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CREATES Research Paper 2013-31

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October 8, 2013

*Christiansen acknowledges support from CREATES funded by the Danish National Research Foundation (DNRF78) and from the Danish Council for Independent Research, Social Sciences.

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Abstract: This paper adopts dynamic factor models with macro-finance predictors to revisit the intertemporal risk-return relation in five large European stock markets. We identify country specific, Euro area, and global factors to determine the conditional moments of returns considering the role of higher-order moments as additional measures of risk. The preferred combination of factors varies across countries. In the linear model, there is a strong but negative relation between conditional returns and conditional volatility. A Markov switching model describes the risk-return trade-off well. A number of variables have explanatory power for the states of the European stock markets.

Keywords: Risk-return trade-off; Dynamic factor model; Markov switching; Macro-finance predictors; Higher order moments

JEL Classifications: C22; G11; G12; G17

1 Introduction

The relationship between the conditional return and conditional variance of asset returns, also referred to as the risk-return relation, has key relevance in areas within financial economics such as optimal portfolio choice and risk analysis. For instance, the Intertemporal Capital Asset Pricing Model (ICAPM) suggests that the conditional expected excess return on the stock market should vary positively with the market's conditional volatility. The literature testing the ICAPM relation documents that the relation is unstable and varies substantially over time; for recent contributions see Ludvigson and Ng (2007), Ghysels, Santa-Clara, and Valkanov (2005), and Brandt (2010) among others.

The present paper contributes to the existing literature as follows. We investigate the risk-return relation for five large European stock markets; France, Germany, Italy, Switzerland, and the UK. So far, little attention has been given to Europe in this respect as most studies focus on the US markets. From a methodological point of view, our work is related to Ludvigson and Ng (2007) who use a dynamic factor approach to test for the risk-return relation with US stock market data. As shown by Stock and Watson (2002) and others, dynamic factor models can usefully summarize the information from a large number of macro-finance series by a relatively small number of estimated factors. Indeed, recent approaches in the finance literature incorporate valuable information from large sets of macro-finance data to predict asset returns, cf. Ludvigson and Ng (2007), Goyal and Welch (2008), and Christiansen, Schmeling, and Schrimpf (2012).

In line with this intuition, we initially estimate the conditional return and conditional variance of excess stock market returns using factor-augmented models. Further, we let the risk of the stock markets be characterized by two additional higher order risk measures, namely the conditional skewness and conditional kurtosis. There is now ample empirical evidence showing that importance of higher-order moments in asset pricing; e.g., Harvey and Siddique (2000) argue that risk averse agents prefer positive skewness to negative skewness, and propose an asset pricing model that incorporates conditional skewness. Theodossiou and Savva (2013) show that it is important to take skewness effects into account when investigating risk-return trade-off. The factors are obtained as follows. First, we estimate country specific factors using a data set of macro-finance variables for each country separately. Second, we use Euro-area macro-finance variables to identify Euro-area factors. Third, we extract US factors from a US data base of macro-finance variables, also denoted global factors. After estimating factor-augmented models for the conditional return, conditional variance, conditional skewness, and conditional kurtosis, we ultimately estimate the relation between the risk and return. So, we add to the literature by investigating the effects upon the risk-return relationship from using three different sets of factors (local, regional, and global) to obtain the conditional returns and conditional volatilities. In addition, we allow for skewness and kurtosis risk.

We further contribute to the literature by the way that the risk-return relationship is investigated. Firstly, we use a simple linear model similar to Ludvigson and Ng (2007). Secondly, we allow the state of the economy to have an effect on the risk-return relation. Initially, we do this by adding a binary indicator for recession periods to the risk-return regression. Subsequently, we let the data determine the states endogenously, namely by using a Markov switching model for the risk-return trade-off. This analysis is in line with the conditional ICAPM where the state of the economy approximating investment opportunities is also important in asset pricing, cf. Merton (1973), Guo and Whitelaw (2006), Lustig and Verdelhan (2012), Nyberg (2012)

The empirical results are as follows. We use monthly data from 1986 to 2012. For each country, the strength of the simple linear risk-return trade-off varies according to which factors are used to calculate the conditional moments of returns. We use the relevant conditional returns, volatilities and higher order moments onwards. Linear risk-return regressions show that there is a negative relation between contemporaneous volatility and return. The risk-return trade-off is only slightly different across the business cycle. Further, the Markov switching model describes the risk-return relation well. The behavior in the most common state is similar to that in the linear model. The effect from the volatility is weaker in the unusual state. A number of variables help us explain which state the stock market is at. Overall, the European stock markets have very different risk-return trade-off behavior than the US stock market.

The structure of the remaining part of the paper is as follows. We introduce the data in Section 2 after which we explain the econometric framework in Section 3. The empirical results are found in Section 4 followed by the conclusion in Section 5. Various details are delegated to an Internet Appendix.

2 Data

We focus on the stock markets of five large European economies, namely France, Germany, Italy, Switzerland, and the UK. The data frequency is monthly with the sample covering the period from $1986M02$ to $2012M05$.

2.1 Realized Risk Measures

We use three risk measures, namely the realized volatility, realized skewness, and realized kurtosis. To calculate the monthly realized volatility we use daily observations. The stock log-returns are obtained from the DataStream total return local currency stock indices.[1] We use the 3-month interbank rates as risk free rates.[2] These are calculated into daily rates by the money market convention (i.e. by dividing the yearly rate by 360). We calculate the end-of-month realized volatility for month t from daily excess returns, $y_{\tau t}$.

$$Vol_t = \sqrt{\sum_{\tau=1}^{n_t} y_{\tau t}^2}$$

where n_t is the number of days in month t and τ indicates the particular day of that month ($\tau = 1, .., n_t$). We treat the realized volatility as an observable variable, cf. Andersen, Bollerslev, Diebold, and Labys (2003).

The realized skewness and realized kurtosis are also calculated from daily excess returns:

$$Sk_t = \frac{1}{n_t - 1} \sum_{\tau=1}^{n_t} \left(\frac{y_{\tau t} - \overline{y_t}}{Vol_t} \right)^3$$

and

$$Ku_t = \frac{1}{n_t - 1} \sum_{\tau=1}^{n_t} \left(\frac{y_{\tau t} - \overline{y_t}}{Vol_t} \right)^4$$

where $\overline{y_t}$ is the average daily excess return for month t.

[1] The DataStream symbols are: TOTMKFR (France), TOTMKBD (Germany), TOTMKIT (Italy), TOTMKSW (Switzerland), and TOTMKUK (UK).

