The European Equity Risk Model

This paper describes the European equity risk model available in POINT, the Barclays Capital portfolio analytics and modeling platform. It consists of two distinct models, the UK equity risk model and the Continental Europe equity risk model, which are designed to capture the specific characteristics of their markets. They incorporate a set of novel methodologies that were originally implemented in the US equity risk model. The consistent approach among these models allows us to combine them in an effective way in a global portfolio setting.

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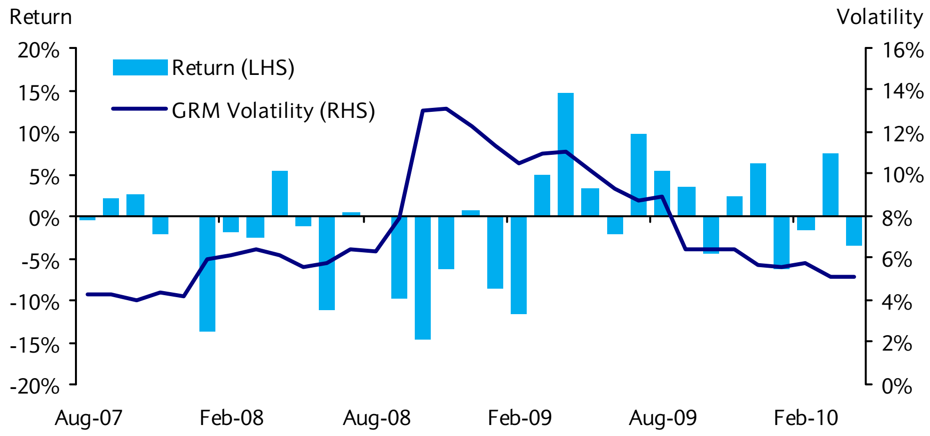
1. Introduction[1]

The recent credit crisis has underscored the importance of prudent risk management. Risk models are central to this practice, allowing managers to quantify the risk embedded in their portfolios. During the course of the crisis, equity markets across the globe have experienced sudden changes in market conditions that highlighted the need for dynamic risk models. The European equity risk model is part of the global risk model (GRM) in POINT and is highly responsive in nature. Figure 1 illustrates how the GRM volatility estimate for the EURO STOXX 50 Index adjusted quickly in the wake of the turbulent market conditions of the recent credit crisis. The model responds very well to both increasing and decreasing volatility in the European equity markets. We see that the volatility estimate for the index more than doubled in a matter of two months around September 2008 and then started coming down at a fairly rapid pace as anxiety eased in the equity markets.

Figure 1: GRM Volatility Estimate and Realized Returns for the EURO STOXX 50 Index



Source: Barclays Capital POINT

[1] The author would like to thank Anthony Lazanas, Antonio Silva, and Arne Staal for their valuable suggestions and comments. Zameer Shaik and Gary Wang contributed to the implementation of the model in POINT.

The European equity risk model consists of two distinct models, the UK equity risk model and the Continental Europe equity risk model, where the latter covers 19 developed countries in Europe (outlined in Appendix 1). Each model is calibrated separately to capture the specific characteristics of their markets. European equity models are part of a suite of global cash equity models in POINT. They incorporate a set of novel methodologies that were originally implemented in the US equity risk model (which are described in this paper only at a high level, for details please refer to Silva, Staal, and Ural (2009)). The consistent approach in the methodology and the factor structure among these models allows us to combine them in an effective way in a global portfolio setting. Common features include:

- Estimation of monthly exposures to the industry factors (betas) through a proprietary model that incorporates daily data. This methodology renders sensitivities that are robust and yet very dynamic.
- Proprietary mixed frequency models to estimate monthly systematic and idiosyncratic volatilities. These models also use daily data and produce estimates that are very responsive to changing market conditions.
- A three-step estimation procedure that facilitates a clean interpretation of risk factors. This also makes hedging more practical for these factors.
- Non-linear transformation of the loadings for selected fundamental factors to eliminate systematic biases inherent in standard linear factor models.
- Proprietary factors that account for market distress and earnings management.

The European equity risk model incorporates a multi-factor approach where all factors are estimated via cross-sectional regression. We use a three-step process to perform this estimation. We estimate the industry factors in the first step, fundamental and technical factors in the second step, and residual market/country factors in the third step. Figure 2 illustrates the list of factors and their estimation order in the model, which is consistent with the structure in the US equity risk model.

Figure 2: List of Factors in the European Equity Risk Models

	United Kingdom	Continental Europe
Step 1	Industry (GICS level 2)	Industry (GICS level 2)
Step 2	Market Value	Market Value
	Corporate Default Probability	Corporate Default Probability
	Momentum	Momentum
	Earnings to Price	Earnings to Price
	Earnings Forecast	Earnings Forecast
	Realized Volatility	Realized Volatility
	Discretionary Accruals	Discretionary Accruals
	Book to Price	
Step 3	Residual Market Volatility	Residual Country (19)

Source: Barclays Capital Portfolio Modeling

Industry factors are the major drivers of risk for a diverse set of equity portfolios in Europe, especially if they are large and diversified. Being estimated in the first step of the estimation process on a univariate basis, the industry factors have a straightforward interpretation – they are statistically very close to the market value-weighted industry indices. Fundamental and technical factors are selected through extensive univariate and multivariate analyses and represent major investment themes of portfolio managers. The residual market volatility factor in the UK captures the remaining systematic risk. Country factors in Continental Europe are also residual factors that represent country effects net of all other factors.

As a result of increasing globalization, economies around the world have been integrating at a fast pace. Europe has been a prominent case for this phenomenon due to the existence of the European Union and a common currency, the euro. This trend has resulted in increasing correlations between stock markets in different countries, thus decreasing the significance of country as a factor in regional/global equity risk models, especially for large countries. As a result, this has elevated the relative importance of industry factors for such models. In Section 3, we will illustrate this phenomenon for Continental Europe. Having said that, country factor can be a significant component of total portfolio risk, especially for portfolios tilted toward smaller countries.

