UDC 336.76(477)-047.37

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TESTING THE CAPM ON THE UKRAINIAN STOCK MARKET: BETA COEFFICIENT DETERMINATION

Introduction. Investors are always interested in how the risk of their investment should affect its expected return and how to construct the optimal portfolio. Using CAPM it is possible to answer these questions and to create such an optimal portfolio based on the idea that there is a positive relation between risk and return. However, it should be remembered that not all risk can affect asset prices and some risks can be diversified away. The CAPM helps us to carry out the close relationship between risks of our assets and their profit, to investigate the Ukrainian Stock Market (using UX index) and analyze the environment for investors in our economy. Our paper lays out the main information of the CAPM usage on the Ukrainian Stock market, calculation and estimation of Beta coefficient. The attempt is made to draw a conclusion about the optimal portfolio of the Ukrainian stocks and answer the question whether it is possible to use a Capital Asset Pricing Model in the Ukraine [1].

Sample selection and Data. The present case is realized by using the data about 16 companies traded in the Ukrainian Stock Exchange (UX). The data are obtained from UX Data Base. The study covers the period from 29.07.2009 to 05.08.2011 [2].

The above 16 companies were chosen according to the following criteria:

1. First 10 companies are 10 blue chip companies. These companies are the most traded and tend to be less volatile than other companies and provide solid growth.

2. Next 6 companies are mid cap stocks and listed in the second quotation list.

All securities included in the sample are traded on the UX on a continuous basis throughout the full Ukrainian stock exchange trading day, and are chosen according to specified liquidity criteria set by art. 24 of the Ukrainian Law „On Joint Stock Companies" and in accordance with Stock exchange Rules.

In order to obtain better estimates of the beta coefficient value, the study uses daily stock returns. Returns calculated using a longer time period (e.g. weekly or monthly) cannot be used by virtue of the lack of data (the Ukrainian Stock Exchange was established in October 2008). The UX index is used as a proxy for the market portfolio. This index is a market value weighted index, which comprises the 10 most highly capitalized shares of the main market, and reflects general trends of the Ukrainian stock market.

Furthermore, the 1-year Ukrainian Government Bonds are used as the proxy for the risk-free asset. The yields were obtained from the statistic data of the National Bank of Ukraine. The yield on the 1-year Ukrainian Government Bonds is specifically chosen as the benchmark that better reflects the period of time which was chosen for estimation in our work.

The methodology of our project precedes from fact that Capital Asset Pricing Model (CAPM) is based on two hypotheses: Efficient-market hypothesis (EMH) and Modern Portfolio Theory (MPT) [3].

Results and analysis. The first part of the study required the estimation of betas for individual stocks by using observations on rates of return for a sequence of dates. All results of beta estimation are represented in Table 1. Firstly, *t-statistic* and *R-squared* will be considered. The purpose is to see what extent the beta as a measure for relative riskiness is relevant. The companies traded in the Ukrainian Stock Exchange are under analysis. The results are presented in the Table 1.

This table of results allows drawing a conclusion that for most companies, which were under estimation, the betas are significant at a level of 10% or even 5%. This means that market influences the stocks' performance a lot. According to this information, the resulting output is that beta is not a reliable and accurate measurement of risk on the Ukrainian stock market. And if the beta values are considered, it is possible to conclude that the stocks are rather risky. Majority of values are greater than 1.

To summarize, it can be maintained that the Ukrainian Stock market is rather risky and will be a good environment for those investors who have high expectation toward returns and want to form an aggressive portfolio.

But the following question is significant as well: „What power has the beta?" Answering this question it is necessary to look at the R-squared. It shows the proportion of explained variance of the dependent variable. The average value of this coefficient is between 0.3 and

Table 1.

Stock beta coefficient estimates

Stock Name	Alpha Coefficient (t-statistic)	Beta Coefficient (t-statistic)	R squared
UNAF	0.0015 (1.75)	0.96 (26.88)	0.553
ALMK	-0.0009 (-0.98)	1.30 (32.76)	0.647
AZST	-0.0004 (-0.57)	1.12 (39.75)	0.730
USCB	-0.0005 (-0.63)	1.35 (38.35)	0.715
CEEN	-0.0004 (-0.60)	1.01 (41.53)	0.747
MSICH	0.0013 (1.72)	0.90 (29.57)	0.599
ZAEN	-0.0014 (-1.72)	0.77 (23.37)	0.483
ENMZ	-0.0017 (-1.92)	1.18 (33.97)	0.651
UTLM	0.0005 (0.59)	0.78 (24.23)	0.487
BAVL	-0.0007 (-0.84)	1.23 (36.93)	0.688
AVDK	-0.0007 (-0.72)	1.01 (26.03)	0.547
DOEN	-0.0010 (-0.97)	1.05 (33.00)	0.666
MZVM	-0.0038 (-1.11)	0.87 (6.41)	0.071
SGOK	0.0027 (1.99)	1.00 (17.28)	0.392
KVBZ	0.0003 (0.28)	0.88 (25.00)	0.538
STIR	-0.0004 (-0.27)	0.76 (16.48)	0.324

