GRA 19002- Thesis

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Coskewness as a driver of excess returns, size premiums and book-to-market effects on emerging and developed markets. An empirical study on Poland and Germany.

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Preliminary Master Thesis

I. Executive Summary

If asset returns present systematic skewness, then the risk associated with it should be compensated accordingly and this compensation should be identified in the premia of the expected returns. Thus, asset pricing models have to incorporate coskewness as an additional explanatory factor, in order to better explain stocks and the phenomenae linked to them.

Starting with the assumptions and ideas of Harvey and Siddique (2000), we conduct an empirical analysis on the stock markets of Germany and Poland during ten periods, with the purpose of identifying some differentiations for coskewness premia. The models employed stress three main hypotheses regarding discrepancies in terms of coskewness premia between emerging and developed markets, as well as relationships between coskewness, size and book-to-market effects.

Our results show that coskewness plays an important role in explaining excess returns, especially when associated with size and book-to-market loadings, is economically important and commands an average risk premium of 5.34% for Germany and of (-1.46%) for Poland (at a 5% confidence level). This supports the idea that emerging markets offer more opportunities to reduce overall volatility as they prove to be more right-skewed market. Additionally, there seem to be no evident connections between coskewness, size and book-to-market effects, each playing an equally important role in explaining excess returns.

II. Introduction

Due to the actual financial environment, which stemmed in a large proportion from the depression of the last years, a lot of investors have seen the financial models according to which they oriented their decisions overwhelmed. During the crisis they witnessed large price drops, unforeseen by theoreticians, and their portfolios plummeted, as well as their investments in mutual funds, which were actually the major losers of the period. In fact, there was nothing they could do to parry this fall of the financial system or even to reduce their losses by offsetting their long positions since the models they used were obsolete and did not take into consideration the sources or even the possibility of such a downside risk. They were left with few options like investing in commodities and gold or "hedging" their positions in stocks, derivatives or fixed income securities, but since everything was suffering a severe distress there were not many strategies to which they could have appealed.

The classical theory in portfolio selection suggests following the "ancient" and somehow outdated CAPM, which has a major flaw as it covers the analysis only for the first two moments-the mean and the variance. However, the idea of separating the systematic risk from the idiosyncratic one and incorporating the second one into an error term does not focus on other sources of risk, which are mainly provided from the introduction of higher order moments. This shortcoming of the classical CAPM of Sharpe (1964) and Lintner (1965) is studied and corrected by Fama-French (1992) in their extended CAPM, by Kraus and Litzenberger (1976) in their three moments CAPM, as well as by Harvey and Siddique (2000) in their model that takes conditional skewness into account. What all these authors have in common is their focus on higher order moments like skewness and kurtosis in their attempt to build models that could explain better the sources of risk in portfolio returns.

Skewness is the third moment of a set of data, measuring the asymmetry of the probability distribution of a time series. It measures the tails of a distribution of a series and provides information regarding the probability of large tail events, which in case of stock returns could be either large gains for positively skewed series or large losses (major depressions) for negatively skewed data. It is important for investors and portfolio managers because it indicates whether a stock has the necessary attributes to be included in a portfolio and end up with larger profits for a lesser risk. This is actually the logic that backs up the techniques of portfolio construction using higher moment models. Since all investors have preferences related to the mean and variance, they all tend to follow the CAPM in their decisions, but they all neglect a plain reality - returns are not normally distributed, and not taking into account higher moments leads to an underestimation of the CAPM. In reality return series are leptokurtic and are lognormally distributed, as a vast majority of financial data, thus it is of a high priority to at least look at skewness (coskewness) as a risk factor with explanatory power in models.

Rational investors dislike variance and have a preference for positive skewness (Kraus, 1976), since this way they take on a smaller risk than in the case of the variance, for which they may expect significantly large risk premiums. Another advantage of right skewed assets is the limited liability they provide in the event of large extreme movements, since investor's risk aversion increases as wealth increases (Harvey, 2000). In essence, right skewed assets serve more as "hedging instruments", or better said risk reducing instruments. Since their addition to a portfolio of assets can reduce the probability of large absolute market movements, the normal logic should dictate that the expected returns should be lower in equilibrium (Barone Adesi, 2004), but overall investors end up better off than by introducing only the mean and the variance, in terms of profits.

In this light, our study attempts to identify the presence of coskewness on the stock markets of Germany and Poland, as sources for portfolio diversification for investors, as well as to confirm the work of authors before us and to prove the well-spread idea that positive skewness is more frequent on emerging markets. It should be of no surprise the selection of two somehow different countries in every area of analysis, except for their appurtenance to the European Union. We try to compare a developed country to a developing one in terms of economies, in our attempt to prove that the ones seeking for positive skewness should diversify their portfolios with stock from emerging markets. We also conduct our research on two most common anomalies encountered on stock markets-the size and book-to-market effects, trying at the same time to identify any link between skewness and these curiosities.

The economic question that interests us in whether it is more advantageous to look for diversification on emerging markets, whether it is worth, or just to stick to developed markets where there is an inflation of negatively skewed assets. The underlying problem is whether it is profitable for investors to take on instability on emerging markets in exchange for lower risks and larger premiums and whether the large gains can make up for the additional risk undertaken (political instability, weak regulation, reduced liquidity on stock markets). However, the most important issue from the perspective of an investor who is willing to migrate to non-domestic markets in search for diversification, is the avoidance of negative skewness. It must be kept in mind that utility is decreased by left skewness, as it increases the chances of downside risk, by adding up probability in the left tail. This is in the end one of the undesirable properties of skewness that everyone is running from and everyone is trying to neutralise.

As a consequence, this is what bothers every investor at the moment, finding new sources of risk reducing assets around the world that could mitigate the effects of a major downfall, as in the case of the 2008-2009 financial crises, when everyone was caught unprepared and overconfident with their risk reducing measures. The probability of such extreme events has increased recently and there should be methods of reducing the exposure to large negative movements by diversifying portfolios with assets that present traits of higher moments.

In order to develop our research objectives we have structured our paper into multiple sections that focus on the economic problem at hand (Section II), the literature review of past works on the subject (Section III), the methodology to be used (Section IV) and the description of the data to be employed (Section V). The empirical results of this study are presented in the sixth (VI) section, while the conclusions (Section VII) summarize the findings. This work is a mere addition to previous attempts to identify new ventures for investors desiring to enrich their portfolios with positively-skewed assets that could reduce downside risk and ensure decent risk premia.

II. Economic problem and objectives

The economic problem that underlies our research is the following question: Can investors gain more by investing on emerging markets (in our case we focus on Poland) relative to a developed market (Germany), provided they concentrate their investing techniques on coskewness? In other words we are trying to find if a well-diversified portfolio of stocks which contains both regular assets and right-skewed assets has a bigger return on the Polish stock market than on the German stock market.

For this purposes we are first going to test whether a higher moment CAPM holds on both markets and then construct benchmark portfolios, with assets arranged according to size, book-to-market and skewness. This method will be applied for both countries and hopefully we would be able to get some differences. The results of our research would show us if an investor with preference for positive skewness should invest in emerging markets to enhance his gains, accepting at the same time a lower risk premium that stems from systematic skewness. Better said, we are looking for differences in risk premiums that arise from the inclusion of left and right skewed assets in portfolios, on the two markets, and start from the assumption that emerging markets are a better deal than developed markets.

The research that we are envisaging has a great utility in practice since all financial data is known to have asymmetric distribution, captured by conditional skewness, and the addition of positively skewed assets to an investment portfolio can mitigate the downside risk. A negatively skewed asset possesses a greater probability of large downfalls while right-skewed stocks can largely increase the probability of substantial gains at a lower risk. In crisis periods, holding a portfolio consisting in a large proportion of negatively skewed stocks can lead to contagion and to significant crashes in returns. At the same time investors become more and more risk averse and try to hedge their positions by switching from assets with negative skewness to ones with positive skewness with the intent to lower risk, even though the returns diminish too (Harvey and Siddique, 2000).

The utility of such an analysis is that it could provide precious information regarding the best sources for acquiring “hedging” instruments for investments that could neutralise the large down movements that occur mainly during recessions. This technique is recommended since the frequency of extreme movements tends to be higher on average (Bali, 2009), due to the asymmetric distribution of stocks, namely leptokurtosis. The non-normality of stocks comes mainly from illiquid markets, the lack of divisibility of assets and the low transparency of information (Ranaldo, 2003). Particularly, the conclusions of such a research can be successfully applied for energy markets, small size stocks and distressed firms which present a high skewness (Harvey and Siddique, 1999), in order to reduce the volatility that arises from asymmetries.

In addition, since a vast majority of investors rely on the CAPM to eliminate systematic risk by depending only on the first two moments and neglect the occurrence of other sources of risk, especially stemming from systematic skewness (Kraus and Litzenberger, 1976), idiosyncratic risk or even systematic risk not captured by the CAPM, it would be beneficial for them to adopt a model that includes a third moment. This way they could ensure control over unexpected volatility movements and be aware of the risk premiums (although not substantial), that compensate investing in assets that present skewness. Should the market equilibrium conditions hold, they could end up with a lower portfolio risk and lower expected returns, provided they rely on positive coskewness as a security enhancing measure (Barone Adesi, 2004).

On the other hand, speculating on negatively skewed assets could bring substantial gains as they imply high risk premiums. However, a potential significant increase in returns comes at a large-cost volatility, which discourages most of the investors who belong to the same typology of risk averse and prudent individuals.

The ultimate purpose of this research is to prove the allegations of some academic circles (Charoenrook and Daouk, 2004) that more stocks with positive skewness can be found on emerging markets, in our case trying to confirm this idea on Poland. We decided to appeal to Poland as object of study since this country is representative for the Eastern European group of developing countries and has presented some of the best investment opportunities since the integration into the EU on the 1st of May, 2004. On the opposite side we put Germany as an important representative of the developed Western European countries, which continues to have a stable and consistent stock exchange.

III. Literature review

The issue of coskewness as a factor that drives the cross-sectional variation of expected returns, as a source of idiosyncratic and systematic risk, as well as an explanatory element of size and book-to-market effects, is quite a recent topic in financial literature. One of the first researches conducted on the matter is that of Kraus and Litzenberger (1976), which introduces the idea of a 3 moment CAPM with the inclusion of systematic skewness. This work is a criticism to Sharpe's (1964) and Lintner's (1965) development of the CAPM, which focuses mainly on the first two moments -the mean and the variance- to identify and explain the source of systematic risk (described by the beta slope of the market).

The main disadvantages of the CAPM are that it is more a linear model, valid only for non-restrictive conditions, the mean and the variance (Smith, 2006), and it neglects the fact that financial data presents leptokurtic distributions, with fat tails and skewness, having the attributes of non-normality. Kraus (1983) starts from the same premises as the creators of the CAPM, namely those of a non-increasing absolute risk aversion with wealth, of a monotone increasing strictly concave utility function and of identical probability beliefs. He concludes in his work that a better model to describe the cross-sectional variation of expected returns is the one which includes a quadratic function, by adding the third moment - skewness.

Kraus and Litzenberger (1976) develop their work on the same idea of including the effects of skewness on valuation. They identify that investors, having a non-increasing aversion to risk, tend to prefer positive skewness, idea which is more suitable for a 3 moment CAPM. Investors concede on a higher volatility in mean and variance in exchange for a greater increase in systematic skewness. This tendency of investors is a result of the fact that positive skewness reduces the probability of large extreme events, but has a drawback – it can also entail a negative risk premium.

Other authors, like Fama and French (1992), introduce a model that incorporates two additional factors-the SMB and HML, to explain the cross-sectional variation of expected returns. The SMB (a proxy for the size premium) and the HML (a proxy for the book-to-market premium) shed a new light on the sources of risk not explained by the variance factor.

Harvey and Siddique (2000) focus on aspects of coskewness, using the same Fama-French proxies for size and book-to-market effects-SMB (small minus big market capitalization), HML (high minus low book-to-market ratio) and a hedge portfolio (SKS), just like size, book-to-market effects and momentum. They also introduce a new measurement for coskewness by the formula:

$$\hat{\beta}_{SKD_i} = \frac{E[\epsilon_{i,t+1}\epsilon^2_{M,t+1}]}{\sqrt{E[\epsilon^2_{i,t+1}]}E[\epsilon^2_{M,t+1}]}$$

Here, $\epsilon_{i,t+1}$ are the residuals of the regression of the excess returns on the contemporaneous market excess returns. The indicator represents the contribution of a stock to the coskewness of a portfolio of assets. Its role is to capture the asymmetries in risk or the extreme events and can be translated as the fact that asymmetric variance is consistent with coskewness (Harvey, 1999).

In their broad analysis they create a model that includes the coskewness slope linked to the square of market return and also expand the Fama-French SMB-HML model with a S^- or S^+ portfolio (sorted according to skewness for the 30% lowest values and 30% highest values). They reach the same conclusions as Kraus and Litzenberger (1976), the ones that a model including a coskewness factor is fitter in explaining cross-sectional variations of returns and can explain size, book-to-market and momentum effects. The path opened by Fama-French was later continued by Moreno (2005) in explaining the variation of ex-ante market risk premia on the Spanish market and also by Hung (2004) in UK.

Barone Adesi (2004) also conducts an analysis using a higher moment model and reaches the conclusion that positive coskewness reduces the risk of a portfolio and should command a lower expected return at equilibrium, meaning a lower risk premium. Also, empirical studies of Barone (2004) and Perez (2000) identify that large companies usually present positive skewness, as opposed to smaller firms that have negative returns and skewness due to outliers of distributions, this explaining their riskiness and their proneness to default. In a previous study, the same author (Barone, 1985) reaches the conclusion that the quadratic model, although it does not explain the entire variation in returns, is a good fit for such attempts.

Aggarwal (1990), in his research on spot and forward exchange rates, lays the first steps in the interpretation of the slopes of the higher moment models, signalling that the coefficient attributable to positive skewness should be negative and significant, coming from investors' preference for this moment that commands a lower risk premium.

Ang (1979), Klemkovsky (1973) and Bali (2009) also support the use of a mean-variance-skewness model which can explain better than CAPM the asymmetries in return distributions, especially because investors have quadratic preferences and financial data has leptokurtic distribution, being skewed to the left, peaked around the mean and having fat tails. However, skewness has to be constrained when used in such optimizing models as their implementation can be quite tedious. In addition, the probabilities of extreme outcomes are much bigger than those of positive ones, which usually take the form of signals or noise. The same foundations were laid by Bali (2007) in a previous work on conditional VaR using skewness and kurtosis.

The study of risk premiums was undertaken by Boyer (2010), who proved that idiosyncratic skewness and returns are negatively correlated and the coefficients of skewness have to be negative and significant. However, Xu (2007) specifies that skewness is only negatively correlated with lagged returns unlike the correlation with contemporaneous returns, which can happen to be positive.

Unlike traditional investors who want to maximize the Sharpe ratio according to a mean-variance optimizing model, rational investors are advised to prefer positive skewness (Boyer, 2010). At the other end of the spectrum, speculative investors bet on higher volatility, coming from low skewness, for a chance at an extreme large gain, just like lottery players. Leland (1999) and Smith (2006) have previously reached the same results, meaning that investors would accept an improvement in mean and variance (a risk premium) in exchange for a negative skewness, as the positive extreme events are less important to them than downside movements. This is why the main roles of positive skewness seem to be those of enhancing risk tolerance and the utility of wealth (Stephens, 1991) and an investor should care more about coskewness when markets are positively skewed.

Another idea is introduced by Mitton (2004), who also supports the trade-off between mean-variance and skewness but accompanied by a non-diversification in portfolios. He proves that the great demand for positive skewness is characteristic for undiversified portfolios, mean-variance inefficient portfolios and higher skewed stock, portfolios that may experience larger positive movements.

Briec (2005), Prakash (2001) and Chiu (2005) remark that positive skewness is beneficial as it entails a lower probability of large negative returns, investors preferring to concede higher payoffs in exchange for a lower risk. Thus, prudent individuals prefer skewness to variance in order to reduce overall volatility.

Christie (2001), Guidolin (2007) and Dittmar (2002) introduce in their valuation models kurtosis as an element which for elevated values enhances prudence and risk aversion in investors and captures non-linear risk. Consequently, all rational investors seem to have an appetite for positive skewness and negative kurtosis since they dislike risk (represented by higher variance and fatter tails) and would rather have low premia for lower risk.

In an attempt to look into size effects, Chung (2004) uses the Fama-French loadings and Fama-MacBeth (1973) cross-sectional methodology to identify the occurrence of such effects, especially in January, when size coefficients showed to be significant in regressions. However, another finding is that the Fama-French loadings together with higher co-moments cancel each other out while used in the same valuation model.

Looking further into the matter, authors have attempted to identify differences on markets (developed and emerging markets) regarding the presence of skewness. Daouk (2004) and Hashmi (2001) find that negative skewness is more frequent on developed markets, predicted by trend adjusted turnover, as opposed to emerging markets. This is a surprising finding because emerging markets depend on a time-varying world factor and someone would expect to find resemblances to developed markets, especially regarding skewness sign. This is a crucial discovery that could guide investors into selecting better sources of risk reducing opportunities. Another surprising finding is that stocks tend to become negatively skewed following a positive returns month, the opposite being valid for a negative return month.

The study of skewness has also been conducted not only on stock markets but also on exchange and hedge markets, all reaching the same conclusions as for the fundamental studies on stocks. Brunnermeier (2008) and Jorda (2009) on carry trades and Ding (2006) and Ranaldo (2003) on hedge funds, all use higher moments valuation models in identifying negative correlation between returns (of interest rates or assets) and skewness. Thus, the possibilities of large crashes, which are frequent on such markets, can be reduced by appealing to positive skewness and negative co-kurtosis (case in which returns increase). On the other hand, because of different properties as relative to stocks, options (market studied by Vanden, 2006 with the same models), derivatives and fixed income markets would rather accept negative skewness for speculative purposes. Stephens (1991) even identifies options as a source of positive skewness if used in combination with stocks, just like in a hedging algorithm.

All these empirical and theoretical works serve as a reference point for those attempting to apply the higher moment models empirically, namely the ones with coskewness, on specific markets. Such applications were the works of Lin (2003) on the Taiwan stock market and Misirli (2009) on the Istanbul exchange. These two papers have tried to incorporate in their research the size, book-to-market and momentum effects, as initially done by Harvey and Siddique (2000). In an exercise to accomplish the same thing, the current paper tries to scout the same effects on two different markets and to provide helpful information for interested parties.

IV. Methodology

In our methodological endeavour towards the analysis of the coskewness problem we take the position of a rational investor who attempts to seize the opportunities offered by right skewed assets on international markets. Our goal is to identify and quantify the risk premiums offered by the two stock exchanges that serve as study objects - the Deutsche Boerse and the Warsaw Stock Exchange.

We use the theoretical mean-variance-skewness approach to test empirically if indeed there is a major difference between risk premiums arising from coskewness on the two markets. The first stage in our methodology consists of gathering all the stock prices available in databases for the two stock exchanges for all the companies traded and available. It has to be noticed that due to the fact that a number of companies present on stock exchanges may not have complete data statistics for market-to-book values and market values, we would be obliged to give them up in order to preserve econometric accuracy and representativity.

The extracted data is going to be filtered and normalised by using the logarithm function to obtain returns. This measure is necessary because stock prices can not have negative values, thus it needs to follow a lognormal distribution which can be induced by using the logarithm.

Also we have to get data regarding the number of shares for each company and their respective book values. Their market capitalisation is the product between the number of shares and the market value of a stock. Alternatively the book-to-market ratio is computed by dividing the book value of the fiscal year with market capitalisation. For this we compute the book values from financial statements by adding deferred taxes and investment tax credit to the book values and subtracting the preferred stock.

The next stage is going to be centred on three sub-stages:

a) the first ranking sub-stage, which involves sorting the data and the formation of panels of portfolios according to size and book-to-market ratios for the T period, as well as coskewness sorted portfolios.

b) the second ranking sub-stage (the re-estimation phase), during which we re-estimate the portfolios from the previous stage for a T+1 period.

c) the testing sub-stage for the T+2 period, where data is used in models in order to obtain relevant results.

During the first and second ranking phases a number of ranking and portfolio formation techniques are going to be used, especially those relying on double sorts and Fama-French loadings procedure.

In order to seize the size and book-to-market effects together with coskewness, the best solution is to use the Fama-French (1995) loadings/ hedge portfolios - SMB and HML for panel A. Portfolios in Panel A are going to be sorted both by size and book-to-market ratios, having the purpose of capturing together the respective effects in correlation with coskewness.

The desired portfolios are constructed by sorting the stocks according to market capitalisation and getting two portfolios sorted by market value by applying a median value. Afterwards we use the book-to-market ratios to split each of the previous two portfolios into 3 subgroups by the following criterion:

-30% for the lowest values of book-to-market ratios

-40% median values

-30% highest values of the ratios.

The results of these procedures are 6 portfolios from the intersection of market value and book-to-market ratios-S/L, S/M, S/H, B/L, B/M, B/H, where S stands for small, M stands for medium, L for low, B for big and H for high. As a clarification, the S/L represents the portfolio that contains small capitalized stocks with low book-to-market ratios. The other notations are interpreted accordingly.

By using the returns obtained in the first step of the methodology we can consequently obtain the SMB and HML portfolios. SMB is the resulting portfolio from the average of the difference between returns of small capitalization portfolios and returns of big capitalization portfolios:

$$\frac{1}{3}\begin{pmatrix} \frac{S}{L} - \frac{B}{L} \\ \frac{S}{M} - \frac{B}{M} \\ \frac{S}{H} - \frac{B}{H} \end{pmatrix}$$

SMB becomes a proxy for the size effect, which is going to be used in regressions to obtain the size premium on the respective market. It will capture the market wide systematic size effect on risk premium (Lin, 2003).

The HML, on the other hand, is a proxy for the book-to-market effect and will be used to capture the market wide systematic book-to-market effect on risk premia (Lin, 2003). It is computed by averaging the differences between the returns of high book-to-market portfolios and returns of low book-to-market portfolios:

$$\frac{1}{2}\begin{pmatrix} \frac{S}{H} - \frac{S}{L} \\ \frac{B}{H} - \frac{B}{L} \end{pmatrix}$$

The other two panels that will be part of our research will separate the size and book-to-market effects. Panel B is going to contain 6 portfolios arranged by firm value and obtained by initially dividing the sample of stocks in three groups after applying 1/3 breakpoints and afterwards by dividing each group in two sub-groups, also by size. This way we get 6 quantiles or sextiles (S loading). Panel C, with portfolios sorted in the same manner, on the other hand, will incorporate 6 portfolios (BM loadings) sorted by book-to-market ratios. This way we try to separate the two effects and analyse the impact of coskewness on them individually.

After reaching the desired outcome regarding the Fama-French loadings, which in theory should have positive values, we move on to the testing phase. It will consist of three steps-calculating the coskewness factors, constructing the coskewness sorted portfolios and incorporating the data into models.

The most appropriate approach for the computation of coskewness is to use the coskewness formula provided by Harvey and Siddique (2000):

$$\hat{\beta}_{SKD_i} = \frac{E[\epsilon_{i,t+1}\epsilon^2_{M,t+1}]}{\sqrt{E[\epsilon^2_{i,t+1}]}E[\epsilon^2_{M,t+1}]}$$

Harvey's coefficient is the contribution of a stock to the coskewness of a larger portfolio (Harvey and Siddique, 2000) and is using the residuals of the following regression:

$$r_{i.t+1} = \alpha_i + \beta_i(r_{M,t+1}) + \epsilon_{i,t+1}$$

The above model is similar to the CAPM, which uses excess returns. In this case $r_{i.t+1}$ is a series of stock excess returns for a specific date and $r_{M,t+1}$ is a series of market excess returns (returns of the market index) for the same dates. $\epsilon^2_{M,t+1}$ are the residuals of a regression of the squares of market excess returns on a constant and market excess returns, while $\epsilon^2_{i,t+1}$ are the error terms of a similar regression of the squares of stock excess returns. The following models are used to compute the coskewness factor:

a) $r_{i.t+1} = \alpha_i + \beta_i(r_{M,t+1}) + \epsilon_{i,t+1}$

b) $r^2_{i.t+1} = \alpha_i + \beta_i(r_{M,t+1}) + \epsilon^2_{i,t+1}$

c) $r^2_{M,t+1} = \alpha_i + \beta_i(r_{M,t+1}) + \epsilon^2_{M,t+1}$

Even though we could identify the coskewness coefficient by running the following regression, which includes the squares of the market returns:

$$r_{i.t+1} = \alpha_i + \beta_i\left(r_{M,t+1}\right) + \beta_{SKD}\left(r^2_{M,t+1}\right) + \epsilon_{i,t+1},$$

we believe that using the $\hat{\beta}_{SKD_i}$ is a better option because it resembles more the Fama-French loadings from before, as opposite to the β_{SKD} from the extended regression, which tends to have the properties of a CAPM beta.

Following the steps of Harvey and Siddique (2000), the next sub-phase involves constructing the $S^-$and S^+ portfolios that are going to be introduced in models during the testing phase, so as to outline the risk premia.

