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How costly is a misspecified credit channel DSGE model in monetary policymaking?

Takeshi Yagihashi[1]

Old Dominion University, Economics Department, 2021 Constant Hall, Norfolk, VA 23529, United States

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ABSTRACT

This paper examines whether misspecification in credit market friction could be costly in the context of monetary policymaking. Using two widely known dynamic stochastic general equilibrium (DSGE) models, we simulate a hypothetical financial crisis and examine how each model performs when the misspecification occurs in the credit channel. We demonstrate that monetary policy suggested by misspecified models tends to destabilize the economy during crisis, even though one of the two models does reasonably well in estimating policy-invariant model parameters. We also show that the opportunity cost of using a misspecified model is high relative to the outcome achieved under a correctly specified model, particularly when public financial intermediation is available in the correctly specified model. Introducing labor-related variables in either the monetary policy rule or stabilization objectives has the potential of improving policy outcomes in the misspecified credit channel model.

1. Introduction

Since the global financial crisis of 2008, many economists have claimed that the environment in which monetary policy operates has drastically changed (Blanchard et al., 2010; Caballero, 2010; Quadrini, 2012). In particular, it has become evident that the monetary transmission mechanism through the supply of credit ("credit channel") matters greatly in times of financial crisis. This has led many central bankers to adopt credit channel models in their routine policy analysis.[2]

Around the same time, we have also witnessed the surge of a new generation of credit channel models, as seen in Adrian and Shin (2010), Cúrdia and Woodford (2010a) ,Cúrdia and Woodford (2011), He and Krishnamurthy (2013); Hollander and Liu (2016), and Meh and Moran (2010). These models commonly feature financial institutions along with detailed balance sheet structures. Such changes are mainly motivated by developments in the financial sector observed during and after the financial crisis. This new modeling practice stands in sharp contrast to the earlier generation of credit channel models, in which the role of financial institutions remained mostly passive or obscured.[3]

Given the numerous ways to specify the credit channel, it has become ever more important to consider *what type of* credit market frictions are more relevant in the context of monetary policymaking. To answer this question, we utilize two dynamic stochastic general equilibrium (DSGE) models that are widely known in the literature. The first model is Bernanke et al. (1999, BGG) credit channel model, which assumes that lenders do not know the productivity of individual borrowers and need to pay agency costs in order to verify the financial state of the borrowers. The second model is Gertler and Karadi's (2011, GK) credit channel model, which assumes that borrowers cannot commit themselves in honoring the loan contract and hence become constrained in their ability to obtain funds. Both models generate a similar feedback loop between the real and the financial sectors ("financial accelerator effect"), with the strength of the feedback loop being dependent on the borrower's balance sheet conditions. This core mechanism of the two models matches well with the deleveraging of the financial sector and unstable overall economy observed during the recent financial crisis. However, these models take different approaches in motivating the underlying credit market friction, which makes the endogenous variables behave differently.

The purpose of our paper is to examine how each model performs as a policy-guiding tool ("approximating model," or AM). Using the *other* credit channel model as the "data-generating model" (DGM), we simulate a hypothetical financial crisis that increases the volatility of

E-mail address: tyagihas@odu.edu.

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[2] In the pre-crisis era, it was customary to use arbitrary dynamic equations as proxies for "credit constraints, house price effects, confidence and accelerator effects" (Harrison et al., 2005). For more details on past practice in the central bank community, see Coenen et al. (2007) and Erceg et al. (2006).

[3] For a few exceptions, see Chari et al. (1995); Goodfriend and McCallum (2007).

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key endogenous variables. In our paper, the approximating model is treated as "misspecified" if it does not fully match the data-generating model.[4] The role of the approximating model is twofold. First, it is used to estimate model parameters, using a maximum-likelihood-based estimation method. Second, it is used to calculate the optimized policy rule parameters that minimize the quadratic welfare loss measure, while using the parameter estimates in the first step as input. Because the approximating model suffers from the credit channel misspecification by construct, the resulting policy outcomes will be necessarily worse than those obtained if the model used in policymaking were correctly specified. The associated cost of credit channel misspecification is assessed as follows: First, we examine how the monetary policy rule suggested by the misspecified approximating model ("AM-optimized policy rule") affects the welfare loss measure across different phases of crisis. Second, we compare the outcomes of the AM-optimized policy rule with the outcomes of the monetary policy rule suggested by the correctly specified model ("DGM-optimized policy rule").

Our main results can be summarized as follows: First, both models generate AM-optimized policy rules that further increase the welfare loss in the DGM, contrary to the original intention by the policymaker. This occurs *despite* the fact that the parameters estimated using the misspecified BGG model remain relatively stable over different phases of the financial crisis. Second, when comparing the welfare losses achieved under the AM-optimized policy rule with those achieved under the DGM-optimized policy rule, we find that the former is considerably larger than the latter, suggesting that the opportunity cost of model misspecification is economically significant. We further examine whether the use of a more flexible monetary policy rule with additional variables or reassigning alternative stabilization objectives as suggested by Rogoff (1985) would improve the performance of the AM-optimized policy rule. We find that if the policymaker were equipped with the misspecified BGG approximating model, he can successfully stabilize the economy by either adding wage rate in the Taylor rule or adding labor as part of the stabilization objective.