0.7. It is a rather high indicator. It means that stocks are highly correlated with the market and the beta explains the model in average in a proportion more than 50%.It means that systematic risk takes a great part. Nevertheless it is not reasonable to claim that the beta as a measurement of risk and expected return can undoubtedly trusted. It is also means that there are other factors that have a great influence on stocks' returns.

In order to have a visual example the Figure 1 is to be considered. It is the examination of AZST („Azovstal") stocks. On the graph some noise in the data is obvious. There are too many observations that deviate from the line. This is one more evidence to prove the significant influence of outside factors.

Thus there appears a question: can it be said that the beta is a good indicator in our case? There is no definite answer. If only the beta is taken into account, there is a great probability of failure when investing in stocks. Values are pretty high, which allows the conclusion that the risk is too high for investment to be safe. So one should be careful when choosing stocks. The daily data shows that there are periods when wealth can increase/decrease rapidly by investing money only in shares of one company. Thus the high value of beta should not please an investor in the case he doesn't like the risk very much.

Nevertheless, calculations and analysis of the dynamics of the individual stocks' beta series show that for any shares their beta coefficient is not stable over time and therefore cannot serve as an accurate assessment of the future risk. The beta of portfolio consisting of even 10 randomly selected stocks is stable enough and, therefore, can be regarded as an acceptable measurement of a risk portfolio. That is why the attempt was made to

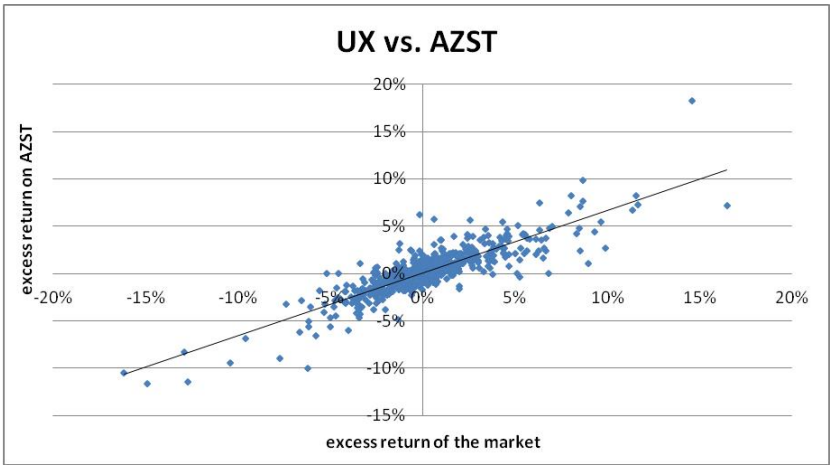

Fig.1. Security Characteristic Line for AZST

create the portfolio of all securities, which were under estimation in the project. At the same time, as it was mentioned before, one of the main purposes of the CAPM model is to help create the effective portfolio.

To verify the statement, mentioned above, the decision was made to form a tangent portfolio, based on stock exchange data, which covers the period from 29.07.2009 to 02.08.2010 and to test it during the next period of time from 03.08.2011 to 05.08.2011. These two periods are equal and consist of 252 working days.

After some calculations, the effective portfolio was determined. The results are represented in Table 2.

The weight of all stocks, which were in the sample, equals to 100% (graph 4 „Weight"). The graph „Portfolio Contribution" shows the return of each stock in the portfolio. Analogically, the graph „Beta Contribution" shows the stock's contribution in the portfolio beta.

Figure 2 represents the Capital Market line and the efficient frontier. The efficient frontier is combination of assets, i.e. a portfolio. It is referred to as „efficient" if it has the best possible expected level of return for its level of risk. In our case it is proxies by the standard deviation of the portfolio's return [4]. On the efficient frontier there is plotted every possible combination of taken assets, without including any holdings of the risk-free asset.