[2] The DataStream symbols are: ECFFR3M (France), ECWGM3M (Germany), ECITL3M (Italy), ECSWF3M (Switzerland),and ECUKP3M (UK).

2.2 Explanatory Variables

We use a large number of explanatory variables to extract the common factors. The sample contains a number of country-specific variables for each country; France 152, Germany 147, Italy 95, Switzerland 152, and the UK 127. We also obtain aggregate data for the Euro area (179 variables) and for the US (174 variables) to construct Euro area (regional) and US (global) factors, respectively. The series are selected judgmental to represent major categories of macro-finance time series: foreign sector, output and income, sales, orders, purchases, employment, labour cost, money, prices, exchange rates, confidence indicators, stock market indices, and interest rates and spreads. The variables are transformed to be stationary (taking logs and differences where appropriate) and standardized. Further details about the data are provided in the Internet Appendix. The choice of series is similar to the what has been used in e.g. Stock and Watson (2002).

2.3 Business Cycle Data

Lustig and Verdelhan (2012) find that expected stock returns are higher in recessions than in expansions. To address the issue, we make use of a business cycle indicator variable for each country. The business cycle data are taken from the Economic Cycle Research Institute (ECRI) following Schrimpf and Wang (2010).

3 Econometric Methodology

3.1 Conditional Return and Conditional Risk

We estimate the conditional return and conditional risk (conditional volatility, conditional skewness, and conditional kurtosis) of excess stock market returns. The first stage of the modelling procedure is to estimate the common factors. Let X_t^{loc} denote a large vector ($N_{loc} \times 1$) of country-specific macro-finance variables, X_t^{Eur} is a large vector ($N_{Eur} \times 1$) of Euro area macro-finance variables, and X_t^{US} is a large vector ($N_{US} \times 1$) of US macro-finance variables. The macro-finance variables are related to the unobserved common factors according to

$$X_t^j = \Lambda^j F_t^j + e_t^j, \text{ for } j = loc, Eur, US \tag{1}$$

where Λ^j is an $N_j \times r_j$ matrix of factor loadings and F_t^j describes the r_j dimensional vector of unobserved common factors, where $r_j << N_j$. The $N_j \times 1$ vector e_t^j denotes the purely idiosyncratic errors that are allowed to be serially correlated and weakly correlated across indicators.[3] The above equation reflects the fact that the elements of F_t^j, which in general are correlated, represent pervasive forces that drive the common dynamics of X_t^j. It is in principle not restrictive to assume that X_t^j depends only on the current values of the factors, as F_t^j can always capture arbitrary lags of some fundamental factors.

We follow Stock and Watson (2002) and Ludvigson and Ng (2007) and split the analysis in two stages. In the first stage, we retrieve the principal component estimates, $\widehat{F}_t^j$. To determine the composition of $\widehat{F}_t^j$, we also use

[3] This cross-correlation must vanish as N goes to infinity. See Stock and Watson (2002) for a formal discussion of the required restrictions on the cross-correlation of the idiosyncratic errors.

the squared factors $(\widehat{F}_{i,t}^{j})^2$ $(i = 1, ..., r_j)$. The dimension of the common factor space, r_j, is selected using the BIC criterion with the maximum order for r_j being set to 6.

Let y_t denote the excess stock market log-returns at month t.[4] In the second stage, we predict the excess stock market return using a linear factor augmented regression

$$\widehat{y}_t = \alpha^{\mathbf{y}} + \beta_1^{\prime\mathbf{y}} \widehat{F}_{t-1}^{loc} + \beta_2^{\prime\mathbf{y}} \left(\widehat{F}_{t-1}^{loc}\right)^2 + \gamma_1^{\prime\mathbf{y}} \widehat{F}_{t-1}^{Eur} + \gamma_2^{\prime\mathbf{y}} \left(\widehat{F}_{t-1}^{Eur}\right)^2 \qquad (2)$$
$$+ \delta_1^{\prime\mathbf{y}} \widehat{F}_{t-1}^{US} + \delta_2^{\prime\mathbf{y}} \left(\widehat{F}_{t-1}^{US}\right)^2 + \phi^{\mathbf{y}} y_{t-1} + \theta^y X_t$$

where X_t includes any additional variables such as the country specific term spread, the country specific dividend yield, and the VIX volatility index.

The conditional volatility is estimated using a similar linear projection based upon the following factor augmented model by simply replacing $\widehat{y}_t$ with $\widehat{Vol}_t$ and the parameters are changed accordingly e.g. from α^y to α^v. The conditional skewness $(\widehat{Sk}_t)$ and conditional kurtosis $(\widehat{Ku}_t)$ are also estimated using similar factor augmented models.

In the empirical analysis we select a more parsimonious specification for eq. (2) (for all four variables) by following a general-to-specific search (deleting the least significant regressor and re-estimating the regressions each time). The reported models are selected using the BIC and retaining only variables that are significant at the 1% level of significance. We investigate the effects of using no factors ($\beta_1^i = \beta_2^i = \gamma_1^i = \gamma_2^i = \delta_1^i = \delta_2^i = 0$), only local factors ($\gamma_1^i = \gamma_2^i = \delta_1^i = \delta_2^i = 0$), only local and Euro factors ($\delta_1^i = \delta_2^i = 0$), and all factors simultaneously for the risk-return relation ($i = y, v, s, k$, where

[4] With a slight misuse of notation letting y_t denote monthly values in place of daily ones.

y is the return regression, v is the volatility regression, s is the skewness regression, and k is the kurtosis regression).

3.2 Risk-Return Regressions

In the most simple setting, we consider the following risk-return relationship (e.g., Ludvigson and Ng (2007)) where the current conditional return is explained by its own lag and the current and lagged values of the conditional risk measures.

$$
\begin{aligned}
\widehat{y}_t = {} & c_1 + c_2 \widehat{y}_{t-1} + c_3 \widehat{Vol}_t + c_4 \widehat{Vol}_{t-1} \\
& + c_5 \widehat{Sk}_t + c_6 \widehat{Sk}_{t-1} + c_7 \widehat{Ku}_t + c_8 \widehat{Ku}_{t-1} + e_t
\end{aligned} \tag{3}
$$

