Written Exam Economics – summer school 2014

# Theoretical and Empirical Foundations of DSGE Modeling

Master's Course

July 12-19, 2014

This exam question consists of 7 pages in total

***The paper must be uploaded as <u>one PDF document</u> (including the standard cover and the appendices). The PDF document must be named with exam number only (e.g. '1234.pdf') and uploaded to Absalon.***

**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
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The Faculty of Social Sciences
The Study and Examination Office
October 2006

Take-home Exam

Theoretical and Empirical Foundations of DSGE Modeling

Summer School, 2014

Notes:

1. For additional instructions on the computational and empirical parts of the exam, please refer to the *readme* file in the exam folder;

2. The submission deadline is July 19, 2014, no later than 12:00 p.m.;

3. The exam paper should not exceed 15 pages. In addition, a maximum of 15 pages of supplementary material (graphs, tables, etc.) can be submitted;

4. 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

This part of the exam draws on Monacelli, 2009, "New Keynesian Models, Durable Goods, and Collateral Constraints", *Journal of Monetary Economics*, Volume 56:2.

Question 1 Derive the first-order conditions for the utility maximization problems faced by the borrowers and the savers. Log-linearize the first-order conditions faced by the two types of households, as well as their budget constraints and the collateral constraint faced by the borrowers (assume this holds with equality).

Question 2 Consider the *Dynare* code *TSNK.mod*, which replicates the DSGE model in Monacelli (2009) and its same baseline calibration (both the average duration of non-durable prices and that of durable prices have been set to 4 quarters). Demonstrate that, with this set of parameter values, positive comovement between aggregate durable and aggregate non-durable consumption arises in the face of a contractionary monetary policy shock.

Question 3 From now on, consider an average duration of durable prices of 2 quarters, while keeping the average duration of non-durable prices to 4 quarters. Recall the financial constraint used by Monacelli (2009):

$$b_t = (1-\chi)(1-\delta) E_t \left\{ \frac{D_t q_{t+1}}{R_t/\pi_{c,t+1}} \right\}, \tag{1}$$

where $\chi$ is the fraction of the durable good value that cannot be used as a collateral. Holding every other parameter fixed, consider the following values for $\chi$: 0.15, 0.25, 0.5, 0.9. For each of these values, plot the correlation between (aggregate) durable and non-durable expenditure. The resulting graph should feature $\chi$ on the x-axis and the associated correlation on the y-axis. Discuss the model's ability to generate positive comovement between aggregate durable and aggregate non-durable consumption for different degrees of credit market tightness.

Question 4 For each of the values of $\chi$ that you have considered in the previous question, plot the standard deviation of both (aggregate) durable and non-durable expenditure. The resulting graphs (one for aggregate durable expenditure and one for aggregate non-durable expenditure) should feature $\chi$ on the x-axis and the associated standard deviation on the y-axis. Illustrate and provide adequate interpretation of the amplification properties of the model under different degrees of market tightness.

Question 5 Set the coefficient $\chi$ back to 0.25. Now consider a modified version of the collateral constraint, in which the credit limit faced by the borrowers is fixed at its steady

state level. In particular, this implies that the collateral constraint (1) is replaced by the following equation:

$$b_t = b, \tag{2}$$

where $b$ denotes the steady state debt level in the baseline model with $\chi = 0.25$ (Hint: this value can be retrieved in the command window as the steady state counterpart of $BBt$ in the TSNK.mod file you have been provided with). Generate a one-period contractionary monetary policy shock. Plot the impulse response function of both (aggregate) durable and non-durable expenditure under (2) against its counterpart under the endogenous credit limit (1). For each of the two types of consumption goods, comment on the degree of amplification that the collateral constraint with the endogenous credit limit ensures with respect to the one with the fixed credit limit. (Hint: examine the response of the multiplier attached to the collateral constraint, $\hat{\psi}_t$).

# Part 2

The file DanishData.xlsx includes Danish macroeconomic data on the (log of) industrial production ($y_t$), the (log of) the consumer price index ($p_t$) and the central bank reference interest rate (Nationalbankens diskonto) ($i_t$) from 1985 to 2008. All data are monthly. Estimate a VAR with 12 lags.

Question 1 Identify the MP shocks as in Christiano et al. (1999), including the 90% confidence interval. Briefly discuss the rationale behind the identification of the monetary policy shock.

Question 2 Discuss the transmission of monetary policy shocks to output, prices and the interest rate. Are the impulse responses consistent with the standard New Keynesian model as presented, e.g., in chapter 3 of Gali (2008)?

Question 3 The standard ordering restriction used by Christiano et al. (1999) has often been criticized in the literature. An alternative is to use sign-restrictions, which are theoretically consistent. For instance, demand, cost-push and monetary policy shocks can be identified by imposing the restrictions summarized in Table 1, which can be easily derived from a standard New Keynesian DSGE model.

Table 1

| | *Demand* | *Cost-Push* | *Monetary Policy* |
|---|---|---|---|
| $y_t$ | + | - | - |
| $p_t$ | + | + | - |
| $i_t$ | + | + | + |

Impose the restrictions for the first 6 months after the shock (i.e., month 0 to 5). Plot the impulse responses for 1000 random rotation matrices that satisfy the sign-restrictions. Compare the responses to those obtained in Question 1 (Part 2).

Question 4 Another investigator wishes to remain 'agnostic' about the impact response of aggregate activity after a monetary policy shock. Believing in the inertial transmission of the monetary policy shock, he is willing to restrict the response of industrial production (to negative) with a delay of 6 months (i.e., restrict the response from month 6 to month 11 after the shock). All the other restrictions are the same as in the previous question. Plot the impulse responses for 1000 random rotation matrices that satisfy the sign-restrictions and compare them with the ones obtained in Question 3 (Part 2).

# References

[1] Christiano L., M. Eichenbaum and C. Evans, 1999, "Monetary Policy Shocks: What Have We Learned and to What End?", In: Taylor J.B. and Woodford M. (Eds.), *Handbook of Monetary Economics*, Elsevier, Amsterdam, pp. 65-148.

[2] Gali, J., 2008, "*Monetary Policy, Inflation, and the Business Cycle*", Princeton University Press, Princeton, New Jersey.

[3] Monacelli, T., 2009, "New Keynesian Models, Durable Goods, and Collateral Constraints", *Journal of Monetary Economics*, Volume 56:2.