The sorting strategy for the $S^-$and S^+ portfolios is oriented around the lowest, median and highest values of the coskewness coefficient. The ranging technique of stocks is:

-30% lowest values of $\hat{\beta}_{SKD_i}$, which we may expect in the final regression to entail a higher risk premium since stocks with lower values of skewness increase the probability of having large return drops, so consequently their market price may be lower in order to even be considered as investment solutions for investors who clearly would not accept them in normal conditions.

-40% median values of $\hat{\beta}_{SKD_i}$

-30% highest values of $\hat{\beta}_{SKD_i}$, which should provide smaller risk premiums and should be traded at higher market prices because of the benefits they bring to a portfolio of assets and the security they confer.

Afterwards, we advance in the same line as Fama-French in the composition of SMB and HML, and create a hedge portfolio that is going to be standing for ex-ante coskewness (Misirli, 2009). SKS is the difference between $S^{-}$and S^{+} and the greater the returns of this portfolio are, the higher should the premium they stand for be. This is clearly the result of the fact that S^{-} dominates S^{+} and negative coskewness has a larger contribution to the overall coskewness of the portfolio, so we may expect a bigger compensation for holding such assets.

The steps described previously will be employed for the first ranking and second ranking stages. The first ranking phase will use data for a one year period, as will the second period do. The purpose of this repetitive procedure (rolling window) is to make sure that from year to year the sorted portfolios are adjusted according to changes on the market. As a result, the data available for the testing period will incorporate all the information regarding changes (mergers and delisting) and new IPO's of new companies and will provide more accurate results.

Finally, the last stage of our methodology will consist of testing the data for the T+2 period (also one year) in models that incorporate the size and book-to-market loadings alongside the coskewness factor. Following the logic employed in constructing the loadings from above we are going to have three models to test for the pre-established NULL hypotheses:

a) H_0: It is not possible to identify more right skewed assets and smaller coskewness risk premiums on emerging markets relative to developed markets, making it less probable to mitigate the downfall risk.

b) H_0: There are no differences in terms of skewness signs between large and small companies or high book-to-market and low book-to-market stocks, as neither offer viable alternatives for right-skew investment.

c) H_0: Book-to-market and size effects have no influence on risk premiums as described by coskewness factors.

The models that serve as tools to get the necessary coefficients are:

a) $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + s_i SMB_t + h_i HML_t + \beta_i^s SKS_t + \epsilon_{i,t}$

This is a generalized model that takes into account the two Fama-French loadings that stand for the size and book-to-market effects (SMB and HML) and gives evidence of the impact of coskewness on excess returns. The risk premiums, denoted by the coefficients in this regression, would quantify the risk premiums associated with holding the respective portfolios. As a consequence we may predict that the risk premium linked to coskewness should be negative and significant for right-skewed assets, as a result of the limited downfall risk they offer, and positive and significant otherwise. However, one of the outcomes of testing may be a presence of residual skewness if the coefficient is not significant and negative. In this case, this supplementary source of volatility would have to be controlled through the means of a more complex model. In practice, nevertheless, situations of residual skewness happen to be rare and do not make the object of our analysis.

b) $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + s_i S_t + \beta_i^s SKS_t + \epsilon_{i,t}$

This second model isolates the presence of the book-to-market effect and presents only the influence of coskewness on the size effect, by using just the size-sorted portfolios from Panel B. The risk premiums may follow the same expectations as above but the results may still be variable.

This variation of the standard model is useful because it could provide information regarding the coskewness for small size companies and large size companies. The first quantile of the sample stands for the smallest firms and the last quantile stands for the largest firms on the market. Therefore, it would be possible to see if smaller companies do indeed have negative skewness and present a higher risk for investors.

c) $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + b_i BM_t + \beta_i^s SKS_t + \epsilon_{i,t}$

The last model to be adapted to this research is the one using only the book-to-market-sorted portfolios from Panel C and has the intent of eliminating the effects of the size effect. As formerly stated, the sign and significance of the risk premiums can be guessed, but not with full confidence.

The above methodology will be applied for ten periods of three years each through a rolling window and will result into ten sets of outcomes which will incorporate all the necessary information for relevant periods. The objective is to trace back the evolution of the markets as well as to keep an eye on the impact of the EU membership, especially in the case of Poland. This will provide us with a clearer image on the opportunities that can arise for investors with a further development of markets.

Of course, the analysis can be extended further by creating other portfolios by industry or momentum, but we have decided to focus just on the size and book-to-market effects. It can be interesting to run regressions just for specific periods of the year, like certain months when financial anomalies appear (the January effect), to see if this curiosity can be somehow attributed to coskewness.

It is important to be specified that the authors of this paper modified the structure of the models employed to best suit their intents. This is why, even though it could have been beneficial for a more thorough inspection to extend the analysis further to other aspects like the premia of $S^{-}$and S^{+} or the calculation technique for the coskewness coefficient $\hat{\beta}_{SKD_i}$, it has been chosen to follow a classical approach (as presented in the model structure).

V. Data

The main sources of data for this master thesis are going to be the DataStream database available at BI Oslo, the financial reports available on the web pages of the stock exchanges and the statistical series provided by national banks regarding the reference short-rate interest rates for government debt that can be used as risk-free rates.

Our intent is to use data for the period 31 December 1998-31 December 2010, the main reason for using such a time span being the fact that we want to focus on an analysis of the ante-EU and post-EU integration of Poland. Also, since a common risk-free rate (EURIBOR) for the two countries can only be traced back to 1998, the choice of data is limited to this starting period.

The frequency of the data is selected to be weekly since we do not have a sufficiently large pool of data at our disposal. Another advantage of such a frequency is that the prices do not have to be adjusted for dividends as in the case of monthly data. However, this time span is going to be divided in a T period for the ranking phase, a T+1 period for the re-estimation phase and a T+2 period for the testing phase. The T, T+1 and T+2 periods are all going to have the same length of one year, in order to end up with ten periods of three years each on which we can employ the pre-established methodology.

For the series of stock returns we are going to extract all the data available on the stock markets regarding all the companies traded in Germany and Poland. The cut-off condition for usefulness of these stock prices is their match with the market-to-book and market value statistics. Thus, there could be potential data losses due to unavailable series describing companies.

Unlike other researches on this subject we chose not to eliminate the dead or delisted companies from the sample so as to eliminate the survivorship bias. The intent is to avoid the results to skew to the right and be artificially higher, as this is not a true image of the market reality. Another reason for choosing such an approach is because in our methodology we do not rely on a larger period of time for testing but rather we employ redundant estimations and tests on ten three-year periods. Companies that may have been delisted during more recent years had an impact during their existence and must be taken into account. The underlying idea is to consider each company as long as it was active on the market, this ensuring a clearer image of the evolution of risk premia as well as of the two- pre and post-EU phases. Therefore, the results can be considered unbiased, relevant and much more reliable for making conclusions.

The risk-free is going to be represented by the EURIBOR rate for both countries since this rate is a good substitute for national rates, which themselves denote a high correlation between them, especially in the EU region.

The DataStream database also provides us with data for the market return, which in the case of the two countries will be the International Financial Corporation Index, the MSCI for Germany and Poland.

Other necessary data is represented by market-to-book ratios and market values, provided by the DataStream database, in order to execute the portfolio sorting. The book-to-market ratios will be computed by inversing the market-to-book ratios available.

After centralising all the inputs for the research we ended up with 249 companies for Poland and 919 companies for Germany, after matching the market values and the market-to-book ratios with prices. This could raise some problems for the portfolio formation phase, as there may not be enough data for Poland to conduct a proper sorting and complete regressions.

VI. Empirical Results

A. Sample

In order to identify the pricing and the effects of coskewness, a sample of stock prices between 31 December 1998-31 December 2010 for the Deutsche Boerse and the Warsaw Stock Exchange is used. In total, there are 626 observations for each stock extracted from the DataStream database. After applying the logarithm to obtain the returns, we divide the sample into ten methodological periods of three years each, as follows:

1. Period 7 January 1999-27 December 2001
2. Period 6 January 2000-26 December 2002
3. Period 4 January 2001-25 December 2003
4. Period 3 January 2002-23 December 2004
5. Period 2 January 2003-22 December 2005
6. Period 1 January 2004-21 December 2006
7. Period 30 December 2004-20 December 2007
8. Period 29 December 2005-18 December 2008
9. Period 28 December 2006-17 December 2009
10. Period 27 December 2007-31 December 2010

As a result of such a selection process each year from the former periods has 52 incorporated observations, thus a period consisting of three years would have 306 observations. However, the tenth period has 308 observations due to the fact that the two supplementary observations were attributed to the last testing period (24 December 2009-31 December 2010). The quality of the final results would not suffer as the methodology involves running cross-sectional regressions and two additional observations can not influence the coefficients significantly.

Table 1. *Number of stocks employed during testing phases for each period. This table summarises the number of stocks available for portfolio formation and model testing during each T+3 year of each period. The number of stocks includes only shares with available prices, market values and book-to-market ratios, even though the series of data do not start at the beginning of the period.*

Periods	*Number of shares*	
	Poland	*Germany*
1	46	615
2	48	625
3	51	630
4	76	646
5	105	686
6	130	812
7	195	889
8	227	906
9	240	910
10	249	919

Source: Authors' calculations

The table on the number of qualified stocks used in cross-sectional regressions shows major discrepancies between the liquidity of the Polish market and the liquidity of the German market. From *Table 1* it can be observed that according to expectations, Germany possesses a more liquid market due to the larger size of the overall economy and the regulations that oversee the listing and IPO procedures that confer stability and investor protection. Thus, the smaller number of stocks available for Poland during the first four periods could distort the results and hamper the portfolio formation phase, having to limit the number of shares per portfolio. However, a portfolio can be deemed representative with at least 7-8 shares in composition and consequently it would be possible to construct viable portfolios by reducing the number of sorted portfolios during the first periods.

Regarding the correlation between the markets (computed using the market indices – MSCI), the markets seem to be highly correlated, with a coefficient of 0.531283. Also, by looking at correlations for each period, the co-movement of the markets proves to be more pronounced starting with the year 2008.

Table 2. *Correlations between MSCI Poland and MSCI Germany per period. The correlation statistic was computed by employing the CORREL function for each of the testing periods in the sample (52 observations for the first nine and 54 observations for the tenth period).*

Correlations	
1	0.388064
2	0.571675
3	0.41156
4	0.559397
5	0.325344
6	0.382781
7	0.593107
8	0.747672
9	0.607786
10	0.742217

Source: Authors' calculations

Possible explanations for such a linked evolution of the two markets might be the proximity of the two economies and the dependency of the Polish economy on German investors (in the energy and telecom sectors), as well as the appurtenance at the same economic and political space, the European Union. As for the last three periods, when the correlation between the markets spiked, a possible reason may be the world financial crisis that deepened the correlations between economies and increased the volatility. The same increase in correlations can be observed during volatile periods as the Dotcom bubble of 2002 and the Polish integration into the EU in 2004. As a consequence, it can be expected for the premia for coskewness, size and book-to-market to evolve closely, as a higher correlation eliminates perspectives of portfolio diversification.

Furthermore, *Graph 1* from *Appendix* presents the evolution of the returns of the two MSCI market indices for Poland and Germany and confirms the positive correlation between markets. It can be noticed that the trendlines for the returns of the indices are similar, with sporadic larger volatility spikes for Poland in times of distress, mainly because Poland is an emerging market with regulatory instability and low levels of liquidity.

B. Portfolio Formation

After double-sorting according to market value and book-to-market ratios, as well as sorting separately according to size and book-to-market ratio, the resulting portfolios for each of the ten periods present different characteristics for each dimension (size, book-to-market, Fama-French loadings and coskewness) across the two countries.

Looking at size portfolios (*Table 3* and *Table 4*) for Poland and Germany, there is a slight anomaly arising in the case of Germany – high value portfolios offer a higher average excess return in 60% of the cases relative to small value portfolios. In 70% of the periods for Poland, big stock portfolios had lower returns than small stock portfolios, which is in accordance with market theory which stipulates that due to higher risk, small stocks should offer a higher return. On the other hand, for Germany, the expectations are rejected slightly since average returns turn to decrease with size, not compensating investors with a higher premium for holding riskier small caps.

Table 3. *Size portfolios for Poland. Size portfolios were formed by dividing each sample during estimation periods (T and T+1) according to market value in six quantiles and adjusting them according to the listing of new stocks. Size H portfolio contains the stocks with the highest market value, while Size L represents the 16.7% smallest size values. The figures in the table are averages of portfolios including data from testing periods (52 observations for the first nine periods and 54 observations for the tenth period).*

Periods	SIZE H	SIZE II	SIZE III	SIZE IV	SIZE V	SIZE L
1	-0.83%	-0.70%	-1.22%	-1.55%	-1.46%	-0.94%
2	-0.56%	-0.64%	-1.69%	-0.24%	-0.83%	-0.97%
3	0.44%	1.55%	1.89%	1.72%	1.61%	1.72%
4	0.32%	0.65%	1.09%	1.25%	0.60%	1.83%
5	0.21%	-0.14%	0.28%	0.19%	0.74%	0.97%
6	0.88%	0.78%	0.93%	0.51%	1.40%	2.15%
7	0.14%	0.15%	-0.38%	-0.39%	0.31%	-0.05%
8	-2.16%	-2.15%	-1.90%	-2.31%	-1.62%	-1.42%
9	0.68%	0.55%	0.65%	0.45%	0.38%	0.81%
10	0.12%	0.13%	0.24%	0.21%	0.20%	0.32%
Average	**-0.08%**	**0.02%**	**-0.01%**	**-0.01%**	**0.13%**	**0.44%**

Source: Authors' calculations

Table 4. *Size portfolios for Germany. Size portfolio averages were computed using the same procedure as in the case of Poland.*

Periods	SIZE H	SIZE II	SIZE III	SIZE IV	SIZE V	SIZE L
1	-1.296%	-1.778%	-1.540%	-1.309%	-0.973%	-0.740%
2	-1.064%	-1.818%	-1.439%	-1.615%	-1.339%	-1.497%
3	0.444%	0.513%	0.615%	0.403%	0.488%	0.619%
4	0.129%	-0.031%	-0.034%	-0.001%	-0.076%	-0.021%
5	0.462%	0.295%	0.330%	0.551%	0.744%	0.826%
6	0.387%	0.131%	0.091%	0.046%	-0.260%	-0.270%
7	0.024%	-0.185%	-0.165%	-0.188%	-0.558%	-0.194%

8	-1.381%	-1.520%	-1.710%	-1.352%	-1.387%	-1.469%
9	0.393%	0.224%	0.270%	0.072%	-0.108%	-0.354%
10	0.276%	0.258%	0.099%	0.030%	0.048%	0.470%
Average	**-0.162%**	**-0.391%**	**-0.348%**	**-0.336%**	**-0.342%**	**-0.263%**

Source: Authors' calculations

As for portfolios sorted according to book-to-market ratios in *Tables 5* and *6*, an investor would distinguish between value stocks, with a high book-to-market ratio, and growth stocks, with a low book-to-market ratio and a higher growth potential. Thus, according to market expectations, the expected return for holding growth stocks should be lower relative to the return offered by value stocks. No surprises arise in the case of the two countries, since for both the market rule regarding low and high book-to-market sorted portfolios is respected.

Table 5. *Book-to-market sorted portfolios for Poland. BTM portfolios were formed by dividing each sample during estimation periods (T and T+1) according to book-to-market ratios in six quantiles and adjusting them according to the listing of new stocks. BTM H portfolio contains the stocks with the highest BMT ratio, while BTM L represents the 16.7% smallest BTM values. The figures in the table are averages of portfolios including data from testing periods.*

Periods	**BTM H**	**BTM II**	**BTM III**	**BTM IV**	**BTM V**	**BTM L**
1	-0.95%					-0.90%
2	-0.19%					-1.49%
3	1.55%					0.99%
4	1.43%	0.52%	0.63%			1.35%
5	0.46%	0.43%	0.75%	0.08%	-0.11%	0.77%
6	1.42%	1.18%	1.15%	0.74%	0.96%	1.33%
7	0.29%	-0.02%	0.10%	0.27%	-0.47%	-0.28%
8	-1.92%	-1.57%	-2.42%	-1.91%	-2.04%	-1.74%
9	0.94%	0.77%	0.59%	0.77%	0.38%	0.07%
10	0.33%	0.36%	0.12%	0.22%	0.18%	0.01%
Average	**0.34%**	**0.24%**	**0.13%**	**0.03%**	**-0.18%**	**0.01%**

Source: Authors' calculations

Table 6. *Book-to-market sorted portfolios for Germany. BTM portfolio averages were computed using the same procedure as in the case of Poland.*

Periods	**BTM H**	**BTM II**	**BTM III**	**BTM VI**	**BTM V**	**BTM L**
1	-0.158%	-0.684%	-1.270%	-1.467%	-2.136%	-1.898%
2	-1.812%	-0.923%	-1.243%	-1.511%	-1.734%	-1.553%
3	0.698%	0.821%	0.547%	0.481%	0.168%	0.360%
4	-0.155%	-0.028%	0.179%	0.080%	0.011%	-0.132%
5	0.625%	0.438%	0.599%	0.658%	0.370%	0.528%
6	-0.164%	0.048%	0.316%	0.132%	0.132%	-0.395%

Table 6 continued

7	-0.142%	-0.008%	-0.187%	-0.160%	-0.167%	-0.646%
8	-1.283%	-1.401%	-1.280%	-1.602%	-1.494%	-1.784%
9	-0.085%	0.295%	0.314%	0.178%	0.016%	-0.212%
10	0.501%	0.137%	0.293%	0.203%	0.070%	-0.066%
Average	**-0.198%**	**-0.130%**	**-0.173%**	**-0.301%**	**-0.476%**	**-0.580%**

Source: Authors' calculations

Finally, the Fama-French loadings (SMB and HML) and the coskewness sorted portfolio (SKS) in *Tables 7* and *8*, proxies for small firm effect, value premium and skewness differential, offer positive returns in most of the cases. With the exception of the SMB portfolio for Germany, which accounts for the size puzzle presented above, all the other portfolios follow investors' expectations.

The SMB portfolio stands for the difference in compensation for holding small caps relative to large caps and should have a positive return to incentivise investors to hold small stocks, which are riskier by definition and command a higher premium. The puzzle in the case of Germany comes from the fact that a negative return SMB portfolio induces the idea that small stocks have a lower return than large value stocks. This contradicts market expectations, as mentioned above for size portfolios, and also supports the intuition that small caps are riskier in an emerging market than in a developed one (since the average return for SMB in Poland is higher than in Poland).

Several explanations for this curiosity are the liquidity premium that can be higher in Poland for small companies, which are not traded as much, or the possibility that investors in Germany would hold small stocks with the belief that they could gain a higher expected return. Some institutional investors or funds may build their market strategies exclusively on small caps as on the long-run they tend to outperform large caps (Cohen, 2003). However, should a lot of investors hold small caps; this increases demand and pushes prices upwards for such stocks, ultimately reducing returns.

Table 7. *SMB, HML and SKS portfolios for Poland. The SMB and HML portfolios were formed using the S/L, S/M, S/H, B/L, B/M, B/H portfolios obtained after double-sorting according to market values and book-to-market ratios (as presented in the Methodology Section). The SKS portfolio was constructed using the coskewness values for each stock provided by the formula from Harvey and Siddique (2000). All averages were calculated using data from the testing periods.*

Periods	SMB	HML	SKS
1	-0.36%	-0.20%	0.60%
2	0.26%	0.81%	0.71%
3	0.28%	-0.59%	-0.71%
4	0.66%	0.69%	0.17%
5	0.54%	0.32%	-0.26%
6	-0.20%	-0.09%	0.10%
7	-0.03%	0.66%	0.00%
8	0.30%	0.09%	-0.11%
9	-0.06%	0.59%	-0.36%
10	0.12%	0.28%	0.10%
Average	**0.15%**	**0.26%**	**0.02%**

Source: Authors' calculations

As for the HML portfolios, which represent the difference between value and growth stock returns, the market expectations are met for both countries, with the sole observation that the HML returns in Germany tend to be higher as high BTM stocks are more common on this exchange and offer higher premiums. Only in 10% of the cases there have been negative values for the HML portfolio in Germany, relative to 30% in Poland. This confirms the idea that value stocks are more sought after on stock exchanges, but also that growth stocks in Poland are assigned a higher return to compensate investors for future growth potential (0.26% return in Poland as compared to a higher 0.35% in Germany).

Table 8. *SMB, HML and SKS portfolios for Germany. The same procedures were applied for identifying SMB, HML and SKS portfolios for the German stock exchange as for the Warsaw Stock Exchange.*

Periods	SMB	HML	SKS
1	-0.1845%	1.5481%	-0.1512%
2	-0.1122%	0.1782%	-0.0614%
3	-0.0338%	0.5058%	0.1231%
4	-0.0586%	-0.1127%	0.0037%
5	0.3475%	0.0841%	0.0700%
6	-0.3985%	0.1843%	-0.0090%
7	-0.1848%	0.0475%	0.0940%
8	0.1215%	0.3904%	0.0904%
9	-0.4554%	0.2701%	-0.0152%
10	-0.0096%	0.4062%	-0.1257%
Average	**-0.0968%**	**0.3502%**	**0.0019%**

Source: Authors' calculations

Finally, by comparing the returns for the SKS portfolios, proxies for the difference between low value and high value skewness stocks (left-skewness minus right-skewness), it can be deduced that negative skewness is predominantly present on both markets. Negative skewness increases the risk of downfall and commands a higher premium. In 40% of the cases in Poland and for 50% of the periods in Germany, negative skewness dominates positive skewness. This may suggest that Poland can provide an investor with more right-skewed assets and the risk premium for right-coskewness is lower relative to negative-coskewness, since a higher collapse risk should be compensated with a higher premium.

To prequel some of the results by judging from the data available on the portfolios that represent the inputs for the research models, it can be expected for the premiums for coskewness factors in Poland to be less than in Germany. The difference between coefficients might not be significant but it can be sufficient for a smart investor to neutralise his risky portfolio of assets on an emerging market. Some stocks in Poland may present significant positive coskewness relative to Germany and by stock picking a manager can reap the benefits of such properties.

Furthermore, size proves to have a large impact on premiums and expected returns on both markets and it may have a decisive role in explaining stock excess returns. Intuitively, the book-to-market effect does not influence excess returns as significantly and might have a secondary role in describing them. However, the logic of Fama and French (1992), who suggest using an extended CAPM, may prove to be pertinent in an endeavour to separate the effects dominating excess returns. Adding coskewness as a factor can improve the quality of explanatory models and should shed a light on what drives returns.

C. Summary Statistics of Cross-Sectional regressions

In order to present the results of research, *Tables 9, 10, 11* and *12* summarise the outputs of the three model regressions run to identify premium coefficients and correlations between portfolios and effects, both for Poland and Germany. *Tables 9* and *10* contain the premiums from Models 1, 2 and 3, while *Tables 11* and *12* describe the correlations between the SKS (coskewness) portfolio with the other input portfolios, as well as the correlations between skewness and coskewness series with stock excess returns.

Table 9.

Premiums from Cross-Sectional Regressions for Portfolio Groups for Poland

After constructing the SMB, HML, SKS, Size and BTM portfolios for each T and T+1 estimation periods, the following models are run during the ten T+1 (testing) periods: a) 3 factors+SKS: $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + s_i SMB_t + h_i HML_t + \beta_i^s SKS_t + \epsilon_{i,t}$

b) Market+Size+SKS: $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + s_i S_t + \beta_i^s SKS_t + \epsilon_{i,t}$

c) Market+BTM+SKS: $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + b_i BM_t + \beta_i^s SKS_t + \epsilon_{i,t}$

The coefficients represented in the Panels are premiums compensating Market, Size (SMB and S), BTM (HML and BM) and Coskewness (SKS) risks. Panel A presents the premia from Model 1 (Fama-French loadings+SKS), Panel B presents Model 2 (the Size High and Low-SKS interaction) and Panel C presents Model 3 premia (the BTM High and Low-SKS interaction). The coefficients are treated at 1%, 5% and 10% confidence levels.

