A comparison of mixed frequency approaches for nowcasting Macedonian GDP

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Introduction

- This paper concentrates on the empirical methods dealing with mixed-frequency data.
- In particular, it goes through the MIDAS approach and its recent extension, the MF-VAR in a Bayesian framework
- The two strategies are evaluated in terms of their accuracy to nowcast Macedonian GDP growth, using same monthly frequency data set
- Specifically, we focus on comparison of the resulting models in terms of the proposed predictions
- Most of the employed variables are part of the regular NBRNM's current economic analysis framework

MF-VAR Approach

- We describe the main features of the Bayesian approach, following Schorfheide and Song (2015) as a most representative study in the field literature
- These authors represent the MF-VAR as a state space model, and use MCMC methods to conduct Bayesian inference for model parameters and unobserved monthly variables
- The state-transition equations of the model are represented by the VAR(p) process, treating quarterly series as monthly series with missing observations
- For all t_m the latent month-on-month GDP growth $y^*_{t_m}$ and the corresponding monthly indicators x_{t_m} follow a VAR(p) process

$$z_{t_m} = F_1(\Phi) z_{t_{m-1}} + F_c(\Phi) + \upsilon_{t_m}$$
$$\upsilon_{t_m} \sim iidN(0, \Omega(\Sigma))$$

MF-VAR Approach (2)

- To write the measurement equation, the authors need to write the aggregation equation
- The disaggregation of the quarterly GDP growth, y_{t_m}, observed every t_m = 3; 6; 9; ::::; T_m, into the month-on-month GDP growth, $y^*_{t_m}$, never observed, is based on the following aggregation equation

$$y_{t_m} = \frac{1}{3}\left(y^*_{t_m} + y^*_{t_{m-1}} + y^*_{t_{m-2}}\right) = \Lambda_{mz} z_{t_m}$$

- The quarterly variable is seen as the three-month average of the monthly process
- Since y_{t_m} is observed only every third month, there is a need of a selection matrix that equals the identity matrix if t_m corresponds to the last month of the quarter and is empty otherwise

MF-VAR Approach (3)

- Therefore, the measurement equation can be written as:

$$\begin{pmatrix} y_{t_m} \\ x_{t_m} \end{pmatrix} = M_{t_m} \Lambda_z z_{t_m}$$

where M_{t_m} is the selection matrix

- A Minnesota prior that shrinks the VAR coefficients toward univariate random walk representations is introduced to deal with the problem of dimensionality

U-MIDAS Approach

- A popular alternative to the multivariate state-space framework used in this research work are MIDAS regressions
- Generated from the distributed lag models technique, this econometric tool is based on both a regression structure and a weight function which tracks the high frequency lags of the explanatory variables
- In some cases the shape of the lag polynomial may be too restrictive compared to the underlying DGP
- Therefore a model without restrictions on the weights of the lag polynomial was introduced by Foroni, Marcellino, and Schumacher (2011)

U-MIDAS Approach (2)

- These authors proposed a new parametrization for the MIDAS that relies on a linearization of the distributed lag function called unrestricted MIDAS (U-MIDAS), where all the parameters are estimated using OLS
- Our U-MIDAS specification includes 3 lags of the monthly indicators in total, covering the quarter for which we observe the last value of real GDP growth as well as data covering the first quarter to forecast, provided they are available
- As the different monthly values of the indicators are released throughout a quarter, the specification of the regression model changes slightly

U-MIDAS Approach (3)

- $X^{(M1)}$ is a quarterly time series consisting of all first monthly values of an indicator X for each quarter over history
- $X^{(M2)}$ is a quarterly time series consisting of all second monthly values of an indicator X for each quarter over history
- $X^{(M3)}$ is a quarterly time series consisting of all third monthly values of an indicator X for each quarter over history
- As in one quarter there are 3 months, each monthly variable will be transformed into 3 quarterly variables
  - $X^{(M1)}$ – only data for months 1,4,7,10 are taken
  - $X^{(M2)}$ - only data for months 2,5,8,11 are taken
  - $X^{(M3)}$ - only data for months 3,6,9,12 are taken

U-MIDAS Approach (4)

