sharpe ratio of 0,43. Graham's strategy revenue distribution function is symmetric, but with fatter positive tail, which makes the strategy profitable. In general, from figure it is evident that it is steady going. Information about Graham's strategy results is given in Figure 5.

Schloss's rules are based on Graham's strategy but with insignificant changes. He chooses companies with real assets with little or no debt and stocks that were selling below their book value. Figure 6 represents Schloss's screen portfolio results. It returned 840.56%. In general, the strategy beats the benchmark. During the crisis there was a drawdown. Sharpe ratio is higher compared to the previous one. A careful analysis of Schloss's return distribution function implies evidence of its reliability. Function is symmetric and has fat tail in positive side.

O'Neil identified stocks based on at least 25% current quarterly earnings per share, P/E in the range of 20 to 45. His strategy returned 758.03% during the whole period. The semivarience has one

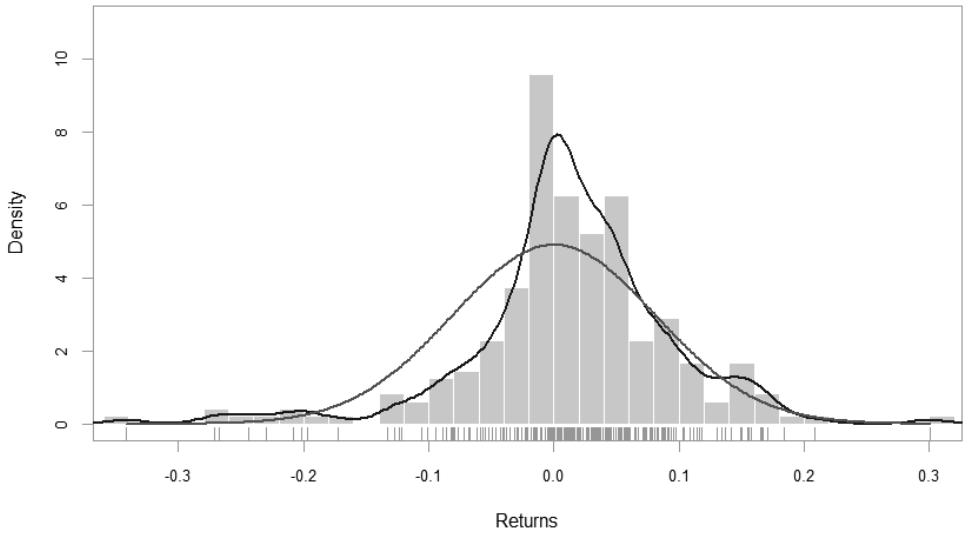


Figure 4. Return distribution function. Piotroski's strategy.

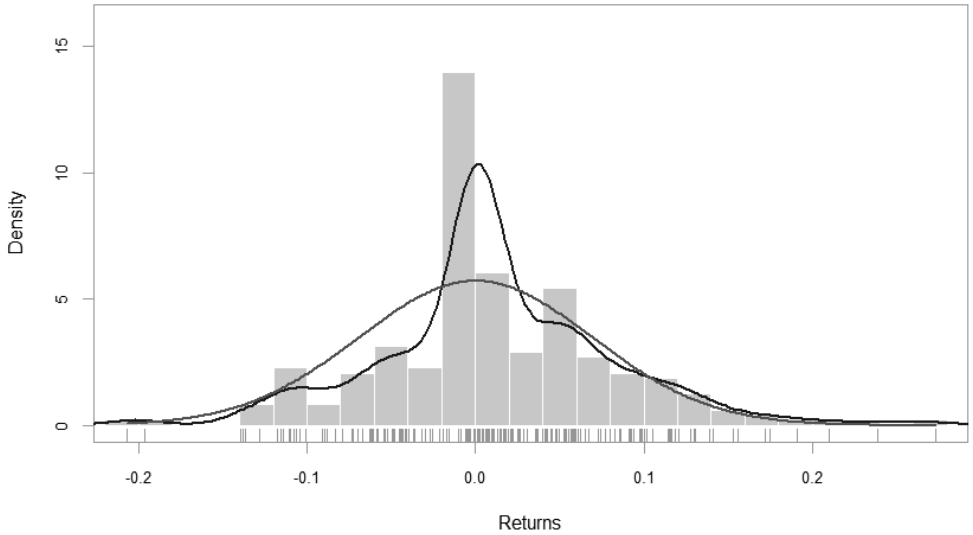


Figure 5. Return distribution function. Graham's strategy.

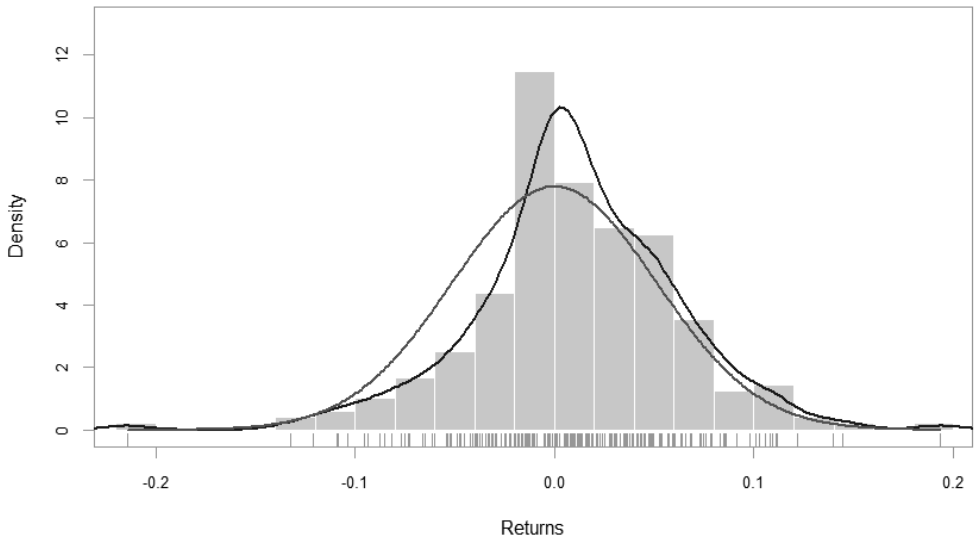


Figure 6. Return distribution function. Schloss's strategy.

of the highest values of strategies we considered. This strategy has a low risk due to relatively high Sharpe ratio and low standard deviation. O'Neil's strategy return distribution function is very close to "ideal" Gauss distribution function. It has normal, flatter than other strategies' figures kurtosis and fat tails both in positive and negative sides (Figure 7).

Greenblat's Screen implements the Magic Formula value investing strategy. It is based on buying 20-30 "good, cheap companies". In Magic Formula he averaged a 17-year annual return of 30.8% and beats the S&P 500.96% of the time. In practice we obtained the following results. Greenblatt's portfolio returned 573.81%. Thus, this strategy in theoretical and practical terms beat the market. During the crisis was the deep drawdown. But the strategy quickly recovered and continued stable growth. Closer look at strategy (return distribution function) explains high returns. This figure is symmetric; a lot of deals with positive returns appear (Figure 8).

Buffet's approach is solely based on stocks overall potential as a company. The screen showed the 569.74% return. From 2001 to 2006 (within 5 years) strategy performed poorly; during the crisis screen returns began to fall before benchmark and fell fairly deeply, but recovered much faster than the market. This strategy appears to have quite large periods of stagnation, followed by periods of sharp recoveries. Standard deviation equals to 26,47, which is one of the highest results obtained. Buffet distribution fig-

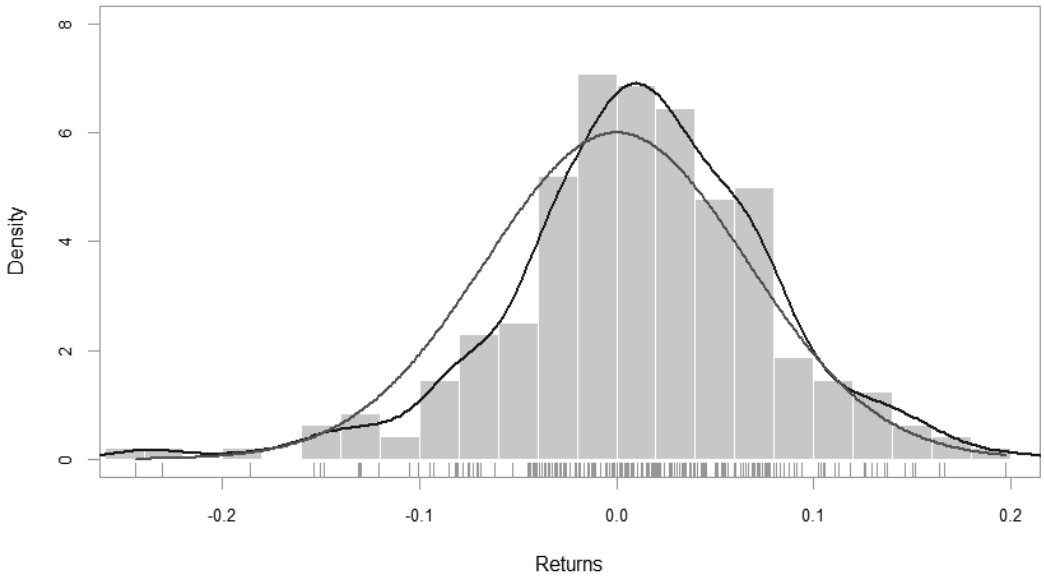


Figure 7. Return distribution function. O'Neil's strategy.

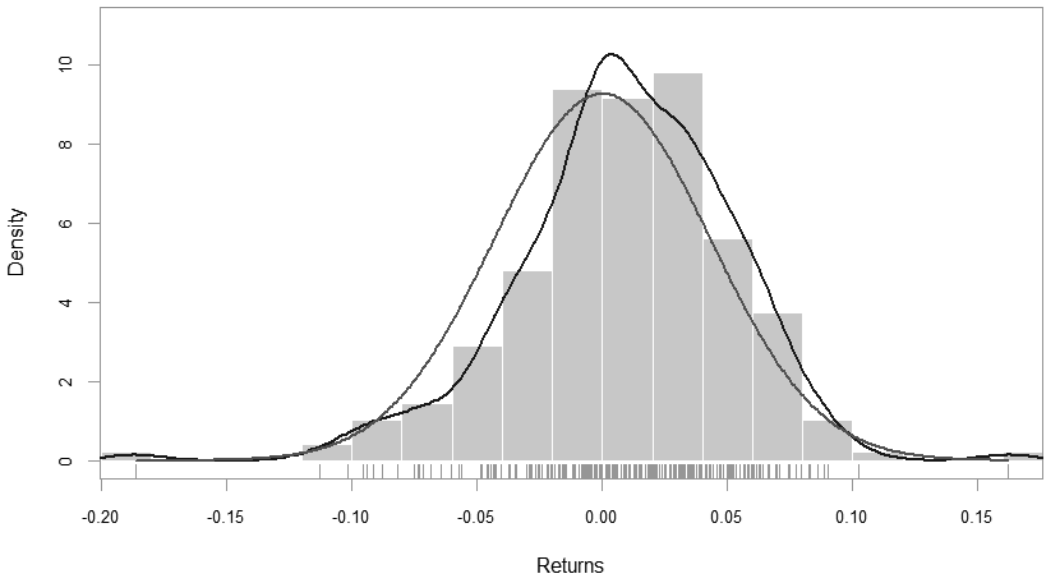


Figure 8. Return distribution function. Greenblat's strategy.

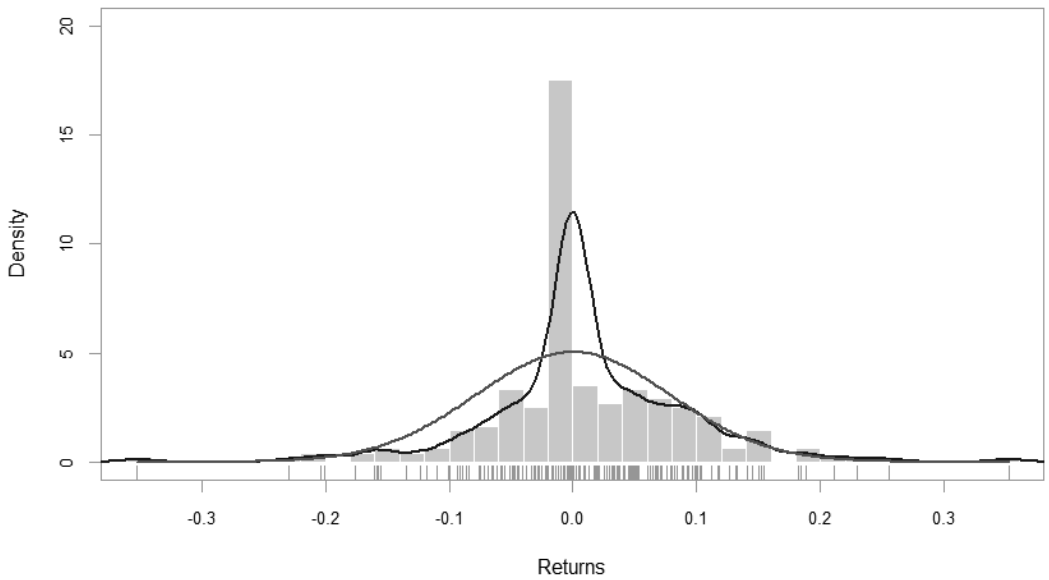


Figure 9. Return distribution function. Buffet's strategy.

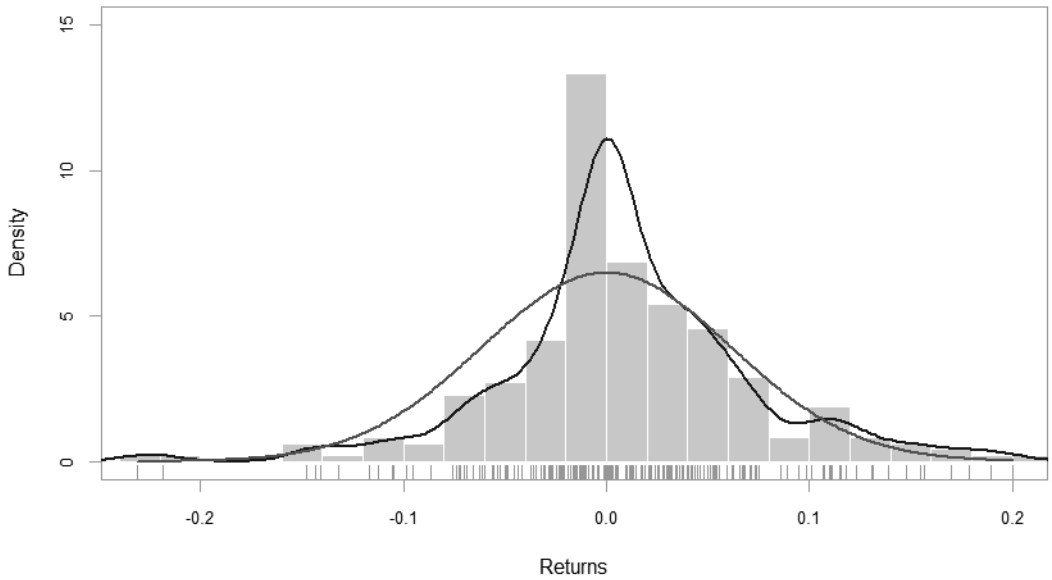


Figure 10. Return distribution function. Eveillard's strategy.

ure is symmetric with long tails. Kurtosis is high, tail to the right is fatter which, gives positive return in general. Results are represented in Figure 9.

Eveillard's portfolio consists of securities whose intrinsic value and long-term potential outweighs market risk. Screen has delivered a return of 503.71%. During the crisis was the deepest drawdown, but the strategy quickly recovered and continued stable growth. The density graph of this strategy is symmetric. As we see from this figure it has fat right tail which indicates its profitability (see Figure 10).

Lynch's strategy for all stocks returned 414.67%. In the whole, this strategy cannot beat the market. From 1999 to 2007 strategy rose more sharply than benchmark and beat it. But during the crisis it fell then slowly recovered and in 2012 fell again. It has negative skewness in return distribution function. But fat tails on the right end shows strategy's profit. Figure 11 gives the illustrated results.

In addition Lynch proposes two approaches – one for fast-growers, the other for slow-growers.

Slow-growers strategy focuses on the large/aging companies growing only slightly faster than the economy as a whole, but often paying regular dividends. Screen returned 256.90%. Strategy started to trade since 1995; during 1995 and 2001 performance was stagnant, while the market grew steadily. Starting from 2003 to 2008, strategy returns were growing and in 2008 it was able to beat

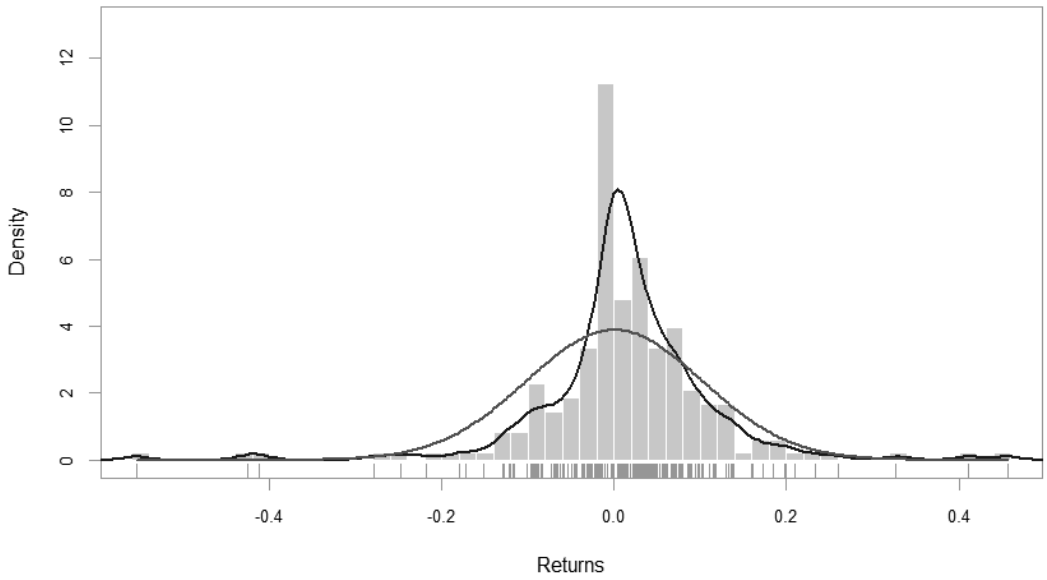


Figure 11. Return distribution function. Lynch's strategy.

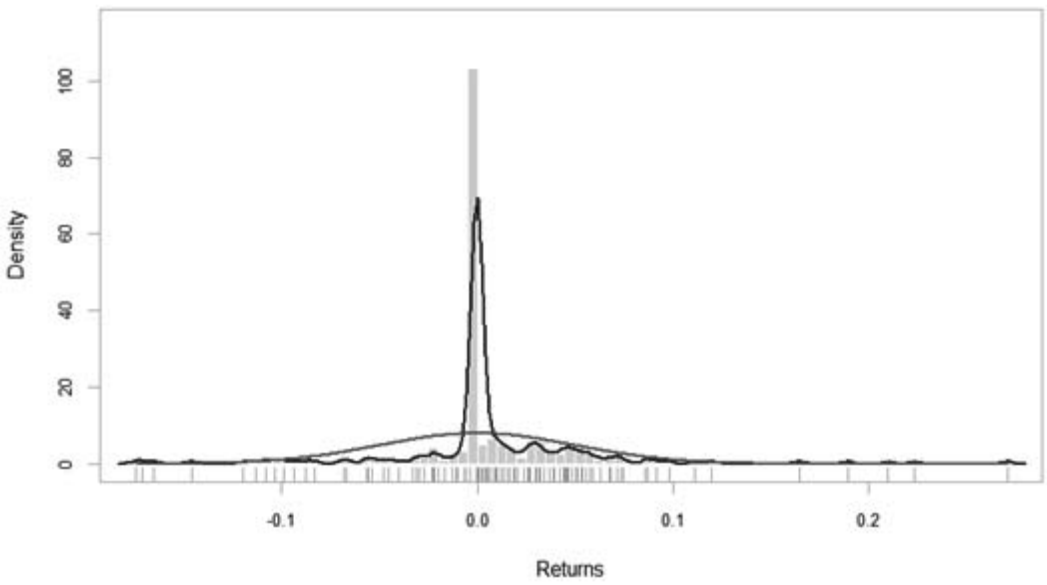


Figure 12. Return distribution function. Lynch's strategy (slow-growers).

benchmark. During the crisis the market dropped deeper than slow-growers strategy. And then, when the market grew stronger and began to gain momentum, this strategy fell and remained in the period of stagnation. Lynch slow strategy's return distribution (see Figure 12) function has asymmetric figure. It has positive skewness. But right tail fatter than left, which leads to profitability of strategy. However, with reference to another Lynch's approach called fast-growers (Figure 13) we see more symmetric figure with flatter kurtosis.

Fast-growing strategy's screen focuses on the small, moderately fast-growing companies bought at a reasonable price. Lynch's screen has 215.19%. The strategy for the entire period fluctuates between periods of stagnation and growth. During the crisis, the strategy has fallen much deeper than the market, but at the same time when the market fell steadily, the strategy of fast-growers grows steadily. Performance during 2009-2011 was better than the benchmark. But then, as the market broke sharply upwards, it began to fall and leave in a period of stagnation.

Lynch – Stalwarts strategy implies focusing on large companies that are still able to grow, with annual earnings growth rates of around 10%–12%. Lynch's slow-growers portfolio returned 79.65%, while the

S&P 500 returned 419.83% during the same period. This strategy does not beat benchmark.