Panel A. Summary results from cross-sectional regressions for Model 1 (Generalised Model)

		Intercept			**β to Market excess**			**λ_{SMB}**			**λ_{HML}**			**λ_{SKS}**		
Confidence level		**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**
Periods	**Stocks**															
1	46	-0.00449	-0.00329	0	0.062781	0.041944	0.01533	0.26071	0.259609	0.05497	-0.00858	-0.02796	-0.0174	**-0.03481**	**-0.05666**	**-0.04296**
2	48	-0.00156	-0.00133	-1.3E-05	0.049722	0.030729	0.01761	0.141275	0.116128	0.02024	0.014578	0.00919	-0.0002	**-0.08178**	**-0.07239**	**-0.05624**
3	51	0.004697	0.002632	0.000391	0.267627	0.157052	0.0161	0.146995	0.099997	0.14407	-0.19954	-0.17401	-0.1341	**0.046915**	**0.06557**	**0.121512**
4	76	1.02E-05	-0.0002	-5.2E-06	0.32252	0.309049	0.21893	0.225333	0.153283	0.1035	-0.0881	-0.09336	-0.0662	**0.110584**	**0.10206**	**0.055369**
5	105	-0.00012	0.000237	4.36E-05	0.317495	0.265249	0.08338	0.376383	0.340529	0.222	-0.06611	-0.04251	-0.0221	**-0.12222**	**-0.11744**	**-0.08125**
6	130	0.003263	0.002312	0.000422	0.534844	0.476394	0.33351	-0.16233	-0.0888	-0.01537	-0.06357	-0.04587	-0.0161	**-0.00998**	**0.03445**	**0.066931**
7	195	-0.00236	-0.00137	-0.00061	0.414955	0.328841	0.1423	0.750289	0.680765	0.48519	0.097884	0.0576	0.01966	**-0.02052**	**0.01601**	**0.003774**
8	227	-0.00705	-0.0055	-0.00233	0.424535	0.399113	0.31296	-0.39929	-0.28837	-0.07672	0.017304	-0.00361	-0.025	**-0.19265**	**-0.13134**	**-0.03924**
9	240	-0.00062	-0.00024	-0.00018	0.449276	0.386497	0.26562	0.349174	0.267518	0.08274	0.286469	0.23849	0.08198	**-0.14409**	**-0.09698**	**-0.02449**
10	249	0.000392	0.000556	6.88E-05	0.502485	0.453494	0.34098	0.323298	0.301147	0.24554	-0.09333	-0.05751	-0.0071	**0.118717**	**0.10981**	**0.046368**
Average		-0.00078	-0.00062	-0.00022	0.334624	0.284836	0.17467	0.201184	0.184181	0.12662	-0.0103	-0.01395	-0.0187	**-0.03298**	**-0.01469**	**0.004977**

Panel B. Summary results from cross-sectional regressions for Model 2 (Specific Model for Size factor)

			Intercept			β to Market excess			λ_{SIZE}			λ_{SKS}		
	Confidence level		**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**
	Periods	Stocks												
Quintile I (Size High)	1	46	-0.00284	-0.00059	0	0.028159	0.028159	0	0.281127	0.281127	0.110196	**-0.04118**	**-0.01724**	**-0.03598**
	2	48	-0.00096	-0.00045	-1.3E-05	0.040134	0.04171	0.03248	0.220763	0.215093	0.114467	**-0.16448**	**-0.1416**	**-0.09295**
	3	51	0.003358	0.002874	0.000391	0.130482	0.042601	0.042601	0.306551	0.281423	0.149886	**0.043034**	**0.016122**	**0.028215**
	4	76	-0.00019	-0.00017	0.000264	0.241324	0.208176	0.12086	-0.08966	-0.07722	0.160432	**0.080933**	**0.078537**	**0.083314**
	5	105	0.001849	0.001406	-5.2E-05	0.1276	0.100375	0.084862	0.328518	0.219393	0.143643	**0.015189**	**0.06522**	**0.041126**
	6	130	-0.00051	-0.0002	-0.0003	0.003554	-0.01218	-0.00382	0.941129	0.790691	0.447002	**0.167401**	**0.133039**	**0.118739**
	7	195	-0.002	-0.00118	-0.00042	0.008661	0.004612	0.013231	0.974609	0.919912	0.687805	**0.024412**	**0.036622**	**0.029092**
	8	227	-0.00253	-0.00193	-0.00086	-0.01153	0.013329	-1.7E-05	0.539335	0.477087	0.327718	**-0.13043**	**-0.14964**	**-0.06155**
	9	240	-0.00064	-0.00047	-0.00027	0.0101	0.01596	0.00958	0.65466	0.562641	0.306741	**-0.05682**	**-0.05378**	**0.007573**
	10	249	0.000844	0.000536	0.000134	-0.0276	-0.00999	0.012448	0.60762	0.507379	0.266752	**0.092967**	**0.046855**	**0.025964**
	Average		-0.00036	-1.8E-05	-0.00011	0.055088	0.043275	0.031222	0.476466	0.417753	0.271464	**0.003102**	**0.001414**	**0.014354**
Quintile VI (Size Low)	1	46	-0.0058	-0.00341	0	0.089146	0.057773	0.015812	0.118052	0.10399	0.113161	**-0.03193**	**-0.01465**	**-0.04743**
	2	48	-0.00111	-0.00044	0	0.029605	0.030421	0.01851	0.184227	0.160255	0.109284	**-0.06549**	**-0.04389**	**-0.07494**
	3	51	-0.00425	-0.00602	-0.00656	0.502797	0.408794	0.306634	0.265501	0.242881	0.158592	**0.061591**	**0.065042**	**0.073886**
	4	76	-0.00089	-5.8E-05	-5.2E-06	0.288981	0.193105	0.133417	0.134566	0.119453	0.087409	**0.060979**	**0.071636**	**0.045442**
	5	105	0.000637	4.16E-05	7.72E-06	0.192934	0.174136	0.143923	0.176959	0.156495	0.129849	**-0.06739**	**-0.07928**	**-0.05627**
	6	130	-0.00182	-0.00109	-0.00071	0.262528	0.224118	0.148931	0.403105	0.316614	0.246258	**0.161386**	**0.13632**	**0.065505**

	Periods	Stocks	Intercept 10.00%	Intercept 5.00%	Intercept 1.00%	β 10.00%	β 5.00%	β 1.00%	λ 10.00%	λ 5.00%	λ 1.00%	λ 10.00%	λ 5.00%	λ 1.00%
	7	195	-0.00085	-0.00042	-9.4E-05	0.097995	0.083501	0.047581	0.534791	0.516314	0.403502	**0.04229**	**0.02387**	**0.03418**
	8	227	-0.0047	-0.00361	-0.00136	0.116811	0.107761	0.077031	0.567255	0.488985	0.266734	**-0.01374**	**-0.01336**	**-0.04097**
	9	240	-0.00065	-0.00052	-0.00015	0.149475	0.118605	0.064826	0.46893	0.432092	0.289475	**-0.00774**	**-0.07171**	**0.012274**
	10	249	-0.00016	-2.4E-06	0	0.260656	0.212153	0.11315	0.310109	0.247345	0.121321	**0.114951**	**0.09412**	**0.029241**
	Average		-0.00196	-0.00155	-0.00089	0.199093	0.161037	0.106982	0.316349	0.278442	0.192559	**0.025489**	**0.016809**	**0.004092**

Panel C. Summary results from cross-sectional regressions for Model 3 (Specific Model for Book-to-market factor)

			Intercept			**β to Market excess**			**λ_{BTM}**			**λ_{SKS}**		
	Confidence level		**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**
	Periods	**Stocks**												
Quintile I (BTM High)	**1**	46	-0.00534	-0.00306	0	0.080893	0.046624	0.014449	0.084035	0.090045	0.099764	**0.020547**	**-0.00599**	**-0.02572**
	2	48	-0.00067	-0.0002	-0.00045	0.016974	0.028284	0.01929	0.115204	0.132686	0.08752	**-0.09293**	**-0.07485**	**-0.07691**
	3	51	-0.00091	-0.00011	0	0.239411	0.179917	0.133188	0.245076	0.246434	0.235264	**0.030895**	**0.02481**	**0.003403**
	4	76	-0.00091	-0.00053	-0.00015	0.177283	0.175151	0.095646	0.224294	0.185043	0.101636	**0.088118**	**0.074868**	**0.043556**
	5	105	0.000742	0.000495	-0.00023	0.178106	0.163659	0.059976	0.260637	0.236786	0.150076	**-0.0138**	**0.006248**	**-0.00128**
	6	130	0.000626	-0.00056	0.000389	0.230787	0.227483	0.161192	0.376983	0.346614	0.226576	**0.055241**	**0.041371**	**0.041141**
	7	195	-0.00281	-0.00153	-0.00035	0.21703	0.179847	0.091919	0.633354	0.588901	0.484287	**0.09884**	**0.067904**	**0.05821**
	8	227	-0.00309	-0.00181	-0.00078	0.088837	0.076911	0.042366	0.609609	0.518833	0.344809	**-0.04583**	**-0.03408**	**-0.05218**
	9	240	-0.00087	-0.00093	-0.00017	0.057089	0.054785	0.032003	0.534189	0.493783	0.343863	**-0.02962**	**-0.05196**	**-0.00327**
	10	249	-4.9E-05	2.95E-06	0	0.083757	0.061639	0.039908	0.380555	0.320854	0.180613	**0.116863**	**0.099794**	**0.026789**
	Average		-0.00133	-0.00082	-0.00017	0.137017	0.11943	0.068994	0.346393	0.315998	0.225441	**0.022833**	**0.014812**	**0.001375**

Table 9 (Panel C) continued

Quintile VI (BTM Low)	**1**	46	-0.00471	-0.00186	0	0.062204	0.022777	0.022777	0.085012	0.08832	0.076348	**0.022916**	**0.022916**	**-0.0745**
	2	48	-8E-05	-0.00049	-1.3E-05	0.015868	0.032154	0.019356	0.102686	0.115862	0.115862	**-0.06533**	**-0.06533**	**-0.07983**
	3	51	0.004447	0.003501	0.000384	0.283813	0.232437	0.082666	0.109223	0.123381	0.089278	**-0.0384**	**0.014953**	**-0.00239**
	4	76	-0.00078	-0.00047	-0.00027	0.10117	0.091282	0.009469	0.180323	0.148212	0.101057	**0.083208**	**0.091275**	**0.045059**
	5	105	-0.00072	-0.00052	1.49E-05	0.205749	0.190669	0.167073	0.207749	0.167259	0.108135	**-0.012**	**0.013292**	**0.012044**
	6	130	0.000716	0.000357	0	0.27467	0.242353	0.160956	0.493754	0.439744	0.293382	**0.073656**	**0.125575**	**0.084545**
	7	195	-0.0018	-0.00145	-0.0015	-0.04507	-0.04305	-0.04322	0.754418	0.717594	0.576985	**-0.23794**	**-0.22339**	**-0.21108**
	8	227	-0.00376	-0.00278	-0.00108	0.126994	0.12694	0.093453	0.502991	0.403777	0.229314	**-0.15267**	**-0.11373**	**-0.06168**
	9	240	0.00083	0.000449	-6.5E-07	0.102848	0.092939	0.0551	0.590394	0.490084	0.355941	**-0.24962**	**-0.15912**	**-0.04614**
	10	249	0.00068	0.000405	0.000345	0.254621	0.200018	0.119927	0.323127	0.268713	0.151334	**0.105868**	**0.078434**	**0.03558**
	Average		-0.00052	-0.00029	-0.00021	0.138287	0.118852	0.068756	0.334968	0.296295	0.209763	**-0.04703**	**-0.02151**	**-0.02984**

Source: Authors' calculations and EViews

Table 10

Premiums from Cross-Sectional Regressions for Portfolio Groups for Germany

The results from Panels A, B and C are extracted, as for Poland, from running cross-sectional regressions according to Models 1, 2 and 3.

Panel A. Summary results from cross-sectional regressions for Model 1 (Generalised Model)

		Intercept			β to Market excess			λ_{SMB}			λ_{HML}			λ_{SKS}		
Confidence level		10.00%	5.00%	1.00%	10.00%	5.00%	1.00%	10.00%	5.00%	1.00%	10.00%	5.00%	1.00%	10.00%	5.00%	1.00%
Periods	Stocks															
1	615	-0.0036	-0.00198	-0.00051	0.468572	0.405594	0.30795	-0.03022	0.004334	-0.01085	-0.04946	-0.04445	-0.0129	**0.04826**	**0.01962**	**0.001199**
2	625	-0.00405	-0.00253	-0.00097	0.39516	0.365838	0.29189	-0.35014	-0.2641	-0.14198	0.04697	0.04322	-0.0067	**0.11079**	**0.09335**	**0.001862**
3	630	0.000666	0.000883	0.000163	0.300696	0.275519	0.18903	0.16299	0.097778	0.03799	-0.03503	-0.02039	-0.0078	**-0.07692**	**-0.04575**	**-0.00038**
4	646	0.000277	8.88E-05	9.28E-05	0.417712	0.338977	0.23339	0.222489	0.167048	0.06089	0.11601	0.0631	0.03124	**0.106218**	**0.03585**	**-0.00753**
5	686	0.000272	7.63E-05	-9.8E-05	0.265897	0.216932	0.11365	0.26773	0.221647	0.13712	0.098026	0.06847	0.07477	**0.082606**	**0.05885**	**0.011086**
6	812	7.83E-05	0.000163	-0.00016	0.410001	0.341558	0.22061	0.209205	0.145092	0.09929	-0.27018	-0.2096	-0.0708	**0.01445**	**0.01349**	**-0.01587**
7	889	-0.00272	-0.00198	-0.00069	0.367319	0.264685	0.15017	-0.4892	-0.3388	-0.10599	-0.33564	-0.25541	-0.1256	**0.07048**	**0.05414**	**0.007304**
8	906	-0.00451	-0.00344	-0.00123	0.402616	0.374681	0.31837	-0.05405	-0.05207	-0.01861	0.064351	0.06011	0.03919	**0.267712**	**0.21141**	**0.108236**
9	910	4.34E-05	5.28E-05	3.89E-05	0.306615	0.25896	0.19008	0.011013	-0.00193	-0.00147	0.142491	0.09006	0.0368	**0.16613**	**0.12094**	**0.008597**
10	919	-0.00034	-0.00014	7.98E-07	0.271337	0.221374	0.13788	0.244871	0.205257	0.10318	0.060754	0.05844	-0.0082	**-0.05384**	**-0.02727**	**0.019947**
Average		-0.00139	-0.00088	-0.00034	0.360592	0.306412	0.2153	0.019469	0.018426	0.01596	-0.01617	-0.01465	-0.005	**0.073588**	**0.05346**	**0.013446**

Panel B. Summary results from cross-sectional regressions for Model 2 (Specific Model for Size factor)

Quintile	Periods	Stocks	Intercept 10.00%	Intercept 5.00%	Intercept 1.00%	β to Market excess 10.00%	β to Market excess 5.00%	β to Market excess 1.00%	λ_{SIZE} 10.00%	λ_{SIZE} 5.00%	λ_{SIZE} 1.00%	λ_{SKS} 10.00%	λ_{SKS} 5.00%	λ_{SKS} 1.00%
Quintile I (Size High)	1	615	-0.00279	-0.00188	-0.00031	0.474376	0.419325	0.307572	0.117653	0.080952	0.029176	**0.125856**	**0.090896**	**0.038264**
	2	625	-0.00191	-0.00126	-0.00072	0.411835	0.376179	0.297425	0.139933	0.111311	0.070321	**0.070602**	**0.049767**	**-0.00746**
	3	630	0.000431	0.00033	9.86E-05	0.305671	0.2772	0.187844	0.076498	0.055839	0.024294	**-0.05423**	**-0.04208**	**-0.00493**
	4	646	-0.0004	-0.00013	-6.7E-05	-0.10905	-0.07312	-0.00894	0.582411	0.391518	0.198794	**0.104562**	**0.055095**	**-0.0147**
	5	686	0.000198	0.000148	-0.00024	-0.1092	-0.06504	0.007597	0.522047	0.378577	0.099328	**-0.03832**	**0.009851**	**-0.0261**
	6	812	-0.00118	-0.00081	-0.0002	-0.17585	-0.10724	-0.02997	0.671485	0.568736	0.340281	**-0.14622**	**-0.13132**	**-0.04638**
	7	889	-0.001	-0.00074	-0.00029	-0.11448	-0.05477	-0.02445	0.644953	0.538781	0.379555	**0.061922**	**0.043441**	**0.002615**
	8	906	-0.00384	-0.0026	-0.00128	0.395141	0.372425	0.317789	0.036556	0.030651	0.01565	**0.297636**	**0.212068**	**0.10656**
	9	910	9.26E-05	8.65E-05	4.4E-05	0.28859	0.248106	0.180825	0.01628	0.016837	0.00022	**0.16917**	**0.096109**	**-0.01032**
	10	919	-0.00025	-0.00031	-0.00014	-0.04963	-0.05018	-0.00615	0.350103	0.288726	0.174416	**-0.17329**	**-0.12892**	**-0.03634**
	Average		-0.00107	-0.00072	-0.00031	0.13174	0.134289	0.122954	0.315792	0.246193	0.133203	**0.04177**	**0.025491**	**0.00012**
Quintile VI (Size Low)	1	615	-0.00391	-0.00212	-0.00085	0.481853	0.436725	0.313778	0.07097	0.044259	0.005713	**0.031891**	**0.027438**	**-0.00163**
	2	625	-0.00313	-0.00178	-0.00083	0.390222	0.355138	0.278436	0.029827	0.000884	0.002041	**0.060136**	**0.04864**	**0.010298**
	3	630	-8E-05	0.000147	0.00014	0.333023	0.305764	0.219444	0.168344	0.105847	0.023258	**0.02295**	**0.005479**	**-0.00187**
	4	646	6.84E-05	0.000119	7.13E-05	0.280039	0.229143	0.164	0.17031	0.113404	0.037818	**0.062761**	**0.032161**	**-0.00768**
	5	686	0.000278	0.000139	-0.00016	0.180845	0.155772	0.113044	0.20412	0.160452	0.128133	**0.04048**	**0.014549**	**-0.02826**
	6	812	-0.00013	-0.00023	-0.00012	0.354596	0.313107	0.253121	0.281801	0.204884	0.063346	**0.055441**	**0.016295**	**0.017037**

	7	889	-0.00131	-0.00092	-0.0004	0.484314	0.435243	0.318111	0.266008	0.187627	0.085796	**0.049139**	**0.023184**	**-0.03012**
	8	906	-0.00279	-0.00172	-0.00073	0.392315	0.369398	0.313587	0.049229	0.038123	0.012113	**0.266758**	**0.197247**	**0.101478**
	9	910	0.000233	0.000294	2.84E-05	0.280121	0.241384	0.182025	0.066932	0.049881	0.022177	**0.165975**	**0.109358**	**0.006099**
	10	919	-0.00027	-0.0002	2.57E-05	0.225109	0.202441	0.174801	0.153125	0.146245	0.106127	**-0.01364**	**0.00933**	**0.031408**
	Average		-0.0011	-0.00063	-0.00028	0.340244	0.304412	0.233035	0.146067	0.105161	0.048652	**0.074189**	**0.048368**	**0.009676**

Panel C. Summary results from cross-sectional regressions for Model 3 (Specific Model for Book-to-market factor)

			Intercept			**β to Market excess**			**λ_{BTM}**			**λ_{SKS}**		
	Confidence level		**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**
	Periods	**Stocks**												
Quintile I (BTM High)	1	615	-0.00278	-0.00187	-0.00035	0.475748	0.421574	0.308052	0.11398	0.076658	0.03053	**0.123227**	**0.085035**	**0.034684**
	2	625	-0.00199	-0.00132	-0.00058	0.399275	0.369079	0.285776	0.06187	0.043239	0.010187	**0.045805**	**0.044558**	**0.004266**
	3	630	7.07E-05	9.88E-05	0.000154	0.325786	0.301	0.210453	0.122717	0.085446	0.031804	**-0.03936**	**-0.02673**	**-0.0004**
	4	646	0.000257	0.000251	0.000154	0.207055	0.181877	0.131905	0.195282	0.122993	0.054876	**0.086207**	**0.033457**	**-0.01155**
	5	686	0.000313	-1.5E-05	-0.00023	0.179017	0.150081	0.114904	0.216577	0.181823	0.12921	**0.04225**	**0.026273**	**-0.0148**
	6	812	9.79E-05	-6E-05	0.000349	0.284366	0.260354	0.176404	0.42891	0.298354	0.160764	**0.066958**	**0.009648**	**0.015494**
	7	889	-0.00159	-0.00095	-0.00038	0.433855	0.378069	0.285244	0.286524	0.238715	0.123489	**0.055399**	**0.026187**	**-0.02817**
	8	906	-0.00347	-0.00223	-0.00091	0.392879	0.364233	0.31353	0.063657	0.053199	0.012269	**0.276136**	**0.187404**	**0.097106**
	9	910	0.000218	0.000273	-1.6E-05	0.271839	0.234397	0.166498	0.098647	0.074685	0.030398	**0.207298**	**0.120503**	**0.022138**
	10	919	-0.00027	-0.00017	2.56E-05	0.228308	0.202415	0.173411	0.174292	0.157295	0.118393	**-0.04806**	**-0.00104**	**0.020781**
	Average		-0.00091	-0.0006	-0.00018	0.319813	0.286308	0.216618	0.176246	0.133241	0.070192	**0.081586**	**0.05053**	**0.013955**

Table 10 (Panel C) continued

Quintile VI (BTM Low)	**1**	615	-0.00383	-0.00214	-0.00085	0.482085	0.440157	0.313866	0.085215	0.048443	0.008731	**0.032855**	**0.031435**	**-0.00263**
	2	625	-0.00211	-0.00144	-0.0004	0.399034	0.368112	0.284951	0.098209	0.068511	0.029402	**0.066577**	**0.056853**	**0.005173**
	3	630	0.000218	0.000143	0.000128	0.322094	0.289228	0.209536	0.173798	0.094493	0.012123	**0.028413**	**0.001311**	**-0.00254**
	4	646	0.000318	0.000455	0.000137	0.239416	0.198837	0.122086	0.234983	0.138452	0.054167	**0.09626**	**0.048267**	**-0.01268**
	5	686	0.000246	0.000241	-0.0001	0.110482	0.091371	0.070719	0.394912	0.333735	0.196904	**0.082295**	**0.067638**	**-0.01305**
	6	812	0.000677	0.000613	0.00025	0.135222	0.132711	0.084519	0.38403	0.274108	0.146986	**-0.06516**	**-0.0592**	**-0.02705**
	7	889	0.000514	0.000566	0.000167	0.221658	0.204928	0.120878	0.483198	0.386045	0.182895	**-0.05111**	**-0.04009**	**-0.01969**
	8	906	-0.00356	-0.00228	-0.00078	0.38952	0.37112	0.312197	0.049673	0.034994	0.007134	**0.286779**	**0.188288**	**0.10734**
	9	910	1.15E-05	0.000243	-3.3E-05	0.251539	0.219306	0.157443	0.085047	0.054895	0.015502	**0.14762**	**0.110093**	**-0.00636**
	10	919	-6.8E-05	-2.1E-05	5.52E-05	0.206077	0.197526	0.154457	0.167757	0.110684	0.055667	**-0.02835**	**-0.01338**	**-0.00735**
	Average		-0.00076	-0.00036	-0.00014	0.275713	0.25133	0.183065	0.215682	0.154436	0.070951	**0.059618**	**0.039121**	**0.002116**

Source: Authors' calculations and EViews

The panels represented in the tables incorporate data from generalised models (size, book-to-market and coskewness effects taken together) and more specific ones (size and book-to-market effects taken separately with coskewness), for the ten study periods. Following the algorithm of Fama-MacBeth (1973) regarding cross-sectional regressions, three types of regressions are run to identify the premiums associated with each type of effect – market, size, book-to-market and coskewness.

For the ***first model*** the data for Poland shows a large impact of the market excess on stock excess returns, as average premiums vary between 17.46%[1] and 33.46%[2]. Thus, holding the market portfolio compensates investors with a high premium for the risk associated with an emerging market. For Germany, on the other hand, it can be observed that the market premiums range between 21.53%[1] and 36.06%[2]. The compensation for risk surpasses the same premiums in Poland on average with 3%. Possible explanations for such an outcome can be the larger size of the German market and limited options for diversification on the Frankfurt exchange. Data underlies these ideas as for a small number of stocks in Poland, premia register low values (between 3% and 15% at a 5% confidence level), while during the same periods German premia have higher values due to a larger number of stocks listed on the exchange.

Initially, it could have been expected for an emerging market as Poland to provide higher market premia since the risks are higher relative to a developed market. The major sources of risk for emerging economies are illiquidity, lax regulatory systems and financial instability. The results disapprove expectations and support the idea that emerging markets offer diversification opportunities at a lower risk. Furthermore, it has to be stated that market risk represents a significant effect on excess returns on both markets and should be compensated accordingly.

As for the size effect, denoted by the SMB portfolio, major discrepancies between markets can be noticed. A positive premium for the size effect represents a dominance of small caps over large caps and intuitively investors expect a compensation for a higher volatility of the portfolio. A negative premium, on the other hand, means an ample impact of large stocks on small stocks, thus decreasing risk and reducing the premium.

[1] 1% confidence level
[2] 10% confidence level

For Poland, average size premiums that are statistically significant at the 1%, 5% and 10% levels dominate the same premiums on the German market by ten times. Additionaly, a period analysis shows a large volatility for size premia in Poland in 2005, 2007 and 2008 with values between 34.05%, 68.07% and (-28.83%). Possible reasons for such a sign volatility can be:

- 2005 represented the first year of the Polish EU membership and a lot of new IPOs of small companies took place during that year (29 new companies listed). Possible regulatory changes may have benefited small company IPOs in 2007 as well, since 65 new small caps were listed on the market. These factors increased the influence of small companies.
- In 2008, on the other hand, in the “eye of the crisis”, a lot of small caps found themselves close to default, forcing investors to shift to more financially secure investments like large caps. This may explain the negative premium during the year.

Germany, in contrast, provided average size premia of 2%, with period characteristic premia following a relatively stable evolution. Major shifts happened during volatile times (2002, 2007-2009), when premiums were negative and during 2005, when a large positive premium could have represented an increased investor risk appetite towards small caps.

The bottom line of the size analysis is that the size effect tends to be significant on both markets, but in different proportions. An emerging market like Poland relies mainly on small cap investors and must compensate them for the additional risk, while a developed market like Germany is dominated by large conzerns which attract risk averse investors with lower but more secure returns.