This paper is organized as follows. In Section 2, we discuss the systematic and idiosyncratic components of the European equity risk model. We describe each systematic factor in detail and explain how we estimate the industry factor sensitivities – betas, systematic factor volatilities, and the idiosyncratic risk. In Section 3, we discuss the relative importance of industry and country factors in Continental Europe and illustrate certain characteristics of the residual country factors. In Section 4, we demonstrate the historical performance of the model for a diverse set of portfolios by means of the back-testing ratio test. Section 5 illustrates the implementation of the model in the POINT risk report. In Section 6, we conclude with a summary of the major features of the model.

2. Model Specification

This section describes the systematic and the idiosyncratic components of the European equity risk model. First we talk about the data sources used to develop and calibrate the model. Then we discuss the set of systematic factors in detail, namely industry, fundamental, technical, and residual market/country factors. Finally, we describe the models used to estimate the systematic factor volatilities and the idiosyncratic risk for European equities. As the European equity risk model utilizes a set of methodologies originally implemented in the US equity risk model, please refer to Silva, Staal, and Ural (2009) for details on the set of methodologies described in this section.

Data

We use the Global Pricing database provided by SunGard-FAME for indicative and technical information including prices and returns, Worldscope for fundamental data, and IBES for earnings estimates. Before we use any of these sources, we perform extensive data cleaning and testing procedures and we are very diligent in merging different data sets. We used data from 1994-2009 to calibrate the European equity risk model and performed our analyses in different sub-periods to ensure that our conclusions are robust across different market environments.

The Systematic Risk Model

European equity risk models are cross-sectional models where all systematic factors are estimated. As mentioned in Section 1, we use a three-step estimation procedure where industry factors are estimated in the first step, followed by fundamental and technical factors in the second step, and residual market/country factors in the third step. The estimation universe is the set of the largest 500 stocks in the UK and 1,000 stocks in Continental Europe. We use weighted least squares regression where the weights are a decreasing function of the realized volatility of daily residual returns. Hence, large and mature companies tend to have more influence in the estimation process as they generally exhibit low residual volatility.

The following equation demonstrates the systematic and the idiosyncratic components of the model for both sub-regions where *r* is the stock return, I is the industry factor return (GICS level 2), β is the industry factor loading - beta, *F* is the set of fundamental/technical factor returns, ℓ is the set of loadings to these factors, *C* is the residual market/country factor returns, respectively, for UK/Continental Europe and ε is the idiosyncratic return.

$$r_i^t = \beta_i^{t-1} I^t + \sum_{j=1}^{n} \ell_{ij}^{t-1} F_j^t + C^t + \varepsilon_i^t$$

First Step: Industry Factors

In the first step of the estimation process, we regress stock returns to industry betas to estimate the industry factor realizations. Due to the univariate nature of this estimation, implicit industry factors have a straightforward interpretation: they are statistically very close to the market value-weighted industry indices (e.g., correlation between the estimated factor and the index for each industry is greater than 90% for both sub-regions). This also makes hedging more practical for these factors. Each stock loads onto a single industry that corresponds to the GICS (Global Industry Classification Standard) level 2 of the issuer.

We use a proprietary methodology to estimate the industry factor loadings, POINT Mixed-Frequency Betas (PMB). Instead of estimating the beta from monthly observations, we compute realized betas using daily observations within each month in recent history and then combine them by means of an optimized weighting scheme to compute the beta forecast for next month. These weights are determined with respect to the time-series characteristics of the time-varying beta process. The use of daily data allows us to employ a much larger number of observations (compared to monthly data), providing more robust estimates of industry betas. It also makes the estimate much more responsive to changing market conditions as we update it with ~20 new observations each month and as we require a relatively short history to perform our computations. This robust estimation methodology along with the broad industry definitions allows us to predict industry sensitivities in an accurate way (for details, see Silva, Staal, and Ural (2009)).

Second Step: Fundamental and Technical Factors

In the second step of the estimation process, we regress residual returns from the first step to the loadings of fundamental and technical factors on a multivariate basis to estimate the monthly realizations for these factors. The loading to any of these factors is a function of the corresponding firm characteristic (e.g., the loading to the earnings to price factor is a function of the E/P ratio of the stock). We standardize the loadings for these factors within each sub-region such that the loading of the market portfolio (value-weighted portfolio of stocks in the estimation universe) to any of these factors is zero. This approach implies a relative view on these variables with respect to their relationship with stock volatilities. Figure 3 defines the fundamental and technical factors used in the UK equity risk model and the Continental Europe (EU) equity risk model.

Figure 3: Definitions of Fundamental and Technical Factors

Factor	Type	Model	Definition
Industry	Sector	EU, UK	GICS level 2 industries
Country	Country	EU	Country of risk
Market Value	Fundamental	EU, UK	Log of market capitalization
Book to Price	Fundamental	UK	Book value over current market capitalization
Earnings to Price	Fundamental	EU, UK	Last one year earnings over current market capitalization
Corporate Default Probability	Fundamental	EU, UK	Next one-year corporate default probability from the proprietary Barclays Capital model
Change in Discretionary Accruals	Fundamental	EU, UK	Measures the degree of earnings management
Residualized Earnings Forecast[2]	Fundamental	EU, UK	Next one year earnings forecast over current market capitalization - residualized
Momentum	Technical	EU, UK	Cumulative stock return in the period from month t=-10 to t=-1
Residualized Realized Volatility[3]	Technical	EU, UK	Realized volatility of daily returns net-of-industry over the past three months – residualized

Source: Barclays Capital Portfolio Modeling

The corporate default probability (CDP) factor in Figure 3 is based on the proprietary CDP model, which was originally developed in POINT to gauge the default risk of fixed income securities. Our research shows that CDP performs better as a factor than distance to default or some more standard measures of leverage in forecasting risk of equity portfolios. In distress conditions, it responds very fast to changing market environment, whereas accounting ratios representing leverage are generally slow to react. See Asvanunt and Staal (2009) for details on the CDP model in POINT. Another proprietary factor in the European equity risk model is discretionary accruals, which was originally used in the ROQS model developed by the Equity Quantitative Strategies group at Barclays Capital. It measures the degree of earnings management by identifying the component in the earnings figures that is subject to managerial discretion.