The graph also shows the point, which is called „Tangent Portfolio". The tangency portfolio is the portfolio of risky assets on the efficient frontier at the point where the CML is tangent to the efficiency frontier and combines this optimal combination of risky assets with a risk-free asset. Combinations of the tangency portfolio and the risk-free asset compose the CML.

In our case the tangent portfolio corresponds to the portfolio which consists of 13.12% of UNAF shares, 11.99% of AZST shares, 14.71% of USCB shares, 12.11% of CEEN shares, 5.95% of ZAEN shares, 8.16% of ENMZ shares, 9.11% of UTLM shares, 21.00% of BAVL shares, 0.53% of AVDK shares, 3.31% of SGOK shares.

So, the Figure 2 below visually represents our Capital Market Line, which is drawn from the point R_f = 10.1%, and Efficient Frontier. The point of their intersection is Tangent portfolio, which characterizes the best and most effective combination of our assets, with expected return equal to 113.52% and Standard Deviation equal to 36.18%.

For more effective presentation, these data are represented by pie and bar charts below. All shares are grouped according to their belonging to different sectors of the economy and summarized in Figure 3 and 4.

One way to allow for the possibility that the CAPM does not hold true is to add an intercept in the estimation of the SML. The CAPM considers that the intercept is zero for every asset. Hence, a test can be constructed to examine this hypothesis.

In order to diversify away most of the firm-specific part of returns, thereby enhancing the precision of the beta estimates, the securities were previously combined into a portfolio. This approach mitigates the statistical problems that arise from measurement errors in individual beta estimates. This portfolio was created for several reasons: (1) the random influences on individual stocks tend to be larger compared to those on suitably constructed portfolio and (2) the tests for the intercept are easier to implement for a portfolio because by construction their estimated coefficients are less likely to be correlated with one another than the shares of individual companies.

The high value of the estimated correlation coefficient between the intercept and the slope indicates that the model used explains excess returns (Table 3). The beta is interesting because it tells us about risk. Alpha is interesting because it tests if the market portfolio is the tangency portfolio.

Table 2.

Portfolio estimates

Equity	Beta	CAPM	Weight	Portfolio Contribution	Beta Contribution
UNAF	0.96	101.39%	13.12%	13.31%	0.13
ALMK	1.30	131.08%	0.00%	0.00%	0.00
AZST	1.12	115.34%	11.99%	13.83%	0.13
USCB	1.35	136.03%	14.71%	20.02%	0.20
CEEN	1.01	106.01%	12.11%	12.84%	0.12
MSICH	0.90	96.11%	0.00%	0.00%	0.00
ZAEN	0.77	84.06%	5.95%	5.00%	0.05
ENMZ	1.18	120.49%	8.16%	9.83%	0.10
UTLM	0.77	84.25%	9.11%	7.68%	0.07
BAVL	1.27	128.61%	21.00%	27.01%	0.27
AVDK	1.01	105.31%	0.53%	0.56%	0.01
DOEN	1.05	108.73%	0.00%	0.00%	0.00
MZVM	0.87	93.28%	0.00%	0.00%	0.00
SGOK	1.00	104.30%	3.31%	3.45%	0.03
KVBZ	0.88	94.45%	0.00%	0.00%	0.00
STIR	0.75	82.80%	0.00%	0.00%	0.00
TOTAL				113.52%	1.10

