

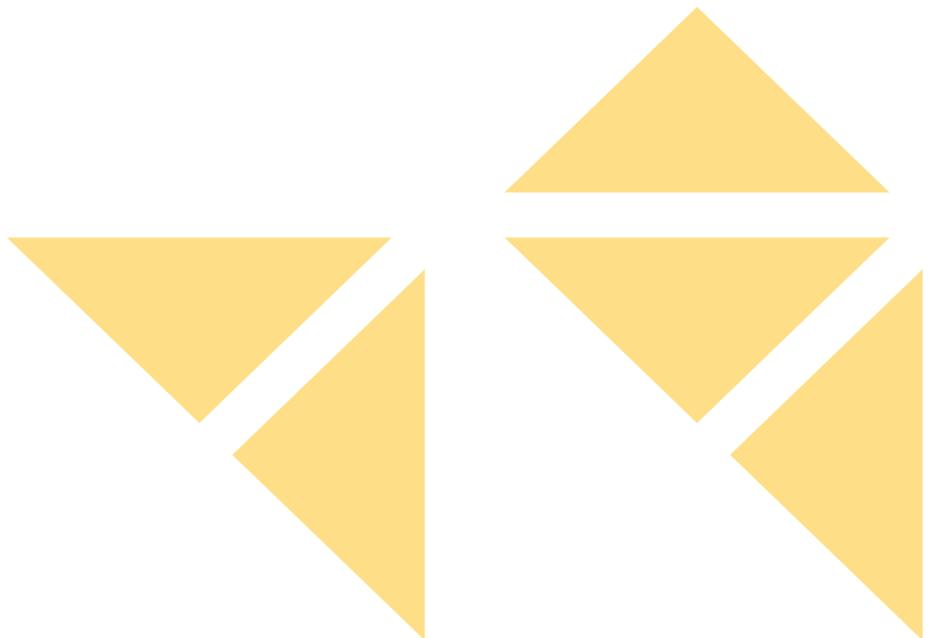


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# Financial Variables and Economic Activity in the Nordic Countries



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## Abstract

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The recent financial crisis has re-highlighted the importance of clarifying the predictive association between financial markets and the real economy. The previous literature suggests that the predictive ability of financial variables for economic growth appears to be largely coincidental for the main industrial countries. This study focuses on similar small open economies in the Nordic context. More specifically, we study the predictive content of stock returns, short-term interest rates and the term spread by using linear models and non-linear regime switching models for forecasting GDP growth in Denmark, Finland, Norway and Sweden. We apply the threshold autoregressive (TAR) model-switching approach and the novel regime-switching signals which combine the inversion of the yield curve and the recession as the signal to switch between economic states. The predictive ability of the observable and known switching approach is compared to the latent switch under the Markov switching approach.

The results suggest that the TAR model approach with an inversion-recession signal is preferable for predicting economic activity in all four of the Nordic countries. However, the predictive ability of financial variables may differ between neighboring countries, although the Nordic countries are similar in terms of economic development and financial institutions. Moreover, the link between the financial sector and GDP growth may not depend straightforwardly on monetary regimes. Among the Nordic countries, the predictive relationship between financial variables and economic activity is found to be the strongest in Finland and Sweden.

**KEY WORDS:** Term spread, Short-term interest rates, Stock market, Forecasting, Macroeconomy

**JEL classification:** E37, E44, E47

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## 1 Introduction

The global financial crisis of 2008 and the subsequent collapses of gross domestic product (GDP) worldwide have generated renewed interest in clarifying the predictive association between the financial sector and the real economy. Previously, several studies found considerable variation in the ability of asset prices to forecast output growth across countries and time. Some asset prices contain predictive power for output growth at some times in some countries; however, the instability of predictive relations based on asset prices can be characterized as the norm (Stock & Watson, 2003). This may be because recessions with financial market origins have distinctively different characteristics from downturns driven by non-financial factors (Ng & Wright, 2013). Considerable evidence of instability and structural breaks in predictive relationships has been reported by, e.g., Binswanger (2000; 2004), Stock and Watson (2003), Giacomini and Rossi (2006), Chinn and Kucko (2010) and Kuosmanen and Vataja (2014). In general, previous evidence suggests that linear models may be misspecified and that the time-varying predictive content of financial variables should be considered when forecasting economic activity. Moreover, with the presence of the financial crises and changes in economic conditions, nonlinearity issues are repeatedly important because economic variables tend to behave differently during periods of economic turbulence (Clements, Franses & Swansson, 2004; Hamilton, 2005) or in the case of changes in government policies (Sim & Zha, 2006; Ma, 2014). The previous literature indicates that the ability of financial variables to predict GDP growth appears to be largely coincidental, at least in the context of the main industrial countries (e.g., Stock & Watson, 2003; Binswanger, 2004). This study provides a non-linear modeling approach to compare the ability of financial variables to predict economic growth in small open economies in the Nordic context.

Forecasts based only on a single financial indicator are known to be unstable (Stock & Watson, 2003). Therefore, this study examines the predictive content of the combination of financial indicators, the term spread, short-term interest rates and stock returns to predict GDP growth in the four Nordic countries: Denmark, Finland, Norway and Sweden. The economic systems of the Nordic countries can be defined as the Nordic model (Andersen, Holmström, Honkapohja, Korkman, Söderström & Vartiainen, 2007). The primary characteristics and institutional developments of the Nordic countries are surprisingly similar: a high degree of cultural homogeneity, similar labor market institutions, high tax rates and extensive income redistribution, comprehensive welfare states and public sectors that commonly exceed 50% of GDP. The Nordic countries share a commitment to free trade and openness to globalization. Moreover, all of the Nordic countries have a similar degree of financial institution development. In sum, the Nordic countries' economies appear much more similar to each other than to the economies of the G-7 countries and the Eurozone.

However, there is one fundamental difference among the Nordic countries' financial systems: each Nordic country has chosen a different monetary regime and different methods of conducting monetary policy. Finland is a member of the Economic and Monetary Union (EMU); thus, its monetary policy is conducted by the European Central Bank (ECB); Sweden has an independent central bank with flexible exchange rates; Denmark has pegged its currency unilaterally to the Euro, but its central bank is independent; Norway has floating exchange rates, but its central bank is under close parliamentary control, i.e., Norway's central bank can exert more discretion to preserve monetary stability (Howells & Bain, 2008: 167–180).

The diversity of monetary policy frameworks across the Nordic countries may also affect the predictive ability of financial variables for GDP growth. The ECB closely follows an inflation target and it sets short-term interest rates for the entire euro area. Hence, the monetary policy of the ECB does not directly reflect the economic conditions of the individual countries, especially in the smaller economies. Because of the Finnish membership in the Eurozone and the Danish currency peg to the Euro, the short-term interest rates may not be so closely associated with GDP growth in these two countries. In contrast, the central banks in Sweden and Norway are able to determine the short-term interest rates solely based on the economic conditions in both countries. Moreover, this rationale may apply to the predictive ability of the term spread through the short end of the term spread. In addition, the predictive ability of stock returns is likely to be linked to the size and importance of stock markets in each country. Hence, the conducted monetary policy may have an effect on stock market valuation, which, in turn, has a wealth effect on consumer spending and economic growth.

The purpose of this study is to address the ability of financial market variables to forecast GDP growth in the Nordic countries' small open economies under different monetary regimes. We employ non-linear modeling to address the time-varying properties of financial variables. More specifically, we apply the inversion-recession signal first proposed by Kuosmanen and Vataja (2014) to distinguish among different growth regimes within the threshold autoregressive (TAR) modeling framework. The predictive ability of TAR models is compared to both the linear financial indicators model and to non-linear Markov switching models. Finally, this paper aims to clarify the association between financial variables and economic growth in the Nordic countries in view of the diversity of their monetary policy frameworks.

