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The Predictive Power of the Yield Curve across Countries and Time

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Abstract

Abstract: In recent years, there has been renewed interest in the yield curve (or alternatively, the term premium) as a predictor of future economic activity. In this paper, we re-examine the evidence for this predictor, both for the United States, and other advanced economies. We examine the sensitivity of the results to the selection of countries, and time periods. We find that the predictive power of the yield curve has deteriorated in the last half of the sample period, although there is evidence of a reversal in the lead-up to the Great Recession. There is reason to believe that European country models perform better than non-European countries when using more recent data. In addition, the yield curve proves to have predictive power even after accounting for other leading indicators of economic activity.

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1 Introduction

In 2006, several observers noted the inversion of the yield curve in the United States. That event sparked a resurgence in the debate over the usefulness of the yield curve as an indicator of future economic activity, with an inversion indicating a slowdown (and in some formulations, a recession). The inverted yield curve as recession indicator, while common in the United States, is not widely used in other countries. Moreover, in the most recent episode, there was widespread conviction that – in light of the increased credibility ascribed to monetary policy – the yield curve no longer served as a useful early warning signal for growth slowdowns. Figure 1 displays the yield spread, the difference between long and short term government interest rates, through time for the United States and select advanced economies. The yield spread dips before and turns negative prior to each recession period, including the recession beginning in 2007. For European countries, the relationship is not as consistent but there does appear to be some level of coincidence.

The motivation for studying the yield spread is of course manifold. First, policy makers often need to make decisions today, based on expectations regarding future economic conditions. Although policymakers rely on a range of data and methods in forecasting future conditions, movements in the yield curve have in the past proved insightful, and could still represent a useful additional tool.

Second, variations in the correlations between asset prices and economic activity might inform debates regarding the workings of the macroeconomy. The fact that it works for some countries, and not others, might be suggestive of certain channels being important, to the exclusion of others. A similar sort of reasoning applies to examining the goodness of fit over different time periods.

While there is already a voluminous literature on the subject of yield curves and US economic activity, we nonetheless believe now is an opportune time to re-examine the evidence. This conviction is rooted in two developments.

The first is the advent of the euro in 1999. The creation of a more integrated European bond market, and increased economic linkages on the real side, suggests that the old historical links (or non-links, as the case may be) between the interest rates and output might have changed. Yet, until recently, there had not been a sustained and significant downturn in the European economy post-EMU, and hence little opportunity to test the predictive power of the yield curve in this context.

The second is the "conundrum", i.e., the failure of long-term interest rates to rise along with the short-term policy rate the mid-2000's, and the subsequent encounter with the zero lower bound (ZLB) in several economies. Some people ascribed the "conundrum" to the disappearance of risk, variously associated with the cross- country decline in inflation and output volatility – what is sometimes called the Great Moderation – or with greater risk-management on the part of financial institutions. Alternatively, attention has been directed to the demand by pension funds for long-term assets, or foreign central bank purchases of Treasury assets.[1] Regardless of the merit of such arguments, we think it of interest to determine whether the previously extant correlations hold in the more recent period. When a country reaches the ZLB, the monetary authority can no longer lower the short-term interests rate and may try to lower long-term rates (which will flatten the yield curve) to stimulate economic growth. One might expect the relationship to degrade or invert when a country reaches the ZLB.

The paper is organized in the following fashion. In section 2, we lay out a framework for examining what determines the long term interest rate relative to the short, and relate that to the extant literature on the yield curve as a predictor of future economic activity. In section 3, we describe the data and the empirical tests we implement. In Section 4, we repeat the exercise, but using as a dependent variable a binary dependent variable called "recession". Section 5 explores these relationships using real-time data. Section 6 concludes.

[1] See for instance Warnock and Warnock (2006). A contrasting view is in Rudebusch et al. (2006) and Wu (2008).

2 Background

2.1 Theoretical Framework

Following previous literature, this paper focuses on the yield spread defined as the 10-year government bond yield less the 3 month treasury yield (or closest equivalent for countries other than the United States)[2].

The linkage between the long-term and short-term interest rates can be decomposed thus:

$$i_t^n = \frac{i_t + E\left(i_{t+1} + \cdots + i_{t+n-1} | \Omega_t\right)}{n} + l_t^n \tag{1}$$

Where i_t^n is the interest rate on a bond of maturity n periods at time t, $E(i_{t+j}|\Omega_t)$ is the expected interest rate on a one period bond in period $t+j$, based on Ω_t, the information available at time t . l_t^n is the liquidity (or term) premium for the n-period bond priced at time t . This specification nests the expectations hypothesis of the term structure (EHTS) (corresponding to the first term on the right hand side of equation 1), and the liquidity premium theory (corresponding to the second term).

The EHTS merely posits that the yield on a long-term bond is the average of the one period interest rates expected over the lifetime of the multi-period bond. The liquidity premium theory allows supply and demand conditions that pertain specifically to bonds of that maturity and affect pricing. The presence of idiosyncratic effects associated with a certain maturity of bond is sometimes linked to the "preferred habitat theory", the idea that certain investors have a preference for purchasing assets of specific maturities. Since $l_t^n > 0$ and is expected to rise as n becomes large, the yield curve will slope upward when short rates are expected to be constant over time.

Now, for the sake of simplicity, consider the case where $l_t^n = 0$ (i.e., the EHTS explains all variation in long rates). Suppose further expected future short-term interest rates are

[2] Using aggregate Euro area data, Moneta (2003) found that the 10-year/3-month spread specification performed better than any other pair of yield maturities that included two of the following: 3-month, 1-year, 2-year, 5-year, 10-year.

lower than the short-term rate today. Then the long rate will be lower than the short rate (i.e., the yield curve inverts). Since low interest rates are typically associated with decreased economic activity, an inverted yield curve could imply an expected downturn. Furthermore, given that $l_t^n > 0$, an inversion should imply a downturn a fortiori.

Why should short interest rates be lower during an economic downturn? The reasoning follows two – not necessarily mutually exclusive - avenues. The first is that decreased economic activity decreases private sector demand for credit; at the same time the monetary authority has likely decreased the policy rate in response to the slowdown. The second is that the monetary authorities raise rates that precipitate a subsequent slowdown.

2.2 Selective Literature Review

The literature on the usefulness of the yield spread in forecasting future growth is extensive and we review only a subset of the analyses here. Some early studies regarding the relationship between growth and the yield spread date to the late 1980s; Harvey (1988, 1989), Stock and Watson (1989), Nai-Fu Chen (1991), Estrella and Hardouvelis (1991) among others, suggested that an inverted yield curve (in this case a negative yield spread) could signal an impending recession. These early studies were primarily conducted using U.S. financial data to predict future Gross Domestic Product (GDP) growth.

Some subsequent research focused on whether the relationship between the yield spread and future economic growth held up in countries other than the United States. Harvey (1991), Davis and Henry (1994), Plosser and Rouwenhorst (1994), Bonser-Neal and Morley (1997), Kozicki (1997), Estrella and Mishkin (1997) and Estrella, Rodrigues and Schich (2003) studied non-US OECD countries using post-1970 data, and generally conclude that the yield spread can be used to some extent in predicting future economic growth. However out-of- sample studies conducted by Davis and Fagan (1997) and Smets and Tsatsaronis (1997) using, respectively, U.S. and German data, and European data, found that parameter estimates are unstable over time. Moreover, the estimated regressions exhibited poor forecasting capabilities.

While the most simple model requires only a single-variable specification with the yield spread as the lone independent variable, some subsequent research allows for additional variables, such as the short term policy rate – at least when predicting recessions (as opposed to growth). One prominent example of this approach is Wright (2006). In his paper, Wright argues that adding the short-term rate strengthens the in-sample forecasting results when using a probit model to predict recessions.

3 Empirical Model and Results

3.1 Data

The compilation of the dataset confronts the researcher with many choices, including the set of countries to study, and the choice of both regressors and regressand. We selected countries in order to adequately represent the Euro Area. Countries outside the Euro Area provide a basis of comparison to provide perspective and sense of robustness regarding the results.

In addition, to ensure the interest rates represent market-determined rates, we selected countries that have robust and liquid financial markets. The need for a sufficiently large time sample (1970- 2013[3]) further restricted the set of countries we could examine. Given these constraints, we restrict our analysis to Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom, and the United States.