- Then, just for an illustration, if X has a 1 month publication delay:
- **In month 1**, the nowcast model of Y consists of a constant, one lag of Y and 3 months of data on indicator X

$$Y_t^{(Q)}=\beta_1^{(M1)}+\varphi_1 Y_{t-1}^{(Q)}+\gamma_{2,1}X_{t-1}^{(M1)}+\gamma_{2,2}X_{t-1}^{(M2)}+\gamma_{2,3}X_{t-1}^{(M3)}+\omega_t^{(M1)}$$

i.e. months 10,11 & 12

- **In month 2**, the specification is the same as in month 1, but the first month of the current quarter ($X^{(M1)}$) is added to the regression:

$$Y_t^{(Q)}=\beta_1^{(M2)}+\varphi_1 Y_{t-1}^{(Q)}+\gamma_{1,1}X_t^{(M1)}+\gamma_{2,2}X_{t-1}^{(M2)}+\gamma_{2,3}X_{t-1}^{(M3)}+\omega_t^{(M2)}$$

i.e. months, 1, 11 & 12

- **In month 3**, two months of the current quarter (t) and one month of the previous quarter (t–1) are included:

$$Y_t^{(Q)}=\beta_1^{(M3)}+\varphi_1 Y_{t-1}^{(Q)}+\gamma_{1,1}X_t^{(M1)}+\gamma_{1,2}X_t^{(M2)}+\gamma_{2,3}X_{t-1}^{(M3)}+\omega_t^{(M3)}$$

i.e. months 1, 2 & 12

Forecasting using U-MIDAS

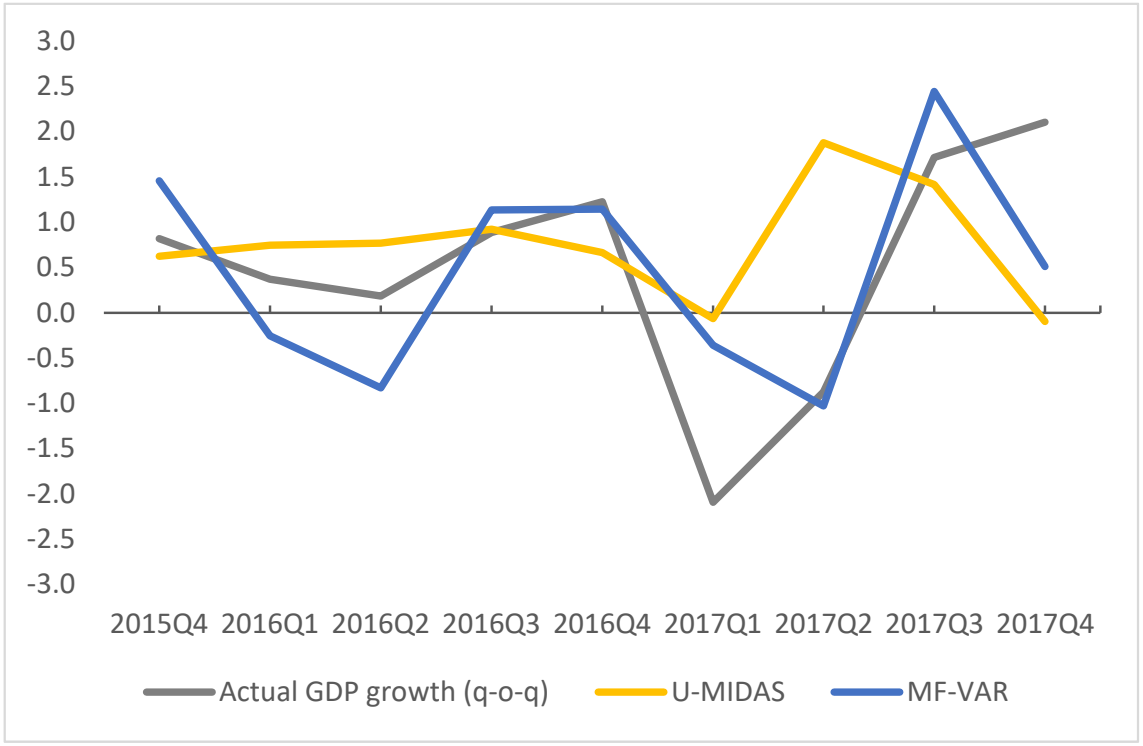
- Unlike other approaches (such as bridge equations), U-MIDAS does not require a forecast of missing months
- Therefore U-MIDAS does not require any assumptions about the behaviour of the indicators in the upcoming months