The rest of this paper is organized as follows. Section 2 contains a brief review of the literature. In section 3, we present our modeling strategy and the benchmark models. Section 4 introduces the data. The in-sample models and the results of the out-of-sample forecasts are presented and analyzed in section 5. Finally, section 6 concludes.

## 2 Literature review

Stock and Watson (2003) note that the own past values of time series are useful predictors when variables are serially correlated, as is typically the case for GDP growth and many other economic time series. Under these circumstances, it is essential to assess whether financial variables have predictive content for future GDP growth above and beyond lagged economic growth.

In spite of the widespread agreement that stock returns contain information about future recessions and economic activity, the predictive ability of stock returns has commonly been overlooked or even ridiculed on many occasions (e.g., Samuelson, 1966; Stock & Watson, 2003). This skepticism may be because stock markets often give incorrect signals and seem to have no substantial predictive content in bivariate regressions for future economic growth (e.g., Harvey, 1989). The strength of the association between the stock market and the real economy may also vary depending on the source of the disturbances driving the business cycle, as suggested by Canova and De Niccolo (1995). Mauro (2003) has found that the association between stock returns and output growth is significantly related to the size and importance of the stock market in each country. Moreover, the degree of financial markets' development has a favorable impact on this association (Patara, Yoonbai & Chong Soo, 2013).

The relationship between the financial and real sectors has been detected in mature markets for a long time; however, the ability of stock returns to forecast economic activity is much weaker or even the reverse in the case of emerging markets (Tsouma, 2009). Moreover, Binswanger (2000; 2004) has presented evidence that during the 1980s, there was at least a temporal breakdown in the predictive relationship between stock returns and future real activity in the U.S. and the other G-7 countries

The predictive ability of stock returns with respect to future output is reduced by including lagged output growth in the regression (Stock and Watson, 2003). However, when combined with other financial variables, stock market information may be useful to predict GDP growth (Kuosmanen & Vataja, 2011). Moreover, evidence suggests that the relationship between the stock market and the real economy is asymmetric: stock returns are able to predict GDP growth when the economy is contracting, but the predictive power of stock returns in non-recession periods is less evident (Henry, Olekalns & Thong, 2004; Kuosmanen & Vataja, 2014).

The term spread (commonly, the difference between 10-year government bond yields and 3-month interest rates) is likely to forecast output better when monetary policy is more responsive to output gaps than inflation and when inflation is relatively persistent (Wheelock & Wohar, 2009). Furthermore, the term spread has predictive information about the stock market during the bearish trend (Fernandez-Perez, Fernández-

Rodríguez & Sosvilla-Rivero, 2014). Alternatively, Ang, Piazzesi and Wei (2006) have discovered that the short-term interest rate contains more information about GDP growth than any yield spread and that the term spread does not significantly improve forecasts of output growth in the U.S. The corresponding result was obtained in Finland during normal economic growth periods (Kuusmanen & Vataja, 2014).

Several studies have found that the predictive content of both the term spread and stock returns for output growth have diminished in the globalized economy, even to the extent that since the 1980s, the predictive ability of these financial variables has been seriously questioned, particularly in the context of the U.S. economy (e.g., Haubrich & Dombrosky, 1996; Dotsey, 1998; Binswanger, 2000; Stock & Watson, 2003; Chinn & Kucko, 2010). With respect to the term spread, this phenomenon may be linked to the increased stability of output growth (Chinn & Kucko, 2010). The financial crisis has made a difference in that respect: the instability of economic growth has increased again, and the Great Moderation seems to be over, at least temporarily.

Moreover, Binswanger (2004) suggests that the relationship between stock returns and real activity in many countries may have weakened because of speculative bubbles or the increasing interdependence of stock markets since the 1980s. The speculative bubble in stock markets has dissolved after the financial crises. Therefore, the perception that the predictive ability of stock markets has permanently disappeared may be greatly exaggerated.

### 3 Forecasting models

Compared to the previous literature, we have two additional major starting points from which to specify the forecasting models. First, we utilize a set of financial predictors to combine information from interest and stock markets: the term spread, the short-term interest rate and stock returns. Although financial forecasting models are rarely structural (Estrella, Rodrigues & Schich, 2003), it is somewhat surprising that the previous literature has rarely included these indicators in the same forecasting equation. Utilizing several financial indicators instead of a single predictor may be advantageous, particularly in the case that the forecasting period is not uniform but contains different stages of economic growth (cf. Figure 1). Moreover, a set of financial indicators may be advantageous for the models' stability. Second, we apply a flexible TAR model framework to capture the major changes in economic conditions during the forecasting period. Finally, the predictive ability of TAR models is compared to two benchmarks: the simple linear autoregressive model and the more advanced non-linear Markov switching model.

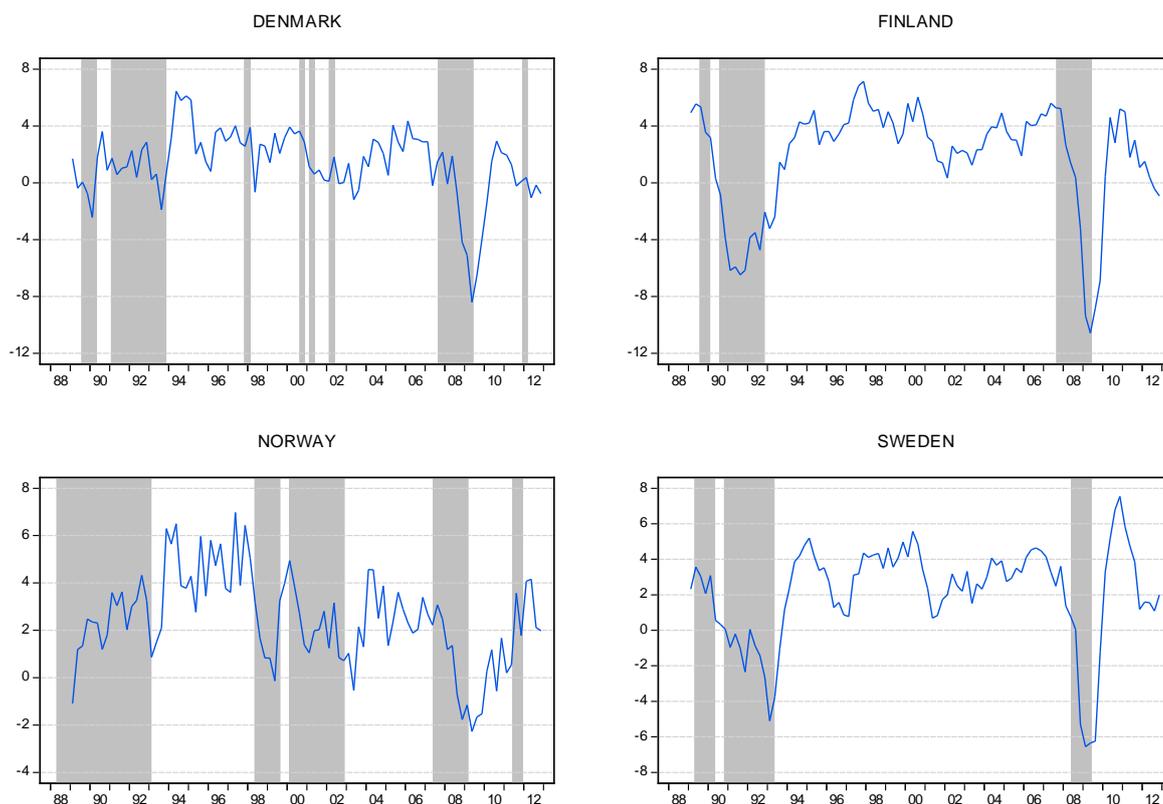
### 3.1 Linear and TAR models

We begin the modeling by specifying the basic linear forecasting model, which consists of the set of financial predictors and past economic activity (Model 1). This model addresses the marginal predictive content of financial indicators in addition to lagged GDP growth.

$$(1) \quad \ln y_{t+4} - \ln y_t = \alpha^1 + \sum_{i=1}^h \gamma_i^1 \Delta \ln y_{t-i+1} + \beta_1^1 TS_t + \beta_2^1 i_t + \beta_3^1 R_t + u_{t+4}^1$$

where  $y$  is the level of real GDP,  $TS$  is the term spread,  $i$  is the short-term interest rate,  $R$  is the stock returns,  $\alpha$  is a constant term,  $\gamma_i^1, \beta_1^1, \beta_2^1, \beta_3^1$  are parameter estimates,  $u_{(t+4)}$  is the error term, and the upper subscripts refer to the model numbers.