Moving on to the book-to-market effect, it must be said that the HML portfolio comprises the difference between value and growth stocks. Investors expect a higher premium for holding value stocks and a lower (even negative one) for investing in growth stocks, which tend to be more volatile. Panels A for both countries depict negative average book-to-market premia, which suggest a dominance of low book-to-market companies on the exchanges.

During the ten periods, premia oscilate around a zero value in both directions and have small values. Only in 2009, both exchanges register significantly large premia (23.84% for Poland and 9% for Germany). A possible explanation for such an evolution can be the reliance of both markets on high-tech companies (telecom, automobile industries, IT), which are in essence growth companies with a high potential to become value stocks in the future.

Finally, regarding the coskewness effect (denoted by the premium associated to the SKS portfolio), it must be mentioned that a positive premium is linked to a dominance of left-skewed stocks , while a negative premium characterises an abundance of positively-skewed stocks.

The differences between markets are significant in terms of the signs of the premiums. While Poland provides on average a negative premium (-1.469%[3]), in Germany the market supplies a positive premium of 5.34%[3]. The percentual difference between premia is not so large, but it might be sufficient for an investor to hedge his positions and limit his downside risks on a developed market. Notable values during the research periods were registered in the year 2008, when premia of (-13.13%[3]) and 21.14%[3] characterised the Polish and German markets, accordingly. The reason for such a change over might be the financial crisis that was affecting at the time the German fiancial system, but was not influencing yet Poland. The contagion towards the emerging countries happened during the last quarters of 2008 and consequently investors could have found refuge on emerging exchanges to limit their losses. To support this idea, the premium for coskewness in Poland increased gradually from 2008 to 2010, up to 10.98%[3], because of the crisis delay and the piling up of sovereign debt effects. In opposition, premia in Germany increased, mainly because Germany was the first European country to recover from the crisis and most importantly, because of the stability of the overall economy and political system.

In summary, ***Model 1*** confirms initial expectations regarding the properties of emerging markets, which possess more right-skewed assets and offer downside-risk reducing opportunities. The difference in coskewness premiums between Poland and Germany underlies the assumption that emerging market investments can neutralise portfolio risk and increase diversification through positive skewness. Thus, the initial hypothesis of this research can be rejected and it can be stated that emerging markets contain more right-skewed assets and ultimately offer lower coskewness premiums for a lower risk. *Graph 5 (Appendix)* illustrates this point and it can be noticed that during the ten research periods premiums have had a diverging evolution with approximately the same intensity. Consequently,

[3] 5% confidence level

investors could hedge their high profitability positions on a developed market with low-return right-skewed assets from an emerging market to reduce the probability of large negative tail movements during volatile times.

The purpose of ***Model 2*** type regressions is to separate the size effect alongside coskewness effects, by reducing the initial Fama-French loadings+SKS model with the book-to-market effect. The cross-sectional regressions were run using six quantiles of size-sorted portfolios, with Size H cumulating the highest market value stocks and Size L the lowest size stocks.

Data from Panels B for Poland and Germany lead to the same conclusions regarding the association of size and coskewness effects in the same model. Appart from the fact that for high size portfolios the market premium is quite low compared to low size portfolios, which is to be expected since high market value stocks represent a large portion of the market and have a similar explanatory power as the market portfolio, the coskewness premia evidentiate some already anticipated results.

MSCI Indices cover 85% of the free-float stocks on a market and inevitably large stocks represent a significant part of a market index. As a result the market premiums for large caps are lower as they are already followed in the market portfolio. By contrast, small caps represent a risky, unexplained portion, uncovered in the market index and they should explain excess returns better than large stocks in such a model, being appointed a higher premium. On average the market premiums for large stocks are half the size of small stock market premiums for Germany and a quarter of the values for Poland. Another major puzzle across countries is that market premiums in Germany are significantly larger than those in Poland, in contradiction with the expectation that premiums on an emerging market should be higher.

Considering the size effect, another anonamly arises as there is a difference between size premia for large and small stocks. Initially, it would be expected for the premium for small stocks to be higher, but the data on both countries goes against this assumption and reverses the expectations.

Moving on to the coskewness premium for small and large stock portfolios, it should follow the logic that small stocks require a higher premium due to the fact that most of the small size companies present negative skewness. Small stocks are more volatile and their probability distribution is more elongated to the left because of the high default and delisting probabilies. Indeed, the expectation is met as low size portfolios command an average premium of 1.68%[3] in Poland and of 4.83%[3] in Germany, as compared to premiums of 0.14%[3] and 2.54%[3] for large size portfolios.

Not in line with the initial reasoning, coskewness premiums in Germany seem to be larger than in Poland, again refuting expectations about the riskiness of an emerging market. *Graph 6 (Appendix)* represents the evolution of coskewness premiums per size portfolio for the research periods and uncovers some previously mentioned conclusions as well as some deviations from expectations. The premium seems to be dropping by moving to a higher size portfolio, but some intermediary portfolios (Size III in the case of Poland and Size V for Germany) command the highest premiums on average. As it turns out, intermediate portfolios could be comprising more negatively-skewed assets than high and small size portfolios and thus command a higher premium. Consequently, having a high market value does not necessarily imply presenting a right-skewed distribution just like having a low market value does not skew the distribution to the left.

However, considering the overall data, the second NULL hypothesis of this research has to be partially rejected. Indeed, there are no sign differences between the coskewness premiums for small and large stock, but there is a discrepancy in terms of the size of the premium. Small size portfolios command a higher premium due to the persistence of more left-skewed stock in its composition, relative to a large size portfolio. As a result, an investor can focus his attention on large size portfolios while in search for positively-skewed assets.

Panels C present the outputs of ***Model 3***, which isolates the book-to-market and coskewness effects in the same regression. The cross-sectional regressions were conducted on six book-to-market sorted quantiles, starting with the highest values (BTM H) and ending with the lowest values (BTM L) portfolios.

What becomes evident from the first coefficients for BTM and market effects is that premiums remain approximately the same for all the portfolios. Value stocks and growth stock do not necessarily differ in terms of size, the parameter that could influence especially market premia, even though it is common for growth stocks to be small caps. For the current research countries it seems that size is evenly distributed among portfolios (partially for Germany where the market and BTM premiums increase slightly with book-to-market ratio) and there seems to be no major contrast in terms of effect impacts.

The distinction arises when it comes down to coskewness premiums, even though the pattern is respected both for Poland and Germany. Coskewness premiums for high BTM portfolios are higher than for low BTM portfolios, but in the case of the Polish exchange premia for BTM Low have a negative sign. Beforehand, expectations would have dictated for high book-to-market stocks (value stocks) to command a higher coskewness premium since their distributions tend to be more left-skewed and present a higher risk of default or price crash. On the other hand, growth stocks were appreciated more secure in terms of downside risk and would have required a lower premium.

As expected, coskewness premiums for BTM portfolios decrease on average with the book-to-market ratio, but the surprising finding is that in Poland the BTM Low portfolio is rewarded with a negative premium of (-2.15%[3]). This result supports the idea that growth stocks on emerging markets tend to be more right-skewed than on developed markets and could be included in risk reducing portfolios of assets. Surely, investing in growth stocks entails a higher risk for long-term investors but for temporary holding purposes within a portfolio designed to reduce extreme movement probability they can be suitable candidates.

Graph 7 (Appendix) presents the evolution of all coskewness coefficients for the third model during the ten research periods for Poland and Germany and it can be noticed that on average previous conclusions remain valid. However, some intermediary portfolios tend to do better than high BTM portfolios, as BTM V for Poland and BTM IV for Germany are rewarded with higher premia. This involves that overall a high book-to-market ratio portfolio is equivalent to holding a higher number of negatively-skewed stocks in composition.

By prolonging the assumptions of the second NULL of this research to BTM portfolios, the hypothesis should not be rejected for Germany since there are no sign changes for coskewness coefficients according to ratio size, but it should be rejected for Poland. Warsaw Stock Exchange presents coskewness premia that change signs for extreme values of the book-to-market ratio, suggesting that low BTM stocks are at the same time positively-skewed and risk reducing instruments.

The third NULL hypothesis of this paper investigates whether there is an independence between size/book-to-market effects and the coskewness portfolio. A pertinent analysis should be conducted on size (SMB and Size)/BTM (HML and BTM) portfolios versus coskewness (SKS) portfolios during the ten research periods in terms of correlations and explanatory power.

Moreover, it would be useful to identify the correlation between stock excess returns and coskewness/skewness series for stocks. Coskewness factors were computed using Harvey and Siddique (2000) formula, described in detail in the methodological part:

$$\hat{\beta}_{SKD_i} = \frac{E[\epsilon_{i,t+1}\epsilon^2_{M,t+1}]}{\sqrt{E[\epsilon^2_{i,t+1}]}E[\epsilon^2_{M,t+1}]}$$

Skewness coefficients, in contrast, were calculated using the classical formula for the third moment:

$$Skewness = \frac{\sum_{i=1}^{N}(Y_i - \bar{Y})^3}{(N-1)\sigma^3}$$

where $\bar{Y}$ represents the mean of the series, N the number of data points (observations) and σ is the standard deviation of the series. Thus, skewness stands for the third central moment around the mean of our series of returns.

Tables 11 and *12* contain all the correlation coefficients between portfolios and series in Panels A and Panels B for Poland and Germany. Presence of elevated correlations between portfolios in models could lead to multicollinearity and to a bias in final results. In opposition, high correlation between series means a similar evolution of results as series tend to move together.

Panels A describe correlations between the SKS portfolio and all the other portfolios included in cross-sectional regressions to deduce premium coefficients. As it can be observed, correlations between effects tend to be quite low, periodically negative, indicating an independence between coskewness vs. size and book-to-market effects.

For Poland, the average correlation coefficients with SMB portfolios are positive and low, meaning that coskewness becomes slightly more positive (with 0.5%) as the size of the stock increases. The HML portfolio, on the other hand, has an inverse evolution with coskewness, with a coefficient of (-6.6%). As a result, coskewness moves to the left with an augmentation in the BTM ratio.

Table 11

Summary of correlations SKS vs. portfolios and coskewness/skewness vs. excess returns series for Poland

Panel A presents correlations per period between the SKS portfolio and SMB, HML, Size and BTM portfolios. Correlation coefficients were computed using CORREL function (*Observation:* Portfolios BTM II, III, IV and V do not have complete data due to the limited number of stocks with book-to-market ratios during initial periods). Panel B summarises correlations between coskewness/skewness series and excess returns series/period.

Panel A. Correlation coefficients between SKS portfolio and SMB, HML, Size and BTM portfolios

Correlation		SMB	HML	SIZE H	SIZE II	SIZE III	SIZE IV	SIZE V	SIZE L	BTM H	BTM II	BTM III	BTM IV	BTM V	BTM L
SKS correlation with portfolios	**1**	0.010631	-0.37106	0.129947	0.099914	-0.0898	0.077283	-0.18192	0.042368	-0.24917					-0.37892
	2	-0.19854	0.150322	0.410754	-0.01054	-0.41634	-0.1392	-0.37197	-0.16275	-0.00059					-0.13903
	3	-0.11396	0.213267	-0.15506	-0.06292	0.113129	0.253735	-0.16506	-0.35871	-0.13525					0.177665
	4	0.103467	0.032728	0.044471	0.317172	-0.09966	-0.00214	0.087366	0.286356	0.195172	-0.12229	0.251792			0.150244
	5	0.184775	0.003571	-0.04051	-0.04667	-0.1843	-0.07795	0.077359	0.165105	-0.02502	0.309291	-0.22922	0.139856	-0.02393	0.012379
	6	-0.16577	-0.05744	-0.21061	0.043323	-0.26311	0.086929	-0.10444	-0.04342	0.030743	-0.18589	0.04043	-0.12076	-0.21189	-0.03306
	7	0.117193	-0.34391	0.106452	0.115926	0.186628	0.161749	0.191947	0.073499	0.008166	0.164897	0.074957	0.147929	0.176989	0.230939
	8	-0.21144	-0.01211	0.242407	0.189481	0.037809	0.169658	0.092011	0.066534	0.10802	0.141547	0.177004	0.126805	0.111179	0.199379
	9	0.150664	-0.16458	-0.25839	-0.32428	-0.26549	-0.23583	-0.26451	-0.2122	-0.24486	-0.29252	-0.29226	-0.26541	-0.36217	-0.09591
	10	0.172418	-0.11123	0.083026	0.138601	-0.0919	0.186512	0.056482	0.103868	0.070739	-0.02745	0.096818	0.072863	0.117813	0.094216
Average		0.004944	-0.06605	0.035249	0.046001	-0.1073	0.048074	-0.05827	-0.00394	-0.0242	-0.00178	0.017075	0.016879	-0.032	0.021791

Source: Authors' calculations

Panel B. Correlation coefficients between Coksewness/Skewness series and excess return series

Periods	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
ρ Coskewness-excess returns	0.005897	0.002947	-0.02323	-0.02544	-0.07868	-0.05323	-0.03895	0.016622	0.064768	-0.03845
ρ Skewness-excess returns	0.106911	-0.22236	-0.26422	-0.042	-0.19065	-0.01161	-0.07242	-0.0105	-0.05285	-0.12409

Table 12

Summary of correlations SKS vs. portfolios and coskewness/skewness vs. excess returns series for Germany

The same methodology as in the case of Poland was used to compute correlations between portfolios and series.

Panel A. Correlation coefficients between SKS portfolio and SMB, HML, Size and BTM portfolios

Correlation		SMB	HML	SIZE H	SIZE II	SIZE III	SIZE IV	SIZE V	SIZE L	BTM H	BTM II	BTM III	BTM IV	BTM V	BTM L
SKS correlation with portfolios	1	-0.17793	0.451712	-0.41842	-0.50993	-0.43354	-0.45293	-0.32229	-0.31064	-0.29735	-0.2905	-0.48341	-0.44316	-0.46977	-0.44969
	2	-0.00249	0.222052	0.100101	0.180742	0.165208	0.214152	0.187981	0.182652	0.245277	0.153522	0.268103	0.147051	0.085487	0.143334
	3	-0.3201	-0.10387	-0.15377	-0.34618	-0.25381	-0.39894	-0.49177	-0.30552	-0.32277	-0.3647	-0.41803	-0.31549	-0.26771	-0.35057
	4	0.112589	0.199754	0.157081	0.248941	0.287352	0.416303	0.049275	0.302229	0.232609	0.329557	0.309679	0.244785	0.192106	0.229647
	5	-0.14563	0.046646	0.117615	0.170988	0.134426	0.02859	-0.08594	0.00674	0.002378	0.021485	0.14833	0.121298	0.146813	-0.09031
	6	-0.247	-0.13466	0.055025	0.09628	0.097887	0.000824	-0.17182	-0.06344	-0.10335	0.029198	-0.00938	-0.0108	0.061489	0.012128
	7	-0.1152	0.000281	0.146821	0.145696	0.100482	0.029085	0.15828	0.096412	0.099576	0.029013	0.152095	0.141996	0.125385	0.207786
	8	0.121277	-0.0833	-0.19698	-0.14313	-0.05992	-0.18362	-0.12308	-0.04908	-0.10396	-0.10451	-0.21736	-0.18707	-0.12075	-0.09081
	9	0.161928	-0.2401	-0.27036	-0.03575	-0.07222	0.046458	-0.16461	-0.07345	-0.18351	-0.11735	-0.15139	-0.1431	-0.16333	-0.01608
	10	-0.30874	-0.11706	0.038381	0.056311	-0.00578	-0.11436	0.018324	-0.30855	-0.29061	0.047581	0.143231	0.078664	0.225696	-0.40319
Average		-0.09213	0.024146	-0.04245	-0.0136	-0.00399	-0.04144	-0.09456	-0.05226	-0.07217	-0.02667	-0.02581	-0.03658	-0.01846	-0.08078

Panel B. Correlation coefficients between Coksewness/Skewness series and excess return series

Periods	1	2	3	4	5	6	7	8	9	10
ρ Coskewness-excess returns	-0.00018	0.057101	0.03444	-0.07154	0.002779	0.004051	0.032852	0.035853	0.050007	0.005193
ρ Skewness-excess returns	0.040279	0.005631	0.111	-0.08683	0.042566	0.047845	0.001051	0.048078	-0.08352	-0.02167

Source: Authors' calculations

From *Table 11* it can also be infered that the sensitivity of coskewness to the SMB loading is less significant than towards the HML loading. Additionaly, size portfolios influence coskewness differently as the size factor decreases. It seems that high size portfolios move together with coskewness with a coefficient of 3.52%, while low size portfolios move in an opposite direction, with a negative value of (-0.39%). There are some disfunctionalities in this pattern as intermediary size portfolios can register more volatile values than for extreme size portfolios. However, the conclusion that can be roughly drawn based on SMB and Size portfolios is that coskewness factors in Poland move in the same direction with SMB and in an opposite direction with size. For size portfolios, the conclusion is in disaccordance with what was identified by analysing coskewness premia, where small stocks commanded a higher premium as they presented more negative coskewness and consequently coskewness should have decreased with size. Nevertheless, the average correlation between SKS and Size portfolios is insignificantly small (-0.67%), meaning that the possibility of a positive correlation is equally probable.

Table 12, for Germany, depicts a totally different picture, with a correlation of (-9.21%) with SMB and negative average correlations with Size portfolios. Relative to Poland, it can stated that in Germany coskewness factors move inversely to size, in contradiction with what was taken out of the premiums analysis. According to this correlation, coskewness should be lower for large stocks, which is less probable as it is known that small stocks present more risk.

Moving on to the relationship between book-to-market and coskewness effects, a new divergence in results arises between Germany and Poland. Only Germany respects the expectations drawn from premia analysis on models as coskewness moves with HML with a coefficient of 2.41%, while coskewness in Poland moves inversely with a value of (-6.6%). BTM portfolios paint a confusing picture as average correlations with SKS reverse the assumptions suggested by correlations with HML portfolios, with a zero correlation for Poland and a negative one for Germany.

The correlation analysis between portfolios turns out to be less conclusive than the model coefficient analysis as it provides diverging results. However, correlations between portfolios are insignificantly different from zero and only several guesses about the state of things can be formulated. Nevertheless, the same statements as in the case of the model analysis above can be formulated – coskewness is positive for large size portfolios and for low book-to-market assets. Consequently, investors should focus their attention on large stocks and on growth assets on emerging markets.

As for correlations between coskewness/skewness values and excess returns in Panels B, it can be observed that on emerging markets excess returns move inversely to coskewness/skewness, while on developed markets the situation is reversed. In Poland, for negatively skewed assets an investor receives an increasing return (with 1.67% for coskewness and 8.83% for skewness). Meanwhile, in Germany, the puzzle arises since positively skewed assets are assigned an increasing excess return (1.5% for coskewness and 1% for skewness), in contradiction with expectations and the situation on an emerging market. Thus, riskier assets with left skewness are not compensated for additional downside volatility and ultimately investors are not that concerned with the skewness of their investments or with the protection of portfolios.

As a result of previous arguments, the third NULL of this research paper is not rejected since there is no tangible influence between coskewness vs. size and book-to-market effects, apart from intuitive beliefs and expectations. The normal order of things dictates that small stocks receive a higher skewness premium, while value stocks be rewarded more for a predominant negative skewness.

Finally, statistics in *Tables 13* and *14 (Appendix)* evidentiate the proportion of right-skewed assets during each estimation period both regarding coskewness and skewness. As it turns out, the percentage of positively-skewed stocks on an emerging market is larger than on a developed market, in terms of coskewness. The same rule applies for proportion of right-skewed stocks in terms of skewness, but at a shorter distance in this case.

All previous facts and statistics have served as support for some conclusions regarding the impact of coskewness on an emerging and on a developed market, as well as basis for rejecting or not rejecting the three NULLs. As it turns out, the first NULL was rejected and it was identified that emerging markets possess more right-skewed assets and have negative premiums for skewness relative to developed countries. The other two NULLs could not be rejected since there are no tangible influences between skewness, size and book-to-market effects and opposite sign skewness premiums for varying sizes and BTMs are not conclusive.

VIII. Conclusions

The objective of this sudy is to empirically verify the impact of coskewness on asset pricing on two markets – emerging (Poland) versus developed (Germany) economies in the EU space. The two stock exchanges were analysed during a twelve year time span (31 December 1998-31 December 2010), by applying a rolling window methodology on ten periods of three years each.

Starting from the assumption that stock on emerging markets presents non-normality in probability distributions, the research envisaged to prove that more right-skewed assets can be identified in Poland relative to Germany. The underlying intuition was that coskewness premia on emerging markets should be negative due to an overall positive skewness on the market, while the Deutsche Boerse should command positive coskewness premia to compensate investors for an increased downside risk.

Starting with three NULL hypotheses as benchmarks:

a) H_0: Emerging markets present less right-skewed assets and higher coskewness premia relative to developed markets.

b) H_0: Skewness premia for large and small companies or high book-to-market and low book-to-market stocks do not change signs

c) H_0: Book-to-market and size effects have no influence on risk premiums as described by coskewness factors,

and by employing cross-sectional regressions according to Fama and MacBeth (1973) within a Fama-French three factor model+SKS framework (Fama and French, 1995 and Harvey and Siddique, 2000), this paper provided pertinent data to formulate conclusions on the effect of coskewness on excess returns.

As anticipated beforehand, descriptive statistics show a significant impact of coskewness factors on excess returns, as well as an important explanatory contribution to the initial Fama-French model. Alongside size and book-to-market effects, coskewness plays an essential role in describing stock excess returns and it also helps to differentiate among emerging and developed markets.

Coskewness premia in Poland turn out to be negative, in opposition to Germany, where a positive premium rewards the higher downside risk of negatively-skewed stocks. Excess returns are negatively correlated with size and coskewness on emerging markets, while on developed markets there can be observed a positive correlation between excess returns and coskewness. These outcomes provide sufficient basis to reject the first NULL and evidentiate the superiority of emerging exchanges in terms of positive skewness.

The data for second and third NULLs does not permit to reject the assumptions as there are no tangible differences between coskewness premia for large vs. small stocks or high vs. low book-to-market ratio assets. As well, coskewness, size and BTM effects seem to have independent evolutions, each of them having an explanatory contribution to excess returns. Only some significant premia suggest that emerging markets offer better investment opportunities in terms of volatility reduction and hedging due to a skew to the right on exchanges.

Finally, the main conclusion that can be drawn out of this empirical research is that investors in search for extreme risk-reducing instruments should focus their attention on emerging markets. Thus, even though the difference in premia is a matter of several percentage points, institutional investors could speculate such properties by matching risky positions in negatively-skewed assets on developed markets with hedging positions in right-skewed assets on emerging markets.

