FINANCIAL FRICTIONS IN DSGE MODELS

Macro-Prudential Regulation

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September 11, 2020

Four Policy Regimes

- Rules considered depend on whether the policymaker can *commit*, or she exercises *discretion* and engages in period-by-period optimization.
- With commitment the welfare-optimal policy is the solution to the *Ramsey problem*; but this is *not time-consistent* in RE models: with the mere passage of time initially optimal policy becomes sub-optimal.
- The Ramsey solution is not the same thing as the *social planner's problem* in any model with some market failure.
- In the absence of commitment the policymaker optimizes period-by-period - the *discretionary solution*. This is sub-optimal.
- Even with commitment the policymaker may be constrained to *simple rules* (e.g., Taylor-type rules)
- Rationale for simplicity: transparency, information available and ease of implementation

NK Model with JR Preferences

- The SW NK model up to now with basically a CD household utility function displays a strong *wealth effect* in response to a positive technology shock.
- As a result household reduce their hours relative to the steady state and “consume” more leisure.
- Hours and output then do *not co-move*, as in the data.
- The following alternative functional form for utility found in Jaimovich and Rebello (2008) controls the wealth effect:

$$\begin{aligned} U_t &= \frac{(C_t - \kappa H_t^{\theta}\Xi_t)^{1-\sigma_c} - 1}{1-\sigma_c} \\ &\to \log(C_t - \kappa H_t^{\theta}\Xi_t) \text{ as } \sigma_c \to 1 \\ \Xi_t &= C_t^{\gamma}\Xi_{t-1}^{1-\gamma}\,; \quad \gamma \in [0,1] \end{aligned}$$

JR Preferences: Calibration of Parameters

- There are three parameters to calibrate: κ, θ and γ:
- Parameters are κ and θ are calibrated to target $\bar{H}$ (as we did using ϱ with the Cobb-Douglas function previously) and the Frisch elasticity as in Holden *et al.* (2018)
- This leaves γ as a free parameter to control for wealth effects
- Note that the CD utility function is less flexible in that it can only target one steady state outcome $H = \bar{H}$ whereas the JR utility function can target the Frisch elasticity as well.

JR Preferences: Household foc

- From Appendix 1.1, the household first-order conditions now become:

$$\text{Euler Consumption} : 1 = R_t \mathbb{E}_t \left[\Lambda_{t,t+1} \right]$$

$$\text{Stochastic Discount Factor} : \Lambda_{t,t+1} \equiv \beta \frac{\lambda_{t+1}}{\lambda_t}$$

$$\text{where} : \lambda_t = U_{C,t} - \gamma \mu_t \frac{\Xi_t}{C_t}$$

$$\text{and} : \mu_t = -U_{\Xi,t} + \beta(1-\gamma)\mathbb{E}_t \frac{\mu_{t+1}\Xi_{t+1}}{\Xi_t}$$

$$\text{Labour Supply} : \frac{U_{H,t}}{\lambda_t} = -W_t$$

- Investment and capital supply foc as before
- The following irfs to a technology shock show how wealth effects are reduced by reducing γ. Note that $\gamma > 0$ is required for a bgp.

Macro-Prudential Policy

- The GK model with outside equity can be used to examine the effects of financial macro-prudential regulation alongside conventional monetary policy.
- We consider a rule that directly regulates capital requirements in the form of the inverse of *leverage* ($lever_t$), defined as the proportion of total loans to inside equity (net worth) plus outside equity defined as:

$$lever_t = \frac{Q_t K_t}{N_t + q_t E_t}$$

- Exercise is illustrative: Parameter Values are those set in the GK Section and are not those estimated subsequently

Direct Regulation of Outside Equity

- Then rules take one of two forms:

$$\log\left(\frac{lever_t}{lever}\right) = \rho_{lever}\log\left(\frac{lever_{t-1}}{lever}\right) - lever_y \log\left(\frac{Y_t}{Y}\right) + lever_{spread}\log\left(\frac{1+\text{spread}_t}{1+\text{spread}}\right) \tag{1}$$

$$\log\left(\frac{lever_t}{lever}\right) = \rho_{lever}\log\left(\frac{lever_{t-1}}{lever}\right) - lever_y \log\left(\frac{Y_t/Y}{Y_t^F/Y^F}\right) + lever_{spread}\log\left(\frac{1+\text{spread}_t}{1+\text{spread}}\right) \tag{2}$$

- With $lever_y, lever_{spread} > 0$, leverage is require to respond counter-cyclically (pro-cyclically) to output (spread)
- Spread $\equiv R_t^K - R_t$ as before.
- The rule then replaces the bank's first-order condition for the decentralized choice of $x_t \equiv \frac{q_t E_t}{Q_t S_t}$, $(1+\lambda_t)\mu_{e,t} = \Theta_t' \lambda_t$.