However, this model specification does not take into account the possible time variation in the predictive ability of financial indicators, particularly during unsettled economic conditions. When forecasting GDP growth in the 2000s in the Finnish context, Kuosmanen and Vataja (2014) found it useful to distinguish among different stages of economic activity. It is reasonable to assume that this stage dependency also applies to the other Nordic countries. Kuosmanen and Vataja (2014) proposed applying the inversion-recession signal to forecast economic activity under changing circumstances. This approach combines the conventional definition of recession and the inversion of the yield curve as the signal to switch between regimes. In particular, augmenting the yield curve data into the model-switching information set is novel and motivated by the forward-looking characteristic of the term structure. We apply the inversion-recession signal to switch between the “normal growth” and the “turbulent” regimes. More specifically, economic turbulence is defined as a negative value of the term spread or the recession (two or more consecutive quarters of negative GDP growth); otherwise, the growth is defined as normal. Figure 1 presents the GDP growth rates and the turbulent regimes during the sample period.



**Figure 1.** Annual GDP growth and turbulent regimes (shaded).

We assume that different stages of economic activity may materialize either through a shift in the mean of the GDP growth process or through a more fundamental change in the association between financial markets and the real economy. Accordingly, the regime switch is modeled through change in the constant term (Model 2). We nominate this procedure as restricted regime switching (“half switching”), and it is expected to be a reasonable choice in the case of the level change in growth ratio. However, in the case of major changes in the growth process, both the constant term and the parameter estimates of the financial indicators are allowed to change. This is the logic behind the unrestricted regime (“full switching”) model specification (Model 3).

Equations (2) and (3) model GDP growth as a regime-switching TAR process. This implies that whereas GDP growth proceeds linearly in each regime, the entire process is non-linear. TAR models have the advantage that the prevailing regime can be determined through an observable on-off switch variable, in our case, by the inversion-recession signal. Moreover, the model can be estimated by ordinary least squares (OLS), and non-linear methods are not required despite the non-linearity of the entire model (e.g., Enders, 2010).

(2)

$$\ln y_{t+4} - \ln y_t = D_{N,t}^2 + D_{T,t}^2 + \sum_{i=1}^h \beta_i^2 \Delta \ln y_{t-i+1} + \beta_2^2 TS_t + \beta_3^2 i_t + \beta_4^2 R_t + u_{t+4}^2$$

(3)

$$\begin{aligned} \ln y_{t+4} - \ln y_t = & D_{N,t}^3 + D_{T,t}^3 + \sum_{i=1}^h \beta_i^3 \left( D_{N,t}^3 \times (\ln y_t - \ln y_{t-1}) \right) \\ & + \sum_{i=1}^h \beta_i^3 \left( D_{T,t}^3 \times (\ln y_t - \ln y_{t-1}) \right) + \beta_3^3 (D_{N,t}^4 \times TS_t) + \beta_4^3 (D_{T,t}^4 \times TS_t) \\ & + \beta_5^3 (D_{N,t}^4 \times i_t) + \beta_6^3 (D_{T,t}^4 \times i_t) + \beta_7^3 (D_{N,t}^4 \times R_t) + \beta_8^3 (D_{T,t}^4 \times R_t) + u_{t+4}^3 \end{aligned}$$

where  $D_N$  = “normal growth dummy” = 1 if  $\Delta \ln y_{t-i}$  or  $\Delta \ln y_{t-i-1} \geq 0$  and  $TS_t \geq 0$ ,  $D_T$  = “inversion-recession dummy” = 1 if  $\Delta \ln y_{t-i}$  and  $\Delta \ln y_{t-i-1} < 0$  or  $TS_t < 0$  (i.e.,  $D_N = 0$ ),  $\gamma_i$  and  $\beta_i$  are parameter estimates, and  $u_{t+4}$  is the error term. The superscripts 2–3 refer to the model specification. In accordance with the Model (1),  $y$  is the level of real GDP,  $TS$  is the term spread,  $i$  is the short-term interest rate, and  $R$  is the stock returns. The number of autoregressive terms ( $h$ ) is determined based on the information criteria.

The linear (Model 1) and the AR model specifications (Model 4) are nested in the switching model specifications (Models 2–3 and 5). While it is obvious that our sample contains different economic stages (see Fig. 1), it is not self-evident that switching models improve forecasting performance in spite of their ability to fit the data well in-sample. TAR models may forecast poorly out-of-sample because of the difficulty of selecting the correct regime at the right time (Dacco & Satchell, 1999).

The analysis is performed for a forecast horizon four quarters ahead. Many previous studies have considered several forecast horizons, typically one, two and four quarters ahead (e.g., Kuosmanen & Vataja, 2011; 2013) or even longer (e.g., Ang et al., 2006; Junttila & Korhonen, 2011). Our choice to focus only on the one-year forecast horizon is based on the economic rationale. Short forecast horizons for GDP growth – i.e., one or two quarters ahead – are less relevant economically and seldom necessary in practice. Conversely, extending the forecast horizon over a number of years markedly increases the forecast uncertainty, and financial variables are most likely not the best choice for forecasting economic growth on a horizon longer than one year. For example, Kozicki (1997) found that the predictive power of the term spread for GDP growth falls rapidly as the forecast horizon is extended over four quarters. This finding is also verified by Wheelock and Wohar (2009) in their extensive research survey.

### 3.2. Benchmark models

The linear autoregressive time series model (Model 4) constitutes a natural and often-used benchmark to which the forecasting ability of competing models is compared.

$$(4) \quad \ln y_{t+4} - \ln y_t = \alpha^4 + \sum_{i=1}^h \beta_i^4 \Delta \ln y_{t-i+1} + u_{t+4}^4$$

Since Hamilton's (1989) seminal paper, Markov switching models have become a popular tool for the nonlinear modeling of business cycles and the identification of properties in a financial time series during growth and crisis periods. Studies such as those by Durland and McCurdy (1994), Filardo (1994), Lammerding, Trede and Wilfling (2013), and Chen, Diebold and Schorfheide (2013), among others, have used Markov switching models to investigate and forecast the behavior of macroeconomic and financial market data. One interesting characteristic of the Markov switching approach is that there is no need for prior information on the states in the time series (Moolman, 2004).