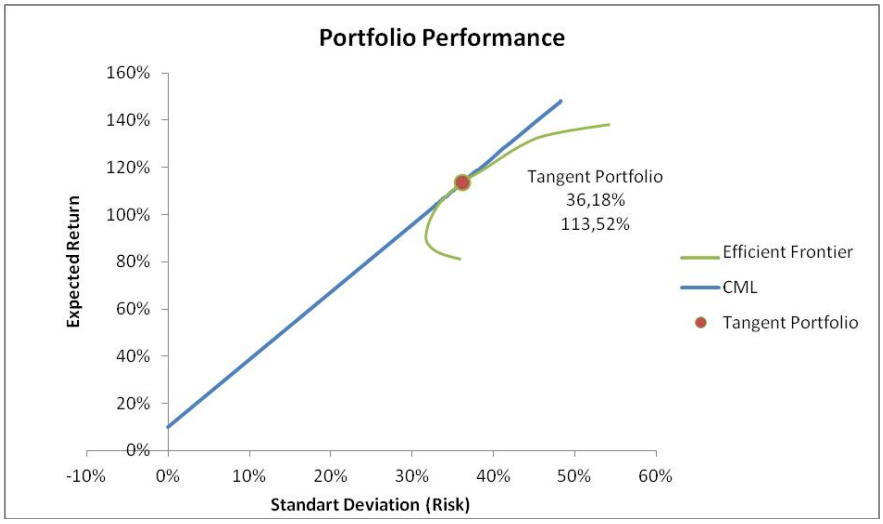

Fig.2. Portfolio Performance

In the estimation, the CAPM's prediction for б is that it should be equal to zero. The calculated value of the intercept is small (-0.00016) but it is not significantly different from zero (the t-value is not greater than 2). Hence, based on the intercept criterion alone the CAPM hypothesis cannot clearly be rejected. And also P-value of б-coefficient is significantly greater than 0.05. It means that б is not statically different from zero.

In order to illustrate the above-mentioned, the following example can be used. If we take a look at the graph, we can understand why t-statistic is high, but adjusted R-square is not so high. Undoubtedly, OLS (Ordinary Least Square) method indicates that the straight line fits the best model. But the data look rather like a cloud. There are many observations that deviate from the line.

All in all, it can be said that if the market portfolio is the tangency portfolio, then the estimated alpha should be zero. This statement does not correspond to our case.

The next step of our portfolio testing was its examination during the next year. But the analysis on the entire one year period did not yield strong evidence in favor of the CAPM. The market shows the annual return on the level of 9.07%, while our portfolio grew only by 0.66%. It means that beta does not explain the relation between return in a good way. According to the portfolio, which was created, it can be maintained that it did not bring expected results.

Unfortunately, there was no opportunity to examine whether a similar approach for a longer period of time would provide more supportive evidence.

Conclusion. This study was aimed at finding the answer to the question whether CAPM is valid for the Ukrainian Stock Exchange. The question appears to be rather controversial. The model does explain, however, excess returns. If one looks at the sign of beta, it can be noticed that risk is related to return and CAPM has passed a first step. However, the fact that the intercept has a value around zero, weakens the above explanation.

In order to diversify away the specific risk and increase the precision of the beta estimates, all the assets are combined into portfolios. That helps to avoid the statistical problems that arise from measurement errors in individual beta estimations. The CAPM's prediction

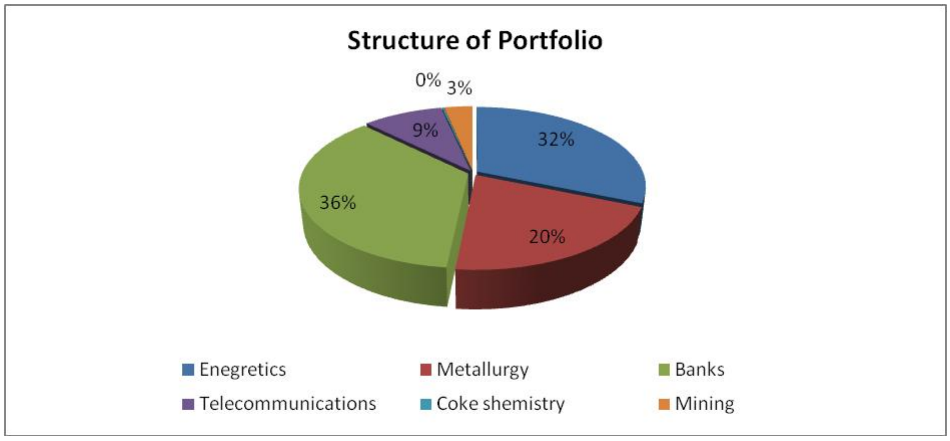

Fig.3. Structure of portfolio

Table 3.

Statistics of the estimation of the SHL of the Portfolio

Coefficient	α	β
Value	-0.00016	1.092492
t-value	-0.16841	33.81939
p-value	0.866328	4.7E-135
Residual standard error: 0,01703 Multiple R-Squared: 0,8252 R-Squared: 0,6809		