To select the fundamental and technical factors described in Figure 3, we performed extensive univariate and multivariate analyses. We first analyzed potential factors on a univariate basis to find variables that help us differentiate low and high volatility stocks. This allowed us to eliminate a large number of potential factors and the resulting set of factors went under multivariate testing (in this paper, we illustrate only a selection of these tests; please refer to Silva, Staal, and Ural (2009) for a more complete discussion of tests performed in factor selection). Some important findings in this analysis include:

- Market value, momentum, and realized volatility are the most significant factors in most tests.
- Fundamental and technical factors that perform well in the US are more likely to perform well in Europe.
- We observe similarities between Europe and US in terms of the volatility patterns of factors.

Quintile analysis is a major test within the context of the univariate analysis where we aim to unravel the relationships between fundamental/technical variables and stock volatilities.

[2] To prevent potential multicollinearity problems, we residualize forecasted E/P to historical E/P where the residual variable represents the additional predictive power provided by analysts' estimates.
[3] We residualize realized volatility to market value as both variables convey significant information but they can be highly collinear in certain times.

In this test, at the beginning of every month, we rank the stocks in our estimation universe with respect to the value of the fundamental/technical variable of interest and construct five quintile portfolios in line with this ranking. Then we compute the time-series volatility of these quintile portfolio returns (net-of-industry returns) and look for any significant patterns. Figure 4 illustrates the monotonically decreasing pattern for the market value variable and the U-shaped pattern for momentum both in US and Europe: smaller companies tend to be more volatile, very low momentum (losers) and very high momentum (winners) stocks tend to be more volatile than average performers.

Figure 4: Partial View from the Univariate Analysis Report for Market Value (MV) and Momentum (MOM) Factors in the US and Europe (EU)

	MV - US	MV - EU	MOM - US	MOM - EU
Q1	3.16%	1.85%	1.88%	1.84%
Q2	2.54%	1.76%	1.01%	0.99%
Q3	1.94%	1.48%	0.80%	0.75%
Q4	1.24%	1.17%	0.94%	0.94%
Q5	0.68%	0.43%	1.47%	1.56%

Source: Barclays Capital Portfolio Modeling

In the selection of fundamental and technical factors, we aimed to be parsimonious as a model with an excessive number of factors is likely to have multicollinearity problems. In the case of multicollinearity, parameter estimates tend to be unstable and factors can lose much of their clean univariate interpretation. As a result of our vigilant selection procedure (e.g., making sure there are no excess correlations), fundamental and technical factors can maintain a rather clean interpretation despite being estimated in a multivariate regression. To illustrate this, we estimate each fundamental/technical factor separately on a univariate basis (in the second step of the estimation process) and compare these univariate realizations with the actual multivariate realizations coming out of our model. Figure 5 shows that the correlations between univariate and multivariate realizations for each factor are fairly high for both UK and Continental Europe.

Figure 5: Univariate/Multivariate Correlations for Fundamental and Technical Factors

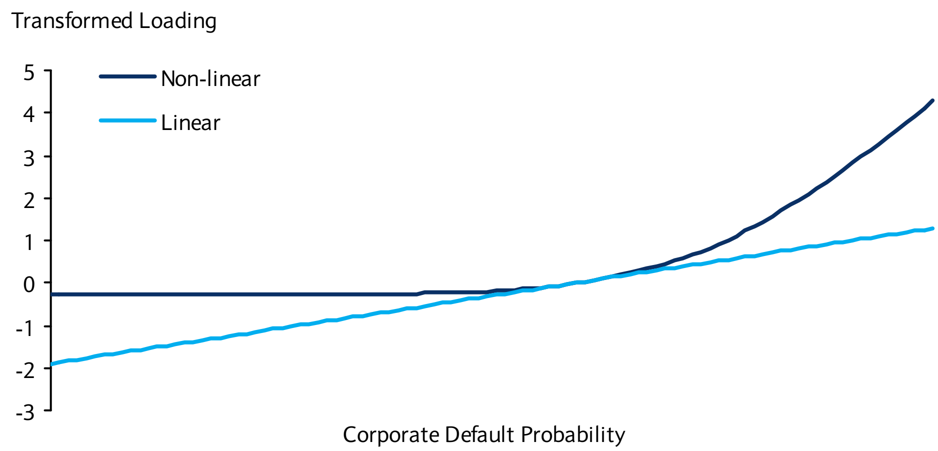
	UK	Continental Europe
Earnings to Price	0.90	0.89
Market Value	0.95	0.96
Momentum	0.92	0.94
Discretionary Accruals	0.83	0.96
Realized Volatility	0.74	0.57
CDP	0.80	0.70
Earnings Forecast	0.91	0.91
Book to Price	0.70	N/A

Source: Barclays Capital Portfolio Modeling

Non-linear Transformation of Fundamental Factor Loadings

Our research shows that using linear loadings for certain fundamental factors in equity models can result in the underestimation or overestimation of volatility for portfolios tilted toward these investment themes. As an example, we see that using a linear loading for the market value variable results in underestimation of volatility for small-cap portfolios and overestimation of volatility for large-cap portfolios (even after the standard log transformation). To eliminate this bias, we perform non-linear transformations to the loadings of certain fundamental factors (market value, CDP, and earnings to price) and use these transformed loadings in the estimation of fundamental/technical factors. We perform this transformation only when there is overwhelming evidence for an improved risk forecast and when the non-linear transformation makes economic sense. Figure 6 illustrates the non-linear transformation for the CDP factor loading. A linear loading for this factor results in the underestimation of volatility for portfolios tilted toward high default probability companies. The non-linear transformation corrects for this bias by assigning a loading that increases exponentially as we move from medium to high CDP companies. Figure 6 shows how this non-linear mapping compares to the case of linear mapping.

