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Doctoral Dissertation Review

Thesis Title: "Does the Long Term Interest Rate Drive GDP in a Small Open Economy? Evidence from Poland"

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This doctoral dissertation studies whether movements in the long-term interest rate affect output fluctuations using a DSGE model estimated with data for Poland. In particular, the thesis shows that the long rate includes a time-varying premium referred to as "term premium," and that this premium works to attenuate (i.e. stabilize) output fluctuations.

The thesis includes eight chapters and an appendix with mathematical derivations. The first chapter provides motivation and introductory remarks. Chapters 2 and 3 are devoted to a literature review and an empirical application of macro/finance work on long rate premia, particularly the expectations hypothesis and its failure. The thesis reaches two main conclusions from these chapters: First, the NeoKeynesian DSGE model with segmented financial markets and imperfect substitutability of assets "should be the most appropriate to estimate the impact of the term premium on a small open economy" (p.23). Second, the empirical application based on data for Poland shows that there is a partial failure of the expectations hypothesis of the long rate premium (the expectations hypothesis is rejected for horizons beyond four years). Since DSGE models typically assume implicitly that the expectations hypothesis holds, the author concludes that those models ignore the potentially important effects of deviations from the expectations hypothesis on macro dynamics, and thus sets as the main goal of the thesis to study these effects. These two chapters are nicely put together and work well to define the empirical regularities that motivate the hypothesis of the dissertation. The conclusion that a NeoKeynesian DSGE model with segmented markets and imperfect asset substitution "should be the most appropriate" seems a bit too strong, and not a conclusion that can be defended substantively with just a literature review. It is quite fair to say, however, that it is worth investigating the effects of the time-varying term risk premia on macro dynamics using a NeoKeynesian DSGE model augmented with those features, and move on to the analysis without a more "absolute" judgement about which model to use.

Chapters 4 and 5 develop the DGSE model and conduct the estimation. The key innovation is in the introduction of modifications that allow the model to capture deviations from the expectations hypothesis on long rate premia and their effects on macro dynamics. At equilibrium, arbitrage conditions in bond markets and financial frictions imply that the term premium responds to endogenous variables and an exogenous shock, which can be viewed as capturing exogenous movements in world capital markets that impact market sentiment or risk aversion. To model long-term, time-varying premia driven by arbitrage conditions, the framework requires multiple bond maturities and frictions in portfolio choice. There are three types of nominal bonds: long- and short-term domestic bonds and foreign long-term bonds. Bond markets are segmented by assuming that there are two types of households with different access to these markets: Unrestricted households, who can buy all bonds, and restricted households, who participate only in the market of domestic long-term bonds. In addition, bonds are made imperfect substitutes by assuming that unrestricted households incur transaction and adjustment costs for participating in the market of international long-term bonds.

The transaction and adjustment costs are key to model the endogenous and exogenous determinants of the time-varying risk premium. The transaction cost that unrestricted agents pay for buying long-term domestic bonds is proportional, and enters as a multiplicative, time-varying, exogenous shock to the nominal interest rate on these bonds. The adjustment cost is quadratic and modeled in a way analogous to capital adjustment costs. The cost is incurred when the ratio of international to domestic long-term bond holdings deviates from a target or "preferred" ratio. With the two costs in place, the arbitrage conditions of unrestricted households (log linearized) yield a term-structure condition that makes it explicit how the model produces deviations from the expectations hypothesis. These deviations have two components. One is simply the exogenous transactions cost shock, which is time-varying because the shock fluctuates over time. The second is proportional to the difference between foreign and domestic long-term bond holdings of unrestricted households, with the factor of proportionality given by the adjustment cost coefficient (normalized by the size of bond holdings and discounted marginal utility). This second component fluctuates endogenously as it depends on bond holdings and marginal utility.

Three caveats about the model: First, a limitation of DSGE models solved by perturbation methods, as in this dissertation, is that they have difficulties in handling the failure of certainty equivalence that emerges in models of incomplete financial markets. In particular, Euler equations like eq. (6) in p. 38 cannot support stochastic stationary equilibria when the rate of time preference equals the real interest rate (as in eq. (70) of p. 104). In this scenario, the optimal self-insurance behavior implied by the incompleteness of asset markets drives agents to accumulate an infinitely large stock of bonds (mathematically, the Euler equation forms a supermartingale, and by the supermartingale convergence theorem we obtain that convergence requires an infinitely large stock of bonds). In a small open economy, the real interest rate in the long run must remain below the rate of time preference for the model to attain a well-defined stochastic stationary state, and the average of bond holdings is largely determined by self-insurance behavior (which typically requires global solution methods). On the other hand, global methods are not suitable for NeoKeynesian DSGE models because of the curse of dimensionality, so it would not be practical to apply them in this dissertation. Hence, the recommendation is not to move to a different solution method, but to acknowledge the limitations of the solution method being applied, and explain how it may relate to the key results of the analysis about the effects of the time-varying term premium on macro dynamics.

