



Contents lists available at ScienceDirect

## International Journal of Forecasting

journal homepage: [www.elsevier.com/locate/ijforecast](http://www.elsevier.com/locate/ijforecast)

# Macroeconomic information, structural change, and the prediction of fiscal aggregates



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## ARTICLE INFO

### Keywords:

Bayesian VARs  
Forecasting  
Fiscal policy

## ABSTRACT

Previous research on the prediction of fiscal aggregates has shown evidence that simple autoregressive models often provide better forecasts of fiscal variables than multivariate specifications. We argue that the multivariate models considered by previous studies are small-scale, probably burdened by overparameterization, and not robust to structural changes. Bayesian Vector Autoregressions (BVARs), on the other hand, allow the information contained in a large data set to be summarized efficiently, and can also allow for time variation in both the coefficients and the volatilities. In this paper we explore the performance of BVARs with constant and drifting coefficients for forecasting key fiscal variables such as government revenues, expenditures, and interest payments on the outstanding debt. We focus on both point and density forecasting, as assessments of a country's fiscal stability and overall credit risk should typically be based on the specification of a whole probability distribution for the future state of the economy. Using data from the US and the largest European countries, we show that both the adoption of a large system and the introduction of time variation help in forecasting, with the former playing a relatively more important role in point forecasting, and the latter being more important for density forecasting.

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## 1. Introduction

The forecasting of future developments in fiscal variables has been of increasing importance in recent years, especially since the latest financial and Euro-area sovereign debt crisis. Fiscal positions affect the credit risk and the sovereign cost of borrowing. Following the latest developments in the international debt markets, it is apparent that markets take economic fundamentals into account seriously, and penalize countries heavily for fiscal

imbalances (von Hagen, Schuknecht, & Wolswijk, 2011). Arghyrou and Kontonikas (2012) claim that there has been a significant shift in market behavior since 2007, from a convergence-based pricing model to a fundamentals-based pricing model, meaning that forecasting fundamental macroeconomic variables has become more important.

A number of institutions produce forecasts of the macroeconomic variables that provide important feedback for their policies. For example, central banks need to identify the impact of fiscal policies on fundamentals and inflation in order to conduct monetary policy. OECD and IMF use forecasts to determine whether they need to intervene, and to provide recommendations to individual countries about the sustainability of their fiscal and monetary policies. National research institutes and rating agencies, which have to assess the default risk entailed in the debt

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<http://dx.doi.org/10.1016/j.ijforecast.2014.06.006>

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securities issued by governments, use forecasts to express their own views on the fiscal and monetary policies followed by national authorities.

Forecasts are also of increasing importance in the determination of budgetary goals. For instance, if high economic growth is forecasted, a government would expect a higher level of structural revenues, and can budget a higher discretionary expenditure. However, official growth forecasts for the Euro-area have been systematically over-optimistic (see Artis & Marcellino, 2001; Jonung & Larch, 2006; Strauch, Hallerberg, & von Hagen, 2004), while the evidence for the US is mixed (Leal, Pérez, Tujula, & Vidal, 2008). Optimistic forecasts from official authorities may have played an important role in the excessive deficits which have been observed in several Euro countries (Jonung & Larch, 2006). Possible reasons for the observed bias may be that governments and official authorities may have non-symmetric loss functions, or that significant economic variables have been omitted from the estimated models. Another type of error may also be introduced via miscalculated fiscal variables, the estimation of which is based on economic variables such as the output gap and GDP volatility (Cassidy, Kamlet, & Nagin, 1989; Feenberg, Gentry, Gilroy, & Rosen, 1989; Leal et al., 2008; Melander, Sismanidis, & Grenouilleau, 2007).