O'Shaughnessy's screener is a combination of two models: a momentum/earnings growth-focused method called "Cornerstone Growth" and a value-focused method called "Cornerstone Value".

In his Cornerstone Growth approach, he chooses companies that have market capitalization of at least $ 150 million, price – sales (P/S) ratios below 1.5. Finally O'Shaughnessy ranks companies for highest relative price strength over the previous year and chooses the top 50. According to equity screen of this approach, we have the following results. In general, for all the period screen does not beat the benchmark. O'Shaughnessy Cornerstone Growth portfolio returned 174.21%. Sharpe ratio is the lowest of other strategies. Return distribution function of this approach is symmetric. Fatter right tail made strategy such profit. Kurtosis is relatively flat (see Figure 14).

Cornerstone Value is a five criteria large-cap dividend yield-focused value screen outlined in James O'Shaughnessy's work. His work showed that a large-caps stock portfolio with above average stock liquidity and cash flow per share which was ranked for high dividend yields performed the worst results over the long term. According to his work, this value strategy has 0% of return, compared to 419.83% for the S&P

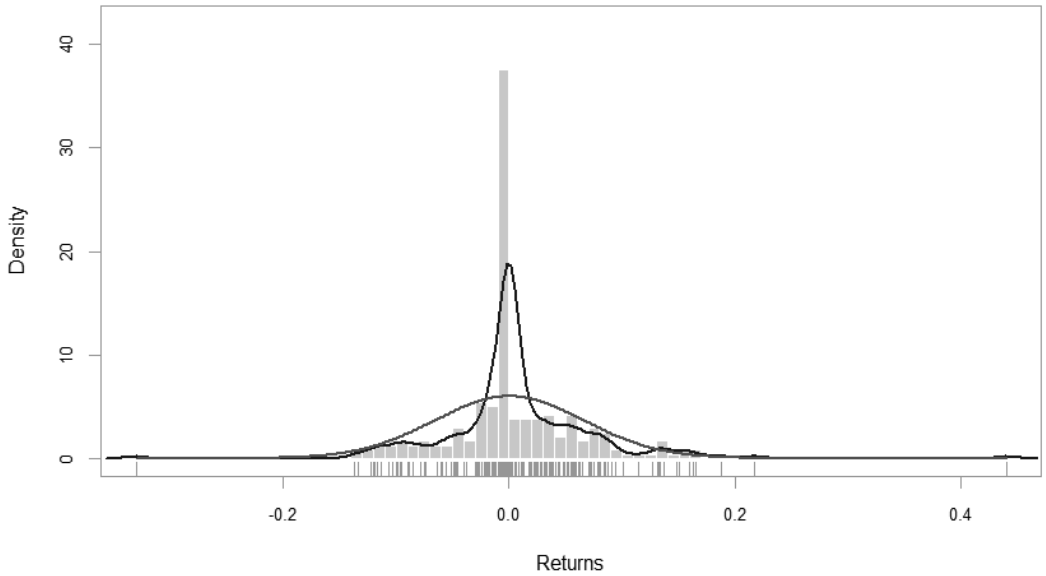


Figure 13. Return distribution function. Lynch's strategy (fast-growers).

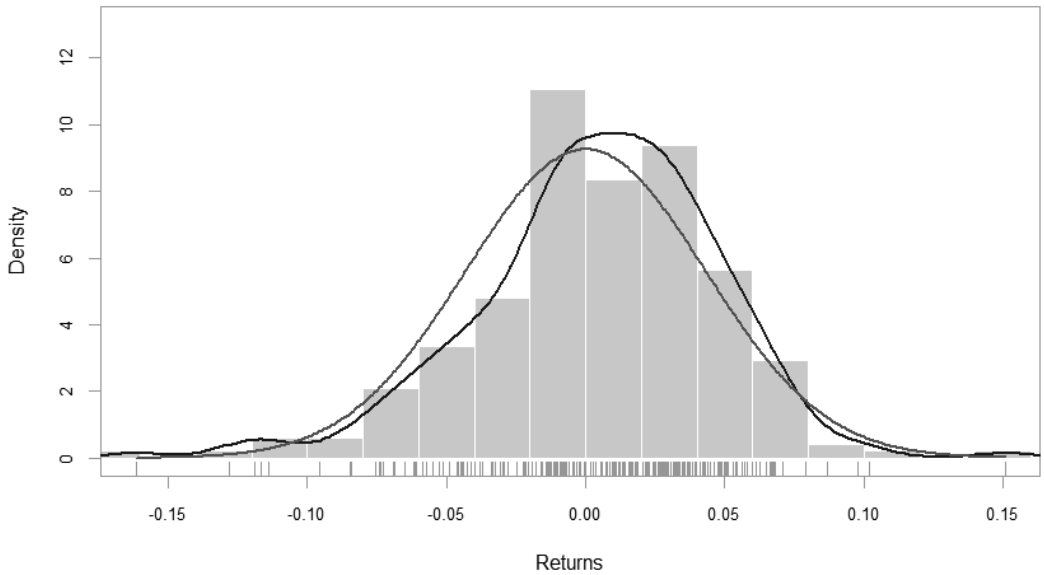


Figure 14. Return distribution function. O'Shaughnessy strategy.

500 Index. For all time, the strategy has not selected any stock. Hence, this strategy does not work.

In addition Dreman's investment approach which is based on interpreting market psychology and using value measures to pick stocks that are out of favor with the market performed with 0% return. Dreman claims that he invests in out-of-favor stocks, often in out-of-favor industries, that he identifies using relatively straightforward formal criteria.

Moreover, P. Lynch's strategy for financial companies does not work. Financial screen has 0% return.

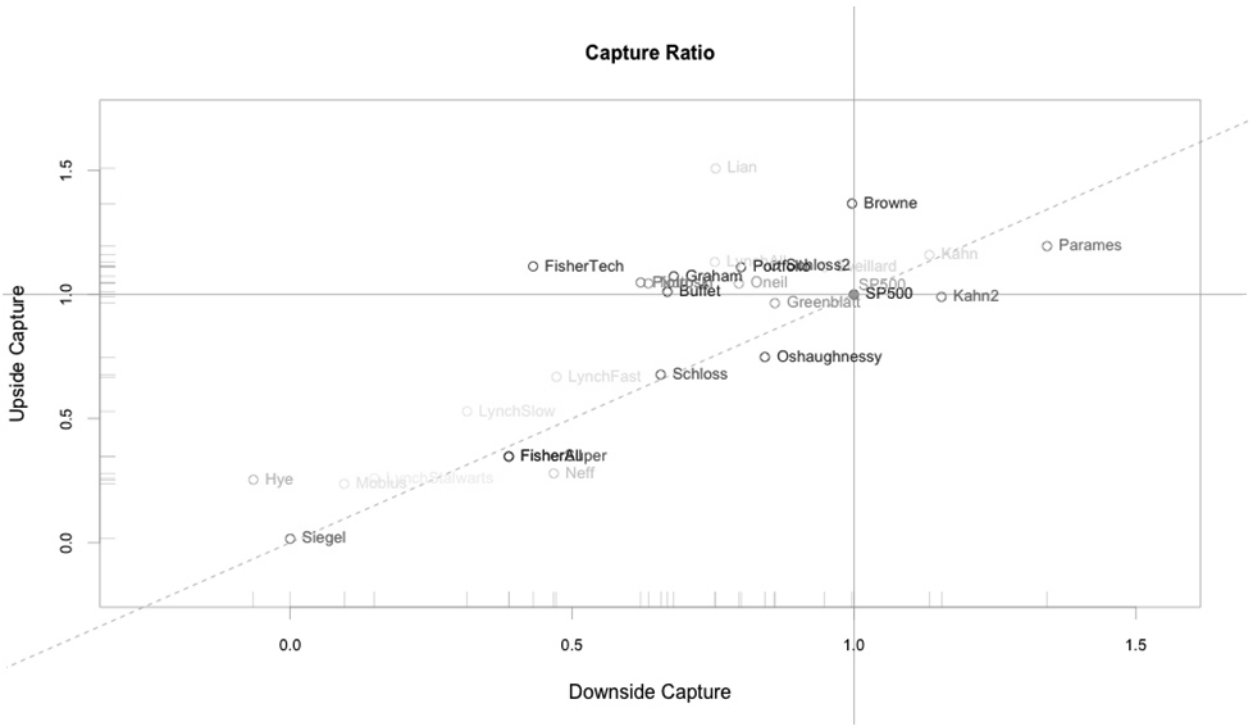
Further research in this area may include other general ratios, indicators and graphs. Capture ratio stands for analyzing strategies' behavior relatively to market's behavior. Capture ratios divided into down-market and up-market ratios. The up capture ratio should be greater than 100%, which would indicate that during periods when the market is up, the investor, on average, did even better. The higher the up capture, the better strategy is. Alternatively, down capture ratios should be less than 100%, meaning that when the market went down the investor caught only a fraction of the losses. The lower the down capture, the better. Although rare, it is possible to see negative down captures, indicating that when markets are down the manager tends to be up.

The Graph 1 represents the typical display of up and down capture. The reference point is the benchmark, as noted by the crosshairs in the middle. The top left quadrant represents the ideal location. Here, the strategies of investors are up more than the market in up periods and down less in falling markets. As we can see that Lian and FisherTech have one of the best results. The down left quadrant represents that investment strategies lag when markets are up, but hedges in down markets (such as: Hye, Siegel, Mobius). In the top right stands the aggressive quadrant, riding high in up markets but losing more in down markets.

The chart represents the portfolio return. First of all, we diversified our portfolio (combined our investment strategies). Portfolio diversification is the means by which investors minimize or eliminate their exposure to specific risk, minimize or reduce systematic risk and moderate the short-term effects of individual asset class performance on portfolio value. In a well-conceived portfolio, this can be accomplished at a minimal cost in terms of expected return. Such a portfolio would be considered to be a well-diversified. We see that such strategies like Fishertech, Lian, Schloss, Nutt are higher than the portfolio line.

DEA MODEL

Each investor accepts different level of risk and other factors. Efficiency of strategy can be also good indicator in making decisions. While backtesting shows us historical behavior of investors' strategies, DEA model gives information about efficiency of different



Graph 1. Up and down capture for strategies.

strategies in general. We analyzed strategies using DEA model to prove backtesting results, obtain new information about strategies and find other acceptable efficient ones.

DEA methodology was widely adopted in literature dedicated to performance evaluation of various classes of financial market participants (see, for example, Gregoriou, Zhu (2005); Fedorova, Didenko (2014a) and (2014b)).

The general property of various DEA techniques is that it uses minimum quantity of parameters and assumptions, independence of unit measurements, support on easily interpreted empiric results. In this regard authors offer to estimate efficiency of management companies in Russia by DEA method. If we estimate efficiency of the companies in such way, there is the following question: How to define the factors influencing efficiency activity?"

Generally, DEA is methodology which connects operational research, mathematics and economics. The DEA methodology uses mathematical programming to process empirical data on inputs and outputs of a given group of decision making units (DMUs). As a result, each DMU is assigned a value within interval (0,1]. Value 1 represents relatively efficient DMU, while the DMU with value less than 1 is deemed inefficient. In this way, the efficiency of each DMU is evaluated with respect to other DMUs. Our DMUs in this case are strategies of different investors. Thus, we will define from 0 to 1 their rate of efficiency.

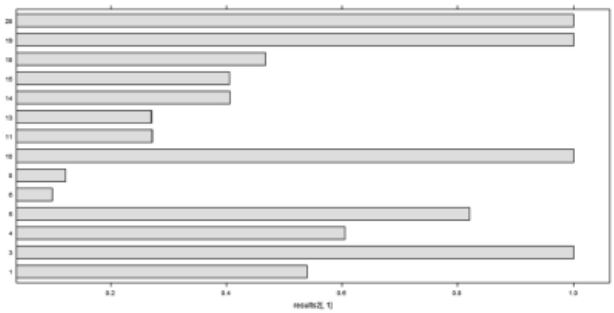
Appropriate inputs and outputs are important in DEA model. Each author offers his own inputs and outputs. We took following ones: "Turnover", "Semivariance" as inputs, "MAR", "Skewness" as outputs. Our decision is based on deep analysis of all the input/output combinations. For example, "Turnover" was taken as an indicator. Higher turnover means higher commissions and strategy will be more money-losing. Hence, with higher turnover expenses are higher and the strategy is worse.

Among 30 strategies only 4 were efficient (with 1-efficiency). As we see from Graph 2, some strategies are not included, because of 0-efficiency. The most effective ones are Graham, Lian, Zweig, Siegel (numbers 2,10,19,28).

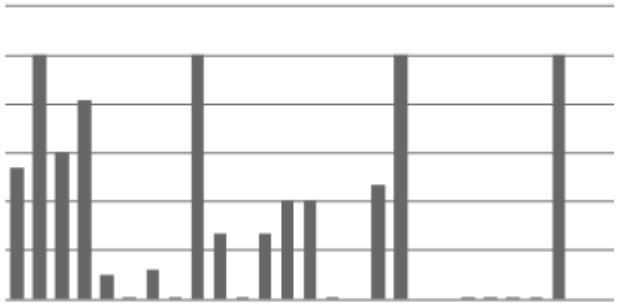
For comparison, we made another model. We took the main indicators of risk as inputs: "Jensen.Alpha", "Beta" and "Information.Ratio", and as outputs "Turnover" and "Total Return".

Despite new parameters, the most effective strategies did not change. "Leaders" are Graham, Lian, Zweig strategies.

Lian's strategy is the best one from both results of backtesting and DEA-score. (see Figure 15). Thus, fat positive tail tells that this strategy is both profitable



Graph 2. Bar chart. Efficiency of strategies (inputs – "Turnover", "Semivariance", outputs – "MAR", "skewness").



Graph 3. Bar chart with efficiency results (inputs — "Jensen. Alpha", "Beta" and "Information. Ratio", outputs — "Turnover" and "Total Return").

and reliable.

Comparing our DEA model results with results obtained after backtesting, we see one contradiction. Siegel's strategy was one of the "worst" strategies from backtesting results while in DEA-score it obtained 1-efficiency. We can explain it with a closer look at the data. According to distribution function, (Figure 16) strategy has high skewness by means of one deal with very high profit. Skewness was taken as output in our first DEA model. Skewness was significant in obtaining DEA-score. Moreover, in second DEA-model with other parameters Siegel did not obtain 1-efficiency. Hence, we can sum up that Siegel's strategy achieved good results due to high skewness. But we can not consider strategy as reliable one. Extremely high skewness makes strategy very risky and non-reliable. Hence, strategy is not satisfactory.

DEA-score indicated strategies as efficient and non-efficient. Interdependence of efficient and inefficient strategies appears to be supported by Dendrogram (Figure 17). Dendrogram reflects information of correlation between different strategies. We can observe that Graham and Lian have very high correlation which shows the identical behavior of these strategies to the changes on the market. FisherTech, Schloss, Lynch, Piotroski have the lowest correlation with other strategies. The most profitable ones we

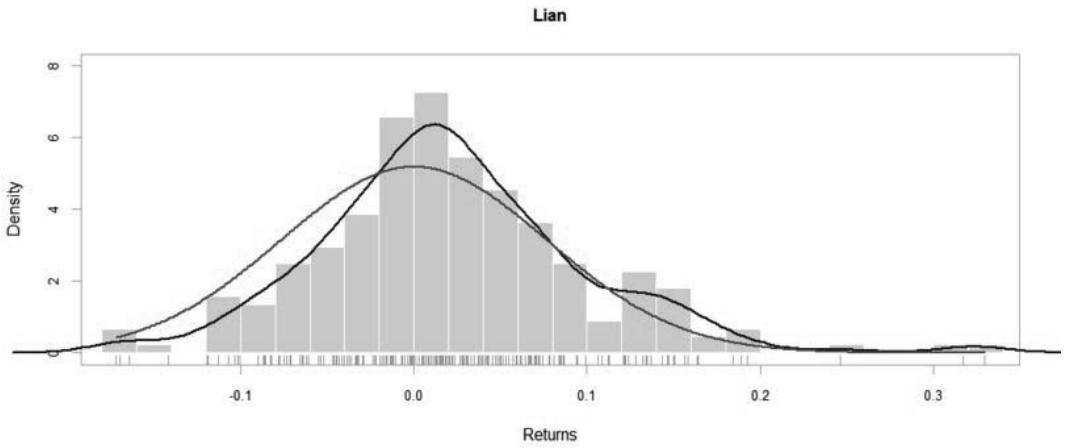


Figure 15. Lian's strategy. Return distribution function.

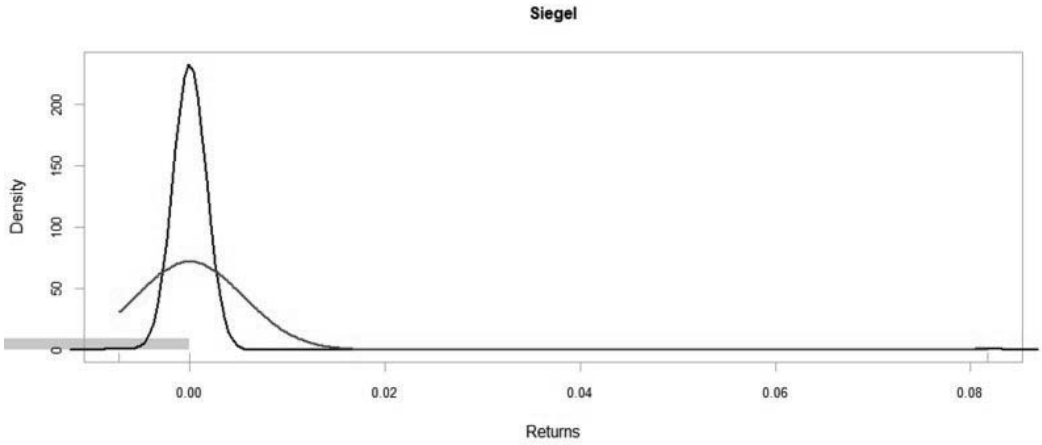


Figure 16. Return distribution function. Siegel's strategy.

got from results of backtesting, FisherTech less correlated with profitable Lian, Siegel, Graham strategies. Efficient Graham and Lian strategies are highly correlated.

CONCLUSION

The results of this study suggest a number of new avenues for research. Concluding our scientific work, we can say that not all the strategies suggested by investors are profitable and reliable. DEA-score and backtesting results provided confirmatory evidence of that.

After backtesting all our strategies, we obtained the following results. Screens of Dreman, O'Shaughnessy (Value), Lynch (Financial Companies) and Siegel have 0% return vs. 419.83% for the S&P 500. That means that they have not invested in anything at any time. The strategies that do not beat the market for the whole period are K. Fisher (Super-Stock), K. Fisher (All Stocks), Kahn, Hye, O'Shaughnessy (Growth), Lynch (Slow-growers), Lynch (Stalwarts), Mobius, Zweig. It means that these investment strategies do not work in the history. In general, these strategies exceed the market, but not much: Greenblatt, Eveillard, Kahn, Lynch (All Stocks), Lynch (Fast-growers). Finally, such strategies as Buffett, Graham, Browne, Fisher (Technology), Lian, O'Neil, Nutt, Piotroski, Schloss and W. Schloss beat the benchmark of the whole period. Most of them have high rates of return, especially Lian's.

DEA-score showed that Graham, Lian, Zweig, FisherTech strategies are efficient and reliable, and 5 strategies appeared to be completely inefficient. However, results of backtesting and DEA are not contradictory. Hence, results of one way of analysis are a ground for another. It is hoped that this study will stimulate further research in the field of investment.

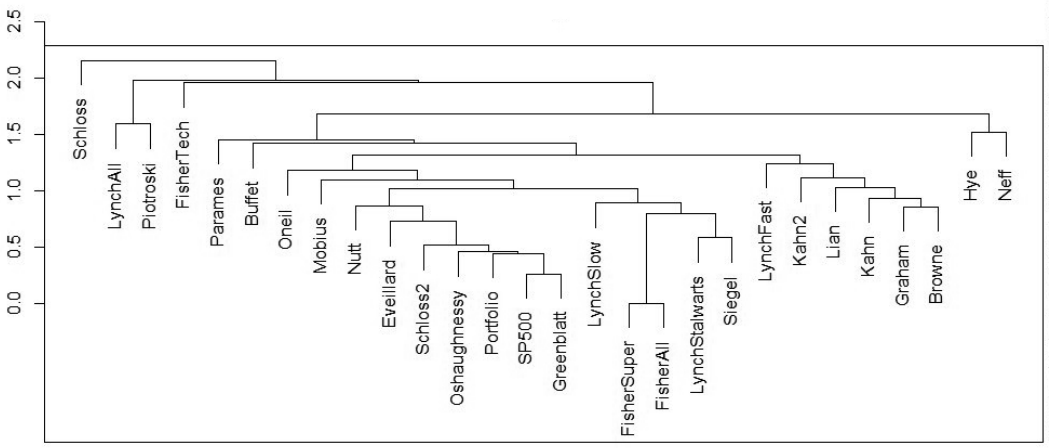


Figure 17. Dendrogram.

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Using Elliott Wave Theory Predictions as Inputs in Equilibrium Portfolio Models With Views*

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Abstract. We evaluate historical performance of one of the most famous Elliott Wave Theory proponents – Robert Prechter using Black-Litterman as framework for portfolio optimization with views. Our choice of the portfolio model for historical backtest contradicts to traditional "straightforward" approach to test historical predictions performance. We argue that this approach is more realistic as it allows to model Bayesian-rational decision-making of risk-averse agent with views, fueled by Elliott theory. Our results show that use of mentioned framework Elliott Wave Theory offers brings value to investor.