Figure 6: Non-linear Transformation for the CDP Factor



Source: Barclays Capital Portfolio Modeling

Third Step: Residual Market/Country Factors

In the third step of the estimation process, we regress the residuals from the second step to a unit loading to estimate the residual market/country factors. In the Continental Europe equity risk model, there are 19 residual country factors as specified in Appendix 1. These factors are estimated on a univariate basis and represent the country effect net of all other factors. In Section 3, we illustrate some major characteristics of these factors. In the UK equity risk model, we estimate the residual market volatility factor in the third step, which captures remaining systematic risk.

Estimation of Factor Volatilities

To estimate the systematic factor volatilities, we use a proprietary methodology, namely the Mixed Frequency Volatility Model (MFVM) (see Silva, Staal, and Ural (2009)). The key principle of this approach is the decomposition of the covariance matrix into correlations and volatilities. Correlations are estimated from the historical monthly factor realizations using an exponential weighting scheme. On the other hand, volatilities are estimated using a mixture of a short-term estimate of volatility that is computed by a weighted sum of daily squared factor returns and a slow moving long-run average level of volatility. Estimation of the covariance matrix is central to producing accurate volatility forecasts for portfolios and, hence, to the performance of the risk model. The use of daily data in MFVM provides more robust, yet responsive estimates of systematic factor volatilities. As a consequence, the European equity risk model reacts quickly to changes in market circumstances. This was illustrated in **Figure 1** where the volatility estimate for the EURO STOXX 50 Index responds very well to both increasing and decreasing volatility in European equity markets over the recent credit crisis. We will further demonstrate the performance of the European equity risk model in a back-testing context in Section 4.

Extended Coverage

We have extended coverage in POINT for European stocks that are not fully covered by the model. For instance, if a security is missing industry beta but has a GICS level 2 classification, it loads onto the corresponding industry factor with a beta of 1. On the other hand, if a stock does not have an industry classification, it loads onto the market factor with a loading of 1. If a stock is missing any fundamental/technical factor loading, we assign a loading of zero, which is a market average loading for these factors. The users have the ability to switch off the extended coverage when they run the risk model in POINT.

The Idiosyncratic Risk Model

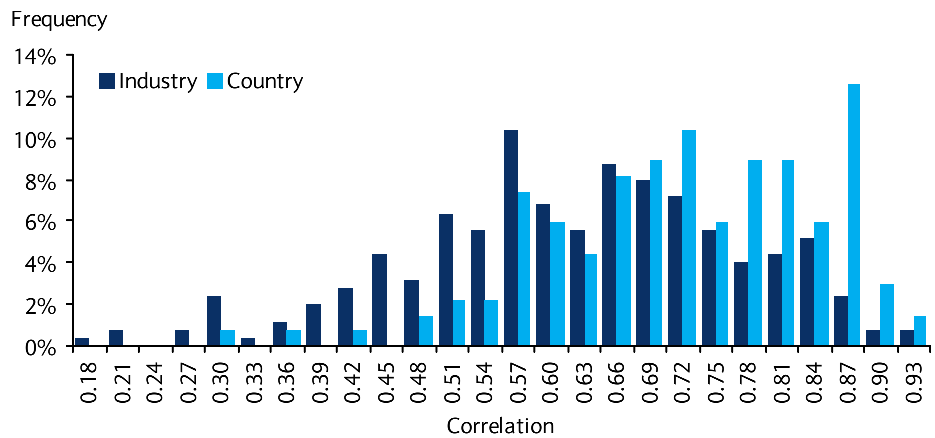
The idiosyncratic risk of European equities is modeled at the company level by means of a proprietary methodology that computes the estimate using recent daily residual stock returns overlaid by certain firm characteristics. As is the case with the estimation of systematic risk, it produces responsive estimates of stock-specific risk. The use of daily data is even more relevant in the estimation of idiosyncratic risk as the nature of individual securities can vary significantly over very short periods of time. Moreover, we can immediately start producing estimates for new issues as we do not need a long history to compute the idiosyncratic risk.

3. Industry and Country Factors in Continental Europe

For regional equity models, there are two major classification variables that are especially important from a risk perspective: industry and country. A major challenge in the development phase of the Continental Europe equity risk model was to gauge the relative significance of industry and country factors. With respect to our multi-step estimation process, the goal was to determine which of these factors would be estimated in the first step. We performed numerous in-sample and out-of-sample tests to address this question. In this section, we first illustrate a couple of these tests and then outline some noteworthy features of the residual country factors in Continental Europe.

As we mentioned in Section 1, due to increasing integration across local European economies, country factor has been losing its significance in the region. As a result, industry factors perform slightly better than country factors for the most part of in-sample and out-of-sample testing, especially in recent history. To illustrate this, Figure 7 compares the distribution of correlations between the industry indices and correlations between the country indices during 2004-09. We see that the distribution of country index correlations is relatively shifted to the right, containing a considerable number of very high correlation figures, mostly attributable to the correlations between large countries. In light of these results, having separate factors becomes somewhat redundant for these countries.

Figure 7: The Distribution of Correlations between Industry Indices and Correlations between Country Indices in Continental Europe (2004-2009)



Source: Barclays Capital Portfolio Modeling

Figure 8 further illustrates the case of excess correlations between country indices: correlations between the largest eight country indices in Continental Europe are generally above 80%, making the case less compelling for separate country factors. Another metric used in the evaluation of factors is the explanatory power of the model. Regressions with country as the only factor result in a (market value-weighted) average 32% r-squared compared to the industry factor resulting in a (market value-weighted) average 39% r-squared. These are part of the analysis, which underscores the increased relative importance of industry factors in the region; hence, industry factors are estimated in the first step and residual country factors are estimated in the third step of the estimation process.