Subsequently, we let the risk-return relationship depend on the business cycle. We use the binary variable D_t to indicate if a country is in a recession at time t. Then the regression becomes

$$
\begin{aligned}
\widehat{y}_t = {} & c_{11} + c_{12} \widehat{y}_{t-1} + c_{13} \widehat{Vol}_t + c_{14} \widehat{Vol}_{t-1} \\
& + c_{15} \widehat{Sk}_t + c_{16} \widehat{Sk}_{t-1} + c_{17} \widehat{Ku}_t + c_{18} \widehat{Ku}_{t-1} \\
& + c_{19} D_t + c_{20} D_t \widehat{y}_{t-1} + c_{21} D_t \widehat{Vol}_t + c_{22} D_t \widehat{Vol}_{t-1} \\
& + c_{23} D_t \widehat{Sk}_t + c_{24} D_t \widehat{Sk}_{t-1} + c_{25} D_t \widehat{Ku}_t + c_{26} D_t \widehat{Ku}_{t-1} + e_t
\end{aligned} \tag{4}
$$

Lastly, we use the Markov switching model to describe the risk-return relationship.[5] The intuition is that the relationship can vary over time, switch-

[5] For more details on the Markov switching method and its popularity in the finance literature, cf. e.g. Guidolin (2011).

ing between two states such as the normal and the unusual state. To uncover this property, we let s_t denote an unobservable state variable, which follows a first order Markov chain with transition probabilities

$$\begin{aligned} prob(s_t = 1|s_{t-1} = 1) &= p_{11} \\ prob(s_t = 2|s_{t-1} = 2) &= p_{22} \end{aligned} \tag{5}$$

that determine the persistence of each state. The first state is the most common, $p_{11} > p_{22}$. The Markov switching risk-return trade-off regression is then given by

$$\begin{aligned} \widehat{y}_t = & c_1^{s_t} + c_2^{s_t}\widehat{y}_{t-1} + c_3^{s_t}\widehat{Vol}_t + c_4^{s_t}\widehat{Vol}_{t-1} \\ & + c_5^{s_t}\widehat{Sk}_t + c_6^{s_t}\widehat{Sk}_{t-1} + c_7^{s_t}\widehat{Ku}_t + c_8^{s_t}\widehat{Ku}_{t-1} + e_t \end{aligned} \tag{6}$$

where the parameters are constant but different in the two states,

$$c_i^{s_t} = \begin{cases} c_i^1 & \text{for} \quad s_t = 1 \\ c_i^2 & \text{for} \quad s_t = 2 \end{cases}, i = 1, ..., 8 \tag{7}$$

The residual follows a conditional normal distribution and its variance is state dependent: $e_t \sim N\left(0, \sigma_{s_t}^2\right)$ where

$$\sigma_{s_t}^2 = \begin{cases} \sigma_1^2 & \text{for} \quad s_t = 1 \\ c_2^2 & \text{for} \quad s_t = 2 \end{cases}. \tag{8}$$

Regime Classification Measures (RCM) have been popularized, see e.g. Ang and Bekaert (2002) as a way to assess the quality of the model's performance. We adopt the following regime classification measure

$$RCM = 100 \times \frac{4}{T}\sum_{t=1}^{T}\xi_{t/T}^{1}\xi_{t/T}^{2} \tag{9}$$

where $\xi_{t/T}^{j} = prob(s_t = j|\widehat{y}_1, ..., \widehat{y}_T; \widehat{\theta})$ for $j = 1, 2$ is the smoothed state probability. That is, the sample average of the products of the smoothed state probabilities. A perfect model will be associated with a RCM close to 0, while a model that cannot distinguish between regimes at all will have a RCM close to 100.

The Markov switching model has the advantage that it does not *a priori* choose a state variable. Instead, the regime classification in this model is probabilistic and determined by the data.

4 Empirical Findings

Throughout we use robust standard errors.

4.1 Factor Estimation

First we estimate a relatively large number of factors (10) for each country and choose the most important ones using the Bai and Ng (2002) criterion. The number of factors that sufficiently describe the data set is 6 for all countries. We present summary statistics of the estimated factors for each country as well as for the Euro area and the US. In particular, in Table 1 we report the accumulated fraction of variation in the data explained by the factors. The first factor explains the largest fraction of the total variation in the panel of data (which varies from 27% for Italy to 40% for the Euro area). The six first factors account for more than 80% of the variability in the data set of each country. To assess the persistence of the estimated factors we also report the first order autoregressive coefficient for each factor with the coefficients showing considerable heterogeneity ranging from small negative (-0.18) to large positive (0.87). This is similar to Ludvigson and Ng (2007).

4.2 Conditional Return and Conditional Risk Measures

Now we present the best models for the conditional return and conditional risk measures for each country. The selection is made among a range of possible specifications that include local, Euro-area, and US factors along with their squared terms, as well as other important variables (the term spread and the dividend yield for the return equation, the VIX volatility index for the volatility equation, and all three variables for the skewness and kurtosis regressions) highlighted in the related literature, see for instance Guo and Whitelaw (2006).

Table 2 displays the results for the conditional return specification from eq. (2) using three specifications: with local factors, with local and Euro factors, and with local, Euro, and global factors. As we move from the restricted to the unrestricted regressions, there is an improvement in fit with the included regressors being similar which is an indication that our specifications search is robust. For France and Germany, local factors are important determinants of the estimated excess returns along with a number of US factors and the term spread. Similarly, the returns for Italy are predicted by local and US factors coupled with Euro squared terms. Switzerland and the UK are rather affected by the US factors along with some squared local factors (and squared Euro factors for the case of Switzerland). Finally, a typical financial ratio such as the dividend yield is an important predictor for fitted returns of all countries except from Germany, with the expected negative coefficient. The explanatory power of the factors is generally large as the adjusted R^2 statistic is large for all countries except for the UK.

Table 3 shows the factors that contain significant information about the conditional volatility according to the volatility version of eq. (2). As in the case of conditional returns, local and US factors along with their squared terms are important predictors for future conditional volatility of France, Germany, and Italy, while for the case of Switzerland and the UK, the conditional volatility is predicted by US and US squared factors (along with a single Euro factor for the case of the UK). The VIX is an important determinant of conditional volatility for all countries. This finding corroborates with the US results in Guo and Whitelaw (2006). The explanatory power of the factors for the volatility is fairly large with adjusted R^2 values ranging from 43% to 69%. The explanatory power is much larger in the volatility equation than in the return equation, except for Germany where they are of about the same size. This was not unexpected since first moments of returns are generally more difficult to estimate than second moments (Merton (1980)).

Tables 3 and 4 show the factors that contain significant information about the conditional skewness and the conditional kurtosis. These two risk measures are not so well described by the macro finance factors as the traditional risk measure. The R^2 statistics are fairly low in all cases and only few factors are significant. It is new to the literature to use macro-finance variables to explain higher-order moments so we do not have any previous findings to compare these results to.

