Real time estimates of GDP growth, based on two-regime models

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Abstract

This paper builds on De Groot and Franses (2005) (Econometric Institute Report 2005-01). It modifies the EICIE, the Econometric Institute Current Indicator of the Economy, by allowing for two regimes. These regimes are marked by positive or negative annual growth in the staffing services data. Real time estimates of GDP growth for 2005 quarters 1 and 2, using this non-linear model, have been published in a Dutch language article in the ESB of April 22 2005 and of July 15 2005.

Keywords: Current indicator, staffing, GDP

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1 Introduction

In this paper we outline a modification of the EICIE indicator, which was published in De Groot and Franses (2005). The explanatory variable concerns temporary employment, and the data are provided by Randstad Staffing Services. The variable of focal interest is real GDP in terms of annual growth rates per quarter. Hence, we consider the percentage growth in real GDP in the current quarter relative to the same quarter in the previous year.

In Section 2, we outline why we believe that using a two-regime model for real GDP could improve the EICIE indicator. In Section 3, we summarize the estimation results for the linear models in De Groot and Franses (2005). In Section 4, we present the non-linear two-regime models that link real GDP with staffing data. Section 5 describes the algorithm to estimate GDP growth in 2005 quarters 1 and 2.

2 Why a model that has regime switches?

One of the authors of De Groot and Franses (2005) gave a presentation of the EICIE indicator on January 17 2005 in at the premises of the Central Bureau of Statistics in Voorburg. The audience contained academic and practical researchers with an interest in the Dutch business cycle. They were affiliated for example with the Central Bureau of Statistics, The Central Planning Bureau, the Dutch Central Bank, Rabobank, VNO/NCW and the University of Groningen, among others.

A suggestion that was given by one of the participants was that perhaps models with two regimes could be better than the one-regime linear model, in terms of fit and of forecasting. The idea was that when staffing services grow, this might exercise an effect on the economy that could differ from when staffing services would fall. A graph of a zero-one indicator for negative growth (NG) appears in Figure 1, and it is clear that long periods of either positive or negative growth can be discerned.

Periods of positive and negative growth of temporary labor alternate over time. In periods of negative growth temporary labor corrects itself faster towards the long term

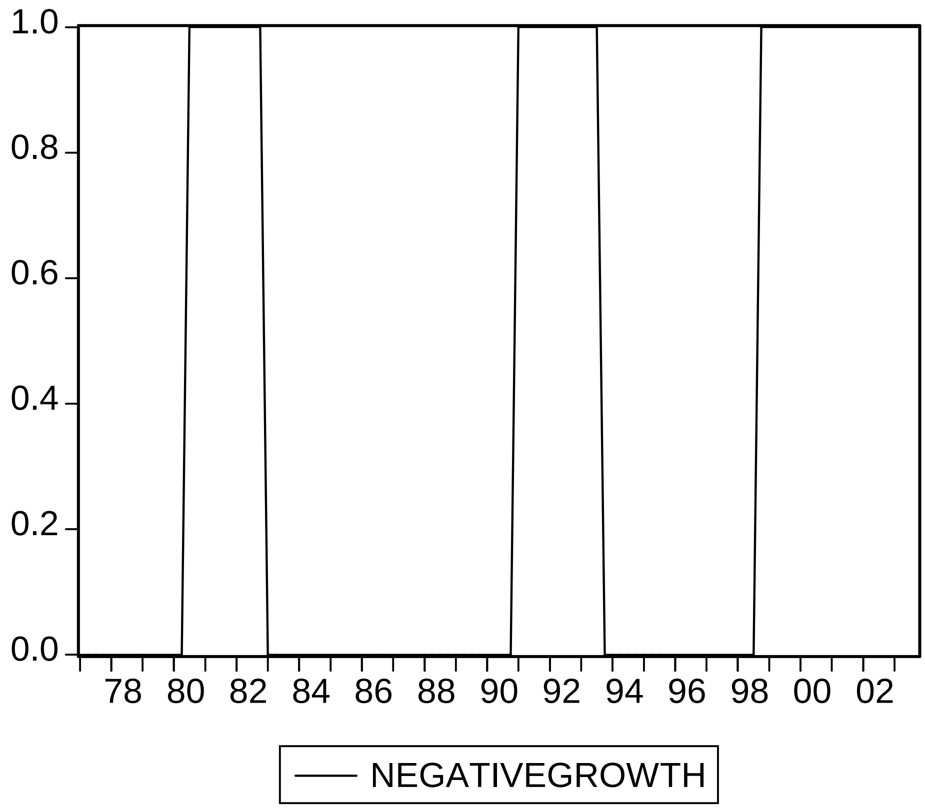

Figure 1: The NG variable takes a value 1 when annual growth (per quarter) in the staffing services data is negative, and it takes a value 0 if it is positive. Negative growth can be seen in the beginning of the 80s, 90s and in the last few years.

