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Equity return predictability in Northern European stock exchange markets

Olga Kozlova and Valeria Shuvatova

Supervisor: Jørgen Haug

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1 Abstract

This thesis presents an analysis of equity return predictability in the stock markets of Norway, Sweden, Denmark and Finland. In consumption-based asset pricing theory, the investment decisions of an average investor are driven by the desire to increase consumption and smooth it across time periods. All multifactor models build upon this idea and include factors which are thought to affect the investors' riskiness of consumption and/or their risk aversion. We test if equity returns are predictable by the three country-level macroeconomic factors: income growth, relative unemployment and house price index growth. Changes in these variables indicate local economic expansions and contractions which we believe affect an average investor's risk-sharing decisions and stock price level in the country. We also control for the effect of the same indicators on the Euro zone level, as well as interest rate spreads, dividend yield and the consumption-wealth ratio, which have been found to predict stock returns in earlier research.

We construct a panel data set containing the four countries' all-share index excess returns, the country-level and Euro zone-level macroeconomic predictors and other controls for the period 2000 to 2016. We estimate a fixed effects regression using Driscoll and Kraay standard errors, which are robust to heteroscedasticity, autocorrelation and cross-sectional dependence present in our sample. According to our results, lower country-level income growth and higher relative unemployment, which are indicative of a local recession, are significant predictors of higher future excess stock returns on all-share indices in Oslo, Stockholm, Copenhagen and Helsinki.

2 Acknowledgements

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3 Introduction

Both in academia and industry, equity return predictability is a topic of high interest. In academia, return predictability is tied with the deeper understanding of the underlying processes in the financial markets and the mechanisms behind price formation. For those in industry, the potential to drive profits is the main motivation for improving the existing pricing models and achieving higher precision.

The existing empirical research results are far from unanimous. A range of factors have been put forward as potential equity return predictors, including past returns, some of the key financial ratios, interest rate spreads and macroeconomic characteristics. The performance of the different predictors has however often been sample-specific, which makes it challenging to draw reliable conclusions on the true nature of equity return predictability. Moreover, it is not rare to encounter results that directly contradict each other. The lack of conclusive results makes this research area potentially open to new contributions and findings.

In our master thesis, we address the relatively uncharted territory of return predictability in Northern European countries. We will consider the following question: *Do country-level macroeconomic indicators predict the return on the benchmark all-share stock indices in Norway, Denmark, Sweden and Finland?* The study of return predictability in Northern European countries is based on the similar analysis by Korniotis and Kumar (2013), who have researched the state-level return predictability contingent on local macroeconomic indicators in the United States, and who have indicated that their research method may be applied to studying country-level return predictability. Similarly to Korniotis and Kumar (2013), we test whether local recessions are associated with higher local future returns.

We believe that regression analysis that employs historical data of interest is the most appropriate empirical strategy for our purposes. We collect the index price data for four benchmark indices in Norway, Sweden, Denmark and Finland, and calculate two types of return measure: excess return over the risk-free rate and excess return over the CAPM-based expected return. We further collect the macroeconomic data for the four countries and the Euro zone and construct several macroeconomic predictors and controls. The choice of macroeconomic predictors is motivated by their ability to signal economic recessions and therefore affect the average investors through changes to their risk aversion and/or future consumption. Specifically, the main macroeconomic predictors are income growth, relative unemployment and house price index growth. Our results indicate that the economic intuition holds true, and the local recessions as signalled by income growth and relative unemployment are followed by higher returns on the benchmark indices.

Following the ideas presented by Korniotis and Kumar (2013), we further discuss the effect of local equity bias on our results and the implications of higher firm visibility and liquidity as well as the effect of a longer prediction horizon. We find that the return predictability is at least as strong for the more visible and liquid stocks, and that the return predictability deteriorates with the longer horizon.

The rest of the thesis is structured as follows. In Section 4 we present the theoretical asset pricing foundation and the mechanisms behind risk adjustment. In Section 5 we present the findings from the existing research on return predictability and the economic intuition in our benchmark article. The details on the regression model, the data construction and the econometric procedure are presented in Section 6, and the main results are found in Section 7. Section 8 contains the discussion of the results and of the economic intuition behind them as well as additional tests of the effects of higher firm visibility and a longer prediction horizon. In Section 9, we present the conclusions of the study and the potential conjunctions for future research.

4 Theory

The theoretical backbone of this thesis is laid by John H. Cochrane in his "Asset Pricing" (2005) as well as other numerous textbooks and articles. The investment decisions are closely tied with the investor's intertemporal consumption decisions, and the consumption-based asset pricing theory is the most general way of modelling these decisions. All the other asset pricing models, including CAPM and multi-factor models, are modifications of the consumption-based asset pricing theory. In the following we go through the arguments from Cochrane (2005) that explain how return predictability may be plausible from theoretical viewpoint. We combine the insight from the formal expressions for excess returns with the consumption-based model to show how risk aversion and/or consumption risk may influence future excess returns. This section also serves to provide theoretical backbone for why linear factor pricing models such as CAPM and Fama-French model as well as other potential models should include factors linked to changes in risk aversion and/or consumption risk.

In the most simple form, the model only has two periods: all that is not consumed and invested in the first period, gives the investor some payoff in the next period and is consumed then. In this way, consumption, and specifically, smooth consumption over time is one of the investor's most important objectives. Formally, this is captured by the utility of consumption. The investor balances the utility of consuming units in the current period and the discounted utility of consuming in the next period. The utility function increases in consumption (more consumption is always more preferable for investor). However, as consumption grows, the utility increases at a decreasing rate, so the marginal utility is diminishing: the utility is a lot higher when the first available unit is consumed than when the last unit is consumed. Therefore, as one starts investing, the utility in the first period is decreased only a little, in comparison with the utility that is going to be gained from this investment in the next period. Gradually, as this process continues, the investor will have to give up higher marginal utility today and gain lower marginal utility tomorrow. When the marginal utility lost today becomes equal to the discounted future marginal utility gained from the investment, the investor stops as further investment would be counterproductive.

The marginal utility from the discounted future asset payoff is therefore exactly offset by the marginal utility from the consumption of this asset in the present in the optimal investment strategy: u'(consume 1 unit today) = u'(save and consume 1 unit tomorrow). The investor will save units by purchasing assets at price p_t in the current period, which will deliver some payoff in the future. Characteristically, the exact payoff x_{t+1} is uncertain and is discounted by the discounting factor m_{t+1}, and the expected future value is equal to the price paid in the current period:

$$p_t = E_t[m_{t+1} \times x_{t+1}] \tag{1}$$

The utility is time-additive: we can express the total utility over the two periods as a sum of utility from current consumption and utility discounted by the subjective discount factor β from the next period:

$$U(c_t, c_{t+1}) = u(c_t) + \beta \times E[u(c_{t+1})] \tag{2}$$

Decreasing marginal utility is captured by the utility function $u(c_t)$=ln(c_t). A concave utility function implies risk aversion. The expected utility of a lottery is always lower than the utility of the expected payoff of this lottery. Thus, the investor will try to maximize the total consumption and will avoid risk - which implies that the investor will smooth the consumption stream. The riskiness of the asset as perceived by the investor depends on the covariance of the asset's payoffs with the consumption. This is the reason for the positive expected returns on assets like stocks and bonds, while insurance will essentially offer negative expected return. To quantify the asset price in the consumption-based asset pricing model, we derive the first order condition to the maximization problem where the investors maximize their utility in each of the two periods given the constraints to each period's consumption:

$$\begin{aligned} \max_{\zeta} \quad & u(c_t) + E_t[\beta \times u(c_{t+1})] \\ \text{s.t.} \quad & c_t = e_t - p_t \times \zeta \\ & c_{t+1} = e_{t+1} + x_{t+1} \times \zeta \end{aligned} \tag{3}$$

The constraints to the maximization problem state that the consumption today is equal to the original consumption level e_t minus the price paid for the purchased investment in amount ζ. The next period's consumption is the original level for the next period e_{t+1} plus the payoff from the asset in amount ζ. The price of the asset is then given by the following first order condition:

$$p_t \times u'(c_t) = E_t[\beta \times u'(c_{t+1}) \times x_{t+1}] \tag{4}$$

and

$$p_t = E_t[\beta \times \frac{u'(c_{t+1})}{u'(c_t)} \times x_{t+1}] \tag{5}$$

In equation 4, the right hand side specifies the utility that investor gives up when purchasing a unit of asset, and the left hand side shows the increase in the future utility - the expected discounted payoff x_{t+1}. Equation 5 gives us the formula for the price of the asset. In equation 5, the second period's payoff is multiplied with the expression $\beta \times \frac{u'(c_{t+1})}{u'(c_t)}$, which makes up the stochastic discount factor for the payoff, denoted as m_{t+1}. Both intuitively and from the formula expression for m_{t+1}, it is clear that it also expresses the rate at which the investor is willing to substitute current consumption for future consumption.

Another way of expressing p_t is through the definition of covariance between the asset payoff x and the discount factor m:

$$cov(m,x) = E(mx) - E(m)E(x), \tag{6}$$

and since $p = E(mx)$, we can also write it as

$$p = E(m)E(x) + cov(m,x) \tag{7}$$

The risk free rate R^f is equal to $1/E(m)$, which we can substitute into equation 7. Applying it to the situation where an asset yields a return R^i and has p=1, we get to the expression for asset excess return in equation 11:

$$1 = E(m)E(R^i) + cov(m,R^i) \tag{8}$$

$$E(R^i) = \frac{1}{E(m)} + \frac{cov(m,R^i)}{E(m)} \tag{9}$$

$$E(R^i) = R^f + \frac{cov(m,R^i)}{E(m)} \tag{10}$$

$$E(R^i) - R^f = \frac{cov(m,R^i)}{E(m)} \tag{11}$$

Constant expected returns are plausible at short horizons. Following the logic of consumption-based pricing model, the price of a stock depends on the marginal utility growth and the payoff determined by future price and dividends:

$$p_t u'(c_t) = E_t[\beta u'(c_{t+1})(p_{t+1} + d_{t+1})] \tag{12}$$

At short horizons β is close to one (subjectively, tomorrow's consumption is not discounted as heavily as consumption in, for example, ten years), and we can assume that there are no dividends. If investors are risk-neutral, so that the utility is linear in consumption, the above formula turns into $p_t = E_(p_{t+1})$, which means $p_{t+1} = p_t + \epsilon_{t+1}$. The latter expression is nothing else than a random walk when the variance of the error term is constant. Dividing by p_t, we get:

$$E_t(R_{t+1}) = 1 \tag{13}$$

Therefore, when stock prices follow a random walk, the expected returns are constant and realized returns are unpredictable as they depend on normally distributed error term.

In the long term, however, it is completely plausible theoretically that the expected returns will not follow the random walk and ergo will be predictable. As shown further in equation 14, extending the insight from equations 8-11 is helpful when looking at the issue of time-varying expected returns and their predictability.

$$\begin{aligned} E_t(R_{t+1}) - R_t^f &= -\frac{cov_t(m_{t+1}, R_{t+1})}{E_t(m_{t+1})} \\ &= -\frac{\sigma_t(m_{t+1})}{E_t(m_{t+1})} \times \sigma_t(R_{t+1}) \times \rho_t(m_{t+1}, R_{t+1}) \\ &\approx \gamma_t \sigma_t(\Delta c_{t+1}) \times \sigma_t(R_{t+1}) \times \rho_t(m_{t+1}, R_{t+1}) \end{aligned} \tag{14}$$

According to Cochrane (2005), the conditional variance of the returns and the correlation from the last expression in equation 14 do not fare well as predictors of conditional excess returns empirically. That leaves the first factor in this expression as the potential predictor: the variance of the consumption growth $\sigma_t(\Delta c_{t+1})$ and time-varying risk aversion γ_t. It follows that the excess returns may be predicted by the extent of the consumption's riskiness and the investors' attitude to that risk. The conjunction that both may vary over time is plausible, at least on the business cycle-length horizon. This link between the factors that affect risk aversion of the investors or the risk in consumption growth is further explored in our thesis.

One way of testing a consumption-based model with an infinite (as opposed to only two) number of periods is to adopt the form $p_t = E_t \sum_{j=1}^{\infty} \beta^j \left(\frac{c_{t+j}}{c_t}\right)^{-j} \times d_{t+j}$, where d_{t+j} are the future expected dividends, which we discount using the familiar discount factor. However, the model does not perform well in practice, when it is tested using the data on consumption and dividends. This leads to the conclusion that we have to find an alternative method of specification for the discount factor m. CAPM and multi-factor models essentially specify function that we expect the discount factor will follow. Considering the form of the discount factor, $m_{t+1} = \beta \times \frac{u'(c_{t+1})}{u'(c_t)}$, the function $m = f(factors)$ should contain factors that affect either the investors' risk aversion or the risk in consumption - which together combine into the marginal utility growth.

This is the idea behind linear factor pricing models. Stochastic discount factor can be expressed as a linear function of some economically relevant variables. One of the central questions in asset pricing is what variables should be used for the model to predict returns accurately. Risk-averse investors are concerned about smooth consumption, and it is especially important in poor economic times. Thus, variables that reflect news about macroeconomic changes are closely tied to future consumption and can be used in asset pricing models.

Therefore, technically, all factor pricing models are based on the most general consumption-based model. Their objective is to substitute consumption in stochastic discount factor m_t by some other empirically observable variables. Using (11), expected return for security i can be expressed as:

$$E(R^i) = R^f + \left(\frac{cov(R^i, m)}{var(m)}\right) \times \left(-\frac{var(m)}{E(m)}\right), \tag{15}$$

or in a simplified notation:

$$E(R^i) = R^f + \beta_{i,m}\lambda_m, \tag{16}$$

where $\beta_{i,m}$ is the regression coefficient of the return R^i on m. $\beta_{i,m}$ reflects the quantity of risk and is individual for each asset, while λ_m is the price of risk common for all assets and depends on the volatility of the discounting factor. In general, beta pricing models can be transformed into linear models for the discount factor m, thus, $E(R^i) = \alpha + \lambda'\beta_i$ is equivalent to $m = a + b'f$, where a and b are free parameters and f is a vector of factors. The market return in CAPM and the Fama-French factors such as SMB and HML are some of the factors that have traditionally been used to estimate m.

Normally, utility functions should reflect basic desire for more consumption. The factor models use additional assumptions that defend certain variables (wealth, mean and variance characteristics of portfolio etc.) as relevant proxies for consumption and, consequently, aggregate marginal utility growth. Though the results can be economically sensible, one should be careful about these assumptions, as they are often unrealistic. The choice of variables should be justified by solid theoretical background to avoid data dredging. Our objective is not as extensive as defending or criticizing different asset pricing models. However, as we test the predictability of excess equity return over the CAPM-based expected return, we will look closer at the assumptions behind CAPM and their implications for our results.

5 Literature review

5.1 Research on return predictability

The results of extensive empirical research on equity return predictability illustrate how this phenomenon has been interpreted over time. The debate about return predictability is naturally connected with the market efficiency. Efficient market is described as the market where all available information is fully reflected by the prices and it is impossible to earn abnormal returns. Fama (1970) and Fama (1991) describe three forms of market efficiency based on what kind of information is considered. Weak form means that historical information is incorporated into prices, so it includes univariate and multivariate return predictability. Semi-strong form is associated with historical and publicly available information such as earnings announcements or stock splits (event studies). Strong form is most extreme and it claims that historical, public as well as insider information is reflected in prices.

The definition of efficient market is too general and cannot be tested directly. To formulate a testable hypothesis, an appropriate asset pricing model is necessary. Therefore, empirical research always tests both market efficiency and a pricing model. If the hypothesis is rejected, one cannot say whether the market is inefficient or the model for equilibrium returns is wrong. This is referred to as the joint hypothesis problem (Fama, 1991).

Early empirical evidence suggested that stock prices follow random walk (Fama (1965)), (Samuelson (1965)). Therefore, as we have shown in Section 4, constant expected returns were assumed. Subsequent research results indicate that there is autocorrelation in both short-horizon and long-horizon returns (Conrad and Kaul (1988), Fama and French (1988b), Lo and MacKinlay (1988), Poterba and Summers (1988), Ball and Kothari (1989), Conrad et al. (1991)). Characteristically, long-horizon returns (2-5 years) demonstrate negative autocorrelation. Two competing explanations are suggested to justify this. The first approach is based on the idea that investors' behavior is rational. Fama and French (1988b) argue that such pattern reflects time-varying equilibrium expected returns. The fundamental values of assets change due to shifts in underlying risk and risk aversion of the investors. Therefore, at long horizons investors adjust their rational expectations accordingly. Formal explanation of this process has been presented in Section 4. Poterba and Summers (1988) instead view long-term return correlations as a sign of irrational behavior. They underline that fundamental asset values are difficult to measure precisely. Valuation errors and their later correction result in deviation of the prices from the unobserved fundamental values. Thus, the behavior of investors is irrational and characterized by noisy trading.

Multivariate predictability analysis is aimed at identifying economically relevant and statistically significant predictors for asset returns. Fama and French (1988a) find that dividend-price ratio and earnings-price ratio explain some fraction of variation in returns at 2-4 years horizon. According to the analysis by Kothari and Shanken (1997), dividend yield explains serial correlation in stock returns. Mankiw and Shapiro (1986), Torous et al. (2004), Lewellen (2004), Campbell and Yogo (2006) investigate the issues related to high persistence of dividend yield and some other predictive ratios such as book-to-market and price-to-earnings ratio. The conclusion is that when properly accounted for autocorrelation, dividend yield demonstrates stronger predictability power for stock returns.

Keim and Stambaugh (1986) find that returns from bond market have explanatory power for stock returns, and variables from stock market predict bond returns. This fact might indicate that there are common underlying forces that affect the level of returns on different assets in the market. One of the variables they test is the spread between low-grade corporate bonds and one-month T-bills. They suggest that this variable can be further decomposed in several variables reflecting maturity and default risk separately. This is what Chen et al. (1986) and Fama and French (1989) do. They use two bond spreads in their analysis. The spread between the long-term low-grade corporate bonds and the long-term government bonds reflects changes in riskiness of the firms. The spread between the long-term and the short-term government bonds proxies for the term structure of the interest rates. Both are found to be significant predictors of expected stock returns. Similar results are obtained by Campbell and Yogo (2006).

