博士論文審査結果報告
Report on Ph.D. / Doctoral Dissertation Defense

National Graduate Institute for Policy Studies (GRIPS)
政策研究大学院大学
Professor LEON-GONZALEZ Roberto

審査委員会を代表し、以下のとおり博士論文審査に合格したことを報告します。
On behalf of the Doctoral Dissertation Review Committee, I would like to report the pass result of the Doctoral Dissertation Defense as follows.

プログラム名 Program	政策分析プログラム Policy Analysis Program	
学位申請者氏名（ID） Ph.D. Candidate (ID)	Baiaman Kyzy Elnura (PHD19303)	
Dissertation Title 論文タイトル (タイトル和訳)	Nonlinear Analysis and Estimation of Dynamic Stochastic General Equilibrium Models ヘテロジニアス・エージェント動学的マクロモデルの非線形解析と推定	
学位名 Degree Title	博士（公共経済学） Ph.D. in Public Economics	
論文提出日/ Submission Date of the Draft Dissertation	2023 年 5 月 9 日/ May 9, 2023	
論文発表・審査会開催日/ Date of the Defense and the Doctoral Dissertation Review Committee	2023 年 6 月 6 日/ June 6, 2023	
論文最終版提出日/ Submission Date of the Final Dissertation	2023 年 8 月 23 日/ August 23, 2023	
審査委員会/ Doctoral Dissertation Review Committee	主査 Main referee	LEON-GONZALEZ Roberto
	審査委員 Referee	藤本　淳一 FUJIMOTO Junichi
	審査委員 Referee	松本　英彦 MATSUMOTO Hidehiko
	審査委員 Referee	Gianni Amisano (Assistant Director and Chief of the Current Macroeconomic Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System)
	審査委員（博士課程委員会） Referee (Doctoral Programs Committee)	隅藏　康一 SUMIKURA Koichi

※ タイトルが英文の場合、文部科学省に報告するため、和訳を付してください

Please add a Japanese title that will be reported to MEXT.

1. Summary of Defense and Evaluation

This dissertation proposes a new method to estimate nonlinear Dynamic Stochastic General Equilibrium (DSGE) models. The method allows the estimation of models that could not be estimated before. The DSGE models are useful for analyzing the impact of monetary and fiscal policy on the economy. The dissertation shows the usefulness of the new approach by estimating two DSGE models with US and Korean data. One of these two models is a new model that the candidate developed, and which captures heterogeneity among households. Specifically, one type of household has access to credit and the other does not. Similar models have been proposed in the literature, but the candidate analyzed and estimated this model nonlinearly, thereby contributing to the literature.

The final defense took place the 6th of June of 2023. The examiners provided 33 comments for revision. The candidate worked to incorporate the comments from the examiners as much as possible, and submitted the final version on the 23rd of August of 2023. I supervised her progress with the revisions and consider that she did them appropriately. She provided a detailed description of how she incorporated the comments, which I attach to this report. I therefore recommend that the candidate be awarded the degree of PhD in Public Economics.

2. Dissertation overview and summary of the presentation.

This dissertation investigates the estimation of Dynamic General Equilibrium models (DSGE) solved using a nonlinear approximation. The DSGE model has been widely used as a theoretical framework for the study of the business cycle and monetary and fiscal policy. To solve DSGE models, it is common practice in macroeconomics to use linear methods to approximate solutions of nonlinear DSGE models. Therefore, the linearization of DSGE models has become a standard tool for the approximation of solutions to the dynamic optimization problem (DOP) in the DSGE model. Linearization is typically obtained by using only the first term of a Taylor expansion around the steady state of the log of the equations representing the first-order conditions of the dynamic optimization problem. This method makes it possible to use formal statistical methods to estimate and test DSGE models. However, the linearization of this class of models also has a cost: some questions, such as welfare evaluation and risk premia in stochastic environments, cannot be fully addressed in a linearized model.

