ANALYTICAL ARTICLES

Economic Bulletin

3/2019

BANCO DE ESPAÑA
Eurosistema

BANCO DE ESPAÑA MACROECONOMIC PROJECTIONS: COMPARISON WITH AN ECONOMETRIC MODEL

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ABSTRACT

The forecasting of macroeconomic variables is an important task of the Banco de España for the satisfactory monitoring of the economic situation. Macroeconomic projections are made by combining various econometric models with expert judgement. This article compares the Spanish GDP growth and inflation projections published by the Banco de España with those that would be obtained automatically from an alternative econometric model. This exercise reveals that the Banco de España's projections surpass those of the econometric model in terms of how closely they coincide with the variables predicted (GDP and inflation), i.e. they have smaller prediction forecasting errors. This confirms that the information provided by expert opinion improves the accuracy of projections, above all in short time horizons and, in particular, in predictions of GDP growth. It is also found that, in the past decade, the accurate prediction of inflation has been considerably more difficult than that of GDP growth.

Keywords: macroeconomic projections, forecast evaluation, vector autoregression.

JEL codes: E17, C52, C53.

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Introduction

One of the Banco de España's main activities for monitoring the Spanish economy is the forecasting of a broad set of macroeconomic variables, including most notably GDP and inflation. To obtain these projections, which are currently published quarterly, various econometric models are used in conjunction with expert judgement.[1] In addition, twice a year, in June and December, macroeconomic projections are prepared jointly by all the Eurosystem central banks (Broad Macroeconomic Projection Exercise or BMPE). On these occasions, projections are prepared for the macroeconomic variables of the euro area and of the individual member states, ensuring they are consistent with each other and applying a common set of external assumptions.[2]

This article compares the Banco de España's GDP and consumer price inflation projections, according to the private consumption deflator, with those that would be obtained from an econometric model of the type most frequently used in the literature to assess macroeconomic projections: a Bayesian Vector Auto-Regression model (BVAR). The results indicate, firstly, that, in statistical terms, the Banco de España's projections are superior to those of the BVAR, insofar as the former have smaller forecasting errors. Secondly, while for short time horizons the Banco de España's projections are more accurate, this difference ceases to be statistically significant for projection horizons above four quarters in the case of GDP growth and above two quarters in the case of inflation. This suggests that the contribution of expert knowledge to the Banco de España's macroeconomic projections is particularly valuable at short time horizons. The third finding is that forecasting inflation is considerably more difficult than forecasting GDP growth.

1 The results of the most recent forecasting exercise are available at https://www.bde.es/bde/en/areas/analisis-economi/analisis-economi/proyecciones-mac/Proyecciones_macroeconomicas.html. The basic ingredient of these projections is expert judgement, supported by a wide range of econometric models used to incorporate short-term indicators (for example, the Spain-Sting or BEST models, see Camacho and Pérez-Quirós, 2011 and Álvarez, Cabrero and Urtasun, 2014) and to ensure that projections are consistent in the medium term (models such as the MTBE and, more recently, JoSE, see Arencibia, Hurtado, de Luis and Ortega, 2017, and Almeida, Hurtado and Rachedi, 2019).

2 For a description of this process, see the guide published by the European Central Bank (2016).

The next section of this article describes the methodology for assessing projections and the last section sets out the empirical results

Estimation of an econometric model for assessing the Banco de España's macroeconomic projections

To assess the Banco de España's macroeconomic projections, we estimated a statistical model with which to derive alternative projections for comparison. We used a Bayesian Vector Auto-Regression model, which allowed us to forecast the behaviour of the macroeconomic variables of interest. It can be either unconditional, or conditional on the behaviour of other variables considered exogenous to the domestic economy. These exogenous variables are usually referred to as "external assumptions of the macroeconomic projections". The conditional projections are constructed incorporating into the BVAR model specific paths envisaged for these external assumptions such as, for example, the exchange rate, oil prices, etc.

Given that the set of variables making up the external assumptions in the Banco de España's macroeconomic projection exercises is broad, the BVAR model estimated is similar to that of Giannone, Lenza and Primiceri (2015). These authors show that this model provides unconditional projections which are fairly accurate even in large systems of variables, in their specific case consisting of up to 22 quarterly macroeconomic variables of the US economy. The same conceptual framework was used by Banbura, Giannone and Lenza (2015) to obtain unconditional and conditional projections of euro area macroeconomic variables.

