

Opponent's Report on Dissertation Thesis

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Title of the Thesis:	Three Essays on Applied Bayesian Econometrics
Type of Defense:	DEFENSE
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Opponent:	Doc. Mária Feldkircher

Address the following questions in your report, please:

- a) Can you recognize an original contribution of the author?
- b) Is the thesis based on relevant references?
- c) Is the thesis defensible at your home institution or another respected institution where you gave lectures?
- d) Do the results of the thesis allow their publication in a respected economic journal?
- e) Are there any additional major comments on what should be improved?
- f) What is your overall assessment of the thesis? (a) I recommend the thesis for defense without substantial changes, (b) the thesis can be defended after revision indicated in my comments, (c) not-defensible in this form.

(Note: The report should be at least 2 pages long.)

Structure of the thesis:

The proposed dissertation by Tomáš Adam consists of three contributions. The first essay, "Assessing the External Demand of the Czech Economy: Nowcasting Foreign GDP Using Bridge Equations", has been jointly authored with Filip Novotný and published as a Working Paper of the Czech National Bank (Nr. 2018/18). The second essay, "Modeling Euro Area Bond Yields Using a Time-Varying Factor Model", was jointly authored with Marco Lo Duca and published as an ECB working paper. The last essay, "Time-Varying Betas of Banking Sectors", jointly authored with Soňa Benecká and Ivo Jánký, dates from the year 2012 when it has been published in the Czech Journal of Economics and Finance (Vol. 62, 2012, no. 6, p. 485-504). Since both, the Czech National Bank (CNB) and the European Central Bank (ECB) use an external referee in the review process of their working papers, as do the two publication outlets, all three contributions have been peer-reviewed to ensure the articles quality and originality.

Originality of the contribution:

I have read all three articles with great interest and can confirm the originality of the contributions. Tomáš Adam's work consists of applications of state-of-the-art, Bayesian techniques to issues that are relevant to institutions such as central banks and the academia in more general. The common element in the three essays is the use of Bayesian methods. In my experience and in dissertations that focus on the application of statistical methods, the empirical application is often of second order importance. This is not the case in Tomáš Adam's submission. In particular the different Bayesian methods, that cover model averaging, time-varying factor models and time-varying parameter models with stochastic volatility have been carefully chosen to fit the specific needs of the research question at hand. This holds especially true for the application estimating systemic risk in banking sectors. The advantages of the time-varying parameter framework with stochastic volatility has been clearly motivated and the drawbacks of alternative specifications (e.g., rolling regressions, multivariate Generalized AutoRegressive Conditional Heteroscedasticity, M-GARCH models) discussed.

Relevant references:

The dissertation contains a comprehensive summary of why Bayesian methods are gaining popularity among economists and applied researchers. The advantages of using Bayesian econometrics are highlighted, for instance when the information set is small, as e.g., when having to use short time series. Also, as VAR models tend to be overparametrized, additional regularization is important to ensure reliability of the results and to obtain sound forecasts. Bayesian methods achieve regularization by using shrinkage priors that push coefficients towards a prior mean (most often zero, in case of pushing against a random walk, 1). The literature developing these methods is growing quickly and a few references could be incorporated in the introduction of the dissertation. For instance, George et al. (2008) propose stochastic search variable selection (SSVS) priors that impose a mixture of Gaussian priors on each regression coefficient in the VAR. In another contribution, Giannone et al. (2015) extend the work of Sims and Zha (1998) and propose a hierarchical model that integrates out the hyperparameters of the Minnesota, the sum of coefficients and the dummy initial observation prior in a Bayesian fashion. These priors are especially popular at institutions such as the ECB, which has developed a MATLAB Toolbox for Bayesian econometrics, especially VAR models (<https://www.ecb.europa.eu/pub/research/working-papers/html/bear-toolbox.en.html>). More recently and to provide more flexibility, Griffin and Brown (2010) introduced a Normal-Gamma (NG) prior that solves several shortcomings of the priors discussed hitherto. This prior, being closely related to the LASSO, possesses far richer shrinkage properties as compared to alternative solutions. Huber and Feldkircher (2019) apply the NG prior of Griffin and Brown (2010) to the VAR with stochastic volatility case. These priors have in common that they push

