

Written Exam Economics Winter 2017-2018

**Advanced Macroeconomics: Business Cycles**

Date: January 12-19, 2018

This exam question consists of 7 pages in total

**A take-home exam paper cannot exceed 10 pages – and one page is defined as 2400 keystrokes.**

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by “eksamen på dansk” in brackets, you must write your exam paper in Danish.

If you are in doubt about which title you registered for, please see the print of your exam registration from the students’ self-service system.

***The paper must be uploaded as one PDF document. The PDF document must be named with exam number only (e.g. ‘1234.pdf’) and uploaded to Digital Exam.***

**Focus on Exam Cheating**

In case of presumed exam cheating, which is observed by either the examination registration of the respective study programmes, the invigilation or the course lecturer, the Head of Studies will make a preliminary inquiry into the matter, requesting a statement from the course lecturer and possibly the invigilation, too. Furthermore, the Head of Studies will interview the student. If the Head of Studies finds that there are reasonable grounds to suspect exam cheating, the issue will be reported to the Rector. In the course of the study and during examinations, the student is expected to conform to the rules and regulations governing academic integrity. Academic dishonesty includes falsification, plagiarism, failure to disclose information, and any other kind of misrepresentation of the student’s own performance and results or assisting another student herewith. For example failure to indicate sources in written assignments is regarded as failure to disclose information. Attempts to cheat at examinations are dealt with in the same manner as exam cheating which has been carried through. In case of exam cheating, the following sanctions may be imposed by the Rector:

- 1. A warning
- 2. Expulsion from the examination
- 3. Suspension from the University for at limited period or permanent expulsion.

Take-home Exam

Advanced Macroeconomics: Business Cycles

Fall 2017

Notes:

1. For additional instructions on the computational and empirical parts of the exam, please refer to the *readme* file in the exam folder in Absalon;
2. The submission deadline is January 19, 2018, no later than 10:00 a.m.;
3. All *Matlab* codes employed in the empirical and computational analysis should be attached as a separate appendix.

The student is asked to address each and every point listed below, providing adequate comments to the empirical and computational evidence that she/he will produce.

## Part 1

The file Exam\_data.xlsx contains data for the U.S. economy for the period 1960:Q1-2017:Q2 (though not all variables are available throughout the period). The dataset consists of the following variables: Real GDP ( $Y_t$ ), real government spending ( $G_t$ ), real private consumption ( $C_t$ ), real tax revenues (net of transfer payments) ( $T_t$ ), real household mortgage debt ( $B_t$ ), the real house price ( $Q_t$ ), and the forecast errors of government spending computed by Auerbach and Gorodnichenko (2012) ( $FE_t$ ).

- Question 1 Apply standard transformations of the data, and estimate a VAR-model of the six real variables in the dataset (i.e., excluding  $FE_t$ ). Use 4 lags and a quadratic trend.
- Question 2 Use a standard Choleski decomposition to identify shocks to government spending. State and discuss your ordering of the variables. Discuss the assumptions you make when you identify government spending shocks with a recursive identification scheme.
- Question 3 Is the structural VAR model fully or partially identified? In particular, could we use it to also identify tax shocks? Explain.
- Question 4 Generate a shock to government spending, and plot the responses of all six variables along with a 68 percent (one standard deviation) confidence band for 20 periods. Are the responses of output and consumption in line with the literature seen during the course? Is the government spending multiplier on output above or below 1? Comment. Plot also (in the same diagram) the median of the bootstrapped impulse-responses, and compare it to the estimated impulse-responses.
- Question 5 Suppose you were able to detect components of government spending which *increase* automatically within-quarter in response to an increase in GDP. Discuss how this would affect your SVAR analysis above. In particular, would the government spending multiplier on output computed in the previous question be biased upwards or downwards? Explain.
- Question 6 You should observe that the house price and mortgage debt both increase after a government spending shock. From an economic viewpoint, do you think the responses of these variables seem reasonable in light of the response of output and private consumption? What does the increase in mortgage debt imply about the nature of the response of private consumption?
- Question 7 A common criticism of Choleski identification of fiscal policy shocks is that by the time government spending data changes, news about this change will have been anticipated by private agents. One way to account for this is to include forecast

errors of government spending in the VAR model, as in Auerbach and Gorodnichenko (2012). Use the forecast errors computed by these authors ( $FE_t$ ) to generate an *unanticipated* shock to government spending. Where in the Choleski ordering do you place this variable? Plot the impulse-responses of all variables to this type of shock. Are the results obtained in the previous questions qualitatively robust to this alternative approach?