In this paper, the switch between regimes of GDP growth in the TAR model is triggered by the inversion of the yield curve or the recession. Alternatively, Markov switching models estimate the probability of being at different states of the regression by using the observed behavior of the variables. These regimes follow an ergodic Markov stochastic process, which is defined as the transition probability between different states as;  $P_{ij} = P(s_t = j | s_{t-1} = i)$  with probabilities summed to unity by definition and  $s_t \in \{1, \dots, M\}$ , where  $M$  is the number of states (Krolzig, 1997). These probabilities are then estimated iteratively using a maximum likelihood estimation that depends on the available information at time  $t$ . Identifying the probability of the correct regime may help yield different estimations and forecasts, thus rendering the model a feasible benchmark for the TAR model employed.

For the Markov switching regression model, we assume that the model has an intercept during the estimation period, and we choose the lag structure of the autoregressive (AR) term based on the Akaike information criteria. The Markov switching autoregressive (MSAR) model is expressed as:

$$(5) \quad \ln y_{t+4} - \ln y_t = \mu_t(s_t) + X_t' \beta_{st} + \sum_{r=1}^p \phi_r(s_t) (AR_p) + u_{t+4}^5$$

where  $y$  is the level of real GDP,  $p$  is the number of autoregressive terms,  $AR_p$  represents the autoregressive part of the model as  $(\ln y_{t+4} - \ln y_t)_{t-r} - \mu_{t-r}(s_{t-r})$ ,  $s_t$  is the specific regime at  $t$  and we assume that there are two regimes, one for normal growth and one for turbulence. Moreover,  $X_t' = (x_{1t}, \dots, x_{nt})'$  is the  $(n \times 1)$  vector of exogenous regressors, and in our case, they include the term spread, the short-term interest rate and stock returns.

## 4 Data

The data are quarterly and cover the 25-year period from 1988Q1 to 2012Q4. GDP growth rates are calculated as logarithmic changes in the real GDP indices and stock returns as logarithmic changes in the general stock markets indices. The short-term interest rate is the three-month interest rate, and the term spread is defined as the difference between ten-year government bond yield and the three-month interest rate. This definition of the term spread has proven the most useful for forecasting economic activity (e.g., Estrella & Mishkin, 1996). The data are obtained from the Organization for Economic Cooperation and Development (OECD) databases. The details of the data and the data transformations are provided in Table 1.

**Table 1.** The data.

Raw data	Data transformation	Details and source of the data
$y$ = Real GDP	$(\ln y_{t+4} - \ln y_t) \times 100$ Annual GDP growth $(\ln y_t - \ln y_{t-1}) \times 100$ Quarterly GDP growth	Millions of national currency. Seasonally adjusted. Source: OECD Quarterly National Accounts.
$i3$ = Short-term interest rate		Three-month interbank offer rate or three-month Treasury bill, Certificates of Deposit or comparable instruments rate. Per cent per annum. Source: OECD Main Economic Indicators.
$i10$ = Long-term interest rate		Ten-year government bond rate. Per cent per annum. Source: OECD Main Economic Indicators.
$TS$ = Term spread	$TS_t = i10_t - i3_t$	
$P$ = Share price index		National all-share or broad share price index. Average of monthly figures, which are averages of daily quotations. Source: OECD Main Economic Indicators.
$R$ = Stock returns	$R_t = (\ln P_t - \ln P_{t-1}) \times 100$ Quarterly stock returns	

Table 2 reports the descriptive statistics of the data. Interestingly, GDP growth, stock returns and short-term interest rates were the highest and the term spread was the narrowest by a distinct margin in Norway, growth in economic activity and short-term interest rates were the lowest in Denmark, and stock returns were the most volatile and term spreads the widest in Finland.

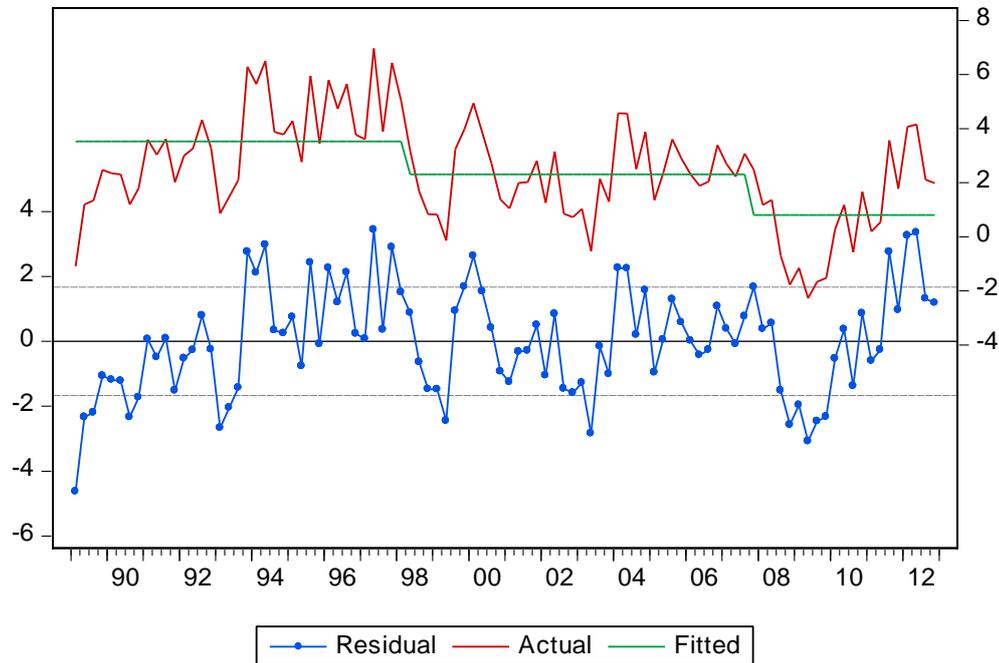
**Table 2.** Descriptive statistics of the data.

	$\Delta ny$ Denmark	$\Delta ny$ Finland	$\Delta ny$ Norway	$\Delta ny$ Sweden	$TS$ Denmark	$TS$ Finland	$TS$ Norway	$TS$ Sweden
<b>Mean</b>	0.32	0.46	0.59	0.52	0.92	1.21	0.25	1.03
<b>Max.</b>	3.82	3.05	3.32	2.31	3.61	4.67	2.77	3.46
<b>Min.</b>	-2.45	-6.74	-1.85	-3.94	-5.57	-2.89	-4.44	-4.57
<b>Std. Dev.</b>	1.28	1.33	1.12	1.00	1.55	1.48	1.42	1.38
<b>DF-GLS</b>	-2.98***	-3.16***	-1.01	-3.70***	-2.52**	-2.25**	-2.19**	-2.37**
	$R$ Denmark	$R$ Finland	$R$ Norway	$R$ Sweden	$i$ Denmark	$i$ Finland	$i$ Norway	$i$ Sweden
<b>Mean</b>	2.07	1.41	2.59	2.03	4.93	5.19	6.05	5.36
<b>Max.</b>	15.39	41.60	29.26	29.19	14.05	15.81	14.37	15.12
<b>Min.</b>	-39.29	-34.82	-51.04	-29.02	-0.12	0.20	1.02	0.16
<b>Std. Dev.</b>	8.54	13.47	11.64	10.17	3.32	4.13	3.44	3.98
<b>DF-GLS<sup>a</sup></b>	-2.42**	-2.16**	-4.39***	-3.49***	-0.29	-0.78	-0.09	-0.46
<b>DF-GLS<sup>b</sup></b>					-1.84*	-2.01**	-0.89	-1.83*

*Notes:* Sample period 1988Q1—2012Q4. DF-GLS(a) = GLS-detrended Dickey-Fuller unit root test (Elliott, Rothenberg & Stock, 1996);  $H_0$ : a time series contains a unit root.  $\Delta ny$  = quarterly GDP growth,  $R$  = quarterly stock returns,  $i$  = short-term (3-month) interest rate,  $TS$  = term spread. Significance levels: \* = 10%, \*\* = 5%, \*\*\* = 1%. *a*: 1988Q1–2012Q4; *b*: 2000Q1–2012Q4.

