Dissecting the Financial Cycle with Dynamic Factor Models

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Abstract

The analysis of the financial cycle and its interaction with the macroeconomy has become a central issue for the design of macroprudential policy since the 2007-08 financial crisis. So far, the great majority of studies (see e.g., Claessens et al. (2011, 2012), Drehmann et al. (2012) and Strohsal et al. (2015)) has assumed that the financial cycle can be parsimoniously represented by a small set of financial indicators related to the credit, housing and equity markets chosen in an ad hoc manner. Alternatively, this paper proposes the construction of financial cycle measures based on a large data set of macroeconomic and financial variables for the US. More specifically, we estimate three synthetic financial cycle components that account for the majority of the variation in the data set using a dynamic factor model. We investigate whether these financial cycle components have significant predictive power for economic activity, inflation and short-term interest rates by means of Granger causality tests in a factor-augmented VAR set-up. Further, we analyze if the synthetic financial cycle components have significant forecasting power for the prediction of economic recessions using dynamic probit models.

Keywords: Financial cycle, dynamic factor model, Granger causality, recession forecasting, dynamic probit models

JEL Classification System: C35, C38, E32, E44, E47

Introduction

- Financial cycle (FC) has played only a minor role in mainstream macroeconomics so far.
- It is vaguely defined as the underlying ebbing and flowing of **general risk sentiment** that is embodied in the positive correlation of **many systemic risk indicators**.

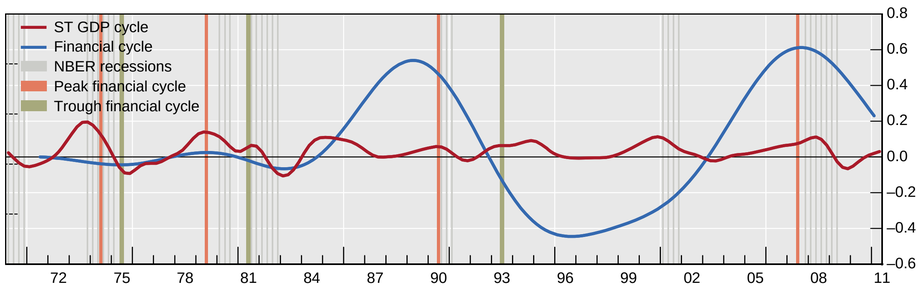

Figure 1: The financial and business cycles in the US (Drehmann et al., 2012).

⇒ **Central question:** Which variables represent the financial cycle?

Main Objectives

1. Estimation and interpretation of synthetic factors representing the FC.
2. Test for Granger causality to GDP growth, inflation and short-term interest rate.
3. Estimation of recession probabilities to assess early-warning indicator properties.

Econometric Methodology

Observation Equation

$$\underset{(N\times 1)}{y_t} = \underset{(N\times p)}{Z}\,\underset{(p\times 1)}{x_t} + \underset{(N\times 1)}{\nu_t}, \tag{1}$$

State Equation

$$\underset{(p\times 1)}{x_t} = \underset{(p\times p)}{\Phi}\,\underset{(p\times 1)}{x_{t-1}} + \underset{(p\times 1)}{w_t}\ . \tag{2}$$

⇒ Estimation via the EM-algorithm including the Kalman filter and smoother.

Empirical Application

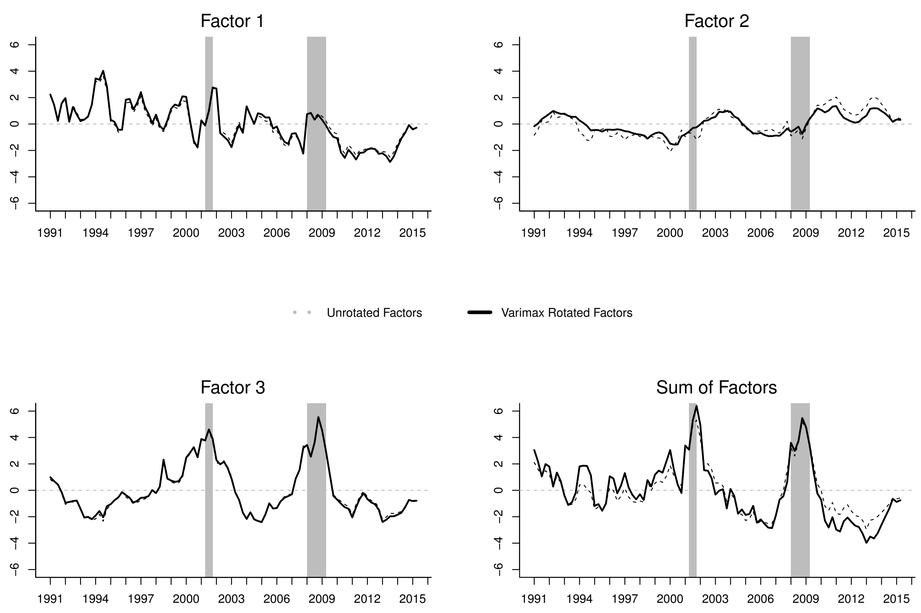

Figure 2: Estimated factors before and after Varimax rotation.

