Testing APT Model upon a BVB Stocks' Portfolio

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Applying the Arbitrage Pricing Theory model (APT), there can be identified the major factors of influence for a BVB' portfolio stocks' trend. There were taken into consideration two of the APT theory models, establishing influences upon portfolio's yield: given to macroeconomic environment and to some stochastic factors. The research's results certify that, on the long term, what influences the stocks' movement in the stock market is mostly the action of specific short-term factors, without general covering, like the ones that are classified in the research area of behavioral finance (investors' preference towards risk and towards time).
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1 Introduction

For covering risk, it is necessary to analyze the relation risk-yield of financial instruments available for investment, in order to make the investment decision one rational. The allocation of the resources decision towards a stocks' portfolio is direct influenced by their yield. This yield can be analyzed by taking the past performances (historic performances) of the financial instruments and the predicted performances (expected anticipated for the future). Based on own expectations, each investor establishes a level of expected yield (requested yield) for each of the investment opportunity, this yield including a series of factors like the inflation rate, economic growth, consumption prices index, interest etc. Between the economic growth rate, that requires a decline of the inflation rate, a strengthening of the national currency in comparison with different universal traded currencies etc., and the investment opportunities exists a close relation, in the way that the investors' requested yield must be at least equal with the economic growth rate (the economy's expansion provokes the growth of the number and the value of the investment opportunities).

The risk premium that an investor is willing to assume must cover all the possible risks, the investor identifying himself with those specific risk factors. This premium is seen by the investors as being direct proportional with their investment's yield (once the risk grows, also the risk premium grows, and is necessary to rise the investment's yield in order to ensure a full cover of the risk). The risk of a financial instrument refers, in this way, to the financial instruments yields' volatility and to the investment's perception upon results' uncertainty.

2 Arbitrage Pricing Theory Model

For covering risks, it is necessary to implement a risk – yield report for the financial instruments available for an investment, in order to make the investment decision one rational [1]. The decision to reserve resources to a financial portfolio is directly influenced by the portfolio's financial instruments yield. This yield can be analyzed through past performances (historical) of the financial instruments and through the predicted performances (expected, anticipated for the future). Depending on own expectations, each investor establishes an expected level of yield (requested yield) for each investment opportunity, and this yield includes a series of factors like inflation rate, economic growth, consumer prices index, interest rate and so on [2]. Between the economic growth, that implies a fall of the inflation rate, a strengthen of the national currency in relation to other universal traded currencies etc, and the investment opportunities there is a tighten relationship, in the sense that the yield requested by the investors must be at least equal to the economic growth rate (the economy's expansion provoke the growth of the number and value of the investment opportunities).

The risk premium that an investor is willing to assume must cover possible risks, the investor identifying himself with the specific risk factors. The risk premium is seen by the investors as being directly proportional with their investments' yield (once the risk grows, and so the risk premium grows, it is necessary for covering the poverty to exist a growth in the investments' yield). The risk of a financial instrument refers at the volatility of those instruments' yield and at the investment perception over the results uncertainty [3].

The APT Model (*Arbitrage Pricing Theory*) is one of the models most recommended to be used in financial portfolio's optimization [4], depending on the relationship between the risk and the yield. The general hypotheses of the APT models are:

- the factorial models can explain the financial yields; in other words, by selecting a number of factors, it can be explained the evolution of the markets;
- the arbitrage opportunities represent, in fact, portfolios without investments, as there is necessary inside this portfolios to exist some perfect hedging operations;
- the arbitrage opportunities appear when the unique price rule is broken; the inexistence on the real market of such a price drives to the existence of some arbitrage opportunities between different financial instruments or different trading places;
- the financial markets are characterized through a high volatility; the permanent fluctuation of the prices is given by the investors' reaction towards different influence factors, that can be, by their nature, of many types (economic, social, psychological etc.) or can be perceived by the investors, and so by the market through its general evolution, in different proportions (the importance of the influence factors for each investor or market differs); breaking the existing principles for the arbitrage conditions is a clear form of irrationality on the market;
- the rational equilibrium of the market is the effect of the pressures made by the arbitrage opportunities; the results of such opportunities do not depend on the risk aversion.

In order to find the factors that can explain the best the yields of the financial instruments, we have tested the APT models of Chen, Ross and Roll and of Morgan Stanley. For the chosen models there were used financial market's and real economy' indicators for the period 2003-2008, taking into consideration a portfolio of 10 stocks traded on Bucharest Stock Exchange (B.V.B.), considered to be *blue-chips*: SIF1 (SIF Banat-Crişana), SIF2 (SIF Moldova), SIF3 (SIF Transilvania), SIF4 (SIF Muntenia), SIF5 (SIF Oltenia), and the 5 stocks that go into BET basket (the general index of B.V.B.), respectively SNP (Petrom), BRD (Groupe Societé Generale), TLV (Banca Transilvania), AZO (Azomureş), RRC (Rompetrol Rafinare) [5].