In summary, conditional returns and conditional volatility can be predicted using a relatively small number of factors, their squared terms, and a few other variables. The conditional volatility is better explained by the factors than the conditional return is. The conditional skewness and conditional kurtosis are not well explained by the factors, i.e. the higher order moments appear not to be highly related to macro-finance variables.

The conditional returns and conditional risk measures are standardized in the remaining analysis.

4.3 Choice of Factors

Table 6 displays the results of risk-return trade-off as it appears when the conditional return and the conditional risk measures are projected upon the different sets of factors, similar to Tables 2 to 5. For Switzerland and the UK it is important to account for all factors when constructing the conditional return and conditional risk measures because the explanatory power of the risk-return trade-off regression is stronger the more factors that are taken into account. Opposite for France where the best fit is achieved when local and Euro area factors only are considered. Interestingly, for Germany and Italy the model with local factors only achieves the best goodness of fit. Thus, we consider the specifications with the largest R^2 values (indicated by boldface) as the benchmarks specifications to build further analysis upon.

4.4 Linear Risk-Return Results

The benchmark linear regressions without and with the recession indicators (see eq. (3) and (4)) are summarized in Table 7. First we focus on the risk-return trade-off as it appears from the linear model without recession indicators.

The explanatory power of the risk-return trade-off equations differs across the European stock markets. It is largest for Switzerland with an adjusted R^2 of 62%, followed by Germany (48%), Italy (35%), France (34%), and the UK (32%). Overall, the conditional risk measures have a very large explanatory power for the conditional returns. For comparison, Ludvigson and Ng (2007) find an R^2 for the US of 41%.

The autoregressive dynamics have a positive sign, which is most reasonable. The current conditional volatility has a negative effect upon the conditional return with the lagged conditional volatility having a positive effect. The sign of the effects is opposite to that of the US stock market documented in Ludvigson and Ng (2007). Nevertheless, summing up the coefficients the relation is negative. In this way we find similar total effect to Ludvigson and Ng (2007).

The new risk measures also play a significant part in the risk-return trade-off. Large skewness implies that the mass of the distribution is centered at the left of the distribution and that the right tail is longer. Thus, we expect that there is a positive relation between conditional skewness and conditional returns. The risk from the current conditional skewness has a positive influence on the returns for Germany and Italy and no effect for the other countries. Thus, this effect is more or less as expected.

Large kurtosis implies fat tails, so we expect there is a positive relation between conditional kurtosis and conditional returns. The conditional kurtosis has a negative influence upon conditional returns for France and a positive effect for Switzerland and no effects for the other countries. The lagged kurtosis has a negative effect for Germany and Switzerland. Similar to the volatility risk, the kurtosis risk has opposite effects from what is expected.

Generally, the risk-return trade-off in the European stock markets is significantly different between recessions and expansions (except for Switzerland). Still, the explanatory power of the risk-return regressions is only slightly larger in the recession model than in the linear model. Typically the recession coefficients have opposite signs of the normal coefficients. So the effects from the risk measures is typically weaker in recessions. Overall, the differences in risk-return trade-off across the business cycles are fairly small. Lustig and Verdelhan (2012) find that there are large differences in the risk-return trade-off across the business cycle, the trade-off being stronger in recessions. So, our results are quite different.

4.5 Markov Switching Risk-Return Results

Table 8 shows the results from estimating the Markov switching risk-return trade-off model from eq. (6). We find evidence of two well distinguished states as the RCM's are small (from 12 to 38). We denote the persistent state 1 the normal state, while state 2 is the unusual state. State 1 applies between 55% and 76% of the time. The explanatory power of the Markov switching regressions is high (R^2 is above 44% for all countries) and particularly so for Germany (R^2 of 85%). For all countries, the explanatory power of the Markov switching model is larger than for the linear model.

As expected, in state 1, the risk-return trade-off is similar to that in the simple linear model. The contemporaneous conditional volatility has a negative effect upon the conditional return, while the coefficient of lagged conditional volatility is positive. The effect from the lagged return itself is positive. The skewness and kurtosis risk variables are only significant in a few cases.

On the other hand, in state 2 the effect from the contemporaneous volatility is still negative but the effect is less strong than in state 1. The effect from the lagged volatility is unaltered positive. The skewness and kurtosis risk measure are more important in state 2. Still, the signs are not totally in accordance with expectations.

Figure 1 shows the smoothed state probabilities for each of the countries as well as their recession periods. The figure stresses that the business cycles are not one-to-one related to the state.

We investigate if a selected set of variables can explain which state the stock market is in. The stock market is in state j when the smoothed state probability exceeds 0.5, that is when $\xi^j_{t/T} > 0.5$. We use a probit model for each country where the dependent variable is an indicator for being in state 2, $[\xi^2_{t/T} > 0.5]$ and the independent variables are the country specific recession dummy, the country specific term spread, the country specific dividend yield, and the VIX volatility index (all variables are standardized). The results are shown in Table 9. Combined, the four variables have a fairly high explanatory power with McFadden R^2 values ranging between 18% (Germany) and 51% (Switzerland). State 2 is positively related to the recession indicator. So it is likely that the unusual state overlaps with recession periods. The country specific term spread has a negative effect for Italy, a positive effect for Germany and Switzerland, and no effect for the other two countries. The country specific dividend yield has a negative effect for all countries. The effect from the volatility index is positive except for Switzerland Overall, the variables help explain the state of the stock market. We observe large differences across countries.

5 Conclusion

In this paper we add to the risk-return trade-off literature in many ways. First, we broaden the existing literature by analyzing five large European stock markets instead of only considering the US stock market. Second, we construct conditional returns and conditional risk measures using factors that are based upon a large number of macro-finance variables. Third, we consider the effect of using local, regional, and global factors and the optimal choice varies across countries. Fourth, we show that there is a strong relation between conditional returns and conditional volatilities. The relation has the opposite sign as for the US. Fifth, we add two new conditional risk measures, namely the conditional skewness and the conditional kurtosis to the risk-return trade-off analysis. Sixth, the risk-return trade-off differs a little bit across the business cycle. Seventh, the Markov switching model describes the risk-return relationship well. The most common state is similar to what is seen in the simple linear model. The other state has higher residual variance and the relation is either stronger or non-existing. Eighth, we find that certain variables help explain the state of the stock market.