We select industrial production as our measure of economic activity for the majority of our analysis. While GDP is the broadest indicator of economic activity, the use of industrial production presents some substantial advantages in terms of timeliness and reliability[4]. In any case, growth rates of industrial production tend to follow GDP closely[5]. All of the countries in the data set (including the Euro Area) report industrial production at a monthly

[3]For Italy and the Netherlands, the data begin in 1971 and 1972 respectively.
[4]By reliability, we mean that the industrial production series do not get revised as significantly as GDP.
[5]For instance, the correlation between GDP and IP growth in the US and UK are .76 and .72 respectively.

frequency while GDP is reported at a quarterly frequency; using IP therefore affords us increased precision.

In terms of our recession indicators, we use the NBER measure for the United States. Since there are not comparable measures for the other countries, we use the recession indicator from the Economic Cycle Research Institute (ECRI).

3.2 In-sample Results

We start with a simple bivariate model:

$$IPGrowth_{t,t+k} = \beta_0 + \beta_1 Spread_t + \varepsilon_{t+k} \tag{2}$$

Where $IPGrowth_{t,t+k}$ is the annualized growth rate over the period t through $t+k$, and $Spread_t \equiv i_t^{10yr} - i_t^{3mo}$.

In words, the yield spread at time t predicts the annualized growth rate of industrial production for the time span beginning in period t to $t+k$ months ahead. We examine this model with k equal to 12 and 24 (i.e. growth over a one and two year time horizon). Since adjacent year over year growth figures will be drawing from overlapping data points, the resulting error terms will be serially correlated. To account for this serial correlation, we conduct our statistical inferences using heteroscedasticity and serial correlation robust standard errors[6].

We turn first to the results from the model using the complete data set (1970-2013), displayed in Table 1. All countries exhibit a significant coefficient estimate on the yield spread parameter over the one year forecast horizon (at the 5 percent significance level), suggesting the yield spread may hold some forecasting value. The magnitude of the parameter estimate is also of economically important. Consider the coefficient estimate of 1.22 for France, for example; this point estimate implies that for each percentage point increase in the yield

[6]We have investigated whether the variables are stationary or not. Unit root tests indicate that the spreads and industrial production changes are stationary.

spread, French industrial production growth over the next year will increase by and additional 1.22 percentage points. The estimated slope coefficients for the countries in our data set vary markedly, ranging from a high of 1.81 in Canada to a low of 0.69 in the United Kingdom.

Despite the existence of statistically significant parameter estimates in each country, the goodness of fit for the model (according to the R-squared statistic), varies substantially across country models. That being said, the *relative* proportion of variation across countries is of interest. The yield spread in United States, Germany, and Canada explains more than 20 percent of the changes in annual industrial production growth. In contrast, the yield spread explains less than 10% of the variation in output in Italy, Japan, and Sweden.

Following Bonser-Neal and Morley (1997) and Kozicki (1997), we also examine the corresponding specification for growth over a two year horizon. While many of the variables are still significant, the explanatory power of the model deteriorates for many countries. Additionally, in every case the magnitude of the yield spread coefficient is smaller in the two-year model relative to the one-year model. The decrease in explanatory power and magnitude of the coefficient estimates at the two-year versus one-year horizon suggests most of the explanatory power is concentrated at the former horizon[7]. Only the German, United Kingdom and United States models exhibit better fit in the two-year model relative to the one-year model.

In order to investigate the time variation in the strength and nature of the yield curve/growth relation, we split the sample at 1997/98. The choice of that specific date is primarily pragmatic in nature; it sets each subsample to be roughly similar in size. At the same time, the choice is somewhat fortuitous, as the latter subsample then conforms approximately to the post-EMU period.

Tables 2 and 3 contain results from the two sub-samples of data, and highlight a key finding. The detection of a statistically significant relationship between term spreads and subsequent output growth is driven by the early portion of the sample. The regressions on

[7]For an empirical investigation into this issue see Kozicki (1997).

date from the early sample (1970-1997) yield coefficients that are significant for eight of nine countries at the 99 percent confidence level. In contrast, the coefficient estimates when using more recent data (1998-2013) are significantly different from zero in only three countries, however point estimates are much larger with the more recent data, making it difficult to determine if the relationship between the yield spread has deteriorated or intensified.

Examining the goodness of fit across sub-samples, four of the models exhibit a better fit when using the later data subset. Japan exhibits the sharpest drop-off in goodness of fit from the two subsets, starting at nearly 0.2 in the 1970-1997 subsample and reaching nearly zero in the 1998-2008 subsample. This data period coincides with the Asian financial crisis and may reflect Japan's short term rates hitting the zero interest lower bound. One implication of the Japanese results, relevant to current debates is that going forward, we might expect a degraded fit for the US yield curve/output relationship, given the effective Fed Funds rate has essentially hit zero.

Haubrich and Dombrosky (1996) and Dotsey (1998) suggest that the relationship between the yield spread and future growth diminishes using data since 1985. The results of our analysis suggest that the relationship continues to deteriorate post 1997, but with a couple of exceptions.

3.3 Out-of-sample Results

A common critique of in-sample estimation is that the model estimates the fitted values using data that would not have been available at the time of the observation being fitted. The results of an in-sample forecast will be using extra information to fit the parameters to the data and could therefore overstate the predictive power of the independent variable. If one attempted to forecast growth from today to one year into the future, we would not be privy to the information in the interim.

To address these forecasting issues we run pseudo-out-of-sample forecasts. Each individual prediction in these forecasts come from separate regressions that restrict data to that which would have been available prior to data point we are trying to forecast. Specifically, our dataset contains information from 1970-2013. However an individual trying to predict industrial production growth from January 1980 to January 1981, in January of 1980 would not have had access to our entire dataset. To forecast IP growth from January 1980 through 1981 we run a regression using only data that would have been available prior to January 1980 (i.e. Jan. 1970- Dec. 1979) to emulate the information set an individual would have had in January of 1980. Then, to estimate IP growth from February 1980 to February 1981, we re-run the regressions using data from January 1970 - January 1980, and so on. The dataset used for each successive forecast is larger than the previous just as a forecaster in recent periods has more data than a forecaster years ago.

The parameter estimates from the pseudo-out-of-sample regressions are used to generate a series of fitted values for year-over-year growth for each country. We opt for the root mean square error (RMSE) as a comparison criterion against a naïve forecast RMSE. In this case, our naïve forecast is a simple AR1 model of growth. We also calculate the RMSE for a forecast using three other specifications: AR(1) and the yield spread yield spread and 3 month rate, and yield spread, 3 month rate and AR(1).

The results can be succinctly summarized. We conclude that there exists a marginal benefit to estimating a growth model with the yield spread (as opposed to the simple AR(1) model) if the RMSE from the yield spread model specification is less than that of the AR(1) model. Figure 2 displays the fitted values for Euro area countries of the the out-of-sample model, using the yield spread as the independent variable and using the AR(1) model. While extreme fluctuations were not always well predicted, the general shape of the data seems to be captured in many cases, certainly when compared to the AR(1) model. Notably, the yield spread did not generate predicted contractions in the late 2000s but tracked the actual series fairly well in Canada and the US during the subsequent recovery.

Results relative to the AR(1) model across all countries were mixed. Table 4 displays the results of the RMSE scores for all model specifications. The yield curve model (column 2) exhibits lower RMSE than the AR(1) model (column 1) for all countries except Japan and the US. However we only reject the test for equal forecasting power for Canada according to the Diebold-Mariano test. Including the 3 month interest rate (column 4) increases the forecasting power, Germany and the United States test score drop to 0.04 and 0.06 respectively.

The relatively poor out-of sample results could, in part, be due to fundamental changes in the relationship between the yield curve and economic activity over time. If the structure of the relationship changed in the middle of our sample the forecasting power, coefficient estimates using historical data may not be useful in predicting growth out of sample. A number of events over the past ten years may have affected the predictive power of the yield curve including: the advent of the European monetary union, the "great moderation", the global savings glut and the Japanese experience with a ZLB policy rate. Each of these events affected different subsets of countries within our dataset therefore if we witness a simultaneous deterioration of predictive power across countries affected by the same event, it may suggest that that event was partially responsible for the observed deterioration. For instance, if each model corresponding to a country that adopted the Euro exhibits a simultaneous drop in the significance of the yield curve coefficient (relative to other countries) shortly after the advent of the euro, this may suggest the adoption of the Euro changed what the yield curve tells us about future economic growth.

To examine changes in the predictive power of the yield curve through time we use rolling window regressions. The dataset for the first regression for each country is restricted to include only data from January of 1970 through December of 1979. The dataset for the next regression is restricted to data from February of 1970 through January of 1980, and so on. Figure 4 plots the coefficient estimate and 95% confidence intervals corresponding to the yield curve for each overlapping 10 year interval from January 1970 – December 1979 through January 1999 –December 2008. Generally declining coefficient estimates and widening confidence bands confirm our suspicion that the relationship between the yield curve and economic growth has deteriorated over the last ten to fifteen years. However many models exhibit a significant strengthening during the Great Recession.