The authors of this article estimated a BVAR model for 14 quarterly variables of the Spanish economy: GDP, private consumption deflator, demand for Spanish goods and services by the rest of the euro area, demand for Spanish goods and services from outside the euro area, various weighted averages of competitors' prices (of exports to the euro area, of exports to outside the euro area, of imports from the euro area, of imports from outside the euro area), of oil prices in US dollars, of non-energy commodity prices in US dollars, short-term interest rates, long-term interest rates, bilateral euro/US dollar exchange rate and the Madrid Stock Exchange General Index. The first two variables are the macroeconomic aggregates of most interest in projection exercises, while the other twelve variables are the external assumptions used as conditions in these projection exercises.

The econometric model is estimated using the variables both in levels and in first differences. The estimation period is 1995Q2-2017Q4. Tables 1 and 2 show the level results, although those for the first-difference estimates are similar.

The properties are also similar when the time lag for the BVAR explanatory variables is allowed to vary between two and five quarters, so a parsimonious model with two lags was chosen.

To compare the projections published by the Banco de España with those produced by means of the econometric model described above, the BVAR was re-estimated each quarter using the most recent data available at each point in time.[3] Also, we used the paths for the eight quarters following the current quarter of the 12 variables making up the external assumptions of the projections, exactly as they were recorded in each projection exercise.

This econometric model – estimated each quarter – was used to generate projections of one to eight quarters for GDP growth and consumer price inflation. Note that, since the data for the current quarter are published with a certain lag, the one-quarter-ahead projection refers to the quarter in which the projection exercise takes place.[4] Given that the BVAR provides a complete distribution of projections for each variable and time horizon, for this assessment exercise we used the mean of the predictive distribution.

When calculating the forecasting errors, the projections made each quarter between 2009Q1 and 2017Q4, both by the Banco de España and by the BVAR model, are compared with the macroeconomic data published after each projection exercise has finished. It should be taken into account that the number of observations with which the projections are compared is smaller for projections with longer time horizons than for current-quarter projections.

Results

To compare the accuracy of alternative economic projections, the econometric test most frequently used in the literature is that developed by Diebold and

3 The data were not used in the exact form in which they were available at each point in time, but rather any revisions they may have undergone since then were included. The GDP and private consumption deflator data used in our study pertain to the Quarterly National Accounts, which customarily undergoes revisions, albeit normally small ones in the case of these two time series. Also, the same number of observations was used in each re-estimate, specifically 55 quarters. This is the number of quarters elapsed since the first available observation, i.e. 1995Q2, and the last one available at the time of the first round of projections assessed in this article: 2008Q4 for the 2009Q1 round.

4 The Banco de España's projections can take into account changes in the variables within the quarter of the projection exercise, whereas the BVAR cannot, meaning that the former potentially has a certain advantage. To mitigate the effects of this, when the BVAR projections are generated, the latest observation of short- and long-term interest rates, of the nominal exchange rate and of the stock exchange index is replaced by the observation relating to the month before the round of projections, since these are the variables which may undergo substantial changes from one month to the next.

Table1

COMPARISON OF THE BANCO DE ESPAÑA'S MACROECONOMIC PROJECTIONS WITH THOSE OF A BVAR ECONOMETRIC MODEL (a)

	GDP growth	Inflation
Forecast horizon		
1 quarter	2.09	4.17
2 quarters	1.88	1.77
3 quarters	2.11	1.00
4 quarters	2.09	1.02
5 quarters	1.19	1.19
6 quarters	0.39	1.12
7 quarters	-0.04	0.99
8 quarters	-0.19	0.72

SOURCE: Banco de España calculations.

a The table shows the Diebold-Mariano statistic (1995) for GDP growth and inflation forecasts between one and eight quarters ahead. The shaded cells are the cases where the Banco de España's projections are statistically better than those of the BVAR econometric model, insofar as the former have smaller forecasting errors.

Mariano (1995). This allows it to be discerned whether a projection method is consistently better than a competing method or whether there is insufficient evidence to distinguish between the predictive quality of the two methods. For each forecast horizon and each variable, use is made of the time series of forecasting errors of the two alternative methods, which in this case are those of the macroeconomic projections published by the Banco de España and those of the projections obtained from the alternative econometric model, i.e. the BVAR. The test evaluates the hypothesis that the two methods have equal predictive accuracy. If it is rejected, the alternative hypothesis would be that the Banco de España's projections are significantly better than those of the BVAR.[5]

Table 1 shows the statistics of the Diebold and Mariano test for GDP growth and consumer price inflation. Positive values indicate better properties of the Banco de España's projections, while negative values show that the BVAR makes better projections. The shaded cases are those in which the Banco de España's projections are significantly better than those of the BVAR, i.e. that the statistic of the Diebold and Mariano test exceeds the critical value. The results show that the Banco de España's projections are significantly better than the BVAR's conditional projections for short time horizons: within four quarters in the case of GDP growth and within two quarters for inflation.

