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When does the yield curve contain predictive power? Evidence from a data-rich environment

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ABSTRACT

This paper analyzes the predictive content of the level, slope and curvature of the yield curve for U.S. real activity in a data-rich environment. We find that, while the slope contains predictive power, the level and curvature are not successful leading indicators. The predictive power of each of the yield curve factors fluctuates over time. The results show that economic conditions matter for the predictive ability of the slope. In particular, inflation persistence emerges as a key variable that affects the predictive content of the slope. The slope tends to forecast the output growth better when inflation is highly persistent.

1. Introduction

Economists have long understood that the behavior of the yield curve changes across the business cycle. In recessions, short-term interest rates tend to be low because the Federal Reserve lowers the policy rate in order to boost economic activity, whereas the long-term rates tend to be high relative to the short-term rates because the Fed is expected to raise the short-term rate in the future when the economic conditions improve. Thus, the slope of the yield curve, or the term spread, is positive in recessions. In contrast, the Fed raises the short-term rate when the economy is overheating or facing inflationary pressures. Such a policy is typically followed, with a lag, by a slowdown in real activity. Monetary policy tightening raises both short- and long-term interest rates. If monetary policy is expected to ease once economic activity or inflation declines, the short-term rate is likely to rise more than the long-term rate, meaning that the yield curve tends to flatten or even invert before slowdowns. This discussion suggests that the short-term rate tends to be procyclical, while the slope of the yield curve tends to be countercyclical. Based on this observation, economists have argued that the yield curve might tell us something about future real activity.

Since the late 1980s, a large body of literature has analyzed the predictive content of the yield curve (see, e.g., Abdymomunov, 2013; Aguiar-Conraria, Martins, & Soares, 2012; Bernanke, 1990; Bernanke & Blinder, 1992; Estrella & Hardouvelis, 1991; Hamilton & Kim, 2002; Harvey, 1988; Mody & Taylor, 2003).[1] This body of literature has found that the yield curve has substantial predictive power. In particular, the slope of the yield curve has been identified as one of the most informative leading indicators for U.S. real economic activity (see, e.g., Stock & Watson, 2003). The relationship between the slope of the yield curve and future real activity is positive; i.e., a high slope precedes periods of strong growth, while a low slope indicates weak activity in the future. Other elements of the yield curve also contain information about subsequent real activity; for instance, Ang, Piazzesi, and Wei (2006) find that the short-term rate predicts U.S. real GDP growth.

Today, there is a considerable amount of evidence that the predictive power of the yield curve fluctuates over time

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[1] For a comprehensive survey of the literature, see Wheelock and Wohar (2009).

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(Estrella, Rodrigues, & Schich, 2003; Gertler & Lown, 1999; Mody & Taylor, 2003; Rossi & Sekhposyan, 2011; Stock & Watson, 2003). For example, many studies have found that the ability of the slope of the yield curve to predict U.S. real growth has largely disappeared since the mid-1980s. There is no universally agreed-upon explanation as to why this variation exists. However, most researchers point out that monetary policy and the yield curve are closely connected. For instance, Giacomini and Rossi (2006) argue that the changes in the predictive content of the yield curve can be linked to changes in the monetary policy behavior of the Fed. They show that the reliability of the yield curve as a predictor of output growth changed during the Burns-Miller and Volker monetary policy regimes.

In a sequence of papers, Bordo and Haubrich (2004, 2008a, b) suggest that the credibility of the monetary policy is the key determinant of the predictive power of the yield curve. Using a very long data sample from 1875 to 1997, they find that the slope of the yield curve tends to forecast output growth particularly well when the credibility of the monetary policy is low, i.e., when inflation is highly persistent. However, using the same data sample as Bordo and Haubrich (2004, 2008a, b) but more flexible methods, Benati and Goodhart (2008) confirm that, while the predictive power of the slope of the yield curve fluctuates over time, these changes do not match the changes in inflation persistence closely. In a recent paper, Hännikäinen (2015) showed that the real-time predictive content of the slope of the yield curve for U.S. industrial production growth has changed since the beginning of the zero lower bound (ZLB) and unconventional monetary policy period in December 2008. The beginning of the ZLB/unconventional monetary policy era represents a fundamental change in U.S. monetary policy. Thus, the results reported by Hännikäinen (2015) provide evidence to support the view that changes in the monetary policy regime affect the predictive ability of the yield curve.