The Euro area countries appear similar to one another in some respects: the coefficient estimates tend to decline into 1990 when they generally become insignificant. This is consistent with the fact that many macroeconomic variables (including both industrial production and the yield spread) became significantly less volatile decreasing the detectability of any relationship. The recent uptick in the coefficient estimates is consistent with recent macroeconomic volatility. However coincidental deterioration is less obvious post 1998 where the coefficient estimates are generally insignificant.

Canada, the United Kingdom and the United States all exhibit deterioration in the post 1998 era; the significance band widens in the United states and Canada while the coefficient estimate draws closer to zero in the United Kingdom. Some have speculated that the global savings glut may have affected not only the United States but also other countries with strong legal regimes and liquid financial markets[8]. If Canada and the United Kingdom were affected by the global savings glut in the same way that the United States may have been, this is the coincidental deterioration one might expect. Certainly there exist other potential confounding factors, yet it remains an interesting coincidence.

Finally, the results for Japan may have been the most dramatic of all models in our sample. As the regression window begins to include data after the ZLB policy rate the coefficient estimate swings wildly to the negative side (albeit mostly insignificant). However the estimate swinging negative is what we would have expected as the short rate hits zero and the government attempts to lower long-term rates as well.

3.4 Marginal Predictive Value

In general, simple univariate regressions tend to suggest the yield curve does in fact hold significant predictive power, especially when the sample includes many business cycles. Next

[8] See, for example, the 2009 Economic Report of the President, Chapter 2.

we explore if yield curve data continues exhibit predictive information when other common leading indicators are introduced into the equation. For the leading indicators, we chose five data series commonly used to construct leading economic indexes[9]: New Private Housing Permits, Average Weekly Hours Worked, Money Supply (as measured by M2), Manufacturers' New Orders of Non-defense Capital Goods, and Stock Prices. Where exact matches were not available for a particular country, the most similar data series was used.

To represent the leading indicators we construct a single "factor" by applying principal component analysis to 12-month changes of five common leading index components[10]. The factor is defined to be the first principle component. For each of the countries we estimate the following equation[11]:

$$IPGrowth_{t,t+k} = \beta_0 + \beta_1 Spread_t + \beta_2 Factor_t + \varepsilon_{t+k} \tag{3}$$

Table 5 summarizes the results of these estimations. Due to data limitations of some leading indicators, the sample size for a number of countries has been reduced for this exercise. Regardless, in nearly every case, results suggest the yield spread does contain information above and beyond other common leading indicators. Netherlands is the sole exception where the yield spread does not appear to provide forecasting value. The small sample size may be contributing to the inconclusive results.

Leading indicator data in Canada, Japan and the United States span the original sample, beginning in 1970. For these countries coefficient estimates for the yield curve are little changed with or without the inclusion of the factor. The largest difference between estimates for these three countries is in the United States where the coefficient estimate on the spread drops from 1.6 to 1.2. As expected, in general the constructed factor is also significant in explaining variation in industrial production growth in many countries, although the

[9]For more on leading economic index components, see the Conference Board's website: http://www.conference-board.org/

[10]This procedure is suggested by Stock and Watson (2005). We adopt an ad hoc approach to selecting the components. A more formal approach is outlined in Groen and Kapetanios (2009).

[11]Sweden is excluded due to data limitations.

relationship appears to be weaker than that between the yield curve and growth.

4 The Yield Curve and Recessions

We now move to a nonlinear version of the same question we asked earlier, to the extent that recessions are a specific characterization of (negative) output growth. Following Montea (2003) and Wright (2006), we test if the yield spread is a predictor of recessions, defined as a binary dependent variable.

Clearly there is little agreement in terms of the findings in the literature, especially in this cross-country context. While Montea (2003) finds the yield curve alone is a useful predictor of recessions when using aggregate Euro area data, Wright (2006) argues there is no reason to believe that an increase in the short-term interest rate should have the same consequence as a decrease in the long term rate. Consequently, augments the conventional recession/yield curve specification with the Federal funds rate to isolate the effect of changes in the short-term rate. Indeed, Wright's model performed better when adding the federal funds when using United States data. Following the literature, the models we use are as follows:

$\Pr(R_{t+1,t+k} = 1) = \phi\left(\beta_0 + \beta_1 Spread_t\right)$

$\Pr(R_{t+1,t+k} = 1) = \phi\left(\beta_0 + \beta_1 Spread_t + \beta_2 3mo_t\right)$

Where t is the current time period and k is the forecast period and $\phi(\cdots)$ denotes the standard normal cumulative distribution function. We use the 3-month interest rate to isolate the effect of movements in short-term interest rates. The recession indicator variable equals one if there is a recession in any month between $t+1$ through $t+k$, inclusive. We estimate both models using k equal to 6 and again with k equal to 12 (i.e. a six month and one year forecast).

Tables 5 and 6 display the results from the probit model estimates for each country over the full sample. The top block of each table reports results from a six-month forecasting horizon, while the lower block displays the twelve-month forecasting results. For the United

States, our results differ somewhat from the results obtained by Wright (2006); the yield spread parameter is significant over both the six-month and twelve-month forecasting periods even when the short term rate is included in the regression. However, the 3-month interest rate parameter is statistically insignificant over either horizon.

The results from the Germany and Canada models are similar to the United States model: the yield spread is significant even with the addition of the short-term interest rate and the short-term interest rate parameter is not statistically significant at either forecast horizon. Interestingly, results for the some of the remaining countries are starkly different. Across many other non-US countries, adding the short term rate to the model reduces both the magnitude and significance of the yield spread. In Sweden the short-term rate is statistically significant while the yield spread coefficient actually becomes statistically insignificant. In the case of the Japan model, adding the short term yield makes the coefficient on the yield spread significant. In all countries excluding Japan, the coefficient on for the short-term interest rate is positive, suggesting high relative short-term interest rates precede periods of slower growth.

We display in Figure 5 the estimated probabilities of recession in the subsequent 12 months using only the yield spread. Generally speaking recessions were well predicted by the yield curve across countries in the 1970s and 1980s. When we look at recessions in the 1990s and 2000s however, results are less consistent. Across most countries recessions earlier in the data set were predicted better when including the short-term interest rate level whereas more recent recessions tend to be better predicted with the yield spread alone. While this stylized fact may be indicative of a structural change in the relationship between interest rates and future economic activity, it could also be due to the decline in short-term interest rate volatility relative to the decline in yield spread volatility since 1995[12].

To highlight some specific characteristics of our findings, for Germany estimated prob-

[12] Variance of 3-month interest rate was, on average, 9.75 times greater in 1970-1994 when compared to 1995- 2008 data while the variance of the yield spread was, on average, 4.95 percent higher in 1970-1994 when compared to 1995-2008. Only two countries exhibited increased relative volatility of the 3-month spread: Sweden and Italy.

abilities peaked near one hundred percent predicted probability prior to the recessions in the 1970s and 1980s, as anticipated. Additionally the estimated probability exceeded 80 percent preceding the 1990 recession. While the probability peaked at lower levels before the 2000 and 2007 recessions, in both cases the model ascribed a probability well in excess of 50 percent. The results for the England, Sweden and France paint a different picture. Probabilities generated by the model fit the recession data reasonably well through 1990; however, models were largely unresponsive in the months leading up to the 2007 recession. These performances suggest something may have been structurally different about the recessions of the 2000s. It is tempting to speculate on the impact of Economic and Monetary Union on this phenomenon, since the 2001 recession is the first one occurring when the ECB was setting short term rates, and long rates had converged to relatively small differentials[13]. Results in Japan and Italy are generally quite poor. When using only the yield spread as in independent variable the coefficient is not statistically significant and the model explains almost nothing. The Great Recession was well predicted by the yield spread in the U.S. and Germany, and to a lesser extent France, Sweden and Canada.

5 Real-time Data

In the previous exercises we used historical data as they looked at the time. However industrial production data, as are most measures of economic activity, is subject to revision. For instance, United States industrial production for December 2008 was originally reported as 106.1 by April 2009, December data had been revised down to 104.8. From a forecasting perspective, using data as it appears most recently (the current vintage) is not the same as using data as it looked prior to the estimation period. If, today, we want to evaluate how the model would have performed in December 2008, using data as it appeared in December 2008 as opposed to today, more closely simulates estimating the model in 2008.