Figure 8: Correlations between Country Indices (2004-2009)

	France	Germany	Switzerland	Spain	Italy	Netherlands	Sweden
Germany	0.93						
Switzerland	0.89	0.88					
Spain	0.82	0.78	0.77				
Italy	0.91	0.86	0.87	0.78			
Netherlands	0.92	0.87	0.85	0.72	0.84		
Sweden	0.86	0.85	0.86	0.73	0.82	0.80	
Belgium	0.85	0.78	0.84	0.79	0.85	0.80	0.86

Source: Barclays Capital Portfolio Modeling

Having said that the country factors are residual, they can still be a significant component of total portfolio risk, especially for portfolios tilted toward small countries. In the Continental Europe equity risk model, there is substantial variation among residual country factors in terms of their volatilities and significance. Factors from large countries such as Germany, France, or Switzerland exhibit minimal volatility, whereas small country factors are much more volatile and significant. Appendix 1 outlines the weighted volatility estimates (coming from the MFVM) for the residual country factors as of April 30, 2010. As an example, volatility estimate for the Germany country factor is 0.9%, whereas the Malta factor exhibits 6.2% monthly volatility (this is a result of a larger percentage of total systematic risk being captured by industry and fundamental factors for German stocks).

Figure 9 illustrates the variation among residual country factors via the factor partition report in POINT. Systematic volatilities for the DAX Index (Germany) and the FTSE-GREECE Index are decomposed into contributions from different factor classes. We see that the contribution of country factors to systematic volatility is significantly higher for Greece (3.72% vs. -0.34%) due to both higher country factor volatility and higher correlations between the country factor and the regional industry factors as compared to Germany.

Figure 9: Partial View from the Factor Partition Report in POINT for the DAX and the FTSE-GREECE Indices (as of 4/30/2010) (in %/month)

	Contribution to TEV	
Risk Factor Partition Bucket	**DAX**	**FTSE - GREECE**
Systematic - Total	4.74	10.10
Country	-0.34	3.72
Sector	5.23	5.56
Other	-0.15	0.82

Source: Barclays Capital POINT

The European equity risk model has a flexible structure that can capture potential changes in the characteristics of the European equity market. As an example, country-specific shocks are fully incorporated through changing volatilities and correlations in the residual country factors. Figure 10 shows how the contribution of the Greece country factor to total volatility increased significantly from the end of March 2010 to the end of April 2010 for the FTSE-GREECE Index as a result of increased country factor volatility due to a series of events that took place during the period (e.g., downgrades to the sovereign debt of Greece, bailout discussions).

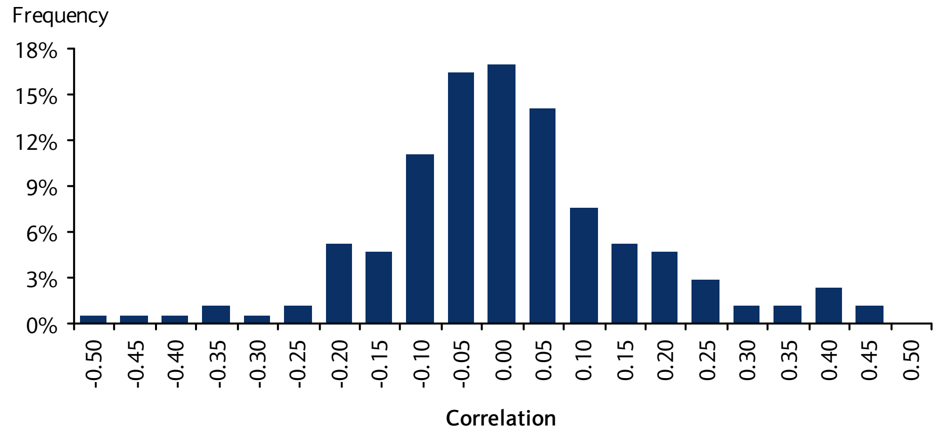
Figure 10: Partial View from the Factor Partition Report in POINT for the FTSE-GREECE Index as of 3/31/2010 and 4/30/201 (in %/month)

	Contribution to TEV	
Risk Factor Partition Bucket	**Mar-10**	**Apr-10**
Systematic - Total	9.05	10.10
Country	2.97	3.72
Sector	5.24	5.56
Other	0.85	0.82

Source: Barclays Capital POINT

Finally, Figure 11 depicts the distribution of correlations between (third step) residual country factors. We see that these factors are pretty much orthogonal, representing country-specific effects net of all other factors in the model.

Figure 11: Distribution of Correlations between Residual Country Factors



Source: Barclays Capital Portfolio Modeling

4. Back-testing the Model

We perform various tests to gauge the performance of our risk models. In this section, we illustrate the performance of the European equity risk model by means of the back-testing ratio test, where the goal is to assess how well the model predicts the volatility of portfolios. To perform this analysis for a given portfolio, we first need to compute the standardized return of the portfolio each month. The standardized return – *u* – is defined as the ratio of the realized return – *r* – of the portfolio in a given month divided by its estimated volatility – σ – at the beginning of that month:

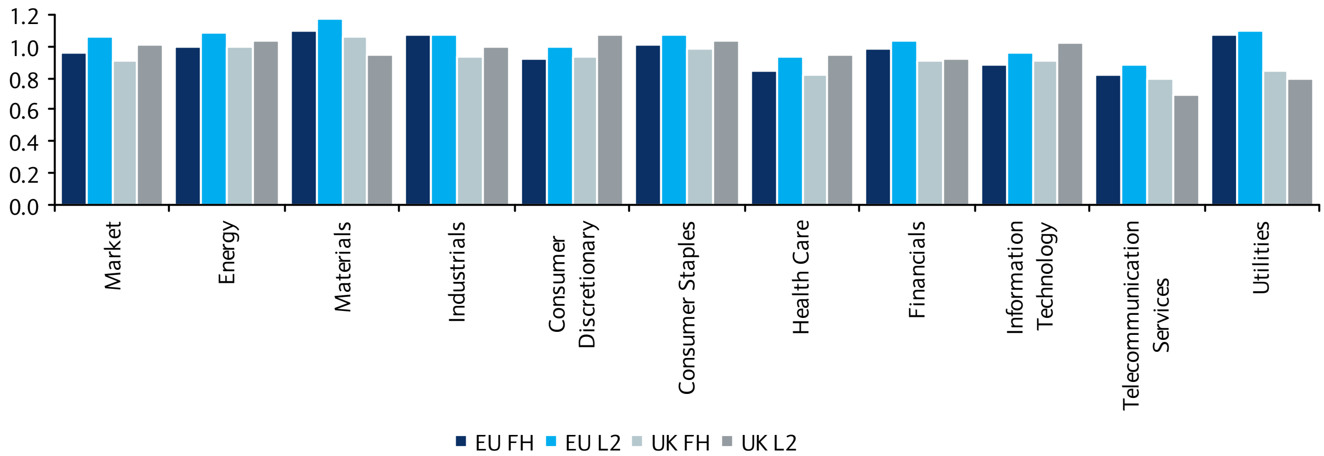
$$u_p^t = \frac{r_p^t}{\sigma_{p,forecast}^t}$$