Question 8 Compute and report the correlation between the residuals from the  $FE_t$ -equation and those from the  $G_t$ -equation in the VAR-model used in the previous question. Comment on what this implies about the possibility of identifying truly unanticipated shocks to government spending using this approach.

## Part 2

Consider the economy in Section II of Iacoviello (2005). Extend the model so as to account for a shock to public spending. Specifically, the aggregate resource constraint becomes

$$Y_t = c_t + c'_t + g_t$$

where  $g_t$  is public spending, and

$$\log g_t = (1 - \rho^g) \log g + \rho^g \log g_{t-1} + u_t^g,$$

where  $\rho^g \in [0, 1)$  and  $u_t^g$  is an iid shock. Households' optimization problem is modified as follows:

$$\begin{aligned} \max E_0 \sum_{t=0}^{\infty} \beta^t & \left( \ln c'_t + j \ln h'_t - \frac{(L'_t)^\eta}{\eta} \right) \\ \text{s.t. } c'_t + q_t & \left( h'_t - h'_{t-1} \right) + \frac{R_{t-1}b'_{t-1}}{\pi_t} + T'_t = b'_t + w'_t L'_t + F_t \end{aligned}$$

where we have removed money balances and  $T'_t$  now denotes lump sum taxes paid by the households.

Question 1 Show that the budget constraint of the government reads as

$$g_t = T'_t.$$

Question 2 Assume that, in the non-stochastic steady state,  $\frac{g}{Y} = \zeta$ , with  $\zeta \in [0, 1)$ . Determine the steady state of the model and provide a log-linear representation analogous to that of Equations (L1)-(L9) in the original manuscript, suitably extended in order to close the model in the presence of fiscal shocks.

Question 3 Consider the *Dynare* code *MI2005.mod*, which provides a numerical solution to the framework we are considering. Plot the impulse responses to a fiscal shock and provide an economic intuition to the responses of the following variables:  $\hat{Y}_t$ ,  $\hat{c}_t$ ,  $\hat{c}'_t$ ,  $\hat{q}_t$ ,  $\hat{b}_t$ ,  $\hat{h}_t$ ,  $\hat{R}_t$ ,  $\hat{\pi}_t$ ,  $\hat{C}_t$ , where  $\hat{C}_t$  denotes the log-deviation of aggregate consumption from its steady state and is denoted by **Chat** in the *Dynare* code. Specifically, comment on the rationale behind the drop in aggregate consumption.

- Question 4 Conditional on the fiscal shock, housing prices and aggregate consumption display positive comovement, as they both contract. Can you provide a solid economic intuition on why this is the case in the present setting?
- Question 5 In light of your answers to Questions 3 and 4, comment on the ability of the DSGE model to reproduce the empirical evidence from your SVAR analysis in Part 1, with a special focus on the responses of housing prices, aggregate consumption and mortgage debt.
- Question 6 Evaluate the robustness of the drop in housing prices with respect to the persistence of the shock to government spending,  $\rho^g$ , by plotting (in the same diagram) the response of housing prices for each of the values  $\rho^g = \{0.3, 0.5, 0.7, 0.9\}$ . Provide intuition for the connection between the size of the response and the persistence of the shock.
- Question 7 We know from Galí *et al.* (2007) that the presence of rule-of-thumb households in New Keynesian models can enable the model to generate an increase in private consumption in response to government spending shocks. Based on the close connection between households' consumption and housing prices in the DSGE model studied above, as discussed in Question 4, do you think that adding rule-of-thumb households to the present model may also enable it to generate an increase in the housing price? Discuss why/why not?

## References

- [1] Auerbach, A., and Y. Gorodnichenko, 2012, Measuring the Output Responses to Fiscal Policy, *American Economic Journal – Economic Policy* 4, 1–27.
- [2] Galí, J., J. Lopez-Salido, and J. Valles, 2007, Understanding the Effects of Government Spending on Consumption, *Journal of the European Economic Association* 5, 227–270.
- [3] Iacoviello, M., 2005, House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle, *American Economic Review* 95, 739–764.