ДЕКОМПОЗИРАНЕ НА ДОХОДНОСТ И РИСКОВА АТРИБУЦИЯ ПО ПРИМЕРА НА НОВОВЪЗНИКВАЩИ ЕВРОПЕЙСКИ ПАЗАРИ[1]

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RETURN DECOMPOSITION AND RISK ATTRIBUTION – A CASE STUDY OF EMERGING EUROPEAN MARKETS[1]

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Анотация: *Използвайки времеви модел, изследването опитва да установи, измери и тълкува източници на фундаментална доходност на акции на даден пазар. Разработката стъпва на допускането че голяма част от риска на акциите произтича от глобални външни фактори. Ако инвеститорите определят значимите фактори (процес наречен рискова атрибуция) и премахнат тяхното влияние (процес наречен декомпозиция на доходността), те ще останат с фундаментални доходности, несвързани помежду си и с въпросните фактори.*

Ключови думи: *Декомпозиция на доходността, Факторна значимост, Резидуализирани фактори, Рискова Атрибуция, Моделиране на Систематичен Риск*

Annotation: *Using a time series model the research attempts to determine, measure and interpret sources of fundamental stock return in a given market. The paper builds on the assumption that big part of stock's risk stems from global exogenous factors. If investors determine significant factors (a process called risk attribution) and remove their influence (a process called return decomposition), they'll be left with fundamental returns unrelated in-between and to said factors.*

Key words: *Return Decomposition, Factor Significance, Residualized Factors, Risk Attribution, Systematic Risk Modeling*

INTRODUCTION

Pre-crisis investing was characterized as a straight-forward process. All investors did was select high-return low-risk investments in compliance with their individual risk tolerance and utility. It was about winning, riding the market, achieving growth and realizing profit. But then came the financial crisis. Winning occurred rarely, markets destabilized, growth came to a halt and profit was replaced by loss. The investing world knew that everything needed to change. Many began focusing on what investment model to use and how to add

[1] The paper is part of a series of case studies on the topic of Preliminary Stock Analysis for the purpose of Active Portfolio Management. Thus this work builds on an established methodology, preliminary data analysis and empirical tests already described in:
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long-term value. Risk neutralization regained popularity not only for the largest institutional investors but for everyone. Today everyone knows that the global economy has its macro-, market, industry and country influence.

This paper is investigating the extent to which observable exogenous factors explain stock return time-volatility. The applied methodology is built on ICAPM and APT model, specified using MUST and GRAM models of Oxelheim (2003) and Montagu (2013). They add a progressive factor decomposition that overcomes well-known biases of MPT and multi-factor regression. After being decomposed stock returns split between returns attributable to said factors and pure fundamental returns.

A) THEORETICAL FRAMEWORK

Economists explore extensively the relationship between stock returns and global risk factors in developed and emerging economies. They try to determine whether risk expositions are enough to explain stock return volatility. Sharpe (1964) tries to explain stock return volatility using his CAPM. Ross (1976) adds the notion of a set of factors attributable to a stock's return volatility – a model known as Arbitrage Pricing Theory. The APT framework is extended by Solnik (1983) who uses global factors. Chen, Roll & Ross (1985) begin some of the earliest investigations on the said link – between stock returns and macro-factors, on the US market. McElroy & Burmeister (1988), Hamao (1988) and Priestley (1996) follow their example by testing this influence again on the US market, but also on the Japanese and UK markets. Banz (1981) and Reinganum (1983) add the notion of company size as a significant factor. Fama & French (1992) add the company type (value or growth) as a significant factor. Asness, Porter & Stevens (2000) throw in the company industry affiliation towards contributable extraneous factors.

Many authors study exogenous factors influence on Turkish stocks. Using APT Büyükşalvarcı (2010) determines negative macro- factor influence on ISE-100 Index. Akar (2011) confirms this using GARCH. Using Johansen's Cointegration test Ozcan (2012) demonstrates the positive impact on Industry indices. Bali & Cinel (2011) cannot confirm external influence using Panel data. In one of the few papers studying markets from Central and Eastern Europe Sokalska (2001) finds that Czech, Hungarian and Polish stocks' prices to move together. She argues that the key factors influencing their movements are exogenous. Mateev & Videv (2008) examine the relationship between macroeconomics and study the role of different economy-wide factors in explaining variation in stock returns in on the Bulgarian stock exchange.