Аннотация. Мы оцениваем гипотетическую историческую доходность Роберта Пречтера, одного из самых известных сторонников волновой теории Эллиотта. Для этого мы используем модель оптимизации портфеля по Блэку-Литтерману. Наш подход противостоит традиционному подходу проверки исторической доходности предсказаний. Мы считаем, что такой подход является более реалистичным, так как позволяет моделировать рациональный метод принятия решений по Байесу для агента с суждениями, основанными на теории Эллиотта. Полученные с помощью такого подхода результаты показывают, что волновая теория Эллиотта имеет ценность для инвестора.

Key words: Black-Litterman portfolio optimization, Bayesian decision theory, Elliott Wave Theory, technical analysis.

INTRODUCTION

Ability of market practitioners to outperform market by predicting prices was in the focus of academicians at least since Cowle's seminal papers "Can stock market forecasters forecast?" (Cowles, 1934), followed by many papers with almost identical approach to research but different results. In (Goetzmann, Brown, 1997) an attempt has been made to reconsider some of Cowles's results on a risk-adjusted basis, using advances of modern portfolio theory. Namely, authors find that timing strategy of one of the major proponents of the Dow Theory, William Peter Hamilton, generate both positive alphas and high Sharpe ratios. On this basis they conclude that there could be some value in Dow Theory, at list there was value in the version, which was used by Hamilton.

Elliot Wave Theory, or Elliott wave principle, is a quasi-theory, pretending to explain and predict returns of the stock market, developed by Ralph Nelson Elliott (1871–1948), and having much in common with Dow Theory. Just as in case with the latter, Elliott Theory could be better perceived in narratives of its proponents, describing how they apply it in practice, other than works, trying to describe on more theoretical level how it should be applied. Softness, fuzziness and non-falsifiability of many of the theory predictions do not allow it to be usual scientific theory. From the other hand, narratives of Elliott Theory are often formulated in flexible form, which refuses direct historical simulation of the form "buy-hold-sell an asset". Predictions could be formulated in relative manner ("equities would outperform bonds"); cover groups of asset classes ("we believe capital assets to grow N%"); and even miss some asset classes in an irregular manner (i.e. mention class A and class B in time t_1, class A and class C in time t_2, class B and class C in t_3, etc.).

One of the advantages of Black–Litterman approach to asset allocation is that it enables to specify investor's views either in direct or relative form, and cover either single asset classes or groups of asset

* Использование предсказаний волновой теории Эллиотта в моделях равновесных портфелей с суждениями.

classes. Following approach of (Cowles, 1934) and (Goetzmann, Brown, 1997) those views will be reconstructed from market predictions made by one of the most famous "guru" of Elliott Wave Theory, Robert Prechter, who began his professional career in 1975 as technical market specialist with the Merrill Lynch Market Analysis Department in New York. We reconstruct the whole picture of Prechter's views and its evolution using Elliott theory's rules based on his narratives published since 1979 in "The Elliot Wave Theorist, Global Market Perspective" newsletter. We further develop approach of (Goetzmann, Brown, 1997) and extend it to Bayesian decision-making in equilibrium market settings, represented by Black-Litterman framework.

The rest of the paper is organized as follows. Next two sections briefly survey Dow Theory performance as reflected in academic literature and Elliott wave principle as reflected in Prechter's theoretical works and narratives. Then we continue with Black-Litterman discussion and description of our backtest and summary of its results. In the final section we conclude.

THE DOW THEORY

The Dow Theory is known to be the background for Elliott Wave Theory. Both typically are described in terms of investor sentiment and crowd behavior. Both Elliott and Dow developed their ideas long before computers were available, so there was little available in the way charts or easily computed technical indicators. The easiest way to describe any theory of stock market behavior would have been to draw on the investors' sentiment and traders who made up the market. The other major comparison between the Dow and Elliott Wave Theory is that both speak of waves. The Dow Theory refers to an accumulation phase, the period when traders who trade on technical analysis enter the market, and the final phase of run-up, when all the investing people enter a bull market. These may approximately coincide with the upward legs of a five-wave impulse move. The Dow Theory does have important point in common with Elliott, Dow Theory discusses primary, secondary, and minor trends in the market. This is the expression of the fractal nature of the markets in which larger trends subdivide into smaller actions and reactions. So it is appropriate to say that the Elliott Wave Theory is built upon this solid foundation.

Cowles in (Cowles, 1934) tried to test if the Dow Theory works properly, and came to conclusion that it does not work. The main reason for that were the outcomes he got after comparison of two strategies. He calculated total returns for Dow timing strategy and got 12% of yield, whereas alternative investment in 100% stock market gave 15.5 % of return per annum. However, he neglected to adjust to relative risk. Cowles also conducted nonparametric analysis of Hamilton's recommendations which show the frequency of correct Bull and Bear market calls. The results were not satisfactory: 29 bullish, 23 bearish, 38 neutral, which means the same as flipping coins. As noted by (Goetzmann, Brown, 1997), the reason for his mistakes is that Cowles did not consider the repetitive Bull forecast in rising market and repeated bear forecast in falling market. There are many methods which could be applied to Dow Theory. Goetzmann, Brown argue that nonparametric Hendrickson–Merton test is the natural test for Dow theory. HM test quite effectively determines whether the manager provided put on the market when it was necessary. It is proper test for Hamilton since he uses the frequency of correct Bear market calls as the basis for verifying market success. The test confirms that HM test is effective in bear markets, so that proportion of correct Bear calls is higher than just in case flipping a coin.

Approach of Goetzmann, Brown is generally based on simulation of trading strategy that shifts from long stocks to short stocks. In comparison with Cowles who used 50 to 50 portfolio mixtures of Dow Industrials and Dow Railroads, the S&P index was used as basis. Short-term commercial paper rates represent alternative investment. Overall, results showed that Hamilton's portfolio is less risky than fully invested strategy. Results on simulated investment strategy were almost indistinguishable from average return holding S&P all stock portfolio.

Hamilton's editorial serves as rare chance to think and recover Dow theorist rules on making good market analysis. All evidences against Hamilton's timing ability seem not justified. Over 27 years' period of market observation with application of Dow Theory brought positive risk adjusted returns. Despite doubts whether it is luck or really good skill of market prediction, it seems that Hamilton followed rules based upon his observations of market trends which could be recovered by nonlinear estimation methods. The fact that Hamilton was successful market timer reasonably justified in the article; this is one of the values of this paper. Also the analysis conducted by Cowles on Hamilton's records led to the idea of random walk hypothesis and played significant role in establishment of efficient market theory.

ELLIOTT WAVE THEORY

In the 1930-s, Ralph Nelson Elliott discovered the first known fractal mathematical model of market dy-

namics. He derived this model through observations of past and current market behaviour. The big part of the Wave principle consists of detailed description of various types of these patterns like five- and three-wave patterns and demonstrated the exact rules that should be followed when joining together to form larger pattern. The patterns he distinguished are repetitive in form, but not necessarily in time or amplitude. Unbreakable rules concerning five-wave movements are: (1) The second wave cannot carry past the beginning of the first wave, or simply second wave does not begin from the start of first wave; (2) The fourth wave cannot enter the price range of the first wave as a rule; (3) The third wave cannot be the shortest wave among other four waves.

The guidelines used to five-wave pattern are: (1) If wave two develops as one type of pattern, then wave four usually develops different type of pattern. Second waves are considered to be the strongest, relatively fast, steep retracements of the prior impulsive movements, whereas fourth waves tend to trace out complex, more sideways shape of wave; (2) Wave one among one, three and five is "extended" that is, it is the longest of the three movement and subdivides into component waves of nearly the size of the other main waves. Wave three is usually extended. (3) When wave three is extended, wave one and five tend to be equal in their price movement and similar in complexity of internal structure. (4) Usually market movement tends to be related in size by a mathematical constant, the Fibonacci ratio and Golden mean, 0.618, and its complement 0.382.

If there is a violation of one or more of these rules, it implies that the wave count is incorrect. If the chart seems not like that, the sequence is not impulsive and Elliot Wave pattern cannot be used here — or there is an extension which will be discussed further. There is crucial point that should be pointed out and remembered. Although it is the best forecasting tool in existence, the Wave Principle is not primarily a forecasting tool: it is a detailed description of how markets behave. The primary value of the Wave Principle is that it provides a context for market analysis.

RESTORATION OF PRECHTER'S PREDICTIONS USING ELLIOTT WAVE THEORY

For the purpose of finding returns on predictions made by Prechter based on Elliott Wave Theory, we

Date	Prediction	Interpretation
March, 1993	*E waves are always accompanied by extreme psychology, so bullish sentiment should be powerful by the time this rally peaks. After that peak, gold will experience its second and final decline to its ultimate bear market bottom."*	Triangle pattern still in place and we are on D wave of A-B-C-D-E. At the moment of forecast in March 1993 gold at the end of wave which says that bullish potential of E wave is coming soon. Dow value on March 1993 is 328. By applying Fibonacci projection and considering that wave E is strong wave, the next target value should be 385,400,408 which are correspond value of Fibonacci numbers. Since wave E considered to be corrective, it was divided to a-b-c corrective waves. What is interesting, tops of a-b-c corrective wave up exactly coincide with target values mentioned above 385, 400,408.Wave E exited on august 1993 with the value about 408. Return received from forecast is the following: |328-410,5|/328/2=12,58% Forecast was in place in two quarters.
May, 1998	*"As it turns out the percentage gain of wave V is 0.609 times that of waves I-III. This value is certainly is close to 0.618, 11889 but we will see".*	According to his writings, Prechter saw that 1982 bottom was the end of wave IV, and the impulse wave from that point can be counted as five-waves up. We can clearly see that the market rally in 1987 was counted as wave 2 down, and if we apply Fibonacci projection, we can see that the length of wave 1 was equal to 0.38 percent of the length applied to 1982 low . The next high reached at the beginning of 1998, and the down market from that point to 8800 is wave 4 down. Now we can see that we are in the wave 5 of Supercycle wave IV up.
February, 2000	*"In May 1998 we published that projections to 11889, which turned out to be only 1,5% away from the high recorded in January 2000 11722,98."*	Based on this prediction and its realization we can convert it to return by simple finding the difference between the point of Dow when prediction were made and forecasted point of realization dividing this difference by initial point of Dow when forecast was made and divide into period it took to realization (in our case it should be quarterly returns, we divide by 8, since 2 years*4 quarters).

Date	Prediction	Interpretation
		|(9055,14-11889)/9055,14/8|=3,91% quarterly return for each quarter since May 1998 till January 2000. As it was stated before, the high in January 2000 was the over of wave V of Supercycle Wave, as forecasted. The trend down from 2000 till 2002 could be counted as *a* corrective wave a-b-c expanded flat correction of previous high.The market downside trend from 2007 till 2009 was the *c* of expanded flat correction. Since that low market took five wave upside trend. In June 2012 we were in last fifth wave up which soon was going to exit and forecast made states that we should have major collapse lasting 4 years: Fifth wave should exit at the point about 15147,22 which is 0,618 of wave one up.
June, 2004	*"This is in line with the wave structure on the monthly and quarterly charts. A third wave down is in progress from the recent high at 116^11, and prices should continue to fall to 102^23, potentially 101^23/100^06. Then in July, an upward fourth wave correction to 106/107 should lead to a new low in the third quarter between 100^06 and 97^04. If prices follow this course, then the wave structure will be in place to support a rally to 115."*	According to counting, the price is in the end of wave 2, so the bear market for bond is in place. Prechter states that there will be some wave 3 down to 100,06, and then go up for fourth wave correction and after that hard down to about 97. As in fact it is seen that the count is not right, since market went in opposite way. The negative return will give us (97,13-111,15)/97,13/2 which is equal to -7,22%.We constructed similar chart to Prechter's counting on the same historical chart, to show the opposite market. The difference between the point of forecast which is down and the point of real market value at that time divided by point of forecast. As you can see Elliott Wave Theory was counting work in real time in most cases. However, there are still cases when chart can be misinterpreted.
January, 2006	*"Silver bulls are virtually certain that the recent steep decline is a great buying opportunity, which the high level of optimism argues is just the opposite. The first downside target is around the $7.30 level, the apex of the triangle that ended in late August. Despite the strong bearish evidence, if the $9.26 high is exceeded, silver's rise will probably end in a wild spike to significantly higher levels prior to a violent reversal. Any such event will not change downside targets. Silver 9,25."*	Since 2004 silver had bullish triangle, which said that bullish market for silver is coming. In august 2005 this triangle had a bottom and started wave 1. In December 2005 counter wave 2 bottomed, which gave wave 3 to start. On the time of forecast, we have in 3 wave up with the price of 9,25. Application of Fibonacci ratio showed that since the wave 3 is the strongest and impulsive wave, it can go far away. The target was 14,36, however it went a little further. After this peak it sharply fell down, which says that wave 4 in place. The next target for wave 5 was 14.96, silver went slightly above that. The forecast has worked and gave return in |9,25-15,22|/9,25/2=32,27%.
January, 2006	*"Bonds broke beneath the lower channel line of the parallel trend channel formed by the rise from 110^03. The decline to today's 112^11 low appears to be a clear impulse wave (five waves), which confirms that a top is in place. Bonds should now be declining back to, and likely well beneath the 110^03 low. The key point is that regardless if a near-term bounce develops, the trend has turned down and the bears control the bond market for the near term.*	The picture says that after peak in mid of January, it started to go down and broke the trend channel up, which says that wave down began. We are at the end of wave 1 down, which says that some rallies up will be just corrective moves of five-wave pattern down. If we apply Fibonacci to June 2005 high and start of bigger wave down, whereas current market down is going to be the wave 5 down of bigger wave down. It shows that retracement of 38% down will lead to about 105. Return will be calculated as of the date December 2006, when the low was exactly 105,11. Return will be |112,21-105,11|/112,21/2 which equals to 3,16% for two quarter period.
January, 2006	*"Since 1980 The EWT has made a case that the gold has been tracing out a major bear market. The partial recovery pattern, which has retraced a Fibonacci 38,2% of wave W, is either ended December 1987 or an A_B_C_D_E triangle that requires one more rally."*	Prechter interpreted market as being in bearish trend (probably in wave D down in case of triangle). So in August 1989 he is somewhere on fifth wave down of bigger wave D. Forecast expects a small thrust up if we apply Fibonacci retracement to 1987 year high. So we can conclude that expected wave up should retrace about 38% or 61% of 1987 high. In August 1989 Dow was at value 359,81, expected forecast is 410,5; we get return of 5,12% since from August 1989 till January 1990 three quarters.
May, 2013	*"With the higher high on weaken momentum the stock market is far more vulnerable that at any time since Supercycle V end in 2000 year. The exhaustion depicted from recent t issue has led to a minor decline from Dow high 13338.7 on May 1. It should soon develop in major collapse lasting 4 years."*	To calculate return we should do the same as in previous example. Dow value at time of forecast, June 2012, 12,566 and forecasted realized value is 15,275 in May 2013 divided by 4 quarters. We get about 7,19%.

restore his countings and calculate projected returns based on information about restored Prechter's market views. Our analysis dates back to beginning of 80-s, and extends to the year 2013. In the following table we have summarized key predictions, made by Prechter, and our interpretation of it.

BLACK-LITTERMAN MODEL

Black-Litterman model was firstly introduced in 1990 and further expanded in (Black, Litterman, 1991, 1992), (Bevan, Winkelmann 1998), (He, Litterman, 2002). It combined ideas of Markowitz' MVO (Markowitz, 1952), Sharpe's CAPM (Sharpe, 1964), reverse optimization (Sharpe, 1974), Theil's mixed estimation, and the universal hedge ratio of Black's global CAPM (Black, 1989). It was argued then that Black-Litterman model creates stable, mean-variance efficient portfolios, which are based on an investor's unique insights, and overcomes the problem of input-sensitivity. It avoids the problem of estimation error-maximization by spreading the errors throughout the vector of expected returns.

It starts with equilibrium no-views situation, which is useful in case Prechter had no views at all for some asset in some particular period. In the case there is an absence of view model just sticks to market views (implied excess equilibrium returns) obtained from reverse optimization process. Three main inputs are needed for calculation of implied excess returns: risk premium, covariance matrix and market capitalization of the assets. The vector implied excess equilibrium returns are derived from already available information applying the following equation:

$$\Pi = \lambda \Sigma wmkt \tag{1}$$

Π – the Implied Excess Equilibrium Return Vector (N x 1 column vector);
λ – the risk aversion coefficient;
Σ – the covariance matrix of excess returns (N x N matrix);
wmkt – the market capitalization weight (N x 1 column vector) of the assets;

Black-Litterman model assumes K represents the number of views and N demonstrates the number of assets. Some rearrangement of the previous formula by substitution μ which characterizes any vector of excess return for $\prod$ which represent the vector of implied Excess Equilibrium Returns offers us new solution which can be considered as unconstrained maximization problem:

$$w = (\lambda\Sigma)^{-1}\mu \tag{2}$$

The important condition is if μ does not equal $\prod$, w will not equal wmkt. The risk aversion coefficient in the reverse optimization process acts as scaling factor for the reverse optimization estimate of excess return and is calculated as follows

$$\lambda = \frac{E(r) - r_f}{\sigma^2} = \frac{Risk\ premium}{Variance} \tag{3}$$

This scaling factor characterizes the expected risk-return trade-off and is the rate at which more return is required for more risk.

Then model mixes forecasts with equilibrium returns in a Bayesian analytic framework. It translates views into explicit security return forecasts and new covariance matrix suitable for conventional mean-variance portfolio optimizer. Fed with new inputs, optimizer produces portfolios tilted to reflect investor's views.

Using Implied Equilibrium Return Vector and the Black-Litterman Formula 4 the new Combined Return Vector (E[R]) is calculated as follows.

$$E[R] = [(\tau\Sigma)-1 + P'\Omega-1P]-1[(\tau\Sigma)-1\Pi + P'\Omega-1Q] \tag{4}$$

Where: E[R] is the new (posterior) Combined Return Vector (N x 1 column vector);
τ is a scalar;
Σ is the covariance matrix of excess returns (N x N matrix);
P is a matrix that identifies the assets involved in the views (K x N matrix or 1 x N row vector in the special case of 1 view);

Ω is a diagonal covariance matrix of error terms from the expressed views representing the uncertainty in each view (K x K matrix);

∏ is the Implied Equilibrium Return Vector (N x 1 column vector); and

Q is the View Vector (K x 1 column vector).

Since market views are always taken into account there is a little chance to run into unstable or corner solutions. On the other hand if investor has some strong views which can rule the market view, this is because the model gives an opportunity to results to be adjusted to these views.

As it was mentioned before the Black-Litterman model allows the investor views to be expressed. These views can be expressed in two forms: absolute and relative. The absolute view states some equity has some excess return and certain confidence level. Whereas relative view is expressed in the form of some asset which outperforms the other asset by some certain rate and with corresponding confidence. In comparison to absolute views, relative views are more close to investor' view about different assets.

Here we come to the conversion of views to the input which can be applied in Black –Litterman model. The model does not require the investors to specify their views on all assets. However, views which are uncertain give random, unknown, independent, normally-distributed Error term vector (ε) which has a mean of 0 and covariance matrix Ω. Therefore, a view will be shown in a form of Q + ε on matrix

$$Q+\varepsilon=\begin{bmatrix} Q_1 \\ \vdots \\ Q_k \end{bmatrix}+\begin{bmatrix} \varepsilon_1 \\ \vdots \\ \varepsilon_k \end{bmatrix} \tag{5}$$

Almost in all cases the error term (ε) is equal to positive or negative number other than 0, except for the situation when investor is hundred percent sure about his expressed view. The Error term vector cannot straightly be included into the Black-Litterman formula. But if we take the absolute difference from the error term's expected value of 0, then it can be included into the given formula, in other words this difference called variance of each error term. Ω is known as a diagonal covariance matrix with zeros in all of the off-diagonal positions which is derived from variances of the error terms (ω). Because the model thinks that the views are independent from each other, off-diagonal elements of Ω are equal to zero. Thus we have relation between two measures, the larger the variance of error term, the greater the uncertainty of the view. Most difficult process is to determine individual variances of the error terms, which in their turn constitute the diagonal elements of Ω

$$\Omega=\begin{bmatrix} \omega_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \omega_k \end{bmatrix} \tag{6}$$

On the matrix Formula 7 below we can see matrix P which serves as matching tool of expressed views in column *Q* to specific assets. We see that each view results in a *1 x N* row vector.

$$P=\begin{bmatrix} p_{1,1} & \cdots & p_{1,n} \\ \vdots & \ddots & \vdots \\ p_{k,1} & \cdots & p_{k,n} \end{bmatrix} \tag{7}$$

For the purpose of specifying the values of matrix P model provides two ways. The first one *a market capitalization weighting scheme;* this scheme shows that the relative weighting of each assets is proportional to the asset's market capitalization divided by the total market capitalization of underperforming or outperforming assets of that particular view. The second one is so-called *equal weighting scheme* under which the weighting is proportional to 1 divided by the number of respective assets which underperformed of outperformed. However, this scheme may outcome in tracking error, the reason for that is ignorance of the market capitalization of the assets involved in the view.

The next thing to do is calculation of the variance of each individual view portfolio. Here, the variance of an individual view portfolio is denoted by $p_k \Sigma p'_k$, p_k is a single *1xN* row vector from P Matrix which corresponds to the *k*-th view, and Σ is the covariance matrix of excess returns. It should not be forgotten that the respective variance of each individual portfolio is vital source of information concerning the certainty, lack of the level of confidence that should be placed on a view. That is important since we use this information to revisit the variances of the error terms forming the diagonal element of Ω.