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Table 1: Summary Statistics for Factors

	France		Germany		Italy		Switzerland		UK		Euro		US	
i	AR1	%Acc	AR1	%Acc	AR1	%Acc	AR1	%Acc	AR1	%Acc	AR1	%Acc	AR1	%Acc
1	0.20	0.38	0.37	0.32	0.12	0.27	0.80	0.33	0.18	0.32	0.22	0.40	0.43	0.30
2	0.74	0.54	0.48	0.46	0.11	0.44	0.38	0.50	0.61	0.53	0.87	0.55	0.64	0.48
3	0.13	0.62	0.11	0.57	0.08	0.58	0.28	0.61	0.82	0.66	0.10	0.66	0.03	0.61
4	0.13	0.69	-0.03	0.66	0.07	0.67	0.32	0.70	-0.09	0.75	0.21	0.74	0.80	0.71
5	-0.18	0.76	0.43	0.74	0.07	0.75	0.04	0.77	0.43	0.80	0.03	0.80	0.22	0.78
6	-0.07	0.82	0.00	0.81	0.19	0.81	0.14	0.82	0.07	0.84	-0.10	0.85	0.17	0.83

Notes: The table shows the summary statistics for the factors where AR1 is the first order autocorrelation coefficient and %Acc is the accumulated fraction of total variation in the data explained by factors.

Table 2: Return Regressions

	France			Germany			Italy			Switzerland			UK		
	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global
constant	0.007	0.007	0.031	0.008	0.007	0.006	0.014	-0.011	-0.016	0.037	0.040	0.039	0.009	0.009	0.035
Local Factor 1				-0.147				-0.299					0.211	0.211	
Local Factor 2	-0.334	-0.334		-0.244	-0.253	-0.187	0.206			0.268	0.329				
Local Factor 3	-0.267	-0.267	-0.206				-0.297	-0.221	-0.410						
Local Factor 4	0.546	0.546	0.542	-0.419	-0.407	-0.361							-0.214	-0.214	
Local Factor 5	-0.407	-0.407	-0.394	-0.210	-0.181	-0.112									
Local Factor 6	-0.509	-0.509	-0.495	-0.919	-0.933	-0.978	-0.204	-0.330	-0.265						
Euro Factor 1								-0.870							
Euro Factor 6					-0.124	-0.141					-0.163				
US Factor 1			-0.624									-0.373			-0.304
US Factor 2			0.561			0.165			0.334						
US Factor 3			-0.315						-0.437			-0.347			-0.315
US Factor 5									-0.210			-0.147			
US Factor 6						-0.248									
$(\text{Local Factor 2})^2$							5.372	6.594	5.194				-13.343	-13.343	
$(\text{Local Factor 3})^2$									2.941						
$(\text{Local Factor 4})^2$	-2.426	-2.426	-2.108							-2.907	-3.082	-3.870	-3.490	-3.490	-4.286
$(\text{Local Factor 6})^2$				-1.625	-1.547	-1.314									
$(\text{Euro Factor 1})^2$									8.262		5.0313				
$(\text{Euro Factor 2})^2$									-3.308		-2.121	-1.434			
$(\text{Euro Factor 4})^2$									1.507		1.107				
$(\text{US Factor 3})^2$						-3.155									
$(\text{US Factor 4})^2$						2.178									
Term Spread			0.005	-0.006	-0.006	-0.006									
Dividend Yield			-0.010				-0.008	-0.008	-0.009	-0.015	-0.0178	-0.014			-0.008
y_{t-1}	-0.271	-0.271	-0.538	-0.106		-0.122		-0.126	-0.248						
BIC	-6.09	-6.09	-6.18	-6.64	-6.67	-6.71	-5.48	-5.61	-5.49	-6.07	-6.07	-6.13	-6.14	-6.14	-6.11
R^2	0.38	0.38	0.47	0.66	0.66	0.70	0.10	0.15	0.20	0.07	0.13	0.16	0.06	0.06	0.09

Notes: The table shows the coefficients from the return regression in eq. (2). The models are selected according to BIC. All coefficients are significant at the 1% level.

Table 3: Volatility Regressions

	France			Germany			Italy			Switzerland			UK		
	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global
constant	0.015	0.014	0.019	0.022	0.018	0.020	0.019	0.019	0.029	0.006	0.012	0.017	0.009	0.010	0.014
Local Factor 1		0.059			0.050	0.083	0.098						-0.087		
Local Factor 2	0.053				-0.070	-0.095		0.098							
Local Factor 3				0.058			0.080	0.080	0.093					-1.659	
Local Factor 4	-0.140	-0.147	-0.130	0.057				1.558						1.594	
Local Factor 5		0.051	0.086							-0.066					
Local Factor 6	0.122	0.121	0.153	0.148	0.145	0.173							-0.065		
Euro Factor 6															-0.053
US Factor 1						-0.171									
US Factor 2			-0.116						-0.095			-0.158			-0.110
US Factor 5			-0.113												
US Factor 6			-0.055			0.079									
$(\text{Local Factor 1})^2$				1.107	1.421					1.767	1.780				
$(\text{Local Factor 2})^2$	0.976	1.053											6.134		
$(\text{Local Factor 3})^2$						0.711				-1.281	-2.180	-1.702	-1.255		-1.53
$(\text{Local Factor 4})^2$	1.604	1.559	1.397		1.220	1.250	1.558		1.610	1.179	1.442	1.108	1.214		1.559
$(\text{Local Factor 5})^2$	0.676	0.685	0.565												
$(\text{Local Factor 6})^2$				2.289	2.245	2.315									
$(\text{Euro Factor 2})^2$					-1.082	-0.945					1.039			1.105	0.728
$(\text{Euro Factor 3})^2$		-0.579													
$(\text{US Factor 1})^2$			-2.590			-4.402									-2.979
$(\text{US Factor 2})^2$			2.023			2.073			1.887			2.468			1.389
VIX	0.085	0.090	0.086	0.143	0.150	0.149	0.058	0.058		0.114	0.084	0.102	0.078	0.067	0.069
RV_{t-1}	0.246	0.260	0.176				0.398	0.398	0.388	0.218	0.221		0.394	0.409	0.276
BIC	-7.96	-7.94	-8.00	-8.08	-8.10	-8.12	-7.56	-7.56	-7.59	-7.67	-7.76	-7.78	-8.00	-7.94	-7.95
R^2	0.57	0.58	0.61	0.64	0.66	0.69	0.40	0.40	0.42	0.37	0.37	0.43	0.47	0.48	0.52

Notes: The table shows the coefficients from the volatility regression in eq. (2). The models are selected according to BIC. All coefficients are significant at the 1% level.