B) ECONOMIC MODEL

The employed model is a standard multi-factor time-series (MFTS) framework that tries to explain stock return with a set of exogenous factors. Traditionally all MFTS models are limited by factor correlation. To solve this problem the study proposes a modification using a step-by-step factor decomposition that eliminates said correlation. The starting point is the initial MFTS model, as it can be seen in the following table:

Table 1 - Factor Decomposition and Model Construction

Model	Dependent variable	Constant	Independent variables				Residuals
Initial Model	Stock return	Stock return alpha	Macro- risk premiums	Market risk premiums	Industry risk premium	Country risk premium	Decomposed Return
	R_i	α_i	$\sum_j \beta_i * F_{Macr}$	$\sum_k \beta_i * F_{Mkt}$	$\beta_i * F_{Ind}$	$\beta_i * F_{Cntr}$	ε_i
Market Factor Decomposition	Market Factor	Market factor alpha	Macro- risk premiums				Decomposed Market Factor
	F_{Mkt}	α_{Mkt}	$\sum_j \beta_i * F_{Macr}$				ε_{Mkt}
Industry Factor Decomposition	Industry Factor	Industry factor alpha	Macro- risk premiums	Decomposed Market risk premiums			Decomposed Industry Factor
	F_{Ind}	α_{Ind}	$\sum_j \beta_i * F_{Macr}$	$\sum_k \beta_i * \varepsilon_{Mkt}$			ε_{Ind}
Country Factor Decomposition	Country Factor	Country factor alpha	Macro- risk premiums	Decomposed Market risk premiums	Decomposed Industry risk premium		Decomposed Country Factor
	F_{Cntr}	α_{Cntr}	$\sum_j \beta_i * F_{Macr}$	$\sum_k \beta_i * \varepsilon_{Mkt}$	$\beta_i * \varepsilon_{Ind}$		ε_{Cntr}
Final Model	Stock return	Stock return alpha	Macro- risk premiums	Decomposed Market risk premiums	Decomposed Industry risk premium	Decomposed Country risk premium	Decomposed Return
	R_i	α_i	$\sum_j \beta_i * F_{Macr}$	$\sum_k \beta_i * \varepsilon_{Mkt}$	$\beta_i * \varepsilon_{Ind}$	$\beta_i * \varepsilon_{Cntr}$	ε_i

Where: R_i is the total realized return of a stock; α_i – stock return component independent of risk factors; F_t – values of a macro-, global market, global industry or country specific factors; β_i – sensitivity of the stock to a risk factor; $\beta_i * F_t$ – risk premium of a factor to the stock return; ε_i – residual stock return component. The attention is on residuals as they measure the dependent variable volatility, unexplained by the independent variables. The presence of residuals translates into low explanatory power of the model. Assuming they are highly correlated with the dependent variable and knowing they are uncorrelated with the independent variables the residuals are highly representative for said dependent variables. In short they can be used instead of independent variables as factors for the construction of a final (modified) model. This construction begins with decomposition of market factors versus macro- factors for the purpose of neutralization of macro- factor influence on market factors. Their residuals are then included in the following industry factor decomposition versus macro- and "Residualized" market factors and so on. Finally there are the macro- factors, Residualized market, industry and country factors, each of which uncorrelated with the others.

C) DATA

Using monthly data of the Turkish, Polish and Bulgarian stock exchanges the study explores which are the exogenous factors that influence returns of stocks from said markets. The data captures the period 2004-2014. Stocks are included based on availability and fullness of data and excluded based on industry (stocks from the financial sector are specific and require alternative methods of analysis), gaps longer than two consecutive months or time series shorter than 50 monthly observations. Stock returns are analyzed versus a wide range of global exogenous factors that can be divided in the following five groups:

Table 2 – Factor groups and Calculation

Factor Group	Factors	Data Availability / Calculation Method
Global Macro-Factors	1Y & 1M ICE Libor, Euribor, and US T-bill rates; their 1Y/1M spreads; Crude oil (Brent) price; S&P Global REIT; MSCI World, ACWI+FM and EM indices; EM/World and EM/ACWI+FM spreads; S&P 500 VIX; USD/SDR, GBP/SDR, EUR/SDR and JPY/SDR exchange rates.	
Custom Macro-Factors	10 year Government Bond Yields, GDP Growth, Industrial Production Indices, Unemployment Rates, Export, Import and Trade Balances, FDI Inflow, Outflow and Net spread, Consumer Price Indices and Credit Default Spreads.	Average values of leading economies' national macro- factors, weighted using said their current national GDPs. Weights larger than three standard deviations are corrected using a winsorizing methodology.
Global Market Factors	Global market factors represent specific internal market relationships, two of which are added towards the selected nine macro- factors: Growth/Value spread, and Value indices spread and Large/Small spread.	S&P Global BMI Growth and STOXX Global 3000 Large and Small indices.
Industry Factor	Industry factors are custom industry indices that capture the specific movement of global industry risk premiums.	Calculation of monthly returns of all companies in the investable universe, followed by the measuring the spreads of equal-weight industry portfolios' returns versus an equal-weight investable universe portfolio.
Country Factor	The country factor is measured using returns of national indices to which the companies belong.	

