Available online at www.sciencedirect.com
SCIENCE DIRECT®
Journal of Econometrics 131 (2006) 359–403
JOURNAL OF Econometrics
www.elsevier.com/locate/econbase

What does the yield curve tell us about GDP growth?

Andrew Ang[a,b,*], Monika Piazzesi[b,c], Min Wei[d]

[a]*Columbia Business School, Columbia University, 3022 Broadway, 805 Uris Hall, New York, NY 10027, USA*
[b]*NBER, USA*
[c]*University of Chicago, Graduate School of Business, 1101 East 58th St, Chicago, IL 60637, USA*
[d]*Board of Governors of the Federal Reserve, Division of Monetary Affairs, Washington, DC 20551, USA*

Available online 16 March 2005

Abstract

A lot, including a few things you may not expect. Previous studies find that the term spread forecasts GDP but these regressions are unconstrained and do not model regressor endogeneity. We build a dynamic model for GDP growth and yields that completely characterizes expectations of GDP. The model does not permit arbitrage. Contrary to previous findings, we predict that the short rate has more predictive power than any term spread. We confirm this finding by forecasting GDP out-of-sample. The model also recommends the use of lagged GDP and the longest maturity yield to measure slope. Greater efficiency enables the yield-curve model to produce superior out-of-sample GDP forecasts than unconstrained OLS regressions at all horizons.

JEL classification: E43; E44; E47

Keywords: Term structure; Forecasting; Financial markets and the macroeconomy; Monetary policy

*Corresponding author. Columbia Business School, Columbia University, 3022 Broadway, 805 Uris Hall, New York, NY 10027, USA. Tel.: +1 212 854 9154; fax: +1 212 662 8474.
E-mail addresses: aa610@columbia.edu (A. Ang), monika.piazzesi@gsb.uchicago.edu (M. Piazzesi), min.wei@frb.gov (M. Wei).
URL: http://www.columbia.edu/~aa610, http://gsbwww.uchicago.edu/fac/monika.piazzesi/research/, http://www.columbia.edu/~mw427.

0304-4076/$ - see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.jeconom.2005.01.032

1. Introduction

The behavior of the yield curve changes across the business cycle. In recessions, premia on long-term bonds tend to be high and yields on short bonds tend to be low. Recessions, therefore, have upward sloping yield curves. Premia on long bonds are countercyclical because investors do not like to take on risk in bad times. In contrast, yields on short bonds tend to be procyclical because the Federal Reserve lowers short yields in recessions in an effort to stimulate economic activity. For example, for every 2 percentage point decline in GDP growth, the Fed should lower the nominal yield by 1 percentage point according to the Taylor (1993) rule.

Inevitably, recessions are followed by expansions. During recessions, upward sloping yield curves not only indicate bad times today, but better times tomorrow. Guided from this intuition, many papers predict GDP growth in OLS regressions with the slope of the yield curve, usually measured as the difference between the longest yield in the dataset and the shortest maturity yield.[1] The higher the slope or term spread, the larger GDP growth is expected to be in the future. Related work by Fama (1990) and Mishkin (1990a, 1990b) shows that the same measure of slope predicts real rates. The slope is also successful at predicting recessions with discrete choice models, where a recession is coded as a one and other times are coded as zeros (see Estrella and Hardouvelis, 1991; Estrella and Mishkin, 1998). The term spread is also an important variable in the construction of Stock and Watson (1989)'s leading business cycle indicator index. Despite some evidence that parameter instability may weaken the performance of the yield curve in the future (see comments by Stock and Watson, 2001), it has been amazingly successful in these applications so far. For example, every recession after the mid-1960s was predicted by a negative slope—an inverted yield curve—within 6 quarters of the impending recession. Moreover, there has been only one "false positive" (an instance of an inverted yield curve that was not followed by a recession) during this time period.

Hence, the yield curve tells us something about future economic activity. We argue there is much more to learn from the yield curve when we explicitly model its joint dynamics with GDP growth. Our dynamic model also rules out arbitrage possibilities between bonds of different maturities and thus imposes more structure than the unrestricted OLS regression framework previously used in the literature. While OLS regressions show that the slope has predictive power for GDP, it is only an incomplete picture of the yield curve and GDP. For example, we would expect that the entire yield curve, not just the arbitrary maturity used in the construction of the term spread, would have predictive power. Using information across the whole yield curve, rather than just the long maturity segment, may lead to more efficient

[1]See, among others, Harvey (1989, 1993), Laurent (1988), Stock and Watson (1989), Chen (1991), Estrella and Hardouvelis (1991), Estrella and Mishkin (1998), Dotsey (1998), Hamilton and Kim (2002), and Moody and Taylor (2003), who regress GDP growth on term spreads on U.S. data. Jorion and Mishkin (1991), Harvey (1991), Estrella and Mishkin (1997), Plosser and Rouwenhorst (1994), Bernard and Gerlach (1998), among others, run a predictive GDP regression on international data. Other traditional GDP forecasting variables include Stock and Watson (1989)'s leading business cycle index and the consumption–output ratio in Cochrane (1994).