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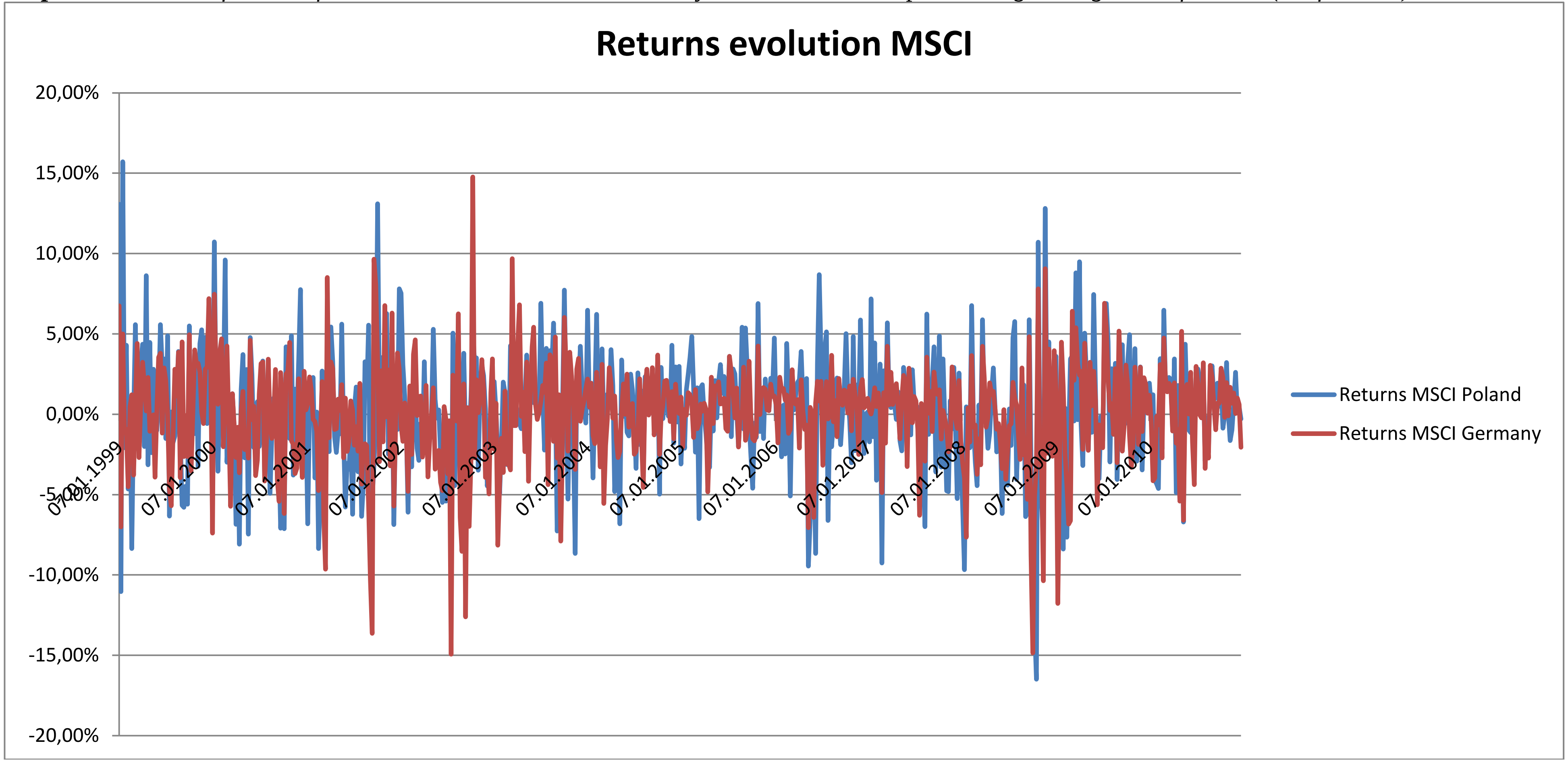
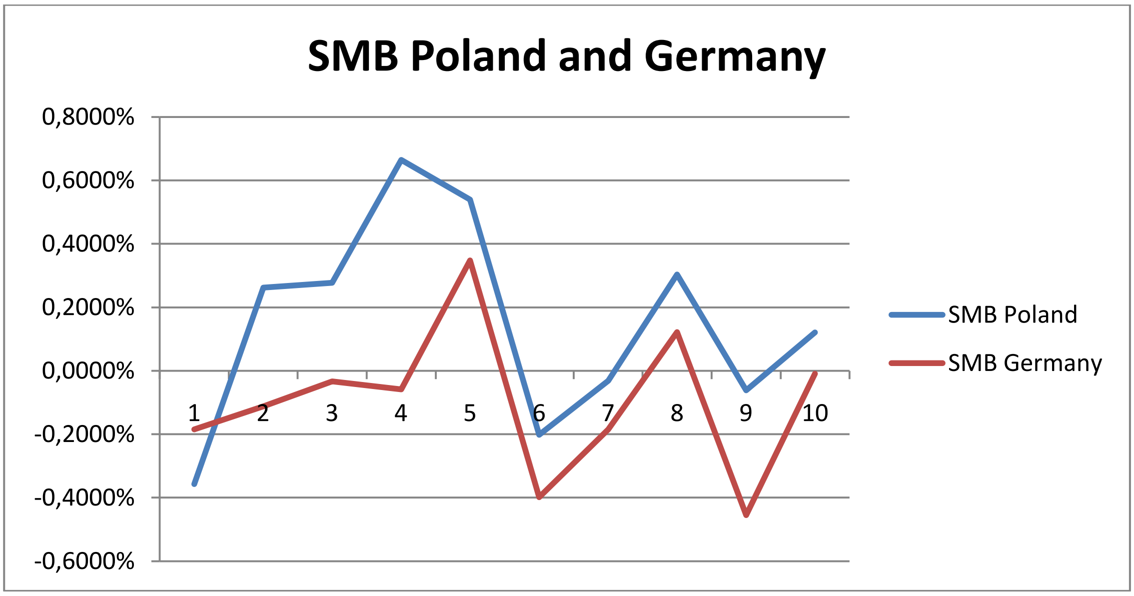
APPENDIX

Graph 1. *Evolution of returns for MSCI Poland and MSCI Germany. Returns were computed using the logarithm function (LN function).*



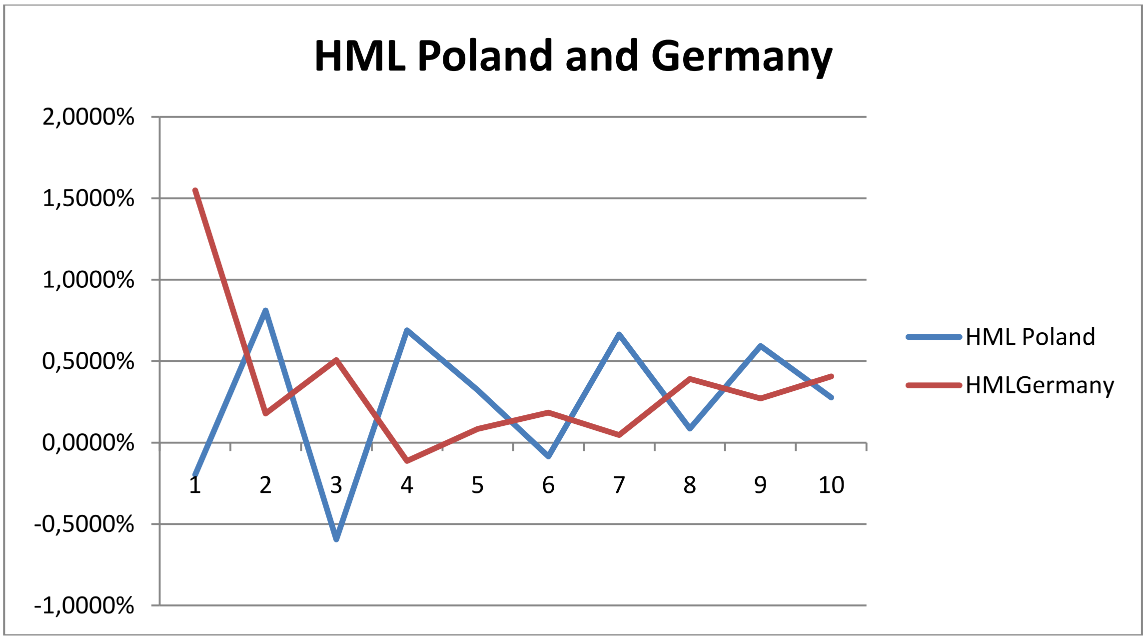
Source: DataStream and Authors' calculations

Graph 2. *SMB portfolios for Poland and Germany*



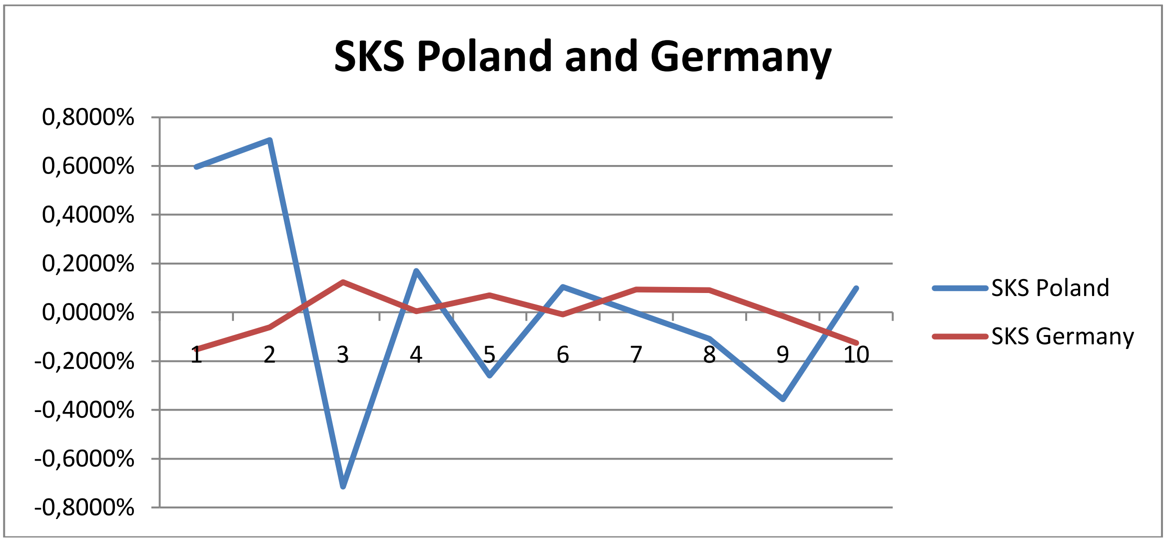
Source: Authors' calculations

Graph 3. *HML portfolios for Poland and Germany*



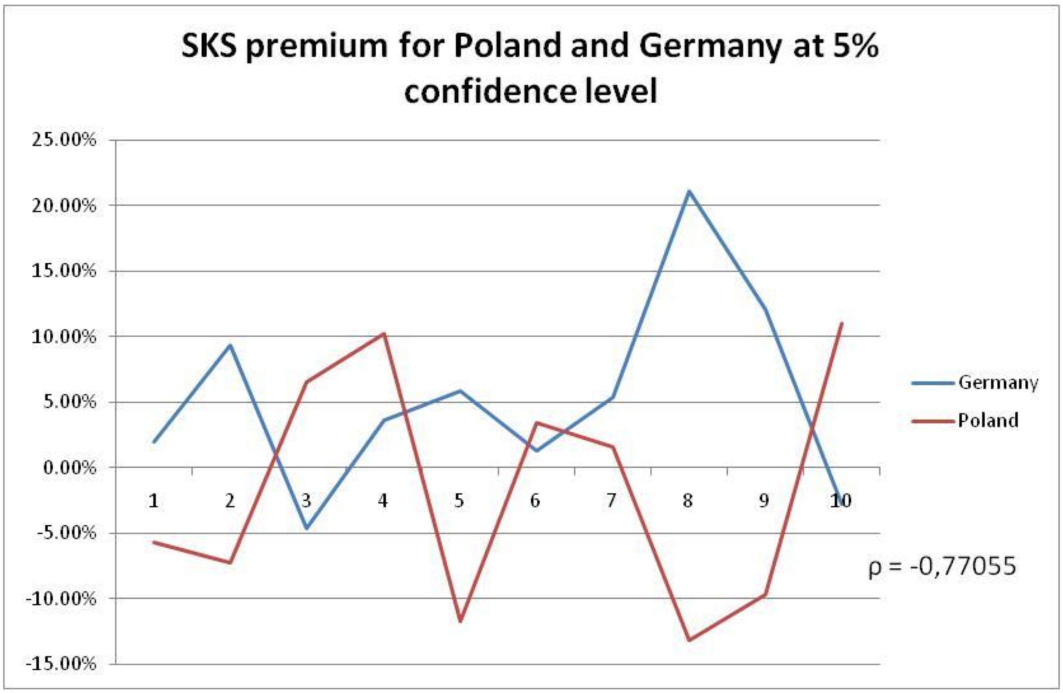
Source: Authors' calculations

Graph 4. *SKS portfolios for Poland and Germany*



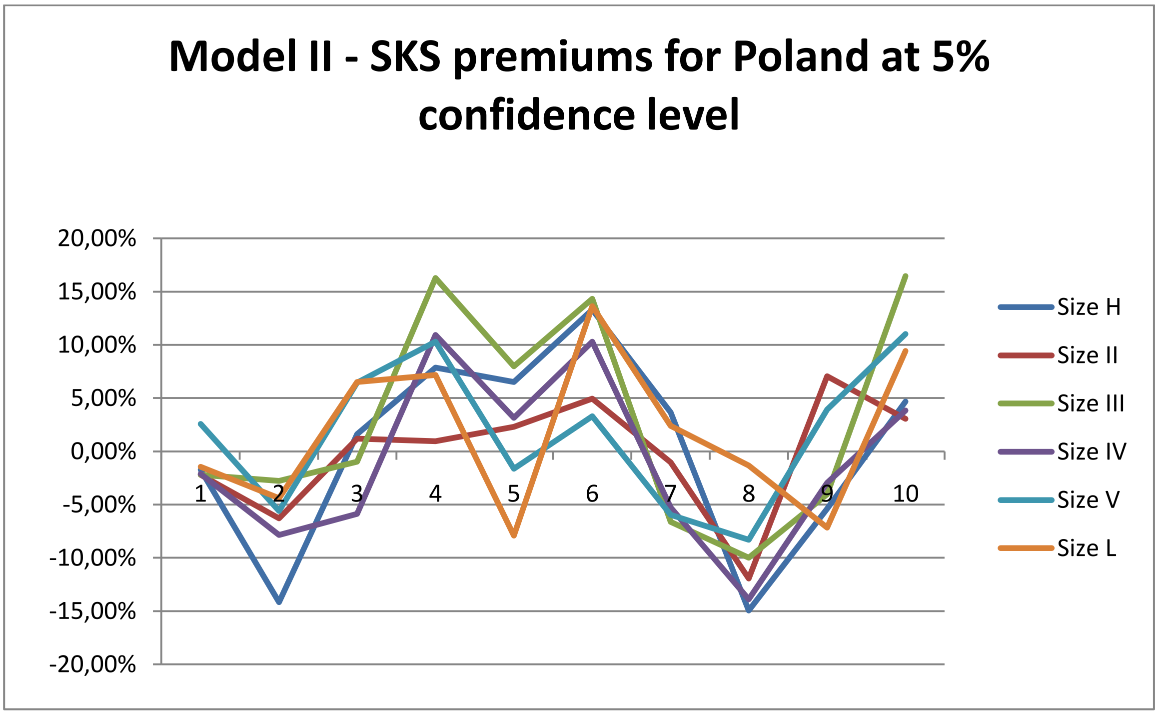
Source: Authors' calculations

Graph 5. *Coskewness premiums symbiotic evolution (generalised Model 1) for Germany and Poland at 5% confidence level. Correlation between coskewness premiums.*

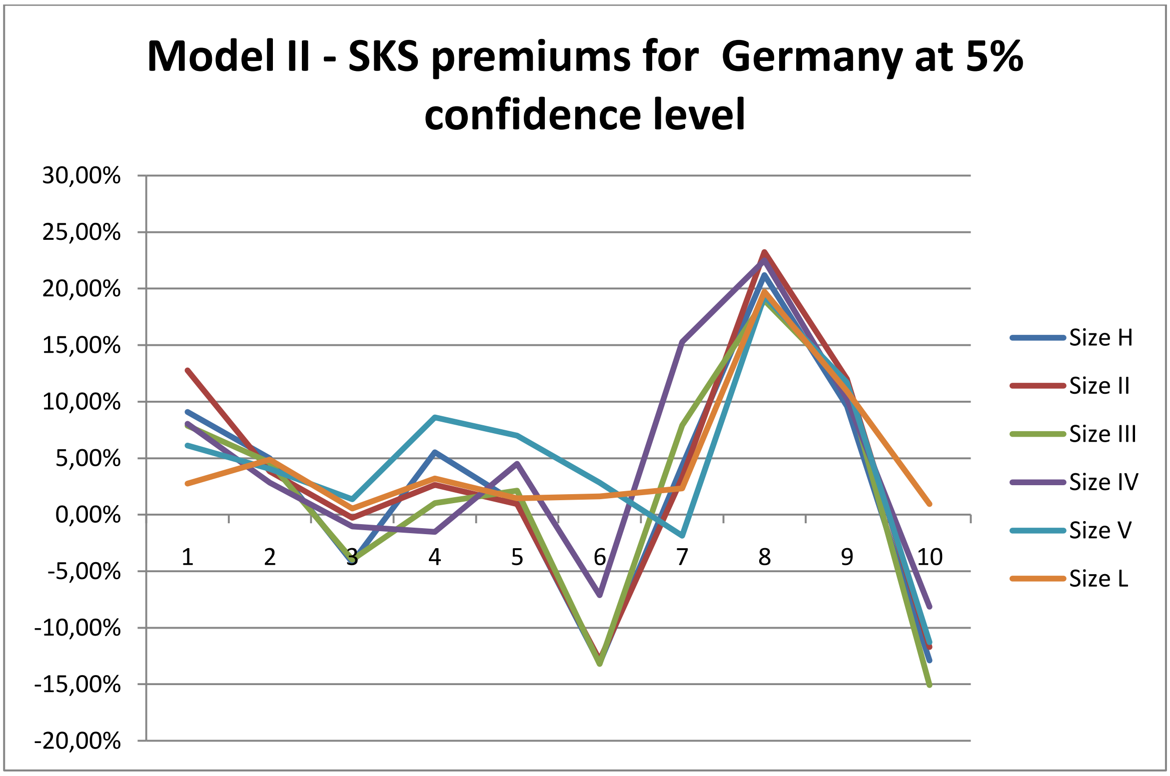


Source: Authors' calculations

Graph 6. *Coskewness premiums from Model II for Germany and Poland at 5% confidence level.*

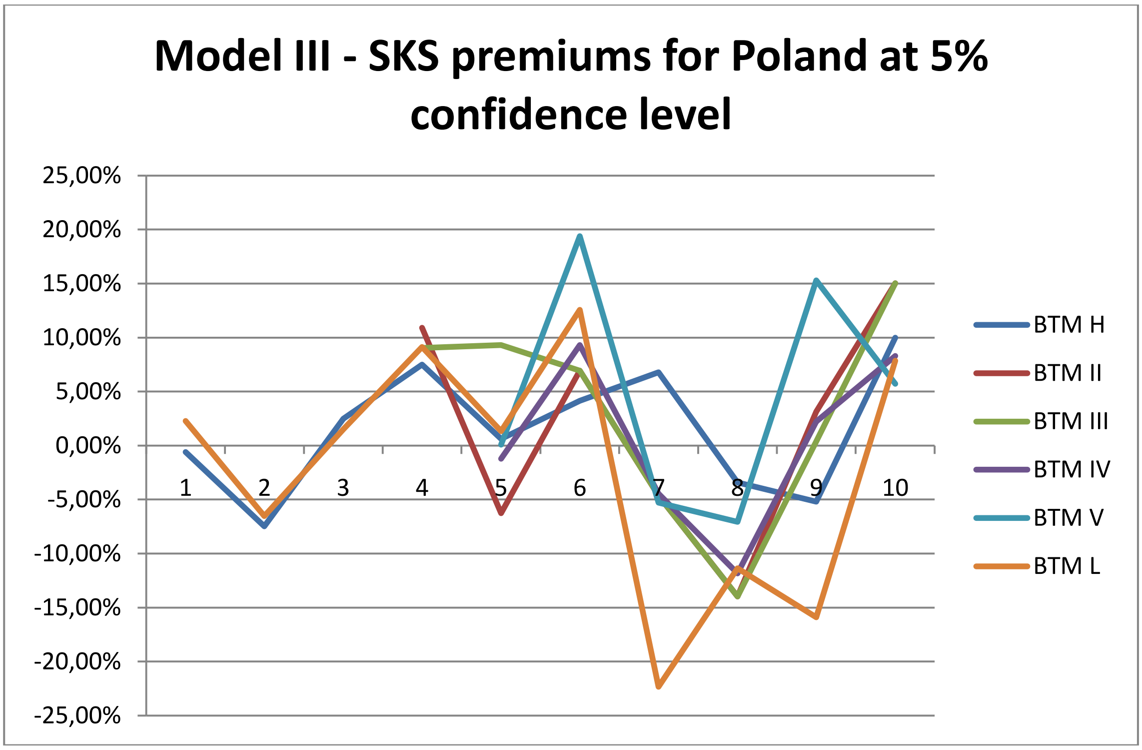


Source: Authors' calculations

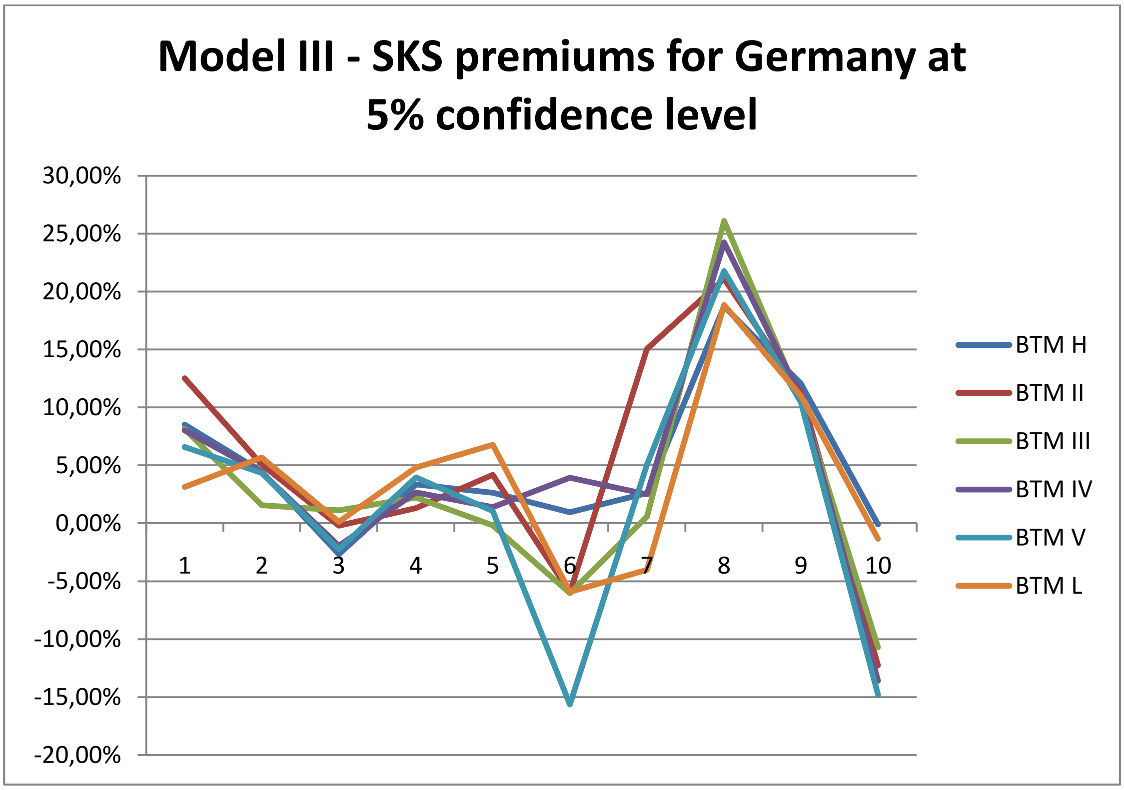


Source: Authors' calculations

Graph 7. *Coskewness premiums from Model III for Germany and Poland at 5% confidence level.*



Source: Authors' calculations



Source: Authors' calculations

Table 13

Coskewness and Skewness Series statistics for Poland

The table presents statistics on coskewness and skewness series of values for all stocks on the Polish exchange. The first two tables contain the proportions of negatively and positively coskewed/skewed stocks during ten periods. The last two tables express minimum and maximum values per period.

	Number of negative values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	1	4	7	4	4	4	5	13	27	30	57
Percentage	2.17%	8.70%	14.58%	7.84%	5.26%	3.81%	3.85%	6.67%	11.89%	12.50%	

	Number of positive values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	6	6	7	10	15	25	32	44	37	26	127
Percentage	13.04%	13.04%	14.58%	19.61%	19.74%	23.81%	24.62%	22.56%	16.30%	10.83%	

	Minimum values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	-4E+23	-4E+23	-1E+24	-2E+24	-7E+23	-4E+23	-3E+23	-4E+23	-3E+23	-4E+23	-2.56921E+23

	Maxmimum values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	3E+24	1E+23	5E+23	2E+25	3E+23	1.1E+24	2E+24	2E+24	6.6E+23	2E+23	1.99201E+24

	Number of negative values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	14	28	28	8	21	32	46	88	141	55	79
Percentage	30.43%	60.87%	58.33%	15.69%	27.63%	30.48%	35.38%	45.13%	62.11%	22.92%	

	Number of positive values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	32	18	19	43	52	73	83	102	86	184	148
Percentage	69.57%	39.13%	39.58%	84.31%	68.42%	69.52%	63.85%	52.31%	37.89%	76.67%	

	Minimum values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	-6.355	-2.321	-5.148	-0.6645	-5.3545	-1.1148	-5.1404	-2.9776	-4.3155	-1.975	-1.765435849

	Maxmimum values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	1.7083	2.3074	2.3568	2.68192	3.40238	3.5992	5.0247	5.13782	3.0677	5.6401	2.601747812

Source: Authors' calculations

Table 14

Coskewness and Skewness Series statistics for Germany

	Number of negative values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	84	54	47	52	62	45	64	87	148	76	372
%	14.36%	8.78%	7.52%	8.25%	9.60%	6.56%	7.88%	9.79%	16.34%	8.35%	

	Number of positive values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	130	87	85	71	64	87	124	90	43	120	401
	22.22%	14.15%	13.60%	11.27%	9.91%	12.68%	15.27%	10.12%	4.75%	13.19%	

	Minimum values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	-4E+23	-7E+23	-2E+25	-3E+24	-3E+24	-2E+24	-5E+23	-9E+23	-2E+25	-3E+24	-3.0297E+24
	Maxmimum values of coskewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	2E+23	7E+23	4E+25	1E+24	3E+24	5E+24	2.3E+24	2E+24	4E+24	2E+24	3.64603E+24

	Number of negative values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	267	272	265	161	217	176	338	408	576	321	337
Percentage	45.64%	44.23%	42.40%	25.56%	33.59%	25.66%	41.63%	45.89%	63.58%	35.27%	

	Number of positive values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	317	339	357	457	426	506	462	477	320	578	572
Percentage	54.19%	55.12%	57.12%	72.54%	65.94%	73.76%	56.90%	53.66%	35.32%	63.52%	

	Minimum values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	-1.952	-7.0487	-7.2111	-6.0065	-6.6355	-5.613	-6.0496	-7.009	-5.932	-6.289	-5.853995898
	Maxmimum values of skewness										
Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Entire period**
Number	3.48954	7.2111	7.2111	6.275	5.7325	4.9075	5.34004	6.4482	6.0411	7.2111	2.56758496

Source: Authors' calculations

Table 15

Regression Summary for Models II and III for Poland

Panels B and C present coefficients (premia) statistics after running cross-sectional regressions according to Models II and III. A summary has been compiled on all size and book-to-market quantiles (Size H to Size L and BTM H to BTM L).

