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Risk-return trade-off for European stock markets☆

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ABSTRACT

This paper adopts factor models with macro-finance predictors to test the intertemporal risk-return relation for 13 European stock markets from 1986 to 2012. We use country specific, euro area, and US macro-finance factors to determine the conditional volatility and conditional return. We find that the risk-return trade-off is generally negative. The Markov switching model documents that there is time-variation in this trade-off that is linked to the state of the economy, but not the business cycles. Quantile regressions show that the risk-return trade-off is stronger at the lowest quantile of the conditional return.

1. Introduction

The risk-return trade-off is fundamental to many areas within financial economics such as optimal portfolio choice and risk analysis. Initially, finance theory postulates a positive risk-return relation, both across assets and over time. For instance, the Intertemporal Capital Asset Pricing Model (ICAPM) of Merton (1973) suggests that the conditional expected excess return on the stock market should vary positively with the market's conditional volatility. However, the literature testing the intertemporal risk-return trade-off documents that the relation is unstable and often can be negative; for recent contributions see, Ghysels, Santa-Clara, & Valkanov (2005), Ludvigson & Ng (2007), and Brandt & Wang (2010), among others.[1]

To explain the mixed results Abel (1988), Backus & Gregory (1993), and Gennotte & Marsh (1993) propose models in which a negative risk-return relation is theoretically plausible. For example, Backus & Gregory (1993), using a dynamic asset-pricing model, examine the relation in a series of numerical examples and show that it can be of virtually any shape; a negative risk-return relation applies when the autocorrelation of the state variables is positive. Another theoretical framework that can generate a negative relation between first and second moments of returns is the model considered by Whitelaw, (2000). He assumes that consumption growth follows a regime-switching process and shows that such a structure can generate time-variation as well as a negative relation between expected returns and volatility.

Since theory supports both a positive and a negative risk-return trade-off across time, the sign of the intertemporal relationship is primarily an empirical question that we set out to answer thoroughly here.

We investigate the risk-return relation for 13 Western European stock markets, mainly old EU member states. So far, little attention has been given to Europe as most studies focus on the US stock market. Extending the US results to a European setting is a worthy exercise, given the importance of these countries and the ongoing process of integration of the European financial markets. Leon, Nave, & Rubio (2007) find that the time series risk-return trade-off for five European stock markets is positive for the sample period 1988 to 2003. Ang, Hodrick, Xing, & Zhang (2009) consider 23 developed stock markets and find a negative cross sectional relation between idiosyncratic volatility and future returns. Bali & Cakici (2010) consider 37 international stock markets and find a

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[1] Further empirical studies that document a negative relation include Campbell (1987), Breen, Glosten, & Jagannathan (1989), Nelson (1991), Glosten, Jagannathan, & Runkle (1993), Whitelaw (2000), Harvey (2001), and Brandt & Kang (2004).

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positive relation between systematic risk and returns and that the trade-off varies across countries.

From a methodological point of view, our work adopts factor models (Stock & Watson, 2002) that summarize the information contained in a large number of economic variables by a relatively small number of estimated factors. Ludvigson & Ng (2007) use the factor approach to determine the risk-return relation for the US stock market. Similar approaches that incorporate valuable information from large sets of macro-finance data to predict asset returns and volatilities are used by Goyal & Welch (2008) and Christiansen, Schmeling, & Schrimpf (2012).

In line with this macro-finance factor approach, we estimate the conditional return and conditional volatility of excess stock market returns using factor-augmented models. The factors are obtained using principal components analysis. We estimate country specific factors using a data set of macro-finance variables for each country separately. Further, we use euro area and US macro-finance variables to identify euro area and US factors, respectively. This way we distinguish between local (own country), regional (euro area), and global (US) factors in line with previous research on volatility spillover effects across international financial markets (Bekaert, Harvey, & Ng, 2005; Christiansen, 2007; Ng, 2000). Hereby, the systematic risk (the conditional volatility) takes into account not only local (own country), but also regional (euro area) and global (US) macro-finance factors. Thus, we consider the global CAPM setting.

First, we estimate the linear risk-return trade-off using the conditional return and conditional variance. Then, we allow the state of the economy to have an effect on the relation by considering time-varying risk-return trade-off regressions. Initially, the coefficients of the model are allowed to depend on a business cycle indicator. Subsequently, we allow for time variation by estimating the risk-return trade-off in a Markov switching framework. Finally, we allow for differences in the trade-off across the distribution of the conditional returns by using quantile regressions. 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 & Whitelaw (2006), Lustig & Verdelhan (2012), and Nyberg (2012). Finally, we take into account the effects from skewness and kurtosis risk in the risk-return relation.