Interest rate spreads and dividend yield reflect business cycle conditions. The spreads capture changes in default and maturity risks: their higher values indicate poor economic state. Dividend yield varies with the firm value as it is constructed using price; lower prices during recessions imply a higher dividend-price ratio. Dividend yield and default spread are linked to long-term conditions, while term spread reflects short-term conditions (Fama and French, 1989). The business cycle framework connects expected returns with intertemporal consumption and investment opportunities. The results by (Fama and French, 1989) indicate that expected returns are low near peaks and high near troughs. The explanation suggests that at poor economic times higher returns are required to make consumers shift from consumption to investment, and vice versa. According to Kandel and Stambaugh (1991), higher elasticity of intertemporal substitution (which occurs at good times) is associated with lower risk premia. Campbell and Cochrane (1999) suggest a consumption-based model that relates long-horizon predictability of excess stock returns by the dividend-price ratio and mean reversion in returns to business cycle fluctuations. The results are also based on the intuition that at poor economic times consumption decreases and expected returns increase. Lettau and Ludvigson (2001) further explore connection between macroeconomic variables and returns. They construct the aggregate consumption-wealth ratio (cay) and show that it predicts variation in stock returns not captured by other popular predictors. They argue that aggregate consumption, asset holdings and labor income follow a common long-term trend, and deviation from this trend reflected by their cointegrating residual reflects expectations of market participants, thus having predictive power for future equity returns.

Recent publications on return predictability indicate that we still have more questions than answers. With return predictability being a popular research area, plenty of models have been developed in the literature. Goyal and Welch (2008) review some of these models using the same estimation techniques, time periods and frequencies, thus performing robustness check for previous research. The variables tested include dividend-price ratio, earnings-price ratio, interest rates, book-to-market ratio, interest spreads, volatility, consumption-wealth-income ratio (cay) and some more. They conclude that these models do not perform significantly better than a simple historic average. Campbell and Thompson (2008) argue that it is possible to get statistically and economically significant results from predictive models by imposing restrictions on the regressions. The restrictions are applied to the coefficients of the predictors so that they have the theoretically expected sign, and to the risk premium so that it is positive. The resulting regressions demonstrate improvement in out-of-sample tests and perform better than the historical mean.

5.2 Intuition in the benchmark article

One of the recent research works about return predictability is the analysis by Korniotis and Kumar (2013). The authors investigate whether macroeconomic information about changing business cycle conditions can be used to predict stock returns. They argue that a model with one representative US investor is not able to accurately describe developments in capital markets as local business cycle conditions vary across states and affect the investors' behavior in a different manner. To capture these differences, they use a framework with one representative investor in each state and focus on state-level macroeconomic conditions.

The authors claim that economic recessions are followed by higher stock returns in the next period. To proxy for business cycle conditions they use state-level income growth, unemployment rate and housing collateral ratio that reflects borrowing constraints for local investors. To make sure that the local effect is separated from shocks to aggregate US economy, the same variables at the national level are included in the regressions as well. Korniotis and Kumar also use a range of additional control variables at the national level. These variables are interest rate spreads and the consumption-wealth ratio. The choice of the variables is motivated by the fact that they had been previously used in empirical studies of return predictability and showed some predictive power for stock returns. For more details see Section 6.1.1 and Section 6.1.2.

The intuition behind the results is that when a recession occurs in one of the states, local investors become more risk averse and less willing to participate in risk sharing. They tend to get rid of risky assets in their portfolios. State-level recession makes stocks of the local companies more risky, and the investors try to sell them, thus increasing the supply and driving the prices down. Lower prices result in higher returns for future periods. This scenario is possible if a significant part of local stocks is owned by local investors. In this case they can affect the market prices by their coordinated actions.

Investors from other states are not affected by these macroeconomic shocks in the same way. Their level of risk aversion remains unchanged, and so does their fundamental valuation of the firms in the distressed state. From their perspective, stocks at current lower prices can be seen as an attractive investment. Higher returns with the same level of risk are an arbitrage opportunity for these investors. Korniotis and Kumar show that trading strategies based on this approach earn economically significant excess returns. By using longer prediction horizons they also find that the mispricing is corrected after one year.

The general conclusion of the article is that the predictable patterns in stock returns are the result of a combination of two factors. The first one is the time-varying systematic risk, which leads to higher risk premia at poor economic times. The second one is the mispricing generated by the trading activity of local and non-local investors.

5.3 Motivation for a replication study

Korniotis and Kumar (2013) test their theory using the US data, but they suggest that similar approach can be used at a cross-country level. Therefore, our aim is to investigate to what extent their findings also apply outside the US, specifically in the European environment. Given that empirical studies of return predictability by different researchers have shown contradictory results, our work can serve as a robustness check of the findings presented in the benchmark article.

The countries selected to represent local economies are Denmark, Norway, Sweden and Finland. To the best of our knowledge, no similar research has been carried out on these countries. The economy of the Euro zone is used as an aggregate economy in our framework. This is reasonable given that all these countries are members of the European Economic Area. Therefore, these countries are affected by macroeconomic shocks at the Euro zone level, though the power of the effect can be different. In particular, Finland has Euro as currency and, consequently, follows interest rate regulations from the European Central Bank, while the rest of the countries have their own national currencies and interest rate policies. Norway is the only country that is not a part of the European Union, so we can expect that it is affected by the EU policies differently. However, all four countries of interest are small open economies and it is important to control for macroeconomic situation at the aggregate European level in order to draw correct conclusions about local return predictability. While our aim is to be as close to the benchmark article as possible, we change some of the variables due to a number of data restrictions. This is further discussed in section 6.1.1.

6 Methodology

6.1 Regression model

6.1.1 Regression model components

In this section we describe the regression model, explain the choice of predictor variables and how they have been constructed and describe the features of the data. Furthermore, we explain and motivate our choice of econometric procedure. Finally, we discuss the regression diagnostics and provide the results to a number of tests on the regression assumptions.

In studying our research question, we closely follow the procedure in Korniotis and Kumar (2013), both in terms of the regression model and variable construction. We provide further comments where our procedure differs from theirs.

The regression model we employ in studying our research question is as follows:

$$\begin{aligned} RET_{i,t} = \alpha_0 + \alpha_1 DYgrowth_{i,t-2} + \alpha_2 RU_{i,t-2} + \alpha_3 HPIgrowth_{i,t-2} + \\ + \alpha_4 \Delta DYgrowth_{EZ,t-2} + \alpha_5 \Delta RU_{EZ,t-2} + \alpha_6 \Delta HPIgrowth_{EZ,t-2} + \\ + \alpha_7 cay_{t-1} + \alpha_8 \Delta DS_{t-1} + \alpha_9 \Delta TS_{t-1} + \alpha_{10} PBS_{t-1} + \alpha_{11} Div_{i,t-1} + \epsilon_i, \end{aligned} \tag{17}$$

In this equation, the subscript i refers to the specific countries in the sample, and denotes a country-level (or by our intuition, "local") macroeconomic indicator. The variables included on this level are $DYgrowth$, RU and $HPIgrowth$, which denote the quarterly income growth calculated year-over-year, the quarterly relative unemployment rate, and the quarterly growth in house price index calculated year-over-year. The same macroeconomic predictors are included in the regression on the Euro zone level (which acts as a "global" level in this setting). These predictors are marked by the subscript EZ. As one can see, they are used in first differenced form. This is done due to stationarity issues and will be further discussed in Section 6.3.2. The right hand side variables cay residual, default spread DS, term spread TS and paper-bill spread PBS are also calculated on the Euro zone level, but are not marked by EZ since we don't have country-level equivalents for these variables in the regression. Finally, the dividend yield Div is an index-specific, and therefore a country-level measure.

The dependent variable RET is a return measure. In the first set of regressions, we estimate it as the excess return over the risk-free rate (further referred to as "risk premium"). In another set of regressions, we estimate it as the return over the CAPM-based expected rate of equity return. For simplicity, we will refer to this return measure as "unexpected return", which it is given that CAPM holds and provides an approximation for the expected returns.

The subscript t refers to the quarter. All six macroeconomic indicators are lagged by two quarters, which is the time frame by which we are expecting that the changes in macroeconomic conditions influence the returns. The other controls: cay, default spread, term spread, paper-bill spread and the dividend yield are lagged by one quarter. Lagging the macroeconomic predictors by two quarters reflects the common two-quarter-rule of dating business cycles. Although following the two-quarter-rule is not the most precise way of measuring business cycles, the decision to lag the macroeconomic predictors by two quarters implies that their development has to be somewhat prolonged to signal a local recession - in order for the investors to perceive this as a ground for a change in risk aversion or consumption risk.

We will now motivate the choice of dependent and independent variables and explain how we have processed the data for the analysis.

6.1.2 Choice of predictor variables

The main macroeconomic predictors are the labour income growth, the relative unemployment rate and the house price index growth. Each of these variables functions as a proxy for the macroeconomic development that influences either the risk aversion or the consumption risk of the average investor.

Since the income growth implies the increase in the capital that is available for investment, higher income growth brings a higher demand for stocks and lower expected returns. A negative change to income growth will therefore influence the returns through an increase in the investors' consumption risk. High income growth is traditionally associated with expansion in the economy, whereas a lower, and negative income growth signals a slowdown: The Conference Board (2017) uses personal income less transfer payments in calculation of the Coincident Economic Index. Therefore, the investors are right to expect a higher consumption risk if the lower income growth persists.

The relationship between unemployment and business cycle is widely documented. According to Okun's Law, rising unemployment usually coincides with falling GDP growth (although GDP tends to fluctuate more). Claims for unemployment insurance are also used by The Conference Board in calculation of their Leading Economic Index. Including the relative unemployment rate is therefore another way to estimate the effect of macroeconomic shocks on equity returns, as the unemployment news has the potential to influence both investors' consumption risk and risk aversion.

We include the house price index growth rate to control for the changes in the investors' housing collateral. Our intuition for the effect of changes in housing collateral follows from Korniotis and Kumar (2013): We expect that a fall in house equity will reduce the investors' ability to borrow on the collateral. When investors do invest in these conditions, they will demand a higher rate of return. Korniotis and Kumar construct a *hy* residual which is a log ratio of housing equity to income. Since the house equity data is not as available for North European countries as it is for the US, we take a cue from Iacoviello (2005) and use house price index growth rate as an approximation for changes in the borrowing constraints. In his analysis of house prices and borrowing constraints in the context of macroeconomic policy, Iacoviello argues that the increase in the house prices alone will increase the investors' ability to borrow and invest in risky assets. We therefore expect that the effect of growth rate in house price index on equity returns will be the similar to the effect of the borrowing constraints proxy from Korniotis and Kumar (2013).

In addition to including these three predictors on the country level, we also include them on the Euro zone level: to control for the effect of the changes in the aggregate European economy and to separate this effect from the possible local return predictability effects. The Euro zone-level macroeconomic predictors will therefore ensure that the coefficients of the state-level indicators only reflect variations in the return due to these local macroeconomic shocks -

instead of reflecting the global macroeconomic development in general. The other predictors on the Euro zone level are the cay residual constructed in accordance with Lettau and Ludvigson (2001), default spread (difference between the rate of return on corporate and government bonds), term spread (difference between the rate of return on long-term and short-term government bonds) and paper-bill spread (difference between the rate of return on commercial papers which represent short-term corporate debt and the rate of return on T-bills). All of these can be expected to have an effect on equity returns based on the existing literature.

The final control variable is the dividend yield, which is specific to each index and is therefore a country-level variable. Dividend yield predicts returns by construction. As it is constructed as a dividend-price ratio, low dividend yield value implies lower price and higher future returns (given that the prices are characterized by mean reversion). The effect of dividend yield on equity return predictability has been widely documented by Fama and French, and we follow their tradition in calculating this variable (Fama and French, 1988a).

6.1.3 Hypotheses

The main purpose of the study is to test whether local economic conditions predict local equity returns. More specifically, local recessions should be followed by higher returns. If that is the case, we expect that the local recession signals will be positively correlated with the local risk premia and local unexpected returns. Thus, the coefficients α_1 and α_3 are negative, and α_2 is positive:

$$H_0 : \alpha_1 = 0, \alpha_2 = 0, \alpha_3 = 0 \tag{18}$$

$$H_1 : \alpha_1 < 0, \alpha_2 > 0, \alpha_3 < 0, \tag{19}$$

where α_1 is the coefficient of the country-level income growth, α_2 is the coefficient of the country-level relative unemployment rate and α_3 is the coefficient of the country-level house price index growth as described in equation 19.

6.2 Data

6.2.1 Construction of variables

The data spans from 2000 to 2016. The sample size is limited by the availability of the data needed for the calculation of certain variables, for example the data on the Euro zone T-Bill, some of the returns and dividend yields. For variables which tend to display seasonality patterns (such as unemployment), the data is not seasonally adjusted.

The quarterly dividend and stock exchange index data is collected from Bloomberg. We use this data to calculate Div and the two quarterly return measures RET. One of the return measures RET is the unexpected return from the CAPM-based return:

$$Unexpected\_return_{i,t} = R_{i,t} - R^f_{i,t} - \beta[R^m_{i,t} - R^f_{i,t}], \tag{20}$$

where β is calculated as a coefficient in a regression of the index's risk premia on market's premia. Thus, unexpected return is the difference between the actual index return and the expected equity return according to CAPM. R^f is the risk-free rate of return, and R^m is the market rate of return, used in accordance with CAPM. The risk-free rate here is the 3-month T-Bill rate: either the Norwegian, Swedish or Danish T-Bill rate issued by the country's government in local currency, or the 3-month Euro T-Bill rates for Finland. The T-Bill rates for all the four countries were obtained from Thomson Reuters via Datastream.

The market rate of return is the return on S&P Europe 350, obtained from Bloomberg. The actual stock exchange index rate of return, R_i, is the quarterly equity return on one of the four benchmark all-share indices from the four countries: Copenhagen's OMXCPI, Stockholm's OMXSPI, Helsinki's OMXHPI and Oslo's OSEBX index. To construct the excess return we use in the regression, we have taken the following steps. First, we calculated the quarterly index returns from the quarterly index data. All the quarterly index returns, including the market returns, are calculated as the difference between the index prices in the two quarters divided by the older index price - as shown in equation 21:

$$R^{nominal}_{i,t} = \frac{Index_{i,t+1} - Index_{i,t}}{Index_{i,t}} \tag{21}$$

We have then adjusted the return data for inflation, using the harmonized index for consumer prices (HICP) from Eurostat, from which we have calculated the inflation rate for each quarter[1]. We have adjusted both benchmark index returns and the market return for inflation following this procedure:

$$inflation_{i,t} = \frac{HICP_{i,t+1} - HICP_{i,t}}{HICP_{i,t}} \tag{22}$$

and

$$R_{i,t} = \frac{R_{i,t}^{nominal}}{1 + inflation_{i,t}} \tag{23}$$

In addition to the CAPM-based unexpected return, we also include risk premium as the dependent variable in another set of regressions:

$$Risk\_premium_{i,t} = R_{i,t} - R_{i,t}^{f}, \tag{24}$$

which is the index equity return adjusted for the risk-free rate of return in country i and quarter t.

The labor earnings growth rate $DYgrowth$ is based on the disposable income in the country's currency that we have obtained from Eurostat via Datastream. Similarly, data for $DYgrowthEZ$ is the total disposable income in the Euro zone. We have then adjusted the disposable income data for inflation, using the same inflation rates as earlier:

$$DY_{i,t} = \frac{Y_{i,t}}{1 + inflation_{i,t}}, \tag{25}$$

where $Y_{i,t}$ is the disposable income in country's currency and $inflation_{i,t}$ is the same quarter's inflation rate. Now, we use the inflation-adjusted disposable income to calculate the quarterly year-over-year growth:

$$DYgrowth_{i,t} = \ln\left(\frac{DY_{i,t+4}}{DY_{i,t}}\right), \tag{26}$$

which approximates the growth rate of the disposable income.

[1]We have discussed the option to use the approximation $R_{i,t}^{n} = R_{i,t} + inflation_{i,t}$, which would eliminate the inflation from the returns as we subtract the risk-free rate and the CAPM-based expected returns. However, we decided against adopting this approximation, as Korniotis and Kumar (2013) specify in the article that they had adjusted their returns for inflation.

To calculate the current relative unemployment RU, we subtract the average unemployment rate over the previous 16 quarters from the current unemployment rate:

$$RU_{i,t} = U_{i,t} - \sum_{a=1}^{16} U_{i,t-a} \tag{27}$$

The harmonized unemployment rate U for all the four countries and the Euro zone is collected from OECD via Datastream. We therefore assess the current unemployment rate in comparison with what may be considered the natural state of unemployment for the country. We operate with short-term effects and short-term changes, therefore the natural state of unemployment at the time is calculated as the average unemployment over the previous 4 years. This average rate of unemployment is then subtracted from the current rate of unemployment to proxy for the changes in the macroeconomic conditions in the local economy.

The third macroeconomic indicator is the house price index growth rate. The house price index HPI is obtained from Oxford Economics via Datastream for the four countries and the Euro zone. We adjust HPI for inflation the same way we have adjusted the disposable income and calculate the approximate growth rate as the log difference in the house price index in the same quarter in two consecutive years:

$$HPIgrowth_{i,t} = \ln\left(\frac{HPI_{i,t+4}}{HPI_{i,t}}\right) \tag{28}$$

Following the main country- and EU-level macroeconomic predictors, the cay residual specifies the consumption that is not explained by the households' wealth and income:

$$C_t = \gamma_0 + \gamma_1 W_t + \gamma_2 DY_t + \epsilon_t \tag{29}$$

and

$$cay_t = \epsilon_t, \tag{30}$$

where C is the consumption expenditure for households in Euro zone obtained from Eurostat via Datastream, W is the gross household wealth in Euro zone obtained from Oxford Economics, and DY is the disposable income. All data has been adjusted for inflation, and cay is the residual from the regression of C on W and DY.

Default spread DS is defined as the difference between the average corporate borrowing rate and the 1-year Euro T-Bill rate index for Euro zone:

$$DS_t = CBR_t - TB1_t \tag{31}$$

The average corporate borrowing rate CBR is collected from Oxford Economics, and the T-Bill rate index for Euro zone, $TB1$, is collected from Thomson Reuters, both via Datastream.
Term spread TS is defined as the difference between the 10-year government bond yield by Maastricht definition obtained from Eurostat and the 1-year Euro T-Bill spread:

$$TS_t = GB10_t - TB1_t \tag{32}$$

Paper-bill spread is defined as the difference between the commercial paper rate and the same 1-year Euro T-Bill that is used to calculate the term and default spreads:

$$PBS_t = CPR_t - TB1_t, \tag{33}$$

where CPR is the average of Euro commercial paper rates and PBS is the paper-bill spread.
All three return spreads are EU-level, and therefore only have the subscript t.
Finally, we include the country-level dividend yield Div. To obtain the dividend yield that we include in the regression, we divide the dividends paid out in a quarter by the stock exchange index value that quarter:

$$Div_{i,t} = \left(\frac{D_{i,t}}{P_{i,t}}\right), \tag{34}$$

where $D_{i,t}$ are the dividends paid out in country i's index in quarter t, and $P_{i,t}$ is the price of country i's index that quarter.