[13]Note that CEPR, using a methodology reminiscent of NBER's, did not declare a recession for this period. See CEPR at http://www.cepr.org/data/Dating/info1.asp .

Koenig, Dolmas & Piger (2003) point out that the relationship between early estimates of economic output and early estimates of explanatory variables is the relationship of interest to forecasters. Any given vintage prior to a forecasting period will have historical figures that have been revised as well as early estimates of more recent data. To capture the relationship between early estimates of output and explanatory variable Koenig, Dolmas and Piger suggest creating a "real-time vintage" by compiling a single time series for each variable that include only the first estimate. Furthermore, Koenig, Dolmas and Piger argue that revisions to data are unpredictable (essentially extraneous noise) at the time if issuance so using a real-time vintage on the left-hand side of an equation eliminates the noise and in fact provides more accurate forecasts.

In this section we use real-time vintage data created from the OECD Main Economic Indicators real-time data and revisions database[14]. Due to data availability, we use real GDP as a measure of economic output and restrict our sample of countries to: Canada, Germany, Japan, U.K. and U.S. Since the interest rates used to construct the yield spread are not typically revised, therefore using the current vintage for the yield spread sufficiently represents a real-time vintage. The dataset contains GDP vintages from 1987Q3 to 2013Q2. To construct this dataset we have a series of real GDP vintages for Canada, Germany, Japan, U.K. and the U.S. For each vintage we calculate four-quarter GDP growth. We collapse the set of vintages of GDP growth rates down to one series for each country that contains only the last growth rate (the first estimate) from each vintage. Current-vintage yield spread data is used to predict four-quarter GDP growth rates in the constructed 'real-time vintage'.

Table 11 displays the results of the real-time data analysis. For comparison, the second column displays estimates of the same equation using a single, recent vintage. Significant parameter estimates across all countries (for the US only at the 90 percent confidence level), except Japan, suggest the yield curve does tend to provide significant information regarding first estimate economic growth over the next four quarters. Table 12 shows a comparable

[14] Vintages prior to 2004 were graciously provided by Lucio Sarno, as used in Sarno and Valente (2009)

set of regressions where the current vintage of GDP is used to calculate growth rates. Results using current-vintage data are very similar to the real-time data results. Industrial production data tend to be revised to a smaller degree than GDP, therefore finding similar results across current-vintage and real-time datasets suggest one can be more confident that the findings in the previous sections using only current-vintage data are not driven by the current-vintage structure.

6 Conclusion

This paper has explored the importance of the yield spread in forecasting future industrial production growth and recession. Generally speaking, when using the entire data series from 1970-20013, in-sample results suggest the yield spread is indeed important and has significant predictive power when forecasting industrial production growth over a one-year time horizon. The results deteriorate when forecasting growth two years ahead. Moreover, it appears that the predictive power of the yield curve for subsequent one-year growth is much weaker during the great moderation and up until the financial crisis of 2008. However, each of the six European country models exhibited relatively high R-squared statistics (above 0.1) when using data from 1998-20013, and for two countries (Italy and Sweden) the proportion of variation explained actually increased. While the explanatory power is somewhat less for certain models estimated over the 1970-1997 data, the data still suggest the yield curve might possess some forecasting power for European countries. The marked deterioration of the significance in the Japan model when using data corresponding to Japan's period of zero interest rate policy (ZIRP) might presage a weakening of the significance of the relationship in the United States, given the effective Federal funds rate has reached the ZLB.

The results we obtained in the out-of-sample forecasting exercises were somewhat less convincing. Of the European countries examined, only for Germany did the yield curve possess significantly greater predictive power than a simple AR(1). Certainly the relationship between the yield spread and growth has declined in recent years; however it appears that the relationship has held up best in some European countries and may have strengthened with the increasing volatility of macroeconomic data over the past two years.

In terms of in-sample explanatory power, the yield curve appears to have predictive power for one year ahead industrial production, even after accounting for other variables that have predictive power. We obtain this result by augmenting the yield curve regression with a factor based upon five variables that are typically used in leading indicators.

The contrast across countries was marked for the probit models. The short-term rate was significant in several instances; however inclusion of the short-rate often resulted in a decrease in the economic and statistical significance of the yield spread. The model predicted recessions relatively well for the US, Germany and Canada over the entire data set while the remaining models largely failed to anticipate the recessions of the 2000s. The Japanese model did not predict recessions well. Low short-term rates appear to precede future economic slowdown and the model performs very poorly without the short-term rate.

In other words, we do not obtain a simple story for the yield curve's predictive power. The yield curve clearly possesses some forecasting power. However, there is also some evidence the United States is something of an outlier, in terms of its usefulness for this purpose. And overall, the predictive power of the yield curve seems to have rebounded in the lead up to the Great Recession, reversing a longer term trend of declining predictive power.

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Data Appendix

Data for this paper came from two sources. All of the recent data came from Haver Analytics. When the series in Haver did not extend back to 1970, the Haver series were spliced with data from the Bonser-Neal and Morely (1997) dataset. These data include the following:

Canada:
3-month interest rate from 1/1970 to 12/1979 (IFS)
Industrial Production from 1/1970 to 12/1980 (BIS)
France:
3-month interest rate from 1/1970 to 5/1989 (BIS)
10-year interest rate from 1/1970 to 8/81 (BIS)
Germany:
10-year interest rate from 1/1970 to 12/1979 (OECD, FRB)
Italy:
3-month interest rate from 1/1971 to 12/1979 (lFS)
10-year interest rate from 1/1970 to 12/1979 (BIS, IFS)
Industrial Production from 1/1960 to 12/1979 (BIS)
Japan:
3-month interest rate from 1/1970-4/1979 (BIS)
10-year interest rate from 1/1970 – 8/1987 (BIS)
Netherlands:
3-month interest rate from 10/1972 – 12/1981 (BIS)
10-year interest rate from 1/1970-4/1982 (IFS)
Industrial Production from 1/70 – 12/79 (IFS)
Sweden:
3-month interest rate from1/1970 – 12/1982 (IFS)
10-year interest rate from 1/1970 – 12/1986 (IFS)
Industrial Production from 1/1970 – 12/1989 (FRB)
UK:
3-month interest rate from 1/1970-12/1985 (FRB)

Table 1: Current Yield Spread as Predictor of Future IP Growth: Full Sample (1970-2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Ned.	(7) Sweden	(8) UK	(9) US
12-Month Growth									
Spread	1.81	1.22	1.52	0.85	1.23	1.03	0.99	0.69	1.14
	[0.23]**	[0.38]**	[0.30]**	[0.31]**	[0.47]**	[0.27]**	[0.41]*	[0.22]**	[0.22]**
Constant	0.079	-0.022	-0.059	0.84	1.26	0.26	-1.54	0.38	1.71
	[0.65]	[0.72]	[0.71]	[0.80]	[0.95]	[0.58]	[1.02]	[0.49]	[0.61]**
R-squared	0.27	0.13	0.23	0.064	0.068	0.11	0.068	0.11	0.20
Observations	501	507	507	495	507	474	495	507	508
24-Month Growth									
Spread	1.22	0.55	1.11	0.056	0.28	0.53	0.74	0.52	0.88
	[0.22]**	[0.24]*	[0.18]**	[0.21]	[0.33]	[0.13]**	[0.36]*	[0.14]**	[0.15]**
Constant	0.71	0.55	0.34	1.13	1.69	0.72	-2.28	0.49	1.85
	[0.58]	[0.55]	[0.48]	[0.58]	[0.74]*	[0.32]*	[1.07]*	[0.39]	[0.50]**
R-squared	0.22	0.053	0.27	0.00065	0.0084	0.10	0.046	0.14	0.22
Observations	489	495	495	483	495	462	483	495	496

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)).