Favero and Marcellino (2005) provide a comprehensive study on the forecasting of fiscal variables using a wide range of econometric models. In particular, they consider univariate autoregressive and moving average models, vector autoregressions (VARs), and small-scale semistructural models, and compare them with institutional forecasts made by the OECD. Their results show that simple time series univariate methods work well and are able to deliver unbiased forecasts, or slightly upward-biased forecasts for the debt–GDP dynamics, whereas the OECD forecasts are typically biased. The fact that univariate models work better than multivariate ones is puzzling, because economic theory would suggest that fiscal variables should be tightly intertwined, and therefore, in theory, models based on a system of macroeconomic variables, such as VARs, should produce better forecasts than simple univariate specifications.

Favero and Marcellino (2005) suggest that these results are due mostly to the short sample available with respect to the number of coefficients to be estimated (overparameterization), the robustness of simple methods to structural breaks, and the difficulty of modelling the joint behaviors of several variables in a period of substantial institutional and economic change.

In this paper, we consider using econometric models that can deal with these problems efficiently. The models that we consider allow the information contained in a large data set to be used without incurring the overparameterization problem, and can allow for time variation in the coefficients and the volatilities, a characteristic which makes them robust to structural changes, regardless of whether such changes happen smoothly or abruptly (breaks). We show that once overparameterization and structural change have been dealt with appropriately, multivariate models do provide a better description of the macroeconomy than univariate specifications, and the use

of a large panel of macroeconomic data does provide improvements in terms of forecast accuracy.

A key aspect in the forecasting of macroeconomic variables is the assessment of the overall uncertainty that exists around point forecasts. This aspect seems particularly relevant for fiscal variables, as assessments of fiscal stability and of the overall credit and default risk of a country should typically be based on the specification of a complete probability distribution for the future state of the economy.

Accordingly, the second contribution of this paper is to focus on forecasting the whole predictive distribution of fiscal variables, rather than limiting the interest to point forecasts only. Our empirical results show that the use of models that allow for drifting coefficients and volatility does provide a better characterization of the uncertainty in the economy, which translates into substantial gains in density forecasts with respect to simpler specifications with constant coefficients and volatilities.

To deal with the problem of overparameterization, we consider the use of Bayesian Vector Autoregressions (BVARs). BVARs have a long history in forecasting, stimulated by their effectiveness, as documented in the seminal studies of Doan, Litterman, and Sims (1984) and Litterman (1986). In recent years, these models seem to have been being used even more systematically for policy analysis and the forecasting of macroeconomic variables. Starting from the paper of Banbura, Giannone, and Reichlin (2010), the benefits of using BVARs for macroeconomic forecasting using large data-sets have been documented in several recent papers (e.g., Carriero, Clark, & Marcellino, 2013a; Carriero, Kapetanios, & Marcellino, 2011; Koop, 2013). The good performance of BVARs is not limited to large data sets with large numbers of parameters to be estimated: Litterman (1986) has shown that in average-sized models with up to six variables, forecasts of BVARs without judgemental adjustments are at least as good and competitive as the best commercially available forecasts.

To account for the possibility that the data generating processes of fiscal variables have experienced changes in behavior over time, we estimate time-varying parameter Bayesian vector autoregressions (TVP-BVARs). We allow for both the autoregressive coefficients and the variance of the errors varying over time. The TVP-BVAR model has also been used in other studies such as that of D'Agostino, Gambetti, and Giannone (2013), who find that it outperforms other methods such as a fixed coefficient VAR and a time varying AR for the forecasting of US unemployment, inflation and short term interest rates. Clark (2011) finds similar results for a model featuring only time variation in volatility.

We explore the performances of BVARs with constant and drifting coefficients in forecasting key fiscal variables such as government revenues, expenditures, and interest payments on the outstanding debt. We focus on forecasting fiscal variables for the US and the three largest E.U. economies, namely the UK, France, and Germany. These European countries were all involved in the European sovereign debt crisis either directly or indirectly, and they still face enormous fiscal constraints with relevant economic implications. The inclusion of European countries that were affected by the recent sovereign debt crisis more

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