In our choice of predictors and controls, we were mostly motivated by the model from Korniotis and Kumar (2013). To see if their findings can be replicated in country-level predictions in Europe, we have to follow their procedure where possible. However, the data on STEP (short-term commercial paper rates) published by the European Central Bank is challenging to use here as many periods' data is missing. We have also obtained commercial paper rates published by the Bank of England for the period between 2003 and 2013. Including this variable reduces our sample size with 80 observations - almost by a third. With a sample size this short, we risk simply not having enough years in the regression to detect the cyclical effects on equity returns.

With this in mind, we will run two alternative sets of regressions: one in which the paper-bill spread is included and one in which it is not.

We also construct an indicator of economic activity using the three macro indicators income growth, house price growth and relative unemployment. According to Korniotis and Kumar (2013), this indicator will account for economic conditions in the aggregate European market. We will therefore run the same set of four regressions: risk premia and unexpected returns as the dependent variables, with and without the paper-bill spread. Later we will add the constructed Economic Activity Index as a robustness check for our main hypothesis.

6.2.2 Descriptive statistics

Table 1 presents the descriptive statistics for the variables we have discussed. Due to stationarity issues, which will be discussed further below, some of the variables have been transformed by taking first difference. The variables for which that is the case, are included in Table 1 both in the original and differenced form, marked by a prefix *diff*.

Table 1: Summary statistics

Variable	**Mean**	**Std. Dev.**	**N**
Risk premium	0.012	0.119	251
Unexpected return	0	0.064	251
DYgrowth	0.043	0.052	260
RU	0	0.012	260
HPIgrowth	0.052	0.057	260
DYgrowthEZ	0.025	0.016	260
RUEZ	0.001	0.012	260
HPIgrowthEZ	0.028	0.034	260
EAI	0.018	0.019	260
cay	-0.328	8.560	260
DS	0.022	0.01	259
TS	0.018	0.012	259
PBS	0.151	0.193	168
DP	0.008	0.01	260
diff_DYgrowthEZ	0	0.009	256
diff_RUEZ	0	0.005	256
diff_HPIgrowthEZ	0	0.007	256
diff_DS	0	0.005	255
diff_TS	0	0.004	255
diff_EAI	0	0.005	256

This table reports the mean and standard deviation statistics for the dependent variables and predictors. The sample period is from 2000 to 2016, with a shorter number of observations N where the whole sample period's data is not available. The dependent variables are the quarterly risk premium and the quarterly CAPM-based unexpected return. The macroeconomic predictors are the year-over-year quarterly income growth, the relative unemployment rate and the year-over-year quarterly house price index growth. These three predictors are included on the country level and the Euro zone level. Economic Activity Index, *EAI*, is calculated on the basis of the three Euro zone-level macroeconomic predictors. *cay* is defined as the consumption that is not explained by wealth and income. *DS* is the default spread, *TS* is the term spread and *PBS* is the paper-bill spread. All interest rate spreads are calculated on the Euro zone level. The dividend yield *DP* is the country-level dividend-price ratio. The last six rows in the table present the summary statistics for the differenced counterparts to the non-stationary variables.

Figure 1: Risk premia and unexpected returns plotted against time

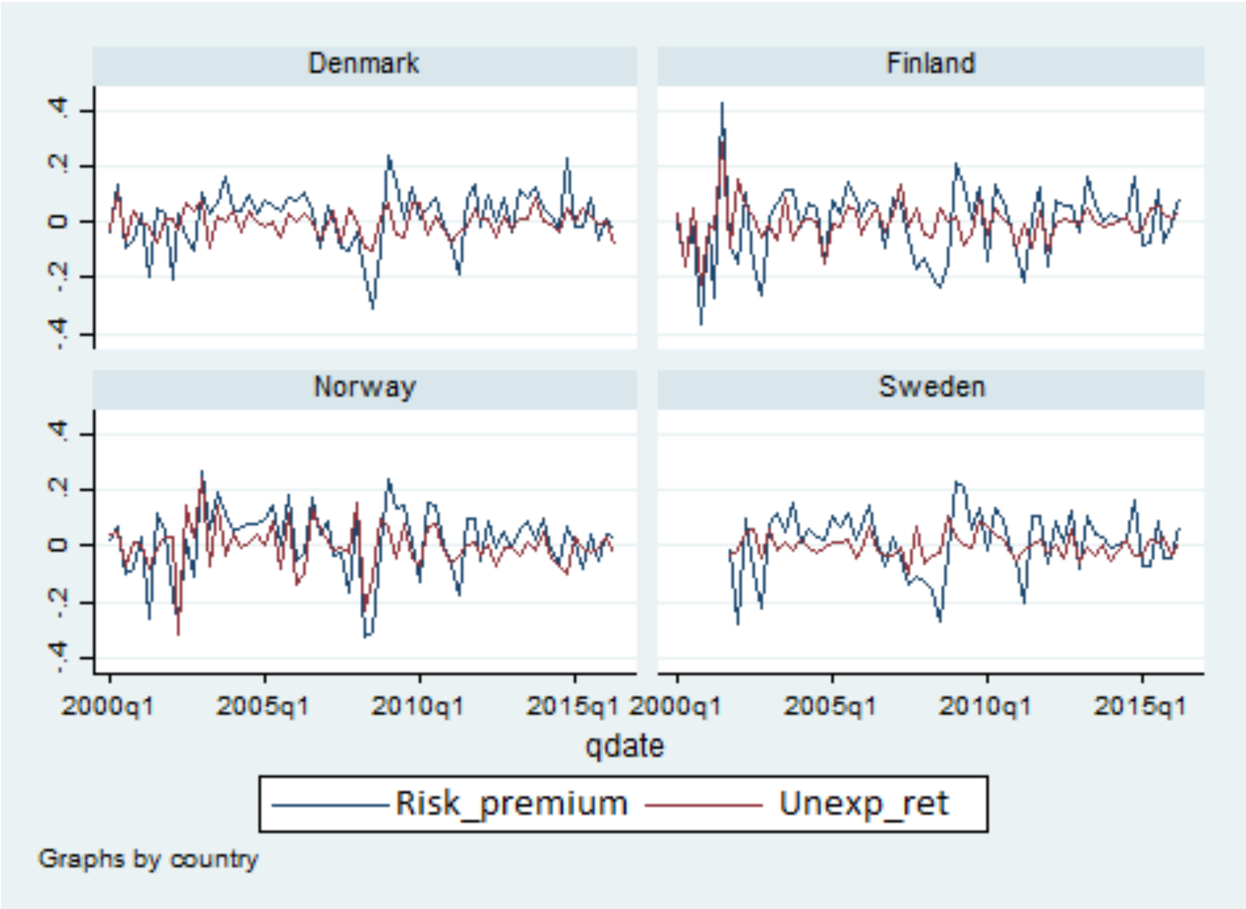

Figure 1 shows fluctuations over time in risk premia and in the unexpected returns over CAPM in the four all-share benchmark indices in Denmark, Sweden, Finland and Norway. The all-share indices from the four countries are Copenhagen's OMXCPI, Stockholm's OMXSPI, Helsinki's OMXHPI and Oslo' OSEBX index. The data is collected from 2000Q1 to 2016Q3

We see that during the financial crisis of 2007-2008 both risk premia and unexpected returns become negative. The drop in risk premia is more severe. This can be explained by the fact that market return falls and CAPM captures this change, so that expected returns based on CAPM are adjusted for falling market index performance. Consequently, unexpected return over CAPM does not indicate abnormal developments in the market.The change in risk premium reflects rapid decrease in realized returns associated with the crisis.

Figure 2: Country-level income growth plotted against time

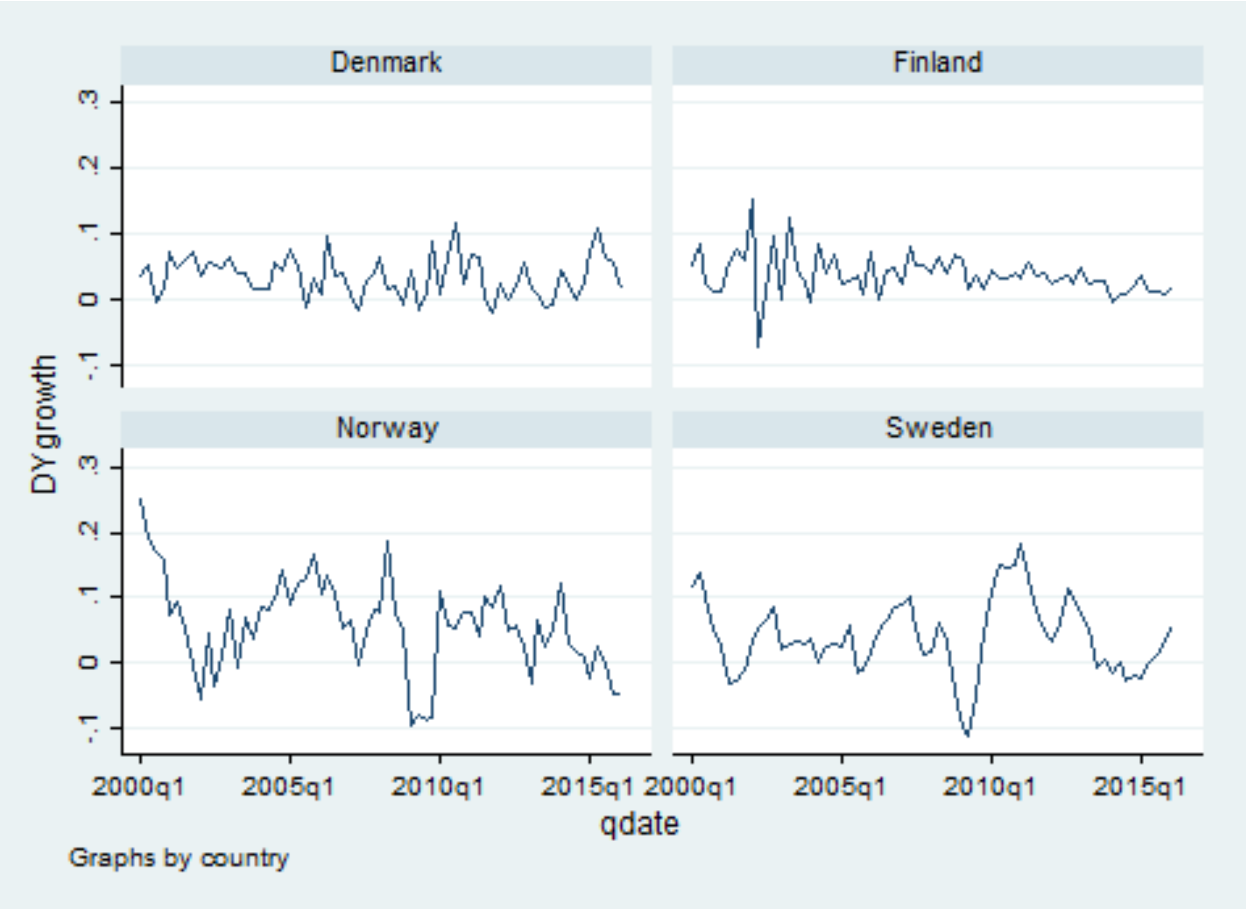

Figure 2 shows fluctuations in quarterly year-over-year income growth in Denmark, Norway, Finland and Sweden from 2000Q1 to 2016Q3.

It is evident from Figure 2 that income growth in Norway and Sweden is more volatile than in Denmark and Finland, with income growth in Denmark being the most stable of the four throughout the sample period. There is a drop in income growth around the dot-com crisis in Finland, Sweden and Norway, and a sharp drop in Norway and Sweden following the financial crisis of 2007-2008. Additionally, in Norway, income growth has been decreasing during the last two years. This might be explained by the contraction in activity related to the oil industry.

Figure 3: Country-level relative unemployment rate plotted against time

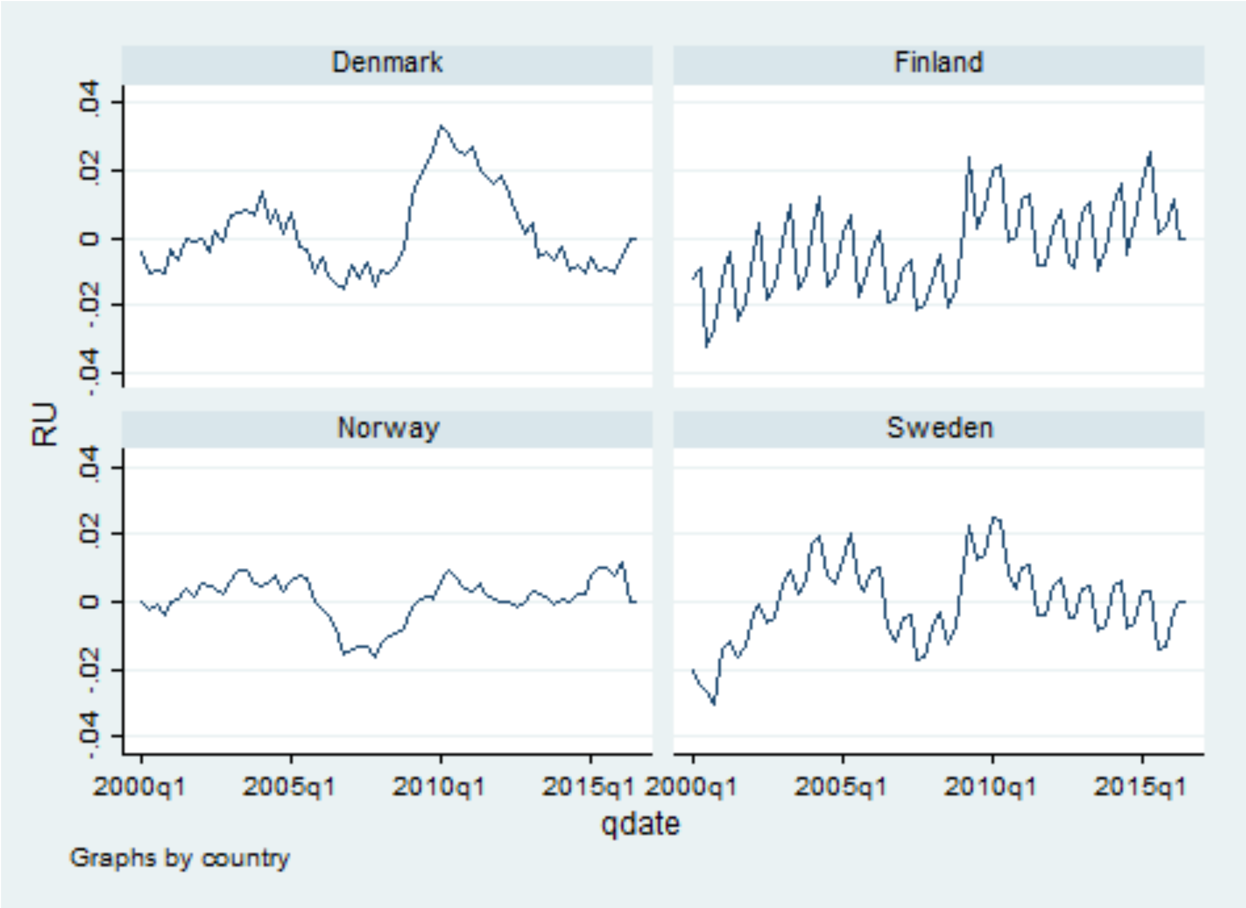

Figure 3 shows quarterly deviations in country-level unemployment rate from the natural unemployment level. The natural unemployment rate level is calculated as the average unemployment rate over the preceding 16 quarters and is subtracted from the current unemployment rate to create a variable which reflects unemployment news. The data is from 2000Q1 to 2016Q3.

Relative unemployment is constructed to show the deviations from the natural rate of unemployment, so the scale of this variable is lower than for the other macroeconomic predictors and the dependent variables. Relative to the deviation from the natural rate of unemployment, seasonality effects are stronger in Finland and Sweden. This may be related to the structure of the economy and legislation. In comparison to other Nordic countries, the primary sector including agriculture and forestry is quite important in Finland. These activities are associated with greater seasonality, which is confirmed by the figure. In contrast, Norway has little seasonality in registered unemployment due to the short stay of foreign workers in the country and the regulations around that (Grady and Kopsalis, 2002). Using seasonally adjusted unemployment data which is also available at OECD database does not significantly affect the main results.

Figure 4: Country-level quarterly year-over-year house price index growth plotted against time

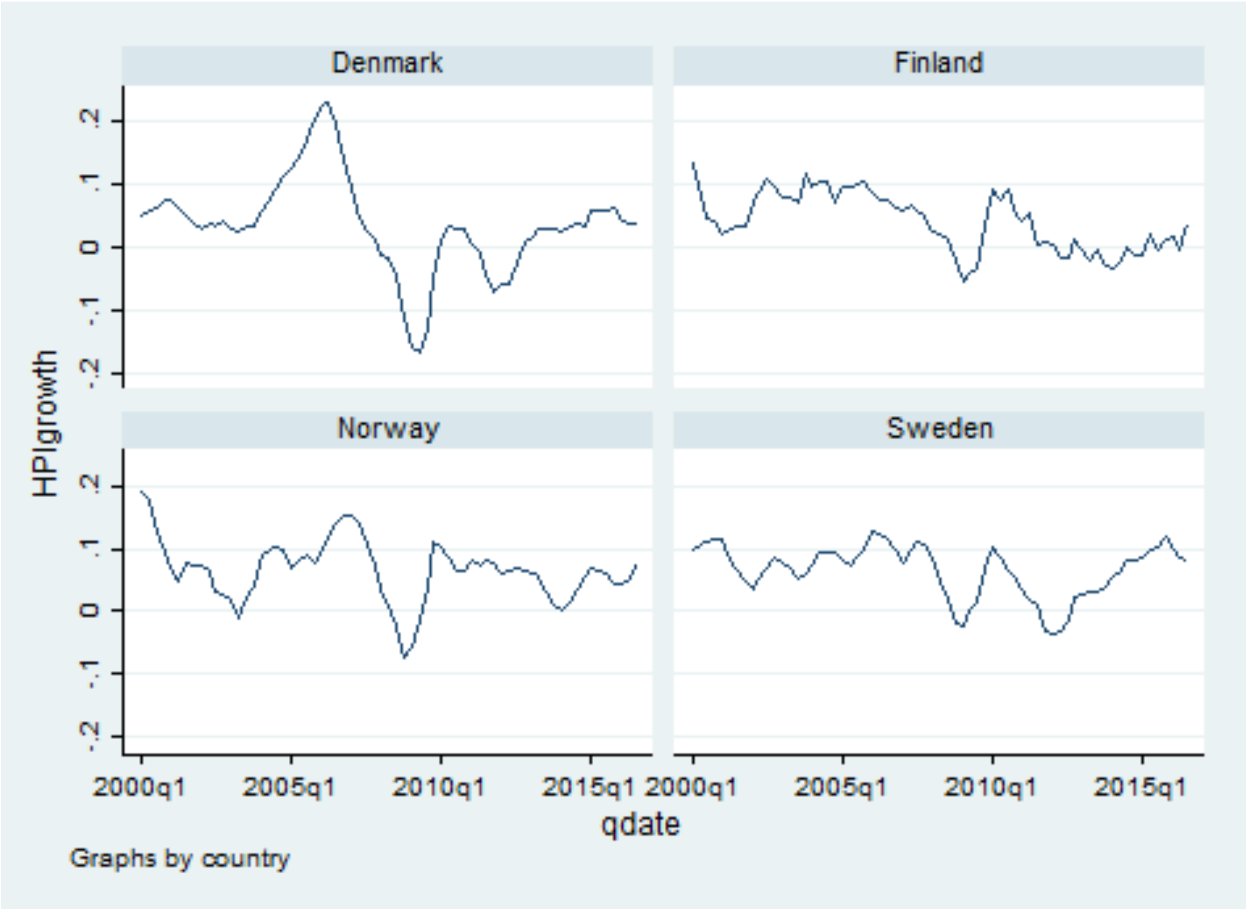

Figure 4 depicts fluctuations in quarterly year-over-year house price index growth in Denmark, Norway, Finland and Sweden from 2000Q1 to 2016Q3.