If the volatility estimates for the portfolio are accurate, the standard deviation of the standardized returns should be close to 1. We perform this test for a diverse set of portfolios, namely market and industry portfolios and portfolios tilted toward different investment themes such as value and momentum. We perform separate tests for UK and Continental Europe in order to isolate the performance of each model. We analyze various statistics of the distribution of the standardized return, but for the purposes of this illustration, we only present the standard deviation.

Figure 12 demonstrates the standard deviation of the standardized return for UK and Continental Europe market and sector portfolios for the full history (2002-2009)[4] and in the past two years (2007-2009). Market portfolio is defined as the market value-weighted portfolio of stocks within the estimation universe, and sector portfolios are subsets of the market portfolio, composed of stocks in each sector, defined by GICS level 1.

[4] The first covariance matrix available in POINT is for November 2002.

Figure 12: Performance of the Model for Market and Sector Portfolios in UK and Continental Europe (EU) for the Full History (FH) and the Past Two Years (L2)

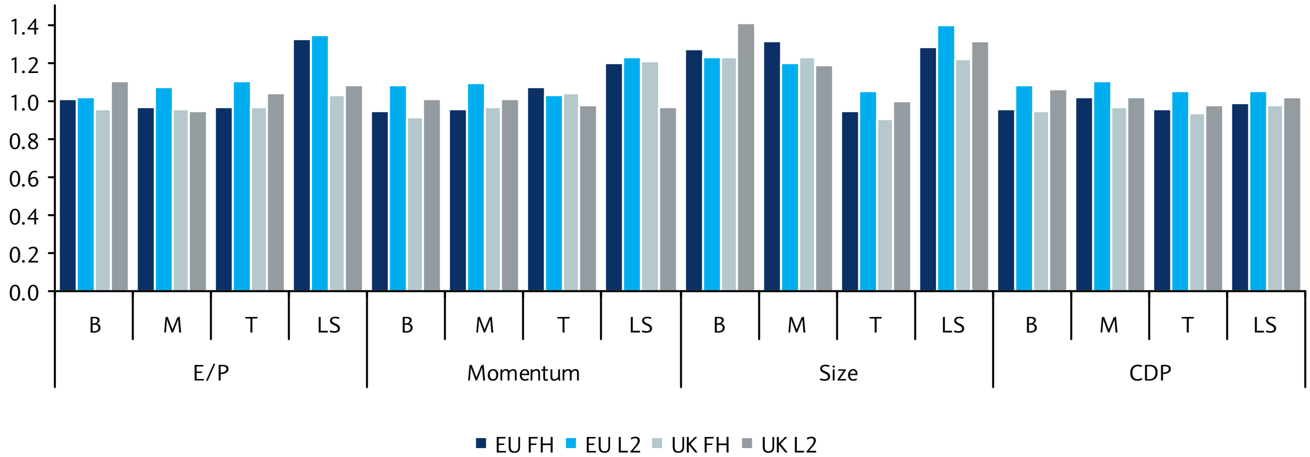


Source: Barclays Capital Portfolio Modeling

We see that the performance figures are generally very close to 1 with a slight bias in certain cases. The results are consistent between the two sub-regions and time periods. This highlights the accuracy of the risk model estimates, underlining the performance of both the factor model structure and the systematic volatility estimation model.

To make the analysis more interesting, we also present the performance of the model for portfolios tilted toward some major investment themes, namely value (E/P ratio), momentum, size, and corporate default probability (CDP). At the beginning of every month, we rank the stocks in our estimation universe with respect to the value of each characteristic (e.g., E/P ratio of the stock) and construct three portfolios corresponding to the bottom, medium, and top third (tercile) of the characteristic value. These portfolios are dynamic in the sense that their composition can change considerably from month to month. We also construct a long-short market-neutral portfolio that each month takes a long position in the top tercile and a short position in the bottom tercile portfolio. Figure 13 demonstrates the results of the back-testing ratio test for bottom (B), medium (M), top (T), and long-short (LS) portfolios for each of the aforementioned investment themes in both sub-regions.

Figure 13: Performance of the Model for Portfolios Tilted toward Investment Themes in UK and Continental Europe (EU) for the Full History (FH) and the Past Two Years (L2)

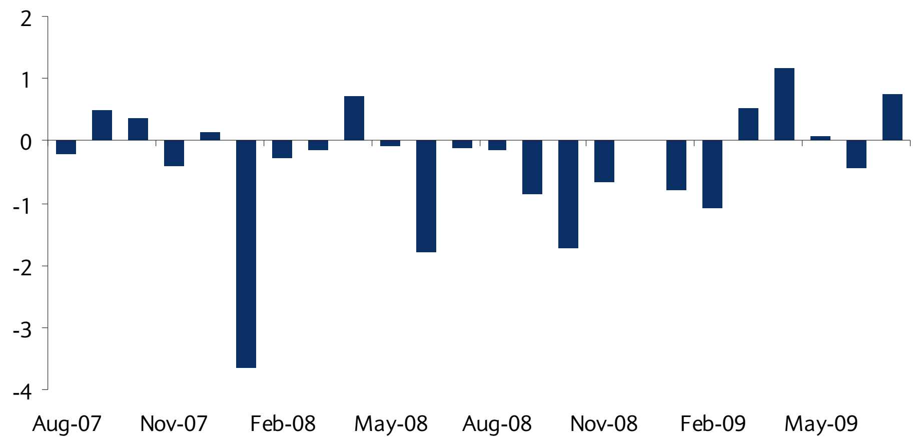


Source: Barclays Capital Portfolio Modeling

We see that the model performs remarkably well for portfolios tilted toward different investment themes. Most notable deviations from a standard deviation of 1 are generally in the case of long-short portfolios where the model tends to underestimate the volatility. This is not surprising as long-short portfolios tend to have return distributions that are not as well-behaved as long-only portfolios (e.g., more likely to be skewed and fat-tailed) and hence are more likely to generate extreme realizations that the (volatility) risk model is not designed to capture.