Panel B. Summary results from cross-sectional regressions for Model 2 (Specific Model for Size factor)

			Intercept			β to Market excess			λ_{SIZE}			λ_{SKS}		
	Confidence level		**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**
	Periods	**Stocks**												
Quintile I (Size High)	**1**	46	-0.00284	-0.00059	0	0.028159	0.02816	0	0.281127	0.28113	0.110196	-0.04118	-0.0172	-0.03598
	2	48	-0.00096	-0.00045	-1.3E-05	0.040134	0.04171	0.03248	0.220763	0.21509	0.114467	-0.16448	-0.1416	-0.09295
	3	51	0.003358	0.002874	0.000391	0.130482	0.0426	0.042601	0.306551	0.28142	0.149886	0.04303	0.01612	0.028215
	4	76	-0.00019	-0.00017	0.000264	0.241324	0.20818	0.12086	-0.08966	-0.07722	0.160432	0.08093	0.07854	0.083314
	5	105	0.001849	0.001406	-5.2E-05	0.1276	0.10038	0.084862	0.328518	0.21939	0.143643	0.01519	0.06522	0.041126
	6	130	-0.00051	-0.0002	-0.0003	0.003554	-0.01218	-0.00382	0.941129	0.79069	0.447002	0.1674	0.13304	0.118739
	7	195	-0.002	-0.00118	-0.00042	0.008661	0.00461	0.013231	0.974609	0.91991	0.687805	0.02441	0.03662	0.029092
	8	227	-0.00253	-0.00193	-0.00086	-0.01153	0.01333	-1.7E-05	0.539335	0.47709	0.327718	-0.13043	-0.1496	-0.06155
	9	240	-0.00064	-0.00047	-0.00027	0.0101	0.01596	0.00958	0.65466	0.56264	0.306741	-0.05682	-0.0538	0.007573
	10	249	0.000844	0.000536	0.000134	-0.0276	-0.00999	0.012448	0.60762	0.50738	0.266752	0.09297	0.04685	0.025964
	Average		-0.00036	-1.8E-05	-0.00011	0.055088	0.04328	0.031222	0.476466	0.41775	0.271464	0.0031	0.00141	0.014354

Table 15 (Panel B) Continued

Quintile II	1	46	-0.00217	-0.00089	0	0.055276	0.04652	0.014081	0.320757	0.24786	0.111943	-0.02745	-0.0219	-0.04431
	2	48	-0.00036	-0.00036	-1.3E-05	0.013887	0.02945	0.019062	0.263224	0.17415	0.122382	-0.08212	-0.063	-0.07621
	3	51	-0.00152	-0.00179	-0.00117	0.176796	0.14715	0.107111	0.311964	0.30167	0.143153	0.0214	0.01195	-0.02615
	4	76	0.00026	-0.00053	0.000178	0.062162	0.05324	0.01227	0.282435	0.23207	0.127408	0.02771	0.0095	0.002227
	5	105	0.002817	0.001706	-0.00014	0.15396	0.13996	0.119449	0.345591	0.27602	0.17198	0.02018	0.02307	0.018285
	6	130	0.000258	0.000127	-0.0004	0.161316	0.13769	0.06187	0.83535	0.70384	0.372349	-0.03275	0.04962	0.052352
	7	195	-0.00235	-0.00075	-0.00011	0.130885	0.10377	0.02965	0.85956	0.79162	0.65115	0.02739	-0.0103	0.018969
	8	227	-0.0027	-0.00179	-0.00067	0.096914	0.07874	0.05644	0.608789	0.52229	0.399963	-0.13205	-0.1195	-0.05175
	9	240	7.7E-05	1.49E-05	-6.6E-07	0.068263	0.06736	0.041654	0.609885	0.53872	0.375013	0.06328	0.07057	-0.00188
	10	249	0.000633	0.000338	0.000129	0.064325	0.05695	0.045876	0.483606	0.35615	0.209137	0.03806	0.03052	0.028968
	Average		-0.00051	-0.00039	-0.00022	0.098378	0.08608	0.050746	0.492116	0.41444	0.268448	-0.00764	-0.0019	-0.00795

Quintile III	1	46	-0.00243	-0.0021	-0.00128	0.059325	0.03396	0	0.213706	0.14035	0.084612	-0.02745	-0.0219	-0.04431
	2	48	-0.00035	-0.00039	-1.3E-05	0.008761	0.03139	0.019543	0.142115	0.14104	0.073995	-0.0469	-0.0279	-0.00634
	3	51	0.000322	0.000322	0	0.236456	0.10744	0.015762	0.221554	0.2104	0.158785	-0.03905	-0.0096	0.009746
	4	76	-0.00084	-0.00083	-0.00034	0.059014	0.01182	0.021436	0.312383	0.21993	0.155014	0.12481	0.16276	0.104182
	5	105	0.002724	0.00248	0.000937	0.155489	0.16641	0.150817	0.321949	0.17109	0.033871	0.09096	0.07986	0.025743
	6	130	0.000967	0.000823	0.000248	0.114284	0.1039	0.056021	0.475653	0.43003	0.221556	0.16261	0.1431	0.080593
	7	195	-0.00015	0.000459	0.000254	0.188447	0.11378	0.076623	0.773714	0.71532	0.55642	-0.06923	-0.0662	-0.05975
	8	227	-0.00142	-0.00086	-2.5E-05	0.218249	0.19757	0.146971	0.563815	0.51091	0.37632	-0.10454	-0.1001	-0.04863
	9	240	-0.00026	-0.00037	-0.00013	0.047541	0.04511	0.038823	0.611939	0.53634	0.374326	-0.00734	-0.0405	-0.00121
	10	249	0.000139	0.000184	-0.00015	0.101039	0.08509	0.044248	0.402088	0.31549	0.184598	0.19943	0.16466	0.070073
	Average		-0.00013	-2.8E-05	-5E-05	0.118861	0.08965	0.057024	0.403891	0.33909	0.22195	0.02833	0.02841	0.01301

Table 15 (Panel B) Continued

Quintile IV	1	46	-0.00191	-0.00161	-0.00072	0.054605	0.03941	0.013091	0.251624	0.23344	0.173702	-0.03001	-0.0211	-0.02507
	2	48	-0.00093	-0.00049	-0.00049	0.007309	0.03067	0.018494	0.203253	0.18261	0.154128	-0.07022	-0.0785	-0.0782
	3	51	0.002907	0.000772	0.000409	0.216153	0.1497	0.015028	0.232062	0.21269	0.123772	-0.1101	-0.0587	-0.04139
	4	76	-2.2E-05	-0.00022	7.99E-05	0.264738	0.23766	0.224713	0.173206	0.16224	0.129003	0.12198	0.10935	0.059619
	5	105	0.00162	0.001195	0.000115	0.080442	0.07967	0.059376	0.308769	0.33018	0.215711	0.03369	0.03139	0.026251
	6	130	0.003389	0.001705	0.000406	0.230016	0.1929	0.14941	0.465384	0.39468	0.285448	0.04742	0.103	0.133007
	7	195	-0.00034	1.15E-05	-8.5E-05	0.076669	0.07592	0.025396	0.560566	0.5393	0.453461	-0.03407	-0.0526	-0.03361
	8	227	-0.00139	-0.00102	-0.00015	0.172411	0.16224	0.108992	0.547005	0.5137	0.340886	-0.1471	-0.139	-0.06043
	9	240	-0.00021	-0.00016	-0.00015	0.136836	0.10833	0.06531	0.59005	0.50007	0.369466	-0.01716	-0.0296	-0.00292
	10	249	0.000199	0.000138	0	0.118228	0.12138	0.074998	0.404846	0.33892	0.229035	0.05976	0.03849	0.025431
	Average		0.00033	3.32E-05	-5.7E-05	0.135741	0.11979	0.075481	0.373677	0.34078	0.247461	-0.01458	-0.0097	0.000269

Quintile V	1	46	-0.00356	-0.00107	0	0.03614	0.02041	0	0.176184	0.15951	0.126874	0.01709	0.02575	-0.04858
	2	48	-0.0005	-0.0005	-0.0005	0.012279	0.0158	0.033138	0.089257	0.09013	0.103099	-0.08343	-0.0561	-0.04015
	3	51	0.002576	0.002073	0.000362	0.106641	0.0346	0.0157	0.198067	0.19359	0.114447	0.03804	0.06457	0.004076
	4	76	0.000338	-1.7E-05	0.000411	0.164874	0.16232	0.071152	0.233092	0.18188	0.086616	0.14828	0.10288	0.073516
	5	105	-0.00024	-0.00059	-0.00061	0.216312	0.20447	0.180253	0.259696	0.22999	0.151723	-0.03749	-0.0165	-0.01255
	6	130	0.001218	0.001157	0.000375	0.239036	0.18964	0.118446	0.361086	0.31148	0.222575	0.01525	0.03297	0.086816
	7	195	-0.00258	-0.00139	-0.00048	0.105948	0.07679	0.030957	0.55508	0.52414	0.414812	-0.06271	-0.0597	-0.05556
	8	227	-0.00314	-0.00214	-0.00083	0.119495	0.10192	0.064554	0.593741	0.49397	0.259167	-0.10793	-0.0831	-0.09943
	9	240	0.000353	0.000115	-6.5E-07	0.102688	0.08092	0.042879	0.575709	0.51298	0.369641	0.05272	0.03929	0.002212

Table 15 (Panel B) Continued

	10	249	0.000265	0.000193	0	0.285351	0.25382	0.154891	0.210582	0.17974	0.149312	0.13411	0.11013	0.032449
	Average		-0.00053	-0.00022	-0.00013	0.138876	0.11407	0.071197	0.325249	0.28774	0.199827	0.01139	0.01602	-0.00572

Quintile VI (Size Low)	**1**	46	-0.0058	-0.00341	0	0.089146	0.05777	0.015812	0.118052	0.10399	0.113161	-0.03193	-0.0147	-0.04743
	2	48	-0.00111	-0.00044	0	0.029605	0.03042	0.01851	0.184227	0.16026	0.109284	-0.06549	-0.0439	-0.07494
	3	51	-0.00425	-0.00602	-0.00656	0.502797	0.40879	0.306634	0.265501	0.24288	0.158592	0.06159	0.06504	0.073886
	4	76	-0.00089	-5.8E-05	-5.2E-06	0.288981	0.1931	0.133417	0.134566	0.11945	0.087409	0.06098	0.07164	0.045442
	5	105	0.000637	4.16E-05	7.72E-06	0.192934	0.17414	0.143923	0.176959	0.15649	0.129849	-0.06739	-0.0793	-0.05627
	6	130	-0.00182	-0.00109	-0.00071	0.262528	0.22412	0.148931	0.403105	0.31661	0.246258	0.16139	0.13632	0.065505
	7	195	-0.00085	-0.00042	-9.4E-05	0.097995	0.0835	0.047581	0.534791	0.51631	0.403502	0.04229	0.02387	0.03418
	8	227	-0.0047	-0.00361	-0.00136	0.116811	0.10776	0.077031	0.567255	0.48899	0.266734	-0.01374	-0.0134	-0.04097
	9	240	-0.00065	-0.00052	-0.00015	0.149475	0.1186	0.064826	0.46893	0.43209	0.289475	-0.00774	-0.0717	0.012274
	10	249	-0.00016	-2.4E-06	0	0.260656	0.21215	0.11315	0.310109	0.24734	0.121321	0.11495	0.09412	0.029241
	Average		-0.00196	-0.00155	-0.00089	0.199093	0.16104	0.106982	0.316349	0.27844	0.192559	0.02549	0.01681	0.004092

Panel C. Summary results from cross-sectional regressions for Model 3 (Specific Model for Book-to-market factor)

			Intercept			**β to Market excess**			**λ_{BTM}**			**λ_{SKS}**		
	Confidence level		**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**
	Periods	**Stocks**												
Quintile I (BTM High)	**1**	46	-0.00534	-0.00306	0	0.080893	0.04662	0.014449	0.084035	0.09004	0.099764	0.02055	-0.006	-0.02572
	2	48	-0.00067	-0.0002	-0.00045	0.016974	0.02828	0.01929	0.115204	0.13269	0.08752	-0.09293	-0.0748	-0.07691
	3	51	-0.00091	-0.00011	0	0.239411	0.17992	0.133188	0.245076	0.24643	0.235264	0.0309	0.02481	0.003403
	4	76	-0.00091	-0.00053	-0.00015	0.177283	0.17515	0.095646	0.224294	0.18504	0.101636	0.08812	0.07487	0.043556

	5	105	0.000742	0.000495	-0.00023	0.178106	0.16366	0.059976	0.260637	0.23679	0.150076	-0.0138	0.00625	-0.00128
	6	130	0.000626	-0.00056	0.000389	0.230787	0.22748	0.161192	0.376983	0.34661	0.226576	0.05524	0.04137	0.041141
	7	195	-0.00281	-0.00153	-0.00035	0.21703	0.17985	0.091919	0.633354	0.5889	0.484287	0.09884	0.0679	0.05821
	8	227	-0.00309	-0.00181	-0.00078	0.088837	0.07691	0.042366	0.609609	0.51883	0.344809	-0.04583	-0.0341	-0.05218
	9	240	-0.00087	-0.00093	-0.00017	0.057089	0.05479	0.032003	0.534189	0.49378	0.343863	-0.02962	-0.052	-0.00327
	10	249	-4.9E-05	2.95E-06	0	0.083757	0.06164	0.039908	0.380555	0.32085	0.180613	0.11686	0.09979	0.026789
	Average		-0.00133	-0.00082	-0.00017	0.137017	0.11943	0.068994	0.346393	0.316	0.225441	0.02283	0.01481	0.001375
Quintile II	**1**	46												
	2	48												
	3	51												
	4	76	-0.00088	-0.00036	-5.2E-06	0.163196	0.13761	0.054301	0.204781	0.19489	0.157584	0.105	0.10914	0.094086
	5	105	0.000767	0.000478	-0.00017	0.181816	0.1657	0.14186	0.228428	0.19379	0.113775	-0.10287	-0.0626	-0.09623
	6	130	2.01E-05	0.000636	-0.00026	0.083917	0.0871	0.058332	0.598639	0.51558	0.352364	0.04747	0.06938	0.038985
	7	195	-0.00095	-0.00045	-9.5E-05	0.045484	0.0471	0.024003	0.628347	0.60714	0.506973	-0.0402	-0.0462	-0.03453
	8	227	-0.00431	-0.00294	-0.00138	0.122894	0.11519	0.083371	0.575546	0.50328	0.360951	-0.11064	-0.1396	-0.05991
	9	240	-0.00067	-0.00092	-0.00015	0.09728	0.07364	0.037928	0.704325	0.63116	0.447227	0.08269	0.0313	-0.00411
	10	249	-0.00046	-0.0003	-0.00018	0.093694	0.08226	0.054711	0.458679	0.34787	0.199665	0.18308	0.15031	0.085789
	Average		-0.00093	-0.00055	-0.00032	0.112612	0.10123	0.064929	0.485535	0.42767	0.305505	0.0235	0.01594	0.00344
Quintile III	**1**	46												
	2	48												

Table 15 (Panel C) Continued

	3	51												
	4	76	0.000345	-0.0003	0.000439	0.216027	0.19463	0.13192	-0.02044	0.04824	0.029495	0.08241	0.0905	0.056841
	5	105	0.000841	0.000506	2.22E-05	0.112636	0.11233	0.097886	0.184241	0.14959	0.093352	0.06402	0.0932	0.041116
	6	130	0.001083	0.000253	0.000249	0.213432	0.20179	0.099563	0.463931	0.38991	0.25491	0.04747	0.06938	0.038985
	7	195	-0.00134	-0.00083	-0.00023	0.098667	0.08598	0.054969	0.610143	0.57771	0.47771	-0.0402	-0.0462	-0.03453
	8	227	-0.00064	-0.00046	0.000277	0.131646	0.11017	0.068635	0.572773	0.50812	0.323789	-0.11064	-0.1396	-0.05991
	9	240	-3.5E-05	-0.00041	-0.00015	0.037828	0.03108	0.032129	0.5907	0.50965	0.349961	0.05961	0.00377	-0.00373
	10	249	0.000385	0.000295	0	0.300584	0.25784	0.164186	0.185029	0.1636	0.146235	0.18308	0.15031	0.085789
	Average		9.08E-05	-0.00014	8.67E-05	0.158688	0.14197	0.092755	0.369482	0.33526	0.23935	0.04082	0.03161	0.017794

Quintile IV	**1**	46												
	2	48												
	3	51												
	4	76												
	5	105	-2.2E-05	-0.00034	-0.00135	0.145086	0.1296	0.11465	0.465014	0.38713	0.253536	-0.04259	-0.0121	-0.01081
	6	130	0.001712	0.000679	0.000232	0.078351	0.05528	0.049459	0.668384	0.56872	0.389953	0.04471	0.09317	0.084932
	7	195	-0.00227	-0.0013	-0.00064	0.116848	0.10005	0.055127	0.678825	0.62724	0.527781	-0.0308	-0.0445	-0.03937
	8	227	-0.00233	-0.00137	-0.00077	0.120168	0.11236	0.079561	0.59412	0.50437	0.370968	-0.10217	-0.1184	-0.05221
	9	240	-0.00087	-0.00102	-0.00028	0.108578	0.08498	0.052034	0.622485	0.54711	0.383918	0.02775	0.02218	0.01516
	10	249	0.000204	0.000252	0	0.113795	0.11117	0.062725	0.386407	0.30699	0.196617	0.12332	0.08301	0.042801
	Average		-0.00059	-0.00052	-0.00047	0.113804	0.09891	0.068926	0.569206	0.49026	0.353796	0.00337	0.0039	0.006751

inti le	**1**	46												

Table 15 (Panel C) Continued

	2	48												
	3	51												
	4	76												
	5	105	0.002373	0.002134	-0.00016	0.14329	0.14329	0.127037	0.233775	0.18937	0.097652	0.00521	0.00095	0.016365
	6	130	-0.00091	-0.00024	-0.00018	0.09951	0.07511	0.054208	0.748974	0.68057	0.491826	0.20199	0.1938	0.138434
	7	195	0.000255	0.000235	0.00012	0.068387	0.05966	0.046499	0.750527	0.71207	0.546283	-0.05437	-0.0527	-0.03239
	8	227	-0.00238	-0.00136	-0.00042	0.073275	0.08827	0.077288	0.645012	0.59512	0.416198	-0.07109	-0.0707	-0.05207
	9	240	0.001006	0.000188	-6.5E-07	0.068443	0.05196	0.03469	0.542838	0.44349	0.280458	0.15557	0.15291	0.034545
	10	249	0.000438	0.000348	-0.00014	0.057802	0.03213	0.064299	0.461085	0.31524	0.183177	0.09542	0.05706	0.025672
	Average		0.00013	0.000218	-0.00013	0.085118	0.07507	0.067337	0.563702	0.48931	0.335932	0.05545	0.04689	0.02176

Quintile VI (BTM Low)	**1**	46	-0.00471	-0.00186	0	0.062204	0.02278	0.022777	0.085012	0.08832	0.076348	0.02292	0.02292	-0.0745
	2	48	-8E-05	-0.00049	-1.3E-05	0.015868	0.03215	0.019356	0.102686	0.11586	0.115862	-0.06533	-0.0653	-0.07983
	3	51	0.004447	0.003501	0.000384	0.283813	0.23244	0.082666	0.109223	0.12338	0.089278	-0.0384	0.01495	-0.00239
	4	76	-0.00078	-0.00047	-0.00027	0.10117	0.09128	0.009469	0.180323	0.14821	0.101057	0.08321	0.09127	0.045059
	5	105	-0.00072	-0.00052	1.49E-05	0.205749	0.19067	0.167073	0.207749	0.16726	0.108135	-0.012	0.01329	0.012044
	6	130	0.000716	0.000357	0	0.27467	0.24235	0.160956	0.493754	0.43974	0.293382	0.07366	0.12557	0.084545
	7	195	-0.0018	-0.00145	-0.0015	-0.04507	-0.04305	-0.04322	0.754418	0.71759	0.576985	-0.23794	-0.2234	-0.21108
	8	227	-0.00376	-0.00278	-0.00108	0.126994	0.12694	0.093453	0.502991	0.40378	0.229314	-0.15267	-0.1137	-0.06168
	9	240	0.00083	0.000449	-6.5E-07	0.102848	0.09294	0.0551	0.590394	0.49008	0.355941	-0.24962	-0.1591	-0.04614
	10	249	0.00068	0.000405	0.000345	0.254621	0.20002	0.119927	0.323127	0.26871	0.151334	0.10587	0.07843	0.03558
	Average		-0.00052	-0.00029	-0.00021	0.138287	0.11885	0.068756	0.334968	0.29629	0.209763	-0.04703	-0.0215	-0.02984

Table 16

Regression Summary for Models II and III for Germany

Panel B. Summary results from cross-sectional regressions for Model 2 (Specific Model for Size factor)

			Intercept			β to Market excess			λ_{SIZE}			λ_{SKS}		
	Confidence level		10.00%	5.00%	1.00%	10.00%	5.00%	1.00%	10.00%	5.00%	1.00%	10.00%	5.00%	1.00%
	Periods	Stocks												
Quintile I (Size High)	1	615	-0.00279	-0.00188	-0.00031	0.474376	0.41933	0.307572	0.117653	0.08095	0.029176	0.12586	0.0909	0.038264
	2	625	-0.00191	-0.00126	-0.00072	0.411835	0.37618	0.297425	0.139933	0.11131	0.070321	0.0706	0.04977	-0.00746
	3	630	0.000431	0.00033	9.86E-05	0.305671	0.2772	0.187844	0.076498	0.05584	0.024294	-0.05423	-0.0421	-0.00493
	4	646	-0.0004	-0.00013	-6.7E-05	-0.10905	-0.07312	-0.00894	0.582411	0.39152	0.198794	0.10456	0.0551	-0.0147
	5	686	0.000198	0.000148	-0.00024	-0.1092	-0.06504	0.007597	0.522047	0.37858	0.099328	-0.03832	0.00985	-0.0261
	6	812	-0.00118	-0.00081	-0.0002	-0.17585	-0.10724	-0.02997	0.671485	0.56874	0.340281	-0.14622	-0.1313	-0.04638
	7	889	-0.001	-0.00074	-0.00029	-0.11448	-0.05477	-0.02445	0.644953	0.53878	0.379555	0.06192	0.04344	0.002615
	8	906	-0.00384	-0.0026	-0.00128	0.395141	0.37242	0.317789	0.036556	0.03065	0.01565	0.29764	0.21207	0.10656
	9	910	9.26E-05	8.65E-05	4.4E-05	0.28859	0.24811	0.180825	0.01628	0.01684	0.00022	0.16917	0.09611	-0.01032
	10	919	-0.00025	-0.00031	-0.00014	-0.04963	-0.05018	-0.00615	0.350103	0.28873	0.174416	-0.17329	-0.1289	-0.03634
	Average		-0.00107	-0.00072	-0.00031	0.13174	0.13429	0.122954	0.315792	0.24619	0.133203	0.04177	0.02549	0.00012

Quintile II	1	615	-0.00292	-0.00148	-0.0004	0.467838	0.41433	0.302659	0.106269	0.07197	0.028961	0.13281	0.12779	0.048433
	2	625	-0.00171	-0.00086	-0.00031	0.411006	0.37633	0.298373	0.13403	0.10036	0.06645	0.02929	0.03839	-0.00403
	3	630	0.000107	0.000461	0.000123	0.310408	0.28201	0.190403	0.124477	0.07725	0.027525	-0.00576	-0.0027	0.010673

	4	646	0.000336	0.000205	0.000215	0.111349	0.10025	0.070466	0.353545	0.23573	0.094336	0.05826	0.02633	0.016999
	5	686	0.000399	0.000364	-7.8E-05	0.036297	0.05936	0.05356	0.367946	0.24083	0.083393	-0.01828	0.00947	-0.03505
	6	812	-0.00053	-0.00027	2.42E-06	-0.00396	0.01013	0.023735	0.49919	0.39439	0.230643	-0.15896	-0.1287	-0.02878
	7	889	-0.00048	-0.00023	3.18E-05	0.072838	0.07718	0.058907	0.54067	0.46023	0.301979	0.04742	0.03293	-0.02571
	8	906	-0.00362	-0.00247	-0.00091	0.384425	0.36661	0.30874	0.058518	0.05027	0.020267	0.29128	0.23224	0.11023
	9	910	0.000138	3.51E-05	5.64E-05	0.278745	0.24007	0.166257	0.030864	0.02843	0.000318	0.15743	0.11989	-0.00617
	10	919	-0.00035	-0.00042	-0.00014	0.051257	0.06847	0.05947	0.325807	0.21839	0.111015	-0.18925	-0.1172	-0.03323
	Average		-0.00086	-0.00047	-0.00014	0.212021	0.19947	0.153257	0.254132	0.18779	0.096489	0.03442	0.03385	0.005336