equilibrium link with GDP. During periods of positive growth this correction towards the long term equilibrium level is slower as compared with periods with negative growth. After a period with negative growth, when the economy starts showing early growth, first temporary labor will regain its upward trend. Employment will grow, however this increase in employment does not translate itself into a decrease of unemployment. First, the hidden unemployment will start to be productive again. Then, if economic growth has strengthened and thought to be sustainable, unemployment will decrease as by then more fixed labor contracts will be offered. Temporary labor will grow quickly in such an early upsurge phase. It will slow down on its growth path after a couple of years, when the natural boundary or ceiling is reached of the amount of temporary laborers at work. During an economic crisis a correction follows. By then, less temporary laborers will be employed, while the same being true for fixed laborers. After the economic trough has been reached, the cycle repeats itself.

As temporary labor behaves differently in an upward cycle as compared to a downward cycle, it might be justified to calibrate this behavior into two separate models. Therefore, we expand our EICIE models with two non-linear models.

3 Linear models

We consider the natural log of quarterly real GDP ($\log GDP_t$) and the natural log of Randstad staffing services ($\log S_t$), for the sample 1977.1 through 2003.4. Using tests for seasonal unit roots and for cointegration, in De Groot and Franses (2005) we arrive at the first linear model for $\log GDP_t$. This model fits annual growth rates of the variables, and it includes an error correction term. It reads as

$$\begin{aligned}\log GDP_t - \log GDP_{t-4} = \underset{(0.111)}{0.308} - \underset{(0.013)}{0.039} (\log GDP_{t-4} - \underset{(0.084)}{0.339} \log S_{t-4}) \\ + \underset{(0.006)}{0.023} (\log S_t - \log S_{t-4}) \\ + \underset{(0.087)}{0.465} (\log GDP_{t-1} - \log GDP_{t-5}) + \hat{\varepsilon}_t - \underset{(0.097)}{0.466} \hat{\varepsilon}_{t-4}, \quad (1)\end{aligned}$$

with estimated standard errors in parentheses. Using a forecast of $\log S_t$ for one quarter ahead, we use this model to make a forecast for $\log GDP_{t+1} - \log GDP_{t-3}$. In this paper we call this forecast LF_1, the first linear forecast.

Along similar lines, we make forecasts for $\log GDP_t$ using a model for the first differences, or quarter-to-quarter growth rates, that is,

$$
\begin{aligned}
\log GDP_t - \log GDP_{t-1} = {} & \underset{(0.152)}{0.559} - \underset{(0.012)}{0.052}\, Q_{1,t} - \underset{(0.011)}{0.037}\, Q_{3,t} \\
& - \underset{(0.017)}{0.066}\,(\log GDP_{t-1} - \underset{(0.036)}{0.316} \log S_{t-1}) \\
& + \underset{(0.016)}{0.046}\,(\log S_t - \log S_{t-1}) \\
& + \underset{(0.018)}{0.060}\,(\log S_{t-2} - \log S_{t-3}) \\
& - \underset{(0.024)}{0.061}\,(\log S_{t-5} - \log S_{t-6}) \\
& - \underset{(0.085)}{0.545}\,(\log GDP_{t-1} - \log GDP_{t-2}) \\
& - \underset{(0.085)}{0.576}\,(\log GDP_{t-2} - \log GDP_{t-3}) \\
& - \underset{(0.087)}{0.403}\,(\log GDP_{t-3} - \log GDP_{t-4}) + \hat{\varepsilon}_t \qquad (2)
\end{aligned}
$$

where $Q_{1,t}$ and $Q_{3,t}$ denote the seasonal dummies in quarters 1 and 3. Again, using a forecast of $\log S_t$ for one quarter ahead, we use this model to make a forecast for $\log GDP_{t+1}$, and with that for $\log GDP_{t+1} - \log GDP_{t-3}$, as that is the focal variable of interest. We call this forecast LF_2.

The EICIE indicator, as it was published in the ESB ("Economisch Statistische Berichten") of January 14 2005, was computed as $\frac{1}{2}LF_1 + \frac{1}{2}LF_2$.

4 The two-regime models

Again, we consider a model for $\log GDP_t - \log GDP_{t-4}$ and for $\log GDP_t - \log GDP_{t-1}$. It is known from the literature that long-run cointegration relationships will be retrieved even in case the parameters in the model switch over time, see Granger and Terasvirta (1993) and Franses and van Dijk (2000), among others.