To quantify risk, the following statistical indicators can be used:

- variance (σ^2- medium square defiance), calculated with the formula:

$$\sigma^2 = E[R-E(R)]^2 = \sum_{i=1}^{s}[R_i - E(R_i)]^2 * p_i = \frac{1}{n-1}\sum_{i=1}^{n}[R_i - E(R_i)]^2$$

- standard deviation (σ), calculated with the formula $\sigma = \sqrt{\sigma^2}$;
- variance coefficient (*CV*), calculated with the formula:

$$CV = \frac{\sigma}{E(R)};$$

- semi variance (*semiVar*): *semiVar*(R) = E[R*]2, where R* = min[R-E(R); 0].

where:
s = number of states (registrations);
n = number of observations from the considered series of yields (for a series of historical yields); formula for the yield is the average of distribution

$E(R_i) = \sum_{i=1}^{s} R_i * p_i$ (p_i is the probability in the state i and R_i is the stock's yield in the

sate *i*).
From the virtual portfolio' financial instruments' distributions, for the period of time analyzed (daily series of data for 01.01.2003-31.12.2008), it can be observed a relative normal distribution (symmetric), the values being situated on both sides of the class with the maximum effective are relatively equal, or differing relatively little (normal distribution law).
Starting from the models' hypothesis, it was followed to explain the portfolio stocks' yield through the factors considered by each tested model. Both tested models have different factors, in this way being tried to cover as many influence possibilities for the yield as much as possible. The portfolio stocks' yields have been calculated, on the basis of the closing prices, for the time period 01.01.2003-31.12.2008, according to the formula:

Yield = (Price at the end of the month – Price at the beginning of the month)/Price at the beginning of the month

The risk preference taken into consideration in testing the chosen models was calculated as a difference between the stocks open-end funds' yield (as being considered with the highest level of risk) and the money-market open-end funds' yield (as being considered with the lowest level of risk). The yield for the open-end funds (FDI) has been calculated on the monthly data series for the period 2003-2008, according to the formula:

FDI Yield = ln (Actual monthly medium value of the unit fund / Previous monthly medium value of the unit fund)

The time preference taken into consideration in testing the chosen models has been calculated as the difference between the stocks' open-end funds' yield and the fix revenue' open-end funds' yield (for the HT indicator – *high time*, long term), respectively the difference with the money market' open-end funds' yield (for the LT indicator – *low time*, short term), the formula of time preference being obtained, on the basis of monthly data series for the period 2003-2008, according to the formula:

Time Pref. = HT – LT

3 Testing the portfolio with the APT model Chen, Ross and Roll

Starting from the Chen, Ross and Roll APT model, it can be observed that the financial instruments' yields on the capital market depend on the following factors:

- industrial production (reflects changes in the expectations related to the cash flows);
- difference of yield between the corporative with low risk and those with high risk (changes in the investors' risk preference);
- difference between the short term interest rate (TS) and the long term one (TL) (changes in investors' time preference);
- un-anticipated inflation;
- anticipated inflation.

Taking into consideration the available data, we've tested an adjusted form of the APT model of Chen, Ross and Roll, that includes inflation instead of un-anticipated and anticipated inflation, industrial production (noted with PINDUST), the difference of yield between the corporative bonds with low risk and those with high risk (as an expression of risk preference; noted with RISCPREF), the difference between the short term interest rate and the long term interest rate (as an expression of time preference; noted with TIMEPREF).
The general equation used is:

Stock = C(1) * PINDUST + C(2) * RISCPREF + C(3) * TIMEPREF + C(4) * INFLATION + ε

where: C(1), C(2), C(3), C(4) are coefficients given to the influence factors (factor's sensibility), and ε is the risk.

The observed values for the dependent variables used in testing of this model are presented as follows:

Table 1. Probability's and R-square's values for Chen, Ross and Roll Model

Share	Probability				R-square
	Industrial Production	Risk Preference	Time Preference	Inflation	
SIF1	0.7166	0.4634	0.5428	0.3463	0.039149
SIF2	0.7858	0.6362	0.7591	0.4867	0.050737
SIF3	0.7004	0.3240	0.2728	0.3677	0.039465
SIF4	0.5328	0.7344	0.8047	0.4152	0.023273
SIF5	0.5129	0.2141	0.3398	0.3231	0.147387
SNP	0.2813	0.7335	0.8502	0.7311	0.048685
BRD	0.3413	0.2853	0.3616	0.2735	0.062626
TLV	0.4118	0.3229	0.3957	0.4630	0.046433
AZO	0.9422	0.0056	0.0101	0.4749	0.162167
RRC	0.3414	0.0893	0.1079	0.3043	0.052361

