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Macroeconomic releases and the interest rate term structure ☆

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ABSTRACT

We extract two systematic economic factors from a wide array of noisy and sparsely observed macroeconomic releases, and link the dynamics and market prices of the two factors to the interest rate term structure. The two factors predict 77.9–82.1% of the daily variation in LIBOR and swap rates from one month to 10 years. Shocks on inflation-related releases have large, positive impacts on interest rates of all maturities, leading to parallel shifts of the yield curve, but shocks on output-related releases have larger impacts on the short rate than on the long rate, thus generating a slope effect.

1. Introduction

This paper studies the fundamental relation between numerous macroeconomic releases on the one hand and the term structure of interest rates on the other. Macroeconomic fundamentals influence the bond market, but the direction and magnitude of that influence are notoriously difficult to quantify. Researchers who have tried to link macroeconomic fundamentals to interest rate movements are faced with the difficult issues of how to measure the fundamentals and how to incorporate the fundamentals into models of the interest rate term structure.

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Releases of macroeconomic indicators happen almost every day. Each release carries some information on a certain aspect of the economy, but it also contains a large amount of noise. To capture accurately the systematic state of the economy, it is essential to look at a large number of macroeconomic indicators; yet, incorporating all the indicators as state variables into a term structure model generates tractability, stability, and identification issues. Besides, most macroeconomic indicators are released on different days and at different frequencies, making it difficult to match them with the much more frequently and regularly observed interest rate data.

To resolve those issues, this paper uses a dynamic factor model to extract two systematic economic factors from numerous noisy and sparsely observed macroeconomic releases. Furthermore, based on the specifications of the monetary policy rule, the economic factor dynamics, and the market prices of economic risks, the paper uses no-arbitrage arguments to link the entire term structure of interest rates to the two systematic economic factors.

Estimation shows that the two systematic factors extracted from the macroeconomic releases predict 77.9–82.1% of the daily variation in LIBOR and swap rates across maturities from one month to 10 years. Shocks on inflation-related variables—such as CPI, core CPI, PPI, core PPI, PCE deflator, core PCE deflator, and GDP deflator—all produce large, positive impacts on interest rates. Their impacts are relatively uniform across different maturities, leading to parallel shifts of the yield curve. By contrast, shocks on output and employment variables—such as real GDP growth, industrial production, nonfarm payrolls, durable goods orders, capacity utilization, business inventories, consumer spending, and personal income—have larger impacts on the short end than on the long end of the yield curve, thus generating a slope effect on the term structure.

By extracting the two systematic factors from the economic releases first and then analyzing their impacts on the interest rate term structure, the procedure forces a one-way information flow: from the macroeconomic releases to the interest rates. The high predictive variation estimates highlight the important information content in the economic releases about interest rate movements. Nevertheless, in reality, the observed interest rate term structure also contains important information about the state of the economy. Therefore, the interest rate data can be used jointly with the macroeconomic releases to better identify the macroeconomic factors.

When the dynamic factors are re-estimated with this joint identification procedure, the factors predict a much higher percentage of variation in both the interest rates (98–99.9%) and the macroeconomic releases (95.4–98.5%). The increased predictive variation highlights the tight linkage and the two-way information flow between the financial market and the fundamental state of the economy. Adding the interest rate data to extract the systematic factors helps identify the linkages more precisely by better separating the signal from the noise and by better distinguishing actual surprises from the information that has always been anticipated by the financial market.

Our work is related to a series of earlier studies that use regression analysis to investigate the impacts of macroeconomic releases on financial security prices such as bond prices and exchange rates.[1] By using dynamic factors to suppress noise and to reduce dimensions in a large array of macroeconomic releases, our approach significantly alleviates the error-in-variable problem of using raw economic numbers and avoids the multicollinearity issue from incorporating highly correlated variables in one regression. Furthermore, our state-space specification and filtering approach naturally separates each economic release into a surprise component, which the financial market responds to, and a predictable component, which the financial market has already taken into account. Estimation shows that a predominant proportion of the economic release variations are predicted by the financial market. Thus, using the raw economic numbers would dramatically exaggerate the magnitude of the economic surprises and accordingly generate much weaker estimates on their impacts.

The dynamic factor approach has been widely explored in another strand of literature to identify the systematic state of the economy from a large array of economic series.[2] What this paper adds on top of this literature is the incorporation of a no-arbitrage dynamic term structure model. Through this term structure model, the two economic factors provide an internally consistent linkage between the large array of economic releases on the one hand and the term structure of interest rates on the other. The no-arbitrage constraints not only enhance the identification of the relation but also offer insights on how the market prices different sources of economic risks.

Recently, several studies also apply no-arbitrage constraints to the relation between macroeconomic variables and the term structure of interest rates. For examples, Ang and Piazzesi (2003) construct a five-factor term structure model with three latent statistical factors and two macroeconomic factors, which are principal components of a small number of selected economic indicators. Diebold et al. (2006) build a six-factor model with three latent factors and three observable factors, which are the federal funds rate and two macroeconomic indicators. Ang et al. (2004) construct a three-factor model with two latent factors and one macroeconomic indicator as the third factor. These studies typically rely on the latent statistical factors to explain the bulk of the term structure movement. For the sake of tractability, they supplement the latent factors with only a few macroeconomic releases or principal components, the estimated impacts of which on the term structure are marginal compared to those of the latent factors. The key advantage of our approach is to incorporate information from a wide array of macroeconomic indicators into the dynamic term structure model through the systematic

[1] Examples include Fleming and Remolona (1999), Balduzzi et al. (2001), Andersen et al. (2003), and Faust et al. (2007).

[2] Examples include Engle and Watson (1981), Stock and Watson (1989, 1991), Quah and Sargent (1993), Bernanke and Boivin (2003), Bernanke et al. (2005), Crone and Clayton-Matthews (2005), Favero et al. (2005), and Giannone et al. (2005).