Smets-Wouters Model

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Background

- Based on Christiano, Eichenbaum and Evans (JPE, 2005).
- No emphasis on optimal policy, but there is a monetary policy rule.
- Pitched against the RBC models, not with Clarida, Gali, Gertler, Monacelli etc. It is a serious challenge of the RBC models.
- It has both price and wage rigidities. Includes private investment and government spending.
- It allows many shocks, 2 preference shocks, labor substitutability shock, intermediate-goods substitutability shock and aggregate productivity shock (standard), goods mark-up or cost push shock (standard), shocks to investment cost, monetary policy rule shock (as in Christiano-Eichenbaum and Evans), fiscal policy etc.
- Outcomes: (a) produces a lot of inertia including that of inflation; (b) "matches up" with data.
- It has become a work-horse.

Model Structure

- Closed economy.
- Households derive utility consumption *relative to their habits* and disutility from work.
- Differentiation of labor; each household provides a particular brand of labor - monopolistically competitively.
- Wages are "Calvo-sticky."
- Various kinds of labor are used produce differentiated intermediate goods. Its production requires labor and (homogeneous) capital.
- These goods produce a single final good. Each intermediate good producer is monopolistically competitive supplier.
- Intermediate good prices are "Calvo-sticky."
- Differentiated labor and capital $\rightarrow$ Differentiated Intermediate goods $\rightarrow$ A homogeneous final good

Model Structure Continued

- Households save and convert part of their savings to capital by a household technology, which has adjustment costs. They rent out their capital to the intermediate-good sector. They also choose total amount of savings or investment and capital utilization rate also.
- The other part of savings goes for lending/borrowing, i.e., bond holding.
- Final good is consumed by households and government. Thus fiscal policy is allowed.
- There is no household demand function for money as such. It doesn't appear in the household budget constraint – as in NKPC models.
- Monetary authority use interest rate as instrument.

Households

Household τ's Problem: Max $E_0 \sum_{t=0}^{\infty} \beta^t U_t^\tau$, where

$$\epsilon_t^b \left(\frac{(C_t^\tau - H_t)^{1-\sigma_c}}{1-\sigma_c} - \frac{\epsilon_t^L (N_t^\tau)^{1+\sigma_l}}{1+\sigma_l} \right)$$

- H_t: external habit
- ϵ_t^b: intertemporal substitution shock.
- ϵ_t^L: labor supply shock.
- $H_t = hC_{t-1}$.

Technologies

Final-Good Production

$$Y_t = \left[\int_0^1 (y_t^j)^{1/(1+\lambda_{pt})} dj\right]^{1+\lambda_{pt}}$$

Intermediate-Good Production

$$y_t^j = \epsilon_t^{\alpha} \tilde{K}_{jt}^{\alpha} L_{jt}^{1-\alpha} - \Phi.$$

"Aggregate" Labor Supply (over households)

$$L_t = \left(\int_0^1 (N_t^{\tau})^{1/(1+\lambda_{wt})} d\tau\right)^{1+\lambda_{wt}}$$

Assumed Stochastic Processes: either i.i.d. or AR(1).

Solution and Estimation

- Household budget constraint is specified.
- Market clearing conditions are specified.
- Euler equations and dynamic equations are derived.
- Eqs. (28)-(36) are 9 equations in 9 variables: capital, consumption, investment, interest rate, rate of return on capital etc.
- Non-linear equations are log-linearized around the flexi-price, no-shock equilibrium. Hence these are "deviations" from the long term trend.
- Some parameter values are assumed, those which couldn't be estimated: $\beta = 0.99$, so that the steady state real interest rate is 4%. Capital depreciation rate is taken as 10%. $\alpha = 0.3$; the share of steady state consumption in total output $= 0.6$; share of investment $= 0.22$. λ_w, mark-up in wage setting $= 0.5$.
- Remaining 32 parameters were estimated by using Baysian methods.

Matching with Empirics

- The model allows for estimating various impulse response functions (by allowing one shock, keeping other shocks fixed at their steady state values).
- It allows for estimation of variances-covariances. How?
- Give random shock to all i.i.d. stochastic terms.
- Calculate the dynamics say from period 0 to 500. Find out over time, variances and covariances.
- Consider another set of random shocks. You may consider 1000 sets of random shock. Find out the average of variances and covariances.
- Compare these with actual variances and covariances in the time-series data.
- However, Smets and Wouters also estimates an astructural VAR and compare their results with the this VAR system.

Criticisms by 'Neoclassicals'

- Instead of a simple neoclassical model founded as much on micro empirics as possible, S-W model has too many shock and "too many" free parameters and thus fit the data better.
- Any good empirical model should avoid too many free parameters.
- See Chari, Kehoe and McGrattan "New Keynesian Models: Not Yet Useful for Policy Analysis," Minneapolis Fed Working paper, 2008.