The plot of house price index growth against time indicates similar patterns for all countries with rapid decrease around the financial crisis. It is most volatile in Denmark and Norway.

We have considered the possibility of a structural break caused by the financial crisis in some of the variables, but our sample is likely too short to thoroughly look into that. This issue is further discussed in Section 9.

6.3 Econometric techniques

This section covers the procedures we have implemented in the analysis of the data. Specifically, we motivate and describe the regression model estimation technique we have used, and explain the grounds for taking the first difference of some of the variables that has been necessary.

6.3.1 Choice of econometric procedure

Our econometric procedure is designed to accommodate several features of the data. First, we employ the modified Wald test for groupwise heteroskedasticity, which tests against the null hypothesis $H_0 : \sigma_i^2 = \sigma^2$ for all i. Then, we use the Breusch-Pagan Lagrange multiplier test, which tests against the null hypothesis of zero correlation between the error terms in the different cross-sections - here, countries. To test for heteroskedasticity, we start with the standard fixed effects regression and perform the tests on the residuals. Both Wald test for heteroskedasticity and Breusch-Pagan LM test for cross-sectional dependence indicate that these properties may be present in the data. Cross-sectional dependence in particular is a common problem in panel data sets. Often it becomes very likely that the cross-sectional units are subject to some kind of common shocks, since our four countries of interest are not picked randomly and as the countries' economies have become more dependent on each other in the physical world (De Hoyos and Sarafidis, 2006). Autocorrelation in the independent variables, however, is not confirmed by the Wooldridge test for first-order autocorrelation process.

It is desirable for our estimates to be BLUE (best linear unbiased estimators), so that the model is useful both to predict the returns and to identify the statistically significant predictors. According to Pesaran (2015), the presence of the confirmed econometric issues may have serious consequences for our findings. Heteroskedasticity and autocorrelation distort the standard errors and though the estimates are still unbiased, the inference is likely to give misleading results - the estimates will not be best. In addition to this, cross-sectional dependence may introduce bias into the estimated coefficients (Klotz, 2004).

The procedure that would give consistent and unbiased estimates in the presence of these econometric issues is a fixed effects model with Driscoll and Kraay standard errors (Hoechle, 2007). This procedure was created by Driscoll and Kraay in 1998 and is available and easily implemented using Stata. The intuition behind it is that the problem of cross-sectional dependence in the panel data may be likened to a dependence in the time-dimension in the time-series data and a similar non-parametric covariance matrix may be estimated by estimating cross-sectional averages of products of the predictor variables and the residuals (Driscoll and Kraay, 1998), (Vogelsang, 2012). We prefer to use the fixed effects model instead of the random effects model because the random effects model assumes no omitted variable bias, while fixed effects model is more forgiving in case some possible predictors are not included, even though the standard errors will be larger. The Driscoll and Kraay fixed effects model will not only provide us with consistent estimates despite cross-sectional dependence and heteroskedasticity, it was also employed by Korniotis and Kumar (2013), which is our chosen benchmark study. It is therefore also beneficial to follow this procedure to replicate their design consistently.

6.3.2 Stationarity in the regression

While stationarity tends to be less of a problem in some panel data sets than with time series models, this is only true for panels where the time dimension is small relative to the cross-sectional dimension (Bond et al., 2005). In our case, our four countries of interest represent the cross-sectional dimension, while the number of time periods in the data set is 65 quarters, spanning over 16 years. That means that the time dimension is large enough for our data to potentially exhibit unit root.

A selection of panel data unit root tests are performed on the variables: Levin-Lin-Chu test, Im-Pesaran-Shin test and Fisher-type tests (Nell and Zimmermann, 2011). These tests build on the Augmented Dickey-Fuller tests, and test against the null of unit root in all the cross-sectional units in the variable. The alternative hypothesis vary between the tests, with Im-Pesaran-Shin test allowing the presence of the unit root in some of the units, and Levin-Lin-Chu test requiring the variable to be stationary for all the cross-sectional units in the variable. Some researchers consider the latter to be too strict for real-life data (Hoang and Mcnown, 2006), and claim that the Im-Pesaran-Shin test is the most powerful. For our data, the Levin-Lin-Chu test was not applicable in Stata for some of the variables. We therefore performed the Im-Pesaran-Shin test on all the variables in the data set, and performed the alternative tests where it was possible.

The conclusions from these unit root tests are consistent. The country-level macroeconomic predictors, cay, paper-bill spread and the dividend yield are stationary independent variables;

the null hypothesis of the unit root is rejected at any conventional confidence level. Both types of dependent variables are also confirmed as stationary. However, a multitude of panel data unit root tests have failed to reject the null hypothesis of a unit root presence for the EU-level macroeconomic predictors and the term and default spreads.

According to Balli et al. (2012), the stationarity of the data is crucial when Driscoll and Kraay method is implemented. To avoid the possibility of the regression being spurious, we take the first difference of the non-stationary variables and replace the non-stationary variables with their differenced counterparts. The unit root tests confirm that the differenced variables are indeed stationary, and are therefore safe to use in the regression.

The decision to include the differenced variables in the regression is reflected in equation 17. Our main hypothesis is therefore unchanged, as the main, country-level predictors of interest do not need modification, but we control for the effect of EU-level predictors through the change in the income growth, change in the relative unemployment and the change in the house price index growth. We also control for the effect of change in term and default spread.

As the Economic Activity Indicator that we use to check the robustness of our results is also non-stationary, we take the first difference of this variable in the set of regressions that include this indicator as a control.

6.4 Regression diagnostics

The Gauss-Markov assumptions for the coefficients to be BLUE (best linear unbiased estimates) in our regression model are a linear relationship between the dependent and independent variables, no perfect collinearity in the independent variables, zero conditional mean of the residuals, homoskedasticity of the residuals and zero autocorrelation in the residuals. The first three of these assumptions ensure unbiased estimates, and the last two assumptions are needed in order for the estimates to be best - that is, have the minimal variance among all the unbiased estimates. Additionally, in order for the t- and F-tests to give correct inference results, the residuals are assumed normally distributed. Some of these assumptions can be tested formally. Unless included in the thesis, the screenshots of the various test results are found in the appendix.

Although it is seldom that the real-life data fits all these conditions perfectly, these tests may produce a benchmark against which we may judge the reliability of our results.

We will approach the assumption of linearity in the relationship between the dependent and independent variables using a scatterplot matrix. Figure 1 gives an overview of the relationships between the dependent variables and the main country-level predictors. The overview of the relationships between the all variables is included in the appendix. From the first column in the matrix we see that the relationship between the risk premium and the country-level predictors may be described as linear, although the variances are high due to the fact that all the four countries' data is plotted. For unexpected return and the same predictors, the linearity is not as apparent, although it is still possible to identify a somewhat linear relationship between the unexpected returns and the country-level income.

Figure 5: Scatterplot matrix for all dependent and main country-level independent variables

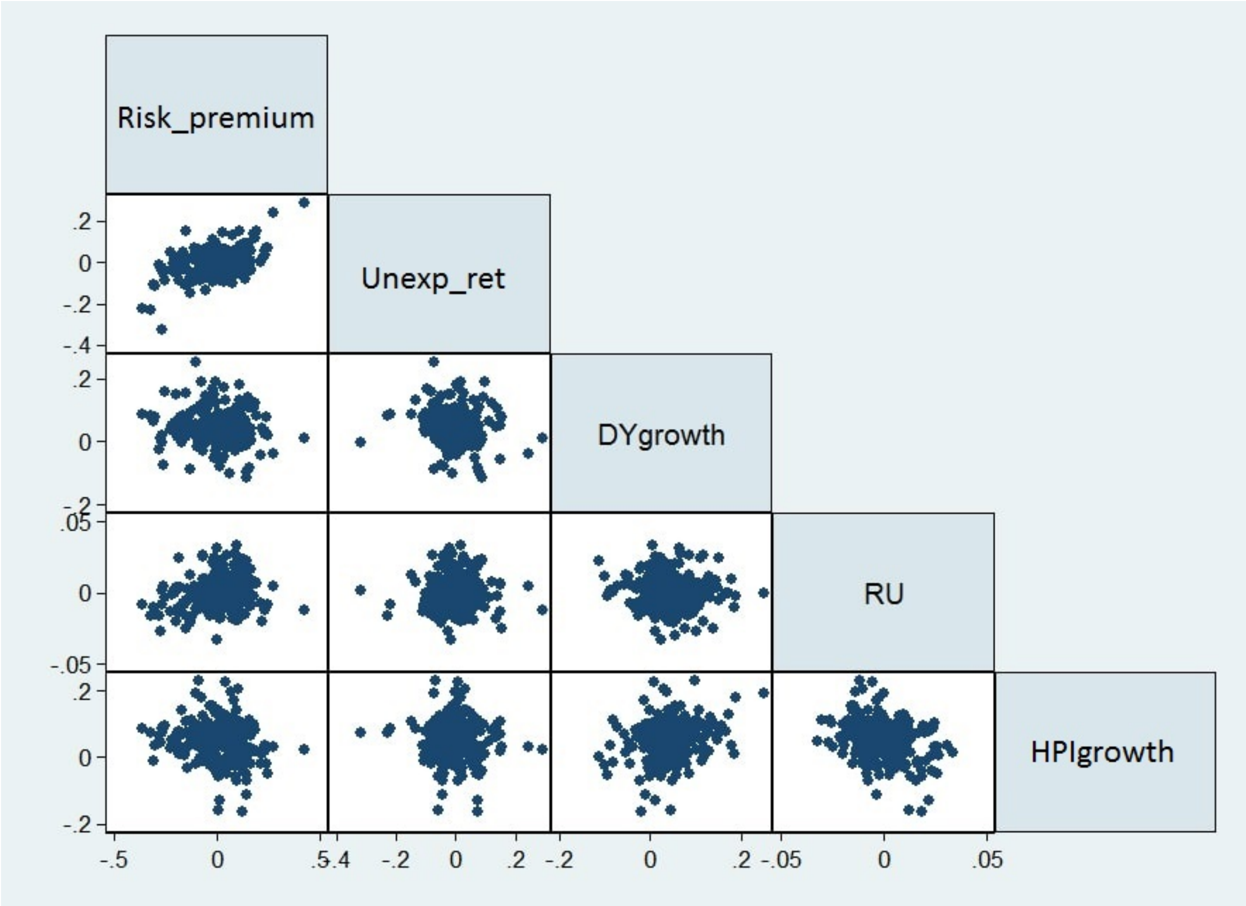

Figure 5 demonstrates the relationship between the dependent and independent variables through a scatterplot matrix. The observations from all four countries are plotted. From the matrix, we can observe a linear relationship between risk premium and the main macroeconomic indicators.

The second assumption of no perfect collinearity is fairly easy to test by estimating a regression in Stata. Perfect collinearity means that one independent variable can be perfectly expressed using a linear combination of some of the other independent variables. Indeed, it makes very little sense to control for the effect of a factor while keeping the other factors, with which it may be expressed, constant. Stata detects perfect collinearity and drops redundant variables automatically. We can therefore be quite sure that the assumption of no perfect collinearity is fulfilled in our regressions.

The final assumption that ensures unbiased estimates, that of zero conditional mean of the error term, means that the possible observed and/or unobserved factors that we have not included in the model, are not correlated with the included independent variables. It means that the dependent variable and the explanatory variables should not be driven by the same factor that is excluded from the model. Often, this is a strong and not a very realistic assumption - in our case, there may still be factors that we have not included that will be correlated with both the equity returns and the macroeconomic predictors. However, we made the effort to include as many relevant variables as possible, employing the existing research as our guide. Since this assumption can not be tested formally, we have to put our faith in the theoretical backbone of our model and in the existing literature on return predictability to make the correct choice of predictors - with which we hopefully will obtain unbiased estimates.

The forth Gauss-Markov assumption is that of no autocorrelation in the residuals. We tested this using Wooldridge test for autocorrelation in panel data. We repeated the test for the four regressions (assuming the standard fixed effects estimation method for this test): one with risk premium as the dependent variable - including and excluding the paper-bill rate from the control variables, and the other with unexpected return as the dependent variable - with and without the paper-bill spread. The tests showed no evidence of autocorrelation in the regressions. Additionally, the Driscoll and Kraay method of estimating standard errors ensures that estimators are robust to autocorrelation (Hoechle, 2007), so we can conclude that the assumption of no autocorrelation in the error term is plausible for our estimates.

Homoskedasticity is also less critical assumption for the regression techniques we are using, since Driscoll and Kraay method provides us with unbiased estimates even when heteroskedasticity and cross-sectional dependence is present.

We can therefore conclude that we see no clear violations of the Gauss-Markov assumptions. However, the linearity of the relationship between the dependent and independent variables is not entirely obvious for the regressions where the unexpected return is the dependent variable, so the results of our estimated models will have to be judged in this light. Since the relationship was more linear when the risk premium was the dependent variable (at least for the main macroeconomic predictors the effect of which we strive to estimate), we can compare the results to the two kinds of regressions to get to better conclusions. Assuming that the zero conditional mean assumption holds, we can conclude to have obtained BLUE estimates at least for the model where the risk premium is being explained.

Although multicollinearity does not violate any of the Gauss-Markov assumptions, high correlation between the independent variables can still lead to higher variance. There is no clear-cut rule on how much multicollinearity is too much, however, and it is hard to fix as dropping relevant variables from the model will result in the violation of the zero conditional mean assumption. In Table 2, we present the correlation coefficients between all the independent variables. We see that the correlation coefficients can be described as quite low, and that the only high correlations are observed between the Economic Activity Index and the variables from which it is constructed.

Table 1: Correlation matrix for the independent variables

Variables	DYgrowth	RU	HPIgrowth	cay	PBS	DP	diff_DYgrowthEZ	diff_RUEZ	diff_HPIgrowthEZ	diff_DS	diff_TS	diff_EAI
DYgrowth	1.000											
RU	-0.070	1.000										
HPIgrowth	0.253	-0.287	1.000									
cay	0.130	-0.050	0.298	1.000								
PBS	0.179	-0.098	-0.013	0.165	1.000							
DP	-0.039	0.057	-0.005	0.370	-0.080	1.000						
diff_DYgrowthEZ	0.161	-0.028	0.223	0.271	0.079	0.053	1.000					
diff_RUEZ	-0.138	-0.018	-0.250	0.025	-0.250	0.539	-0.147	1.000				
diff_HPIgrowthEZ	0.083	0.246	0.304	0.212	-0.066	-0.022	0.251	-0.252	1.000			
diff_DS	0.032	-0.199	-0.067	-0.398	0.140	-0.198	-0.001	-0.022	-0.230	1.000		
diff_TS	-0.037	-0.099	-0.191	-0.379	0.127	-0.092	-0.036	0.179	-0.352	0.819	1.000	
diff_EAI	0.183	0.112	0.367	0.258	0.086	-0.158	0.768	-0.544	0.731	-0.108	-0.256	1.000

Table 2 gives an overview over the correlation between the independent variables in the regression. Overall, the correlation coefficients are low, which strengthens our view that multicollinearity is not a problematic issue for our data.

We have also calculated the variance inflation factor, which can in some instances give an indication of the extent to which multicollinearity may be a problem. For all four regressions, the variance inflation factor is well within the limits of what is considered acceptable. We can therefore conclude that multicollinearity is not a big problem in our regression. The details are provided in the appendix.

Finally, correct inference testing relies on normal distribution of the residuals. In many cases, this assumption will not be correct, especially when the independent variables have very different distributions, and when the effect of the error term on the dependent variable is not just additive. In situations where the unobserved forces affect the dependent variable in different directions, for example, the normality assumption will likely not hold. This is less of a problem in larger samples, but in our case it might skew the inference results. Also, considering the features of our data set, it will not be surprising to see that the distribution of the residuals deviates from the normal distribution.

First, we plot the residuals from the four regressions (risk premium and unexpected return as the dependent variable, both with and without paper-bill spread on the right hand side) against the normal distribution curve. These figures are included in the appendix. Just a visual assessment of the fit leads to the conclusion that while residuals seem to roughly follow the normal distribution density curve, there is some possibility of non-normality in the residuals. To quantify this possibility, we use the Shapiro-Wilk W test for normality of residuals. Based on the 95% confidence level, we reject the normality of the residuals for all regressions except the second one - where the risk premium is the dependent variable and the paper-bill spread is included in the controls. We can therefore confirm that the assumptions necessary for correct inference are only fulfilled in this regression - and there too, the p-value is only slightly above 5%. The estimates from all four regressions are unbiased, though, even if the inference is not reliable.

From the scatterplots of residuals against time (see the appendix), we can see that some of the returns act as outliers: they are abnormally high or low according to our model. However, even if they may be considered outliers, there is little justification for removing them from our sample, as the residuals are based on the actual returns from the specific country's indices at a specific point in time.

All in all, we may consider our estimates to be BLUE at least for the first two out of four regressions - where the risk premium is being explained. Where the paper-bill spread is included among the controls, the residuals are normally distributed as well. We can therefore conclude that the regression where the risk premium is the dependent variable, and where the controls include the paper-bill spread, provides us with the BLUE estimates and correct inference testing. The results of the other three regressions can be compared against it.

7 Results

The question we are studying is whether country-level macroeconomic indicators can predict the stock exchange index returns in Norway, Denmark, Sweden and Finland. We have four main regression results reported in Table 3. The first two regressions are of the risk premium on the set of predictors. The second two regressions are of the CAPM-based unexpected return on the same set of variables. We estimate both types of regressions including and excluding the paper-bill spread. The use of paper-bill spread shortens the sample and excludes the volatile data on the index returns from early 2000s associated with the dot-com bubble. However, one thing to note straight away is that the inclusion of this variable hardly changes our main estimates and their statistical significance.