The most abstract and complicated parts to specify parameters of the model are the scalar (τ) and the uncertainty in the views. To make the Black-Litterman model more standardized we should make an assumpition on the value of the scalar. Guangliang He and Robert Litterman adjusted the confidence of a view so that the ratio τ/ω is equal to variance of the view portfolio ($p_k \Sigma p'_k$). If we take the general case the covariance matrix of the error term (Ω) is represented in the following way in Formula 8:

$$\Omega=\begin{bmatrix} p_1\sum(p_1')*\tau & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & p_k\sum(p_k')*\tau \end{bmatrix} \tag{8}$$

After calculation of the covariance matrix of the error term, the actual value of the scalar is not relevant since only the ratio ω/τ enters the model. Making sure that the scalar value and the covariance matrix of the error term are available, we are at the end point to derive new combined return vector. That we can get if we enter all inputs into the Black-Litterman formula and solve the unconstrained maximization problem.

BACKTEST

Prechter in his publications mostly covers the major asset classes which have significant influence on financial market, so portfolios made with his predictions could enjoy high level of diversification. Our backtest cover quarter returns of the following assets:

Domestic fixed income

– Government bonds – 30 year US Treasury Bond Futures.

Domestic equity

– Dow Jones Industrial Average Total Return Index;

– Large-caps – S&P 500 Total Return Index;

– Small-caps – Russell 2000 Total Return Index.

Gold

– Historical gold spot prices.

Silver

– Historical silver spot prices.

Crude Oil

– Crude Oil Futures.

REITS

– FTSE/NAREIT US Real Estate Index.

Other Commodities

– The Standard and Poor's Goldman Sachs Commodity Index (S&P GSCI).

Black-Litterman requires market capitalization measures as well as historical returns. Equities capitalization was calculated directly from weights and capitalizations of respective index members. Market capitalization for 30 year Treasury Bonds was proxied by value of open market interest. Market capitalization of gold was taken from all investable gold of US institutions (data provided by World Gold Council). For silver and futures, we used exchange data.

We compared two types of Black-Litterman portfolios with other methods of allocation, namely passive market portfolio (cap-weighted benchmark returns), equally-weighted portfolio and classical 60/40 stock/bond allocation. The Black-Litterman model provides us with two types of portfolio:

- ✓ The Black-Litterman Equilibrium Returns portfolios without views;
- ✓ The Black-Litterman with Prechter's views specified portfolios.

Following (Mikaelyan, 2012) approach we chose from 5 portfolios efficient frontier for every type of Black-Litterman portfolio which are:

- the minimum risk portfolio (minrisk);

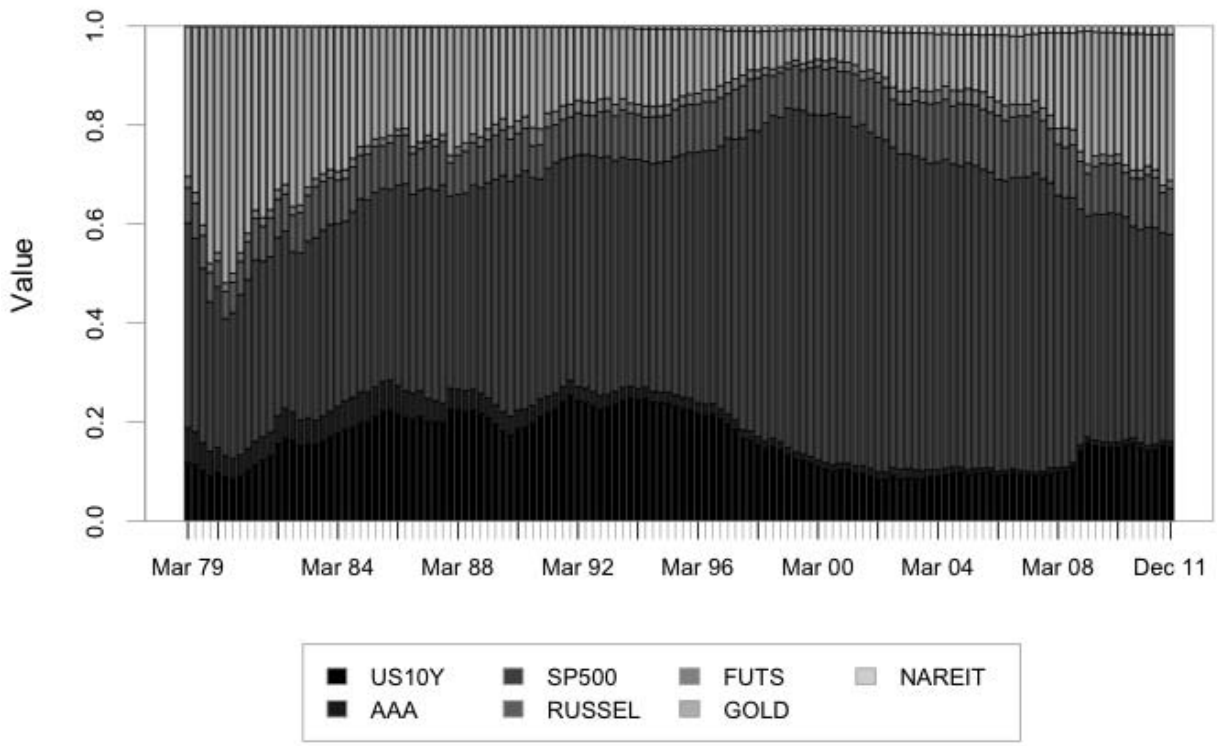

Figure 1. Market portfolio historical allocation.

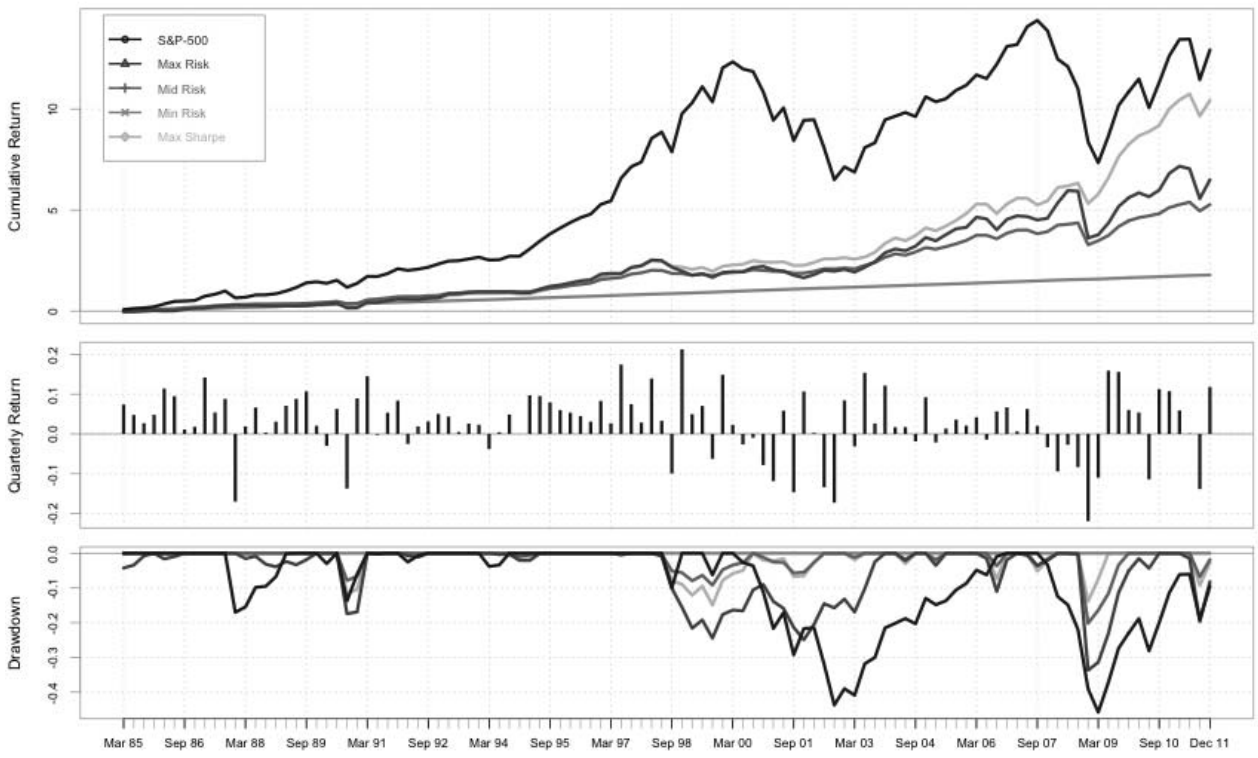

Figure 2. Performance of Black-Litterman active portfolios with views.

- the maximum risk portfolio (maxrisk);
- the medium risk portfolio (midrisk);
- the middle between minimum and medium risk portfolio (minmidrisk);
- the middle between medium and maximum risk portfolio (midmaxrisk).

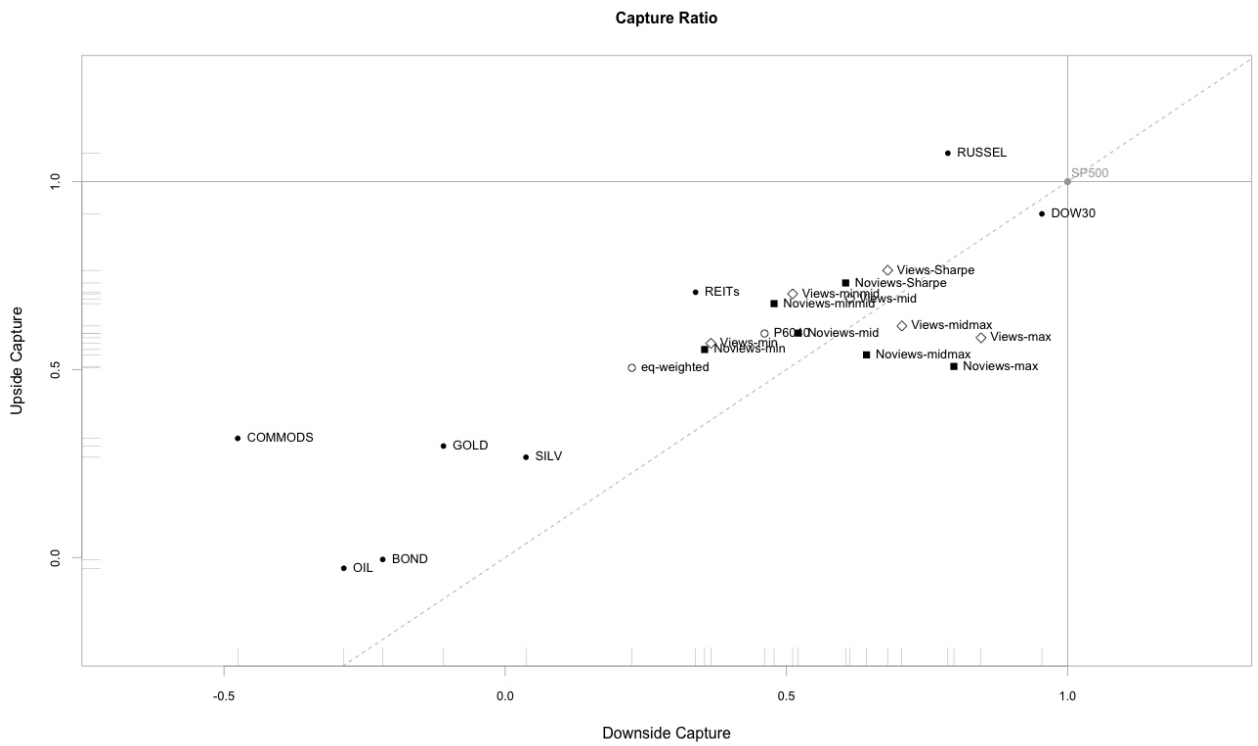

Figure 3. Capture ratios of basic assets in universe (dots), equilibrium Black-Litterman portfolios (squares), Black-Litterman portfolios with Prechter's views (diamonds).

Table 1. Performance ratios.

Portfolios		Calmar	Sterling	Drawdown	Sortino
Minimum risk	Prechter	0,1252	0,1057	0,5417	0,3601
	Equilibrium	0,1182	0,1001	0,5544	0,3495
Min-med risk	Prechter	0,3111	0,2307	0,2870	0,6881
	Equilibrium	0,3106	0,2297	0,2839	0,8013
Medium risk	Prechter	0,2705	0,2008	0,2885	0,5805
	Equilibrium	0,2428	0,1796	0,2839	0,6246
Med-max risk	Prechter	0,1449	0,1145	0,3775	0,3601
	Equilibrium	0,1263	0,0993	0,3669	0,3496
Maximum risk	Prechter	0,0740	0,0609	0,4677	0,2235
	Equilibrium	0,0555	0,0457	0,4677	0,1910
Maximum Sharpe ratio	Prechter	0,2970	0,2214	0,2930	0,5960
	Equilibrium	0,1182	0,1001	0,5544	0,3494
Market Portfolio		0,3105	0,2296	0,2839	0,7489
60/40 portfolio		0,2931	0,2095	0,2510	0,6610
Equally-weighted portfolio		0,1838	0,1466	0,3950	0,5551

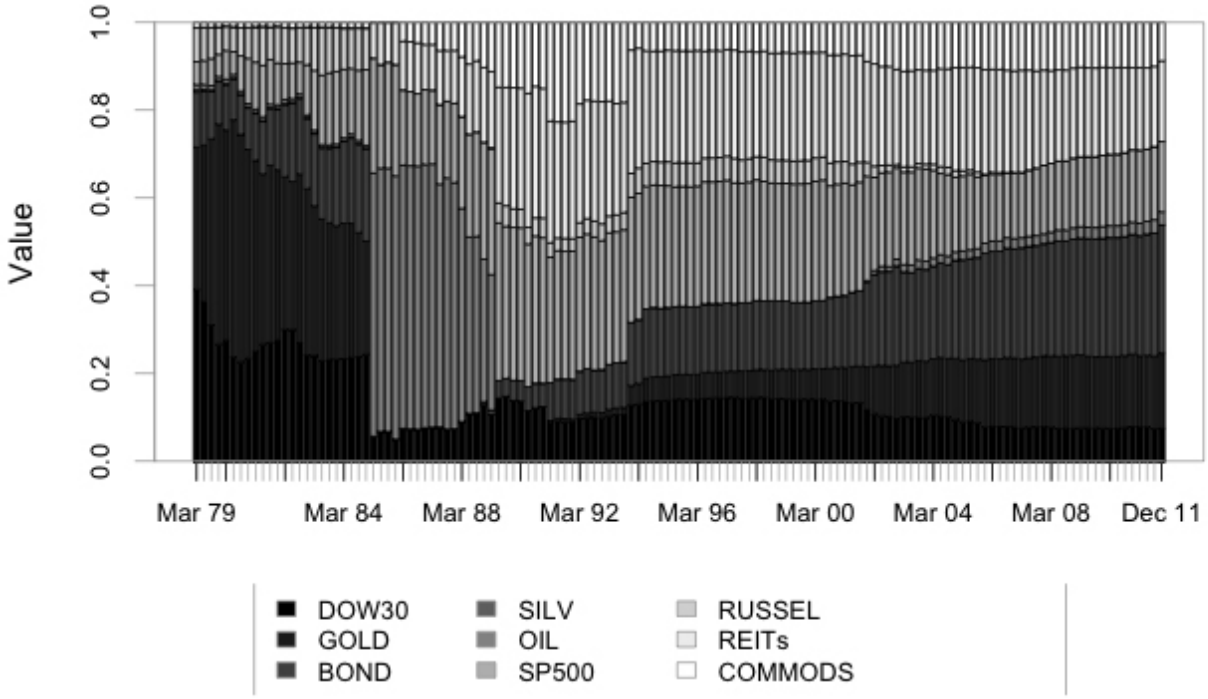

Figure 4. Minimum level of risk Black–Litterman Portfolio with Prechter's views.

Having chosen this set of portfolios, we will define which portfolios type of portfolio allocation method will be better in corresponding level of risk. The same technique we can apply to other portfolios. They will be subdivided by the risk-interval they belong to. Performance of the created portfolios was assessed with Calmar, Sterling, Sortino ratios, and maximum drawdown measure (Table 1). We also used capture ratios and equity curves visual analysis to determine best portfolios (Figure 2 and 3). In the coming section we define which type of portfolio is better for a given level of risk on the basis of performance analysis ratios discussed above.

Equity curve and ratios analysis show that all Black-Litterman portfolios with views have significantly lower drawdowns and returns than benchmark (Figure 2). Moreover, with-views Black-Litterman portfolios are dominating equilibrium ones on upside/donwnside capture space (Figure 3), which may suggest that Prechter views are actually adding value. The evidence is supported by Calmar, Sterling, Sortino ratios and maximum drawdown measures (Table 1).

From the other hand, almost all one-asset concentrated portfolios outperform all Black-Litterman-diversified portfolios in terms of upside/downside capture ratio. The observation probably owes to the fact, that concentrated portfolios are 100% invested in assets, which are well-known di-

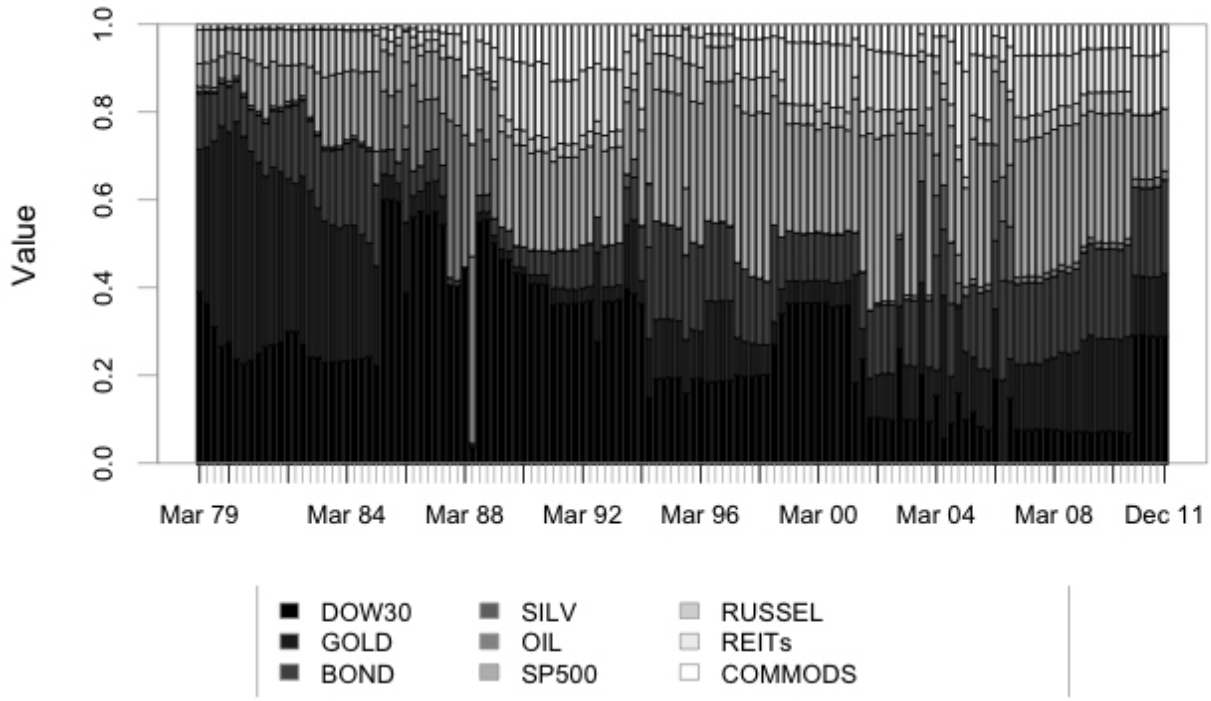

Figure 5. Minmid risk level of Black-Litterman portfolio with Prechter's views.

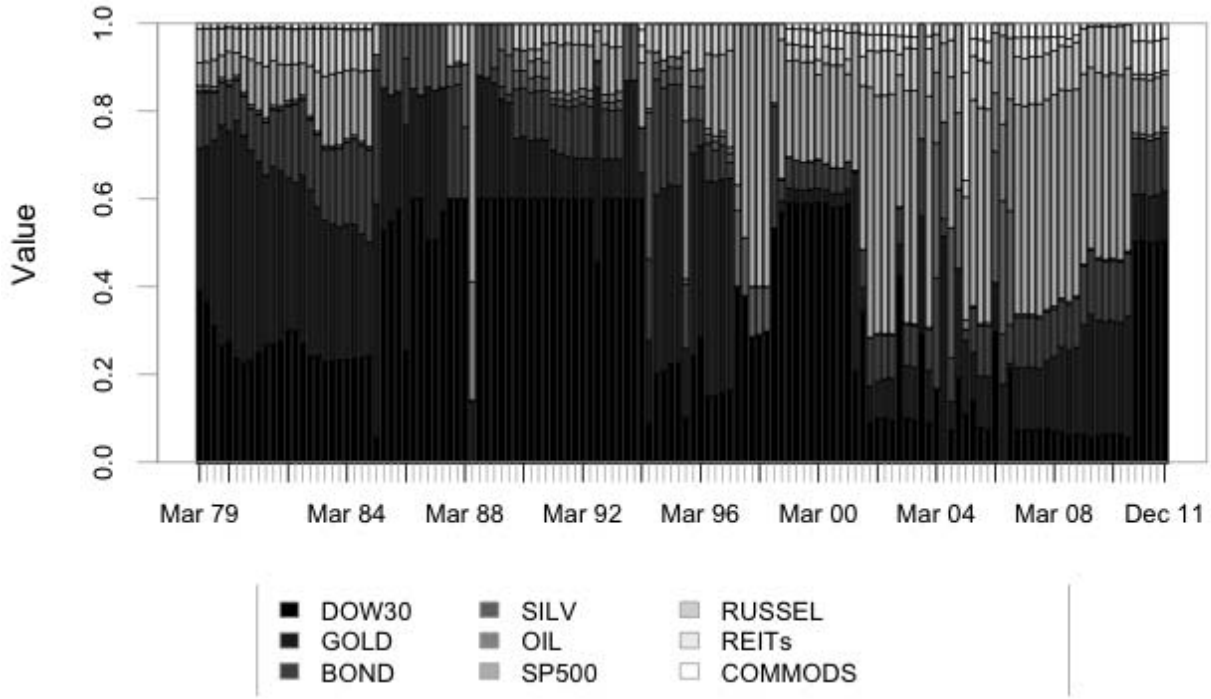

Figure 6. Medium level of risk Black-Litterman portfolio without views.