Table 2. Regression coefficients' values for Chen, Ross and Roll Model

Share	Coefficients			
	Industrial Production	Risk Preference	Time Preference	Inflation
SIF1	-0.002310	2,009,907	-1,656,402	2,579,542
SIF2	-0.001768	1,324,805	-0,853060	1,946,416
SIF3	-0.002568	-2,821,864	3,161,019	2,587,325
SIF4	-0.003808	0,889990	-0,644222	2,137,268
SIF5	-0.004792	3,929,112	-2,992,741	3,112,851
SNP	-0.005495	0,743817	-0,409983	0,749439
BRD	-0.005042	2,445,521	-2,074,078	2,495,861
TLV	-0.005397	2,798,655	-2,387,088	2,070,790
AZO	0.000469	7,929,593	-7,287,427	1,988,604
RRC	-0.007360	5,695,060	-5,347,955	3,413,429

Applying the obtained results from Table 1 and Table 2, the estimated equations become:

SIF1 = -0.002310074588 * PINDUST + 2.009907344 * RISCPREF – 1.65640249 * TIMEPREF + 2.579542263 * INFLATION + ε

SIF2 = -0.001768459305 * PINDUST + 1.324804855 * RISCPREF – 0.8530602313 * TIMEPREF + 1.946416221 * INFLATION + ε

SIF3 = -0.002568469315 * PINDUST – 2.821863517 * TIMEPREF + 3.161018678 * RISCPREF + 2.587324941 * INFLATION + ε

SIF4 = -0.003807643417 * PINDUST + 0.8899898697 * RISCPREF – 0.644222161 * TIMEPREF + 2.137268037 * INFLATION + ε

SIF5 = -0.004791674586 * PINDUST + 3.929112249 * RISCPREF – 2.992741479 * TIMEPREF + 3.112851376 * INFLATION + ε

SNP = -0.005494624743 * PINDUST + 0.7438166006 * RISCPREF – 0.4099827055 * TIMEPREF + 0.7494393582 * INFLATION + ε

TLV = -0.00539681391 * PINDUST + 2.798654605 * RISCPREF – 2.387087802 * TIMEPREF + 2.07078993 * INFLATION + ε

BRD = -0.005042411472 * PINDUST + 2.445521353 * RISCPREF – 2.074078204 * TIMEPREF + 2.495860683 * INFLATION + ε

AZO = 0.000469346612 * PINDUST + 7.92959265 * RISCPREF – 7.287426535 * TIMEPREF + 1.988604207 * INFLATION + ε

RRC = -0.00735991758 * PINDUST + 5.695060019 * RISCPREF – 5.347954758 *

TIMEPREF + 3.41342949 * INFLATION + ε

The obtained data, as seen in Table 2 draw attention to the *R-square*. This represents a statistical measure that shows in which way (as good as possible) a regression line approximates the data real points (a value of *R-square* over 1, respectively 100%, indicates a perfect match).
The formula applicable for this value is:

$$r(X,Y) = [Cov(X,Y)] / [StdDev(X) * StdDev(Y)]$$

When applying this indicator in finance, *R-square* measures the proportion in which a model can predict or explain the actual performances of an investment or of a portfolio of financial instruments. As closer is its the value to 1, as much the portfolio's financial instruments' yield depends on the factors taken into consideration by the model.
From Table 2 it can be observed that the values of the statistical indicator *R-square* are very small, without being closet o the level of 100% (unit value), for neither of the financial instruments selected for the portfolio.
The first conclusion that comes out is that there is a very weak relationship between the portfolio's stocks' yields and the influence factors (industrial production, risk preference, time preference, and inflation). Therefore, the prices of the instruments cannot be explained through the perspective of these factors (as not being influenced by this combination of factors).
Also, it can be observed a probability higher than 0.05 (5%) of the factors considered by the model (the optimum probability for these factors to be relevant is 95%). In this way can be drawn a second conclusion, that the considered model, through its selected factors, is not relevant for measuring the yield for the portfolio and for its stocks.
In the case of data presented in Table 2, we can also observe the direct and inverse proportionality of the coefficients considered by the model towards the stocks' yield. The existence of negative coefficients shows an inverse influence of the coefficients over the stocks, namely if their values are positive there is a direct proportional influence.
In the case of testing the portfolio by this model it can be observed that:

- the industrial production influences in a reverse way the stocks' yield (with an exception - AZO, that responds to the industrial production trend);
- the risk preference influences directly the stocks' yield (with the exception of SIF3, which stocks can be traded by the moderate risk investors);
- time preference influences in a reverse way the stocks' yield (with the exception of SIF3, being preferable to invest on long term in this stock);
- inflation influences in a reverse way the stocks' yield (without any exception).

The lack of direct proportional relations between the industrial production, inflation and time preference and the stocks' yields, and also the lack of reverse proportionality relations between risk preference and stocks' yield (between risk aversion and the growth of prices for a stock there must be a direct proportional relationship) show (as a third conclusion) that the stocks' prices do not depend on the sum of these factors.

4 Testing the portfolio with the APT model Morgan Stanley

Taking into consideration the conclusions of the testing applied to APT model Chen, Ross and Roll over the virtual portfolio's stocks' yield, we have tested another APT model. Starting from the hypothesis of APT model Morgan Stanley, the financial instruments' yields on the capital market depends on the following factors:

- GDP's growth;
- long term interest rate;
- exchange rate (as a currency basket);
- market factor;
- consumer prices index (IPC) or the prices index for petroleum goods.