Table 3: **Fixed Effects Regression Estimates: main results**

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
DYgrowth	-0.188	-0.095	-0.154**	-0.157*
	(0.164)	(0.356)	(0.016)	(0.052)
RU	2.678**	3.734**	0.188	0.613
	(0.040)	(0.040)	(0.743)	(0.299)
HPIgrowth	0.114	0.346	0.005	0.061
	(0.604)	(0.146)	(0.951)	(0.412)
diff_DYgrowthEZ	0.344	3.235**	0.263	0.819
	(0.820)	(0.027)	(0.746)	(0.311)
diff_RUEZ	0.264	2.142	-0.344	-0.853
	(0.919)	(0.440)	(0.640)	(0.405)
diff_HPIgrowthEZ	-1.340	-3.242**	0.069	-0.733
	(0.269)	(0.022)	(0.907)	(0.189)
cay	-0.003	-0.005***	-0.001	-0.001*
	(0.106)	(0.000)	(0.125)	(0.072)
diff_DS	0.861	7.438	1.510	1.766

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Table 3 – continued from previous page

	(1) Risk_premium	(2) Risk_premium	(3) Unexpected_return	(4) Unexpected_return
	(0.881)	(0.106)	(0.512)	(0.572)
diff_TS	2.822	-3.340	-0.582	-2.138
	(0.650)	(0.533)	(0.818)	(0.479)
DP	1.586	0.897	0.650*	0.626*
	(0.157)	(0.422)	(0.060)	(0.062)
PBS		-0.190		-0.021
		(0.109)		(0.446)
Constant	-0.002	0.014	0.000	-0.003
	(0.924)	(0.477)	(0.984)	(0.763)
Adjusted R^2	0.121	0.388	0.037	0.076
Prob >F	0.000	0.000	0.015	0.003
Observations	248	168	248	168

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 reports the results of the set of four benchmark regressions. The first regression has risk premium as the dependent variable and excludes the paper-bill spread from the controls. The second regression has risk premium as the dependent variable and includes the paper-bill spread in the controls. The third regression has CAPM-based unexpected return as the dependent variable and excludes the paper-bill spread from the controls. The forth regression has CAPM-based unexpected return as the dependent variable and includes the paper-bill spread in the controls.

Relative unemployment rate has a positive and statistically significant coefficient in the first two regressions. The effect of relative unemployment in these two regressions is not only significant statistically, but also economically: a 1-percentage point increase in relative unemployment (that is, a 1-percentage point increase in unemployment relative to the "natural" rate of unemployment) is associated with a 2.7-3.7 percentage point increase in future risk premia.

In the two regressions with unexpected return as the dependent variable, the income growth coefficient is negative and significant both when the paper-bill spread is included and excluded from the regression. We can also observe that the estimated coefficient on the income growth stays negative and has similar magnitude in all four regressions in the table, although it only becomes statistically significant on the 90% to 95% confidence level in the regressions 3 and 4. The economical significance of the coefficient is modest: a 1-percent increase in income growth decreases future unexpected return by 0.09 - 0.19 percentage points. At the same time, the relative unemployment coefficient is greatly reduced in these regressions, and is no longer statistically significant.

Although the house price index coefficient is not statistically significant, the coefficients of income growth and relative unemployment are consistent with our hypothesis of higher returns following after the periods of local economic slowdown. The coefficient on income growth especially seems to be robust, as it hardly changes in size in all the four regressions.

Another way to check the robustness of the main findings is to run a regression where the EU-level income growth, relative unemployment rate and house price index growth are replaced with a single Economic Activity Indicator. This is done in order to minimize the noise caused by the differenced predictors with low variance in the main regression. The procedure for calculating the Economic Activity Index replicates the one in Korniotis and Kumar (2013). More details and the results of this regression are reported in the appendix. The general conclusion from comparing the two sets of regressions with each other is that our findings are quite robust to this change.

Overall, our main results indicate that a decrease in local income growth is associated with higher future CAPM-based unexpected return, and an increase in local relative unemployment is associated with higher future risk premium. Thus, local recessions are followed by increased future stock returns. The results do not change significantly if we shorten the sample period by including the paper-bill spread. They also turn out to be robust when we reduce the number of noisy variables by constructing the Economic Activity Indicator.

8 Discussion

In this section we will focus on the economic intuition and discuss the possible reasons for the observed predictability patterns. Next, we estimate a range of additional regressions to obtain the evidence of the possible effects of local bias and of longer time horizon. We then discuss if these findings are consistent with our main results.

8.1 Predictability patterns in benchmark regression

8.1.1 Economic intuition for the results

Our main results presented in Table 3 appear theoretically plausible: macroeconomic indicators linked to a local economic slowdown are associated with higher future equity returns. The coefficient of income growth is negative in all four regressions, although it is statistically significant only in the last two regressions. The negative sign of the coefficient might indicate that lower income growth makes the investors feel poorer, increasing their risk aversion and subsequently cutting their risk-sharing. At an aggregate level such changes lead to a fall in stock prices, thereby increasing the future returns. This is consistent with the classical theoretical foundation as described by Cochrane (2005). Local income growth is a factor that is likely to affect an "average" investor through their own salary, and may influence both the investors' consumption risk and their risk aversion. Additionally, decreased income causes the funds available for investment to decrease, decreasing the demand for the investment products and bringing the prices down - thereby increasing the future returns on these investments.

The coefficient of the local relative unemployment rate is positive and significant in the first two regressions, where risk premium is the dependent variable. Risk-averse investors change their expectations of risk premia when there is an indication of changes in their consumption risk. Local recessions, proxied by higher relative unemployment, signal about a possible fall in consumption, which may cause the investors to reduce their level of risk-sharing. Similarly to the effect of the decreased income growth, this leads to lower stock prices and higher future returns. However, the effect disappears completely in the third and forth regression, where CAPM-based unexpected return is the dependent variable.

Why does the effect of relative unemployment disappear when we predict the unexpected return? The reason for this may be that the CAPM-based expected return is already correlated with the unemployment changes. Unemployment is directly related to the activity level in the economy, and the companies' activity level is reflected in the price of the market index as well. By its very construction, the CAPM-based expected return is adjusted for the risks connected with the market return, so the relative unemployment will not provide new information about the possible consumption risk to the investors given that they know the CAPM-based expected return.

While unemployment is a significant predictor in the first two regressions in Table 3, the only significant predictor in the third and forth regressions is income growth. What is the reason for this? Relative unemployment is likely to be more sensitive to a slowdown in economic activity when compared to income growth. Due to the trade union system in the countries we are studying, labor income can hardly decrease, so it is not common to see negative income growth, while positive relative unemployment occurs more often. This can be confirmed by the mean values of income growth and relative unemployment from Table 1, as well as the plots of the corresponding time series presented in Figures 2 and 3. This may be the reason why unemployment turns out to be a stronger predictor of risk premia in comparison to income growth.

Comparing the two observed predictability patterns with each other, the magnitude of the effect of relative unemployment is higher than that of income growth. However, investors who wish to predict the unexpected return will find using the local income growth much more useful. Taken together, the results of the main regression align with our hypotheses that economic recessions are followed by higher excess equity returns. The underlying reasons are likely to do with the effect of macroeconomic changes on an average investor's risk aversion and the riskiness of the consumption path as discussed by Cochrane (2005).

One implication of the observed predictability patterns that we will discuss in further detail below, is that of the observed predictability of the unexpected returns. The evidence of some predictability in unexpected returns means that CAPM on its own does not explain all the variation in risk premia. In the next section, we'll discuss some of the features of CAPM that have implications for our views on this observed predictability.

8.1.2 Predictability in unexpected returns

As one of the main variables in our regressions is based on the CAPM, we will briefly discuss the main features of this model that we consider relevant to our study. Theoretically, a well-functioning asset pricing model should account for fundamental risk factors and explain all variation in compensation for risk. Our results indicate that excess return over CAPM can be predicted by income growth. There may be several ways of explaining this. From the perspective of market efficiency, predictability of unexpected returns can either mean inefficient market or an inappropriate asset pricing model. As discussed in Section 5.1, this is the joint hypothesis problem. If we assume that the CAPM prices the stocks correctly, then the market is likely to be inefficient and the predictability results can potentially be exploited to earn abnormal returns. If the market is efficient, then the observed predictability in the unexpected returns indicates that CAPM alone might not accurately price the assets.

It is beyond the scope of our study to claim whether the markets are efficient or not. However, there are some issues related to CAPM that can potentially explain the observed predictability if we assume efficient markets. As it has already been mentioned, CAPM is one of the linear factor pricing models. To be precise, it is the first and most basic of these models. The model is based on the work by Sharpe (1964), Lintner (1965) and Mossin (1966). We underline again, that all factor models are simplifications of the consumption-based model and their objective is to suggest relevant proxies for investors' marginal utility growth.

The main point of CAPM is to replace consumption data by rate of return on total wealth. Cochrane (2005) demonstrates that, assuming specific utility forms and additional conditions one can arrive to the same result, that is, stochastic discount factor is linear in return on total wealth. The assumptions behind CAPM are mean-variance preferences, homogeneous beliefs among investors regarding capital markets, the existence of a risk-free security, either normally distributed returns or quadratic utility, and perfect capital markets. These assumptions do not describe real economic situation accurately, and this can be the reason for the observed predictability of the unexpected returns.

Another question concerning CAPM is the proxy for total wealth. In empirical work, it is usually the return on a broad stock market index, while theoretically total wealth should include other types of securities as well as real assets and human capital. It is challenging to find a proxy for total wealth in this sense. We use return on S&P Europe 350 index which seems to be a reliable proxy for European stock market, but we do not take into account other components of total wealth implied by the financial theory.

Overall, predictability of unexpected returns may be related to the strong assumptions behind the model and empirical issues such as the choice of a reliable proxy for total wealth. In our case it is not possible to draw more detailed conclusions about the nature of predictability due to the joint hypothesis problem.

8.1.3 The role of local bias

Korniotis and Kumar (2013) find predictability patterns similar to our results and explain their nature by a combination of time-varying expected returns and mispricing caused by coordinated trading activities of the local investors. These coordinated trading activities can potentially affect stock prices if home bias and the level of local ownership are high enough.

Unfortunately, the data on trading activity and ownership in the indices we are studying is not readily available, which makes it hard for us to test some of the most interesting conjunctures: do local investors react in a coordinated manner to local macroeconomic changes, and do foreign investors follow suit?

Some evidence of home bias can be found in research literature. Home bias is defined as a strong preference for securities of investor's own country despite the fact that investment in foreign assets reduces risk through diversification and optimal risk-sharing. It has been empirically proven that investors tend to invest more than the optimally justified share of their wealth in their home country securities (French and Poterba, 1991). This can be explained by information asymmetries, as investors feel more comfortable to buy familiar assets (Coval and Moskowitz, 1999). Then it is reasonable to assume that recent technological development, globalization and financial markets integration should lower the level of home bias. Schoenmaker and Soeter (2014) claim that home bias in Europe has decreased due to the introduction of Euro and, thus, elimination of exchange rate risk. Three of four countries in our study are outside the Euro zone, but the findings of Schoenmaker and Soeter (2014) indicate that equity home bias in Denmark, Sweden and Finland has decreased significantly since 1990s. Another study on home bias by Lau et al. (2010) claims that North European countries have quite high level of home bias in comparison to, for example, the US. The difference in conclusions is most probably due to different approaches to measuring the home bias. Therefore, current research on local bias in North European countries is not conclusive.

On the other hand, even if the presence of local bias is empirically proven, it does not automatically mean that the levels of local ownership are high enough to affect the prices. Following the logic of Sharpe (1964), optimal risk sharing is based on holding the world market portfolio. Each country's weight in this portfolio is determined by its market capitalization. To illustrate this, we can imagine an average investor from Norway. This investor should optimally hold the world market portfolio, and the share that should be invested in Norwegian market is equal to the ratio of the market capitalization of Norwegian firms to the market capitalization of all firms in the world market. The countries in our study are not likely to have a high weight in the world market portfolio. So even moderate holdings of their stocks by local investors can be seen as too high and formally indicate local bias. This means that high local bias is not equivalent to high local ownership. However, it is the latter which is needed to induce local price changes through the coordinated trading of local investors.

Therefore, we consider general levels of local vs. foreign ownership in Northern European stock markets. The level of foreign investors in Norway has been between 27% and 40% over the past 15 years (Oslo Boers, 2016). About one third of the Swedish stock market has been owned by foreigners at the beginning of 2000s (Munck et al., 2006). Foreign ownership level in Finland has been between 40% and 70% since the beginning of 2000s (Keloharju, 2015). The share of foreign investors in the Danish stock market was approximately 40% in 2011 (Davydoff et al., 2013). Thus, we can see that in most cases more than half of all assets is owned by local investors which means that their behavior can potentially affect prices given that they are managing their investments actively.

There is one implication of high local bias and local ownership-induced local return predictability: the stocks that are expected to be most affected by the local investors' trading are the small, less visible stocks. As hypothesized in Korniotis and Kumar (2013), the implication of high local ownership and local bias is that the share of foreign ownership is higher for the larger, more visible stocks. The intuition for this assumption is that the foreign investors are more aware of these stocks' existence, and are more likely to hold them. Additionally, foreign investors may prefer highly visible stocks due to their higher liquidity. Consequently, prices of such stocks should be less affected by local macroeconomic shocks - given that the predictability effects are due to the local investors' more extreme reactions to the local macroeconomic shocks and their consequent correlated trading. In the next section we present the results of additional regressions where we replace all-share indices by indices containing the most traded stocks to test the effect of higher visibility. We also test the effect of a longer prediction horizon for both types of indices.

8.2 Additional tests: effects of high visibility and longer prediction horizon

8.2.1 Predictability effects for most traded stocks

Compared to the predictability of the returns on all-share indices that we have studied so far, we can expect the effects to deteriorate for the indices that contain only the most visible and actively traded stocks in presence of local bias. To test this conjunction, we focus on four new indices: OBX (25 most liquid stocks at Oslo Stock Exchange), OMXS30 (30 most liquid stocks at Stockholm Stock Exchange), OMXH25 (25 most liquid stocks at Helsinki Stock Exchange), OMXC20 (20 most liquid stocks at Copenhagen Stock Exchange). All indices are value-weighted.

We calculate risk premia and unexpected returns and estimate a new set of four regressions. The procedure and intuition are completely equivalent to that earlier. The results are reported in Table 4, and they do not indicate that the returns on indices with the most traded stocks are any less predictable. On the contrary, relative unemployment is confirmed as a statistically and economically significant predictor of both risk premia and the unexpected returns. Each 1-percentage point increase in relative unemployment is associated with a 2.2-3.2-percentage point increase in expected returns two quarters later. Local income growth and house price growth, however, do not seem to have any effect on these returns.

Table 4: **Fixed effects regression estimates for indices with the most traded stocks**

	(1) Risk_premium	(2) Risk_premium	(3) Unexpected_return	(4) Unexpected_return
DYgrowth	-0.149	0.039	-0.129	0.040
	(0.351)	(0.820)	(0.358)	(0.802)
RU	3.256***	3.150**	2.556**	2.243**
	(0.007)	(0.026)	(0.016)	(0.043)
HPIgrowth	0.044	0.234	0.050	0.210
	(0.815)	(0.318)	(0.754)	(0.272)
diff_DYgrowthEZ	-0.009	-0.704	-0.021	-1.383
	(0.997)	(0.657)	(0.993)	(0.339)
diff_RUEZ	-1.448	-0.454	-1.417	-1.011
	(0.610)	(0.884)	(0.589)	(0.733)
diff_HPIgrowthEZ	-2.028	-2.229	-1.625	-1.552
	(0.217)	(0.120)	(0.303)	(0.312)
cay	-0.001***	-0.000	-0.001**	0.000
	(0.009)	(0.918)	(0.042)	(0.801)
diff_DS	-0.510	-2.900	-0.177	-4.583
	(0.936)	(0.682)	(0.978)	(0.529)
diff_TS	1.876	8.240	0.604	7.978
	(0.807)	(0.253)	(0.931)	(0.252)
DP	-0.633	-0.934	-0.832	-0.818
	(0.471)	(0.267)	(0.359)	(0.387)
PBS		-0.241**		-0.184**
		(0.023)		(0.024)
Constant	0.021	0.048*	0.009	0.025
	(0.207)	(0.061)	(0.536)	(0.270)

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Table 4 – continued from previous page

	(1) Risk_premium	(2) Risk_premium	(3) Unexpected_return	(4) Unexpected_return
Adjusted R^2	0.123	0.300	0.088	0.220
Prob >F	0.012	0.000	0.005	0.000
Observations	254	168	254	168

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4 reports the results of the four regression where the most traded stock indices in Denmark, Norway, Sweden and Finland are used to calculate the dependent variables. The first regression has risk premium as the dependent variable and excludes the paper-bill spread from the controls. The second regression has risk premium as the dependent variable and includes the paper-bill spread in the controls. The third regression has CAPM-based unexpected return as the dependent variable and excludes the paper-bill spread from the controls. The forth regression has CAPM-based unexpected return as the dependent variable and includes the paper-bill spread in the controls. The results indicate that the predictability effects do not decrease when the all-share indices are replaced by the most traded stock indices and that the country-level relative unemployment is a significant predictor of excess returns in all four regressions.

Therefore, from the results in Table 4, we fail to find evidence that higher level of local ownership has much influence on the investors' trading, since we observe return predictability effects of similar magnitude for both the all-share indices and the indices with the most traded stocks. Therefore, the predictability that is observed is likely to come from synchronized behavior of all investors, both local and foreign. We can not observe that there is any evidence of mispricing and subsequent correction, since all the investors seem to react in the same way and can therefore be assumed to be equally affected by macroeconomic shocks.

However, the results in Table 4 contradict the main results reported in Table 3, where we found that risk premia are predicted by relative unemployment while the unexpected returns are predicted by income growth. In Table 4, relative unemployment is the only significant predictor for both types of dependent variables. Therefore, the results differ in the predictor of unexpected returns. These unexpected returns are calculated based on the same market return, S&P Europe 350, and the same risk-free rate. This means that the difference in significant predictors has to originate from the difference in the returns on the indices themselves: all-share indices are less correlated with unemployment news than the most traded indices. Whether the predictability of all-share index returns and the most traded index returns is systematically different due to some underlying processes will have to be confirmed by further replication studies. However, it is also possible that the observed difference is sample-specific.

All in all, the local bias is not likely to be the main driver of the results in Table 3, as effects of similar magnitude are also observed in Table 4. The results are not completely consistent, which we believe might be a sample-specific finding. On the other hand, there could be systematic differences in the way the two types of stock indices react to the economic news reflected in unemployment and income growth, but further research is necessary for this to be confirmed.

