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Forecasting dynamically asymmetric fluctuations of the U.S. business cycle

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ABSTRACT

The generalized smooth transition autoregression (GSTAR) parametrizes the joint asymmetry in the duration and length of cycles in macroeconomic time series by using particular generalizations of the logistic function. The symmetric smooth transition and linear autoregressions are nested in the GSTAR. A test for the null hypothesis of dynamic symmetry is presented. Two case studies indicate that dynamic asymmetry is a key feature of the U.S. economy. The GSTAR model beats its competitors for point forecasting, but this superiority becomes less evident for density forecasting and in uncertain forecasting environments.

1. Introduction

The U.S. business cycle is characterized by asymmetric fluctuations, as is confirmed by a consolidated body of literature (see Milas, Rothman, van Dijk, & Wildasin, 2006, and references therein). The problem of defining asymmetry has been an important issue for many years. Sichel (1993) classifies two types of asymmetry: (i) the "steepness" that arises when the contractions in the levels are steeper than the expansions, corresponding to negative skewness in the first differences of the sample (or, from a graphical perspective, to asymmetry in the level axis); and (ii) the "deepness" that occurs when the series undergoes contraction at an accelerating pace until a given minimum, after which it starts to recover with quickly decreasing acceleration until it smoothly recovers the peak, corresponding to negative skewness in the levels (or asymmetry in the time axis). Dynamic asymmetry occurs when these two definitions of asymmetry are combined. McQueen and Thorley (1993) use the term "sharpness" to refer to the probability that the transitions to and from the two regimes (expansion and contraction) are not identical. As a logical implication of these definitions, a dynamically asymmetric process can be identified by asymmetry in either the conditional mean or the conditional density.

The primary focus of this paper is on out-of-sample forecasting for the U.S. index of industrial production (IP) and the U.S. unemployment rate (UR).[1] These series are displayed in Fig. 1, and a simple application of Sichel's test for deepness and steepness is reported in the first panel of Table 1. All of the series under consideration present at least some type of asymmetry. (i) In IP, the type of asymmetry varies, as the quarterly and monthly growth rates amplify the steepness (the lowest p-values are 0.07 for the sample at a quarterly frequency and 0.06 for the sample at a monthly frequency) with respect to the deepness (0.14 and 0.09, respectively) that prevails in the series of yearly growth rates (0.07 for the quarterly sample and 0.05 for the monthly sample). (ii) The UR is both steep and deep, regardless of the transformation or frequency.

A good forecasting model for the U.S. business cycle might incorporate all of the possible types of dynamic asymmetry that have been mentioned. In connection with this aim, which is common in this literature — particularly the first generation, such as the papers by Neftçi (1984), De Long and Summers (1984), and Rothman (1991) — studies have frequently used a piecewise linear autoregression

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[1] All series, at both the quarterly and monthly frequencies, are in real time and can be downloaded from the OECD's main economic indicators database.