against a prior mean which is often specified depending on the time series properties of the underlying data (such as the Minnesota prior pushes against a random walk) or to induce more parsimony (in which case the prior mean is zero). Another prominent form of using Bayesian priors is by using priors derived from structural models. For example, Del Negro and Schorfheide (2004), Del Negro et al. (2007), Filippeli and Theodoridis (2014), and De Luigi and Huber (2018) use dynamic stochastic general equilibrium (DSGE) based priors, that center the system of equations in the VAR towards the implied moments of a DSGE model. As compared to the priors reviewed above, DSGE-based priors allow for shrinkage towards the cross correlations implied by the models' behavioral equations without imposing theoretical restrictions dogmatically. This has the advantage of providing a stronger theoretical underpinning for the VAR framework without ignoring the information in the data. Incorporating (some) of these references depends on how comprehensive the literature survey in the introduction should be and is only an optional comment.

Additional comments:

Here, I focus on the two most recent and hence unpublished chapters of the thesis, "Assessing the External Demand of the Czech Economy: Nowcasting Foreign GDP Using Bridge Equations" and "Modeling Euro Area Bond Yields Using a Time-Varying Factor Model". Starting with the nowcasting contribution, an interesting evaluation would be to see by how much GDP forecasts for the Czech economy improve by having better forecasts of external demand. Tomáš Adam responded to this comment by noting that this research question will be dealt with in a follow-up paper:

Second, as central banks start to provide more and more often not only the point forecast but the surrounding uncertainty (see e.g., the inflation report of the CNB), I think it would be worth looking at density measures of forecast evaluation, such as log-predictive scores. These would ensure that models are selected that yield both a precise mean forecast that is not surrounded by a large degree of forecast uncertainty caused by overfitting. In case, in future work, alternative models such as VARs are considered for short-term forecasting (p. 28) one might consider having specifications with stochastic volatility, as there is a large literature that demonstrate that that accounting for time variation in variances significantly improves forecasts (Cogley and Sargent, 2005; Clark and Ravazzolo, 2015; Carriero et al., 2016; Chan and Eisenstat, 2018). I can understand that this is computationally intensive when evaluating numerous benchmark models; once the set of models is narrowed down – and for practical purposes / implementations of nowcasting at the CNB -- I think it is worthwhile to look at density forecasts. Also for future work, it would be interesting to investigate the properties of Bayesian MIDAS regressions, see for example the recent R package of Ankargren and Yang, <https://cran.r-project.org/web/packages/mfbvar/index.html>, which implements mixed-frequency Bayesian VAR models with a range of modern priors. Looking more at the dimensionality of the data set, recent econometric alternatives to factor / principal component analysis are random compressions. These methods map the (large) design matrix into a subspace of smaller dimension, which is then used to estimate parameters and perform forecasting. Again, this is rather a suggestion for future work than for the current thesis.

Third, the paper on euro area bond yields finds evidence for a decoupling of euro area core and periphery bond yields, starting with the period of the sovereign debt crisis. More specifically, bond yields in the periphery became more sensitive to a periphery factor and less to the core factor. This finding could be in line with results of a recent study by Leombroni et al. (2018) that attributes the decoupling to ECB communication. More precisely, in their work, they show that communication by the ECB has affected core and periphery bond yields in a similar way


until up to the crisis after which the effect has ceased for periphery bond yields. Here, an additional risk premium materialized that affected periphery bond yields more than core yields driving a wedge between the two. I am happy that Tomáš Adam could incorporate these arguments into the relevant chapter of his thesis.

Summing up, I have enjoyed reading the three articles which are using state-of-the-art techniques to relevant and important economic topics. I am happy with the way Tomáš Adam has responded to my comments and I strongly believe that the two unpublished papers can be published in highly reputable journals. I also believe that the thesis would be defendable at other universities, such as the Vienna University of Economics and Business (WU), from which I received my *venia docendi*. I hence **recommend the thesis for defense without substantial changes**.



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Date:	02.10.2019
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