A Regulatory Rule in the GK-equity Model

feedback	Welfare	E	Spread	Y	R_n	SD(E)	SD(lever)
No MPR	-405.47	0.567	0.0044	0.146	1.0634	0.153	0.475
0.1	-406.07	0.555	0.0045	0.145	1.065	0.283	0.054
1.0	-406.60	0.249	0.00472	0.144	1.066	0.529	0.542

Table: **A Regulatory Rule in the GK-equity Model.**

The table reports ergodic means except where SDs are indicted. External Habit and Standard Taylor Monetary Rule. feedback$=lever_y = lever_{spread}$. $\rho_{lever} = 0.7$

- Second-order perturbation solution
- We see a marked increase in the volatility of equity which for higher values of the feedback coefficients involves a significant *welfare cost*.
- But for a given MPR rule of thus form, feedback$=lever_y$, $lever_{spread}$ and ρ_{lever} can be chosen to be *welfare-optimal*.

A Welfare-Optimal Regulatory Rule

feedback	Welfare	CE Cost of MPR	SD(lever)
No MPR	-405.47	0	0.475
0.1	-406.07	0.1276	0.054
0.17	-406.0623	0.1260	0.092
0.18	**-406.0622**	**0.1259**	0.095
0.19	**-406.0622**	**0.1259**	0.103
0.2	-406.06	0.1260	0.108
0.3	-406.07	0.1276	0.163
0.4	-406.10	0.1340	0.217
0.5	-406.14	0.1425	0.271

- Given the rule, $\rho_{lever} = 0.7$ and $lever_y = lever_{spread}$, the welfare optimal outcome is where $lever_y = lever_{spread} = 0.18 - 0.19$.
- An optimized rule over $lever_y$, $lever_{spread}$ and ρ_{lever} can be found using the matlab minimization routine, **fmincon**
- A 1% permanent increase in consumption gives a welfare gain of 4.7026 - see next slide

Welfare and Consumption Equivalent Calculation

- In *stationarized form* (See Section 2.6.1 of notes) with a shock to trend, the intertemporal welfare is given by

$$\begin{aligned} \Omega_t &= U_t + \mathbb{E}_t\left[(1+g_{t+1})\beta_{g,t+1}\Omega_{t+1}\right] \text{ where} \\ \beta_{g,t} &\equiv \beta(1+g_t)^{-\sigma_c} \text{ (growth-adjusted discount factor)} \end{aligned}$$

- Given a particular equilibrium for C_t and H_t and single-period utility, $U_t = U(C_t, C_{t-1}, H_t)$, compute CE, the increase in the given by a 1% increase in consumption, by defining the variable:

$$\begin{aligned} CEequiv_t &\equiv U_t(1.01\, C_t, 1.01\, C_{t-1}/(1+g), H_t) - U_t \\ &+ \mathbb{E}_t\left[(1+g_{t+1})\beta_{g,t+1} CEequiv_{t+1}\right] \end{aligned}$$

- Then we use the deterministic steady state of $CEequiv_t$, $CEequiv$, to compare welfare outcomes.
- Then for two welfare outcomes, W_1 and W_2, we define $ce \equiv \frac{W_1 - W_2}{CEequiv}$ reported in Table above.

Discussion

- Third order approximations to the perturbation solution (or even global solutions) are required to incorporate time-varying risk (see Dewachter and Wouters (2014)).
- One can optimize with respect to the feedback and persistence parameters in the rule.
- But since optimized simple rules depend on the variance-covariance matrix of shocks an *estimated* form of the model should be used.
- The main purpose of the MPR rule is to reduce the risk of a systemic default is not explicitly modelled.
- What we show are the costs of MPR given that it is desirable and implemented through a rule such as (1).

Dynare Codes

- The code for the material of this section is in the folder **Policy**.
- The exercise in the two tables above is carried out in **GK_equity_MPR.mod** with an option to turn off MPR and replace the rule with the bank's first-order condition for the decentralized choice of x_t, $(1+\lambda_t)\mu_{e,t} = \Theta'_t \lambda_t$.

Exercises

1. Use the graph plotter to compare of the GK model with and without MPR. In the former case choose the upper limit of the feedback parameter.
2. Rework the two tables above with an implementable monetary rule. What do you notice?

Conclusions and Future Research

- This one-day Course has covered a range of banking models suitable for incorporation into a DSGE modelling framework.
- The course has covered both theory and practical implementation. DO READ THE NOTES!
- We have shown how to set the models up in Dynare to perform second-order perturbation solutions, estimate the models and carry out monetary and macro-prudential policy exercises.
- The models can be generalized to the small open economy interacting with the ROW (see Surrey Easter Course).
- For the needs of a central bank in the Euro-zone the ROW can be the Euro-zone
- More generally, modelling financial frictions is a very active area of current research.
- This Course has hopefully provided you with the tools necessary to participate in this agenda.

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