Table 2: Current Yield Spread as Predictor of Future IP Growth: Early Sample (1970-1997)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Ned.	(7) Sweden	(8) UK	(9) US
12-Month Growth									
Spread	2.00	1.63	1.15	1.28	1.47	0.91	0.55	0.68	1.37
	[0.21]**	[0.42]**	[0.22]**	[0.31]**	[0.47]**	[0.25]**	[0.35]	[0.24]**	[0.27]**
Constant	0.93	1.03	0.37	2.59	2.46	0.43	-1.14	1.12	2.68
	[0.60]	[0.63]	[0.61]	[0.80]**	[0.92]**	[0.58]	[1.00]	[0.58]	[0.61]**
R-squared	0.41	0.29	0.25	0.18	0.21	0.12	0.035	0.12	0.34
Observations	336	336	336	324	336	303	324	336	336
24-Month Growth									
Spread	1.29	0.71	0.89	0.26	0.52	0.48	0.41	0.50	0.98
	[0.21]**	[0.26]**	[0.16]**	[0.24]	[0.32]	[0.13]**	[0.38]	[0.13]**	[0.16]**
Constant	1.60	1.42	0.58	2.28	2.60	0.77	-2.30	1.22	2.79
	[0.52]**	[0.49]**	[0.46]	[0.58]**	[0.78]**	[0.35]*	[1.29]	[0.45]**	[0.49]**
R-squared	0.33	0.12	0.33	0.021	0.049	0.11	0.019	0.16	0.33
Observations	336	336	336	324	336	303	324	336	336

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)).

Table 3: Current Yield Spread as Predictor of Future IP Growth: Late Sample (1998-2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Ned.	(7) Sweden	(8) UK	(9) US
12-Month Growth									
Spread	1.60	2.45	5.04	2.57	5.86	1.95	6.04	0.44	1.19
	[0.89]	[1.26]	[1.40]**	[1.49]	[5.92]	[1.19]	[1.67]**	[0.53]	[0.50]*
Constant	-1.75	-4.49	-4.25	-5.01	-6.74	-0.99	-8.51	-0.99	-0.38
	[2.27]	[2.72]	[2.22]	[3.00]	[8.53]	[2.01]	[3.00]**	[0.78]	[1.48]
R-squared	0.10	0.21	0.46	0.19	0.035	0.13	0.45	0.041	0.14
Observations	165	171	171	171	171	171	171	171	172
24-Month Growth									
Spread	1.54	2.24	3.21	1.77	0.30	0.93	4.59	0.24	1.32
	[0.81]	[0.81]**	[0.72]**	[1.03]	[2.90]	[0.47]	[0.89]**	[0.38]	[0.43]**
Constant	-1.90	-4.04	-2.16	-3.60	-0.40	0.20	-7.16	-0.97	-0.73
	[1.97]	[1.70]*	[1.32]	[2.11]	[4.20]	[0.85]	[1.98]**	[0.55]	[1.14]
R-squared	0.18	0.34	0.42	0.19	0.00030	0.11	0.43	0.026	0.34
Observations	153	159	159	159	159	159	159	159	160

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)).

Table 4: Historical Ex Post Simulation: MSE

	AR1	Spread	Spread and AR1	Spread and 3mo	Spread 3mo AR1
Canada	33.10	25.25	22.83	20.74	20.64
D-M Stat*	.	0.0601	0.0106	0.0189	0.0179
France	20.43	22.33	16.57	16.27	16.30
	.	0.445	0.242	0.213	0.253
Germany	27.37	21.49	19.46	20.22	19.49
	.	0.0404	0.0755	0.0408	0.0656
Italy	37.03	39.54	30.69	30.26	30.22
	.	0.544	0.250	0.259	0.225
Japan	58.85	66.56	52.81	54.20	48.80
	.	0.0260	0.279	0.369	0.323
Netherlands	20.32	20.24	16.86	19.65	16.80
	.	0.974	0.0959	0.789	0.114
Sweden	52.54	50.68	46.94	46.88	46.81
	.	0.558	0.281	0.256	0.263
UK	16.33	13.60	12.21	11.57	11.66
	.	0.413	0.211	0.123	0.134
US	20.76	20.86	15.92	15.81	15.71
	.	0.976	0.0374	0.0607	0.0574

*Diebold-Mariano p-value for equal forecasting power.

Table 5: Current Yield Spread as Predictor of Future Recession: Full Sample (1970-2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 Months								
Spread	-0.39	-0.37	-0.68	-0.094	-0.059	-0.29	-0.067	-0.46
	[0.11]**	[0.091]**	[0.17]**	[0.093]	[0.095]	[0.12]*	[0.10]	[0.085]**
Constant	-0.73	-0.43	0.11	-0.51	-0.42	-0.21	-0.68	-0.64
	[0.23]**	[0.19]*	[0.23]	[0.19]**	[0.18]*	[0.19]	[0.19]**	[0.19]**
R-squared	0.18	0.12	0.34	0.016	0.0045	0.10	0.0094	0.27
Observations	519	519	509	505	519	519	519	519
Next 12 Months								
Spread	-0.49	-0.44	-0.63	-0.053	-0.020	-0.29	-0.11	-0.69
	[0.12]**	[0.10]**	[0.15]**	[0.089]	[0.099]	[0.13]*	[0.099]	[0.12]**
Constant	-0.50	-0.14	0.31	-0.36	-0.23	-0.047	-0.51	-0.29
	[0.22]*	[0.20]	[0.24]	[0.19]	[0.18]	[0.19]	[0.19]**	[0.20]
R-squared	0.24	0.15	0.29	0.0050	0.00051	0.11	0.025	0.38
Observations	519	519	509	505	519	519	519	519

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* $P<.05$, ** $P<.01$)). Reported R-squared is pseudo R-squared.

Table 6: Current Yield Spread as Predictor of Future Recession: Full Sample (1970-2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 Months								
Spread	-0.33	-0.22	-0.51	-0.025	-0.74	-0.11	-0.036	-0.46
	[0.15]*	[0.13]	[0.21]*	[0.12]	[0.16]**	[0.14]	[0.095]	[0.12]**
threemonth	0.031	0.096	0.12	0.036	-0.37	0.14	0.029	-0.0036
	[0.090]	[0.066]	[0.098]	[0.044]	[0.072]**	[0.057]*	[0.063]	[0.083]
Constant	-1.00	-1.26	-0.68	-0.88	1.25	-1.42	-0.93	-0.62
	[0.85]	[0.62]*	[0.70]	[0.49]	[0.35]**	[0.52]**	[0.60]	[0.66]
R-squared	0.18	0.16	0.35	0.028	0.26	0.19	0.015	0.27
Observations	519	519	509	505	519	519	519	519
Next 12 Months								
Spread	-0.44	-0.28	-0.44	0.0044	-0.70	-0.12	-0.070	-0.68
	[0.16]**	[0.14]*	[0.18]*	[0.12]	[0.15]**	[0.14]	[0.094]	[0.13]**
threemonth	0.022	0.100	0.15	0.030	-0.37	0.13	0.041	0.00082
	[0.086]	[0.059]	[0.088]	[0.043]	[0.073]**	[0.057]*	[0.062]	[0.079]
Constant	-0.69	-1.00	-0.66	-0.67	1.53	-1.18	-0.86	-0.29
	[0.80]	[0.58]	[0.61]	[0.48]	[0.38]**	[0.50]*	[0.60]	[0.65]
R-squared	0.24	0.19	0.32	0.013	0.27	0.18	0.036	0.38
Observations	519	519	509	505	519	519	519	519

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)). Reported R-squared is pseudo R-squared.

Table 7: Current Yield Spread as Predictor of Future Recession: Early Sample (1970-1997)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 Months								
Spread	-0.49	-0.35	-0.66	-0.16	-0.14	-0.23	-0.20	-0.55
	[0.11]**	[0.11]**	[0.19]**	[0.091]	[0.11]	[0.098]*	[0.13]	[0.11]**
Constant	-0.79	-0.46	0.057	-0.60	-0.85	0.037	-0.71	-0.82
	[0.29]**	[0.22]*	[0.27]	[0.23]**	[0.24]**	[0.23]	[0.23]**	[0.23]**
R-squared	0.30	0.11	0.42	0.046	0.041	0.091	0.097	0.39
Observations	336	336	336	324	336	336	336	336
Next 12 Months								
Spread	-0.58	-0.41	-0.59	-0.10	-0.10	-0.24	-0.24	-0.86
	[0.12]**	[0.12]**	[0.16]**	[0.089]	[0.11]	[0.10]*	[0.12]*	[0.15]**
Constant	-0.57	-0.21	0.24	-0.42	-0.66	0.22	-0.51	-0.46
	[0.27]*	[0.22]	[0.28]	[0.22]	[0.23]**	[0.23]	[0.23]*	[0.25]
R-squared	0.36	0.14	0.36	0.019	0.022	0.098	0.13	0.52
Observations	336	336	336	324	336	336	336	336

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)). Reported R-squared is pseudo R-squared.