The time series properties of GDP growth, the term spread, the short-term interest rate and stock returns were explored by using the DF-GLS unit root test (Elliott, Rothenberg & Stock, 1996). The number of lagged terms was selected based on the modified Akaike criterion as proposed by Ng and Perron (2001). The test results consistently suggested that all of the term spreads and stock returns series were stationary, whereas all of the short-term interest rates series were found non-stationary for the entire sample period. The GDP growth series were found to be stationary, excluding Norway. The result of non-stationarity in Norway appears peculiar, given the evident presumption that GDP growth is stationary (Cochrane, 1991). Therefore, we analyzed Norwegian growth rates more thoroughly by testing possible structural breaks using the Lumsdaine and Papell (1997) unit root test, which allows for a maximum of two breaks in the time series. The test results suggested two downward level shifts in Norway's economic activity, one starting during 1998Q2 and another starting during 2007Q4. The first break coincides with the Asian financial crisis, and the latter break is associated with

the beginning of the global financial crisis. By considering these shifts, Norwegian GDP growth was found to be stationary, as illustrated in Figure 2.<sup>4</sup>



**Figure 2.** Level shifts in Norwegian GDP growth.

Short-term interest rates were found to be non-stationary for the whole sample period. The non-stationarity of short-term interest rates is most likely due not only to exceptionally high interest rates in defense of the fixed exchange rate system but also to the high inflation rates of the late 1980s. However, the forecasting period of the study covers the ten-year period from 2003Q1 to 2012Q4. Consequently, we also conducted the unit root tests for the 2000s and found evidence of stationarity, excluding Norway (cf. Table 2). Stock and Watson (2003) considered interest rates both in levels and after first differencing because it is unclear which is the correct version. However, Cochrane (1991: 207–208) noted that variables that are already rates – e.g., interest rates – should be used in levels despite the fact that unit root tests often suggest the opposite. Given the mixed results, we conducted the forecasting analysis by specifying short-term inter-

<sup>4</sup> The test statistics for the Lumsdaine–Papell test was -15.58, which is significant at least at the 1% level. Only breaks in the intercept term were allowed, and the number of autoregressive lags was determined using the Bayesian information criterion (BIC).

est rates both in levels and in first differences and ultimately selected the level specification because this approach consistently yielded the lowest forecast errors.

**Table 3.** Pairwise correlations of Nordic data

(a) GDP growth

(b) Term spread

	Den	Fin	Nor	Swe		Den	Fin	Nor	Swe
Den	1				<b>Den</b>	1			
Fin	0.60	1			<b>Fin</b>	0.72	1		
Nor	0.60	0.36	1		<b>Nor</b>	0.70	0.71	1	
Swe	0.63	0.85	0.34	1	<b>Swe</b>	0.72	0.82	0.69	1

(c) Short-term interest rates

(d) Stock returns

	Den	Fin	Nor	Swe		Den	Fin	Nor	Swe
<b>Den</b>	1				<b>Den</b>	1			
<b>Fin</b>	0.94	1			<b>Fin</b>	0.63	1		
<b>Nor</b>	0.88	0.89	1		<b>Nor</b>	0.84	0.61	1	
<b>Swe</b>	0.94	0.96	0.87	1	<b>Swe</b>	0.82	0.81	0.80	1

In many ways, the Nordic countries are at similar stages of economic and financial development. This raises the question of whether real economies and financial sectors are also similarly associated in those countries. The similarity of the economic performance is first assessed on the basis of the pairwise correlations between real economies and financial sectors in the Nordic context. In general, the correlation pattern of the economic growth between neighboring countries seems to be surprisingly diverse. Swedish and Finnish GDP growth proved to be highly correlated (0.85), whereas the corresponding correlations between Sweden and Norway (0.34) and Finland and Norway (0.36) were much lower. Alternatively, the correlations between the financial variables were clearly higher than the correlations between the GDP growth figures. The correlation of the term spread between Finland and Sweden was the highest (0.82), and the term spread between Sweden and Norway was the lowest (0.69). The same pattern occurred in the case of short-term interest rates: the highest correlations were between Finland and Sweden (0.96), and the lowest were between Sweden and Norway (0.87). The pattern was somewhat different for stock returns: the stock returns between Denmark and Norway demonstrated the highest correlations (0.84), and the stock returns between Norway and Finland were the lowest correlations (0.61). The preliminary data analysis of pairwise correlation shows that the associations between real economies and financial sectors differ considerably in the Nordic context. This suggests that the predictive ability of financial variables for economic growth may differ across the Nordic countries.

## 5 Empirical results

The forecasting analysis of this study covers the ten-year period from 2003Q1 to 2012Q4. During this period, GDP growth was distinctly two-edged in the Nordic countries (Table 4). The first part of the forecasting period (2003Q1–2007Q4) can be characterized as a period of relatively steady GDP growth, whereas the latter period (2008Q1–2012Q4) represents weak and turbulent GDP growth due to the worldwide financial crisis.

**Table 4.** Average annual GDP growth during the forecasting period.

Forecasting period	Denmark	Finland	Norway	Sweden
2003Q1–2012Q4	0.48	1.59	1.60	2.23
2003Q1–2007Q4	2.00	3.68	2.49	3.41
2008Q1–2012Q4	-1.03	-0.50	0.72	1.06

During the entire forecasting period, average annual GDP growth was the largest, with a distinct margin in Sweden. Interestingly, this phenomenon is due to the Swedish economy's more favorable development during the financial crisis compared to the other Nordic economies, particularly those of Denmark and Finland. Before the financial crisis average GDP growth was the highest in Finland and Sweden. Danish economic growth was consistently the lowest during the forecasting period.

### 5.1. *In-sample analysis*

The initial parameter estimates of the forecasting models (1)–(4) are based on the first 15 years (1988Q1–2002Q4) of the data.<sup>5</sup> The estimation method is OLS with heteroscedasticity- and autocorrelation-robust Newey–West standard errors.<sup>6</sup> The number of AR terms in all of the models is determined on the basis of the Schwartz information criterion.<sup>7</sup>

Because the predictive content of the financial indicators is this study's primary interest, we present the in-sample results only for the linear financial indicator models (1) (Table 5).

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<sup>5</sup> This comprises 60% of the data.

<sup>6</sup> The number of truncation lags for the calculation of the Newey–West standard errors was set to 5 on the basis of the sample size (see e.g., Greene, 2012: 960).

<sup>7</sup> The Schwartz information criterion suggested one AR term for all countries except for Finland, for which two AR terms were suggested. This lag structure was also applied throughout the out-of-sample forecasting analysis.

**Table 5.** In-sample estimation results for the linear financial indicator models (1).

	Denmark	Finland	Norway	Sweden
<b>Constant</b>	4.52*** (1.74)	4.18*** (1.10)	3.97*** (1.17)	3.99*** (1.07)
<b><math>TS_t</math></b>	-0.46 (0.36)	0.40* (0.22)	0.08 (0.35)	0.51** (0.26)
<b><math>i_t</math></b>	-0.33* (0.20)	-0.42*** (0.15)	-0.08 (0.14)	-0.30*** (0.10)
<b><math>R_t</math></b>	0.07 (0.05)	0.04*** (0.01)	0.03 (0.02)	0.04* (0.02)
<b><math>\Delta \ln y_t</math></b>	-0.28* (0.16)	0.17 (0.34)	-0.34*** (0.13)	-0.18 (0.27)
<b><math>\Delta \ln y_{t-1}</math></b>		0.37* (0.22)		
<b><math>\bar{R}^2</math></b>	0.15	0.70	0.07	0.58

*Notes:* The estimation period is 1988Q1–2002Q4. Heteroscedasticity- and autocorrelation-robust Newey–West standard errors are in parentheses below the parameter estimates. \*\*\*, \*\* and \* = statistically significant at least at the 1%, 5% and 10% significance levels.