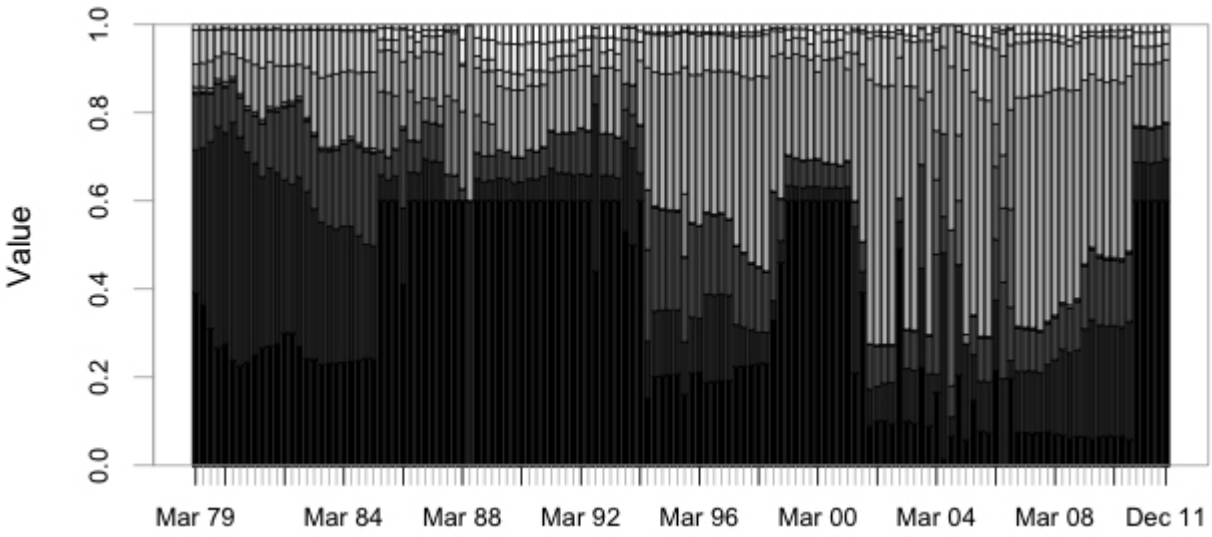

Figure 7. Black-Litterman Sharpe portfolio with Prechter's views.

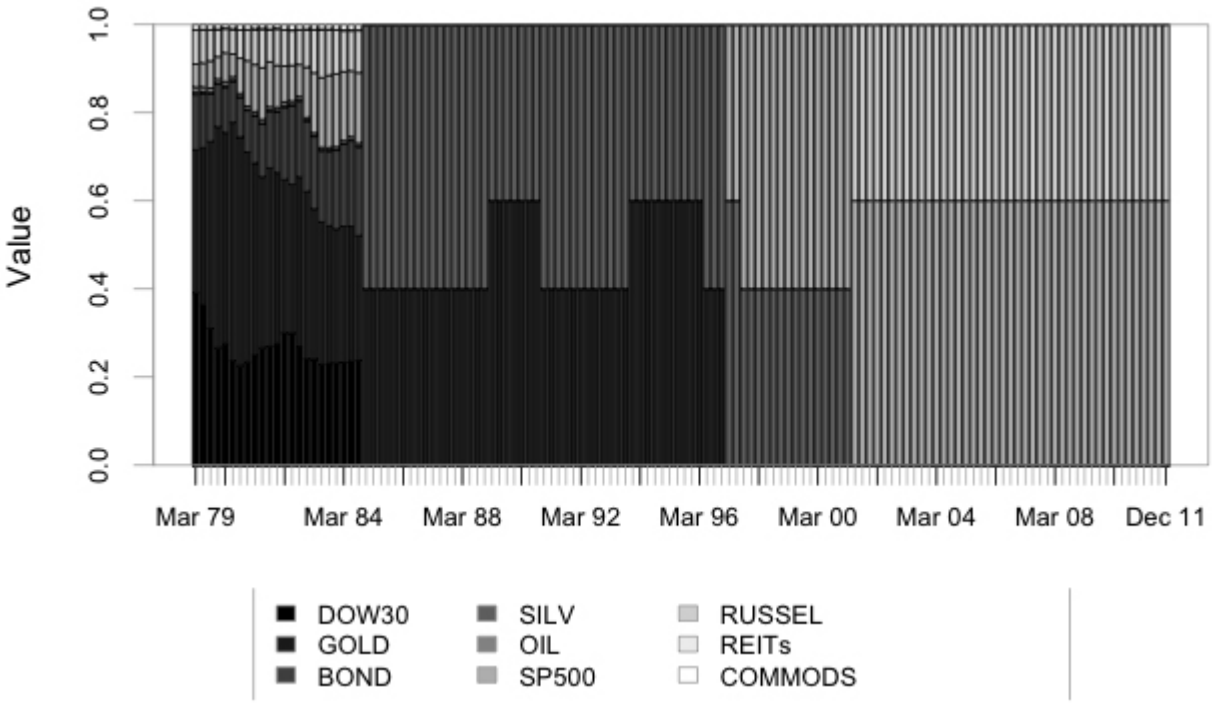

Figure 8. Maximum risk level Black-Litterman portfolio without views.

versifiers to big US caps, selected as benchmark. Nevertheless, mid-max and max Black-Litterman portfolios, both with and without views, appear to be inefficient in terms of upside/downside ratios, as they bear more than one unit of downside risk for a unit of upside risk taken.

Based on ratio analysis, Black-Litterman minimum-to-medium risk portfolio without views shows better results than same risk level portfolio with Prechter's views. While with-views portfolio has drawdown-adjusted return (i.e. the best Calmar and Sterling ratios) slightly better than all other portfolios we analyze, equilibrium Black-Litterman portfolio pays the most for its downside semideviation (has the best Sortino ratio). Upside/downside analysis shows that two portfolios are very close to each other; with-views portfolio seem to be a bit riskier, as it captures both more upside and downside.

Medium-to-maximum portfolios have varying scores under different measures: while portfolio with views have better risk ajusted return (Calmar, Sterling and Sortino ratios), portfolio without views has

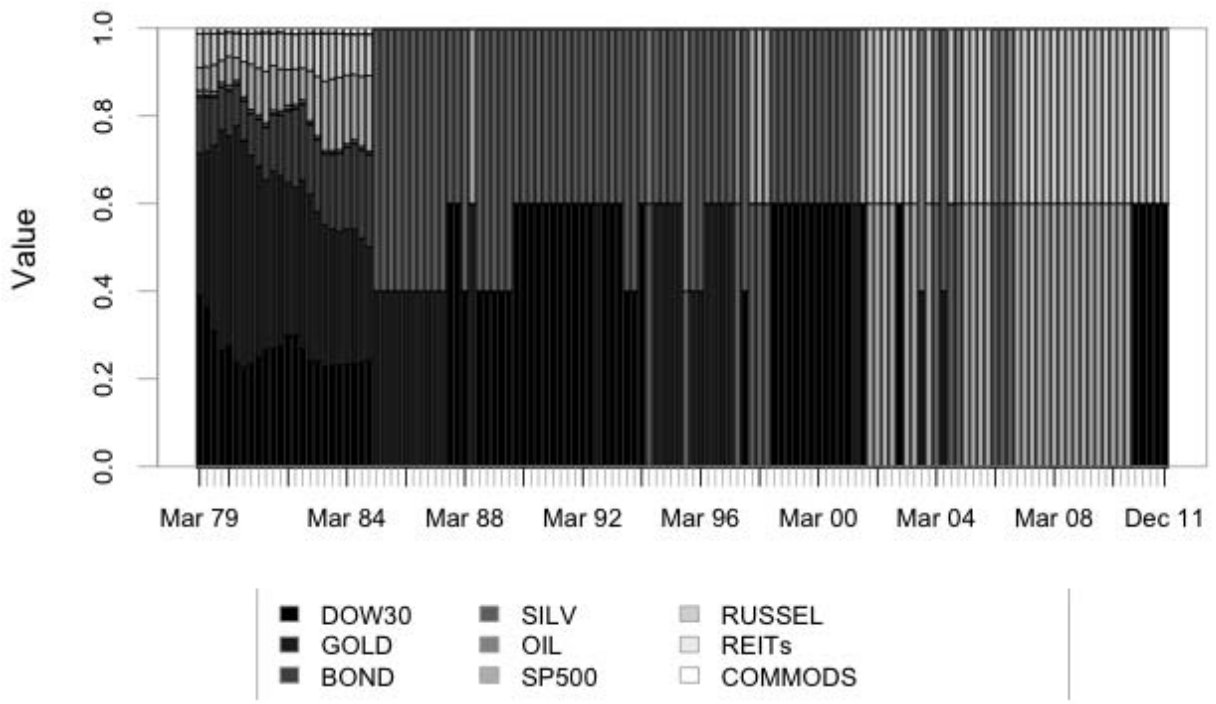

Figure 9. Maximum level of risk Black-Litterman portfolio with Prechter's views.

smaller Max Drawdown and higher upside potential ratio.

All medium-to maximum and maximum-risk portfolios, both equilibrium (Figure 8) and Prechter's (Figure 9) are inefficient in terms of upside/downside capture (Figure 3). Clearly, these portfolios are overconcentrated and exhibit very sharp changes in portfolio allocations, which suggest high transaction costs. Still, even here we see that Prechter's portfolios are better in terms of upside and worse in terms of downside, hence more risky.

Having considered asset allocation methods and their corresponding assets combination, we should pay attention to approximate returns they could bring. Based on historical returns, we have analysed all portfolios with trading simulation approach, where the initial investment was 1,000,000 USD. We have received the result that *Black-Litterman portfolio with Prechter's Views at Minimum Medium risk* have beaten *Market Portfolio*, bringing 16 822 472,57 USD versus 16 250 805,14 USD of Market portfolio.

CONCLUSION

Almost at all risk levels with-views portfolios have advantage over equilibrium ones in terms of drawdown-adjusted returns (but not drawdowns). This advantage is smaller at portfolios of lowest and highest risk levels, and peaks at medium-risk and maximum Sharpe ratio portfolios. Equilibrium portfolios, on overall, have smaller drawdowns, and better Sortino ratios for all lower-than-medium risk portfolios. More risky with-views portfolios are dominating by all possible measures. This is consistent with upside/downside capture ratios analysis, as portfolios built on Prechter views seem to have riskier returns than equilibrium portfolios of comparable risk levels.

On overall, risky Black-Litterman portfolios (medium-to-maximum and maximum), both equilibrium, and with-views, seem to be worse than market portfolio, capturing less than one unit of market upswings, and more than one unit of market downswings. While one might blame overconcentration of portfolios on the right side of efficiency frontier, the problem is not in overconcentration as it is: clearly, portfolios, 100% invested in any of alternative assets proved to be better in upside/downside to equity, than almost any other portfolio in the investment universe. As Black-Litterman portfolios are bounded by capitalization, overconcentrated riskier-than-average Black-Litterman portfolios are usually 100% invested in equity. Prechter views sometimes tilt this allocation toward alternatives, and this is, probably, one of the reasons why with-views portfolios are better. But this advantage works only when alternatives are mixed in diversified portfolios.

We used Black-Litterman optimization approach to obtain diversified portfolios, resembling portfolios of real market participants. Comparing these portfolios to various benchmarks by various measures we have found that Prechter's forecasts have at least marginal value for market participants.

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Some Stylized Facts about Analyst Errors*

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Abstract. In our paper we outline some empirical evidences about aggregated analyst errors, i.e. systematic differences between consensually forecasted and observed prices. In particular, we find that the error is independent from the amount of analysts covering the stock, while industry plays an important role, although an error is bigger for growth companies. We also confirm previous evidence that price estimates aggregation over an index result in better estimates performance. Along with that, EPS is predicted better than price itself. Based on mentioned facts we deduce that the main reason for poor performance of analysts should likely be in their disability to choose correct discount rate. Our result contributes to literature on efficient market hypothesis, to studies of stock market analyst accuracy and to surveys of best/worst practices of equity valuation.

Аннотация. В статье приводятся эмпирические свидетельства об ошибках в агрегированных прогнозах аналитиков рынка акций, т.е. систематических различиях между прогнозируемыми и наблюдаемыми ценами. В частности, мы показываем, что ошибка не зависит от количества аналитиков, покрывающих акцию, в то время как отрасль, в которую входит акция, играет существенную роль; вместе с тем компании роста в целом имеют большую ошибку по сравнению с компаниями стоимости. Мы также подтверждаем предыдущие свидетельства того, что сложение оценок аналитиков в индекс позволяет сделать оценку более точной (т.е. индекс предсказывается лучше отдельных акций). Вместе с тем EPS прогнозируется лучше, чем цена. На основании указанных фактов мы предполагаем, что основная причина неточности в прогнозах, скорее всего, заключается в неспособности аналитиков выбирать правильную ставку дисконтирования. Наш результат является вкладом в литературу одновременно по теории эффективного рынка, исследования точности аналитиков рынка акций и лучших/худших практик оценки капитала.

Key words: Analyst performance, efficient market hypothesis, equity valuation.

1. INTRODUCTION

There are two types of stock prices: observed and theoretic, or "fair". The latter is usually defined by discounting expected flows from the stock and multiplying it by some factor, reflecting comparative current utility of the risk, implied by holding the stock – approach, generally referred to as "stochastic discounting factor" framework (see, e.g. (Lucas, 1978), (Ross, 1978), (Harrison & Kreps, 1979), (Campbell, 2014)). Though efficient market hypothesis postulates that there should be no systematic difference between the fair and observed price, at least from the seminal papers by (Shiller, 1993) and (Mehra & Prescott, 1985), it is generally doubted that this claim is supported by empirical evidence. Many pro-EMH and contra-EMH arguments were brought since then. Instead of directly proxying "fair" price in SDF framework, in our paper we resort to other approach: we calculate divergence between predicted and fair prices and test for possible reasons of such discrepancy. Our approach, thus, is at least particularly in lines with (Fernandez, 2015) and many other papers, published recently on issues of divergence between valuation practice and theory. The rest of the paper is organized as follows: first, we describe the very stylized facts and their derivation; secondly, we discuss possible reasons of errors; in final section we conclude.

2. STYLIZED FACTS

2.1 DATASET AND GENERAL STATISTICS

Our dataset includes estimated stock prices for S&P-500 constituents from 2000 to 2014, taken from Bloomberg. Estimates are aggregated across stocks, and blended 12 months forward. We calculate errors at time t for each stock as follows:

$$E^{t} = \frac{P^{t}_{forecast} - P^{t+12}_{observed}}{P^{t+12}_{observed}} \quad (1)$$

* Несколько стилизованных фактов об аналитических ошибках.

where E^t is error, $P^t_{forecast}$ is forecasted price, and $P^{t+12}_{observed}$ is the price observed in 12 months after forecast. There are 99731 historical and 52279 target returns (hence 52279 errors) in our dataset.

Both observed and target returns exhibit extreme fat tails as compared to normal distribution (Figure 1). While observed prices are extremely leptokurtic (which is in line with previous literature on stock returns stylized facts), target returns are, on opposite, platykurtic. Historical returns are almost symmetrical around its mean with left tail slightly bigger. We confirm widely reported extreme positive bias in analyst recommendations (mean observed return 0.0086 *vs*. mean target return 0.1421, KS-test results: D = 0.5256, p-value < 2.2e-16). Extreme positive bias for target returns leads to significant difference in standard deviations: 0.0857 for historical prices *vs*. 0.1570 for target.

2.2. STYLIZED FACT 1: AGGREGATION OF ESTIMATES ACROSS INDEX DECREASES ERRORS

As was shown in (Didenko, 2014), the index overall level estimates are more accurate than those of the individual stock price. In our research, instead relying on graphical analysis, we choose more rigorous approach and compare average individual errors of stocks in index and average aggregated error of forecasted index price.

As can be seen from the Figure 2, while mean error for the index is 0.1, almost symmetric and normal, mean error for individual stock is right-tailed and leptokurtic with the mean 0.1498.

By applying KS-test, we get D = 0.6055 with p-value < 2.2e-16. Thus, we confirm observation in (Didenko, 2014) that the aggregated expectation of price is more accurate than individual. Several further chapters are dedicated to finding possible reasons for that.

2.3. STYLIZED FACT 2: LEVEL OF COVERAGE IS INSIGNIFICANT

First natural reason for increasing analyst accuracy with aggregation of their estimates in index could be plain offset of individual errors, achieved with pooling together individual target returns: estimated "undershoots" should on average offset "overshoots". Hence our first hypothesis to test would be as follows: the more analysts are covering the stock, and, consequently, the more estimates a stock has, the more accurate will be aggregated estimates for the stock. We

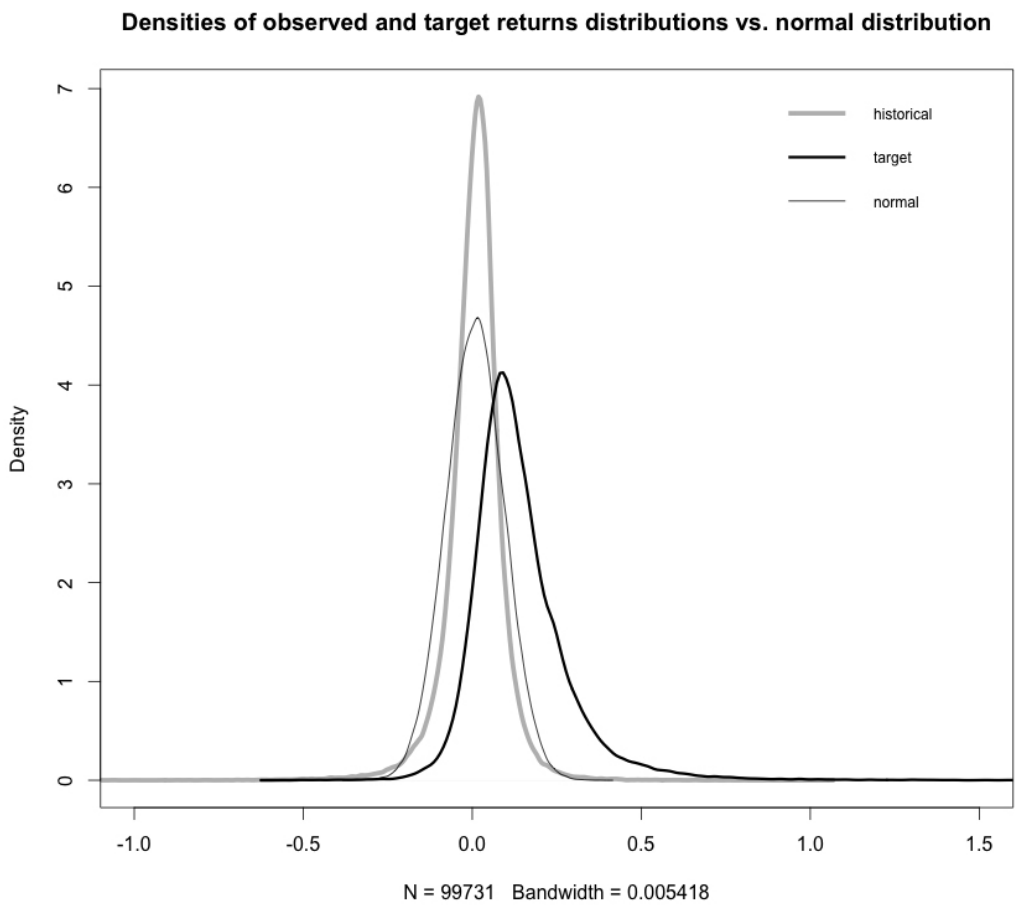

Figure 1.

test it in the following manner: take current number of analysts covering a stock, and correlate it to average error for this stock throughout the whole timespan. Resulting Pearson correlation coefficient 0,03, obtained for an array of 500 stocks in our database, suggests that there is no statistically significant relationship between the scale of error and the quantity of analysts covering the stock. Hence we can conclude that consensual forecast accuracy is not determined by the size of the crowd of analysts watching the stock.

2.4. STYLIZED FACT 3: INDUSTRY IS SIGNIFICANT

Second possible reason of decreasing error with aggregation in wide-market index could be due to industry-level errors offset. For example, analysts could systematically underprice stocks of some industry while overpricing others; it may lead to inefficient estimates of individual stocks, but again, offset errors on index level. That industry-level differential inefficiency could be explained by various factors, including cyclical issues, differences in average maturities of companies across industries, etc. For example, if a company was founded as a zinc extraction and even computer components assembly and successfully operated on the market, for instance, for fifty years, we may consider analyst predictions to be more accurate.