Keeping the same data available and the same financial instruments as in the previously tested model, in order to ensure a future comparability of data, we've tested this model with a linear regression equation, in which the independent variables are:

- interest rate (represented by the interest rate applicable at bank credits);
- exchange rate (CSV – a currency basket formed by Euro - 80% and US dollar - 20%);
- market factor (represented by BET index of B.V.B.);
- inflation, used as an adjusted form that took into consideration inflation instead of un-anticipated or anticipated inflation (inflation rate = IPC – 100).

The applied equation is:
Stock = C(1) * INTEREST + C(2) * CSV + C(3) * BET + C(4) * INFLATION +ε

In the testing of this model, the values observed for the dependent variables are presented in the next tables:

Table 3. Probability's and R-square's values for Morgan Stanley Model

Shares	Probability				R-square
	Interest	CSV	BET	Inflation	
SIF1	0.8317	0.1221	0.3938	0.5166	0.059407
SIF2	0.8736	0.1127	0.2731	0.7742	0.071520
SIF3	0.9507	0.1654	0.4375	0.7209	0.047628
SIF4	0.9448	0.1788	0.5511	0.5761	0.042711
SIF5	0.6409	0.3469	0.0066	0.5573	0.131706
SNP	0.8795	0.0059	0.5037	0.5921	0.128760
BRD	0.8107	0.0207	0.2741	0.4662	0.110009
TLV	0.4468	0.3216	0.3694	0.6568	0.047679
AZO	0.3671	0.0385	0.2966	0.6019	0.082609
RRC	0.0932	0.0598	0.8231	0.0956	0.066698

Table 4. Regression coefficients' values for Morgan Stanley Model

Shares	Coefficients			
	Interest	CSV	BET	Inflation
SIF1	-0.039810	-1.631.944	0.151352	3.056.758
SIF2	0.030473	-1.712.928	0.199271	1.381.288
SIF3	-0.012232	-1.542.850	0.145406	1.775.976
SIF4	-0.012433	-1.357.916	0.101308	2.525.870
SIF5	-0.102516	-1.157.739	0.579673	3.242.586
SNP	-0.021929	-2.289.173	0.091560	1.949.063
BRD	-0.037224	-2.024.626	0.160181	2.836.657
TLV	0.148731	-1.083.996	0.166000	-2.180.100
AZO	-0.182298	-2.366.596	0.199601	2.644.254
RRC	-0.386316	-2.425.996	0.048115	9.635.849

The estimated equations are:
SIF1 = -0.03980993813*INTEREST - 1,631944066*CSV + 0,1513519589*BET + 3.056758137*INFLATION +ε
SIF2 = 0.03047261264*INTEREST – 1.712928377*CSV + 0.1992712824*BET + 1.381287745*INFLATION +ε
SIF3 = -0.01223239692*INTEREST – 1.542850064*CSV + 0.1454059768*BET + 1,775975719*INFLATION +ε
SIF4 = -0.01243266517*INTEREST – 1.357916093*CSV + 0.1013078093*BET + 2.525870211*INFLATION +ε
SIF5 = -0.1025161647*INTEREST – 1.157738713*CSV + 0.5796725389*BET + 3.242586292*INFLATION +ε
SNP = -0.02192851799*INTEREST – 2.289173374*CSV + 0.09155954364*BET +

1.94906333*INFLATION +ε
BRD = -0.03722386141*INTEREST – 2.024625511*CSV + 0.1601808093*BET + 2.836656783*INFLATION +ε
TLV = 0.1487314609*INTEREST – 1.083996437*CSV + 0.1659999085*BET – 2.180099781*INFLATION +ε
AZO = -0.1822983759*INTEREST – 2.36659587*CSV + 0.1996006543*BET + 2.64425428*INFLATION +ε
RRC = -0.3863164573*INTEREST – 2.425996486*CSV + 0.04811531515*BET + 9.635849435*INFLATION +ε

The obtained data, as seen in Table 3, draws attention over the *R-square* index (with the same formula and the same statistical significance from the previous model) and it can be observed that the values of *R-square* are smaller also for this model, without being close to the level of 100% (unit value), for neither of the portfolio's selected financial instruments.
The fourth conclusion is that neither in this model, there is no strong connection between the stocks' yields and the influence factors considered (credits' interest rate, exchange rate, BET index, inflation). Therefore, in this case too, the prices of the financial instruments selected in the portfolio cannot be explained from the point of view of the influence factors (as not being influenced by this combination of factors).
Moreover, it can be observed that neither in this model there is a probability over 0.05 (5%) of the considered factors (the difference towards the optimum probability shows that the chosen factors are not relevant). It can be drawn a fifth conclusion, that the model considered, through its factors, is not relevant to measure the portfolio's yield or its stocks' yields.
In the case of the data presented in Table 4, it can be observed the direct and reverse proportional influence of the coefficients considered by the model towards the stocks' yields, namely:

- the interest rate influence in a reverse way the stocks' yield (with the exception of SIF2 and TLV);
- the exchange rate (CSV) influences in a reverse way the stocks' yield;
- BET and inflation influence directly proportional the stocks' yield (with the exception of TLV in the case of inflation).