The following results appear noteworthy. First, all of the parameter estimates of the financial indicators are correctly signed, excluding the negative sign for Denmark's term spread; however, this variable was statistically insignificant. Second, the in-sample explanatory power of the financial indicators differs markedly between the two country groups. The explanatory power of the models is reasonably high for Sweden (0.58) and particularly high for Finland (0.70); moreover, all of the financial indicators are statistically significant in this group. Conversely, the estimation results are much weaker for Denmark and, in particular, Norway. The weak performance of the financial indicators in explaining Norway's GDP growth ( $\bar{R}^2 = 0.07$ ) is also reflected by the fact that all of the parameter estimates of financial indicators are insignificant. In the case of Denmark ( $\bar{R}^2 = 0.15$ ), only the short-term interest rate is statistically significant.

## 5.2 Out-of-sample forecasting analysis

The forecasting analysis aims to mimic the actual forecasting process by using the pseudo-out-of-sample method as proposed by Stock and Watson (2003). The forecasts are calculated by utilizing all the available information up to the period when the forecast is made; however, the forecasts are calculated outside the estimation period. We

apply this pseudo-out-of-sample forecasting method recursively. More specifically, we estimate the forecasting models (1)–(5) using the data from the beginning of our sample from 1988Q1 to 2002Q4 and then compute the first forecast for 2003Q1. The analysis continues by re-estimating the models through 2003Q1 and computing the forecast for 2003Q2, and so on.

**Table 6.** Out-of-sample forecast errors.

(1) Model	(2) Denmark	(3) Finland	(4) Norway	(5) Sweden
(1) Linear	2.76	3.36	2.03	2.59
(2) TAR (restricted)	2.69	2.80	1.91	2.39
(3) TAR (unrestricted)	2.57	2.47	2.12	2.34
(4) AR-model	3.10	4.53	2.20	3.16
(5) Markov switching	3.79	5.32	2.11	3.22

*Notes:* Forecast period: 2003Q1–2012Q4. Figures in columns 2–5 are the RMSEs of the forecasting models.

The out-of-sample forecasting results (Table 6) indicate that the financial indicators constitute useful predictive content for all of the Nordic countries. The forecast errors (RMSEs) of the basic linear financial indicators model (Model 1) are lower than the forecast errors of the simple autoregressive benchmark model (Model 4).

The previous literature suggests that the predictive content of financial indicators may depend on economic conditions. The forecasting period of this study contains distinctly different economic circumstances (cf. Table 4); therefore, it is reasonable to scrutinize whether forecasting performance can be improved by applying state-dependent model specifications. This is accomplished using the TAR model specifications (Models 2 and 3), which apply the inversion-recession signal to switch the model between different economic states. The results suggest that this is indeed the case: the forecast performance improves in all four of the Nordic countries. The lowest RMSEs are yielded by the most versatile version of the TAR models (Model 3) in Denmark, Finland and Sweden; however, the restricted TAR (Model 2) yielded the best forecasts in the case of Norway. It is also noteworthy that even the less restricted TAR model specification is capable of yielding lower forecast errors than the simple linear model specification (Model 1). Finally, the forecasting ability of the MSAR approach (Model 5) proved to be weak out-of-sample, as it was unable to outperform the simple linear financial indicators model (Model 1). Moreover, the MSAR model was not capable of beating the simple AR benchmark excluding Norway. Possible explanations for the poor results of the Markov switching in out-of-sample forecasting are either a misclassification of the regimes (Dacco & Satchell, 1999) or parameter instability (Marsh, 2000).

**Table 7.** Relative forecasting performance.

(1) Relative RMSEs	(2) Null hypothesis	(3) Denmark	(4) Finland	(5) Norway	(6) Sweden
RMSE(1) / RMSE(4)	RMSE(1) = RMSE(4)	0.89 (0.04)	0.74 (0.06)	0.92 (0.10)	0.82 (0.00)
RMSE(2) / RMSE(1)	RMSE(2) = RMSE(1)	0.97 (0.09)	0.83 (0.11)	0.94 (0.02)	0.92 (0.15)
RMSE(3) / RMSE(1)	RMSE(3) = RMSE(1)	0.93 (0.02)	0.74 (0.07)	1.04 (0.09)	0.90 (0.10)
RMSE(5) / RMSE(1)	RMSE(5) = RMSE(1)	1.37 (-)	1.58 (-)	1.04 (0.01)	1.24 (-)

Note: Table entries in columns (3)–(6) are RMSE ratios as defined in column (1). Entries in parentheses are the  $p$ -values of the Clark–West test for the null hypothesis given in column (2). (-) = the test statistics is in the wrong tail of the distribution to reject the null hypothesis.

Table 7 reports the relative forecasting performance and the formal Clark–West test results (Clark & West, 2007) for the null hypothesis of equal RMSEs among nested forecasting models. Row 1 compares the predictive ability of the linear financial indicators model (Model 1) relative to the simple autoregressive benchmark (Model 4), rows 2–3 focus on the predictive ability of the restricted (Model 2) and the unrestricted (Model 3) TAR model specifications relative to the linear financial indicators model (Model 1). Finally, row 5 addresses the predictive content of the Markov switching model (Model 5) relative to the linear financial indicators model.

The Clark–West test accounts for the bias that arises because estimation of the larger model adds extra noise to the forecast under the null hypothesis. Therefore, the RMSE ratio  $> 1$  in Table 7 does not automatically imply weaker forecasting performance for the larger model. More specifically, define  $e_{1i}$  as the forecast errors from the more parsimonious Model 1 and  $e_{2i}$  as the forecast errors from the larger Model 2, and Model 1 is nested within Model 2. Suppose that the data are generated from Model 1. Under the null hypothesis of the equal forecast performance, any discrepancy between the (squared) forecast errors should be zero in infinite sample, i.e.,  $z_i = (e_{1i})^2 - (e_{2i})^2 = 0$ . In finite samples, however, the estimation of the redundant parameters brings about noise in the forecasts of Model 2 if the data are generated from Model 1; hence, the forecast errors of Model 2 are expected to be larger, i.e.,  $(e_{2i})^2 > (e_{1i})^2$ . However, if the data are generated from Model 2, the discrepancy of the forecast errors is positive, i.e.,  $(e_{2i})^2 < (e_{1i})^2$ , and the null hypothesis is rejected in favor of Model 2 if the discrepancy is sufficiently large. Clark & West (2007: 294) derived how to account for the noise introduced by estimated redundant variables under the null hypothesis. This is accomplished by adjusting the  $z_i$  series as follows:  $z_i^* = (e_{1i})^2 - [(e_{2i})^2 - (f_{1i} - f_{2i})^2]$ , where  $f_1$  and  $f_2$  are the forecasts from Models 1 and 2, respectively. Note that the adjusted forecast errors are smaller than the unadjusted forecast errors, i.e.,  $(e_{2i})^2 - (f_{1i} - f_{2i})^2 < (e_{2i})^2$ , hence  $z_i^* \leq z_i$ . Thus, the test is one-sided and conducted by regressing  $z_i^*$  series on a constant term. The test statistic is the  $t$ -statistic for the constant term.