We start with the linear models in the previous section. Next, we add the same variables on the right hand side when multiplied by NG_t. For example, the model for the annual growth rates in (1) has on the right-hand side an intercept, $\log GDP_{t-4} - 0.339 \log S_{t-4}$, $\log S_t - \log S_{t-4}$, and $\log GDP_{t-1} - \log GDP_{t-5}$ and a moving average term at lag 4. In the two-regime model, we add to these the variables NG_t, $NG_t(\log GDP_{t-4} - 0.339 \log S_{t-4})$, $NG_t(\log S_t - \log S_{t-4})$, and $NG_t(\log GDP_{t-1} - \log GDP_{t-5})$. Next, we delete insignificant parameters (at the 5% level). For the annual growth rates, this amounts to the model

$$\begin{aligned}
\log GDP_t - \log GDP_{t-4} = & \underset{(0.065)}{0.145} + \underset{(0.162)}{0.362} NG_t \\
& - \underset{(0.008)}{0.016} (\log GDP_{t-4} - 0.339 \log S_{t-4}) - \underset{(0.021)}{0.050} (NG_t(\log GDP_{t-4} - 0.339 \log S_{t-4})) \\
& - \underset{(0.019)}{0.037} (NG_t(\log S_t - \log S_{t-4})) \\
& + \underset{(0.102)}{0.265} (\log GDP_{t-1} - \log GDP_{t-5}) + \underset{(0.161)}{0.424} (NG_t(\log GDP_{t-1} - \log GDP_{t-5})) \\
& + \hat{\varepsilon}_t - \underset{(0.081)}{0.699} \hat{\varepsilon}_{t-4}, \qquad (3)
\end{aligned}$$

with standard errors in parentheses. An $F-$test for the joint significance of the variables multiplied by NG_t gets a value of 6.254, which is significant even at the 0.1% level. Using a forecast of $\log S_t$ for one quarter ahead, we use this model to make a forecast for $\log GDP_{t+1} - \log GDP_{t-3}$. We call this forecast NLF_1, the first non-linear model-based forecast.

Our second model is a switching model for the quarter-to-quarter growth rates. It extends (2) as

$$
\begin{aligned}
\log GDP_t - \log GDP_{t-1} = \; & \underset{(0.113)}{0.408} + \underset{(0.176)}{0.365} \; NG_t \\
& - \underset{(0.011)}{0.052} \; Q_{1,t} - \underset{(0.011)}{0.036} \; Q_{3,t} \\
& - \underset{(0.015)}{0.047} \; (\log GDP_{t-1} \underset{(0.036)}{-0.316} \log S_{t-1}) \\
& - \underset{(0.022)}{0.047} \; NG_t(\log GDP_{t-1} \underset{(0.036)}{-0.316} \log S_{t-1}) \\
& + \underset{(0.020)}{0.028} \; (\log S_t - \log S_{t-1}) \\
& + \underset{(0.021)}{0.047} \; (\log S_{t-2} - \log S_{t-3}) \\
& - \underset{(0.023)}{0.063} \; (\log S_{t-5} - \log S_{t-6}) \\
& - \underset{(0.083)}{0.572} \; (\log GDP_{t-1} - \log GDP_{t-2}) \\
& - \underset{(0.084)}{0.606} \; (\log GDP_{t-2} - \log GDP_{t-3}) \\
& - \underset{(0.085)}{0.423} \; (\log GDP_{t-3} - \log GDP_{t-4}) + \hat{\varepsilon}_t
\end{aligned} \tag{4}
$$

where $Q_{1,t}$ and $Q_{3,t}$ denote the usual seasonal dummies in quarters 1 and 3. This model also passes the diagnostic tests for residual autocorrelation. Clearly, again, the regime switches exercise most effect on the intercept and on the adjustment parameters. In negative growth periods for Randstad, the tendency to return to the equilibrium level between staffing and GDP is much stronger than it is on average (-0.047$-0.047 = -0.094$), as was predicted in Section 2. Again, using a forecast of $\log S_t$ for one quarter ahead, we use this model to make a forecast for $\log GDP_{t+1}$, and with that for $\log GDP_{t+1} - \log GDP_{t-3}$. This forecast is called NLF_2.

5 Algorithms

The EICIE indicator presented in January 14 2005 in the ESB was computed according to the schema

$$\frac{1}{2}LF_1 + \frac{1}{2}LF_2. \tag{5}$$

The indicator published in April 2005 incorporated the two non-linear models as

$$\frac{4}{10}LF_1 + \frac{4}{10}LF_2 + \frac{1}{10}NLF_1 + \frac{1}{10}NLF_2, \tag{6}$$

as we were not keen on giving too much weight to the two non-linear models, at least not immediately. In July 2005 we had more confidence in the non-linear models, and by then we computed the EICIE as

$$\frac{1}{4}LF_1 + \frac{1}{4}LF_2 + \frac{1}{4}NLF_1 + \frac{1}{4}NLF_2. \tag{7}$$

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