To test this hypothesis we separate errors of companies in our dataset by industries and compare means, deviations and overall form of distributions (Figure 3). Companies in the energy sector were the hardest to predict, which perhaps can be explained by energy markets volatility. In contrast, the utilities segment is predicted best, probably due to relative simplicity of business models of utility companies. In other industries, there are some differences that are at a relatively generic level, while overall result suggesting that industry membership plays significant role for how accurate would be aggregated stock price forecast.

2.5. STYLIZED FACT 4: VALUE COMPANIES ARE HARDER TO PREDICT

In this section we consider such factors as possible discrepancies in errors between the companies often denoted as the companies of growth and value. Growth company is perceived by investors as an object yielding from repricing, or growth, hence an investor would benefit from selling a stock in a future receiving a marginal revenue. From the other side, the value company is a mature corporation that is at par-

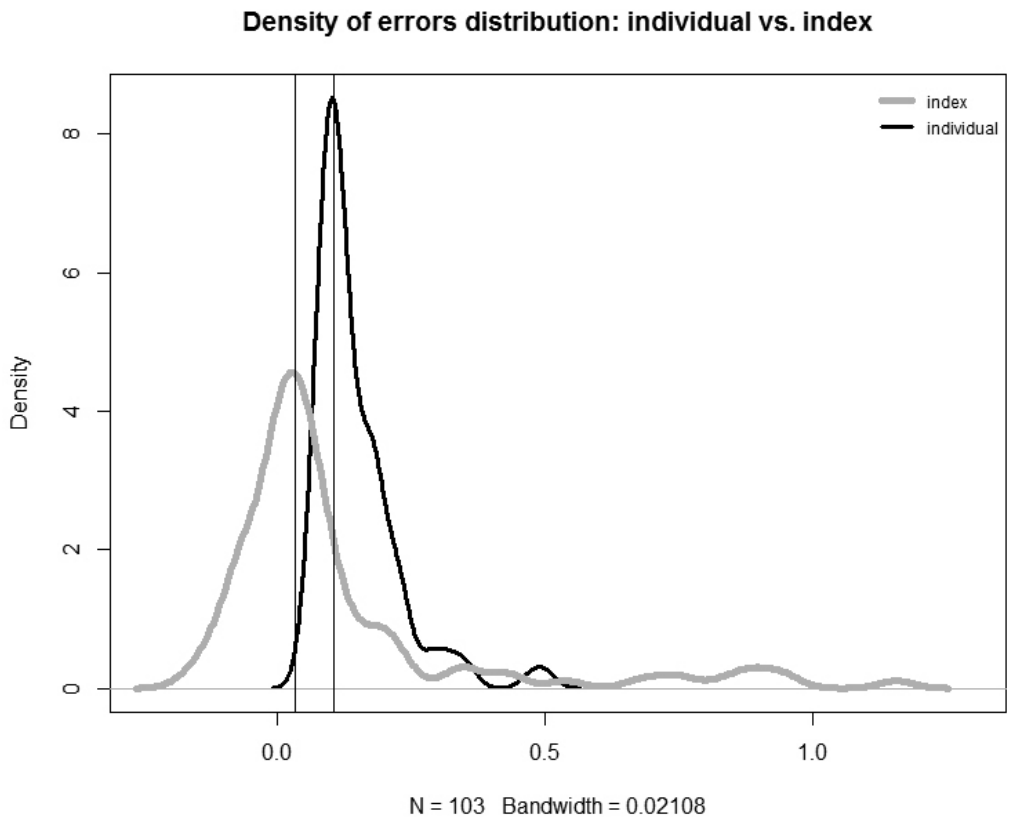

Figure 2.

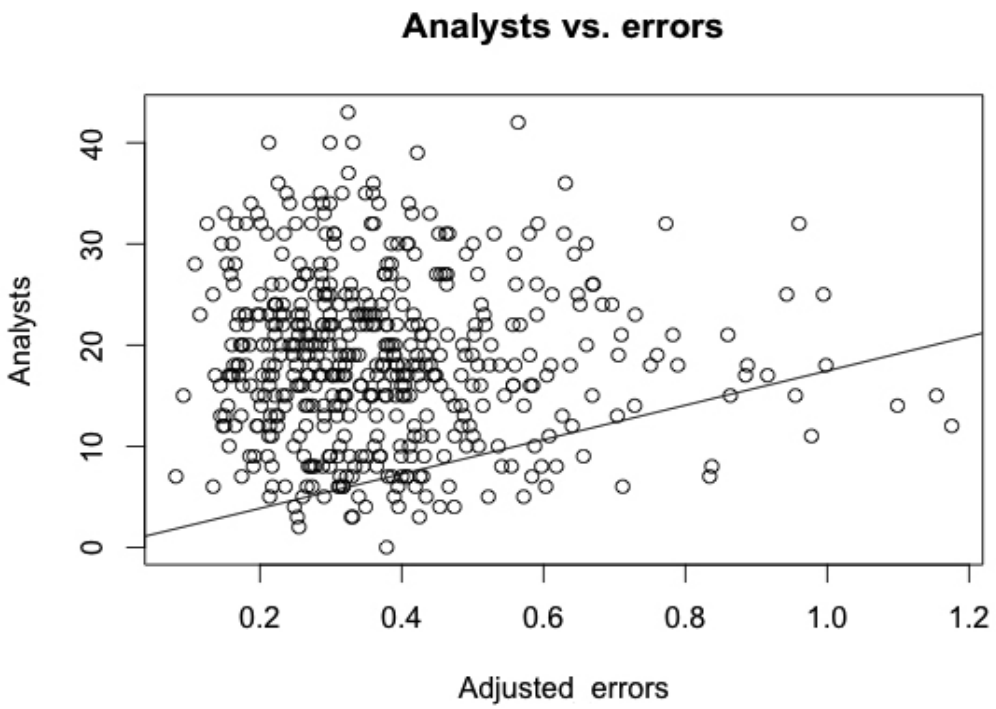

Figure 3.

amount of its growth potential, operating in mature stable industry, which started to pay out dividends.

To test this hypothesis we take extremely best and worst predicted stocks in our dataset throughout the whole history, and check whether there is significant difference in ratio of growth to value companies in these two groups. As a basis we took the natural exponent of P/E and compared it with the average P/E across the whole dataset. Companies with lesser than average P/E were considered value stocks. Extremely best and worst predicted stocks were identified as follows: if the average error for a company during observing period was more than the average error in the sample for the same time period plus ½ of the error, hence the stock can be defined as an error "leader". After that the already described iterations for each leader were produced. Thus, through the implementation of the above plan, we can safely say that the value companies are consistently worse predicted.

2.6 STYLIZED FACT 5: EPS IS PREDICTED BETTER THAN PRICE

If we can not figure out where brokers are wrong, we should find out why they are wrong. It can be elucidated by taking three indicators: share price, sales and EPS, and then by comparing the first to the second and third. Thus, we may have two possible outcomes: either an error is in EPS and sales, or if they, in principle, quite correctly predict these figures, it means that the problem is in the discount rate.

This hypothesis was tested out in the following way. Firstly, we calculate EPS and sales forecast errors analogous to target price errors (i.e. by calculating ratio of difference between indicator's actual value and its 12 months blended forward indicator, to its actual value). Then we apply KS-test criterion to average error for target price and EPS. Result is as follows: D = 0.1884 with p-value = 1.401e-02. Error in EPS is lower than the error in price; hence the case is in the discount rate.

3. DISCUSSION

In this section we elaborate more on possible reasons of deviation of observed prices from prices expected by analysts.

In our research we start from checking whether aggregated expected level of an index is more precise, than a future value of each specific share. Perhaps, averaging of fat-tails at the expense of predictions of the shares having rather high precision can serve one of the reasons for it. It can seem obvious, but it is confirmed with the result we received. The second point is the confuted assumption that the more analysts predict future value of the share, the more exact will be the assessment. Whatever logical this assumption seemed, it is confuted by the value of the Pearson correlation coefficient 0.22 counted in total for five hundred companies of the S&P500 Index. In contrast the result received during research shows that the industry in which the company functions is one of the determining factors in a prediction of future cost of its share. This fact means that there are industries which are easier to predict

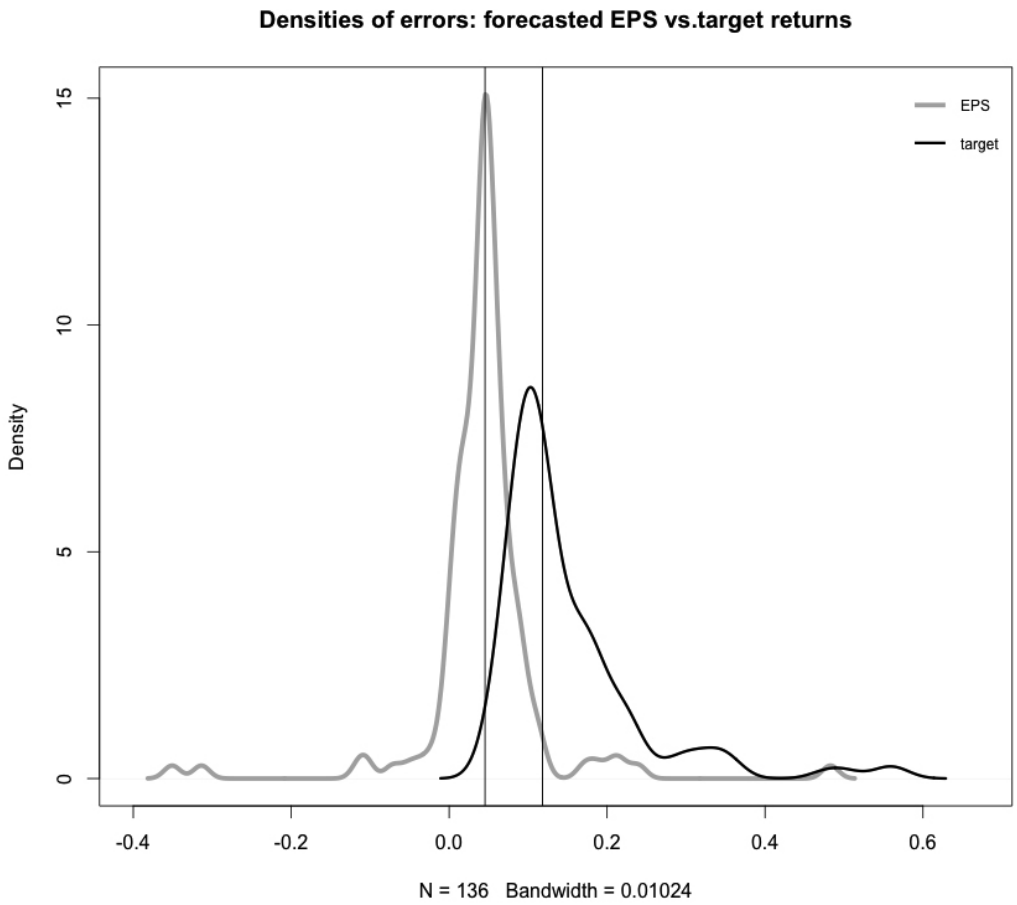

Figure 5.

than others. In other words, the future is not equally ambiguous for all companies. However, there is information that allows starting with something when predicting the future value of the shares, namely confirmed hypothesis that the value companies are worse predicted than the growth companies. Having assumed P/E indicator as a basis we calculated that the companies with the current P/E lower than average P/E of an index have higher and more frequent mistakes that may be due to the fact that it is more difficult to predict the amount of dividend payments than share value, because it is necessary to predict correctly considerable quantity of other indicators, such as sales to the company, profit, net profit etc.

Another hypothesis we confirmed is the case that the EPS indicator of the company is foretold better than share value that, obviously, means that a problem is in a discounting rate. Thus, we localized a problem space of analytical estimates, gave them a chance to be focused on a specific indicator – a discount rate. Even though it opens, perhaps, a large field for research, since the definition of the correct discount rate is very complex, result we received shows to which point analysts need to pay special attention. Difficulties in choosing the right discount rate can occur primarily due to the fact that if brokers take it as WACC, then in one of its components is necessary to use CAPM beta of the future period; the obstacle is that beta is calculated *ex-post* and hence the prediction is biased.

Finally there is a subjective factor; it is perception of market data by every analyst, and as they all cannot be right, which follows from the first hypothesis, the overall result will be anyway wrong.

4. CONCLUSION

Based on our research, it is possible to allocate several noteworthy moments for analysts performing forecasts of the stock quotations. As we found out, the problem is in the incorrect estimates; it lies in wrong determination of a discount rate, and the problem core is that it is necessary to be based on historical data to predict future values.

Thus, analysts should take into account the fact that historical data are not completely representative on the basis of which all expected values for future periods should be taken not as a number, but as an interval. In this manner the total cost of the company should be considered as the consolidated interval calculated on the basis of values of each component of the chosen method. At the same time,

it is necessary to pay attention that if the impossibility of exact determination of any values leads to an essential discrepancies between the predicted and actual value, moreover, to various results of the different analysts using the same method of estimation, perhaps it is necessary to standardize some key parameters, for instance, risk-free rate for several groups of companies.

Thus, in conditions of the current development of the estimation process there are a lot of discrepancies which lead to the fact that a significant role in predicting of future share value plays by the subjective factor. It means that the perception of the veracity of estimation results depends on the estimator's authority.

Perhaps, in the long term it is necessary to test such hypotheses as: whether the mistake in predictions of future share price depends on the size of the capitalization of the company, or on the size of its volatility? Evidently, there are several moments which should be tested and in perspective our research will be more detailed and reflect the current situation in the financial markets.

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Productivity Spillovers from Foreign Direct Investment in Vietnam*

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Abstract. During the last decades the linkage between foreign direct investments (FDI) and economic growth has been extensively reviewed in the economic literature. Theories and modern literature provide conflicting results concerning this issue. Some authors argue that foreign direct investment could result in boosting host country economy, while others believe that FDI may bring about vulnerability and dependence to the country. This paper tries to extract the relationship between foreign direct investment and economic growth, specifically in Vietnam, trying to eventually extract a meaning revelation.

Аннотация. В течение последних десятилетий проблема связи между прямыми иностранными инвестициями (ПИИ) и экономическим ростом широко рассматривается в экономической литературе. Теории и современная литература показывают противоречивые результаты в отношении этого вопроса. Некоторые авторы утверждают, что прямые иностранные инвестиции могут привести к стимулированию экономики принимающей страны, в то время как другие считают, что ПИИ могут вызывать уязвимость и зависимость. В данной статье автор старается проследить взаимосвязь прямых иностранных инвестиций с экономическим ростом, в частности, во Вьетнаме.

Key words: Foreign direct investment, FDI, economic growth, Vietnam.

INTRODUCTION

Since the 1990-s, the expansion of globalization and worldwide trade liberalization has pushed Multinational Enterprises (MNEs) into undertaking a growing number of Foreign Direct Investment (FDI) projects across the world. Many studies compared the efficiency between FDI and domestic investment, and most economists tend to favor the free flow of capital across national borders, because it allows capital to sort out the highest rate of return. Therefore, many economies around the world would invest significant resources to attract FDI.

Foreign direct investment serves as a form of international capital flows. It is considered to play an important role in the process of world capital allocation across countries. It is often pictured, together with other forms of capital flows, as shifting capital from well-off, capital-abundant economies to poor, capital-scarce economies, so as to close the gap between the rates of return to capital and strengthen the efficiency of the worldwide stock of capital.

Based on the motive behind the investment from the perspective of the investors, FDI can be divided into three types. The first type of FDI is called market-seeking FDI, whose foremost aim is to serve local and regional markets. It is also called horizontal FDI, as it involves replication of production facilities in the host country. As the reason for horizontal FDI is to better serve a local market, market growth, local production and market size of the host economy play important roles. Barriers to accessing local markets, such as tariffs and transport costs, also encourage this type of FDI. The second type of FDI is called resource-seeking or vertical: when firms invest abroad with main goal to obtain resources not available in the home country, such as natural resources, raw materials, or/and low-cost labor. Particularly in the manufacturing sector, when multinationals directly invest in order to export, factor-cost considerations become important. In contrast to horizontal FDI, this type of FDI involves relocation of parts of the production chain to the host country. Low-cost labor is usually the biggest driver for export-oriented FDI. The third type of FDI, called efficiency-seeking, takes place when the firm can benefit from the common governance of geographically dispersed activities in the presence of economies of scale and scope.

Moving on, the impact of FDI on economic growth has been an interest for many empirical studies. For

* Переливы продуктивности от прямых иностранных инвестиций во Вьетнаме.

developing countries, FDI has by far proved to be more efficient than domestic investment in host developing countries. Hereby, while there is substantial evidence that foreign investments are more efficient than domestic ones, the evidence of its effects on the economy remains relatively mixed.

LITERATURE REVIEW

Foreign direct investment is a particular type of foreign capital, as opposed to domestic investment. The International Monetary Fund's Balance of Payments Manual defines FDI as "investment that is made to acquire a lasting interest in an enterprise operating in an economy other than that of the investor, the investor's purpose being to have an effective voice in the management of the enterprise"[1]. While OECD's benchmark definition of FDI identifies FDI's objective is to obtain a lasting interest by a resident entity ("direct investor") in one economy other than that of the investor ("direct investment enterprise"). The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence on the management of the enterprise[2].

Many studies compared the efficiency between FDI and domestic investment. For developing countries, FDI has proved to be more efficient than domestic investment in host developing countries. Borensztein E., De Gregorio, J. and Lee, J.W. used a model where economic growth is determined by FDI, human capital, government expenditure, domestic investment, inflation rate and institutions. As a result, they found that: FDI inflows positively influence economic growth, and FDI and domestic investment were complementary[3]. However, De Gregorio in his study on Latin America finds that FDI was three times more efficient than domestic investment[4]. Blomstrom *et al.* and his colleagues confirm that there was no evidence of "crowd out" effect on domestic investment[5]. In contrast, after running the model for 12 countries during the period 1971–2000, Agosin and Machado conclude that in three developing regions (Africa, Asia and Latin America), FDI has no influence on domestic investment. There are several sub-periods for specific regions where FDI displaces domestic investment[6]. Hence, the effects of FDI are discussable.

Although empirical studies have been conducted in different areas and countries of the world to examine the relationship between FDI and economic growth, not much literature has been found for the case of Vietnam. The main obstacle is that there is not enough data available to conduct any system of regression equation; hence the sample might be small due to a short timeframe. Moreover, the two-way linkage between FDI and economic growth in which FDI promotes economic growth and, in turn, economic growth is viewed as a tool to attract FDI is not thoroughly investigated. This paper attempts to analyze the outstanding problem.

According to the Foreign Investment Advisory Service (FIAS) of World Bank, Vietnam had the highest level of FDI as percentage of GDP among all the developing economies during the transitioning period[7]. Factors that stimulated the foreign investor appetite for Vietnam, as suggested by various authors, both foreign and native, included the market size, accessions of Vietnam in international and global organizations, associations and agreements (ACEAN, WTO, BTA, etc.), the attractiveness of a transitional economy, the strong work ethos, the high levels of education yet relatively low labor rate, plentiful resources, and so on (Le Dang Doanh[8], Nguyen Phi Lan[9], Schaumburg-Muller[10], Andréosso-O´Callaghan[11] etc.). Geographical location was also one factor that led to the impressive rise in FDI inflows to Vietnam[12].

Subsequently, in order to thoroughly analyze the factors influencing FDI, studies have been conducted

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during different timeframes using diverse types of methods, applying either to regions, industries or to the whole country; hence the results may lead to variation of the authors' opinions.

For instance, Nguyen Phi Lan – together with Sajid Anwara – in 2010, using simultaneous equations model, revealed that in overall terms a mutually reinforcing two-way linkage between FDI and economic growth exists in Vietnam. However, this is not the case for each and every region of Vietnam. The results presented in this study suggest that the impact of foreign direct investment on economic growth in Vietnam will be larger if more resources are invested in education and training, financial market development and in reducing the technology gap between the foreign and local firms[13]. The same results were derived from researches done by Nguyen Dinh Chien, empirical results of which showed that FDI has a positive impact on economic growth of Vietnam only in 4 out of 6 regions[14]. In another paper he analyzed the North Central Area and South Central Coast of Vietnam, both of which showed different levels of bidirectional relationship between FDI and GDP[15]. And last but not least, Malesky Edmund also noticed differences in reaction of each province to FDI and vice versa, how FDI helps to explain variation in provincial economic governance[16].

Another study from Nguyen Phi Lan and Sajid Anwara in early 2011 examined the impact of FDI on exports, imports and net export of Vietnam based on a recently released panel dataset involving Vietnam's 19 major trading partners. The empirical analysis reveals that a complementary relationship exists between FDI and exports and FDI and imports[17]. Three months later the duo wrote another article on FDI and export spillovers. According to them, the presence of foreign firms in Vietnam, through horizontal and forward linkages, significantly affects the decision of domestic firms to export as well as their export share[18]. A year before they already covered the problem of investment-linked spillovers and economic growth in Vietnam. Empirical results suggested that FDI-generated spillovers have made a significant contribution to manufacturing sector growth in Vietnam through vertical-backward linkages. The positive impact of vertical-backward linkages on manufacturing sector growth is strengthened by the stock of human capital. Specifically, manufacturing industries with a larger stock of human capital have experienced a higher level of technological advancement and hence stronger economic growth[19]. A study from Thu Thi Hoang, Paitoon Wiboonchutikula and Bangorn Tubtimtong confirmed those results, stating that there is a strong and positive effect of FDI on economic growth in Vietnam as a channel of increasing the stock of capital. However, human capital and trade in Vietnam are not yet the channels that give access to advance technology and knowledge transfers from FDI inflows to increase Vietnamese economic growth[20]. Nguyen Kim Anh also considered the fact that FDI may contribute to generation of positive inter-industry spillover in the form of backward/forward linkage effects in some industries, yet may cause negative impact on others[21].