Normally, the interest rate, the exchange rate and the stock exchange index should influence in a direct proportional way the stocks' yields, namely their growth should have as an effect the growth of the yields. The economic factors selected offer a growth or a fall of the risk premium accepted by the investor that modifies the expected yield of his investment, making his preference to be orientated to certain financial instruments or certain prices or yields available. The growth in credit interest rate and in exchange rate make the investor to look for a higher yield for his stock exchange investments (in this case, stocks from the portfolio), and therefore provoking the generalized growth of market prices (quotations) (the relation price/yield must include the growth supported by the investor and created by the growth of credit interest rate, exchange rate or inflation rate).
If for the index BET of B.V.B. one can say that there is a direct proportional relationship with the statistical data regarding the selected stocks' yields (which is normal, considering that in the selected portfolio are 5 of the 10 *blue-chips* from BET), for the other factors there is no such relation of normality.
The lack of direct proportionality relation between the stocks' yield and the credit interest rate and exchange rate and the lack of reverse proportionality relation between stocks' yield and inflation show (a sixth conclusion) that the stocks' prices do not depend on the sum of factors considered by the APT model Morgan Stanley.

5 Virtual portfolio test using the adjusted APT Model

After testing the two APT models, it has been observed that neither of these two could explain the selected portfolio stocks' yield. There is, as observed, an atypical evolution of portfolio's financial instruments, that can not be correlated with the APT models factors' evolution (the second model includes

also the market's evolution factors, and therefore the lack of correlation rises a serious question).
Taking into consideration that both APT models tested before didn't presented a significant relevance for the selection of influence factors, the conclusions that were drawn after testing the Chen, Ross and Roll model and the Morgan Stanley model over the virtual portfolio stocks' yield didn't gave an explanation for the yield in the analyzed period (2003-2008). Therefore, it was necessary to test, on the same data series, other models of the same type, but with a different combination of factors.
A set of seven factors (from the ones before analyzed) were chosen (industrial production, risk preference, time preference, inflation, interest rate for credits, exchange rate and BET-C index of B.V.B.), in order to detect a certain structure that can offer a relationship between them, and to permit a classification by importance and relevance over the stocks' yield. Generating a case with multiple variables ensures the defining of a space in which the stocks' yield depends upon the influence factors.
The composing method of the factors was realized based on the *principal component analysis* principle (generated with the SPSS software), as this method is the most appropriate for the case in which, for a set of variables observed, one can whish for selecting a group of other artificial variables (*principal components*), that will sum together with the biggest variance of the initial factors' set. The components resulted (influence factors) have the capacity to be used as prognosis factors or criteria variables in the present tests. Through this method it is applied the procedure of reducing the variables.
The analyze used in composing the factors within the method chosen is based on an independent sample (the virtual portfolio created), with more than two independent variables (multivariate analyses) and has as objective the measuring of the association level and the central determination, respectively the evaluation of the significance of the differences between the variables and the groups of variables (causality relationship of the sample and the variables).
Following the before analyzed models, other two models were built for testing: F1 and F2. For testing of these two, seven factors of influence were taken, as mentioned above, and, starting from correlations equal to 1 between the factors included in the analyze, it resulted, after the extract based on principal components analyses, in a set of indicators differently correlated, in connection to their relevance in the actual testing. From the obtained data, as shown in Table 5, it can be observed that, in this model, the highest relevance for the dynamic of the portfolio selected stocks' yield is given for the risk preference, the time preference and BET-C index.
The obtained data are sustained by the dynamics that the stocks' prices had in the analyzed period (2003-2008) and by the investment behavior.

Table 5. Selection method for factors by its relevance (relevance test – scree plot test)

Factors (F)	Initial	Extraction
Industrial production	1.000	0.168
Risk preference	1.000	0.958
Time preference	1.000	0.958
Inflation	1.000	0.682
Interest	1.000	0.464
Exchange rate	1.000	0.420
BET-C	1.000	0.914

The *communality* represents the explained proportion of factors from the variance of a variable. Because the tries are correlations between variables and components and because the components are octagonal, the communality of a variable represents the determination coefficient (R^2), if the variable is predicted by components. It can be computed the communality of a variable as sum of tries' squares on variables. The initial communalities are equal to 1, being calculated before reducing the dimension.

The factors tries (the extraction column) represents the base of the factors' naming, an important problem in factorial analysis. A factor, as passive variable, must have a name that can be understood, used, referred to and so on. The loading structure of a factor can offer suggestions in this sense, as tries bigger than 0.6 are considered being important, and as those with a value under 0.4 are considered as being small. The variables with big tries constitute the initial variables' combination that determines the factor.

