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The information content of capacity utilization for detrending total factor productivity

C. Planas [a,*], W. Roeger [b], A. Rossi [a]

[a] European Commission, Joint Research Centre, Belgium, Italy
[b] European Commission, Economic and Financial Affairs, Belgium, Belgium

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ABSTRACT

In the production function approach, an accurate output gap assessment requires a careful evaluation of the total factor productivity (TFP) cycle. We build a common cycle model that links TFP to capacity utilization and we show that, in almost all of the pre-enlargement EU countries, using information about capacity utilization reduces both the total estimation error and the revisions in real-time estimates of the concurrent TFP cycle compared to a univariate decomposition. We also argue that relaxing the constant drift hypothesis in favour of a non-linear specification helps to offset a general tendency to underestimate the TFP cycle in the last decade.

1. Introduction

Strong criticisms have been directed at the output gap concept due to measurement uncertainty. According to Orphanides (2003), the underestimation of the output gap was responsible for the US's high inflation rate in the 1970s. Nelson and Nikolov (2003) reach a similar conclusion for the UK. Both studies attribute the output gap mis-measurement to an undetected slowdown in productivity growth. In the production function framework, which is the standard method used in institutions such as the IMF, the OECD, and the European Commission (EC; see D'Auria et al., 2010), the output gap combines the cycles of labour and of TFP. In addition to secular growth, TFP contains a strong cyclical component that is indeed difficult to measure in real-time, also because of data revisions. For almost all pre-enlargement EU countries, we show that the information included in the capacity utilization (CU) indicator improves the accuracy of concurrent TFP cycle estimates in real-time and reduces the revisions that these estimates incur when new vintages become available.

The use of CU indicators to detrend TFP has already been suggested in the literature (see for instance Runstler, 2002; Proietti et al., 2007, and the European Commission, 2008, pp. 94–105), but so far without a model-based rationale being

* Corresponding author.
E-mail addresses: Christophe.Planas@jrc.ec.europa.eu (C. Planas), Werner.Roeger@ec.europa.eu (W. Roeger), Alessandro.Rossi@jrc.ec.europa.eu (A. Rossi).

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given. Our common cycle model for TFP and CU is instead derived from the Cobb–Douglas production function. In this framework, CU is especially relevant for estimating the cycle of TFP which is not adjusted for the utilization rate of capital and labour. Such TFP measures are conventional since factor specific utilization rates are unavailable and proxies inadequate: for instance, the average hours worked per employee is not a good measure of the under utilization of labour or labour hoarding in recessions. Moreover, the existing CU indicators only account for manufacturing, so the sectoral coverage of advanced economies is limited. We therefore construct an aggregate capacity utilization series on the basis of business survey indicators for manufacturing, construction, and services, that are extracted from the EC Business Surveys database (see European Commission, 2006, 2007). These business survey series are free of revisions.

Focusing on European countries, we show that the information contained in CU series enhances the real-time estimates of the TFP cycle compared to univariate decompositions. Both the total estimation error in concurrent estimates and the revisions that these estimates incur as new vintages become available shrink when CU data are included in the information set. In many cases, a further enhancement can be achieved by specifying a non-linear trend model that allows the drift to change at random points in time such as Hamilton's (1980) Markov-switching drift or the mixture innovation model discussed in Giordani and Kohn (2008). Thanks to their flexibility, these non-linear models fit well the growth slowdown that characterized most European TFP series over the last decade. They are thus helpful in contrasting a general propensity to overestimate the current TFP trend. This modelling approach therefore helps to alleviate the difficulty for policy makers in detecting trend productivity growth changes in real time, an issue that has been forcefully pointed out by Orphanides (2003).

Other approaches are of course possible to detrend TFP. In univariate settings, the Hodrick and Prescott (1997) low-pass filter and the Baxter and King (1999) band-pass filter for cycle extraction are perhaps the most popular. Recent developments have made multivariate filtering feasible, either in a non-parametric (see Valle e Azevedo, 2011) or in a model-based setting (see Valle e Azevedo et al., 2006, or also Creal et al., 2010). Although quite powerful, we exclude these methods since our aim is to improve the production function approach by inserting relevant information into the analysis. In this search for improvement we follow the guidelines given by the macroeconomic theory which underpins the production function framework. Our approach is similar to Kahn and Rich's (2007) who exploit neoclassical growth theory to refine the estimation of the productivity trend. Leaving aside the non-linear extension, the TFP-CU model which we end up with belongs to the wide class of multivariate structural time series models discussed for instance in Harvey et al. (2007).

The paper is organized as follows. In Section 2, we derive a common cycle model for TFP and CU from the production function. Section 3 discusses the construction of the CU series and presents the TFP vintages. The focus is put on twelve pre-enlargement EU countries, namely Belgium (BE), Denmark (DK), Germany (DE), Greece (EL), Spain (ES), France (FR), Ireland (IE), Italy (IT), Luxembourg (LU), the Netherlands (NL), Portugal (PT), and the UK. For each country, twelve real-time TFP vintages are available over the period 2000–2011. The database can be downloaded at *eemc.jrc.ec.europa.eu/eemcarchive/dataset/tfpvintages+cu.xls*. Each country is analysed separately. We reject the possibility of implementing a panel analysis due to the heterogeneity across countries: there are indeed country-specific features in the degree of labour hoarding as well as in business cycle characteristics (see Camacho et al., 2008).

Section 4 introduces the three trend models that we consider. These models are selected on the basis of the TFP vintages. The linear trend model assumes a persistent but stationary departure around a constant drift; this assumption is well-justified looking at the 2000 vintage. The two non-linear models assume instead a stationary departure around a drift that can either switch or change at random points in time. They are designed to reproduce the growth slowdown that is visible in the last TFP vintages.

Section 5 describes the econometric methodology. Inference is made using the Bayesian approach. This is most convenient when the likelihood function is intractable as in the two non-linear models. The prior distributions of the model parameters are given in the Appendix. We stress that this is a genuine real-time exercise since the TFP cycle is estimated recursively with the actual vintages.

The model is tested in Section 6. We check the null hypothesis of a coincident common cycle shared by TFP and CU against an alternative that puts together the following three possibilities: there is no cycle in CU, the TFP and CU cycles are idiosyncratic, and the cycle is common but in phase-opposition. The test is based on the marginal likelihood of the competing models and it is computed on all vintages. For IE the posterior evidence in favour of the null is weak, whereas for EL it is adverse for all vintages except the last one. The null hypothesis is confirmed for the other 10 countries.

For monitoring economic activity in real-time, a most important requirement is the reliability of the concurrent cycle estimates. We thus compare our bivariate estimates to those returned by a univariate decomposition under the three trend models. We show in Section 7 that in all countries the use of CU data reduces the total estimation error around the concurrent TFP cycle.

In Section 8, we concentrate on the revisions of the TFP cycle estimates. As Maravall (1986) states it, "revisions are of interest because $(\cdots)$ they represent measurement error in the preliminary estimate". We expect that if CU contains valuable information for decomposing TFP, its use should limit the revisions in concurrent cycle estimates. We find that CU data reduce the first-four revisions in the 2000–2010 TFP cycle estimates in all countries. This result is generally robust to the trend model specification. If the focus is put on the first revision only, then an improvement is obtained in all countries except EL and LU. For LU this negative outcome may be due to an insufficient coverage of the service sector, reflecting an absence of business surveys in this country. Section 9 concludes.