INVESTMENT AND FDI IN VIETNAM

Located in the midst of one the most dynamic economic region, in Southeast Asia, Vietnam took on an ambitious economic reform at the end of the 1980-s named *Doi Moi*, which included foreign direct investment (FDI) policies aiming to promote national economic development through technological transfer and employment generation. Over the past few decades, Vietnam has achieved a most remarkable economic development that has radically transformed the economic outlook of the country. One of the objectives of the *Doi Moi* reform was a move towards openness. Thus, already in 1987 a new Foreign Investment Law was promulgated by the Vietnamese government. Since then various measures have been taken to increase the

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attractiveness of Vietnam for FDI (i.e. simplified access to licenses for FDI, various investment incentives and reduced restrictions on FDI).

Vietnam has a favorable geographical location right at the heart of East Asia – home to a number of large and vibrant economies. Furthermore, the country is a market economy, a member of the WTO, and a party to multiple frameworks for international economic integration, including free trade agreements with partners both within and outside the region. In particular, the country is part of the Trans-Pacific Partnership negotiations. These factors all go the same way to explaining why so many choose to invest in Vietnam – and should draw in more foreign investors.

Concerning typology and characteristics of investment in Vietnam, according to the General Statistical Office (GSO)[22], in Vietnam the majority of foreign enterprises, 51.6 per cent, are large, while around 28 per cent are small, and around 20 per cent are medium; almost 70 per cent are TNCs and only one third (31 per cent) are stand-alone enterprises. The database is quite balanced in terms of country of foreign investor origin: around 57 per cent originate from industrialized countries, whereas some 43 per cent come from developing countries. Foreign enterprises are mainly located in the province of Binh Duong (33.5 per cent), Ho Chi Minh City (22.4 per cent), Dong Nai (21.5 per cent) and Hanoi (around 10 per cent). In terms of sectorial distribution, three sectors – fabricated metal products (except machinery and equipment), wearing apparel, and plastics products – constitute approximately one quarter, with a high presence of the furniture, textiles and computer, electronic and optical products industries. Categorization according to technology level (following OECD 2005) – shows that most enterprises fall into the low-technology level (47 per cent). Around 28 per cent of foreign firms are located in the high-technology industries, and 22 per cent – in medium-technology manufacturing activities.

Next, Vietnam has been securing socio-political stability, and is known to be one of the most dynamic economies. Economic growth between 1991 and 2010 averaged 7.5% each year and, despite of many difficulties the country faced between 2011 and 2013, GDP growth still rose by 5.6%. Several international forecasts suggest that this trend will continue in 2014–2015 and beyond.

To add new chapters to this success story, the Vietnamese government is continuing to revitalize its business and investment climate. One way it is doing this is its work on three "strategic breakthroughs": putting in place market economy institutions and a legal framework; building an advanced and integrated infrastructure, particularly transport; and developing a quality workforce. These should all be completed by 2020.

The government remains determined to fulfill its treaty obligations and promote the negotiation and conclusion of a new generation of free trade agreements. Vietnam views the success of FDI enterprises as its own success. As such, the government is committed to ensuring a stable socio-political environment, protecting the legitimate rights and interests of investors, and creating an enabling environment for FDI enterprises in the country.

EMPIRICAL RESEARCH

The paper uses a panel data set covering the period 2005 to 2013, constructed from the Statistical Yearbook of Vietnam published annually by General Statistics Office of Vietnam. This Yearbook comprises basic data reflecting the general socio-economic dynamic and situation of the whole country, regions and provinces. In addition, this publication also contains selected statistics of countries and territories in the world to provide reference information for studies and international comparison.

The local TFP was modeled using the DEA (Data Envelopment Analysis), which is a nonparametric method in operations research and economics for the estimation of production frontiers[23]. The framework has been adapted from multi-input, multi-output production functions. Thus we can translate this into a function transforming the energy consumption, labor force and capital investment (or fixed assets) into the GDP. The model is adopted by the one suggested by Didenko A. and Egorova T. in 2014 and is formulated as follows[24]:

$$log(TFP) \sim log(EnergyCons) + log(Labor) + log(FixAssets) + FDISpill$$

where TFP stands for total factor productivity, EnergyCons translates energy consumption, Labor is labor force, FixAssets implies Fixed assets and FDISpill denotes FDI spillovers, which are measured as the ratio of

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[24] Didenko A., Egorova T. 2014. *Innovations as Factor of Absorptive Capacity of FDI Spillovers across Regions of Russian Federation.* Review of Business and Economics Studies, Volume 2, Number 3.

Coefficients:

	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	−1.0460e+01	3.1548e+00	−3.3155	0.001727 **
log(EnergyCons)	−1.4962e+00	3.3513e−01	−4.4645	4.718e−05 ***
log(Labor)	1.6814e+00	3.8311e−01	4.3889	6.055e−05 ***
log(FixAssets)	−3.9381e−02	7.4032e−02	−0.5319	0.597171
FDISpill	1.8390e−03	8.4983e−04	2.1640	0.035366 *

R-Squared: 0.84335
Adj. R-Squared: 0.76526

FDI capital to total volume of capital of enterprises. The one-way (individual) Random Effect Model was also estimated.

As a result, all coefficients are proved to be significant except for Fixed Assets. While energy consumption is tested to affect TFP negatively, other factors show positive influence. R-Squared or coefficient of determination is relatively close to unity (0.84335) indicating how well data fit a statistical model or how well observed outcomes are replicated by the model, which in our case is good. Adjusted R-Squared, the coefficient of determination that compares the explanatory power of regression model that contains different numbers of predictors, is equal to 0.76526, which is comparatively high, meaning a good regression quality and is proved to be less than R-Squared. The results also show that the impact of FDI spillover effect is positive meaning foreign direct investments may contribute in boosting local productivity in the forms of spillovers.

Subsequently, the following revelations can be obtained. Among the other positive areas, improved efficiency in implementing FDI, skilled human resource with the competitive wage level, improvements in the quality of transport and energy infrastructure can be observed to positively influence the quality and the quantity of FDI inflows into Vietnam. However, with ever growing prices of electricity and other energy resources in the country, energy consumption was shown to affect TFP negatively. Besides, while Vietnam has a potential to attract a critical mass of FDI to accelerate its industrialization, the number of projects and registered and implemented capital are still relatively small and tend to fluctuate annually.

In short, as a major growing emerging economy, Vietnam has integrated into the global economic and business environment and developed a dynamic open market economy. In order to overcome outstanding problems and to enhance the role of FDI in Vietnam's development process policymakers need to improve the investment environment to attract foreign capital inflows for sustainable growth (i.e. more simplified process of granting licenses for FDI, better investment incentives and reduced restrictions on FDI). Moreover, legal framework needs to be more transparent and stable to satisfy foreign investor's requirements, and Vietnam's FDI attraction strategy also needs completion. Then, the attraction of high-quality, capital-intensive, advanced technology FDI projects requires a certain skillful labor force along with better infrastructure, hence the strategy for training a good quality labor force is necessary.

CONCLUSION

In the medium and long term, Vietnam will continue its efforts to attract and efficiently use FDI inflows to advance socio-economic development. The country will target "high quality" FDI inflows, focusing on FDI projects that use advanced and environmentally friendly technologies, and use natural resources in a sustainable way. It will also target projects with competitive products that could be part of the global production network and value chain.

International forecasts suggest that as the world economy recovers, FDI flows will be returning to dynamic economies. Given the positive prospects for both global and regional economies, hopefully Vietnam will continue to find success in this area.

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Exchange Rate Management in Vietnam for Sustaining Stable and Long-Term Economic Growth*

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Abstract. The purpose of this paper is to measure empirically the effects of currency depreciation on inflation and trade balance in the case of Vietnam. The author utilizes the quarterly data from 2000 to 2012 for the Vector Auto-Regression (VAR) model to build the impulse response functions and variance decompositions of inflation and trade balance. The obtained results are remarkably consistent with economic principles in the theory review. The impulse response functions indicate that currency depreciation has considerable negative impact on inflation while having fairly positive impacts on trade balance. However, variance decompositions of trade balance show that exchange rate itself can hardly explain much about the change in trade balance. Basing on these results, the author proposes (1) stabilization of exchange rate to restrain inflation and (2) enhancing the quality of exported goods to improve competitiveness.

Аннотация. Целью данной работы является эмпирическое измерение влияния обесценивания валюты на инфляцию и торговый баланс на примере Вьетнама. Автор использует квартальные данные с 2000 по 2012 год для построения модели вектора авторегрессии (VAR). Полученные результаты полностью соответствуют принципам экономической теории. Функции импульсных откликов показывают, что обесценение валюты оказывает значительное негативное воздействие на инфляцию, имея при этом положительное влияние на сальдо торгового баланса. Основываясь на полученных результатах, автор предлагает: 1) использовать стабилизацию обменного курса для сдерживания инфляции; 2) повышать качество экспортных товаров для повышения конкурентоспособности.

Key words: Exchange rate, inflation, trade balance, Vietnam, VAR model.

1. INTRODUCTION

Exchange rate has long since been a controversial issue concerned by both macroeconomic policy makers and most of the population. By nature, exchange rate is simply the price of a currency denominated in another one; nonetheless, in a highly open economy like Vietnam, exchange rate exerts strong impacts on other macroeconomic variables, most significantly inflation and trade balance. In theory, the situation is even more complicated as the impacts of exchange rate on inflation and trade balance are mutually contradictory: an increase in exchange rate will help to improve the trade balance while affects inflation negatively, *vice versa*. Therefore, developing optimal exchange rate policy for satisfying both of the factors is critically important to keep inflation under control while gradually improving trade balance. There have been quite a few researches in the world in this topic, namely those of Amit Ghosh (2008), Atish R. Ghosh (2006), Khim-Sen Liew (2005) and Michele Ca Zorzi (2007). These researches have provided both a general background in and deep insight to this issue of South East Asian nations in particular and emerging economies in general. Among these countries, the case of Vietnam is of special interest of Carmen Ulrich (2006), Vo Tri Thanh (2011), Nguyen Van Tien (2009), Nguyen Thi Hien (2011), Nhat Trung (2011), Nguyen Duc Thanh (2011) and Nguyen Thi Kim Thanh (2011). However, all of these researches have only focused on either the inflation aspect or trade balance aspect rather than taken the trade-off between them into consideration.

* Управление обменным курсом для поддержки стабильности экономического роста во Вьетнаме.

2. THEORY REVIEW OF EXCHANGE RATE'S EFFECTS ON INFLATION AND TRADE BALANCE

2.1. EFFECTS OF EXCHANGE RATE ON INFLATION

In 1990s, exchange rate was proved to have effects on inflation which was called exchange rate pass-through (ERPT). The strength of the effect depends on three fundamental passages, including the direct one, the indirect one and the behavioral one.

For the direct passage, an increase in the exchange rate will inflate the price of imported goods denominated in the domestic currency. This will, in turn, raise the domestic price level as much as the imported goods play their role in total domestic consumption. Besides the immediate consumption, some of the imports are also inputs for domestic production. The higher price of the inputs will be partly transferred to the final price of the products, which also contributes to the rise in national price level.

For the indirect passage, by the same manner, currency depreciation will push up the price of imported goods denominated in the domestic currency. This will, in turn, make the domestic goods become relatively cheaper, which encourages people to switch from the imported goods to the domestic ones (expenditure-switching effect). In addition, an increase in the exchange rate will reduce the price of exported goods denominated in the foreign currency. Then the exported goods would be more competitive in term of price, which will boost the foreign demand of these goods (expenditure-changing effect). Both of these spur the demand for domestic goods, fueling the demand-pull inflation. Moreover, in the specific case of Vietnam, the depreciated currency and the trend of economic openness have attracted foreign investment, increased labor demand, and then raised the domestic wage level. This occurrence causes both cost-push and demand-pull inflation.

For the behavioral passage, in most developing countries with economic instability and high and persistent inflation, their people have the tendency to lose confidence in the domestic currency. Especially, in these countries, most of the population is of low educational level; therefore, there is much room for the speculators to manipulate the exchange rate. In case the domestic currency is devalued, the magnitude of the devaluation will be greater with the phenomenon of speculation, intensifying the ERPT effect. Further, the act of devaluation is a clear signal that the government is losing its control over inflation. This provides a sound basis for the people to expect higher inflation in the future, and expected inflation also plays a notable part in the increase of the real inflation.

2.2. EFFECTS OF EXCHANGE RATE ON TRADE BALANCE

Three economic theories have approached the effects of exchange rate on trade in various ways. These approaches have complemented each other and helped to understand more deeply the effects in particular situations.

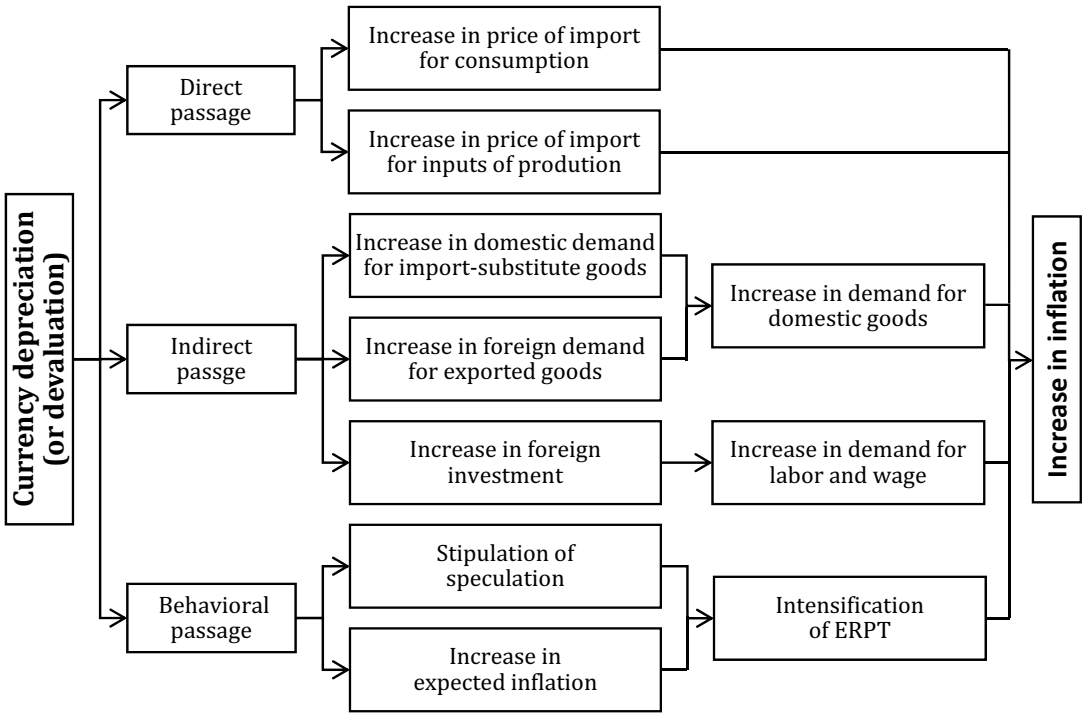

Figure 1. Three passages of exchange rate pass-through effect.

For the theory of price elasticity of demand, nominal devaluation would be able to improve the trade balance as long as foreign demand for the exported goods is price elastic. Given that the price of exported goods denominated in foreign currency is unchanged, the revenue of the exporter will go up. This will, in turn, increase the volume of export and the opposite will happen to the volume of import and *vice versa*. The power of exchange rate over trade balance depends on the price elasticity of demand of the goods. The more elastic the demand is, the stronger the effect is.

For the theory of aggregate expenditure, only if the national income exceeds its aggregate expenditure could trade balance be improved by currency devaluation. This theory emphasizes on the power of exchange rate over national income, aggregate expenditure, and ultimately trade balance. When the government conducts devaluation of the domestic currency, the value of export will rise and the opposite will happen to import, which eventually stimulates aggregate demand. In case the economy is not producing at its potential level, it will have enough unemployed resources to increase the output to meet the higher aggregate demand. On the contrary, in case the economy is producing at its potential level already, it cannot produce more outputs. Then the increase in aggregate demand will push up wage and price level speedily, which erodes the country's international competitiveness and drives the trade balance back to the initial level. When the wage and price level increase by the same proportion that the currency has been devalued by, the country's international competitiveness will also come back to its initial level.

For the monetary theory, trade balance is of monetary nature; thus, it needs to be systematically analyzed through the supply and demand of money. The imbalance of trade balance is the manifestation of the imbalance in the money market. Devaluation of a currency, at first, may raise the domestic price level, which makes the country's residents cut back on spending. And then the trade balance would be improved swiftly but the new equilibrium is only maintained in short term. Due to the higher price level, there is an increase in money demand which gradually drives the trade balance back to the original level with a lower price level, however, still higher than the initial one. Even though this overshooting effect happens in a short amount of time, it is widely considered favorable by the authority, especially in developing countries, as it allows the foreign-exchange reserve to be built up without worsening the trade balance. Nevertheless, in case the devaluation is expected precisely by the population, the process will happen in no time and the devaluation will be ineffective even in the short-term.

3. QUANTITATIVE ANALYSIS OF EXCHANGE RATE'S EFFECTS ON INFLATION AND TRADE BALANCE

3.1. METHODOLOGY AND DATA

In this section, the modern quantitative method, econometrics, is utilized to analyze the effects of exchange rate on inflation and trade balance in the case of Vietnam in the period from 2000 to 2012. Year 2000 is chosen to be the starting year as Vietnam has been taking actions to liberate the foreign exchange market since 1999. The liberation movement starting with Resolution No. 65/1999/QĐ-NHNN7 of State Bank of Vietnam (SBV) is highly crucial as it is the indispensable prerequisite for economic laws to be applied in any econometric model. The data for the model is collected quarterly, including 52 observations and meeting the large-sample-size requirement (more than 30 observations).

As all of the variables in the model are time series ones and some of them have the manifestation of autocorrelation; Vector Autoregression (VAR) model is employed to handle the two issues effectively. The VAR model is the transformation of the Autoregression model into vectors of economic variables. VAR model is especially useful for forecasting as the relationships between economic variables are not always one-way ones (independent variables influence dependent ones), but in many cases, dependent variables could have influence back on independent ones. Besides, VAR model also has several advantages including rather easy implementation, conventional inference, lag length criteria, impulse response function and variance decomposition. The equations of the VAR model used in this paper are the following:

$$CPI_t = \propto + \sum_{j=1}^{k} \beta_j * CPI_{t-j} + \sum_{j=1}^{k} \gamma_j * MS2_{t-j} + \sum_{j=1}^{k} \delta_j * LEN_{t-j} + \sum_{j=1}^{k} \theta_j * EXR_{t-j} + \sum_{j=1}^{k} \omega_j * TBR_{t-j} + \varepsilon_t$$

$$TBR_t = \propto' + \sum_{j=1}^{k} \beta'_j * TBR_{t-j} + \sum_{j=1}^{k} \gamma'_j * MS2_{t-j} + \sum_{j=1}^{k} \delta'_j * LEN_{t-j} + \sum_{j=1}^{k} \theta'_j * EXR_{t-j} + \sum_{j=1}^{k} \omega'_j * CPI_{t-j} + \varepsilon'_t$$

Where:

CPI stands for Consumer Price Index and acts as the inflation index. Its index reference period is year 2000.

TBR stands for Trade Balance Ratio, and it is calculated by dividing the total export turnover of Vietnam in one year by its total import turnover. Increase in trade balance ratio means trade balance is improved. It has also been mathematically proved that the percentage change in trade balance ratio is approximately equal the percentage change in trade balance itself.

EXR stands for exchange rate of Vietnamese Dong (VND) to US Dollar (USD). The data on exchange rate is announced by SBV daily then consolidated quarterly by computing the average.

MS2 stands for money supply of type M2 including all cash, transactional accounts and time deposits in the economy. Even though change in money supply may not exert any impact on inflation immediately, excessive increase in money supply has been proved to be the most fundamental cause of inflation in the mid-term and the long-term.

LEN stands for the average short-term lending rate of commercial banks. The rate is usually for three month loans and announced by SBV. It wields great and direct influence upon the import condition as most of the firms in the import business have to borrow to imported goods. Increase in short-term lending rate will reduce the profit of the business and drive down the amount of import.

The data is collected quarterly from the first quarter of year 2000 to the fourth quarter of year 2012. The sources of data for exchange rate and lending rate are obtained from SBV; those for inflation and total import-export turnover is collected from General Statistics Office of Vietnam; those for money supply and others indicators are attained from International Financial Statistics, Databank of World Bank and Annual Reports of Asian Development Bank. All of the seasonal component of the data are removed by X-12-ARIMA Seasonal Adjustment Program of US Census Bureau. First difference of common logarithm of some variables is calculated to measure the growth rate of these variables quarterly.

3.2. TEST FOR STATIONARITY AND LAG LENGTH SELECTION

To avoid the phenomena of spurious regression in the equations, Augmented Dickey-Fuller test is used for all variables in the model (Table 1). The tested lag length is selected according to Schwarz Information Criterion with the maximum lag length of 12 quarters.

Sequential modified Likelihood-Ratio test (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz information Criterion (SC) and Hannan-Quinn information criterion (HQ) are utilized to determine the optimal lag length for the variables in the model (Table 2). According to these criteria, one quarter and three quarters are the optimal lag length. Nonetheless, one quarter lag length seems not to be of common economic sense. Moreover, many quantitative researches (Khim-Sen Liew, 2004) have proved that AIC and FPE criteria are preferable for time series data with less than 120 observations. In addition, AIC and FPE criteria are also least likely to be confronted with the underestimate issue. LR criterion is often employed to test the stability of AIC and SC criteria. Hence, the lag length of three quarters is selected due to LR, FPE and AIC criteria which are more creditable.