Factor Interpretation

- **Factor One** = Effect of the business cycle on the term structure of interest rates.
- **Factor Two** = Financial accelerator dynamics.
- **Factor Three** = *Excessive* financial cycle dynamics resulting from over-speculation or the inherent uncertainty of financial markets.

Granger Causality Analysis

We set up the following FAVAR(1) and test for Granger-causality:

$$y_t = \mathbf{A}_1 y_{t-1} + u_t, \tag{3}$$

with $y_t = \{\text{DF1}_t, \text{DF2}_t, \text{DF3}_t, \text{GDP Growth}_t, \text{Inflation}_t, \text{ST-Interest Rates}_t\}$.

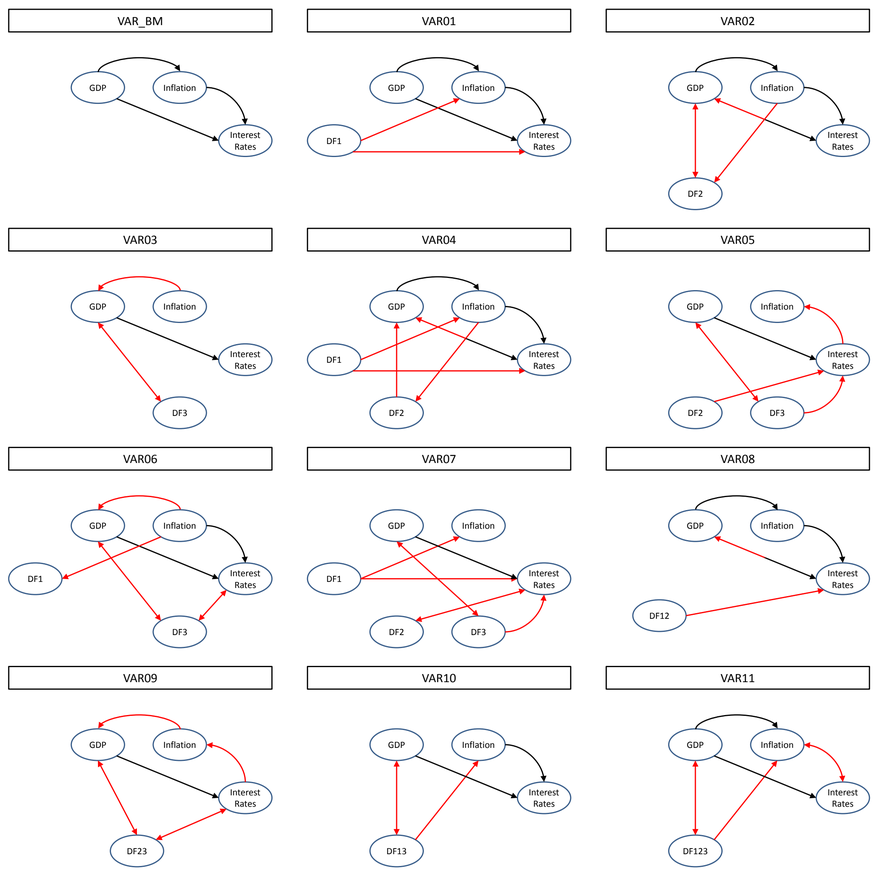

Figure 3: Summary of Granger-Causality Tests. Black arrows denote the causal relations from the benchmark model and red arrows changes due to the inclusion of factors..