Quintile III	**1**	615	-0.00339	-0.00189	-0.00026	0.468337	0.41391	0.301768	0.089382	0.05687	0.013919	0.09498	0.07877	0.020661
	2	625	-0.0022	-0.00135	-0.00044	0.403752	0.36793	0.287431	0.10362	0.07646	0.038999	0.06149	0.04629	0.00821
	3	630	0.000191	-6.8E-05	4.93E-05	0.317193	0.2806	0.200099	0.145564	0.07814	0.037543	-0.03753	-0.0399	-0.00505
	4	646	0.000464	0.000259	0.000128	0.103063	0.09766	0.068632	0.357835	0.28079	0.124004	0.06249	0.01013	-0.01529
	5	686	0.000246	3.07E-05	-0.00015	0.137397	0.11792	0.076029	0.334055	0.18925	0.083542	-0.00458	0.02131	-0.01666
	6	812	-0.00069	-0.00043	-0.00013	0.064727	0.05239	0.055808	0.422718	0.352	0.229298	-0.14865	-0.1319	-0.04285
	7	889	-0.00051	-0.00027	6.56E-05	0.053862	0.05511	0.049137	0.585507	0.51088	0.349802	0.09704	0.07908	-0.01498
	8	906	-0.00338	-0.00232	-0.0007	0.383271	0.35084	0.299416	0.065186	0.05403	0.0212	0.28258	0.18949	0.107346
	9	910	-6.9E-05	7.03E-06	4.21E-05	0.275978	0.23838	0.163929	0.087093	0.05877	0.020758	0.15868	0.11524	-0.00096
	10	919	-0.00016	-0.00022	-5.5E-05	0.154917	0.12856	0.107397	0.194168	0.15365	0.14015	-0.16573	-0.1507	-0.03668
	Average		-0.00095	-0.00062	-0.00015	0.23625	0.21033	0.160965	0.238513	0.18108	0.105922	0.04008	0.02178	0.000375

Quintil e IV	**1**	615	-0.0032	-0.00152	-0.00026	0.474444	0.42117	0.310227	0.100641	0.07872	0.02109	0.11133	0.0803	0.032667
	2	625	-0.00189	-0.00122	-0.00049	0.408155	0.37141	0.289608	0.122711	0.09542	0.050734	0.04124	0.02826	-0.00791

	3	630	0.000566	0.000291	0.000106	0.301246	0.26998	0.188464	0.153342	0.09148	0.023403	0.01494	-0.0104	-0.00056
	4	646	8.15E-05	0.000161	0.000169	0.161579	0.12013	0.088664	0.325179	0.25109	0.059363	-0.02304	-0.0153	0.018176
	5	686	-0.00036	-0.0003	-0.00016	0.13411	0.11147	0.09634	0.309248	0.21318	0.041151	0.04074	0.04513	-0.01377
	6	812	-0.00064	-0.00061	-0.00014	0.107543	0.11064	0.081248	0.518872	0.41605	0.188429	-0.09711	-0.0711	-0.07015
	7	889	-0.00026	-0.00013	-1.3E-05	0.113502	0.08768	0.053781	0.637785	0.53532	0.329513	0.1829	0.1527	-0.00575
	8	906	-0.00361	-0.00225	-0.00081	0.37874	0.35001	0.296638	0.107849	0.09075	0.035671	0.30528	0.22495	0.105929
	9	910	0.000109	0.000108	2.25E-05	0.264	0.22668	0.156682	0.07216	0.04524	0.009947	0.14441	0.10236	-0.00225
	10	919	-0.00015	-0.00019	2.48E-05	0.213924	0.18431	0.160051	0.141628	0.11064	0.102809	-0.14949	-0.0813	-0.01418
	Average		-0.00094	-0.00057	-0.00016	0.255724	0.22535	0.17217	0.248941	0.19279	0.086211	0.05712	0.04556	0.004221
Quintile V	**1**	615	-0.0029	-0.00095	-0.00026	0.484871	0.43198	0.316458	0.194333	0.15249	0.044975	0.08971	0.06109	0.01634
	2	625	-0.00228	-0.00151	-0.00052	0.396285	0.36669	0.279896	0.069281	0.0593	0.019253	0.05675	0.0406	-0.00228
	3	630	0.000248	0.000158	9.64E-05	0.311725	0.28492	0.201922	0.131808	0.08886	0.022121	0.02833	0.01376	-0.0056
	4	646	0.000206	0.000324	0.000143	0.191529	0.15491	0.119433	0.253931	0.15081	0.040812	0.14914	0.0862	-0.00487
	5	686	-0.00023	-0.00023	-0.00019	0.128407	0.10234	0.096901	0.33143	0.23415	0.124604	0.06954	0.07004	0.001395
	6	812	-7.8E-05	0.000327	0.000146	0.227586	0.20207	0.142623	0.396033	0.30026	0.175926	0.12462	0.0284	0.026794
	7	889	0.001009	0.000801	0.000273	0.29542	0.28305	0.202305	0.605581	0.47566	0.290605	-0.00113	-0.0185	-0.0075
	8	906	-0.00352	-0.00225	-0.00076	0.386762	0.35122	0.299747	0.106737	0.07182	0.02472	0.29804	0.19335	0.112367
	9	910	0.00015	0.000236	3.15E-05	0.268269	0.22978	0.159016	0.162346	0.09	0.019203	0.19846	0.11685	0.008516
	10	919	-0.00016	-0.00021	-5.3E-05	0.216896	0.19379	0.172885	0.186786	0.14447	0.078484	-0.17525	-0.1128	-0.03639
	Average		-0.00075	-0.00033	-0.00011	0.290775	0.26008	0.199119	0.243827	0.17678	0.08407	0.08382	0.0479	0.010877
VI (Si	**1**	615	-0.00391	-0.00212	-0.00085	0.481853	0.43673	0.313778	0.07097	0.04426	0.005713	0.03189	0.02744	-0.00163

	Periods	Stocks	Intercept 10.00%	Intercept 5.00%	Intercept 1.00%	β to Market excess 10.00%	β to Market excess 5.00%	β to Market excess 1.00%	λ_{BTM} 10.00%	λ_{BTM} 5.00%	λ_{BTM} 1.00%	λ_{SKS} 10.00%	λ_{SKS} 5.00%	λ_{SKS} 1.00%
	2	625	-0.00313	-0.00178	-0.00083	0.390222	0.35514	0.278436	0.029827	0.00088	0.002041	0.06014	0.04864	0.010298
	3	630	-8E-05	0.000147	0.00014	0.333023	0.30576	0.219444	0.168344	0.10585	0.023258	0.02295	0.00548	-0.00187
	4	646	6.84E-05	0.000119	7.13E-05	0.280039	0.22914	0.164	0.17031	0.1134	0.037818	0.06276	0.03216	-0.00768
	5	686	0.000278	0.000139	-0.00016	0.180845	0.15577	0.113044	0.20412	0.16045	0.128133	0.04048	0.01455	-0.02826
	6	812	-0.00013	-0.00023	-0.00012	0.354596	0.31311	0.253121	0.281801	0.20488	0.063346	0.05544	0.01629	0.017037
	7	889	-0.00131	-0.00092	-0.0004	0.484314	0.43524	0.318111	0.266008	0.18763	0.085796	0.04914	0.02318	-0.03012
	8	906	-0.00279	-0.00172	-0.00073	0.392315	0.3694	0.313587	0.049229	0.03812	0.012113	0.26676	0.19725	0.101478
	9	910	0.000233	0.000294	2.84E-05	0.280121	0.24138	0.182025	0.066932	0.04988	0.022177	0.16598	0.10936	0.006099
	10	919	-0.00027	-0.0002	2.57E-05	0.225109	0.20244	0.174801	0.153125	0.14624	0.106127	-0.01364	0.00933	0.031408
	Average		-0.0011	-0.00063	-0.00028	0.340244	0.30441	0.233035	0.146067	0.10516	0.048652	0.07419	0.04837	0.009676

Panel C. Summary results from cross-sectional regressions for Model 3 (Specific Model for Book-to-market factor)

			Intercept			**β to Market excess**			**λ_{BTM}**			**λ_{SKS}**		
	Confidence level		**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**	**10.00%**	**5.00%**	**1.00%**
Quintile I (BTM High)	**Periods**	**Stocks**												
	1	615	-0.00278	-0.00187	-0.00035	0.475748	0.42157	0.308052	0.11398	0.07666	0.03053	0.12323	0.08504	0.034684
	2	625	-0.00199	-0.00132	-0.00058	0.399275	0.36908	0.285776	0.06187	0.04324	0.010187	0.04581	0.04456	0.004266
	3	630	7.07E-05	9.88E-05	0.000154	0.325786	0.301	0.210453	0.122717	0.08545	0.031804	-0.03936	-0.0267	-0.0004
	4	646	0.000257	0.000251	0.000154	0.207055	0.18188	0.131905	0.195282	0.12299	0.054876	0.08621	0.03346	-0.01155
	5	686	0.000313	-1.5E-05	-0.00023	0.179017	0.15008	0.114904	0.216577	0.18182	0.12921	0.04225	0.02627	-0.0148
	6	812	9.79E-05	-6E-05	0.000349	0.284366	0.26035	0.176404	0.42891	0.29835	0.160764	0.06696	0.00965	0.015494

Table 16 (Panel C) Continued

	7	889	-0.00159	-0.00095	-0.00038	0.433855	0.37807	0.285244	0.286524	0.23872	0.123489	0.0554	0.02619	-0.02817
	8	906	-0.00347	-0.00223	-0.00091	0.392879	0.36423	0.31353	0.063657	0.0532	0.012269	0.27614	0.1874	0.097106
	9	910	0.000218	0.000273	-1.6E-05	0.271839	0.2344	0.166498	0.098647	0.07468	0.030398	0.2073	0.1205	0.022138
	10	919	-0.00027	-0.00017	2.56E-05	0.228308	0.20242	0.173411	0.174292	0.1573	0.118393	-0.04806	-0.001	0.020781
	Average		-0.00091	-0.0006	-0.00018	0.319813	0.28631	0.216618	0.176246	0.13324	0.070192	0.08159	0.05053	0.013955

Quintile II	**1**	615	-0.00296	-0.00146	-0.0004	0.467502	0.41815	0.302929	0.110715	0.07704	0.027817	0.12711	0.12516	0.043436
	2	625	-0.00224	-0.00142	-0.00048	0.402077	0.36753	0.287481	0.140956	0.10664	0.055546	0.06392	0.05074	-8.4E-05
	3	630	0.000178	-6.7E-06	8.02E-05	0.313886	0.28913	0.203723	0.140461	0.11054	0.021016	0.00128	-0.0022	-0.00383
	4	646	0.000211	0.000276	0.000115	0.142178	0.11761	0.104228	0.302585	0.21575	0.110466	0.03734	0.01298	-0.03087
	5	686	6.55E-05	-8E-05	-0.00012	0.092132	0.09434	0.06885	0.35985	0.23252	0.054187	0.04358	0.04173	-0.00779
	6	812	-0.00058	-0.00043	2.28E-05	0.036563	0.06213	0.078244	0.517543	0.42618	0.220204	-0.08705	-0.0598	-0.05147
	7	889	-0.0013	-0.00086	-0.00022	0.075223	0.081	0.050248	0.633066	0.52089	0.316418	0.16668	0.15067	-0.00701
	8	906	-0.00338	-0.00216	-0.00089	0.384704	0.36217	0.307871	0.086528	0.06583	0.030431	0.29167	0.21117	0.109174
	9	910	-3.7E-05	1.8E-05	4.31E-05	0.273338	0.23173	0.163759	0.048229	0.03657	0.006585	0.15897	0.11263	-0.00138
	10	919	-0.00024	-0.00023	-5.6E-05	0.134498	0.13094	0.103006	0.276478	0.12102	0.053221	-0.18683	-0.1228	-0.03868
	Average		-0.00103	-0.00064	-0.00019	0.23221	0.21547	0.167034	0.261641	0.1913	0.089589	0.06167	0.05204	0.00115

Quintile III	**1**	615	-0.00332	-0.00193	-0.00026	0.468215	0.41779	0.302174	0.092804	0.06238	0.01576	0.09642	0.08122	0.020661
	2	625	-0.00213	-0.00128	-0.0005	0.407784	0.37748	0.292821	0.123975	0.09523	0.064872	0.00795	0.01564	-0.01296
	3	630	0.000435	0.000441	5.76E-05	0.308099	0.28092	0.191799	0.121609	0.08259	0.025285	0.01735	0.01109	-0.00663
	4	646	-0.00028	-9.6E-05	-5.8E-05	0.112269	0.08167	0.065337	0.436156	0.32038	0.163862	0.03097	0.02225	-0.01838
	5	686	-6.6E-06	-0.00019	-0.00023	0.072312	0.08287	0.058172	0.396667	0.27976	0.110136	-0.03967	-0.0017	-0.03584

	6	812	-0.00134	-0.00088	-0.00024	-0.00652	-0.01209	0.019272	0.568596	0.42965	0.196405	-0.05747	-0.0603	-0.05119
	7	889	-0.00038	-0.00028	9.47E-05	0.063204	0.05628	0.044821	0.608916	0.54773	0.382028	0.02334	0.00553	-0.01302
	8	906	-0.00364	-0.00227	-0.00081	0.384714	0.3547	0.307383	0.079987	0.06318	0.029603	0.33595	0.26114	0.10176
	9	910	2.91E-05	0.000104	4.21E-05	0.277481	0.23631	0.160749	0.049256	0.0298	-0.00561	0.18698	0.10572	0.002896
	10	919	-0.00044	-0.00035	-0.00011	0.051536	0.05791	0.052043	0.345558	0.23002	0.070074	-0.22151	-0.1069	-0.02905
	Average		-0.00111	-0.00067	-0.0002	0.213909	0.19339	0.149457	0.282352	0.21407	0.105241	0.03803	0.03337	-0.00418
Quintile IV	**1**	615	-0.00318	-0.00147	-0.00026	0.474731	0.41626	0.309814	0.101966	0.07896	0.02102	0.11148	0.08032	0.032667
	2	625	-0.00132	-0.00084	-0.00025	0.410651	0.37799	0.291649	0.15914	0.12559	0.069213	0.02243	0.04377	-0.00332
	3	630	0.000248	0.000337	9.89E-05	0.299587	0.27098	0.185504	0.117391	0.08712	0.025573	-0.02037	-0.0193	0.001701
	4	646	0.00021	0.000219	3.88E-06	0.052609	0.05093	0.045632	0.473325	0.32066	0.101181	0.04399	0.02673	-0.02293
	5	686	4.35E-05	-0.0002	-0.00012	0.098385	0.08965	0.068204	0.274765	0.16291	0.066668	0.00083	0.01403	-0.02058
	6	812	-0.00084	-0.00065	-0.00049	0.025555	0.03283	0.035428	0.575925	0.41603	0.213367	0.0246	0.03925	-0.02664
	7	889	-0.00038	-4.4E-05	-5.4E-05	0.068436	0.04523	0.05953	0.556839	0.49581	0.329268	0.04618	0.02506	-0.00954
	8	906	-0.00354	-0.00232	-0.00105	0.390527	0.36717	0.309571	0.057363	0.04949	0.020659	0.31037	0.24262	0.10957
	9	910	0.000146	5.65E-05	4.18E-05	0.281032	0.24538	0.176403	0.052156	0.03958	-0.00373	0.18133	0.10922	0.003902
	10	919	-0.00035	-0.00015	-1.4E-05	0.103199	0.09762	0.083716	0.255729	0.1619	0.07406	-0.19568	-0.1361	-0.03856
	Average		-0.0009	-0.00051	-0.00021	0.220471	0.1994	0.156545	0.26246	0.1938	0.091728	0.05252	0.04256	0.002626
Quintile V	**1**	615	-0.00295	-0.00094	-0.00022	0.484256	0.42541	0.315897	0.180368	0.14491	0.043319	0.09256	0.06579	0.01634
	2	625	-0.00168	-0.00106	-0.00054	0.408372	0.37694	0.294289	0.128981	0.09856	0.065717	0.06399	0.04355	0.004775
	3	630	0.000777	0.00049	0.000109	0.298588	0.26947	0.184891	0.13451	0.10625	0.048857	-0.00122	-0.0225	-0.00546
	4	646	0.000358	0.000401	5.59E-05	0.115777	0.10348	0.063161	0.404242	0.30301	0.098752	0.08272	0.03952	-0.01302

	5	686	0.000346	2.76E-05	-0.00016	0.068891	0.07287	0.062201	0.304502	0.17657	0.065921	-0.02491	0.01055	-0.02317
	6	812	-0.0008	-0.00039	-6.5E-05	0.012999	0.00561	0.040234	0.512792	0.42706	0.247699	-0.17073	-0.1564	-0.03692
	7	889	-0.00067	-0.00044	0.000109	0.064837	0.06684	0.044476	0.561275	0.47792	0.285463	0.06794	0.05053	-0.02123
	8	906	-0.00331	-0.00228	-0.00109	0.382516	0.35787	0.302378	0.082917	0.05579	0.022584	0.29698	0.2176	0.112088
	9	910	0.000131	9.31E-05	6.37E-05	0.285496	0.23903	0.171571	0.048255	0.04014	0.004423	0.18983	0.10452	-0.00483
	10	919	-0.00021	-0.00022	-6.1E-05	0.134916	0.13179	0.121715	0.279386	0.20266	0.070821	-0.26032	-0.1479	-0.04236
	Average		-0.0008	-0.00043	-0.00018	0.225665	0.20493	0.160081	0.263723	0.20329	0.095356	0.03368	0.02053	-0.00138

Quintile VI (BTM Low)	**1**	615	-0.00383	-0.00214	-0.00085	0.482085	0.44016	0.313866	0.085215	0.04844	0.008731	0.03285	0.03143	-0.00263
	2	625	-0.00211	-0.00144	-0.0004	0.399034	0.36811	0.284951	0.098209	0.06851	0.029402	0.06658	0.05685	0.005173
	3	630	0.000218	0.000143	0.000128	0.322094	0.28923	0.209536	0.173798	0.09449	0.012123	0.02841	0.00131	-0.00254
	4	646	0.000318	0.000455	0.000137	0.239416	0.19884	0.122086	0.234983	0.13845	0.054167	0.09626	0.04827	-0.01268
	5	686	0.000246	0.000241	-0.0001	0.110482	0.09137	0.070719	0.394912	0.33374	0.196904	0.08229	0.06764	-0.01305
	6	812	0.000677	0.000613	0.00025	0.135222	0.13271	0.084519	0.38403	0.27411	0.146986	-0.06516	-0.0592	-0.02705
	7	889	0.000514	0.000566	0.000167	0.221658	0.20493	0.120878	0.483198	0.38604	0.182895	-0.05111	-0.0401	-0.01969
	8	906	-0.00356	-0.00228	-0.00078	0.38952	0.37112	0.312197	0.049673	0.03499	0.007134	0.28678	0.18829	0.10734
	9	910	1.15E-05	0.000243	-3.3E-05	0.251539	0.21931	0.157443	0.085047	0.05489	0.015502	0.14762	0.11009	-0.00636
	10	919	-6.8E-05	-2.1E-05	5.52E-05	0.206077	0.19753	0.154457	0.167757	0.11068	0.055667	-0.02835	-0.0134	-0.00735
	Average		-0.00076	-0.00036	-0.00014	0.275713	0.25133	0.183065	0.215682	0.15444	0.070951	0.05962	0.03912	0.002116

Source: Authors' calculations and EViews

GRA 19002- Preliminary Thesis Report

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Coskewness as a driver of excess returns, size premiums and book-to-market effects on emerging and developed markets. An empirical study on Poland and Germany.

Supervisor: Bruno Gerard

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Master of Science in Financial Economics

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I. Introduction

Due to the actual financial environment, which stemmed in a large proportion from the depression of the last years, a lot of investors have seen the financial models after which they oriented their decisions overwhelmed. During the crisis they witnessed large price drops, unforeseen by theoreticians, and their portfolios plummeted, as well as their investments in mutual funds, which were actually the major losers of the period. In fact, there was nothing they could do to parry this fall of the financial system or even to reduce their losses by offsetting their long positions since the models they used were obsolete and didn't take into consideration the sources or even the possibility of such a downside risk. They were left with few options like investing in commodities or "hedging" their positions in stocks, derivatives or fixed income securities, but since everything was suffering a severe distress there were not many strategies to which they could have appealed.

The classical theory in portfolio selection suggests following the "ancient" and somehow outdated CAPM, which has a major flaw as it covers the analysis only for the first two moments-the mean and the variance. However, the idea of separating the systematic risk from the idiosyncratic one and incorporating the second one into an error term does not focus on other sources of risk, which are mainly provided from the introduction of higher order moments. This shortcoming of the classical CAPM of Sharpe (1964) and Lintner (1965) is studied and corrected by Fama-French (1992) in their extended CAPM, by Kraus and Litzenberger (1976) in their three moments CAPM, as well as by Harvey and Siddique (2000) in their model that takes conditional skewness into account. What all these authors have in common is their focus on higher order moments like skewness and kurtosis in their attempt to build models that could explain better the sources of risk in portfolio returns.

Skewness is the third moment of a set of data, measuring the asymmetry of the probability distribution of a time series. It measures the tails of a distribution of a series and provides information regarding the probability of large tail events, which in case of stock returns could be either large gains for positively skewed series or large losses (major depressions) for negatively skewed data. It is important for investors and portfolio managers because it indicates whether a stock has the necessary attributes to be included in a portfolio and end up with larger profits for a lesser risk. This is actually the logic that backs up the techniques of portfolio construction using higher moment models. Since all investors have preferences related to the mean and variance, they all tend to follow the CAPM in their decisions, but they all neglect a plain reality-returns are not normally distributed, and not taking into account higher moments leads to an underestimation of the CAPM. In reality return series are leptokurtic and are lognormally distributed, as a vast majority of financial data, so it is of a high priority to at least look at coskewness as a risk factor with explanatory power in models.

Rational investors dislike variance and have a preference for positive skewness (Kraus, 1976), since like this they take on a smaller risk than in the case of the variance, for which they may expect significantly large risk premiums. Another advantage of right skewed assets is the limited liability they provide in the event of large extreme movements, since investor's risk aversion increases as wealth increases (Harvey, 2000). In essence, right skewed assets serve more as "hedging instruments", or better said risk reducing instruments. Since their addition to a portfolio of assets can reduce the probability of large absolute market movements, the normal logic should dictate that the expected returns should be lower in equilibrium (Barone Adesi, 2004), but overall investors end up better off than while introducing only the mean and the variance, in terms of profits.

In this light, our study attempts to identify the presence of coskewness on the stock markets of Germany and Poland, as sources for portfolio diversification for investors, as well as to confirm the work of authors before us and to prove the well-spread idea that positive skewness is more frequent on emerging markets. It should be of no surprise the selection of two somehow different countries in every area of analysis, except for their appurtenance to the European Union. We try to compare a developed country to a developing one in terms of economies, in our attempt to prove that the ones seeking for positive skewness should diversify their portfolios with stock from emerging markets. We also conduct our research on two most common anomalies encountered on stock markets-the size and book-to-market effects, trying at the same time to identify any link between skewness and these curiosities.

The economic question that interests us in whether it is more advantageous to look for diversification on emerging markets, whether it is worth, or just to stick to developed markets where there is an inflation of negatively skewed assets. The underlying problem is whether it is profitable for investors to take on instability on emerging markets in exchange for lower risks and larger premiums and whether the large gains can make up for the additional risk undertaken (political instability, weak regulation, reduced liquidity on stock markets). However, the most important issue from the investor's perspective, one who is willing to migrate to non-domestic markets in search for diversification, is the avoidance of negative skewness. It must be kept in mind that utility is decreased by left skewness, as it increases the chances of downside risk, by adding up probability in the left tail. This is in the end one of the undesirable properties of skewness that everyone is running from and everyone is trying to neutralise.

As a consequence, this is what bothers every investor at the moment, finding new sources of risk reducing assets around the world that could mitigate the effects of a major downfall, as in the case of the 2008-2009 financial crises, when everyone was caught unprepared and overconfident with their risk reducing measures. The probability of such extreme events has increased recently and there should be methods of reducing the exposure to large negative movements by diversifying portfolios with assets that present traits of higher moments.

In order to develop our research objectives we have structured our paper into more sections that focus on the economic problem at hand (Section II), the literature review of past works on the subject (Section III), the methodology to be used (Section IV) and the description of the data to be employed (Section V). This work is a mere addition to previous attempts to identify new ventures for investors desiring to enrich their portfolios with positively-skewed assets that could reduce downside risk and ensure decent risk premia.

II. Economic problem and objectives

The economic problem that underlies our research is the following question: Can investors gain more by investing on emerging markets, in our case we focus on Poland, relative to a developed market (Germany), provided they concentrate their investing techniques on coskewness? In other words we are trying to find if o well-diversified portfolio of stocks which contains both regular assets and right-skewed assets has a bigger return on the Polish stock market than on the German stock market.