RESULTS

Figures 1 through 6 visualize factors' risk attribution through factor risk premiums, measured in size and sign.

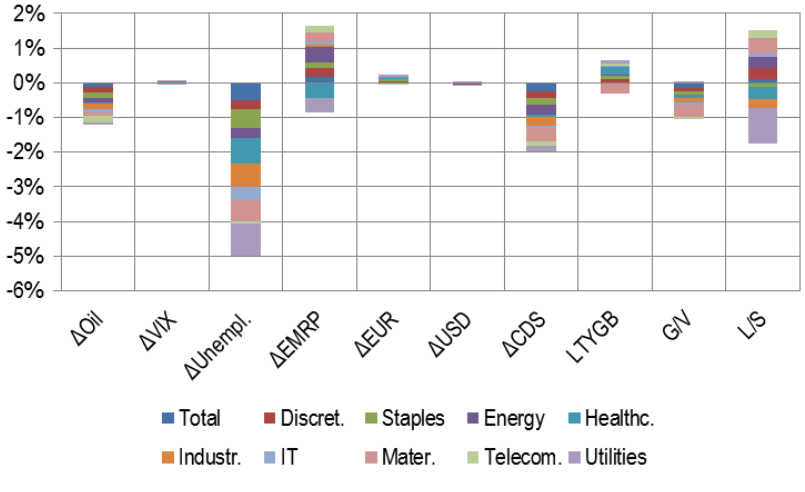

Figure 3 - Turkey - Risk premium by industry

Figure 3 depicts significant factors in Turkey in relation to industries. Unemployment, emerging market risk premium and Size are most[2] influential factors, while VIX, USD and EUR, are least influential. The implication is that Turkish companies are sensitive towards the global working employment. The explanation is rather simple – as Turkey is one of the countries with highest rate of work-related emigration towards developed markets, Turkish stock returns are in a causal relationship with developed markets' labor demand. When people migrate companies lose potential labor force, which in term heightens the alternative cost of real labor. The other two factors – EMRP and Size are both key indicators for a typical emerging market – a large quantity of companies are still in start-up phase, that try to progress in the specific of an emerging market – economic instability and turmoil.

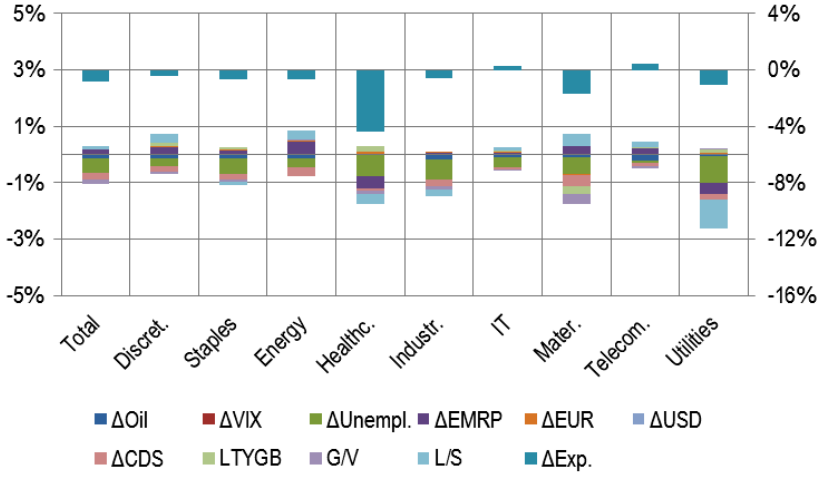

Figure 4 - Turkey - Risk premium by factor

Figure 4 depicts the same data, but from the point of view of strength of impact of each factor. As it can be seen most influenced industries are Healthcare, Materials and Utilities, while least influenced are IT and Telecom. As it was skipped in the previous figure, here the factor Export is measured in a second scale for as it is highly influential. The most impacted by both Export and other factors industries are mainly pharmaceuticals, resource extraction and resource distribution companies, strongly affected by the global economy – an ascertainment of great importance of export for the Turkish economy.