Recession Prediction

Along the lines of Dueker (1997) and Estrella and Mishkin (1998) we use a dynamic probit model with the linear model equation

$$\psi_t = c + \beta_1 R_{t-h-r} + \sum_{j=h}^{q} \beta_2 X_{t-j} + \varepsilon_t, \tag{4}$$

where the probability of a recession in time t is given by

$$\text{Prob}(R_t = 1) = \Phi(\psi_t). \tag{5}$$

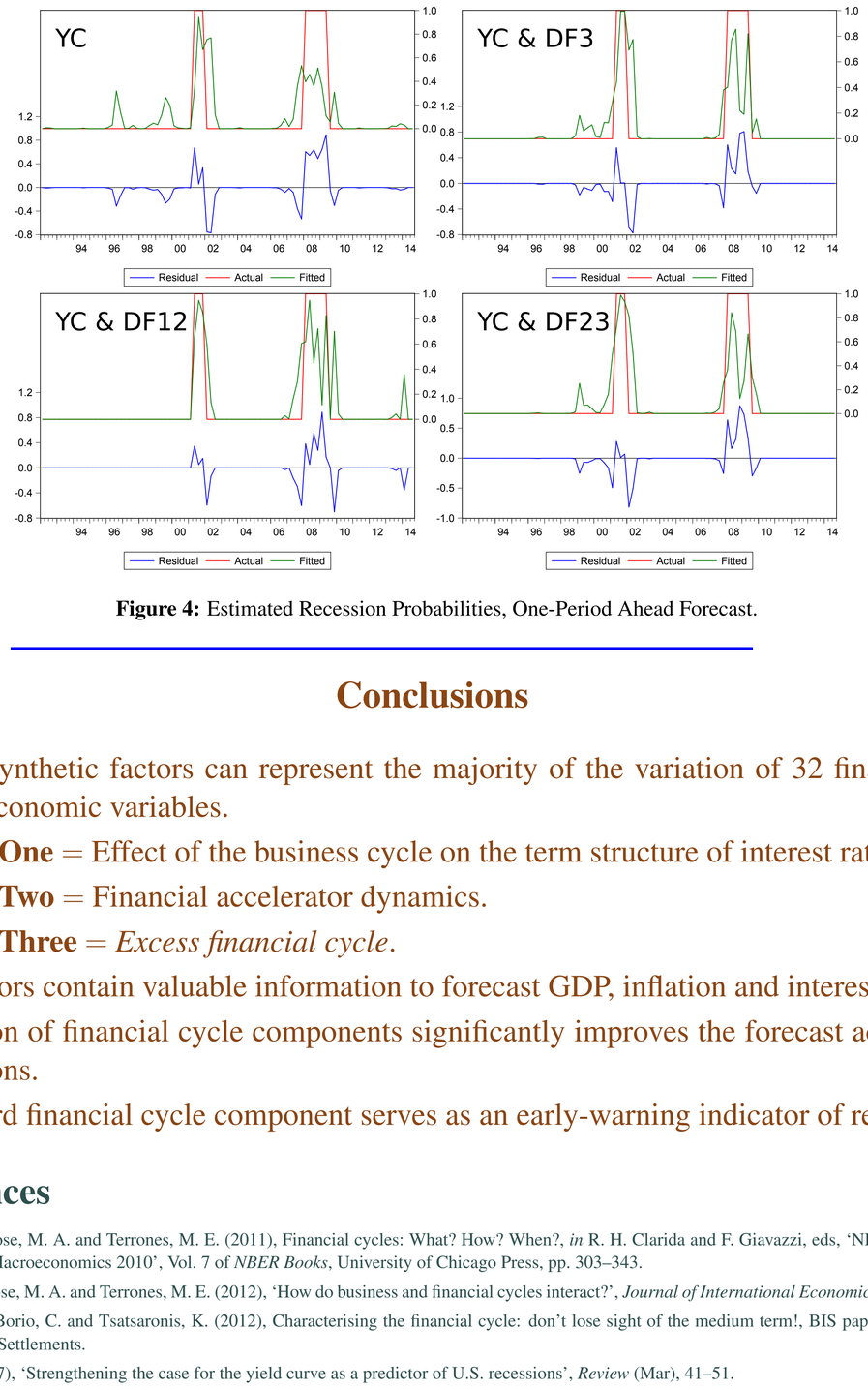

Figure 4: Estimated Recession Probabilities, One-Period Ahead Forecast.

Conclusions

- Three synthetic factors can represent the majority of the variation of 32 financial and macroeconomic variables.
- **Factor One** = Effect of the business cycle on the term structure of interest rates.
- **Factor Two** = Financial accelerator dynamics.
- **Factor Three** = *Excess financial cycle*.
- All factors contain valuable information to forecast GDP, inflation and interest rates.
- Inclusion of financial cycle components significantly improves the forecast accuracy of recessions.
- The third financial cycle component serves as an early-warning indicator of recessions.

References

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