For this purposes we are first going to test whether a higher moment CAPM holds on both markets and then construct benchmark portfolios, with assets arranged according to size, book-to-market and skewness, that will be applied for both countries and hopefully we would be able to get some differences. The results of our research would show us if it is better to invest on emerging markets if an investor with preference for positive skewness decides to enhance his gains, as he is willing to take a higher risk that stems from systematic skewness. Better said, we are looking for differences in risk premiums that arise from the inclusion of left skewed assets in portfolios, on the two markets, and start from the assumption that emerging markets are a better deal than developed markets.

The research that we are envisaging has a great utility in practice since all financial data is known to have asymmetric distribution, captured by conditional skewness, and the addition of positively skewed assets to an investment portfolio can mitigate the downside risk. A negatively skewed asset possesses a greater probability of large downfalls while right-skewed stocks can largely increase the probability of substantial gains at a lower risk. In crisis periods, holding a portfolio consisting in a large proportion of negatively skewed stocks can lead to contagion and to significant crashes in returns. At the same time investors become more and more risk averse and try to hedge their positions by switching from assets with negative skewness to ones with positive skewness with the intent to lower risk, even though the returns diminish too (Harvey and Siddique, 2000).

The utility of such an analysis is that it could provide precious information regarding the best sources for acquiring “hedging” instruments for investments that could neutralise the large down movements that occur mainly during recessions. This technique is more recommended since due to the asymmetric distribution of stocks, namely leptokurtosis, the frequency of extreme movements tends to be higher on average (Bali, 2009). The non-normality of stocks comes mainly from illiquid markets, the lack of divisibility of assets and the low transparency of information (Ranaldo, 2003). Particularly, the conclusions of such a research can be successfully applied for energy markets, small size stocks and distressed firms which present a high skewness (Harvey and Siddique, 1999), in order to reduce the volatility that arises from asymmetries.

In addition, since a vast majority of investors rely on the CAPM to eliminate systematic risk by depending only on the first two moments and neglect the occurrence of other sources of risk, especially stemming from systematic skewness (Kraus and Litzenberger, 1976) and idiosyncratic risk or even systematic risk not captured by the CAPM, it would be beneficial for them to adopt a model that includes a third moment. This way they could ensure control over unexpected volatility movements and be aware of the risk premiums (although not substantial), that compensate investing in assets that present skewness. Should the market equilibrium conditions hold, they could end up with a lower portfolio risk and lower expected returns, provided they rely on positive coskewness as a security enhancing measure (Barone Adesi, 2004).

On the other hand, speculating on negatively skewed assets could bring substantial gains as they imply high risk premiums. However, a potential significant increase in returns comes at a cost-large volatility, which discourages most of the investors who belong to the same typology of risk averse and prudent individuals.

The ultimate purpose of this research is to prove the allegations of some academic circles (Charoenrook and Daouk, 2004) that more stocks with positive skewness can be found on emerging markets, in our case trying to confirm this idea on Poland. We decided to appeal to Poland as object of study since this country is representative for the Eastern European group of developing countries and has presented some of the best investment opportunities since the integration into the EU on the 1st of May, 2004. On the opposite side we put Germany as an important representative of the developed Western European countries, which continues to have a stable and consistent stock exchange.

III. Literature review

The issue of coskewness as a factor that drives the cross-sectional variation of expected returns, as a source of idiosyncratic and systematic risk, as well as an explanatory element of size and book-to-market effects, is quite a recent topic in financial literature. One of the first researches conducted on the matter is that of Kraus and Litzenberger (1976), which introduces the idea of a 3 moment CAPM with the inclusion of systematic skewness. This work is a criticism to Sharpe's (1964) and Lintner's (1965) development of the CAPM, which focuses mainly on the first two moments-the mean and the variance- to identify and explain the source of systematic risk (described by the beta slope of the market).

The main disadvantages of the CAPM are that it is more a linear model, valid only for non-restrictive conditions, the mean and the variance (Smith, 2006), and it neglects the fact that financial data presents leptokurtic distributions, with fat tails and skewness, having the attributes of non-normality. Kraus (1983) starts from the same premises as the creators of the CAPM, namely those of a non-increasing absolute risk aversion with wealth, of a monotone increasing strictly concave utility function and of identical probability beliefs. He concludes in his work that a better model to describe the cross-sectional variation of expected returns is the one which includes a quadratic function, by adding the third moment-skewness.

Kraus and Litzenberger (1976) develop their work on the same idea of including the effects of skewness on valuation. They identify that investors, having a non-increasing aversion to risk, tend to prefer positive skewness, idea which is more suitable for a 3 moment CAPM. Investors concede a higher volatility in mean and variance for a greater increase in systematic skewness. This tendency of investors is a result of the fact that positive skewness reduces the probability of large extreme events and entails a positive risk premium.

Other authors, like Fama and French (1992), introduce a model that incorporates two additional factors-the SMB and HML, to explain the cross-sectional variation of expected returns. The SMB (a proxy for the size premium) and the HML (a proxy for the book-to-market premium) shed a new light on the sources of risk not explained by the variance factor.

Harvey and Siddique (2000) focus on aspects of coskewness, using the same Fama-French proxies for size and book-to-market effects-SMB (small minus big market capitalization) and HML (high minus low book-to-market ratio) and a hedge portfolio (SKD), like size, book-to-market effects and momentum. They also introduce a new measurement for coskewness by the formula:

$$\hat{\beta}_{SKD_i} = \frac{E[\epsilon_{i,t+1}\epsilon_{M,t+1}^2]}{\sqrt{E[\epsilon_{i,t+1}^2]}E[\epsilon_{M,t+1}^2]}$$

Here, $\epsilon_{i,t+1}$ are the residuals of the regression of the excess return on the contemporaneous market excess return. The indicator represents the contribution of a stock to the coskewness of a portfolio of assets. Its role is to capture the asymmetries in risk or the extreme events and can be translated as the fact that asymmetric variance is consistent with coskewness (Harvey, 1999).

In their broad analysis they create a model that includes the coskewness slope linked to the square of market return and also expand the Fama-French SMB-HML model with a S^{-} or S^{+} portfolio (sorted according to skewness for the 30 % lowest values and 30 % highest values). They reach the same conclusions as Kraus and Litzenberger (1976), the ones that a model including a coskewness factor is fitter in explaining cross-sectional variation of returns and can explain size, book-to-market and momentum effects. The path opened by Fama-French was later continued by Moreno (2005) in explaining the variation of ex-ante market risk premia on the Spanish market and also by Hung (2004) in UK.

Barone Adesi (2004) also conducts an analysis using a higher moment model and reaches the conclusion that positive coskewness reduces the risk of a portfolio and should command a lower expected return at equilibrium, meaning a lower risk premium. Also, empirical studies of Barone (2004) and Perez (2000) identify that large companies usually present positive skewness, as opposed to smaller firms that have negative returns and skewness due to outliers of distributions, this explaining their riskiness and their proneness to default. In a previous study, the same author (Barone, 1985) reaches the conclusion that the quadratic model, although it doesn't explain the entire variation in returns, is a good fit for such attempts.

Aggarwal (1990), in his research on spot and forward exchange rates, lays the first steps in the interpretation of the slopes of the higher moment models, signalling that the coefficient attributable to skewness should be negative and significant, coming from investors' preference for this moment that commands a lower risk premium.

Ang (1979), Klemkovsky (1973) and Bali (2009) also support the use of a mean-variance-skewness model which can explain better than CAPM the asymmetries in return distributions, especially because investors have quadratic preferences and financial data has leptokurtic distribution, being skewed to the left, peaked around the mean and having fat tails. However, skewness has to be constrained when used in such optimizing models as their implementation can be quite tedious. In addition, the probabilities of extreme outcomes are much bigger than those of positive ones, which usually take the form of signals or noise. The same foundations were laid by Bali (2007) in a previous work on conditional VaR using skewness and kurtosis.

The study of risk premiums was undertaken by Boyer (2010), who proved that idiosyncratic skewness and returns are negatively correlated and the coefficients of skewness have to be negative and significant. However, Xu (2007) specifies that skewness is only negatively correlated with lagged returns unlike the correlation with contemporaneous returns, which can happen to be positive.

Unlike traditional investors who want to maximize the Sharpe ratio according to a mean-variance optimizing model, rational investors are advised to prefer positive skewness (Boyer, 2010). At the other end of the spectrum, speculative investors bet on higher volatility, coming from low skewness, for a chance at an extreme large gain, just like lottery players. Leland (1999) and Smith (2006) have previously reached the same results, meaning that investors would accept an improvement in mean and variance (a risk premium) in exchange for a negative skewness, as the positive extreme events are less important to them than downside movements. This is why the main roles of positive skewness seem to be those of enhancing risk tolerance and the utility of wealth (Stephens, 1991) and an investor should care more about coskewness when markets are positively skewed.

Another idea is introduced by Mitton (2004), who also supports the trade-off between mean-variance and skewness but accompanied by a non-diversification in portfolios. He proves that the great demand for positive skewness is characteristic for undiversified portfolios, mean-variance inefficient portfolios and higher skewed stock, portfolios that may experience larger positive movements.

Briec (2005), Prakash (2001) and Chiu (2005) remark that positive skewness is beneficial as it entails a lower probability of large negative returns, investors preferring to concede higher payoffs in exchange for a lower risk. Thus, prudent individuals prefer skewness to variance in order to reduce overall volatility.

Christie (2001), Guidolin (2007) and Dittmar (2002) introduce in their valuation models kurtosis as an element which for elevated values enhances prudence and risk aversion in investors and captures non-linear risk. Consequently, all rational investors seem to have an appetite for positive skewness and negative kurtosis since they dislike risk (represented by higher variance and fatter tails) and would rather have low premia for lower risk.

In an attempt to look into size effects, Chung (2004) uses the Fama-French loadings and Fama-MacBeth (1973) cross-sectional methodology to identify the occurrence of such effects, especially in January, when size coefficients showed to be significant in regressions. However, another finding is that the Fama-French loadings together with higher co moments cancel each other out while used in the same valuation model.

Looking further into the matter, authors have attempted to identify differences on markets (developed and emerging markets) regarding the presence of skewness. Daouk (2004) and Hashmi (2001) find that negative skewness is more frequent on developed markets, predicted by trend adjusted turnover, as opposed to emerging markets. This is a surprising finding because emerging markets depend on a time-varying world factor and someone would expect to find resemblances to developed markets, especially regarding skewness sign. This is a crucial discovery that could guide investors into selecting better sources of risk reducing opportunities. Another surprising finding is that stocks tend to become negatively skewed following a positive returns month, the opposite being valid for a negative return month.

The study of skewness has also been conducted not only on stock markets but also on exchange and hedge markets, all reaching the same conclusions as for the fundamental studies on stocks. Brunnermeier (2008) and Jorda (2009) on carry trades and Ding (2006) and Ranaldo (2003) on hedge funds, all use higher moments valuation models in identifying negative correlation between returns (of interest rates or assets) and skewness. Thus, the possibilities of large crashes, which are frequent on such markets, can be reduced by appealing to positive skewness and negative co kurtosis (case in which returns increase). On the other hand, because of different properties as relative to stocks, options (market studied by Vanden, 2006 with the same models), derivatives and fixed income markets would rather accept negative skewness for speculative purposes. Stephens (1991) even identifies options as a source of positive skewness if used in combination with stocks, just like in a hedging algorithm.

All these empirical and theoretical works serve as a reference point for those attempting to apply the higher moment models empirically, namely the ones with coskewness, on specific markets. Such applications were the works of Lin (2003) on the Taiwan stock market and Misirli (2009) on the Istanbul exchange. These two papers have tried to incorporate in their research the size, book-to-market and momentum effects, as initially done by Harvey and Siddique (2000). In an exercise to accomplish the same thing, the current paper tries to scout the same effects on two different markets and to provide helpful information for interested parties.

IV. Methodology

In our methodological endeavour towards the analysis of the coskewness problem we take the position of a rational investor who attempts to seize the opportunities offered by right skewed assets on international markets. Our goal is to identify and quantify the risk premiums offered by the two stock exchanges that serve as study objects-the Deutsche Boerse and the Warsaw Stock Exchange.

We use the theoretical mean-variance-skewness approach to test empirically if indeed there is a major difference between risk premiums arising from coskewness on the two markets. The first stage in our methodology consists of gathering all the stock prices available in databases for the two stock exchanges for all the companies traded and available. It has to be noticed that due to the fact that a number of companies present on stock exchanges may not have complete data statistics for market-to-book values and market values, we would be obliged to give them up in order to preserve econometric accuracy and representativity.

The extracted data is going to be filtered and normalised by using the logarithm function to obtain returns. This measure is necessary because stock prices can not have negative values, so it needs to follow a lognormal distribution which can be induced by using the logarithm.

Also we have to get data regarding the number of shares for each company and their respective book values. Their market capitalisation is the product between the number of shares and the market value of a stock. Alternatively the book-to-market ratio is computed by dividing the book value of the fiscal year with market capitalisation. For this we compute the book values from financial statements by adding deferred taxes and investment tax credit to the book values and subtracting the preferred stock.

The next stage is going to be centred on three sub-stages:

a) the first ranking sub-stage, which involves sorting the data and the formation of panels of portfolios according to size and book-to-market ratios for the T period, as well as coskewness sorted portfolios.

b) the second ranking sub-stage (the re-estimation phase), during which we re-estimate the portfolios from the previous stage for a T+1 period.

c) the testing sub-stage for the T+2 period, where data is used in model in order to obtain relevant results.

During the first and second ranking phases a number of ranking and portfolio formation techniques are going to be used, especially those relying on double sorts and Fama-French loadings procedure.

In order to seize the size and book-to-market effects together with coskewness, the best solution is to use the Fama-French (1995) loadings/ hedge portfolios-SMB and HML for panel A. Portfolios in Panel A are going to be sorted both by size and book-to-market ratios, having the purpose of capturing together the respective effects in correlation with coskewness.

The desired portfolios are constructed by sorting the stocks according to market capitalisation and getting two portfolios sorted by market value by applying a median value. Afterwards we use the book-to-market ratios to split each of the previous two portfolios into 3 subgroups by the following criterion:

-30 % for the lower values of book-to-market ratios

-40 % median values

-30 % highest values of the ratios.

The results of these procedures are 6 portfolios from the intersection of market value and book-to-market ratios-S/L, S/M, S/H, B/L, B/M, B/H, where S stands for small, M stands for medium, L for low, B for big and H for high. As a clarification, the S/L represents the portfolio that contains small capitalized stocks with low book-to-market ratios. The other notations are interpreted accordingly.

By using the returns obtained in the first step of the methodology we can consequently obtain the SMB and HML portfolios. SMB is the resulting portfolio from the average of the difference between returns of small capitalization portfolios and returns of big capitalization portfolios:

$$\frac{1}{3}\begin{pmatrix} \frac{S}{L}-\frac{B}{L} \\ \frac{S}{M}-\frac{B}{M} \\ \frac{S}{H}-\frac{B}{H} \end{pmatrix}$$

SMB becomes a proxy for the size effect, which is going to be used in regressions to obtain the size premium on the respective market. It will capture the market wide systematic size effect on risk premium (Lin, 2003).

The HML, on the other hand, is a proxy for the book-to-market effect and will be used to capture the market wide systematic book-to-market effect on risk premia (Lin, 2003). It is computed by averaging the differences between the returns of high book-to-market portfolios and returns of low book-to-market portfolios:

$$\frac{1}{2}\begin{pmatrix} \frac{S}{H} - \frac{S}{L} \\ \frac{B}{H} - \frac{B}{L} \end{pmatrix}$$

The other two panels that will be part of our research will separate the size and book-to-market effects. Panel B is going to contain 6 portfolios arranged by firm value and obtained by initially dividing the sample of stocks in three groups after applying 1/3 breakpoints and afterwards by dividing each group in two sub-groups, also by size. This way we get 6 quantiles or sextiles (S loading). Panel C, with portfolios sorted in the same manner, on the other hand, will incorporate 6 portfolios (BM loadings) sorted by book-to-market ratios. This way we try to separate the two effects and analyse the impact of coskewness on them individually.

After reaching the desired outcome regarding the Fama-French loadings, which in theory should have positive values, we move on to the testing phase. It will consist of three steps-calculating the coskewness factors, constructing the coskewness sorted portfolios and incorporating the data into models.

The most appropriate approach for the computation of coskewness is to use the coskewness formula provided by Harvey and Siddique (2000):

$$\hat{\beta}_{SKD_i} = \frac{E[\epsilon_{i,t+1}\epsilon_{M,t+1}^2]}{\sqrt{E[\epsilon_{i,t+1}^2]}E[\epsilon_{M,t+1}^2]}$$

Harvey's coefficient is the contribution of a stock to the coskewness of a larger portfolio (Harvey and Siddique, 2000) is using the residuals of the following regression:

$$r_{i.t+1} = \alpha_i + \beta_i(r_{M,t+1}) + \epsilon_{i,t+1}$$

The above model is similar to the CAPM, which uses as in this case excess returns. In this case $r_{i.t+1}$ is a series of stock excess returns for a specific date and $r_{M,t+1}$ is a series of market excess returns (returns of the market index) for the same dates. $\epsilon_{M,t+1}^2$ are the residuals of a regression of the squares of market excess returns on a constant and market excess returns, while $\epsilon_{i,t+1}^2$ are the error terms of a similar regression of the squares of stock excess returns.

Even though we could identify the coskewness coefficient by running the following regression, which includes the squares of the market returns:

$$r_{i.t+1} = \alpha_i + \beta_i(r_{M,t+1}) + \beta_{SKD}(r_{M,t+1}^2) + \epsilon_{i,t+1},$$

we believe that using the $\hat{\beta}_{SKD_i}$ is a better option because it resembles more the Fama-French loadings from before, as opposite to the β_{SKD} from the extended regression, which tends to have the properties of a CAPM beta.

Following the steps of Harvey and Siddique (2000), the next sub-phase involves constructing the $S^-$and S^+ portfolios that are going to be introduced in models during the testing phase, so as to outline the risk premia.

The sorting strategy for the $S^-$and S^+ portfolios is oriented around the lowest, median and highest values of the coskewness coefficient. The ranging technique of stocks is:

-30 % lowest values of $\hat{\beta}_{SKD_i}$, which we may expect in the final regression to entail a higher risk premium since stocks with lower values of skewness increase the probability of having large return drops, so consequently their market price may be lower in order to even be considered as investment solutions for investors who clearly wouldn’t accept them in normal conditions.

-40 % median values of $\hat{\beta}_{SKD_i}$

-30 % highest values of $\hat{\beta}_{SKD_i}$, which should provide smaller risk premiums and should be traded at higher market prices because of the benefits they bring to a portfolio of assets and the security they confer.

Afterwards, we advance in the same line as Fama-French in the composition of SMB and HML, and create a hedge portfolio that is going to be standing for ex-ante coskewness (Misirli, 2009). SKS is the difference between $S^-$and S^+ and the greater the returns of this portfolio are, the higher should the premium they stand for be. This is clearly the result of the fact that S^- dominates S^+ and negative coskewness has a larger contribution to the overall coskewness of the portfolio, so we may expect a bigger compensation for holding such assets.

The steps described previously will be employed for the first ranking and second ranking stages. The first ranking phase will use data for a one year period, as will the second period do. The purpose of this repetitive procedure (rolling window) is to make sure that from year to year the sorted portfolios are adjusted according to changes on the market. As a result, the data available for the testing period will incorporate all the information regarding changes (mergers and delisting) and new IPO's of new companies and will provide more accurate results.

Finally, the last stage of our methodology will consist of testing the data for the T+2 period (also one year) in models that incorporate the size and book-to-market loadings alongside the coskewness factor. Following the logic employed in constructing the loadings from above we are going to have three models to test for the pre-established NULL hypotheses:

a) H_0: It is not possible to identify more right skewed assets and larger coskewness risk premiums on emerging markets relative to developed markets, making it less probable to mitigate the downfall risk.

b) H_0: There are no differences in terms of skewness signs between large and small companies, as neither offer viable alternatives for right-skew investment.

c) H_0: Book-to-market and size effects have no influence on risk premiums as described by coskewness factors.

The models that serve as tools to get the necessary coefficients are:

a) $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + s_i SMB_t + h_i HML_t + \beta_i^s SKS_t + \epsilon_{i,t}$

This is a generalized model that takes into account the two Fama-French loadings that stand for the size and book-to-market effects (SMB and HML) and gives evidence of the impact of coskewness on excess returns. The risk premiums, denoted by the coefficients in this regression, would quantify the risk premiums associated with holding the respective portfolios. As a consequence we may predict that the risk premium linked to coskewness should be negative and significant for right-skewed assets, as a result of the limited downfall risk they offer, and positive and significant otherwise. However, one of the outcomes of testing may be a presence of residual skewness if the coefficient is not significant and negative. In this case other, this supplementary source of volatility would have to be controlled through the means of a more complex model. In practice, nevertheless, situations of residual skewness happen to be rare and do not make the object of our analysis.

b) $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + s_i S_t + \beta_i^s SKS_t + \epsilon_{i,t}$

This second model isolates the presence of the book-to-market effect and presents only the influence of coskewness on the size effect, by using just the size-sorted portfolios from Panel B. The risk premiums may follow the same expectations as above but the results may still be variable.

This variation of the standard model is useful because it could provide information regarding the coskewness for small size companies and large size companies. The first quantile of the sample stands for the smallest firms and the last quantile stands for the largest firms on the market. Therefore, it would be possible to see if smaller companies do indeed have negative skewness and present a higher risk for investors.

c) $r_{i.t} = \alpha_i + \beta_i(r_{M,t}) + b_i BM_t + \beta_i^s SKS_t + \epsilon_{i,t}$

The last model to be adapted to this research is the one using only the book-to-market-sorted portfolios from Panel C and has the intent of eliminating the effects of the size effect. As formerly stated, the sign and significance of the risk premiums can be guessed, but not with full confidence.

The above methodology will be applied for ten periods of three years each through a rolling window and will result into ten sets of outcomes which will incorporate all the necessary information for relevant periods. The objective is to trace back the evolution of the markets as well as to keep an eye on the impact of the EU membership, especially in the case of Poland. This will provide us with a clearer image on the opportunities that can arise for investors with a further development of markets.

Of course, the analysis can be extended further by creating other portfolios by industry or momentum, but we have decided to focus just on the size and book-to-market effects. It can be interesting to run regressions just for specific periods of the year, like certain months when financial anomalies appear (the January effect), to see if this curiosity can be somehow attributed to coskewness.

It is important to be specified ex-ante that the authors of this paper hold the freedom to modify the structure of the models employed to best suit their intents. This is why it could be beneficial for a more thorough inspection to extend the analysis further to other aspects like the premia of $S^-$and S^+ or the calculation technique for the coskewness coefficient $\hat{\beta}_{SKD_i}$.

V. Data

The main sources of data for this master thesis are going to be the DataStream database available at BI Oslo, the financial reports available on the web pages of the stock exchanges and the statistical series provided by national banks regarding the reference short-rate interest rates for government debt that can be used as risk-free rates.

Our intent is to use data for the period 31 December 1998-31 December 2010, the main reason for using such a time span being the fact that we want to focus on an analysis of the ante-EU and post-EU integration of Poland. Also, since a common risk-free rate (EURIBOR) for the two countries can only be traced back to 1998, the choice of data is limited to this starting period.

The frequency of the data is selected to be weekly since we do not have a sufficiently large pool of data at our disposal. Another advantage of such a frequency is that the prices don't have to be adjusted for dividends as in the case of monthly data. However, this time span is going to be divided in a T period for the ranking phase, a T+1 period for the re-estimation phase and a T+2 period for the testing phase. The T, T+1 and T+2 periods are all going to have the same length of one year, in order to end up with ten periods of three years each on which we can employ the pre-established methodology.

For the series of stock returns we are going to extract all the data available on the stock markets regarding all the companies traded in Germany and Poland. The cut-off condition for usefulness of these stock prices is their match with the market-to-book and market value statistics. Thus, there could be potential data losses due to unavailable series describing companies.

Unlike other researches on this subject we chose not to eliminate the dead or delisted companies from the sample so as to eliminate the survivorship bias. The intent is to avoid the results to skew to the right and be artificially higher, as this is not a true image of the market reality. Another reason for choosing such an approach is because in our methodology we do not rely on a larger period of time for testing but rather we employ redundant estimations and tests on ten three-year periods. Companies that may have been delisted during more recent years had an impact during their existence and must be taken into account. The underlying idea is to consider each company as long as it was active on the market, this ensuring a clearer image on the evolution of risk premia as well as on the two- pre and post-EU phases. Therefore, the results can be considered unbiased, relevant and much more reliable for making conclusions.

The risk-free is going to be represented by the EURIBOR rate for both countries since this rate is a good substitute for national rates, which themselves denote a high correlation between them, especially in the EU region.

The DataStream database also provides us with data for the market return, which in the case of the two countries will be the International Financial Corporation Index, the MSCI for Germany and Poland.

Other necessary data is represented by market-to-book ratios and market values, provided by the DataStream database, in order to execute the portfolio sorting. The book-to-market ratios will be computed by inversing the market-to-book ratios available.

After centralising all the inputs for the research we ended up with 249 companies for Poland and 919 companies for Germany, after matching the market values and the market-to-book ratios with prices. This could raise some problems for the portfolio formation phase, as there may not be enough data for Poland to conduct a proper sorting and complete regressions.

VI. References

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