[2] Most influential factor is Export but because of its large scale, it is removed from the figure, but can be seen in the next one.

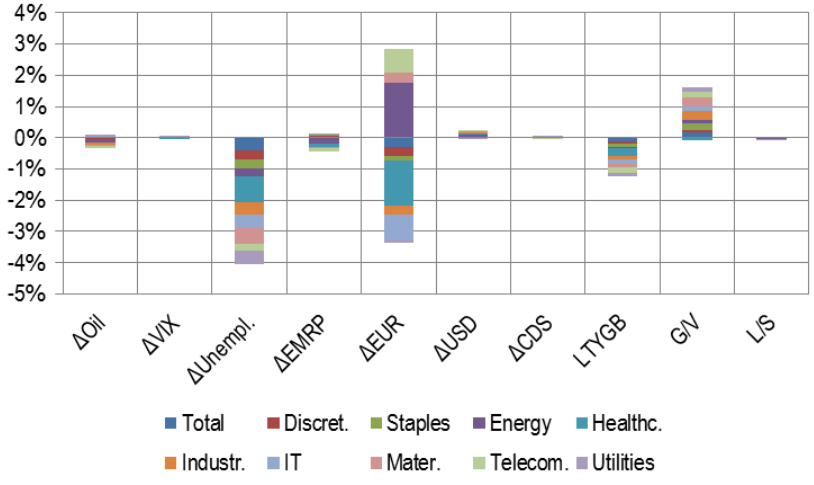

Figure 5 - Poland - Risk premium by industry

Figure 5 repeats factor significance by industries, but for the polish economy. Most influential[3] factors are Unemployment, the Euro, Growth/Value spread and Long-term government bond yield size. This is typical for a country with economy highly connected with the European Union, but still outside of the Eurozone. This is also indicative for the status of Poland as a typical emerging economy in Central Europe – affected by the Debt Crisis. Least influential factors are the VIX index, USD, CDS and size. This translates into weak impact of the US economy on Polish stocks, neutrality towards global risk of stock and bond markets and a specific state of transition from a typical emerging market toward a weak developed market (as seen in weak impact of size, as it shows that big part of companies have grown in size greater than new businesses).

[3] Most influential factor is Export but because of its large scale, it is removed from the figure, but can be seen in the next one.

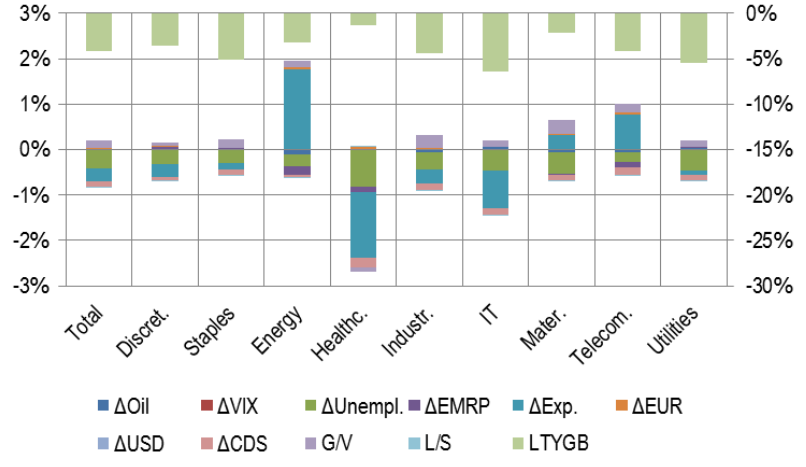

Figure 6 - Poland - Risk premium by factor

Figure 6 presents factors influence on industries. Most influenced are Energy, Healthcare and IT and Telecoms, while least influenced are Staples and Utilities. The factor Long-term yield of government bonds is measured in a second scale because of the high values of risk premiums on all industries. This shows that the Polish economy is composed of many companies in the energy extraction, pharmaceutics, internet and mobile communications. Staples and Utilities are stable industries composed of companies that produce luxury goods and technology, but also electrical, water and waste distribution.