8.2.2 Predictability at longer horizons

In Table 5, we report the results of another estimated regression, where the horizon for the predictions is extended to one year. Extending the horizon of the predictions to one year for the most traded stock indices - that is, lagging the macroeconomic predictors by four quarters and the other variables by three quarters - leads to the disappearing of any return predictability stemming from the local indicators. The coefficients on local relative unemployment are drastically reduced and no longer statistically significant. At the same time, the Euro zone-level relative unemployment rate emerges as a strong predictor in all four regressions in Table 5.

The reason for this has likely to do with the delayed effect of the European business cycle. According to Aastveit et al. (2015), there is no clear indication of synchronizing business cycles in Scandinavian countries relative to Europe and USA. However, their empirical results show that, at least during the 2007-2008 financial crisis, business cycle peaks in Norway and Sweden lag behind the official European business cycle defined by the Centre for Economic Policy Research. This means that indications of recessions at aggregate European level might occur earlier than in the Northern European countries. Therefore, they become significant predictors for expected returns in the Northern European stock markets at a longer horizon. If this is the case, it seems reasonable that the level of unemployment in Euro zone lagged by four quarters has approximately the same effect on index returns as the country-level relative unemployment in Northern European countries lagged by two quarters.

Table 5: **Fixed effects regression estimates: most traded stocks, 1-year horizon**

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
DYgrowth	-0.041	-0.042	-0.042	-0.028
	(0.763)	(0.800)	(0.729)	(0.862)
RU	1.585	1.705	1.034	1.259
	(0.152)	(0.400)	(0.301)	(0.481)
HPIgrowth	-0.194	-0.153	-0.112	-0.021
	(0.290)	(0.463)	(0.472)	(0.909)
diff_DYgrowthEZ	0.438	0.462	0.314	-0.985
	(0.758)	(0.855)	(0.841)	(0.667)
diff_RUEZ	5.352***	5.580*	5.780***	6.389**
	(0.005)	(0.054)	(0.002)	(0.013)
diff_HPIgrowthEZ	0.001	-0.248	0.649	0.384
	(0.999)	(0.909)	(0.635)	(0.845)
cay	-0.001	-0.001	-0.001	-0.000
	(0.214)	(0.330)	(0.293)	(0.381)
diff_DS	10.980**	10.682***	9.410**	9.672***
	(0.012)	(0.003)	(0.026)	(0.008)
diff_TS	-10.509***	-8.716**	-8.682**	-7.714**
	(0.005)	(0.022)	(0.018)	(0.037)
DP	0.369	-0.233	0.203	-0.389
	(0.669)	(0.793)	(0.824)	(0.688)
PBS		-0.054		-0.040
		(0.486)		(0.558)
Constant	0.024	0.039*	0.009	0.015

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Table 5 – continued from previous page

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
	(0.167)	(0.092)	(0.531)	(0.422)
Adjusted R^2	0.116	0.150	0.097	0.151
Prob >F	0.005	0.007	0.027	0.007
Observations	248	168	247	168

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5 reports the results of the four regression where the most traded stock indices in Denmark, Norway, Sweden and Finland are used to calculate the dependent variables, and where the prediction horizon is increased by two quarters, so that the macroeconomic predictors are lagged by four quarters. The first regression has risk premium as the dependent variable and excludes the paper-bill spread from the controls. The second regression has risk premium as the dependent variable and includes the paper-bill spread in the controls. The third regression has CAPM-based unexpected equity return as the dependent variable and excludes the paper-bill spread from the controls. The forth regression has CAPM-based unexpected equity return as the dependent variable and includes the paper-bill spread in the controls. The results indicate that the most traded stock indices are predictable using the relative unemployment on the Euro-zone level when the prediction horizon is increased to four quarters.

When the horizon for the same type of regression is further extended by two more quarters, the evidence of return predictability largely deteriorates. The results of this estimated regression are reported in Table 6. Since we have not found evidence to support the possible mispricing hypothesis, we can conclude from the results in Tables 4, 5 and 6 that the returns on the most traded and liquid stocks, both in the form of risk premia and of the CAPM-based unexpected returns, are predictable on a two to four quarters horizon.

Table 6: **Fixed effects regression estimates: most traded stocks, 1.5-year horizon**

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
DYgrowth	0.049	0.022	0.036	-0.032
	(0.687)	(0.865)	(0.767)	(0.815)

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Table 6 – continued from previous page

	(1) Risk_premium	(2) Risk_premium	(3) Unexpected_return	(4) Unexpected_return
RU	0.873	0.409	0.497	0.240
	(0.449)	(0.805)	(0.630)	(0.875)
HPIgrowth	-0.261	-0.397*	-0.202	-0.347*
	(0.213)	(0.059)	(0.270)	(0.073)
diff_DYgrowthEZ	-2.315	0.035	-2.439	0.122
	(0.125)	(0.982)	(0.115)	(0.926)
diff_RUEZ	-0.771	-0.184	-2.814	-2.589
	(0.849)	(0.974)	(0.433)	(0.604)
diff_HPIgrowthEZ	-0.546	-0.563	-0.744	-0.693
	(0.806)	(0.787)	(0.689)	(0.658)
cay	0.000	-0.000	-0.000	-0.000
	(0.677)	(0.516)	(0.952)	(0.238)
diff_DS	1.326	-0.255	-0.241	-0.712
	(0.727)	(0.959)	(0.949)	(0.896)
diff_TS	-4.191	-2.931	-2.430	-1.609
	(0.358)	(0.511)	(0.563)	(0.731)
DP	-0.388	0.541	-0.137	0.929
	(0.755)	(0.666)	(0.906)	(0.395)
PBS		0.041		0.037
		(0.549)		(0.554)
Constant	0.033**	0.030	0.016	0.013
	(0.030)	(0.143)	(0.209)	(0.448)
Adjusted R^2	0.087	0.070	0.088	0.059
Prob >F	0.300	0.062	0.524	0.194
Observations	242	168	241	168

p-values in parentheses

Continued on next page

Table 6 – continued from previous page

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 reports the results of the four regression where the most traded stock indices in Denmark, Norway, Sweden and Finland are used to calculate the dependent variables, and where the prediction horizon is increased by four quarters, so that the macroeconomic predictors are lagged by six quarters. The first regression has excess risk premium as the dependent variable and excludes the paper-bill spread from the controls. The second regression has risk premium as the dependent variable and includes the paper-bill spread in the controls. The third regression has CAPM-based unexpected return as the dependent variable and excludes the paper-bill spread from the controls. The forth regression has CAPM-based unexpected return as the dependent variable and includes the paper-bill spread in the controls. The results show that return predictability effects for the most traded stocks largely deteriorate when the prediction horizon is increased to six quarters.

Although not completely consistent with the baseline results, where relative unemployment was not a significant factor in predicting the unexpected returns, these findings are consistent with our initial hypothesis of a positive coefficient of relative unemployment rate. These findings are also still theoretically plausible and consistent with the reasoning from Korniotis and Kumar (2013) and Cochrane (2005), expecting higher unemployment rate to increase the average investor's riskiness of consumption and/or risk aversion. The investor in this situation wants to hold fewer risky assets. Since the reasoning and intuition is applicable to a large pool of investors, their coordinated trading activities bring the prices down, and the future expected returns increase. As new macroeconomic shocks occur - for example as the baseline for the relative unemployment rate gradually changes and the perceived macroeconomic conditions change as well, the trading activities may gradually begin to tip in the other direction, which may explain why the return predictability effects largely disappear after one and a half years.

For consistent comparisons of the results, we estimate the same kinds of regressions with the all-share index excess returns as the dependent variable. Table 7 reports the estimated results for one year-horizon return predictability, and Table 8 reports the results for one and a half year horizon. From these results, it is evident that the return predictability effects from Table 3 disappear when the horizon is extended. Thus, the Euro zone-level business cycle does not have any pronounced effects that we could observe from Table 5.

Table 7: **Fixed effects regression estimates: all-share indices, 1-year horizon**

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
DYgrowth	-0.076	0.060	-0.106	0.093
	(0.579)	(0.744)	(0.276)	(0.403)
RU	0.942	1.065	-0.579	-0.421
	(0.404)	(0.497)	(0.115)	(0.282)
HPIgrowth	-0.167	-0.266	-0.053	0.002
	(0.386)	(0.242)	(0.438)	(0.971)
diff_DYgrowthEZ	1.166	4.788*	-0.014	-0.320
	(0.488)	(0.060)	(0.988)	(0.538)
diff_RUEZ	-0.555	-0.723	1.280	0.928
	(0.838)	(0.811)	(0.232)	(0.497)
diff_HPIgrowthEZ	-2.151	-3.210	-0.204	-0.901*
	(0.328)	(0.183)	(0.739)	(0.084)
cay	-0.004*	-0.003	-0.000	-0.000
	(0.054)	(0.254)	(0.821)	(0.439)
diff_DS	-0.668	-1.988	-3.975***	-5.125***
	(0.904)	(0.655)	(0.009)	(0.002)
diff_TS	-3.959	-1.997	2.628*	3.057*
	(0.487)	(0.730)	(0.056)	(0.067)
DP	1.178	0.401	-0.728*	-0.678
	(0.440)	(0.826)	(0.096)	(0.169)
PBS		-0.036		-0.016
		(0.609)		(0.371)
Constant	0.014	0.028	0.014*	-0.001

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Table 7 – continued from previous page

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
	(0.436)	(0.427)	(0.052)	(0.926)
Adjusted R^2	0.120	0.183	0.058	0.106
Prob >F	0.004	0.001	0.000	0.006
Observations	242	168	242	168

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 reports the results of the four regression where the all-share indices are used to calculate excess returns and where the prediction horizon is increased by two quarters, so that the macroeconomic predictors are lagged by four quarters. The first regression has risk premium as the dependent variable and excludes the paper-bill spread from the controls. The second regression has risk premium as the dependent variable and includes the paper-bill spread in the controls. The third regression has CAPM-based unexpected return as the dependent variable and excludes the paper-bill spread from the controls. The forth regression has CAPM-based unexpected return as the dependent variable and includes the paper-bill spread in the controls. The results indicate that the predictability effects from the benchmark set of regressions deteriorate when the prediction horizon is increased to four quarters.

Table 8: **Fixed effects regression estimates: all-share indices, 1.5-year horizon**

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
DYgrowth	0.010	0.169	-0.089	0.007
	(0.928)	(0.329)	(0.334)	(0.944)
RU	1.159	0.614	-0.049	0.150
	(0.189)	(0.759)	(0.890)	(0.752)
HPIgrowth	-0.171	-0.138	-0.019	0.016
	(0.379)	(0.612)	(0.775)	(0.876)
diff_DYgrowthEZ	0.560	-1.151	-0.062	-0.860
	(0.658)	(0.466)	(0.939)	(0.227)

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Table 8 – continued from previous page

	(1) Risk_premium	(2) Risk_premium	(3) Unexpected_return	(4) Unexpected_return
diff_RUEZ	5.437*	6.538**	-0.500	-0.885
	(0.100)	(0.021)	(0.603)	(0.334)
diff_HPIgrowthEZ	0.496	0.147	-0.207	-0.454
	(0.831)	(0.963)	(0.670)	(0.469)
cay	-0.002	-0.002	-0.001	-0.001*
	(0.212)	(0.413)	(0.421)	(0.079)
diff_DS	7.440	3.898	3.315**	2.084
	(0.125)	(0.536)	(0.034)	(0.272)
diff_TS	-8.319	-7.976	-2.350	-2.576
	(0.127)	(0.205)	(0.208)	(0.220)
DP	0.484	-0.201	0.359	0.518
	(0.653)	(0.870)	(0.482)	(0.323)
PBS		0.040		0.010
		(0.487)		(0.597)
Constant	0.015	0.007	0.001	-0.012
	(0.512)	(0.881)	(0.925)	(0.426)
Adjusted R^2	0.117	0.106	0.042	0.055
Prob F	0.121	0.001	0.061	0.003
Observations	238	168	238	168

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Table 8 – continued from previous page

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return

Table 8 reports the results of the four regression where the all-share indices are used to calculate excess returns and where the prediction horizon is increased by four quarters, so that the macroeconomic predictors are lagged by six quarters. The first regression has risk premium as the dependent variable and excludes the paper-bill spread from the controls. The second regression has risk premium as the dependent variable and includes the paper-bill spread in the controls. The third regression has CAPM-based unexpected return as the dependent variable and excludes the paper-bill spread from the controls. The forth regression has CAPM-based unexpected return as the dependent variable and includes the paper-bill spread in the controls. The results indicate that, similarly to the case where the prediction horizon is set to four quarters, the predictability effects from the benchmark set of regressions deteriorate when the prediction horizon is increased to six quarters.

We believe that return predictability of all-share index returns disappears at longer horizons because they contain the smaller and less liquid stocks. These stocks are mostly held by the local investors. It is reasonable to assume that not all local investors holding small firms' stocks trade actively and consider macroeconomic situation at aggregate European level. They rather react to local shocks. That is why, in contrast to the predictability effects from Table 5, the Euro zone-level unemployment is not a significant predictor of all-share index returns.

To sum up, our hypothesis that local recessions are followed by higher equity returns is supported by our findings. Decreases in local income growth and increases in local relative unemployment are associated with higher stock returns two quarters later. This is consistent with the financial theory: changes in income growth and unemployment affect the investors' risk aversion or the riskiness of their consumption path, leading to adjustments in the level of their risk sharing. Additionally, we find that predictability at longer horizons disappears for all-share indices. However, for most traded stock indices at four quarter horizon the effect of Euro zone-level unemployment becomes significant, while the local predictability effects deteriorate. We believe that the difference in the predictability effects for the two types of indices is related to the difference in the balance of local and foreign ownership.

9 Conclusion

We find that risk premia and CAPM-based unexpected returns on all-share indices in Norway, Sweden, Denmark and Finland vary with the local business cycle conditions. In general, this indicates that the reward for taking on risk varies with the economic state determined by the predictor variables in our regressions. As summarized in Table 3, risk premia are predictable by local relative unemployment. CAPM-based unexpected returns are predictable by income growth.

The fact that the two different dependent variables are predicted by different factors is explained by the different degree of risk adjustment in risk premia and the unexpected returns. By definition, risk premia reflect all systematic risk, while CAPM-based unexpected returns capture the risks not priced by CAPM. Specifically, CAPM includes the market return as the only priced source of risk. The level of unemployment is tightly connected with the level of firms' activity reflected by the changes in market return, so CAPM-based expected returns might be highly correlated with the rate of unemployment. If that is the case, the unexpected returns will not be predicted by unemployment - as observed in our main findings. At the same time, changes in income growth are not directly related to market return, so CAPM-based expected return is not necessarily correlated with all income risks. Therefore, income growth becomes a significant predictor for CAPM-based unexpected returns. Still, unemployment, and not income growth, is a significant predictor of risk premia because unemployment has a higher propensity to increase in poor economic times. Conversely, income growth increases in good times, but it hardly decreases in nominal terms during recessions due to labor market regulations. Thus, compared to income growth, unemployment is a more sensitive predictor of future risk premia.

In both cases, the result is consistent with our hypotheses and intuition of the benchmark article. Country-level income growth has a negative effect on future returns, while country-level relative unemployment has a positive effect. Therefore, local recessions are followed by higher equity returns. These results are in line with the financial theory explaining time-varying expected returns. Fundamentally, the average investor is concerned about smooth consumption. This investor will be more risk-averse during recessions in order to avoid the undesirable fall in consumption, and will therefore expect higher returns. That is why risk premia are higher in presence of economic slowdown.

Time-varying expected returns presuppose that markets are efficient, thus all assets are priced rationally (Fama and French, 1988b). The fundamental values of firms vary through time due to changes in underlying systematic risk and the investors' risk aversion. Another approach suggests that time variation in asset returns can be explained by mispricing caused by irrational behavior of the investors. Intrinsic values of assets are unobserved and market participants tend to overreact to news. This results in long-term deviations from fundamental prices and their subsequent correction (Poterba and Summers, 1988).

According to Korniotis and Kumar (2013), the observed predictability can be explained by a combination of time-varying expected returns and mispricing arising from local equity bias. If the levels of local ownership are high, local investors can affect the asset prices by their coordinated actions. It may be the case that the local investors experience local recessions differently from the foreign investors, and that the local investors' risk aversion or the riskiness of their future consumption increases more than the foreign investors' risk aversion and/or consumption risk. This will induce coordinated trading by the local investors, who will reduce their holdings of risky assets - in this case the local stocks from their portfolio. Then the prices of these stocks will decrease and future returns will increase. Foreign investors who are less affected by the local recessions will buy these discounted stocks and eventually correct the mispricing.

However, if the foreign investors react to the local recessions in exactly the same way as the local investors, the changes in the price of the index that occur in the wake of the local recessions will not be induced by mispricing, but by rational changes to risk aversion and trading behavior on part of both the local and the foreign investors, resulting in changes to the future expected index return. The same outcome may be the case if both the foreign and local investors are affected by the local macroeconomic development, and while the local investors are more affected by it, there is no significant local bias in stock ownership and the effect of local ownership is not enough for the local investors' trading to create mispricing.

We have tested if the indices constructed from the most visible stocks (which thus are expected to have a higher level of foreign ownership) are less affected by the local macroeconomic shocks than the all-share indices. The results indicate that returns on the most visible stocks are not less predictable, so there is no evidence of mispricing induced by the local traders.

In addition, we test if the signs of return predictability are still present at longer horizons. The results are unexpected: at one-year horizon the local factors are no longer significant, but the Euro zone-level unemployment becomes a significant predictor for all risk premia and unexpected returns on indices containing the most liquid stocks. This can be possibly explained by the fact that business cycles in Northern Europe lag behind the EU-level business cycles. All-share indices are not predicted by the Euro zone-level variables at longer horizons, which might be due to noisy trading patterns induced by the small local stocks owners. At one and a half year horizon, there is no evidence of predictability in any of our regressions.

Research on the presented topic can be further developed in several directions. Firstly, since our sample has only 65 observations for each cross-sectional unit, future research may benefit from a longer time dimension in the data. The number of business cycles that may be observed during 65 quarters is very limited, and this makes certain types of robustness tests challenging. For instance, if we were to divide the current sample into sub-periods and estimate the regressions for these periods, the time dimension is likely to become too short to allow for reliable regression analysis, especially since the number of independent variables is quite high. With a larger sample, however, this kind of robustness testing may be possible to implement, and the benchmark regression is likely to benefit from a larger sample as well. Of course, this research improvement is not possible until at least several years have passed, since we used all the data currently available in the thesis.

Secondly, increasing the number of countries is also likely to provide us with additional insights. For example, adding the other countries in the Euro zone would improve our distinction between the country-level and the Euro zone-level effects.

Additionally, there are several alternative ways of calculating unexpected returns, such as various multifactor models as used in Korniotis and Kumar (2013). Testing the predictability of these unexpected returns will provide a more complete picture of how excess returns from the various asset pricing models behave with the local business cycles.