Table 8: Current Yield Spread as Predictor of Future Recession: Early Sample (1970-1997)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 Months								
Spread	-0.086	-0.18	-0.0072	-0.025	-1.25	-0.14	0.086	-0.38
	[0.16]	[0.15]	[0.42]	[0.13]	[0.27]**	[0.15]	[0.16]	[0.14]**
threemonth	0.30	0.27	0.58	0.12	-0.70	0.074	0.38	0.15
	[0.12]*	[0.13]*	[0.27]*	[0.065]	[0.16]**	[0.100]	[0.12]**	[0.091]
Constant	-3.95	-3.17	-4.55	-2.13	3.29	-0.74	-5.13	-2.12
	[1.43]**	[1.27]*	[2.28]*	[0.89]*	[0.90]**	[1.01]	[1.44]**	[0.79]**
R-squared	0.42	0.29	0.52	0.12	0.33	0.10	0.34	0.43
Observations	336	336	336	324	336	336	336	336
Next 12 Months								
Spread	-0.17	-0.20	0.14	0.010	-1.00	-0.19	0.045	-0.66
	[0.19]	[0.18]	[0.33]	[0.13]	[0.24]**	[0.16]	[0.15]	[0.18]**
threemonth	0.33	0.35	0.62	0.098	-0.59	0.041	0.40	0.23
	[0.12]**	[0.10]**	[0.23]**	[0.064]	[0.15]**	[0.10]	[0.13]**	[0.083]**
Constant	-3.99	-3.69	-4.69	-1.65	2.89	-0.20	-5.08	-2.41
	[1.42]**	[1.06]**	[1.90]*	[0.86]	[0.90]**	[1.00]	[1.44]**	[0.74]**
R-squared	0.47	0.36	0.48	0.071	0.27	0.10	0.38	0.57
Observations	336	336	336	324	336	336	336	336

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)). Reported R-squared is pseudo R-squared.

Table 9: Current Yield Spread as Predictor of Future Recession: Late Sample (1998-2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 Months								
Spread	-0.068	-0.60	-0.78	0.045	-1.45	-1.46	0.49	-0.32
	[0.26]	[0.27]*	[0.29]**	[0.30]	[0.62]*	[0.76]	[0.26]	[0.13]*
Constant	-1.02	-0.059	0.29	-0.62	1.86	-0.069	-0.86	-0.50
	[0.53]	[0.55]	[0.38]	[0.60]	[0.68]**	[0.58]	[0.44]	[0.36]
R-squared	0.0023	0.11	0.17	0.0014	0.092	0.36	0.21	0.084
Observations	183	183	173	181	183	183	183	183
Next 12 Months								
Spread	-0.25	-0.80	-0.85	0.066	-1.38	-1.38	0.42	-0.52
	[0.30]	[0.27]**	[0.25]**	[0.28]	[0.80]	[0.52]**	[0.26]	[0.16]**
Constant	-0.64	0.45	0.60	-0.47	2.15	0.14	-0.67	-0.12
	[0.53]	[0.53]	[0.37]	[0.58]	[0.90]*	[0.57]	[0.41]	[0.37]
R-squared	0.031	0.18	0.19	0.0029	0.087	0.32	0.15	0.19
Observations	183	183	173	181	183	183	183	183

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)). Reported R-squared is pseudo R-squared.

Table 10: Current Yield Spread as Predictor of Future Recession: Late Sample (1998-2013)

	(1) Canada	(2) France	(3) Germany	(4) Italy	(5) Japan	(6) Sweden	(7) UK	(8) US
Next 6 Months								
Spread	-0.43	-0.21	0.16	0.58	-1.20	-1.41	0.21	-0.52
	[0.32]	[0.53]	[0.48]	[0.43]	[0.62]	[0.77]	[0.51]	[0.34]
threemonth	-0.31	0.30	0.98	0.59	1.13	0.11	-0.20	-0.13
	[0.19]	[0.33]	[0.36]**	[0.31]	[0.88]	[0.31]	[0.29]	[0.23]
Constant	0.28	-1.45	-3.81	-3.31	1.33	-0.45	0.010	0.13
	[1.07]	[1.57]	[1.57]*	[1.53]*	[0.77]	[0.98]	[1.49]	[1.15]
R-squared	0.062	0.13	0.35	0.067	0.12	0.36	0.22	0.093
Observations	183	183	173	181	183	183	183	183
Next 12 Months								
Spread	-0.62	-0.31	0.46	0.30	-1.00	-1.33	0.26	-0.58
	[0.37]	[0.52]	[0.42]	[0.44]	[0.79]	[0.55]*	[0.49]	[0.32]
threemonth	-0.30	0.38	1.52	0.25	2.19	0.19	-0.11	-0.041
	[0.21]	[0.37]	[0.46]**	[0.34]	[1.12]	[0.29]	[0.27]	[0.22]
Constant	0.64	-1.31	-5.59	-1.62	1.33	-0.47	-0.18	0.075
	[1.13]	[1.61]	[1.99]**	[1.66]	[0.98]	[0.96]	[1.38]	[1.07]
R-squared	0.084	0.20	0.50	0.016	0.16	0.34	0.16	0.19
Observations	183	183	173	181	183	183	183	183

Notes: Each coefficient is from a different regression of the Yield spread on industrial production growth. Italy sample begins in Jan. 1971.
HAC standard errors in brackets (* P<.05, ** P<.01)). Reported R-squared is pseudo R-squared.

Table 11: Current Yield Spread as Predictor of Future GDP Growth: Real-time Data

	(1) Canada	(2) Germany	(3) Japan	(4) UK	(5) US
Yield Spread	0.75	0.72	-0.63	0.47	0.35
	(0.23)**	(0.34)*	(0.37)	(0.22)*	(0.19)
Constant	1.04	0.82	1.98	1.43	1.87
	(0.54)	(0.66)	(0.63)**	(0.36)**	(0.49)**
Observations	104	104	104	104	104
R^2	0.257	0.134	0.040	0.141	0.074

Each column is a separate regression of the yield spread on GDP growth over the next 4 quarters. HAC standard errors (* P<.05, ** P<.01). Data range from 1987q3 to 2013q2 for all countries.

Table 12: Current Yield Spread as Predictor of Future GDP Growth: Current Vintage

	(1) Canada	(2) Germany	(3) Japan	(4) UK	(5) US
Yield Spread	0.69	0.66	-0.69	0.36	0.32
	(0.17)**	(0.32)*	(0.47)	(0.23)	(0.20)
Constant	1.53	0.61	2.15	2.38	2.23
	(0.46)**	(0.60)	(0.85)*	(0.46)**	(0.55)**
Observations	104	86	104	104	104
R^2	0.231	0.143	0.036	0.066	0.052

Each column is a separate regression of the yield spread on GDP growth over the next 4 quarters. HAC standard errors (* P<.05, ** P<.01). Data range from 1987q3 to 2013q2 for all countries.