POINT is a multi-asset class platform where a diverse set of equity and fixed income asset classes are fully integrated to deliver an accurate representation of risk for multi-asset class portfolios. Figure 14 illustrates the standardized returns for a long-short portfolio where we take a long position in the EURO STOXX 50 Index and a short position in the Barclays Capital Euro Credit Index. Standard deviation of the standardized returns for this portfolio over the course of the recent credit crisis is 1.01, which highlights the ability of the global risk model in POINT to effectively capture the relationships between different asset classes. The -3σ move that the long-short portfolio experienced in January 2008 is due to global stock markets plummeting in value during the month as a result of heightening fears of a US recession at the time. Please refer to Silva (2009) for a brief note on the credit risk model in POINT.

Figure 14: Standardized Returns for Continental Europe Equity vs. Credit



Source: Barclays Capital POINT

5. The Risk Report

In this section, we illustrate the POINT risk report, which incorporates analyses of the portfolio volatility and tail risk from several dimensions. For the purpose of this illustration, we focus on the volatility component of the report. Please refer to Lazanas, Phelps, and Gabudean (2009) for a discussion of the Barclays Capital tail risk model. The risk report is very comprehensive in nature, and in this section we only present a few of its components.

There are various options in running the risk report that allow for extensive customization. For this exercise, we run all our reports as of April 30, 2010. We choose "weighted" option for time-weighting, which uses the Mixed Frequency Volatility Model (Silva, Staal, and Ural (2009)) to estimate the systematic factor volatilities. In all examples, benchmark is cash, hence, the tracking error volatility (TEV) corresponds to the volatility of the portfolio. The security partition report is a component of the POINT risk report that demonstrates the contribution of different security buckets to portfolio volatility. Here the partition is fully flexible; it can be defined by the user or can be a system partition. Figure 15 illustrates a partial view from this report where the portfolio is the EURO STOXX 50 Index, partition is country, and the base currency is EUR. As expected, we see that the top contributors to volatility (France and Germany) are the largest countries in the euro-zone as they have the largest weights in the index. The idiosyncratic contribution to volatility is very small as this index is composed of very large companies and is well diversified.

Figure 15: Partial View from the Security Partition Report in POINT for the EURO STOXX 50 Index with Country Partition (in %/month)

Security Partition Bucket	Market Weight(%)	Contribution to TEV		
		Systematic CTEV	Idiosyncratic CTEV	Total CTEV
Total	100.00	5.00	0.12	5.12
Belgium	1.70	0.03	0.01	0.04
Finland	2.20	0.15	0.00	0.15
France	35.57	1.61	0.05	1.66
Germany	27.24	1.27	0.02	1.29
Ireland	0.97	0.06	0.00	0.07
Italy	10.21	0.61	0.01	0.62
Luxembourg	1.76	0.09	0.01	0.10
Netherlands	6.08	0.39	0.00	0.40
Spain	14.28	0.78	0.02	0.80

Source: Barclays Capital POINT

The factor exposure report in POINT summarizes the exposure, volatility, and the TEV contribution of each individual factor and provides sensitivity analysis Figure 16 illustrates a partial view of this report where the portfolio is the EURO STOXX 50 Index and the base currency is EUR. The factor with the largest contribution to total risk is "EU Equity FIN Banks" due to both the large weight of banking stocks in the index and the high volatility of this factor. At a high level, industry factors are the most volatile factors, followed by country factors and the fundamental/technical factors. As mentioned in Section 3, we see that there is substantial variation among the country factors in terms of their volatilities where the volatility of small country factors such as "Luxembourg" (4.11%) is much higher than that of larger countries such as "Germany" (0.92%). The index has a slight positive exposure to the "Market Value" factor, as it is composed of a group of very large-cap companies in the euro-zone and a slight positive exposure to the "Earnings Forecast" factor, which implies that the analysts expect more than average earnings revision for these companies in the near future. The contribution of the "Market Value" factor to total volatility is negative (-19.27bps) owing to its negative correlation with the industry factors. Hence, controlling for everything else, larger (positive) exposure to the "Market Value" factor – more bias toward large-cap stocks – would reduce the total volatility of the portfolio.

Figure 16: Partial View from the Factor Exposure Report in POINT for the EURO STOXX 50 Index (in bps/month)