The second caveat is that the model assumes that the expectation hypothesis holds in world financial markets (i.e. in the market where the price of long-term external bonds is determined). This can be seen as an odd assumption, because if time-varying risk premia truly result from asset market segmentation and transaction and adjustment costs for asset trading, it is difficult to rationalize why similar frictions would not be affecting global markets. If the world consists of a large set of similar small open economy models, this would certainly be the case. Perhaps a robustness check allowing the world interest rate to display a time-varying premium would be a good way to address this issue.

The third caveat is that the model abstracts from modeling capital accumulation. The main finding that long-term premium fluctuations dampen GDP fluctuations could be sensitive to this assumption. One can imagine that investment expenditures (including residential investment) are more sensitive to long-term interest rates than to short-term interest rates. Hence, it is natural to wonder if the result that GDP fluctuations are dampened would hinge on this assumption.

An additional caveat is that it would be useful to go through the entire thesis and check for typos and inconsistencies in the notation. For example, eq. (9) in p. 38 and eq. (91) in p. 109 should be identical, but they are not (is "d" the same as $b^{U,L}$?). Also, in some of the equations there is a "beta" with a superscript "L". Is this the same as the beta without it? These are just two examples, but it would be best to clean up and/or clarify the notation throughout.

Overall, Chapters 4 and 5 are also very nicely put together and reflect the strong skills of the author as a modeler and his creativity at developing a variant of the NeoKeynesian DSGE model that can accommodate a time-varying premium in the term structure as an equilibrium outcome. It would

be very nice to have deeper microfoundations for the two costs that drive the premium, but on the other hand the author is already doing a lot with the formulation proposed in the thesis, and following the same approach that DSGE models typically use to set aside deeper microfoundations to favor model flexibility and tractability.

Chapters 6 and 7 are the most important chapters of the dissertation, particularly Chapter 6, which deals with analyzing the role of the term premium in driving macro dynamics. Once this role is established, Chapter 7 deals with an analysis of optimal monetary policy that takes into account long-term interest rates.

Chapter 6 does an excellent job at studying separately the effects of the exogenous term premium fluctuations (i.e. the transactions cost shock) v. the effects of the endogenous mechanism implied by the presence of both transactions and portfolio-adjustment costs. Exogenous term premium shocks have played a negligible role in driving GDP fluctuations (figure 8, p. 64), but it is also clear that they have a dampening effect that reduces GDP for about three years before the effect washes out (fig. 11, p. 66). To examine the effects of the endogenous term-premium mechanism, the author examines the implications of switching off both financial costs present in the model. A key result is that output and consumption volatility increase by 36% and 60% respectively when the term-premium mechanism is fully removed. Hence, term-premium movements dampen business cycles. The author then goes through a careful analysis to understand the features of the model behind these results, including an analysis of impulse response functions for the various shocks driving the model and historical v. counterfactual time-series simulations. The main finding is that output volatility is dampened as the volatility of the exchange rate and the long-term interest rate increase, and that these two work specially to dampen the effects of shocks affecting the risk premium and export demand.
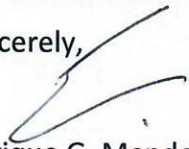
Chapter 7 is very short and shows that the optimal monetary policy rule is not significantly affected by the inclusion of the term-premium in the Taylor rule. This is due to the fact that the term premium does not add significant additional information that is not already captured in the Taylor rule. An alternative policy question that would be worth studying is whether the monetary authority would want to take advantage of the dampening effect of long-term premium variations to reduce output volatility by affecting directly long-term rates (as in the U.S. experience with "operation twist").

Overall, Chapters 6 and 7 are very strong and provide substantive quantitative, theoretical and empirical evidence to validate the conclusions of the dissertation. A stand-alone paper made of some of the elements of Chapters 4 through 7 should have very high potential to be publishable in a well-established academic journal.

The main finding that the financial frictions examined in this thesis provide a mechanism that dampens output fluctuations offers an interesting contrast with other recent and ongoing research efforts in the macro/finance field that are attempting to build amplification mechanisms by adding financial frictions into DSGE models. It would be interesting to provide some arguments to compare these approaches and provide some intuition for what makes modeling of financial frictions produce dampening v. amplifying mechanisms.

In summary, I believe this dissertation is a very solid and well-executed project of innovative research that makes an interesting contribution in the field of quantitative macro/finance. It uses state-of-the-art tools and provides strong theoretical, empirical and quantitative arguments to substantiate its findings. It is a high-quality research product that certainly fulfills the dissertation requirement for a doctoral degree.

Sincerely,

Enrique G. Mendoza