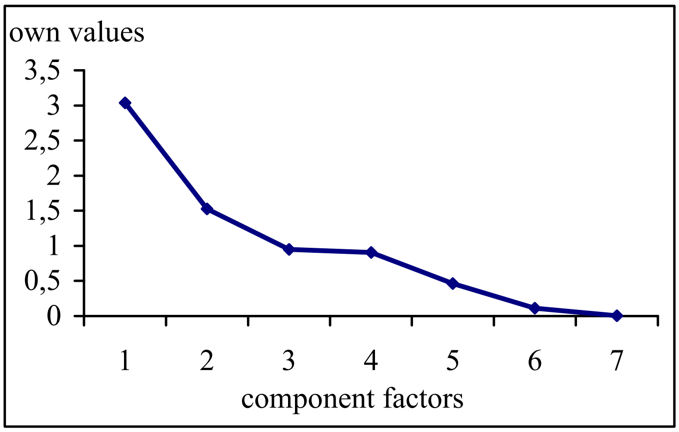

Fig. 1. Scree plot test

Table 6 shows in which proportion the total variance can be explained by the factors included in the analysis. An important point is that of establishing the number j of principal components that will be kept in the final model (the relevance test – *scree plot test*). It can be observed that the first three factors explain the total variance in a proportion of 78.763% (summed up), and that the first two explain the total variance in a proportion of 65.211% (summed up). The direction change of the curve that takes place after factor 3 shows the low relevance of the previous factors, namely from factor 3 to factor 7, as seen in Fig. 1.

Table 6. Total variance explanation

F	Initial own value			Extraction of square tries sums*			Rotation of square tries sums*		
	total	variance %	cumulative %	total	variance %	cumulative %	total	variance %	cumulative %
1	3.038	43.395	43.395	3.038	43.395	43.395	2.998	42.836	42.836
2	1.527	21.816	65.211	1.527	21.816	65.211	1.566	22.375	65.211
3	.949	13.552	78.763	-	-	-	-	-	-
4	.906	12.942	91.705	-	-	-	-	-	-
5	.465	6.645	98.350	-	-	-	-	-	-
6	.113	1.613	99.963	-	-	-	-	-	-
7	.003	0.037	100.000	-	-	-	-	-	-

* square structures = *squared loadings*, method of computing the relevance of a factor by comparing to a structure from which it belongs (weight in total structure, variance towards the total structure or towards the rest of components' parts of the structure) depending on its weight in a total of many factors.

The extracting method: *principal component analysis*

The explained variance for each component after the rotation is equal to the tries' square sum, contributing to the decision regarding the number of components that must be kept, the sum of the tries' squares (SSL, *sum of squared loadings*) after rotation being somehow similar to own value. As a result, it can be kept those components with a post-rotation SSL higher as value than 1, the smaller values not being calculated anymore (are not presenting a significance).

The own value table (*eigen values*) contains, besides the effective value, the necessary calculation for identifying the explained variances of the components. The sum of the seven own values is equal to 7 (number of variables). The variance proportion explained by a component is represented by the ratio between the own value and 7 (reminding that each own value represents the explained variance, captured by the component). The initial own value under a cumulative form (cumulative %) shows directly how much of the total variance is explained by retaining a number of components.

Extracting the following data (sums of the square structures and their rotation) of the factors 3-7 is no longer relevant, due to the initial own values obtained for the seven variables (influence factors).

The extraction's results of two principal components out of the seven indicators are presented in Table 7, named also the "*Component Matrix*" (*loading matrix, factor pattern matrix*). Essentially for the analyses, this contains the loading of the factors (*factor loadings*); the matrix's elements (tries) represents the correlations between components (columns) and the initial variables (rows).

Given the components' proprieties (that are octagonal), the tries have also the interpretation of standardized coefficients from the multiple regression, in other words it shows with how many standard defiance s_x is modified x, if the factor modifies with a standard defiance s_F.

The columns shows how each of the selected influence factors is correlated with the two components previous selected (risk preference and time preference). A negative relation indicates the reverse proportionality between the two values, namely a positive relation for a direct proportionality. Therefore it can be observed that if the risk preference grows, this can be realized simultaneous with the growth of time preference and of the value of BET-C index (a value close to 1 indicates a strong connection).

There exist, also, a weak relation (values close to 0) between risk preference and industrial production, inflation and exchange rate. Regarding the time preference, this is directly proportional with the inflation, exchange rate and interest rate, proving the existence of a strong relation, more pronounced in the case of inflation.

Table 7. Extracting two principal components

	Components	
	Risk preference	Time preference
Industrial production	-0.086	-0.401
Risk preference	0.970	-0.130
Time preference	0.970	-0.128
Inflation	0.218	0.796
Interest	0.419	0.537
Exchange rate	-0.141	0.633
BET-C	0.951	-0.099

Interpreting the extraction on two components determines exactly how much of each element is measured by each. It exist more validation conditions (interpretation) for the method's preciseness that shows if the hypothesis of the selected models F1 and F2 started from just rationalities:

- the existence of three variables (factors) with significant impact (higher than 0.5 and going towards 1) for each of the two components;

- the three variables of each component are into the same group of significance (risk preference, time preference and BET-C are inter-connected/inter-dependent, the same as in the case of inflation, exchange rate and interest rate);
- the groups of significance for the components differ (component 1 means the investment behavior, and component 2 means the macro-economic evolution);
- there is a rotation in the significance of the factors, similar to applying the first matrix (there are three important factors, followed by other factors with lower relevance) for each of the two components.