4. FINDINGS ABOUT ECONOMETRIC MODEL

4.1. FINDINGS ABOUT EFFECTS OF EXCHANGE RATE ON INFLATION

Analyses of impulse response function of inflation to exchange rate are reasonably consistent with economic theories and estimation for the case of Vietnam (Appendix 2). Response of inflation to a

Table 1: Test for stationarity of variables in model.

Variable	ADF test	Stationarity	Variable	ADF test	Stationarity
CPI	4.480050	Non–stationary	dlogCPI	–4.238069***	Stationary
TBR	–3.582007***	Stationary			
EXR	0.113497	Non–stationary	dlogEXR	–1.640168**	Stationary
MS2	1.985719	Non–stationary	dlogMS2	–4.281709***	Stationary
LEN	-1.351350**	Stationary			

****, **: statistically significant at 1% and 5% level, respectively.*

Table 2. Selection of optimal lag length for model.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	657.0107	NA	1.09e–18	–27.16711	–26.97220	–27.09345
1	749.4069	161.6934	6.64e–20	–29.97529	–28.80579*	–29.53333*
2	771.4099	33.92126	7.79e–20	–29.85041	–27.70633	–29.04016
3	804.6235	44.28476*	6.06e–20*	–30.19265*	–27.07398	–29.01410
4	821.8628	19.39426	1.01e–19	–29.86928	–25.77603	–28.32244

*: the optimal lag lengths selected by the criterion.

positive exchange rate shock is negligible in the first three quarters. Somehow, in the period, increase in exchange rate discourages import and then reduces aggregate demand, bringing down the inflation, which is a minimal effect. Inflation is not affected immediately due to price stickiness. For example, contracts signed previously are carried out with the price in the past, which makes the price level to be rigid in the short term. After the third quarter, inflation starts to rise quickly, reaches the peak in the sixth quarter, then gradually lowers until the eighth quarter and becomes stable. The reason why inflation cannot achieve the state of equilibrium in the first six quarters is that inflation may overreact to the change in exchange rate (overshooting effect) and it takes time to reconcile the expected inflation with the actual one. Quantitatively, the accumulated response of inflation to an exchange rate shock is 0.338, which means that an 1% increase in exchange rate will be translated into a 0.338% increase in inflation in eight quarters. According to a research by IMF (2007), the ERPT of Taiwan, China, Korea and Thailand are 0.02%, 0.07%, 0.12%, and 0.28%, respectively. That ERPT of Vietnam is relatively high in comparison with other nations in the region, which could be attributed to high and persistent inflation, import as a large proportion of consumption and inputs of domestic industries, rampant speculation among the population, etc.

The variance decomposition of inflation (Appendix 3) indicates the substantial influence of exchange rate over inflation. In the first two quarters, when a change in exchange rate has not yet exerted considerable impact upon inflation, it only accounts for about 8% of the change in inflation. From the third quarter, exchange rate explains more and more variation in inflation. In the long term, up to 19% of fluctuation in inflation could be attributed to an exchange rate shock. Besides exchange rate, inflation in the past (causing expected inflation) and trade balance are also major factors behind changes in inflation. Contrary to exchange rate, expected inflation has the greatest impact on inflation in the first two quarters; it accounts for 100% and 88% in the first and second quarter, respectively. Then the impact is gradually alleviated and becomes stable at 52% in the long term. For the influence of trade balance on inflation, as it demonstrates strong correlation with GDP, improvement of trade balance could increase GDP, causing the demand-pull inflation.

4.2. FINDINGS ABOUT EFFECTS OF EXCHANGE RATE ON TRADE BALANCE

Analyses of impulse response function of trade balance to exchange rate are also reasonably consistent with economic theories and estimation in the case of Vietnam (Appendix 2). To a positive exchange rate shock, trade balance is improved insignificantly in the first two quarters. An increase in exchange rate will immediately encourage available extra export (marginal export) and discourage easy-to-substitute export (marginal import). This effect has no impact on the structure of import and export. After the second quarter, the trade balance ratio worsens continuously for three quarters. The reason for this worsening is the overwhelming of price effect over volume effect: (1) lower revenue from export turnover, (2) higher cost for import in total. From the fifth quarter, trade balance is improved again due to the growing stronger volume effect and the adapting structure of import and export for more export and less import. After nine quarters, the effects of exchange rate on trade balance diminish completely. Quantitatively, the accumulated response of trade balance ratio to an exchange rate shock is 0.00255, which means that an 1% increase in exchange rate will be translated into a 0.255% improvement in trade balance in nine quarters. The impulse response function of trade balance ratio exhibits the tendency to closely resemble the J curve effect. If Vietnamese Dong is devalued by 1%, the economy will endure a four quarter period of trade balance worsening with the accumulated effect equal to 0.138% of the total import and ex-

port turnover in a quarter. In 2012, the total import and import turnover was about 28.448 billion USD, then the possible amount of trade balance worsening is approximately 39.144 million USD, as much as 0.098% of the foreign reserve of Vietnam by the end of the first quarter in 2013. However, the net accumulated improvement of trade balance ratio which is only 0.224% (equal to merely 63,946 million USD) could be considered fairly modest.

The variance decomposition of inflation (Appendix 3) shows that the influence of exchange rate over trade balance is not as much as conventionally expected. In the first four quarters, exchange rate only accounts for up to 10.64% of the variation in trade balance. From the fifth quarter, exchange rate explains a little bit more change in trade balance, from 13.44% to 17.03%. In the long term, from 13% to 15% of fluctuation in trade balance could be attributed to an exchange rate shock. Meanwhile, trade balance ratio is affected mostly by the value of itself in the past, not by the exchange rate as the conventional belief. Up to 85% of the variation in trade balance is explained by the value of itself in the past for the first quarter. The rate gradually slows down to 61% in the second quarter and 50% in the third quarter. This phenomenon could be interpreted as follows. How well the goods are exported depends largely on their quality: if a kind of goods has been exported well in the past they will continue to be exported well in the future, and *vice versa*. Specifically, if the quality of goods meets the requirements widely accepted all over the world, the market for the goods is potentially huge. This means the demand for the goods is rather price-elastic and a relative reduction in price would encourage exporting more goods. However, the opposite happens in the case of Vietnam. As most of the country's exported goods are low quality ones, raw materials, or unprocessed produce, their price elasticity is quite low. In brief, the quality of exported goods is the decisive factor in how much Vietnam could export.

5. CONCLUSIONS AND POLICY PROPOSALS

Two conclusions could be derived from this paper: Firstly, in the case of Vietnam, an increase in exchange rate could affect inflation negatively and the influence is relatively profound in comparison with other nations in the region. This could be attributed to some specific factors of the country that maintain ERPT at high level. They consist of, mainly but not exclusively, high and persistent inflation, import as a large proportion of consumption and inputs of domestic industries, rampant speculation among the population.

Secondly, a positive exchange rate shock could improve Vietnam's trade balance slightly; however, compared with other factors, it just plays a lesser role in explaining the variation in trade balance. This could be due to the fact that Vietnam has not achieved enough prerequisites for a successful currency devaluation which can substantially improve the trade balance. For Vietnam, the most essential condition among these ones is that its exported goods have not met the criteria to be internationally tradable ones.

Quantitatively, an 1% increase in exchange rate will be translated into a 0.224% improvement in trade balance but with a 0.338% increase in inflation. Thus, at the moment, as the first priority is stabilizing the macro economic conditions, the author proposes maintaining the exchange rate as a powerful tool to keep inflation under control. Besides, the author also proposes raising the quality of the exported goods to enhance the competitiveness as it is the decisive factor in improving trade balance which accounts for up to 85% of variation in trade balance ratio. Currency devaluation for the purpose of trade balance improvement must be taken into careful consideration, as its contribution to the improvement is relatively minor (about 15% of variation in trade balance).

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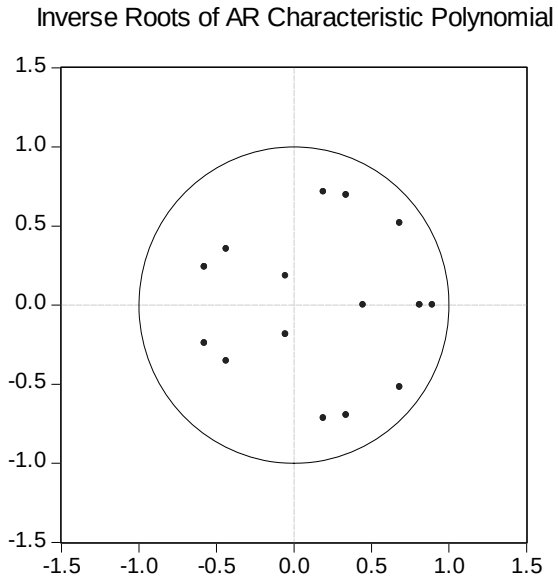
APPENDIX 1. Testing the model.

Unit root test yields the result that all the roots are smaller than one. It can be concluded that the model is statistically stable. Unit root test is an indispensable test to confirm the stationarity of variables, then to avoid the phenomenon of spurious regression. In case of spurious regression, the estimators of the coefficients are still statistically significant and have high R^2, but the genuine cause is that there exists at least one non-stationary independent variable and it has an increasing (decreasing) trend rather than the variables have economic relations.

Autocorrelation test shows that there exists no correlation among the variables after twelve quarters. All of the value of LM-Stat has the probability higher than 0.05, which fails to reject the null hypothesis that there is no serial correlation among the variables. The results of this test are highly important as in case correlation exists among the variables, (1) variances of coefficients' estimators are biased, (2) confidence intervals is unreliable, and (3) statistical hypothesis of coefficients is unreliable.



VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Sample: 2000Q1 2012Q4

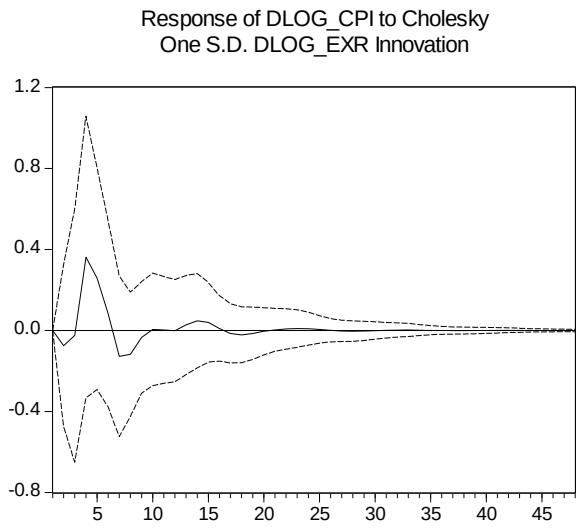
Included observations: 52

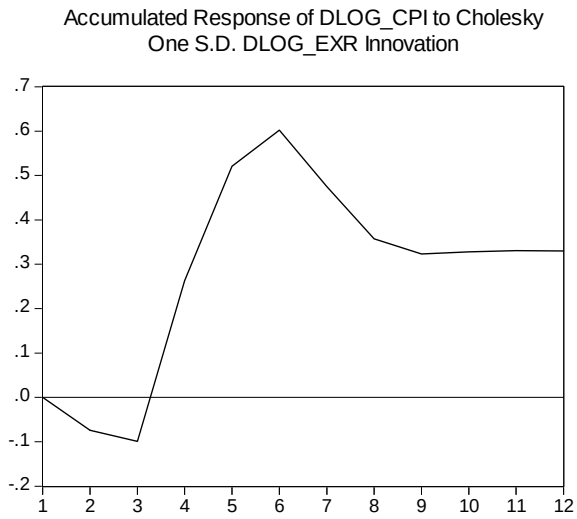
Lags	LM-Stat	Prob
1	27.98470	0.3086
2	24.94875	0.4652
Lags	**LM-Stat**	**Prob**
3	12.81941	0.9786
4	31.05690	0.1871
5	16.04437	0.9135
6	17.26466	0.8720
7	21.61754	0.6577
8	29.35058	0.2495
9	16.60964	0.8955
10	19.19823	0.7875
11	25.15489	0.4537
12	37.13798	0.0560

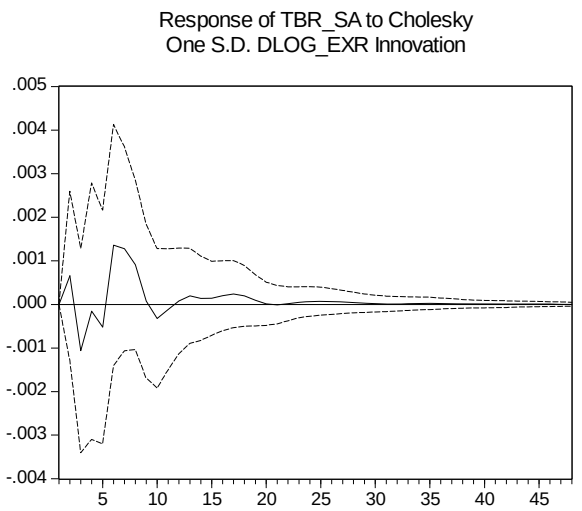
Residual Heteroskedasticity Tests fail to reject the null hypothesis that the error term has a constant variance. This is also a crucial test as the consequences of an inconstant variance of the error term are especially severe, including (1) estimators of coefficients are unreliable, and (2) confidence intervals and statistical hypothesis of coefficients are worthless.

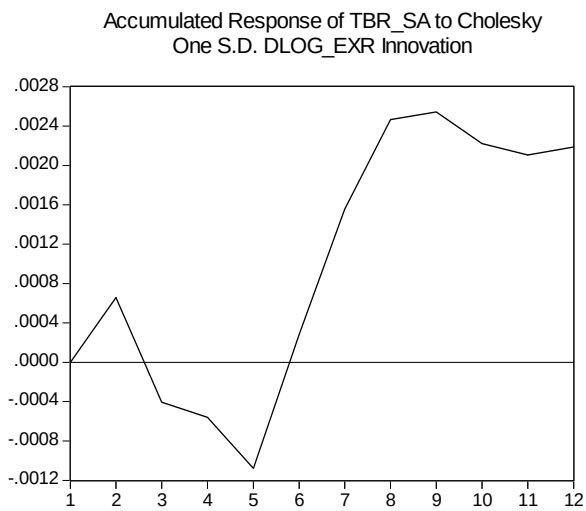
VAR Residual Heteroscedasticity Tests: No Cross Terms (only levels and squares)		
Sample: 2000Q1 2012Q4		
Included observations: 52		
Joint test:		
Chi-sq	df	Prob.
466.1351	450	0.2899

APPENDIX 2. Impulse response functions and accumulated responses functions of inflation and trade balance ratio to exchange rate.









APPENDIX 3. Variance decomposition of inflation and trade balance ratio.

Variance decomposition of inflation

Variance Decomposition of DLOG_CPI:						
Period	S.E.	DLOG_CPI	TBR_SA	DLOG_MS2	LEN_SA	DLOG_EXR
1	0.010533	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.015915	88.29226	1.713742	1.789966	0.092683	8.111351
3	0.020370	69.91496	8.171073	6.082558	1.337083	14.49433
4	0.022083	64.04432	11.87168	6.977521	3.187235	13.91924
5	0.023319	57.66264	15.03356	6.458203	3.985253	16.86034
6	0.024146	53.78640	18.30095	6.106606	3.790631	18.01541
7	0.024431	52.81520	19.06944	6.254073	3.811607	18.04968
8	0.024661	52.30823	19.18863	6.159269	3.750372	18.59350
9	0.024926	52.20429	18.80862	6.028836	4.006227	18.95203
10	0.024997	52.02956	18.87739	6.009689	4.236674	18.84668

Variance decomposition of trade balance ratio

Variance Decomposition of TRBR_SA:						
Period	S.E.	DLOG_CPI	TBR_SA	DLOG_MS2	LEN_SA	DLOG_EXR
1	0.005930	15.19949	84.80051	0.000000	0.000000	0.000000
2	0.008107	24.31917	60.85745	5.328275	0.021810	9.473299
3	0.009947	27.18014	50.00318	3.767649	11.38391	7.665128
4	0.011059	22.30037	45.19291	3.322363	18.54690	10.63746
5	0.011566	20.46056	41.63579	4.571206	18.83397	14.49848
6	0.012065	24.92267	38.91863	5.073787	17.64353	13.44139
7	0.012158	24.54320	38.35485	5.234014	17.67861	14.18933
8	0.012396	25.01608	37.68825	5.035425	17.06537	15.19488
9	0.012610	24.56021	36.56387	5.059118	16.97743	16.83936
10	0.012682	24.28771	36.15923	5.187837	17.33902	17.02620

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Abstract. It's commonplace, that information drives prices. Can we infer the impact of information by just observing prices? Can we observe regime changes during crises, when markets are overwhelmed with waves of fear and greed? What happens in the aftermath? We estimate information flows on the world markets by modeling volatility of regional stock indexes. Then we estimate VAR models for volatilities and use the capabilities of 'circlize' package from statistical environment 'R project' to visualize patterns of exposure and auto-determinism of information processes in global stock markets.

Аннотация. Общеизвестно, что ценой движет информация. Можем ли мы оценить эффект информационного воздействия, наблюдая цены? Меняется ли это воздействие в кризисы и бумы, когда рынки захлестывают эмоциональные волны? Что происходит после? Мы оцениваем информационный процесс на мировых рынках, моделируя волатильность региональных фондовых индексов, строим модели векторной авторегрессии и используем возможности пакета circlize статистической среды R project для визуализации информационных процессов на мировых фондовых рынках.

Key words: Information flows, volatility spillovers, volatility, crises.

HOW TO READ OUR INFOGRAPHICS

Each chord diagram shows the pattern of sharing information flows between traders on Eurasian and American markets, formed during certain period of time. Each sector represents one regional market; the radius of the sector is proportional to the radius of the "influence" of the market in the overall system. Links capture spillovers of information flows; the thicker the link, the more the information process is determined by another process. If the link points to a market it stems, it means that the information of previous periods continues to have an impact on the volatility of the current (i.e., there is a possible indication of the market inefficiency in the weak form.)

Periods are bounded by major market events (primarily, market crashes). Across periods flow regimes are changing significantly. Thus, we get seven periods:

POSSIBLE INTERPRETATION

I.1996 – VII.1997 – US dot-com bubble inflates. We see that the information flows on the world markets are practically independent; moreover, markets seem to be close to the efficiency at least in the weak form, since virtually no memory is observed in volatility. It is not the case for Russia, where volatility does have a memory. In addition, Hong Kong equity traders largely follow the news from the US market.

VIII.1997 – IV.1999 – Asian/Russian crises. The pattern changes dramatically: from now on there is volatility memory, which may mean that the market does not have time to "digest" the information during current trading session, and an increase (decrease) in previous sessions of volatility affects the current volatility. This pattern is typical for all markets. Interestingly, during the Asian/Russian crisis it is US information process, which leads the others: news flow firstly affects the volatility of the equity index in the US, and only then is transferred to Asian and Russian markets. The only thing, which US stock traders follow, is news from the gold market, which could be regarded as a sign of a flight to quality. Unfortunately, we were unable to

* Инфографика: разделение информационных потоков и переливы волатильности.

capture the relationship of information flows with Thailand market, where Asian crisis was born.

IV.1999 – III.2000 – a short period of relative calm before dotcom crash. Markets again are unlinked, but the memory of volatility remains as a legacy of stormy (at least for financial markets) finale of the XX century.

III.2000 – I.2004 – the dotcom bubble crash. Expectedly, US stock market is playing the first fiddle (but the degree of separation of information flows is much less than the one during Asian/Russian crisis). To a large extent the flow of information from the US market is shared by traders in Asian securities. The role of the information flow of the European markets is rising (period coincides with introduction of the euro): flow is shared by traders in gold, as well as Singapore and Hong Kong equity. Information flows in China, Thailand, Russia and Indonesia are practically unaffected by the world's news (of course, indices experienced a sharp drop during the period, but volatility was only determined by its lagged values).

I.2004 – I.2007 – the second period of relative calm. Regional information flows are again closed in on itself. Perhaps the remaining links could be explained by traders habit formation. It is interesting, that Indian information flows seem to be exposed to Indonesian one.

I.2007 – V.2009 – Lehman Brothers. The information flow from United States begins to dominate strongly again; our model captures exposure of the Philippines information flow. Indonesian information flow now defines the Philippines as well; there is also a slight but reliable information exposure of Hong Kong to Indonesian information process. Gradually the influence of the news flow in Europe and the United States to Hong Kong is reduced; perhaps the reason is increased integration with the Asian market.

V.2009 – III.2013 – Aftermath. As always after a crisis, information flows are closed in on itself. There is gradually increasing integration within the Asian markets. However, information flows of Russia and China remain largely independent.

OUR DATA AND METHOD

We use daily data from Bloomberg on major stock indices of US, Germany, India, Russia, China, Indonesia, Philippines, Thailand, Korea, Singapore, and Hong Kong, as well as continuous data for oil and gold futures. Data gaps caused by national holiday's non-synchronicity were linearly interpolated. Returns were normalized across means using standard deviations.

We estimate GARCH using 'rugarch' package for R project. Our model specification follows Bollerslev (1986) standard GARCH model with Johnson's parameterized SU distribution. We estimate VAR model using 'vars' package; the lag is chosen as maximum lag, suggested by VARselect procedure, based on various information criteria. For info graphics we use only VAR components with p-values less than 0.0001; the intercepts, as well as coefficient signs, are ignored.

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