Factor name	Sensitivity/ Exposure	Net exposure	Factor volatility	TE impact of an isolated 1 std. dev. up change	TE impact of a correlated 1 std. dev. up change	Marginal contribution to TEV	Percentage of tracking error variance (%)	Contribution to TEV
CURRENCY								
EUR (European Euro)	MW%	0.00	0.00	0.00		0.000	0.00	0.00
EQUITIES DEVELOPED MARKETS								
EU Equity Energy	Empirical Beta	0.089	507.69	45.13	474.46	470.264	8.16	41.80
EU Equity Materials	Empirical Beta	0.066	586.15	38.61	489.33	559.953	7.20	36.88
EU Equity IND Capital Goods	Empirical Beta	0.111	593.02	65.73	480.36	556.130	12.03	61.64
EU Equity CYC Automobiles	Empirical Beta	0.023	670.49	15.61	475.25	622.102	2.83	14.48
EU Equity CYC Consumer Durables	Empirical Beta	0.016	583.21	9.43	488.14	555.793	1.76	8.99
EU Equity CYC Media	Empirical Beta	0.015	487.43	7.19	479.10	455.915	1.31	6.72
EU Equity NCY Retailing	Empirical Beta	0.021	423.62	9.00	429.31	355.049	1.47	7.54
EU Equity NCY Food	Empirical Beta	0.052	389.24	20.07	477.50	362.857	3.65	18.71
EU Equity NCY Household	Empirical Beta	0.013	405.78	5.41	417.37	330.637	0.86	4.41
EU Equity HLT Pharmaceuticals	Empirical Beta	0.081	344.96	27.78	425.18	286.345	4.50	23.06
EU Equity FIN Banks	Empirical Beta	0.165	785.14	129.21	485.49	744.156	23.91	122.47
EU Equity FIN Diversified Financials	Empirical Beta	0.066	678.36	44.67	493.58	653.668	8.40	43.04
EU Equity FIN Insurance	Empirical Beta	0.074	544.77	40.44	490.36	521.514	7.56	38.72
EU Equity FIN Real Estate	Empirical Beta	0.009	407.06	3.61	472.12	375.187	0.65	3.33
EU Equity TEC Software	Empirical Beta	0.022	506.48	11.11	463.86	458.661	1.96	10.06
EU Equity TEC Hardware	Empirical Beta	0.028	623.03	17.48	453.81	551.980	3.02	15.48
EU Equity Telecommunication	Empirical Beta	0.102	413.21	42.15	347.31	280.175	5.58	28.58
EU Equity Utilities	Empirical Beta	0.120	400.18	48.21	494.10	386.014	9.08	46.50
EU Equity Corporate Default Probability	CDP	0.024	41.42	1.00	151.49	12.250	0.06	0.29
EU Equity Momentum (9m)	Momentum	-0.091	52.68	-4.78	-420.44	-43.237	0.77	3.92
EU Equity Discretionary Accruals	Accruals	-0.057	36.52	-2.09	44.46	3.169	-0.04	-0.18
EU Equity Market Value	Size	0.401	58.64	23.50	-420.16	-48.099	-3.76	-19.27
EU Equity Realized Volatility	Realized Volatility	-0.158	52.84	-8.33	-47.38	-4.888	0.15	0.77
EU Equity Earnings to Price	Earnings/Price	0.104	38.51	4.00	-150.76	-11.334	-0.23	-1.18
EU Equity Earnings Forecast	Earnings Forecast	0.385	34.94	13.46	267.01	18.212	1.37	7.02
EU Equity Belgium	MW	0.017	119.62	2.03	-86.64	-20.233	-0.07	-0.34
EU Equity Finland	MW	0.022	196.79	4.33	-91.29	-35.074	-0.15	-0.77
EU Equity France	MW	0.356	57.51	20.46	-90.55	-10.166	-0.71	-3.62
EU Equity Germany	MW	0.272	91.54	24.93	-256.60	-45.857	-2.44	-12.49
EU Equity Ireland	MW	0.010	350.25	3.40	99.63	68.122	0.13	0.66
EU Equity Italy	MW	0.102	120.69	12.32	13.13	3.093	0.06	0.32
EU Equity Luxemburg	MW	0.018	411.23	7.23	-61.57	-49.430	-0.17	-0.87
EU Equity Netherlands	MW	0.061	92.49	5.62	-156.92	-28.334	-0.34	-1.72
EU Equity Spain	MW	0.143	174.20	24.87	-106.25	-36.134	-1.01	-5.16

Source: Barclays Capital POINT

As we mentioned at the beginning of this section, the risk report in POINT is very comprehensive. It starts with a high level analysis of the portfolio, including the contribution of different asset classes to TEV, major systematic risk exposures, and summary statistics/analytics for the portfolio and the benchmark. Then it provides a detailed analysis of the systematic component of the model, decomposing TEV into contributions from different risk factor and security buckets, summarizing factor exposures, and providing sensitivity analysis. Furthermore, it provides analyses at the issue and issuer level, including the idiosyncratic risk. Other components of the report include a historical simulation of systematic returns and a summary of warnings and parameters used to run the model.

6. Conclusions

The European equity risk model consists of two distinct models, the UK equity risk model and the Continental Europe equity risk model. These models are calibrated separately to capture the specific characteristics of their local equity markets. They incorporate a set of novel methodologies originally implemented in the US equity risk model. These include proprietary techniques to estimate industry factor sensitivities, systematic factor volatilities, and the idiosyncratic risk and non-linear transformations for certain fundamental factor loadings. A common set of methodologies, along with a consistent factor structure between European and other cash equity risk models, allows for an effective combination of regional risk models for global equity portfolios.

European equity risk model factors are estimated by means of a three-step process. Industry factors are estimated in the first step on a univariate basis and, thus, have a very straightforward interpretation. Fundamental and technical factors are estimated in the second step and represent major investment themes of portfolio managers. In the Continental Europe equity risk model, we estimate the residual country factors in the third step, which represent country effect net of all other systematic factors. The residual market volatility factor is estimated in the third step in the UK equity risk model and captures remaining systematic risk.

The European equity risk model performs very well in estimating the volatility for a diverse set of portfolios in both sub-regions. To demonstrate this, we used the back-testing ratio test and ran that on market and sector portfolios and portfolios tilted toward different investment themes such as size and value. The performance of the model over the recent credit crisis is especially remarkable, owing to the responsive nature of the risk model estimates.

The risk report in POINT incorporates a comprehensive analysis of portfolio volatility and tail risk from several dimensions. This includes decomposition of TEV into contributions from different risk factor and security buckets, a factor exposure report, and analyses at the issue and issuer level. The risk report is also highly customizable and offers various options for the user.

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Appendix 1: Country Factor Volatilities In the Continental Europe Equity Risk Model

(weighted as of 4/30/2010)

Country	Monthly Volatility
Austria	1.9%
Belgium	1.2%
Cyprus	9.0%
Denmark	2.3%
Finland	2.0%
France	0.6%
Germany	0.9%
Greece	6.1%
Ireland	3.5%
Italy	1.2%
Luxemburg	4.1%
Malta	6.2%
Netherlands	0.9%
Norway	2.4%
Portugal	3.3%
Slovenia	3.5%
Spain	1.7%
Sweden	1.8%
Switzerland	1.0%

Source: Barclays Capital POINT

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