This paper makes several contributions to the monetary DSGE literature. First, the paper finds that the BGG model, widely used by many central banks, is mostly immune to the parameter invariance problem *a la* Lucas (1976). This finding is important because it is customary in the empirical DSGE literature to interpret the change in model parameters as structural changes rather than the consequence of model misspecification (e.g., Canova, 2009; Smets and Wouters, 2005). Second, our paper provides a detailed analysis of how the use of "unconventional" monetary policy affects model performance when credit channel misspecification is present. In particular, we show that if public financial intermediation is available to the monetary policymaker, it would help significantly in improving the policy outcome as opposed to when the policymaker is restricted to using a more conventional Taylor-type rule. Third, the type of model misspecification we examine in this paper differs from existing studies. It is customary in the literature to treat one of the two models as the more "structural" one over the other.[5] We follow a more agnostic approach by altering the role of the two models in terms of generating data. Our approach is useful for policymakers who wish to refine their model by incorporating several off-the-shelf models when they do not know how robustly each model performs under potential misspecification.

Finally, using a simulation method to assess the cost of a misspecified credit channel model has advantages over methods that work with observed data. Empirical studies on DSGE models usually utilize long time-series data to identify model parameters, but observed data necessarily cover both crisis and non-crisis periods, making it difficult to assess model performance across different phases of the crisis.[6] At a more technical level, our approach focuses on the asymptotic performance of the model based on the Kullback-Leibler Information Criterion (aka *KLIC*), which helps to isolate the effect of model misspecification from uncertainties that may arise from a limited sample period.

Methodologically, this paper is close to two studies (Cogley and Yagihashi, 2010; Chang et al., 2013) that also use a simulation method to assess model performance when misspecification is present. However, this paper differs from them in two aspects. First, their studies calibrate policy shifts based on historical episodes in the US. In Cogley and Yagihashi (2010), policy rule parameters before the policy shift were selected to resemble the accommodative policy stance of the Federal Reserve before the Volcker disinflation started in 1980. Chang et al. (2013) prepared several combinations of their capital/labor tax rates that corresponded to the historical values in the United States that were realized during the period 1950-2003. This paper instead uses an "optimized" policy rule directly calculated from the model. In our view, this provides a cleaner laboratory for assessing how the misspecified model performs in the context of policymaking.[7] Second, the aforementioned studies use models with a relatively small number of equations in their simulation, whereas the models examined in this paper match the "medium-scale" DSGE model *a la* Smets and Wouters (2005), Smets and Wouters (2007) and Justiniano et al. (2010), which is now the standard practice in monetary policy analysis. Thus, our results can be easily compared with more recent studies that worked with similar models.

Our paper is organized as follows. The next section explains the simulation design. The third section provides the main results and the cost of misspecification. The fourth section conducts additional experiments on how to overcome the cost of misspecification. The last section summarizes this study and draws several conclusions.

2. Simulation design

2.1. Models

We use the Bernanke et al. (1999 BGG) model and Gertler and Karadi's (2011, GK) model as the two representative credit channel models. Below we will briefly describe the rationale for choosing these models and review their key mechanisms.

2.1.1. Selection of the credit channel models

The BGG model received broad attention from monetary policymakers during the recent financial crisis. In January of 2008, the Federal Reserve governor Mishkin stated in his speech that the financial accelerator mechanism featured in the BGG model describes well the nature of macroeconomic risks that the monetary policymaker faces (Mishkin, 2008). Many central banks, such as the European Central Bank, the Bundesbank, and the Riksbank, have now formally incorporated the BGG-style credit channel into their DSGE models (Gerke et al., 2013). Several empirical studies have further shown that the credit market friction in the BGG model is empirically relevant.[8] The BGG model has become one of the most widely used credit channel models within and outside the academic community.

[4] This means that we deviate from the practice of treating all models as misspecified in the sense that they inherit deviation from the reality in some way or the other.

[5] See for example, An and Schorfheide (2007); Canova (2009); Canova and Sala (2009); Chang et al. (2013); Cogley et al. (2011); Cogley and Yagihashi (2010); Fernandez-Villaverde and Rubio-Ramirez (2007); Hurtado (2014); Leeper and Sims (1994); Lubik and Schorfheide (2004); Lubik and Surico (2010); Rudebusch (2005).

[6] For example, Villa (2016) examines how well the BGG/GK models fit the data by utilizing the time-series data for the period 1983q1-2008q3.

[7] It should be noted that the monetary policy we consider in this paper is restricted to a certain type of simple feedback rule that is popularized within the monetary DSGE literature. It is *not* the "first-best" policy that the fully-informed policymaker would freely choose to replicate the resource allocation in a decentralized, frictionless economy.

[8] See for example, Christensen and Dib (2008), Christiano et al. (2014), and Merola (2015).