Figure 1: Yield Curves and Recessions: Selected Countries

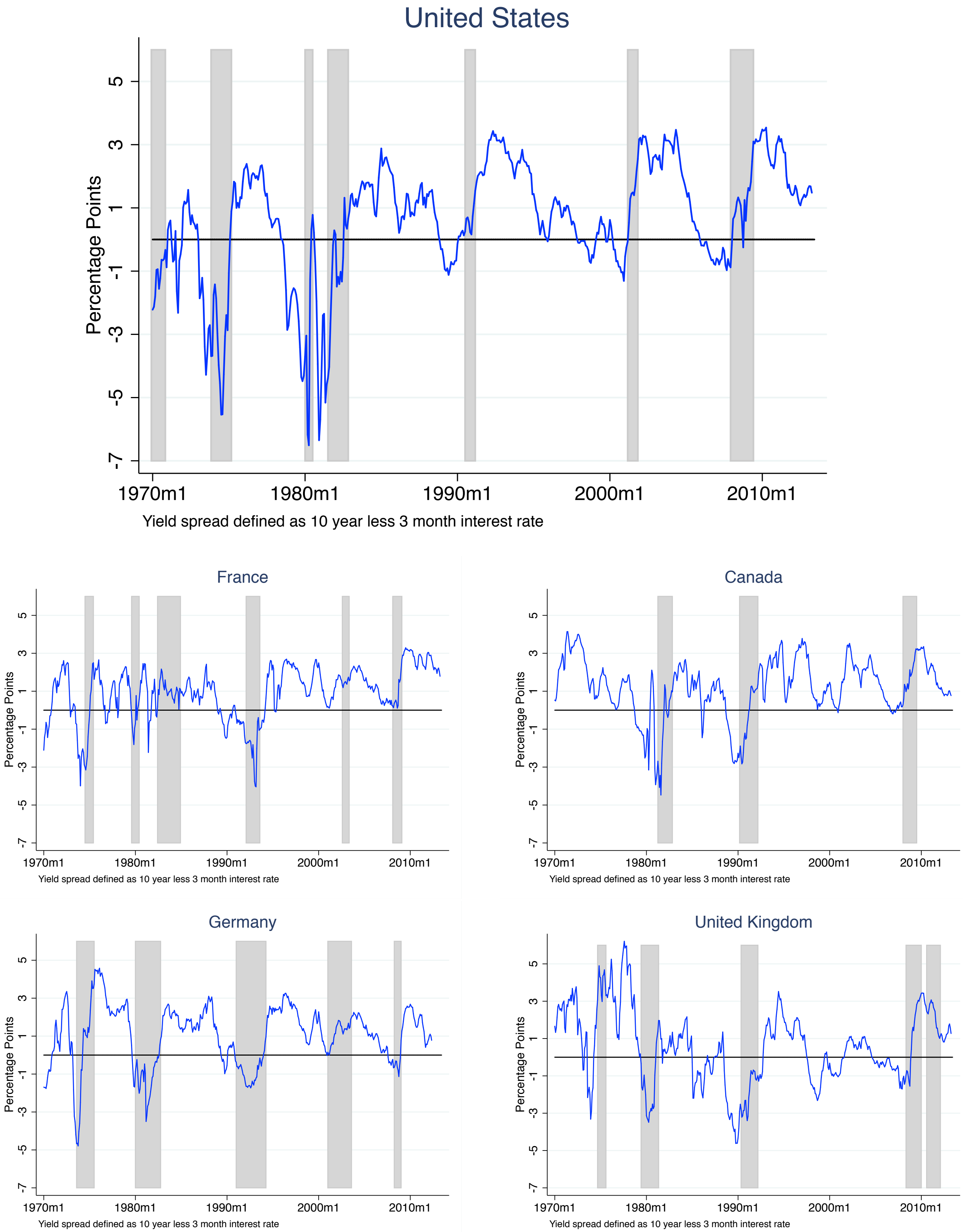
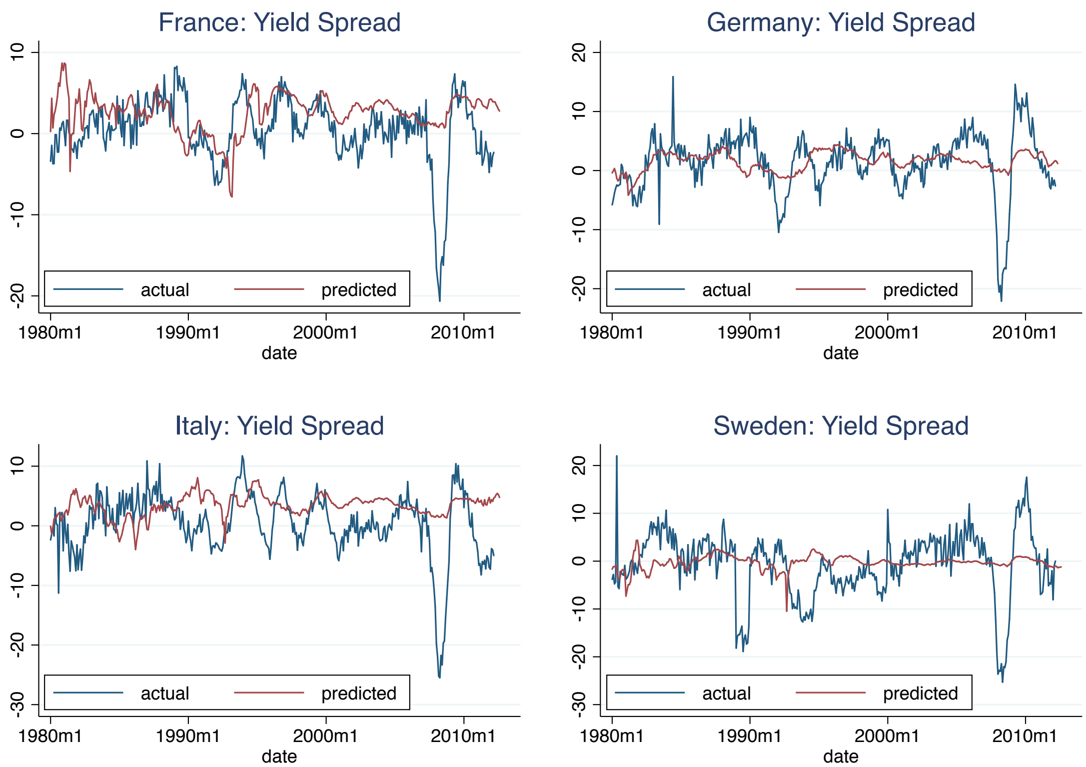


Figure 2: Pseudo Out-of-Sample forecasts: Euro Area
Yield Spread as Predictor



AR(1) Model

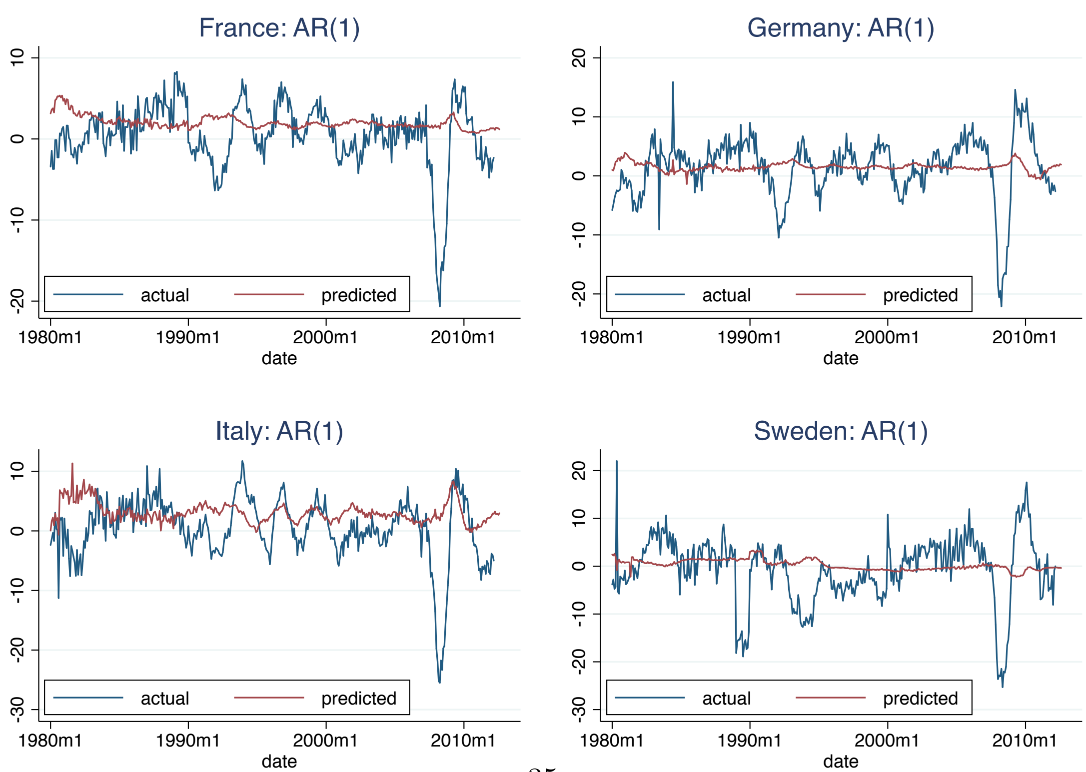
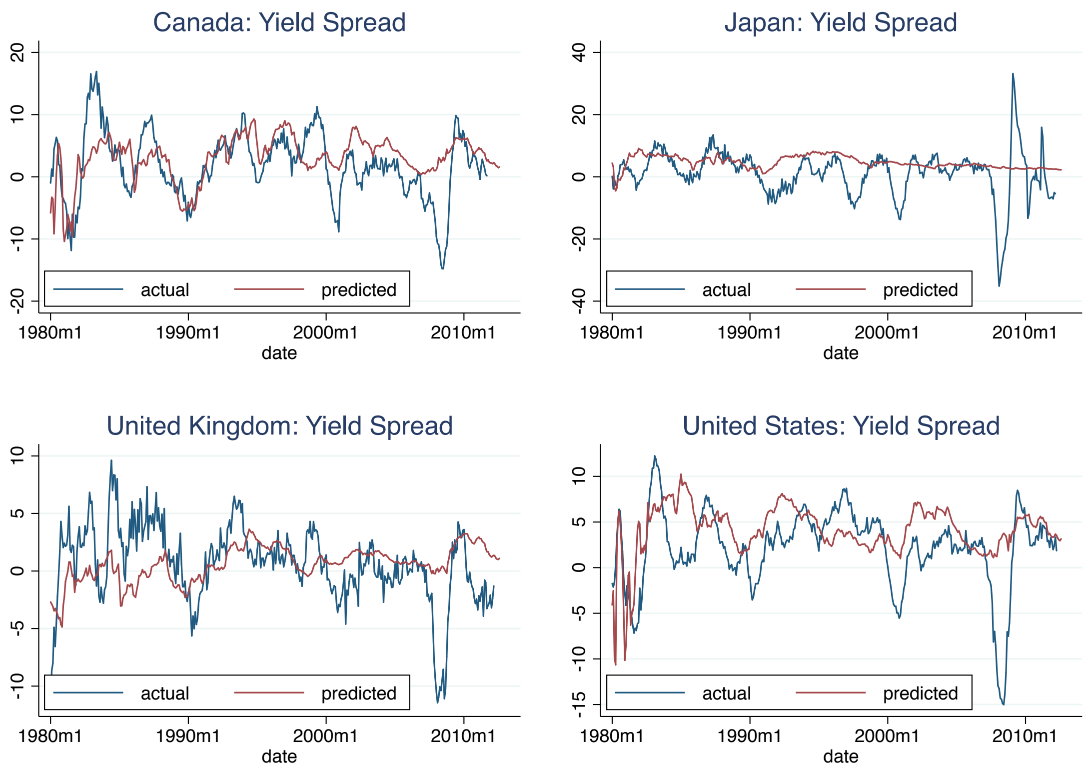