Results -- U-MIDAS & MF-VAR

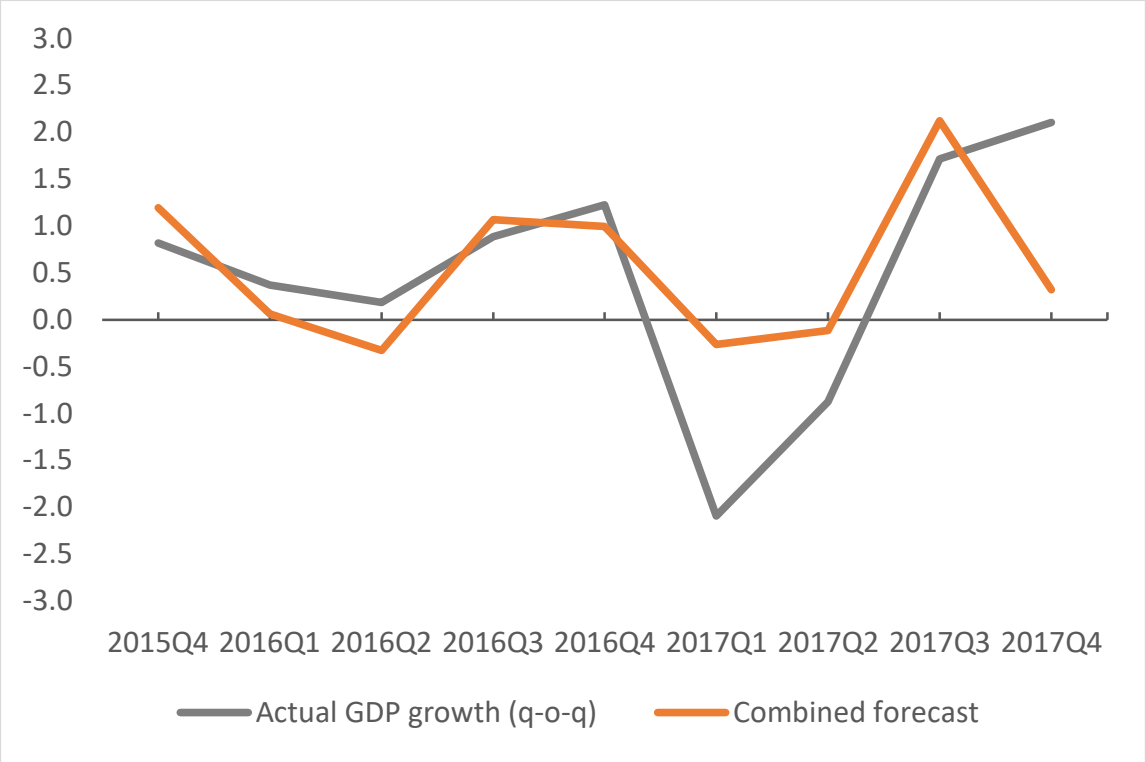
- Overview on nowcast pooling based on twelve single indicator U-MIDAS regressions, as well as the MF-VAR individual nowcasts (obtained recursively, based on log difference approximation, seasonally adjusted figures) and combined forecast, for the evaluation sample 2015Q4 - 2017Q4 (third months of the quarter)

	actual GDP growth	U-MIDAS $h_m=1$	MF-VAR $h_m=1$	Combined $h_m=1$
2015Q4	0.82	0.62	1.46	1.20
2016Q1	0.37	0.75	-0.25	0.06
2016Q2	0.18	0.77	-0.83	-0.33
2016Q3	0.89	0.92	1.14	1.07
2016Q4	1.23	0.67	1.15	1.00
2017Q1	-2.09	-0.06	-0.36	-0.27
2017Q2	-0.88	1.88	-1.03	-0.12
2017Q3	1.72	1.41	2.45	2.12
2017Q4	2.10	-0.10	0.51	0.32
RMSE		1.39	0.94	0.93

Results -- U-MIDAS & MF-VAR



Results -- Combined



Conclusion

- The two approaches are more complementary than substitutes, since their combined forecast in general tends to be superior in predicting business cycle turning points
- However, in our empirical exercise, the MF-VAR model delivered more accurate predictions in times of increased uncertainty, when reliable assessments of the current situation are most needed

Thank you for your attention!

Appendix – Data set

Main releases	Publishing lag	Frequency
Number of employees – Total –Industry	1 month	monthly
Turnover recorded in capital goods industries	2 months	monthly
Industrial production index – Total – Germany	1 month	monthly
Manufacture of motor vehicles, trailers and semi-trailers in EU-28	1 month	monthly
PPI – Exporting industries (PPI=Producer Price Index)	1 month	monthly
Hours worked - Construction	2 months	monthly
Industrial production index - Manufacture of other non-metallic mineral products	1 month	monthly
M2-Denar part	1 month	monthly
Real average monthly net-wage	2 months	monthly
Tourism-overnight stays	2 months	monthly
EC ESI–Macedonia (EC ESI=European Commission Economic Sentiment Indicator)	1 month	monthly
EC ESI–Germany (EC ESI=European Commission Economic Sentiment Indicator)	1 month	monthly
Gross value added at constant prices (mio Denar) - All NACE branches - Total	1 quarter	quarterly