

Essays on forecasting

In this thesis I apply modern econometric techniques on macroeconomic time series. Forecasting is here developed along several dimensions in the three following chapters. The chapters are in principle self-contained. However, a common element is represented by the business cycle analysis.

In the first paper, which primarily deals with the problem of forecasting euro area inflation in the short and medium run, we also compute the country-specific responses of a common business cycle shock.

Both chapters **2** and **3** deal predominately with business cycle issues from two different perspectives. The former chapter analyses the business cycle as a dichotomous non-observable variable and addresses the issue of evaluating the euro area business cycle dating formulated by the CEPR committee, while the latter chapter studies the entire distribution of GDP growth. Therefore, I also use different tools. On the one hand, in chapter **2** I consider the classical approach ([Burns and Mitchell, 1946](#)) to the business cycle which distinguishes two phases depending on the general economic situation; thus, I use a generalized linear model with a logit link function. On the other hand, the analysis presented in chapter **3** focuses on different regions of the distribution of GDP growth by means of the expectile regression: on the basis of the fitted expectiles I estimate the entire parametric distribution from which I can also compute recession probabilities, in an alternative way with respect to the logit model of chapter **2**.

Chapter **1**, coauthored with Angela Capolongo (ECARES-ULB and CEPS), is related to the issue of inflation forecasting in the euro area. The primary objective of the European Central Bank is to maintain price stability in the euro area as a whole, therefore a timely assessment of the economic drivers and the most likely outlook for inflation are a fundamental input for monetary policy. However, while a large number of models have been proposed to forecast inflation, interpreting the inflation

dynamics and providing an informed view on the inflation outlook has always been a challenging exercise (see [Faust and Wright, 2013](#) for a review).

In this chapter I build a Bayesian vector autoregressive model with three layers of information: *inflation key drivers*, *cross-country dynamic interactions* and *country-specific variables*. The model exhibits good forecasting accuracy with respect to popular benchmarks used in the literature. I perform a step-by-step analysis to shed light on which layer of information is more crucial for accurate forecasts of euro area inflation. The empirical analysis reveals the importance of including the inflation key drivers and accounting for the multi-country dimension of the euro area. In particular, the results show that the model has overall better forecasting performance for inflation excluding energy and unprocessed food than a model only based on aggregate euro area variables, while the latter works relatively better for headline inflation.

This multi-country model, allowing for both country heterogeneity and cross-country spillovers, could be especially suitable for policy-relevant analysis. In this chapter I illustrate one example by looking at the country-specific responses of a business cycle shock. The shock is identified targeting the forecast error variance decomposition of the euro area GDP at a given horizon. [Angeletos et al. \(2020\)](#) indeed show that maximising the spectral density at the business cycle frequencies (6-32 quarters) roughly corresponds to maximising the forecast error variance at one-year horizon in the time domain. This exercise allows me to describe interesting stylized facts on the euro area as a whole and on cross-country heterogeneity with useful implications for the conduct of monetary policy.

In chapter 2 I analyse which variables better predict the euro area business cycle chronology, where the turning points are those detected by the CEPR business cycle dating committee. Since the Great financial crisis the attention on business cycle analysis has strongly increased: the literature on recession probabilities has further developed and the performance of non-linear models is tested vis-à-vis the recession periods, implicitly assuming that the underlying turning points are correctly identified. In the euro area the chronology formulated by the CEPR is well-established, likewise the one for the US by the NBER. The aim of this chapter is to evaluate the business cycle chronology of the euro area as identified by the CEPR.

Following the classical business cycle definition, the committee detects turning points looking at the dynamics of several macroeconomic aggregates. The issue arises because the choice of peaks and troughs does not only depend mechanically on the quarterly growth of GDP or on a fixed threshold of a selected indicator. The decision on the two states of business cycle is very difficult, because it is even ex-post

unobservable, and it does not rely on one single variable.

This is a statistical classification problem, which considers the business cycle as represented as a mixture of two distributions, one for recessions and the other for expansions. In practice, when analyzing standard macroeconomic variables in growth rates one can expect that high magnitude of growth rates are categorized as expansion or recession if positive or negative respectively, while the classification of growth rates close to zero is not straightforward. In the spirit of [Berge and Jordà \(2013\)](#) the methodology I use is the ROC analysis.

The evaluation of the classification ability of the CEPR is here studied along different dimensions. Firstly, I show that the CEPR dating is not completely in line with alternative dating rules based only on GDP dynamics, thus revealing that the committee considers more indicators. Moreover, evaluating peaks and troughs of the business cycle, where the cycle itself is defined by either one single variable (i.e. GDP) or estimated as a latent unobservable factor, I find that the dating proposed by the CEPR committee correctly reflects the business cycle features common to most real macroeconomic time series. That points out that recessions and expansions are correctly defined.

Chapter **3** is a joint work with Fabio Busetti, Michele Caivano, and Davide Delle Monache (Bank of Italy). The aim of the chapter is to evaluate the impact of real and financial variables of domestic and foreign origin on Italian GDP growth by allowing for non-linearities.

In an influential recent paper [Adrian et al. \(2019\)](#) have used quantile regressions to study the distribution of US GDP growth as a function of financial conditions, finding significant effects on the left tail dynamics of output but not on the right tail. Differently, I consider multiple sources of risks, spanning both the financial and the real side of the economy. In particular, I argue that risks related to foreign developments may be very relevant for a small open economy like Italy and these can influence both the lower and the upper tail of the distribution of GDP growth.

A further novelty is the use of expectile regression (or asymmetric least squares), as opposed to quantile regression, to study the conditional distribution of output growth and be able to study the possible heterogeneity across different regions of the distribution over time. Expectiles are measures of location similar to quantiles (into which they can be easily mapped), but they are simpler to characterize in terms of minimization of a loss function ([Efron, 1991](#); [Newey and Powell, 1987](#)).

Furthermore, as showed by [Taylor \(2008\)](#), expectiles are closely linked to the Expected Shortfall (ES), a widely used measure of risk alternative to Value-at-Risk with desirable properties. Here I propose a decomposition of the Expected Shortfall

of Italian GDP in terms of contributions of various risk factors, which allows to track over time the main drivers of risk.

Overall, the analysis confirms that financial conditions are relevant for the left tail of the distribution of Italian GDP but it also highlights that other factors have substantial explanatory power for both the left and the right tail. In particular, GDP risks appear to have been mostly driven by foreign developments around the Great Recession, by domestic financial conditions at the time of the Sovereign Debt Crisis and by economic policy uncertainty in more recent years.

References

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