In the first study, this dissertation proposes a new likelihood-based approach using perturbation methods to estimate nonlinear DSGE models. The new method implicitly uses a nonlinear approximation to the policy function that is invertible with respect to the shocks, implying that in the approximation, the shocks can be recovered uniquely from some of the control variables. Based on this approximation, the likelihood can then be obtained by using a

standard change of variables theorem and a Lagrange inversion formula. This technique is implemented to estimate the DSGE model. In contrast with previous likelihood-based approaches, the method developed here allows for unobserved non-stochastic state variables and requires neither additional shocks nor simulation to evaluate the likelihood. Using US data, the proposed approach is used to estimate the well-known neoclassical growth model of Fernandez-Villaverde (2010). In addition to the baseline model, versions of the model in which the structural shocks have time-varying variances are also considered. It is found that a

nonlinear heteroscedastic model has much better empirical performance. It is a better fit for the observed data than the linearized model. In addition, it is found that the monetary policy shock primarily drives the time changes in the uncertainty in the economy.

The second study develops a more general New Keynesian model with limited heterogeneity featuring two agent properties, referred to in the macroeconomic literature as the Two-Agent New Keynesian (TANK) DSGE model, and estimates the model using the method developed in the first study. The proposed model incorporates technology, monetary and fiscal shocks. The model features price and wage rigidity dynamic and capital adjustment cost. This work argues for the importance of explicitly considering nonlinearities when analyzing the behavior of the TANK DSGE model. Thus, the nonlinear estimation method developed in the first study is used. This study uses quarterly aggregate Korean data for 1999 Q4—2021 Q4.

It if found that the nonlinear model has a better empirical performance than the linear model. Similar to previous literature, it is found that the government expenditure shock has an expansionary effect on consumption and output. However, this effect differs for different types of households. It is also found that distortionary taxation has a crowding-out effect, and a contractionary monetary policy shock can effectively curb inflationary pressures in the economy.

In summary, the dissertation investigates the estimation of DSGE models using the nonlinear approximation of order two and proposes a new likelihood-based approach to estimate them. The studies reported here demonstrate the methodology's effectiveness and provide insights into the model under a different framework.

3. Evaluation Notes from the Doctoral Dissertation Review Committee (including changes required to the dissertation by the referees)

The final defense took place the 6th of June of 2023. In total the examiners provided 33 points for revision. I attach a document where the candidate explains how she incorporated the comments in the revised version of the thesis.

Some of the comments were as follows:

Comment 3: p45, Figure 2.1: I am concerned that the impulse responses from M2 differ considerably from those from other three models (see, e.g., aggregate consumption and investment). I suggest double-checking the accuracy of the code.

Comment 19: As a policy implication, she describes "Nonlinear DSGE models can afford a better understanding of the sources of uncertainty in the economy." Additionally, to theoretical explanation in the current version of her thesis, in order to clarify original contribution of the thesis, it is recommended to suggest one or more concrete policy issues that could not be estimated by prior models and to which her new models are applicable.

Comment 23: The crucial contribution of the thesis is the method to compute the likelihood. It looks really interesting and promising, but:

  • It is not really clear how it works in practice. Could you provide an example with a scalar model?

  • How well the approximation works in practical circumstances?

  • For instance, can we say that the likelihood computations are unbiased or correct on average?

  • How do approximation errors made when computing the conditional likelihood of each observation cumulate throughout the sample?

  • In order to shed light on these aspects, it would be great if Ms Elnura could provide a

practical example, maybe based on the simple homoscedastic model that Amisano and Tristani (2011) use to explain their procedure.

• In that case the likelihood can be obtained recursively and compared with the likelihood computed using Ms Elnura's method.

• Another possibility would be to use a dsge specification that is compatible with running the particle filter and with Ms Elnura's procedure and see if they produce the same likelihood computations.

Comment 33: In section 4.3 the author calls "uncertainty shocks" shocks with GARCH properties. I am not sure it is appropriate.

• When I think about uncertainty shocks, I think about a SEPARATE shock that changes the volatility of shocks affecting the level of variables. In a GARCH word, shocks to the level automatically change uncertainty, in other words all shocks are uncertainty shocks. Maybe it is just a semantic thing…

4. Confirmation by the Main Referee that changes have been done to the satisfaction of the referees and final recommendations

The candidate worked to incorporate the comments from the examiners as much as possible, and submitted the final version on the 23rd of August of 2023. I supervised her progress with the revisions and consider that she did them appropriately. I therefore recommend that the candidate be awarded the degree of PhD in Public Economics.