Table 4: Skewness Regressions

	France			Germany			Italy			Switzerland			UK		
	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global
constant	-0.020	-0.020	-0.020	-0.176	-0.176	-0.176	0.015	-0.044	0.147	-0.413	-0.413	-0.243	-0.063	-0.063	-0.066
Local Factor 1												1.966			
Local Factor 2													4.925	4.925	4.423
Euro Factor 4								-1.249	-1.283						
US Factor 1												118.996			
US Factor 2									-2.243						
US Factor 3									-2.891						
US Factor 4															-1.800
US Factor 5															1.747
US Factor 6															-1.578
$(\text{Local Factor 1})^2$	26.125	26.125	26.125												
$(\text{Local Factor 2})^2$				26.186	26.186	26.186									
$(\text{Local Factor 3})^2$															
$(\text{Local Factor 4})^2$	-26.485	-26.485	-26.485												
$(\text{Local Factor 5})^2$										32.307	32.307				
$(\text{Local Factor 6})^2$				24.046	24.046	24.046									
$(\text{US Factor 1})^2$												118.996			
$(\text{US Factor 4})^2$												47.364			
$(\text{US Factor 5})^2$												-24.996			
Dividend Yield							-0.047		-0.061			0.051			
VIX										1.003	1.003				
BIC	-1.22	-1.22	-1.22	1.14	1.14	-1.14	-1.10	-1.10	-1.08	-1.14	-1.14	-1.11	-1.23	-1.23	-1.22
R^2	0.03	0.03	0.03	0.05	0.05	0.05	0.01	0.01	0.04	0.03	0.03	0.05	0.02	0.02	0.05

Notes: The table shows the coefficients from the skewness regression in eq. (2). The models are selected according to BIC. All coefficients are significant at the 1% level.

Table 5: Kurtosis Regressions

	France			Germany			Italy			Switzerland			UK		
	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global	Local	Euro	Global
constant	3.057	3.057	3.057	3.155	3.222	3.222	2.905	2.904	2.904	2.894	2.894	2.974	2.705	2.701	2.673
Local Factor 1							-6.372	-6.380	-6.380						
Local Factor 2					-5.516	-5.516									
Euro Factor 4								2.873	2.873						
Euro Factor 5					6.322	6.322									
US Factor 1												-8.642			-5.266
US Factor 4															3.213
(Local Factor 3)^2													-50.955		-53.038
(Local Factor 5)^2							64.57	66.221	66.221	57.967	57.967				
(Local Factor 6)^2	-44.514	-44.514	-44.514										75.538	47.627	85.053
(Euro Factor 5)^2					-65.770	-65.770									
Term Spread	-0.122	-0.122	-0.122	-0.184	-0.187	-0.187									
BIC	0.13	0.13	0.13	0.59	0.60	0.60	0.40	0.40	0.40	0.52	0.52	0.52	-0.10	-0.11	-0.09
R^2	0.02	0.02	0.02	0.03	0.06	0.06	0.03	0.04	0.04	0.01	0.01	0.02	0.04	0.03	0.06

Notes: The table shows the coefficients from the kurtosis regression in eq. (2). The models are selected according to BIC. All coefficients are significant at the 1% level.

Table 6: Linear Regressions Using Different Factors

France	Raw Data	Local Factors	Euro Factors	Global Factors
Cons	0.00	0.01	0.01	0.01
Ret(-1)	0.00	0.24 ***	0.27 ***	0.23 ***
Vol	-0.64 ***	-0.56 ***	-0.63 ***	-0.67 ***
Vol(-1)	0.38 ***	0.42 ***	0.47 ***	0.49 ***
Sk	-0.05	-0.15	-0.14	-0.11
Sk(-1)	-0.12 *	-0.01	0.00	-0.03
Ku	0.05	-0.27 ***	-0.23 ***	-0.14
Ku(-1)	-0.14	0.09	0.08	0.00
Adj R^2	0.24	0.29	**0.34**	0.34

Germany	Raw Data	Local Factors	Euro Factors	Global Factors
Cons	0.00	0.01	0.01	0.01
Ret(-1)	0.01	0.08	0.05	0.05
Vol	-0.61 ***	-1.11 ***	-1.01 ***	-0.36 ***
Vol(-1)	0.31 ***	0.73 ***	0.62 ***	0.16
Sk	0.02	0.27 ***	0.25 ***	-0.03
Sk(-1)	0.04	-0.08	-0.07	0.02
Ku	-0.03	-0.06	-0.04	-0.09
Ku(-1)	-0.10 *	-0.12 **	-0.14 ***	-0.11 *
Adj R^2	0.24	**0.48**	0.41	0.11

Italy	Raw Data	Local Factors	Euro Factors	Global Factors
Cons	0.00	0.01	0.00	0.00
Ret(-1)	0.10	0.29 ***	0.35 ***	0.31 ***
Vol	-0.47 ***	-0.55 ***	-0.35 ***	-0.30 ***
Vol(-1)	0.31 ***	0.32 ***	0.21 *	0.08
Sk	0.17 **	0.22 ***	0.02	0.03
Sk(-1)	-0.08	0.16 ***	0.26 ***	0.19 ***
Ku	0.04	0.00	0.07	0.10
Ku(-1)	-0.13 **	-0.06	-0.01	-0.08
Adj R^2	0.15	**0.35**	0.31	0.24

Switzerland	Raw Data	Local Factors	Euro Factors	Global Factors
Cons	0.00	0.02	0.01	0.00
Ret(-1)	0.02	0.68 ***	0.54 ***	0.57 ***
Vol	-0.62 ***	-0.29 ***	-0.56 ***	-0.33 ***
Vol(-1)	0.24 ***	0.21 ***	0.32 ***	0.30 ***
Sk	-0.08	-0.09 *	-0.08	-0.02
Sk(-1)	0.23 ***	0.15 ***	0.16 ***	0.00
Ku	0.19 **	-0.09	-0.02	0.59 ***
Ku(-1)	-0.07	-0.05	-0.06	-0.25 ***
Adj R^2	0.35	0.54	0.54	**0.62**

UK	Raw Data	Local Factors	Euro Factors	Global Factors
Cons	0.00	-0.01	-0.01	-0.01
Ret(-1)	0.03	0.38 ***	0.38	0.51 ***
Vol	-0.68 ***	-0.70 ***	-0.62	-0.29 ***
Vol(-1)	0.45 ***	0.45 ***	0.36	0.33 ***
Sk	0.01	-0.01	-0.01	0.06
Sk(-1)	-0.06	0.00	-0.02	-0.04
Ku	-0.11	0.22 ***	0.22	-0.06
Ku(-1)	0.08	-0.01	-0.02	0.11
Adj R^2	0.27	0.32	0.34	**0.36**

Notes: The table shows the results from the regressions in eq. (3) using various restrictions on the factors in eq. (2). */**/*** indicates that the parameter is significant at the 10%/5%/1% level.