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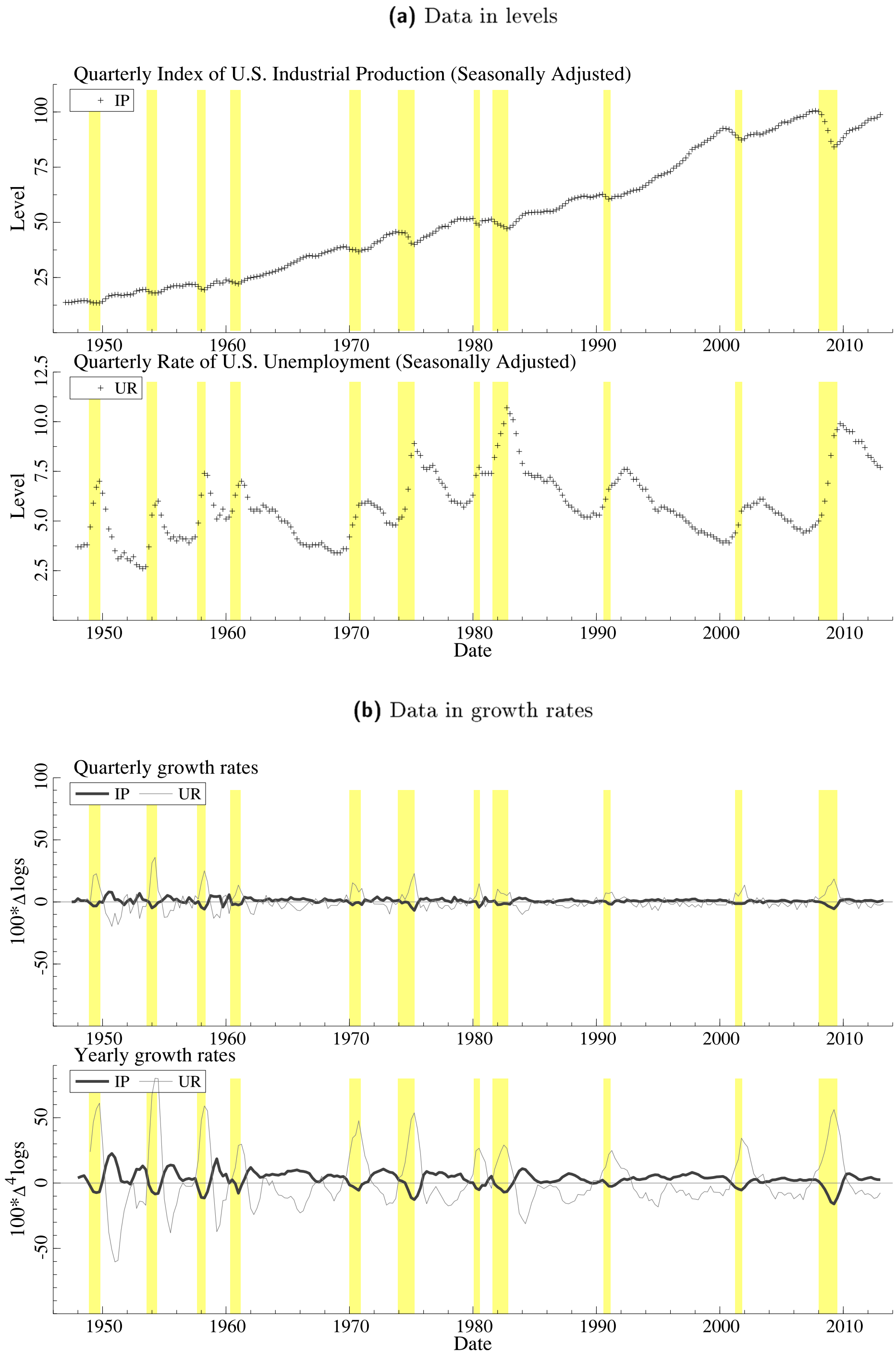

Fig. 1. The U.S. quarterly data. NOTE: This figure plots the quarterly data from the U.S. index of industrial production (IP) and unemployment (UR) that are used to illustrate the performances of the GSTAR model in Section 4. In particular, panel (a) plots the series in levels, while panel (b) plots the same series in quarterly (upper graph) and yearly (lower graph) growth rates, respectively. The yellow bands are the NBER recession dates.

with a Markov-switching mean or variance (MSAR) and a pre-specified number of unobserved states (usually two). This approach has the benefits of easy implementation and close connections with algorithmic rules for dating; see Harding and Pagan (2006) for recent developments. The current research adopts the alternative strategy of treating the process as a continuum of observable states that oscillate between two extremes, and fitting a general, flexible, nonlinear function over the observables using the smooth transition autoregressions (STARs) introduced by Haggan and Ozaki (1981) and Chan and Tong (1986) and developed by Teräsvirta (1994). These piecewise linear models are