The validation criteria for the selection are fulfilled and results into the validation of the selection of factors, namely in rolling over the F1 and F2 models, in a similar way as the APT models tested before, for the set of seven factors available.

The equations used for applying the APT models F1 and F2 are:

F1: Stock = C(1) * F1 + C(2) * C(2) + ε

F2: Stock = C(1) * F2 + C(2) * C(2) + ε

where:

C(1) and C(2) are the coefficients from the regression equation, with *C(1)* referring to factors and *C(2)* being the free coefficient from the equation.

The coefficient *C(2)* can catch any factor differed by F1/F2 care that could estimate the yield if we consider it not equal to 0. If C(2) = 0, there is no other factor that could influence the yield (false hypothesis), and therefore results that the relevance for the situation in which *C(2)* is not equal to zero (C(2) ≠ 0).

The observed values for the dependent variables used in testing models F1 and F2 are shown in Tables 8 and 9:

Table 8. Probability's, regression coefficients' and R-square's values for F1 Model

Shares	Probability		Coefficients		R-square
	F1	C2	F1	C2	
SIF1	0.1278	0.8212	0.027772	0.003949	0.033773
SIF2	0.0508	0.6970	0.036645	0.006964	0.054929
SIF3	0.1702	0.9555	0.026990	-0.001053	0.027480
SIF4	0.1702	0.7517	0.023638	0.005235	0.027486
SIF5	0.0012	0.8619	0.072035	-0.003604	0.143359
SNP	0.0628	0.8781	0.028283	0.002225	0.049974
BRD	0.0387	0.6828	0.032982	0.006190	0.062263
TLV	0.1093	0.6774	0.031509	0.007841	0.037266
AZO	0.0656	0.4365	0.036529	-0.014765	0.048974
RRC	0.3160	0.5139	0.023098	-0.014499	0.014783

The estimated equations for F1 model application are:

SIF1 = 0.02777243616 * F1 + 0.003949133658 * 0.003949133658 + ε

SIF2 = 0.03664496421 * F1 + 0.006964251883 * 0.006964251883 + ε

SIF3 = 0.02698956254 * F1 – 0.001053087384 * -0.001053087384 + ε

SIF4 = 0.02363826219 * F1 + 0.005235076144 * 0.005235076144 + ε

SIF5 = 0.07203472967 * F1 – 0.00360409364 * -0.00360409364 + ε

SNP = 0.0282825186 * F1 + 0.002225304096 * 0.002225304096 + ε

TLV = 0.03150888512 * F1 + 0.007840719662 * 0.007840719662 + ε

BRD = 0.03298205378 * F1 + 0.006189695552 * 0.006189695552 + ε

AZO = 0.03652911693 * F1 – 0.01476540284 * -0.01476540284 + ε

RRC = 0.02309836327 * F1 – 0.0144985722 * -0.0144985722 + ε

From the obtained data, presented in Table 8, it can be observed that *R-square* still has values not close to 1, resulting a statistical relevance but not significant from the point of view of the intensity, as the intensity of the relation is low (between the portfolio stocks' yield and the influence factors). Including in the model of all influence factors (seven) shows a diminishing of the values of *R-square* obtained in the previous testing of the APT models (Chen, Ross and Roll and Morgan Stanley), and therefore can be drawn a first conclusion: the stocks' yields have a lowest intensity relation when the seven factors are being composed than when they are taken separate (on categories, in the APT model), and that means a statistical relevance.

Moreover, it can be observed a probability for F1 close to the value 0.05 (5%) for the factors in the model, but also a probability of *C(2)* bigger than the value 0.05. it can be distinguished a second conclusion, that certain factors included in the F1 model (risk preference, time preference and BET-C index) are relevant for measuring the portfolio's yield, and meantime the other four factors do not present a significant relevance level. Concerning the value of the coefficients F1 and *C(2)*, it can be observed that these are mostly positive, therefore they influence directly proportional the stocks' yield, and the values of *C(2)* are very small, and therefore it results a minimum influence of the excepted factors in F1 model.