Figure 3: Pseudo Out-of-Sample forecasts: Other Countries
Yield Spread as Predictor



AR(1) Model

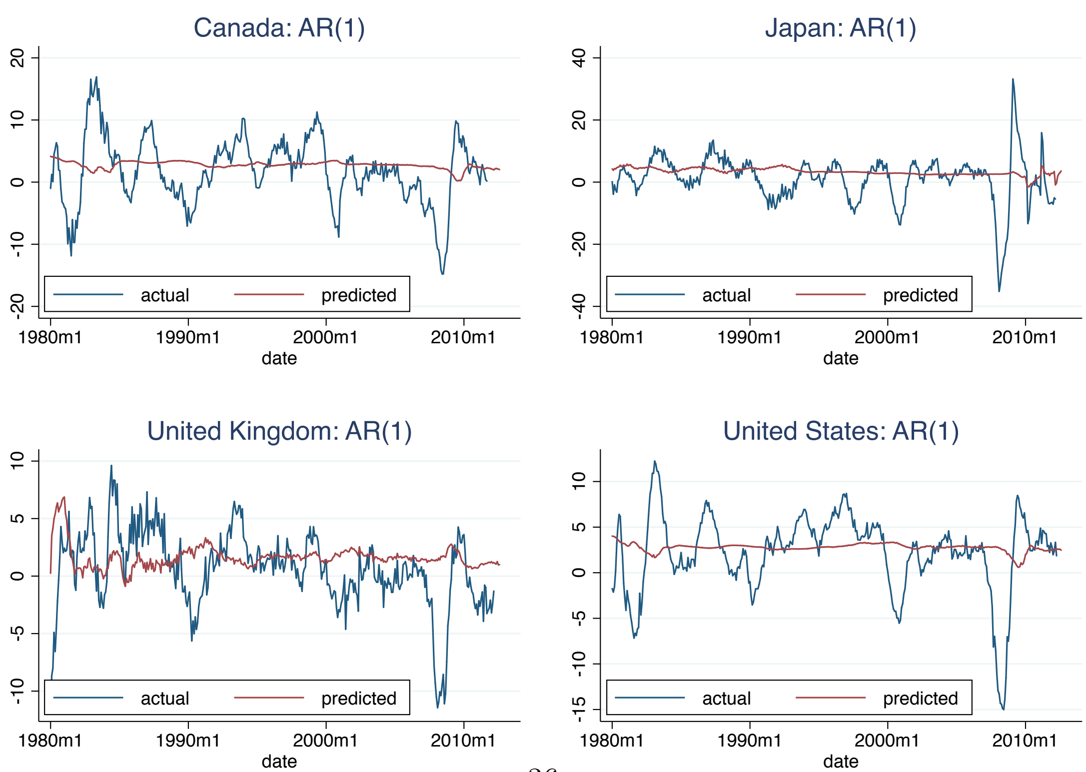


Figure 4: Rolling Window Regressions

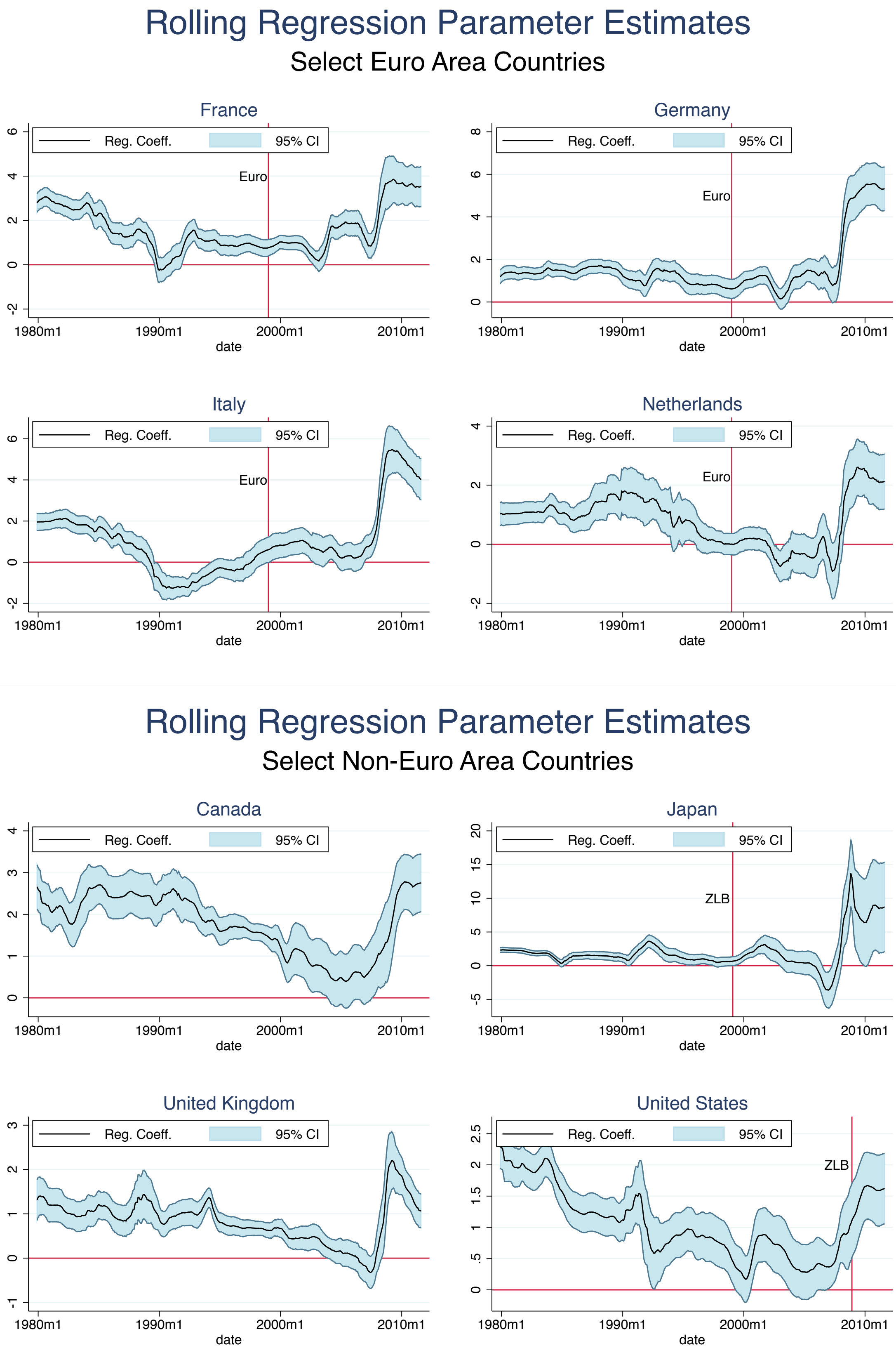


Figure 5: Predicting Recessions