The test results in the first row of the Table 7 verify that the financial indicators have statistically significant (10%) predictive content above and beyond lagged GDP growth in all of the Nordic countries. The improvements in forecasting performance relative to the simple autoregressive time-series model are the largest in the cases of Finland (26%) and Sweden (18%). These results can also be considered economically significant. Alternatively, the improvements in forecasting ability for Denmark (11%) and Norway (8%) prove to be less significant. It is shown in row 2 that the restricted non-linear TAR model specification (Model 2) improves the forecasting performance relative to the linear financial indicators model (Model 1). The improvement is the largest for Finland (17%), while in other countries, the improvements are of smaller importance, varying between 3% (Denmark) and 8% (Sweden). The unrestricted TAR model specification (row 3) yields the largest improvement in forecasting performance in the case of Finland (26%), whereas for the other countries, the improvements are again rather modest. Finally, the forecasting content of the Markov switching model (Model 5) is found to be weak relative to the linear financial indicators model, as all of the relative RMSE figures are greater than one.

The  $p$ -values of the Clark–West test (Table 6) suggest that the relative RMSE figures are not straightforward to interpret, especially in the case of Norway. Remember that the Clark–West test accounts for the bias arising from the noise that the larger model adds to the forecast under the null hypothesis of equal RMSEs. The relative RMSE figures for Norway show that the unrestricted TAR (Model 3) and the Markov switching models (Model 5) yield larger RMSEs than the linear financial indicators model (Model 1), but the  $p$ -values suggest that the null hypothesis should be rejected in favor of the unrestricted TAR and Markov switching models (Models 3 and 5). This means that the (noise-) adjusted forecast errors from Models 3 and 5 are significantly smaller than the forecast error from the Model 1. The effect of the noise adjustment is also visible in other  $p$ -values. For example, the Finnish relative RMSE figures indicate a considerably larger improvement in forecasting performance for the linear and the TAR model specifications than in the case of Denmark, while the  $p$ -values for Finland are higher compared to Denmark. Finally, the formal Clark–West results should be interpreted cautiously because the power of the test is likely to be low because the number of forecasts (40) is relatively low (Ang et al, 2006: 390).

### 5.3 *Interpretation of the results*

The results in this study suggest that the monetary policy framework seems not to be decisive regardless of whether the short-term interest rate or the term spread is able to forecast economic growth in the Nordic context. For instance, despite the substantial differences in the monetary regimes between Finland and Sweden, financial variables

are of importance in forecasting economic activity in both countries. This result is in line with those found by Korkman and Suvanto (2013), who emphasize that in Finland and Sweden, monetary regimes matter less for economic performance than conducted economic policy and other institutions. In general, Rose (2014) finds out that small and similar economies are able to maintain radically different monetary regimes with negligible macroeconomic and financial consequences.

According to many studies (e.g., Wheelock & Wohar, 2009), the term spread should forecast GDP growth less accurately if monetary authorities concentrate exclusively on controlling inflation instead of output growth. Although the ECB and the Bank of Sweden closely follow the inflation target, interest rate variables appeared to be a useful predictor of economic growth in both countries. Alternatively, the Bank of Norway is able to pursue discretion in preserving economic stability; however, the term spread and short-term interest rate are found to be only vaguely associated with the real economy in Norway. In sum, it appears that neither the monetary regime nor the ability to conduct independent monetary policy is closely connected with the predictive ability of financial variables for economic growth. This outcome contradicts the results found by Bordo and Haubrich (2004).

Mauro (2003) notes that the stock-market-capitalization-to-GDP ratio is a useful predictor of whether a country tends to have a robust predictive association between the stock market and economic growth. This outcome is in line with our results in the Nordic context. Finland and Sweden are countries with a high stock-market-capitalization-to-GDP ratio, with an average of 81% in Finland and 89% in Sweden during the sample period. These countries also have the closest association with stock market activity and economic activity according to our results. Alternatively, in the cases of Denmark (51%) and Norway (41%), the association between the stock market and GDP growth proved to be weaker. This diversity in stock market capitalization may also lead to differences in the transmission of monetary policy because share values are sensitive to interest rates. When the relative size of the stock market is large in the economy, the conducted monetary policy may be enhanced through wealth effects on consumer spending and economic growth. Consequently, monetary policy may have more important wealth effects on GDP growth in both Finland and Sweden compared to Denmark and Norway.

Binswanger (2000, 2004) suggests that during the 1980s, there was a fundamental breakdown in the traditional predictive relationship between stock returns and economic growth in the U.S. and the other G-7 countries. This phenomenon may be due to the globalization and integration of stock markets such that national stock markets and internationalized corporations are only partially linked to national economic activity (e.g., Hueng, 2014). Surprisingly, the same phenomenon appears to occur in the inter-

est markets: national economic activity may be only partially linked to the term spread and short-term interest rates; moreover, there may be considerable time variation in those relationships.

The evidence from the Nordic countries suggests that the strength of the relationship between stock markets and economic growth may vary considerably between neighboring small open economies. In spite of this phenomenon, the evidence from the Nordic countries implies that the predictive breakdown may not be as fundamental and irreversible as Binswanger (2000, 2004) suggests. The observed lack of predictive content may be a consequence of a non-linear time-varying relationship between financial markets and the real economy, as emphasized by Ng and Wright (2013). Domian and Louton (1997) note that symmetric models omit information; they also find asymmetry to be of a threshold type. In this study, the non-linear link between real and financial variables is addressed by applying non-linear regime-switching modeling in line with Henry, Olekalns and Thong (2004) and Domian and Louton (1997). Our results suggest that reasonable thresholds can be defined by the inversion-recession approach.

## 6 Conclusions

This study addresses the predictive association between financial markets and the real economy in the four Nordic countries: Denmark, Finland, Norway and Sweden. Our results suggest that this relationship may differ between neighboring countries even though all of the Nordic countries have a largely equal degree of financial market development, and the countries were similarly affected by the recent severe recession of financial-market origin. Moreover, the link between the financial sector and economic activity may not depend on the monetary regimes or the independence of monetary policy. The relationship between financial variables and economic activity is found to be stronger in Finland and Sweden than in Denmark and particularly in Norway.

The association between the financial and real sectors proved to be weakest in Norway among the Nordic countries, even though Norway's monetary policy is highly independent. Paradoxically, although the Finnish monetary policy is conducted exclusively by the ECB, the relationship between financial variables and the real economy is obvious. Given that financial indicators are highly correlated among all of the Nordic countries, the scant predictive content of financial variables in Norway may indicate a sporadic connection between the financial markets and the real economy in that country. Generally, if financial markets are only weakly attached to the national real economy, then it is most likely that the expected predictive content of financial variables is weak.

This study lends support to the notion that the predictive content of financial variables is time-varying. The predictive ability of the term spread, short-term interest rate and stock returns appears to depend on the state of the economy: during normal growth periods, the relationship is different than it is during unsettled times. This suggests that the model-switching approach is useful in forecasting economic activity. Moreover, our results propose that it is reasonable to define the state of the economy by using the inversion-recession signal to switch between forecasting models.