In the case of F2 model testing, the estimated equations are built by using the coefficients of this model, as seen in Table 9:

SIF1 = -0.006230405343 * F2 + 0.004949647681 * 0.004949647681 + ε
SIF2 = -0.008771980149 * F2 + 0.008264870718 * 0.008264870718 + ε
SIF3 = -0.003841895182 * F2 – 2.353266977e-006 * -2.353266977e-006 + ε
SIF4 = -0.01503962467 * F2 + 0.005741591933 * 0.005741591933 + ε
SIF5 = -0.0166121183 * F2 – 0.00102503038 * -0.00102503038 + ε
SNP = -0.02281187421 * F2 + 0.002660610306 * 0.002660610306 + ε
BRD = -0.02267601181 * F2 + 0.006453528296 * 0.006453528296 + ε
TLV = 0.0184444501 * F2 + 0.009880011983 * 0.009880011983 + ε
AZO = -0.003991768683 * F2 – 0.01330047014 * -0.01330047014 + ε
RRC = 0.02210412035 * F2 – 0.01269944283 * -0.01269944283 + ε

Table 9. Probability's, regression coefficients' and R-square's values for F2 Model

Shares	Probability		Coefficients		R-square
	F2	C2	F2	C2	
SIF1	0.7302	0.7804	-0.006230	0.004950	0.001761
SIF2	0.6387	0.6527	-0.008772	0.008265	0.003260
SIF3	0.8436	0.9999	-0.003842	-2.35E-06	0.000577
SIF4	0.3764	0.7306	-0.015040	0.005742	0.011525
SIF5	0.4644	0.9633	-0.016612	-0.001025	0.007897
SNP	0.1284	0.8556	-0.022812	0.002661	0.033674
BRD	0.1482	0.6751	-0.022676	0.006454	0.030951
TLV	0.3431	0.6046	0.018444	0.009880	0.013227
AZO	0.8397	0.4937	-0.003992	-0.013300	0.000606
RRC	0.3289	0.5674	0.022104	-0.012699	0.014022

From the obtained data presented in Table 9, it can be seen that neither in this model's case, *R-squared* doesn't have values close to 1, therefore the same type of conclusions can be drawn as in the previous model case (F1). But, in this case, the F2 probability is not close to the value 0.05, and therefore no strong connection between stocks' yield and F2 influence factors is observed. Also, the F2 coefficients are mostly negative, showing a reverse proportionality relationship towards stocks' yield.

6 Conclusions

For adopting an efficient strategy for covering risk, it is a must, in the light of establishing the foundation of a rational investment decision, to analyze the risk-yield relation associated to the portfolio's stocks. Taking into consideration the national stock market particularities, we have considered that the most appropriate model (from the correctness of the applicability point of view) for testing the built portfolio is APT (*Arbitrage Pricing Theory*).

After testing the portfolio by using the APT Chen, Ross and Roll Model and Morgan Stanley Model, we have noticed that there is an atypical reaction of the financial instruments from the portfolio towards the factors of influence considered by the models. The two tested models used different factors, trying to cover as much as possible the influence possibilities of the yield, but the testing's result showed that none of these two models can explain the selected portfolio stocks' yield, being hard to estimate an economic based relationship between the historical yields (2003-2008) of the shares and reference economic indicators.

The obtained result's irrelevance, considering the influence factors, determined the necessity of testing the portfolio by a re-combined set of factors, on the same series of dates and a similar estimation model. Other two APT models were built (F1 and F2), that had as influence factors a set of seven from before analyzed ones (industrial production, risk preference, time preference, inflation, interest rate for credits, exchange rate and BET-C index from B.V.B.). Applying the composing model by *principal component analysis* principle, it was looked for detecting a certain structure that could offer a relationship between influence factors, taking into consideration their relevance towards the evolution of the portfolio's yield. From the gained information and data it can be observed that the highest influence towards the yield's dynamic is settled by the risk preference and the time preference of the investors, in other words one can observe the existence of an investment herd behavior, deeply speculative, despite the investment behavior orientated towards economic substantiation of the financial decision [6]. In fact, it is revealed that the stocks' prices movement is existing as an effect of an investment decision without rationality and without a long term financing perspective, given only by the ”feeling” of certain ”market makers”, speculative type [7]. The selection made was then tested, the validation criteria being fulfilled and a correct selection being generated.

The testing conclusion for the two APT models F1 and F2 is that, in both cases, these are statistical relevant but not relevant from the point of view of the relationship's intensity between stocks' yield and the influence factors, the low intensity showing that neither of the factors can explain, without any doubt, the stocks from the selected portfolio yield.

Anyway, in the case of F1 model, the probability's values are close to the level of 0.05 and, in comparison to the same values obtained by testing the APT models Chen, Ross and Roll, Morgan Stanley and F2, these values are the most favorable to testing, existing the conclusion that, from all seven selected factors, the ones that can influence most significant the stocks yield are the risk preference, the time preference and BET-C index.

The previous conclusion, according to which one can say that there is an atypical evolution of the stocks yield, sustains the lack of correlation between the stocks' yield and the influence factors from the APT models, no matter if these are specific to the stock exchange or of macro-economic type [8]. Only characteristic factors for the investment behavior are the ones that respond to the application of the APT models, in different proportions.

After testing all four models from above, for the 2003-2008 period, one can mainly say that the Romanian capital market listed stocks' yield, respectively B.V.B. market, as a market for listing blue-chips type stocks, is correlated only with investors' risk preference and time preference and the BET-C index' evolution. In other words, to explain the stock exchange's trend one can analyze the investment behavior, respectively through behavioral finance.

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