Finally, several of the possible explanations for return predictability that we have discussed above, including possible mispricing, can be formally tested as suggested by Korniotis and Kumar (2013). We have not performed these tests due to data limitations, as time series data on trading activity and local ownership is required. Although mispricing cannot be tested directly, one could for example look at whether the local investors' trading is correlated during the local recessions and whether the foreign investors display a similar trading activity pattern or not. Then it would be possible to test whether foreign investors trade in a correlated manner after the local macroeconomic shock - whether they buy up the stocks shorted by the local investors.

Overall, the mechanisms behind the return predictability conditioned on macroeconomic news are yet to be confirmed, but provide several interesting conjunctions for future research.

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10 Appendix

The appendix contains the results from Stata to a number of statistical tests which we have mentioned in the methodology chapter. These tests are Wald test of heteroskedasticity, Breusch-Pagan test of cross-sectional dependence, Woolridge test of autocorrelation, Im-Pesaran-Shin unit root test for panel data, Shapiro-Wilk test of normality and the calculated variance inflation factor (vif) for the independent variables.

To make it clearer which tests refer to which kind of regressions, we will in this appendix refer to regressions 1, 2, 3 and 4. These are the regressions which are estimated in Table 3 - our main results. Regression 1 is the regression with the stock index return over the risk-free rate as the dependent variable, and regression 2 is the same kind of regression but including the paper-bill spread as a control variable. Regressions 3 and 4 follow the same pattern, only now the residual return over the CAPM-based expected return is the dependent variable.

Furthermore, some tests such as unit root tests are not on the regressions but on separate variables in our dataset. They are captioned accordingly.

10.1 Wald tests of heteroskedasticity

Wald tests of heteroskedasticity confirm that both regressions with the CAPM-based unexpected return as the dependent variable suffer from heteroskedasticity in the residuals.

Figure 6: Wald test of heteroskedasticity in regression 1

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (4)  =        4.31
Prob>chi2 =      0.3652
```

Figure 7: Wald test of heteroskedasticity in regression 2

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (4)  =        3.04
Prob>chi2 =      0.5518
```

Figure 8: Wald test of heteroskedasticity in regression 3

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (4)  =      109.04
Prob>chi2 =      0.0000
```

Figure 9: Wald test of heteroskedasticity in regression 4

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (4)  =       47.65
Prob>chi2 =      0.0000
```

10.2 Breusch-Pagan tests of cross-sectional dependence

Breusch-Pagan tests of cross-sectional dependence confirm the presence of cross-sectional dependence in all four regressions.

Figure 10: Breusch-Pagan test of cross-sectional dependence in regression 1

```
Correlation matrix of residuals:

         __e1     __e2     __e3     __e4
__e1   1.0000
__e2   0.7676   1.0000
__e3   0.8359   0.8216   1.0000
__e4   0.6404   0.5661   0.5658   1.0000

Breusch-Pagan LM test of independence: chi2(6) =   177.812, Pr = 0.0000
Based on 59 complete observations over panel units
```

Figure 11: Breusch-Pagan test of cross-sectional dependence in regression 2

```
Correlation matrix of residuals:

         __e1     __e2     __e3     __e4
__e1   1.0000
__e2   0.7079   1.0000
__e3   0.7942   0.7179   1.0000
__e4   0.6047   0.5342   0.4930   1.0000

Breusch-Pagan LM test of independence: chi2(6) =   106.739, Pr = 0.0000
Based on 42 complete observations over panel units
```

Figure 12: Breusch-Pagan test of cross-sectional dependence in regression 3

```
Correlation matrix of residuals:

          __e1      __e2      __e3      __e4
__e1    1.0000
__e2    0.2426    1.0000
__e3    0.4075    0.2948    1.0000
__e4    0.3186    0.0511   -0.0003    1.0000

Breusch-Pagan LM test of independence: chi2(6) =    24.544, Pr = 0.0004
Based on 59 complete observations over panel units
```

Figure 13: Breusch-Pagan test of cross-sectional dependence in regression 4

```
Correlation matrix of residuals:

          __e1      __e2      __e3      __e4
__e1    1.0000
__e2    0.3214    1.0000
__e3    0.4774    0.2059    1.0000
__e4    0.2939    0.1653   -0.0292    1.0000

Breusch-Pagan LM test of independence: chi2(6) =    20.505, Pr = 0.0023
Based on 42 complete observations over panel units
```

10.3 Woolridge tests of autocorrelation

The results of Woolridge test of autocorrelation find no statistically significant evidence of autocorrelation in the four regressions.

Figure 14: Woolridge test of autocorrelation in regression 1

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,        3) =      4.222
           Prob > F =      0.1321
```

Figure 15: Woolridge test of autocorrelation in regression 2

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,        3) =      3.205
           Prob > F =      0.1714
```

Figure 16: Woolridge test of autocorrelation in regression 3

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,        3) =      4.450
           Prob > F =      0.1254
```

Figure 17: Woolridge test of autocorrelation in regression 4

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,       3) =      1.231
           Prob > F =      0.3481
```

10.4 Unit root test results

The following unit root tests have been used to determine the presence of the unit root in the data: Im-Pesaran-Shin tests, Levin-Lin-Chu tests and Fisher-type tests. Not all variables fulfilled the criteria for the Levin-Lin-Chu tests and Fisher-type tests, so they were used to confirm the results where possible. The main conclusions about the presence of the unit root in the data were drawn from the results to the Im-Pesaran-Shin tests, the results to which we report below.

Figure 18: Im-Pesaran-Shin unit root test for $Residual\_return$ (risk premium)

```
Im-Pesaran-Shin unit-root test for Residual_return
--------------------------------------------------
Ho: All panels contain unit roots           Number of panels       =      4
Ha: Some panels are stationary              Avg. number of periods =  62.75

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                     sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -12.1481        0.0000
------------------------------------------------------------------------------
```

Figure 19: Im-Pesaran-Shin unit root test for $CAPM\_res$ (CAPM-based unexpected return)

```
Im-Pesaran-Shin unit-root test for CAPM_res
-------------------------------------------
Ho: All panels contain unit roots           Number of panels       =      4
Ha: Some panels are stationary              Avg. number of periods =  62.75

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                     sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -17.4174        0.0000
------------------------------------------------------------------------------
```

Figure 20: Im-Pesaran-Shin unit root test for $DYgrowth$ (local year-over-year quarterly income growth)

```
Im-Pesaran-Shin unit-root test for DYgrowth
-------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     65

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Not included

ADF regressions: 0.25 lags average (chosen by BIC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              -10.4246       0.0000
------------------------------------------------------------------------------
```

Figure 21: Im-Pesaran-Shin unit root test for RU (local relative unemployment rate)

```
Im-Pesaran-Shin unit-root test for RU
-------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     65

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar               -2.7121       0.0033
------------------------------------------------------------------------------
```

Figure 22: Im-Pesaran-Shin unit root test for $HPIgrowth$ (local year-over-year quarterly annual house price growth)

```
Im-Pesaran-Shin unit-root test for HPI_gr
-----------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     65

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                     sequentially
Time trend:   Not included

ADF regressions: 0.75 lags average (chosen by BIC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar               -4.4475       0.0000
------------------------------------------------------------------------------
```

Figure 23: Im-Pesaran-Shin unit root test for $HPIgrowthEZ$ (EU-level year-over-year quarterly house price growth)

```
Im-Pesaran-Shin unit-root test for HPI_EZ_gr
--------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     65

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                     sequentially
Time trend:   Not included

ADF regressions: 1.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar               -1.1629       0.1224
------------------------------------------------------------------------------
```

Figure 24: Im-Pesaran-Shin unit root test for $DYgrowthEZ$ (EU-level year-over-year quarterly income growth)

```
Im-Pesaran-Shin unit-root test for DYgrowthEZ
---------------------------------------------
Ho: All panels contain unit roots            Number of panels  =      4
Ha: Some panels are stationary               Number of periods =     65

AR parameter: Panel-specific                 Asymptotics: T,N -> Infinity
Panel means:  Included                                         sequentially
Time trend:   Not included

ADF regressions: 1.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.3159        0.3761
------------------------------------------------------------------------------
```

Figure 25: Im-Pesaran-Shin unit root test for $RUEZ$ (EU-level relative unemployment rate)

```
Im-Pesaran-Shin unit-root test for RUEZ
---------------------------------------
Ho: All panels contain unit roots            Number of panels  =      4
Ha: Some panels are stationary               Number of periods =     65

AR parameter: Panel-specific                 Asymptotics: T,N -> Infinity
Panel means:  Included                                         sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.4461        0.3278
------------------------------------------------------------------------------
```

Figure 26: Im-Pesaran-Shin unit root test for EAI (EU-level Economic Activity Index)

```
Im-Pesaran-Shin unit-root test for EAI
---------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     65

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              -0.3164       0.3758
------------------------------------------------------------------------------
```

Figure 27: Im-Pesaran-Shin unit root test for cay (consumption over the level predicted by income and wealth)

```
Im-Pesaran-Shin unit-root test for cay2
---------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     65

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              -6.1481       0.0000
------------------------------------------------------------------------------
```

Figure 28: Im-Pesaran-Shin unit root test for *DS* (default spread)

```
Im-Pesaran-Shin unit-root test for DS1
--------------------------------------
Ho: All panels contain unit roots           Number of panels       =      4
Ha: Some panels are stationary              Avg. number of periods =  64.75

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                     sequentially
Time trend:   Not included

ADF regressions: 0.25 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -1.2238        0.1105
------------------------------------------------------------------------------
```

Figure 29: Im-Pesaran-Shin unit root test for *TS* (term spread)

```
Im-Pesaran-Shin unit-root test for TS
-------------------------------------
Ho: All panels contain unit roots           Number of panels       =      4
Ha: Some panels are stationary              Avg. number of periods =  64.75

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                     sequentially
Time trend:   Not included

ADF regressions: 1.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.9680        0.1665
------------------------------------------------------------------------------
```

Figure 30: Im-Pesaran-Shin unit root test for *PBS* (paper-bill spread)

```
Im-Pesaran-Shin unit-root test for PBS
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     42

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -3.2254        0.0006
------------------------------------------------------------------------------
```

Figure 31: Im-Pesaran-Shin unit root test for *DP* (dividend yield)

```
Im-Pesaran-Shin unit-root test for DP2
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     65

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -18.8663        0.0000
------------------------------------------------------------------------------
```

Figure 32: Im-Pesaran-Shin unit root test for $diff\_DYgrowthEZ$ (differenced EU-level year-over-year quarterly income growth)

```
Im-Pesaran-Shin unit-root test for diff_DYgrowthEZ
--------------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     64

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -23.5484        0.0000
------------------------------------------------------------------------------
```

Figure 33: Im-Pesaran-Shin unit root test for $diff\_RUEZ$ (differenced EU-level relative unemployment rate)

```
Im-Pesaran-Shin unit-root test for diff_RUEZ
--------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     64

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -17.1975        0.0000
------------------------------------------------------------------------------
```

Figure 34: Im-Pesaran-Shin unit root test for $diff\_HPIgrowthEZ$ (differenced EU-level year-over-year quarterly house price growth)

```
Im-Pesaran-Shin unit-root test for diff_HPIgrowthEZ
---------------------------------------------------
Ho: All panels contain unit roots            Number of panels  =      4
Ha: Some panels are stationary               Number of periods =     64

AR parameter: Panel-specific                 Asymptotics: T,N -> Infinity
Panel means:  Included                                    sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -4.6108        0.0000
------------------------------------------------------------------------------
```

Figure 35: Im-Pesaran-Shin unit root test for $diff\_DS$ (differenced default spread)

```
Im-Pesaran-Shin unit-root test for diff_DS
------------------------------------------
Ho: All panels contain unit roots            Number of panels       =      4
Ha: Some panels are stationary               Avg. number of periods =  63.75

AR parameter: Panel-specific                 Asymptotics: T,N -> Infinity
Panel means:  Included                                    sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -7.8540        0.0000
------------------------------------------------------------------------------
```

Figure 36: Im-Pesaran-Shin unit root test for $diff\_TS$ (differenced term spread)

```
Im-Pesaran-Shin unit-root test for diff_TS
------------------------------------------
Ho: All panels contain unit roots           Number of panels       =      4
Ha: Some panels are stationary              Avg. number of periods =  63.75

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                    sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -7.0812        0.0000
------------------------------------------------------------------------------
```

Figure 37: Im-Pesaran-Shin unit root test for $diff\_EAI$ (differenced Economic Activity Index)

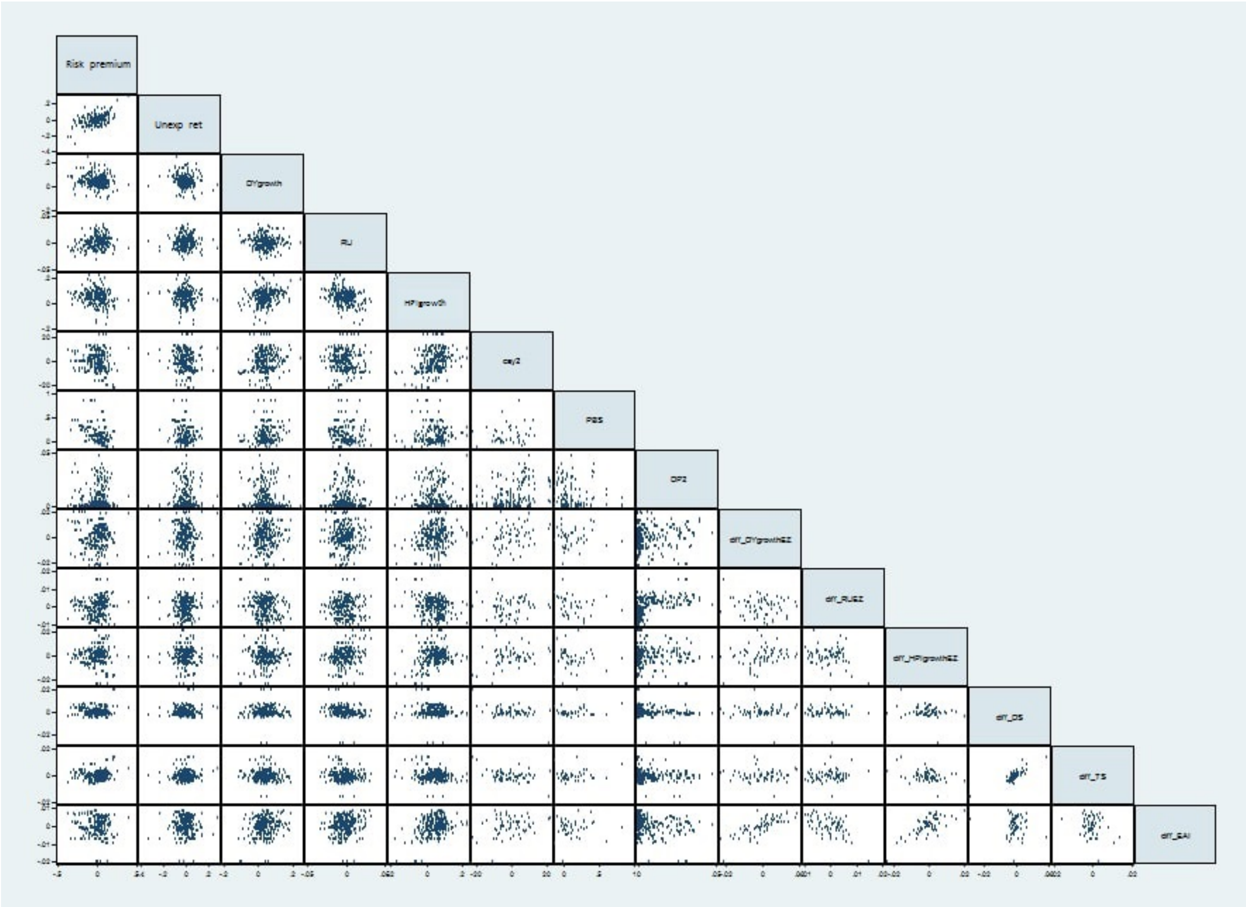
```
Im-Pesaran-Shin unit-root test for diff_EAI
-------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      4
Ha: Some panels are stationary              Number of periods =     64

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                    sequentially
Time trend:   Not included

ADF regressions: 0.00 lags average (chosen by BIC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -10.0929        0.0000
------------------------------------------------------------------------------
```

10.5 Scatterplot matrix

Figure 38: Scatterplot matrix for all independent and dependent variables



10.6 Normality of residuals

This section includes the residuals plotted against the density curve of the normal distribution and the Shapiro-Wilk tests results from the four regressions. In all cases except the second regression, we can reject the null hypothesis of normally distributed residuals.