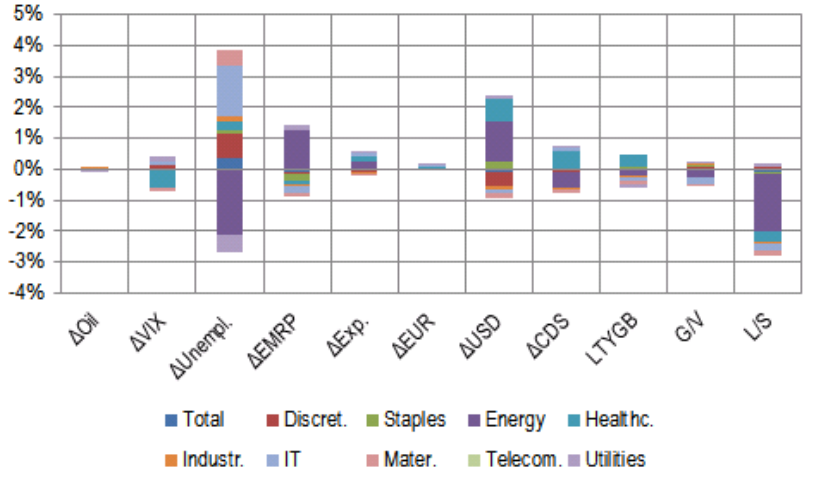

Figure 7 - Bulgaria - Risk premium by industry

Figure 7 shows the situation in Bulgaria. The most influential (this time without the exclusion of export) is again Unemployment, followed by the Dollar and the size of a company. The least influential factors are Oil, VIX and Euro. The lack of export significance is very important, as it gives reason to believe that the Bulgarian economy is too weak to be dependent on this global factor. Unemployment is significant but almost always with a positive sign, with the exclusion of Energy and Utilities industries. This is indicative for the Bulgarian economy. The strong relationship with the dollar and weak relationship with the euro is a consequence of the Bulgarian CBA and the socio-economic history of Bulgaria as an ex-socialist state. The weak relationship with Oil and VIX are results of different but connected processes – weakening of industrial production and distribution (in relationship with Oil price) and weakening capital market of public companies (in relationship with the VIX). This all proves the argument that the Bulgaria is a weak and slowing emerging economy.

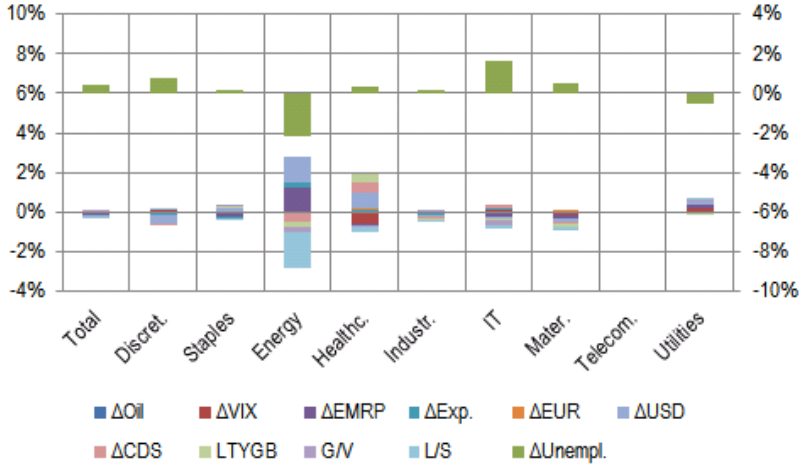

Figure 8 - Bulgaria - Risk premium by factor

Figure 8 continues the explanation of the case of Bulgaria. Most influenced are Energy, Healthcare and IT while least influenced are Industrials and Staples. The outliners here are Industrials as weakly influenced and IT as strongly influenced. Both are specific sectors in the Bulgarian economy, characterizing its national specifics. In the last twenty years IT is maybe the fast developing sectors in the Bulgarian economy, while the industrials sector decays. Energy is a sector too strongly dependent on global economic influence, because of the fact that mostly all energy companies in Bulgaria are either foreign owned or subsidiaries.

CONCLUSIONS

Return decomposition and risk attribution are models that give investors and analyst the opportunity to examine the effect of global exogenous factor on stock returns. In addition to this, the models can also help economic agents find, measure and explore national and sector specific economic relationships. On the other hand the return decomposition and risk attribution gives investors and analysts information cleared of a big part of its „white noise", caused by said extraneous factors. Having decomposed residual returns, investors and analysts can use them for the research of cross-sectional relationship between stock return and fundamental company information (measured with financial ratios and coefficients), for the purpose of finding investing signals for Active Portfolio Management.

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