Table 7: Linear Risk-Return Regressions

	France		Germany		Italy		Switzerland		UK	
Cons	0.01	0.03	0.01	0.00	0.01	0.03	0.00	0.00	-0.01	-0.02
Ret(-1)	0.27 ***	0.31 ***	0.08	0.19 ***	0.29 ***	0.37	0.57 ***	0.61 ***	0.51 ***	0.48 ***
Vol	-0.63 ***	-0.73 ***	-1.11 ***	-1.24 ***	-0.55 ***	-0.51	-0.33 ***	-0.32 ***	-0.29 ***	-0.40 ***
Vol(-1)	0.47 ***	0.62 ***	0.73 ***	1.00 ***	0.32 ***	0.34	0.30 ***	0.27 ***	0.33 ***	0.39 ***
Sk	-0.14	-0.11	0.27 ***	0.27 ***	0.22 ***	0.14	-0.02	0.01	0.06	0.04
Sk(-1)	0.00	0.00	-0.08	-0.22 ***	0.16 ***	0.12	0.00	0.01	-0.04	-0.06
Ku	-0.23 ***	-0.13	-0.06	-0.07	0.00	-0.01	0.59 ***	0.59 ***	-0.06	-0.25
Ku(-1)	0.08	0.05	-0.12 **	-0.10 *	-0.06	0.05	-0.25 ***	-0.25 ***	0.11	0.15
D		0.35		0.03		-0.34		-0.04		0.02 **
D*Ret(-1)		0.03		-0.34 ***		-0.27		-0.09		0.08
D*Vol		0.40 ***		0.28		-0.48		-0.03		0.31
D*Vol(-1)		-0.37 ***		-0.56 ***		0.42		0.04		-0.21
D*Sk		0.16		-0.03		0.35		-0.07		0.02
D*Sk(-1)		-0.37		0.27 ***		0.00		0.00		-0.08
D*Ku		-0.64 ***		-0.08		-0.10		0.00		0.37
D*Ku(-1)		-0.23		-0.06		-0.47		-0.03		-0.13
Adj-R^2	0.34	0.37	0.48	0.51	0.35	0.42	0.62	0.61	0.36	0.37
BIC	-0.32	-0.24	-0.57	-0.49	-0.35	-0.34	-0.86	-0.72	-0.35	-0.20
Wald test stat for all D's=0		27.62 ***		11.81 **		37.93 ***		6.82		9.93 **

Notes: The table shows the results from the regressions in eq. (3) and (4). D is the country specific recession indicator. */**/*** indicates that the parameter is significant. France: European factors. Germany: local factors. Italy: local factors. Switzerland: global factors. UK: global factors.

Table 8: Markow Switching Risk-Return Regressions

	France	Germany	Italy	Switzerland	UK
Regime 1					
Cons	-0.28 ***	-0.37 ***	-0.13 **	-0.28 ***	-0.20 *
Ret(-1)	0.20 ***	0.02	0.45 ***	0.31 ***	0.59 ***
Vol	-1.13 ***	-1.00 ***	-0.46 ***	-0.48 ***	-0.44 **
Vol(-1)	0.70 ***	0.46 ***	0.11	0.27 ***	0.19
Sk	0.00	0.11 ***	0.08	0.02	0.06
Sk(-1)	0.05	0.08 *	0.28 ***	-0.05	-0.10
Ku	-0.10	0.08	0.00	0.43 ***	-0.05
Ku(-1)	0.04	-0.19 ***	-0.02	-0.05	0.09
σ	0.22 ***	0.24 ***	0.37 ***	0.34 ***	0.91 ***
Regime 2					
Cons	0.47 ***	0.67 ***	0.62 ***	0.55 ***	0.21 ***
Ret(-1)	0.11	-0.13 ***	-0.05	0.18 **	0.24 ***
Vol	-0.40 ***	-0.54 ***	-0.42 ***	-0.21 ***	-0.27 ***
Vol(-1)	0.14	0.37 ***	0.75 **	0.19 ***	0.39 ***
Sk	-0.33 ***	0.85 ***	0.24	-0.06	0.04
Sk(-1)	-0.14 ***	-0.20 ***	-0.22 *	0.11 **	-0.15 ***
Ku	-0.29 ***	0.07 *	-0.07	0.58 ***	0.14 ***
Ku(-1)	0.00	-0.02	-0.03	0.10	0.08
σ	0.79 ***	0.13 ***	0.39 ***	0.16 ***	0.21 ***
p11	0.94 ***	0.78 ***	0.94 ***	0.97 ***	0.92 ***
p22	0.90 ***	0.73 ***	0.81 ***	0.96 ***	0.91 ***
p(s(t)=1)	0.62	0.55	0.75	0.63	0.52
E(Duration regime 1)	15.9	4.5	15.8	39.9	12.1
E(Duration regime 2)	9.9	3.6	5.4	23.2	11.3
Adj R^2	0.61	0.85	0.65	0.74	0.44
RCM	23.3	37.3	33.7	12.7	34.1

Notes: The tables shows the results from the model in eq. (6). */**/*** indicates that the coefficient is significant at the 10%/5%/1% level. France: European factors. Germany: local factors. Italy: local factors. Switzerland: global factors. UK: global factors.

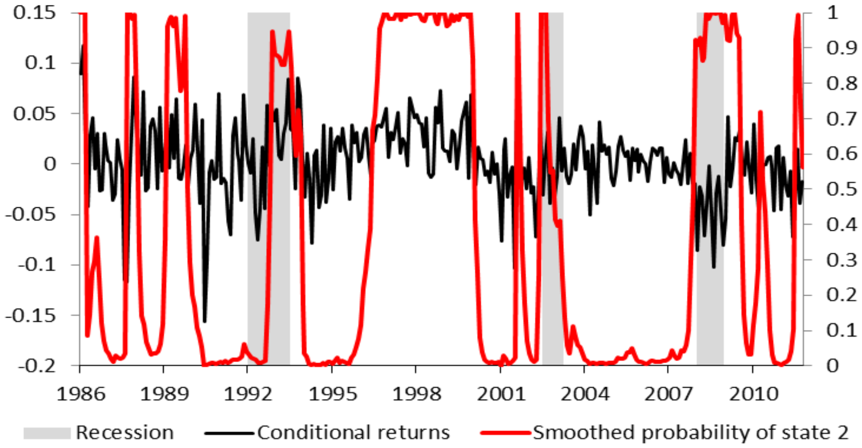
Table 9: Probit Models for State 2

	France	Germany	Italy	Switzerland	UK
cons	-0.57 ***	-0.19 **	-1.13 ***	-0.97 ***	-0.25 ***
D (recession)	0.98 ***	0.44 *	0.73 **	0.69 ***	1.52 ***
Term Spread	-0.08	0.43 ***	-0.35 ***	0.98 ***	-0.11
Dividen Yield	-0.29 ***	-0.57 ***	-0.75 ***	-1.17 ***	-0.69 ***
VIX	0.76 ***	0.25 ***	0.22 **	-0.30 ***	0.09
McFadden R^2	0.21	0.18	0.19	0.51	0.18