Figure 39: Residuals from regression 1 against the normal distribution density curve

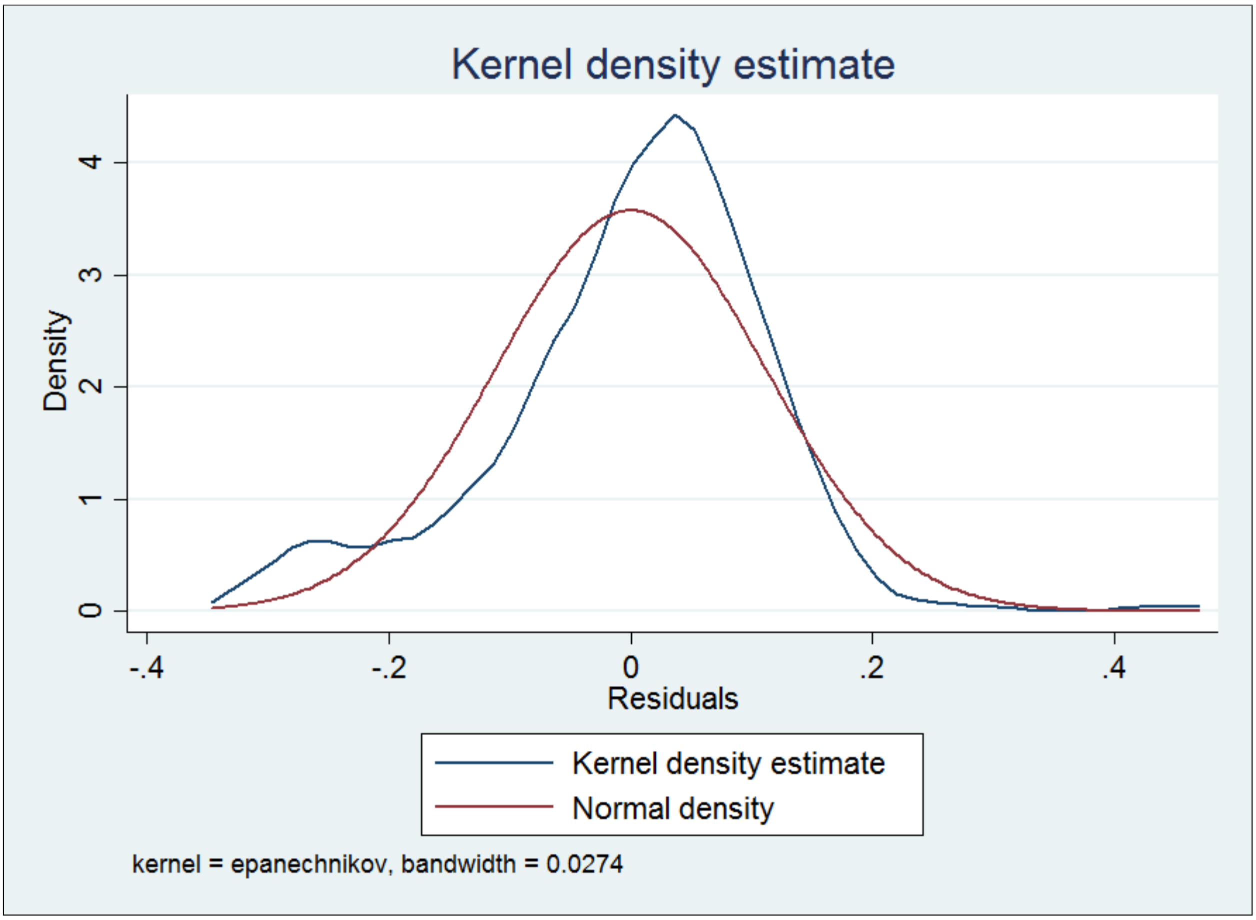


Figure 40: Shapiro-Wilk test of normality results for regression 1

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
res1	248	0.95610	7.906	4.809	0.00000

Figure 41: Residuals from regression 2 against the normal distribution density curve

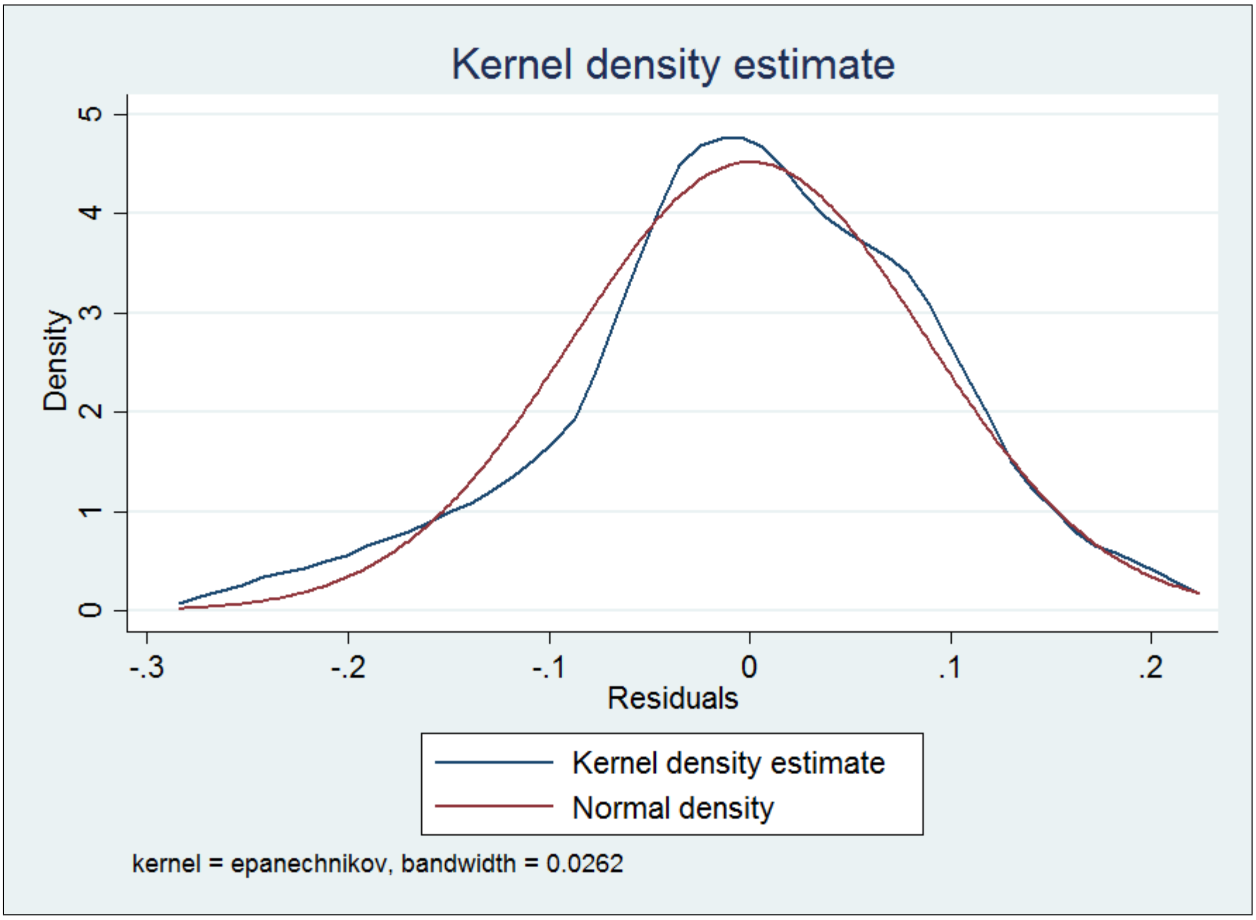


Figure 42: Shapiro-Wilk test of normality results for regression 2

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
res2	168	0.98421	2.026	1.610	0.05372

Figure 43: Residuals from regression 3 against the normal distribution density curve

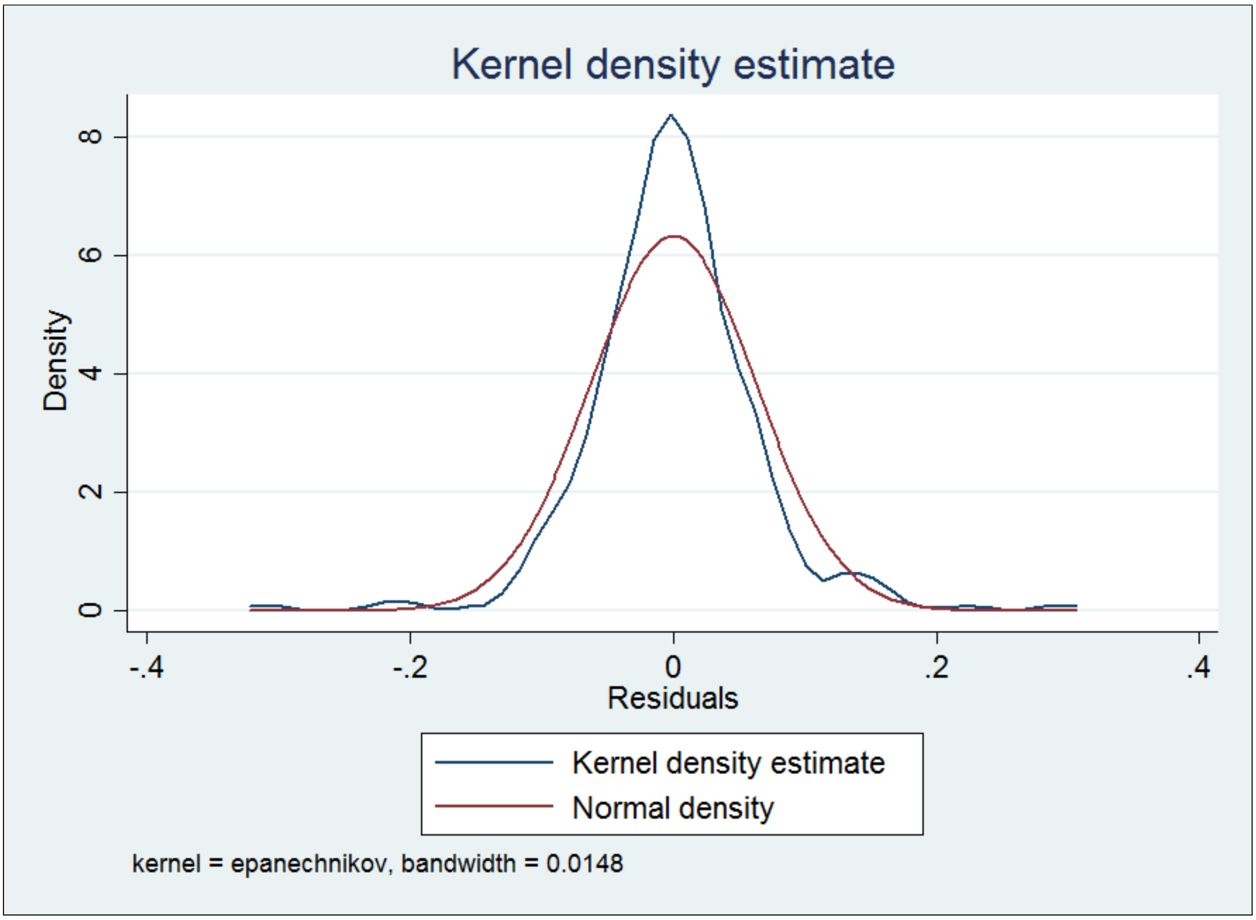


Figure 44: Shapiro-Wilk test of normality results for regression 3

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
res3	248	0.93754	11.249	5.629	0.00000

Figure 45: Residuals from regression 4 against the normal distribution density curve

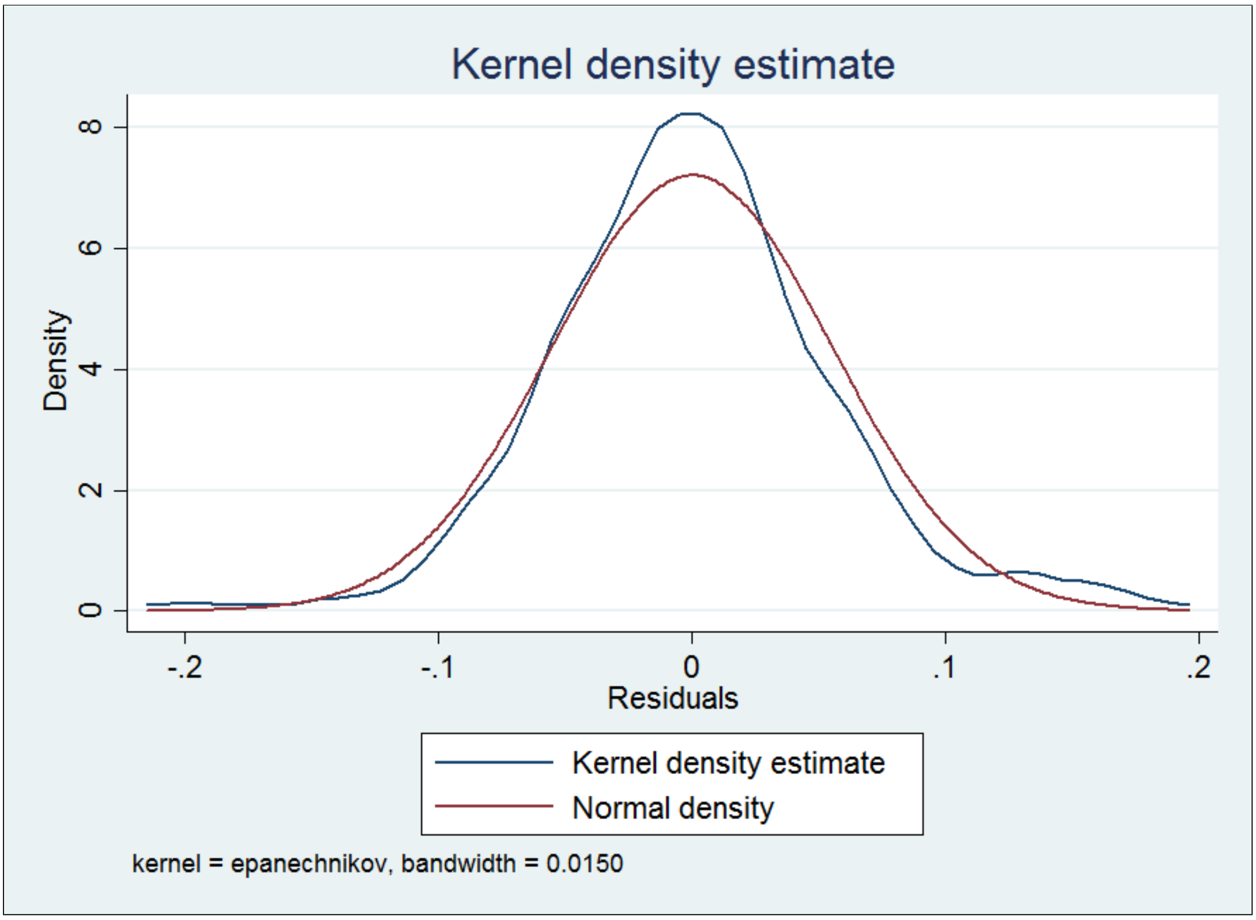


Figure 46: Shapiro-Wilk test of normality results for regression 4

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
res4	168	0.97828	2.786	2.336	0.00974

10.7 Variance inflation factor

In this section we include the two calculations of the variance inflation factor for the independent variables in the regression. The first calculation is based on the regression that includes the paper-bill spread as a control variable, while the second one does not. Conventionally, the critical value for the variance inflation factor is 5 for the separate variables, and 10 for the mean VIF. The variance inflation factor in our case is below this in both cases, which indicates that multicollinearity is not likely a big problem.

Figure 47: Variance inflation factor for regressions 1 and 3

Variable	VIF	1/VIF
diff_TS	3.27	0.305570
diff_DS	3.21	0.311999
DP2	2.06	0.484378
HPI_gr	1.99	0.502515
diff_RUEZ	1.78	0.563195
DYgrowth	1.58	0.632371
diff_HPIgr~Z	1.43	0.700108
RU	1.33	0.751468
cay2	1.31	0.762267
diff_DYgro~Z	1.17	0.851102
Mean VIF	1.91	

Figure 48: Variance inflation factor for regressions 2 and 4

Variable	VIF	1/VIF
diff_TS	3.70	0.270596
diff_DS	3.23	0.309890
DP2	2.80	0.357684
diff_RUEZ	2.25	0.445339
HPI_gr	2.16	0.462626
DYgrowth	1.92	0.520868
diff_HPIgr~Z	1.76	0.567213
PBS	1.71	0.585760
cay2	1.55	0.646880
RU	1.49	0.670748
diff_DYgro~Z	1.28	0.781540
Mean VIF	2.17	

10.8 Robustness check of the main results

In this section we report the results of a regression where the three differenced macroeconomic variables at the Euro zone level are replaced by a single Economic Activity Index. This test is performed in order to minimize the number of noisy variables in the main regression and to see how this change affects the results. As discussed in section 6.3.2, the income growth, relative unemployment and house price index growth at the Euro zone level are non-stationary, thus first difference of the three variables is used in the regression. We exclude these variables and construct Economic Activity Indicator following the procedure by Korniotis and Kumar (2013). Specifically, we add the values of income growth and house price index growth, subtract the value of relative unemployment and divide the result by three. Intuitively, this indicator might reflect the overall pattern of macroeconomic development. Higher income growth and house price index growth as well as lower relative unemployment are signs of economic expansion. Thus, the higher value of the Economic Activity Indicator should reflect a good economic state. We perform the panel regressions equivalent to the main one with the residuals over the risk-free rate and over the CAPM-based expected return as the dependent variables, including and excluding the paper-bill spread.

From Table 9 we see that the magnitude of the coefficients of the income growth is similar to the ones from the main regression reported in Table 3. Moreover, income growth is still statistically significant with the same confidence level of 90% to 95% in the third and fourth regression, and it is not statistically significant in the first two regressions. The relative unemployment coefficient also stays similar in size to the estimated coefficients from Table 3, although it is now only statistically significant in the regression with the risk premium as the dependent variable, where the paper-bill spread is omitted. We see however that the inclusion of the paper-bill spread increases the coefficient, but also increases the p-value up to almost 14 percent. Considered that the sample size is reduced in this regression, it might still be a noteworthy finding. House price index growth still has no effect on the returns.

All in all, income growth is the macroeconomic indicator that has the most stable effect: it maintains a size between -0.07 and -0.19 in all eight estimated regressions in Table 3 and Table 9, and is consistently significant at a 90% to 95% confidence level in the regressions where the dependent variable is the CAPM-based unexpected return. Relative unemployment is less consistent in its statistical significance, but still has an effect in the regressions where risk premium is the dependent variable. In these regressions, its economical significance is quite high, and given that the F-tests confirm the overall model's eligibility for predicting the returns, it can still be used in estimating the risk premium over the risk-free rate.

Table 9: **Fixed Effects Regression Estimates with Economic Activity Index**

	(1)	(2)	(3)	(4)
	Risk_premium	Risk_premium	Unexpected_return	Unexpected_return
DYgrowth	-0.178	-0.073	-0.153**	-0.149*
	(0.178)	(0.523)	(0.016)	(0.061)
RU	2.472*	2.620	0.167	0.384
	(0.057)	(0.138)	(0.757)	(0.499)
HPIgrowth	0.084	0.205	0.003	0.047
	(0.681)	(0.388)	(0.973)	(0.554)
diff_EAI	-0.885	-0.019	0.624	0.493
	(0.740)	(0.995)	(0.617)	(0.721)
cay	-0.003	-0.004***	-0.001	-0.001*
	(0.124)	(0.001)	(0.138)	(0.089)
diff_DS	0.747	5.851	1.532	1.741
	(0.895)	(0.212)	(0.503)	(0.570)
diff_TS	3.564	-0.422	-0.546	-2.018
	(0.552)	(0.938)	(0.829)	(0.484)
DP2	1.625*	1.635	0.620	0.535*
	(0.082)	(0.138)	(0.100)	(0.070)
PBS		-0.194*		-0.014
		(0.082)		(0.603)

Continued on next page

Table 9 – continued from previous page

	(1) Risk_premium	(2) Risk_premium	(3) Unexpected_return	(4) Unexpected_return
Constant	-0.000	0.023	0.000	-0.002
	(0.978)	(0.331)	(0.940)	(0.869)
Adjusted R^2	0.117	0.333	0.037	0.063
Prob >F	0.000	0.000	0.008	0.002
Observations	248	168	248	168

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9 reports the results of the set of four regressions which include the differenced Economic Activity Index in place of the three differenced Euro zone-level macroeconomic indicators income growth, relative unemployment and house price index growth. The first regression has risk premium as the dependent variable and excludes the paper-bill spread from the controls. The second regression has risk premium as the dependent variable and includes the paper-bill spread in the controls. The third regression has CAPM-based unexpected return as the dependent variable and excludes the paper-bill spread from the controls. The forth regression has CAPM-based unexpected return as the dependent variable and includes the paper-bill spread in the controls. The results of these four regressions confirm our benchmark results in Table 3 as robust.