The empirical findings are as follows. We find that it is important to account for country specific, euro area, as well as global macro-finance factors when determining the conditional return and risk. Thus, the international aspect is important because the European stock markets are not segmented. The risk-return trade-off is generally negative. We also find evidence of time-variation in the risk-return trade-off across the states of the economy. However, when we only consider time-variation induced by the business cycle indicator there are no signs of time-variation. Therefore, we conclude that the states of the economy with respect to the risk-return trade-off are not characterized by the business cycle alone. The quantile regressions show that the risk-return trade-off is strongest (negative) for the lowest conditional returns. The effects of higher order risk measures such as the skewness and kurtosis appear to be insignificant for the risk-return trade-off.

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 additional tables are delegated to the Appendix A.

2. Data

We focus on the stock markets of 13 Western European economies, namely Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Spain, Switzerland, and the UK. In the main text we tabulate the empirical findings concerning the four largest countries, namely France, Germany, Italy, and the UK. The results for the remaining smaller countries are reported in the Appendix A.

The data frequency is monthly with the sample covering the period from 1986*M*02 to 2012*M*05 for most countries. The sample period begins later for Austria (1991*M*8), Finland (1987*M*3), Greece (1994*M*3), and Spain (1992*M*2).

2.1. Realized volatility

Motivated by recent findings in the volatility modeling literature, we use realized volatility to model return volatility. Andersen, Bollerslev, Diebold, & Labys (2003) argue that realized volatility is free of tightly parametric functional form assumptions and provide a consistent estimate of ex-post return variability. To calculate the monthly realized volatility we use daily observations. The log-returns are obtained from the DataStream total return local currency stock indices. We use the 3-month interbank rates as risk free rates.[2] We calculate the end-of-month realized volatility for month t from daily excess returns, $y_{\tau t}$.

$$Vol_t = \sqrt{\sum\nolimits_{\tau=1}^{n_t} y_{\tau t}^2} \tag{1}$$

where n_t is the number of days in month t and τ indicates the particular day of that month ($\tau = 1,..,n_t$).

2.2. Common factors

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; Austria 110, Belgium 134, Denmark 130, Finland 134, France 152, Germany 147, Greece 125, Ireland 96, Italy 95, the Netherlands 146, Spain 155, Switzerland 152, and the UK 127. We also obtain data for the aggregate euro area (179 variables) and for the US (174 variables) to construct euro area (regional) and US (global) factors, respectively. The series are selected to represent major categories of macro-finance time series: foreign sector, output and income, sales, orders, purchases, employment, labor cost, money, prices, exchange rates, confidence indicators, stock market indices, and interest rates and spreads. The variables are made stationary (taking logs and differences where appropriate) and standardized. Further details about the data are available in the Appendix A. The choice of variables is similar to Stock & Watson (2002) and others.

3. Econometric methodology

3.1. Conditional return and conditional risk

We estimate the conditional return and conditional volatility of excess stock market returns. The first stage of the modeling procedure is to estimate common factors similar to Stock & Watson (2002) and Ludvigson & Ng (2007). Our aim is to filter out country specific, euro area, and global macro-finance factors from the conditional volatility and conditional return in order to identify the risk-return relationship. Related literature shows that there are local, regional, and global factors at play for financial market volatility spillover, e.g. Bekaert et al. (2005) and Christiansen (2007).

For each country we use the local macro-finance variables to estimate the local factors using principles components analysis. The estimates are denoted $\hat{F}_t^{loc}$ where the number of factors is determined by the Bai & Ng (2002) criterion (max 10). In a similar manner, we estimate the euro factors ($\hat{F}_t^{eur}$) and the US factors ($\hat{F}_t^{US}$) from the euro and US macro-finance variables.

Let y_t denote the excess stock market log-returns at month t. We predict the excess stock market return using a linear factor augmented regression

$$\begin{aligned}\hat{y}_t = \alpha^{\mathbf{y}} + \beta_1'^{\mathbf{y}}\hat{F}_{t-1}^{loc} + \beta_2'^{\mathbf{y}}\left(\hat{F}_{t-1}^{loc}\right)\circ\left(\hat{F}_{t-1}^{loc}\right) + \gamma_1'^{\mathbf{y}}\hat{F}_{t-1}^{eur} + \gamma_2'^{\mathbf{y}}\left(\hat{F}_{t-1}^{eur}\right)\circ\left(\hat{F}_{t-1}^{eur}\right)\\ +\delta_1'^{\mathbf{y}}\hat{F}_{t-1}^{US} + \delta_2'^{\mathbf{y}}\left(\hat{F}_{t-1}^{US}\right)\circ\left(\hat{F}_{t-1}^{US}\right) + \phi^{\mathbf{y}}y_{t-1} + \theta^{y}X_t\end{aligned} \tag{2}$$

[2] The interest rates are transformed into daily rates by the money market convention, i.e. by dividing the yearly rate by 360.