There are also various other explanations for the apparent changes in the predictive power. For example, D'Agostino, Giannone, and Surico (2006) argue that the reduced informativeness of the yield curve in recent years is due to the increased stability of U.S. output growth and other key macroeconomic variables since the mid-1980s. When the macroeconomic variable to be forecast is not volatile, simple benchmark forecasting models, like low order autoregressive (AR) models, produce accurate forecasts. In such cases, it is very challenging to find leading indicators that contain marginal predictive power over and above that already encoded in the lagged values of the series to be forecast.

This paper examines the predictive power of the entire yield curve for U.S. industrial production growth. We extract the level, slope and curvature of the yield curve using the dynamic Nelson-Siegel model developed by Diebold and Li (2006). Unlike the vast majority of previous studies, we explore the out-of-sample predictive content of each of the three components of the yield curve in a data-rich environment using factor models.[2] The standard practice in the extant literature is to analyze the predictive power of the yield curve over and above that in the past values of output growth by using AR models. There are two reasons why we prefer factor models to AR models. First, factor models provide a parsimonious way to study the crucial issue of whether the components of the yield curve contain predictive information which is not already encoded in other macroeconomic variables. Second, factor models produce substantially more accurate industrial production forecasts than simple AR models (see e.g. Bernanke & Boivin, 2003; Clements, 2016; Stock & Watson, 2002a, b). The predictive content of leading indicators often fluctuates over time (see e.g. Rossi, 2013; Stock & Watson, 2003). For this reason, we pay attention to time variations in the predictive power over time. The previous literature has examined whether the predictive power of the slope remains stable over time, but we are the first to analyze whether the predictive abilities of the three individual yield curve elements vary over time.

Finally, and most importantly, we investigate whether the forecasting abilities of any of these components of the yield curve can be linked to economic conditions. Following the recent papers by Dotsey, Fujita, and Stark (2015), Hännikäinen (2015), and Ng and Wright (2013), we employ the test of equal conditional predictive ability that was developed by Giacomini and White (2006). The novelty of the Giacomini and White (2006) test is that it allows forecast accuracy tests that are conditional on a set of possible explanatory variables. Thus, for instance, it enables us to analyze how inflation persistence, output volatility, recessions and monetary policy regimes affect the reliability of the yield curve as a predictor of real activity. To the best of our knowledge, no other paper has linked the predictive power of the yield curve to economic conditions in a systematic way. Our paper is designed to bridge this gap. This is an important contribution. The results of the conditional predictive ability tests reveal when the elements of the yield curve are informative about future output growth, and also shed some light on why the different elements of the yield curve have predictive power.

Our main findings can be summarized as follows. First, the slope of the yield curve is a better predictor of real

2 In related studies in the macro-finance literature, Diebold, Rudebusch, and Aruoba (2006) and Moench (2012) analyze the dynamic interactions between the macroeconomy and the yield curve. Diebold et al. (2006) find evidence in favor of a bidirectional link between the macroeconomy and the yield curve. Moench (2012) studies the impulse responses of macroeconomic variables to surprise changes in the three yield curve components, and shows that the curvature factor contains information about both the future evolution of the yield curve and the macroeconomy. However, Diebold et al. (2006) and Moench (2012) do not consider out-of-sample forecasting. This paper evaluates the predictive power of the components of the yield curve in an out-of-sample forecasting exercise. It is well-known that parsimonious models typically produce better out-of-sample forecasts than more parametrized models. The macro-finance models of Diebold et al. (2006) and Moench (2012) contain more parameters than the factor model that is often used in the forecasting literature (see Section 2 below). Both for this reason and for the sake of simplicity, our forecasting exercise does not consider macro-finance models.