5 At the 0.05 level of significance, the initial hypothesis is rejected and it can be concluded that one method produces significantly better economic projections than the other if the test of Diebold and Mariano exceeds the critical value of 1.64 (the 95th percentile of the standard normal distribution).

Table 2
PERCENTILES OF THE OBSERVATIONS IN THE BVAR MODEL'S PREDICTIVE DISTRIBUTION (a)

	GDP growth	Inflation
Forecast horizon		
1 quarter	49	40
2 quarters	52	32
3 quarters	52	37
4 quarters	53	30
5 quarters	54	31
6 quarters	54	31
7 quarters	55	32
8 quarters	56	33

SOURCE: Banco de España calculations.

a The table shows, for each forecast horizon and variable, the average percentile of the econometric BVAR model's predictive distribution in which the observed GDP growth and inflation data fell. For example, in the case of GDP growth at the one-quarter-ahead horizon, a value of 49% means that, on average over the full forecast evaluation period, the observed GDP growth outcome fell slightly below the median of the BVAR model's predictive distribution for that horizon.

Also, the Diebold and Mariano statistics show that the predictive advantage of the Banco de España decreases as the projection horizon increases. Intuitively, this suggests that the informational advantage exercised by expert judgement in the case of the Banco de España's projections is very valuable, although it decreases for projections more distant in time.

In each round of projections, the alternative econometric model estimated provides predictive distributions for GDP growth and inflation with time horizons of up to eight quarters. Consequently, for each projection horizon and each variable, there is a time sequence of predictive distributions of the BVAR to compare with the finally observed values for each variable. At each moment during this sequence, the percentile of the distribution of the BVAR's projections at which the observed value falls can be calculated. For example, the 50^{th} percentile divides the full range of the distribution in two equal parts, each with a probability of 50%. That is to say, it assigns a probability of 50% to the event that the final observation is less than or equal to the value indicated by the 50^{th} percentile, and another probability of 50% to it being more than that value.

Table 2 summarises this information for each projection horizon and for each of the quarterly macroeconomic projection exercises assessed between 2009Q1 and 2017Q4, showing the average percentile over all the forecasting rounds of the finally observed GDP growth and inflation figure.

It is found that the medians of the distributions of the econometric model projection (the 50th percentile) are reasonably in line with the GDP growth figures. However, the BVAR model systematically overpredicts inflation: for each time horizon, the finally observed inflation figure falls around the bottom third of the distribution of the BVAR model's projections. This suggests that in the past decade it has been more difficult to make accurate forecasts of inflation than of GDP growth.

11.9.2019.

REFERENCES

Almeida, G., S. Hurtado and O. Rachedi (2019), *"JoSE: Joint Spain Euro Area Model"*, Occasional Paper, Banco de España, forthcoming.

Álvarez, L. J., A. Cabrero and A. Urtasun (2014) *"A procedure for short-term GDP forecasting",* Economic Bulletin, Banco de España, October 2014.

Arencibia, A., S. Hurtado, M. de Luis and E. Ortega (2017), *"New Version of the Quarterly Model of Banco de España (MTBE)",* Occasional Paper 1709, Banco de España.

Banbura, M., D. Giannone and M. Lenza (2015) "Conditional Forecasts and Scenario Analysis with Vector Autoregressions for Large Cross-Sections", *International Journal of Forecasting,* 31(3): 739-756.

Banco Central Europe (2016) "A guide to the Eurosystem/ECB staff macroeconomic projection exercises", URL: http://www.ecb.europa.eu/pub/pdf/other/staffprojectionsguide201607.en.pdf?02d74e035a969ea3281294994b9f0109.

Camacho, M., and G. Perez-Quiros (2011). "Spain-Sting: Spain Short-Term Indicator of Growth", *Manchester School*, 79(1), pp. 594-616.

Diebold, F. X., and R.S. Mariano (1995), "Comparing Predictive Accuracy," *Journal of Business & Economic Statistics*, 13(3): 253-263.

Giannone, D., M. Lenza and G. Primiceri (2015), "Prior Selection for Vector Autoregressions", *Review of Economics and Statistics*, 97(2): 436-451.