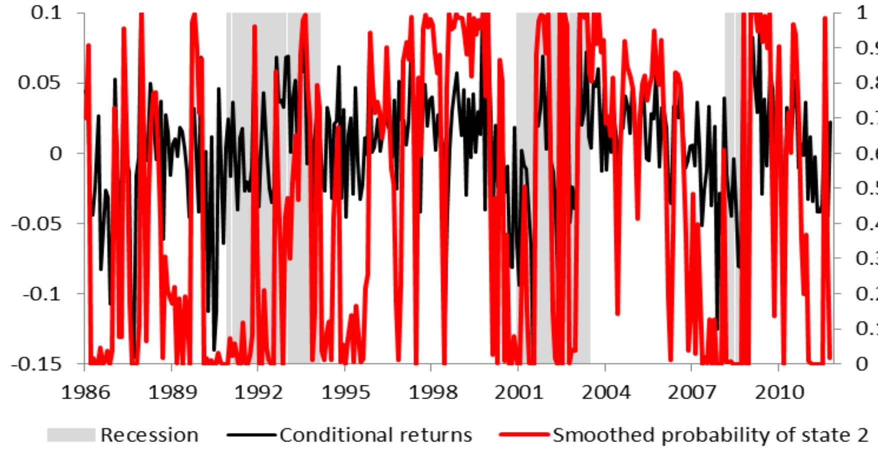
Notes: The tables shows the results from the probit model for the indicator variable for state 2. */**/*** indicates that the coefficient is significant at the 10%/5%/1% level. France: European factors. Germany: local factors. Italy: local factors. Switzerland: global factors. UK: global factors.

Figure 1: Smoothed Probability of State 2

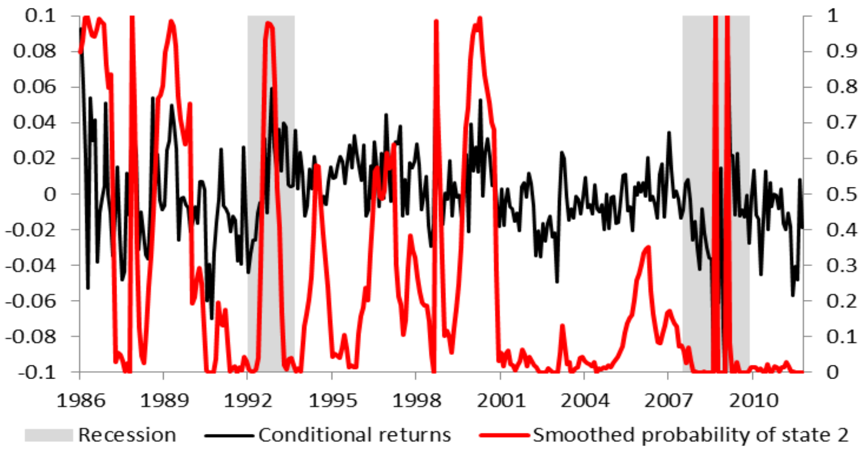
France



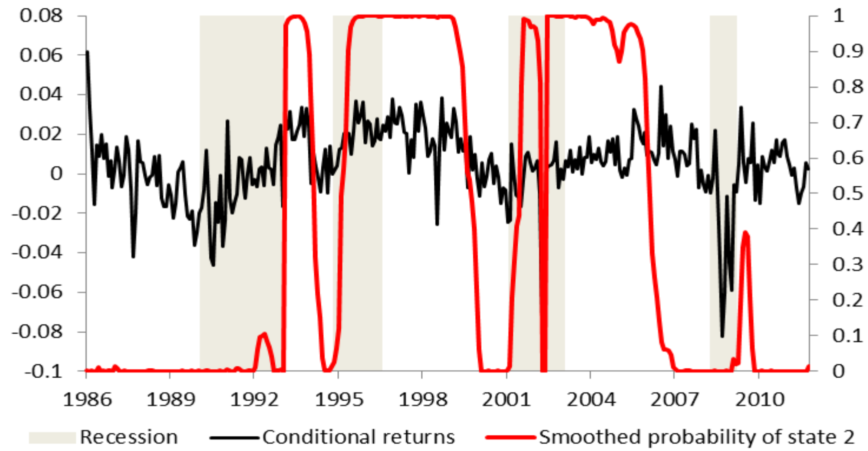
Germany



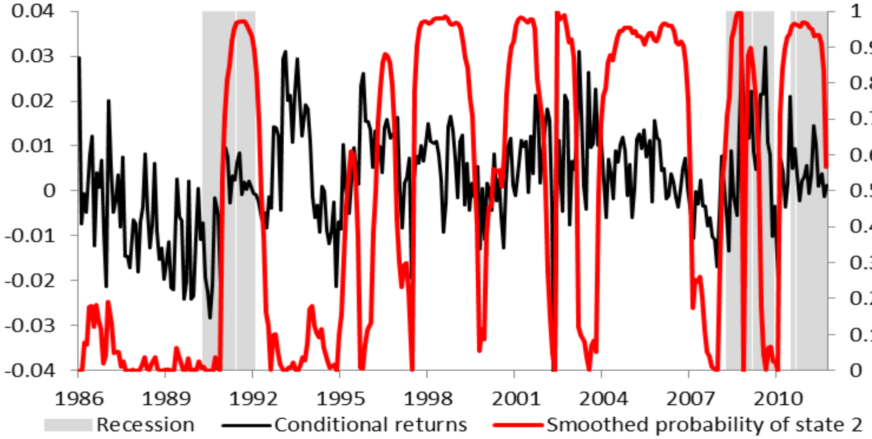
Italy



Switzerland



UK



0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
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1986
1989
1992
1995
1998
2001
2004
2007
2010
Recession
Conditional returns
Smoothed probability of state 2

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