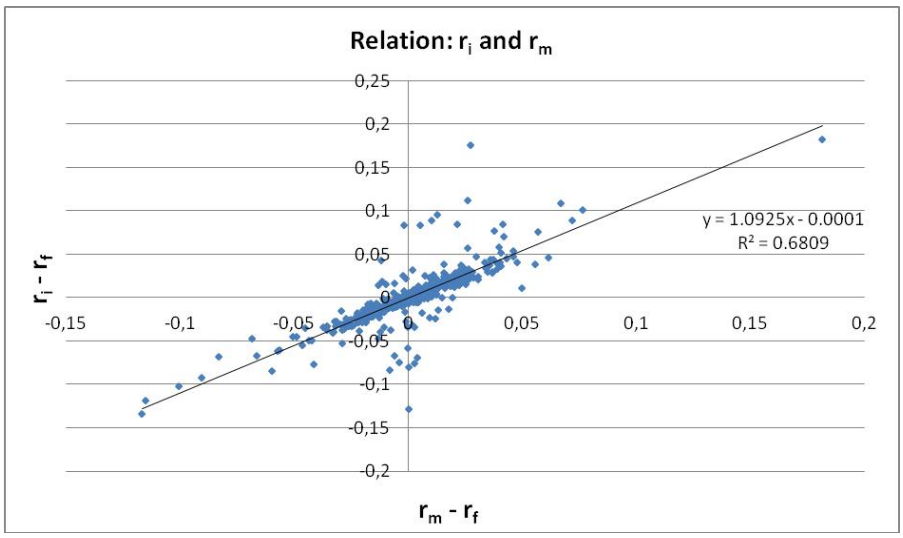

Fig.4. Portfolio's return regressed on UX return

for the intercept is that it should be equal to zero and the slope should equal to the excess returns on the market portfolio. The findings of the study contradict the above hypothesis and indicate evidence against the CAPM.

The results of the tests conducted on the data from the Ukrainian stock exchange for the period of July 2009 to August 2011 do not appear to clearly reject the CAPM. This does not mean that the data do not support the CAPM.

Such conclusion has been made because there are some inhibited factors.

First of all, the Ukrainian Stock Market is an emerging market. Exchange trading in Ukraine has existed since 1992. Before „the Ukrainian Stock Exchange" started to function in 2009, there had been no system, which guaranteed the execution of transactions on any of the exchanges. Exchanges were represented as a bulletin board and messaging system. In such technologies, there were some difficulties for a private investor associated with additional costs and time. That is why there are small number of participants, transactions and financial instruments on the stock exchange. There are also many zeros in data (especially at the second tier when the number of observations falls in some cases to 10 – 20 during the year).

Another weak point of the Ukrainian Stock Market is the significant influence of external factors. Or simply, 3 – 4 main players can influence the market movement.

And last, but not the least is imperfection of the legislation. The striking example in this case can be the fact that „The Securities Act", which was created in 2006, already has 14 amendments.

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Малишко О. В., Молчанов О. І., Шейка К. С. Дослідження моделі оцінки фінансових активів на українському ринку цінних паперів : бета-коефіцієнт

У статті відображено результати тестування CAPM моделі на українському фондовому ринку, зокрема дослідження Бета коефіцієнта й можливостей формування оптимального портфеля цінних паперів. Дослідження грунтується на даних Української фондової біржі та індексу UX за 2009 – 2011 рр.

Ключові слова: український ринок цінних паперів, диверсифікація, ризик, модель оцінки фінансових активів, сучасна портфельна теорія, бета-коефіцієнт, оптимальний портфель, межа ефективності.

Малышко А. В., Молчанов А. И., Шейка Е. С. Исследование модели оценки финансовых активов на украинском рынке ценных бумаг : бета-коэффициент

В статье отображены результаты тестирования CAPM модели на украинском фондовом рынке, в частности исследование бета-коэффициента и возможности формирования оптимального портфеля ценных бумаг. Исследование базируется на данных Украинской фондовой биржи и индекса UX за 2009 – 2011 гг.

Ключевые слова: украинский рынок ценных бумаг, диверсификация, риск, модель оценки финансовых активов, современная портфельная теория, бэта-коэффициент, оптимальный портфель, граница эффективности.

Malyshko A. V., Molchanov O. I., Sheyka K. S. Testing the CAPM on the Ukrainian Stock Market: Beta-Coefficient

This article represents the results of testing CAPM model on the Ukrainian stock market, in particular calculation and estimation of Beta coefficient and attempts to form an optimal portfolio. The study is based on data from the Ukrainian Stock Exchange and UX index for 2009 until 2011.

Key words: Ukrainian Stock Market, Diversification, Risk, Capital Asset Pricng Model, Modern Portfolio Theory, Beta-Coefficient, Optimal Portfolio, Efficient Frontier.

Received by the editors: 15.06.2012
and final form 20.11.2012