## References

- Andersen T.M., B. Holmström, S. Honkapohja, S. Korkman, H.T. Söderström & J. Vartiainen (2007). *The Nordic Model. Embracing globalization and sharing risks*. The Research Institute of the Finnish Economy (ETLA). Printed in Yliopistopaino, Helsinki.
- Ang, A., M. Wei & M. Piazzesi (2006). What does the Yield Curve tell us about GDP growth? *Journal of Econometrics* 131, 359–403.
- Binswanger, M. (2000). Stock market booms and real economic activity: Is this time different? *International Review of Economics and Finance* 9, 387–415.
- Binswanger, M. (2004). Stock returns and real activity in the G-7 countries: did the Relationship change during the 1980s? *Quarterly Review of Economics and Finance* 44, 237–252.
- Bordo, M. D. & J.G. Haubrich (2004). The yield curve, recessions and the credibility of the monetary regime: long-run evidence 1875–1997. *NBER working paper* 10431.
- Canova, F. & G. De Niccolo (1995). Stock returns and real activity: A structural approach. *European Economic Review* 39, 981–1015.
- Chen, F., F.X. Diebol & F. Schorfheide (2013). A Markov-switching multifractal inter-trade duration model, with application to US equities. *Journal of Econometrics* 177(2), 320–342.
- Chinn, M.D. & K.J. Kucko (2010). The predictive power of the yield curve across countries and time. *NBER Working Paper* 16398.
- Clark, T. E., & West, K. D. (2007). Approximately normal tests for equal predictive accuracy in nested models. *Journal of Econometrics*, 138, 291–311.
- Clements, M., P. Franses & N. Swanson (2004). Forecasting economic and financial time-series with non-linear models. *International Journal of Forecasting* 20(2), 169–183.
- Cohrane, J. (1991). What macroeconomists should know about unit roots: comment, in O. Blanchard & S. Fisher (eds.) *NBER Macroeconomics Annual, Vol. 6*. University of Chicago Press, 201–210.
- Dacco, R. & S. Satchell (1999). Why do regime-switching models forecast so badly? *Journal of Forecasting* 18(1), 1–16.

- Domian, D.L. & D.A. Louton (1997). A threshold autoregressive analysis of stock returns and real economic activity. *International Review of Economics and Finance* 6(2), 167–179.
- Dotsey, M. (1998). The predictive content of the interest rate term spread for future economic growth. *Federal Reserve Bank of Richmond Economic Quarterly* 84(3), 31–51.
- Durland, M. & McCurdy, T (1994). Duration-Dependent Transitions in a Markov Model of U.S. GNP Growth. *Journal of Business & Economic Statistics* 12(3), 279–288.
- Elliott, G., Rothenberg, T. J., & Stock, J. H. (1996). Efficient tests for an autoregressive unit root. *Econometrica*, 64, 813–836.
- Enders, W. (2010). *Applied Econometric Time Series*. 3rd edition. Wiley.
- Estrella, A., A.P. Rodrigues & S. Schich (2003). How Stable Is the Predictive Power of the Yield Curve? Evidence from Germany and the United States. *Review of Economics and Statistics* 85(3), 629–644.
- Estrella, A. & F.S. Mishkin (1996). The yield curve as a predictor of U.S. recessions. *Current Issues in Economics and Finance* 2(7), June 1996. Federal Reserve Bank of New York.
- Fernandez-Perez, A., F. Fernández-Rodríguez & S. Sosvilla-Rivero (2014). The term structure of interest rates as predictor of stock returns: evidence for the IBEX 35 during a bear market. *International Review of Economics and Finance* 31, 21–33.
- Filardo, A. (1994). Business-Cycle Phases and Their Transitional Dynamics. *Journal of Business & Economic Statistics* 12(3), 299–308.
- Giacomini, R. & B. Rossi (2006). How stable is the forecasting performance of the yield curve for output growth. *Oxford Bulletin of Economics and Statistics* 68, 783–795.
- Greene, W. (2012). *Econometric Analysis*. 7<sup>th</sup> edition, Pearson.
- Hamilton, J. (2005). Regime switching models. *Working paper*, University of California, San Diego.
- Harvey, C.R. (1989). Forecasts of economic growth from the bond and stock markets. *Financial Analyst Journal* (September/October), 38–45.
- Haubrich, J.G. & A.M. Dombrosky (1996). Predicting real growth using the yield curve. *Federal Reserve Bank of Cleveland, Economic Review* 32(1), 26–35.

- Henry, Ó.T., N. Olekalns & J. Thong (2004). Do stock market returns predict changes to output? Evidence from a nonlinear panel data model. *Empirical Economics* 29, 527–540.
- Howells, P & K. Bain (2008). *The Economics of Money, Banking and Finance. A European Text*. 4. Edition. Prentice Hall.
- Hueng, C.J. (2014). Are global systematic risk and country-specific idiosyncratic risk priced in the integrated world market? *International Review of Economics and Finance* 33, 28–38.
- Junttila, J. & M. Korhonen (2011). Utilizing financial market information in forecasting real growth, inflation and real exchange rate. *International Review of Economics & Finance* 20(2), 281–301.
- Korkman, S. & A. Suvanto (2013). Finland and Sweden in cross-country comparison: what are the lessons? *10<sup>th</sup> Euroframe Conference*. Available at: <http://www.euroframe.org>.
- Kozicki, S. (1997). Predicting real growth and inflation with the yield spread. *Federal Reserve Bank Kansas City Economic Review* 82, 39–57.
- Krolzig, H. M. (1997). *Markov-Switching Vector Autoregressions: Modelling, Statistical Inference, and Application to Business Cycle Analysis*. Springer.
- Kuosmanen, P. & J. Vataja (2011). The role of stock markets vs. the term spread in forecasting macrovariables in Finland. *Quarterly Review of Economics and Finance* 51, 124–132.
- Kuosmanen, P. & J. Vataja (2014). Forecasting GDP growth with financial market data in Finland: Revisiting stylized facts in a small open economy during the financial crisis. *Review of Financial Economics* 23(2), 90–97.
- Lammerding, M.P. S.M. Trede & B. Wilfling (2013). Speculative bubbles in recent oil price dynamics: Evidence from a Bayesian Markov-switching state-space approach. *Energy Economics* 36, 491–502.
- Lumsdaine, R.L. & D.H. Papell (1997). Multiple Trend Breaks and the Unit-Root Hypothesis. *Review of Economics and Statistics* 79(2), 212–218.
- Ma, Y. (2014). Monetary policy based on non-linear quantity rule: evidence from China. *International Review of Economics and Finance* 34, 89–104.
- Marsh, I.W. (2000). High frequency Markov switching models in the foreign exchange market. *Journal of Forecasting* 19, 123–134.

- Mauro, P. (2003). Stock returns and output growth in emerging and advanced economies. *Journal of Development Economics* 41, 129–153.
- Moolman, E. (2004). A Markov switching regime model of the South African business cycle. *Economic Modeling* 21(4), 631–646.
- Ng, S. & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica*, 69, 1519–1554.
- Ng, S. & J. H. Wright (2013). Facts and challenges from the Great Recession for forecasting and macroeconomic modeling. *Journal of Economic Literature* 51(4), 1120–1154.
- Patara, T., Yoonbai, K. & Chong Soo, P. (2013). Linking the missing market: the effect of bond markets on economic growth. *International Review of Economics and Finance* 27(C), 529–541.
- Rose, A.K. (2014). Surprising similarities: recent monetary regimes of small economies. *Journal of International Money and Finance* (article in press), 1–23.
- Samuelson, P. (1966). Science and stocks. *Newsweek* 19 (September), 92.
- Sims, C.A. & T. Zha (2006). Were There Regime Switches in U.S. Monetary Policy? *American Economic Review* 96(1), 54–81.
- Stock, J.H. & M.W. Watson (2003). Forecasting output and inflation: the role of asset prices. *Journal of Economic Literature* 41 (September), 788–829.
- Tsouma, E. (2009). Stock returns and economic activity in mature and emerging markets. *Quarterly Review of Economics and Finance* 49, 668–685.
- Wheelock, D.C. & M.E. Wohar (2009). Can the term spread predict output growth and recessions? A survey of the literature. *Federal Reserve Bank of St. Louis Review* 91 (September/October), 419–440.

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