DSGE Models for Monetary Policy
(provisional title)

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Background:

• A consensus macro model has emerged for the analysis of monetary policy.

• Developing versions of the model to address urgent, *practical* monetary policy questions:
  
  – How should policy react to asset price volatility, interest rate spreads?
  – Define ‘exigent circumstances’ and how the effects of monetary and fiscal policy might be different then.

• That model fits the data well (CEE, SW, LOWW, CMR).

• But,
  
  – Lacks implications for standard labor market variables: unemployment, vacancies, separations, etc

• ‘Parallel’ literature on search and matching in the labor market:
  
  – Mortensen-Pissarides, Hall, Shimer, Gertler-Trigari, Gertler-Sala-Trigari (GST), den Haan-Ramey-Watson.
What we do:

• Consider a version of GST model (Christiano-Illut-Motto-Rostagno).
  – Like GST, has *fixed* rate of job separations

• Model fits less well than standard model with EHL labor market (i.e., CEE model).

• Introduce endogenous separations:
  – Fit is similar to that of standard model, but depends on how exactly separations are endogenized.
Standard Model

Firms

Supply labor: $Y_t \equiv \left[ Y_{jt} \bigcap \frac{1}{0} Y_{jt} \bigcup dj \right] \bigcap F_{jt}$, $1 \bigcap F_{jt}$

Investment goods: $Y_{jt} \equiv K_{jt} \bigcap l_{jt} \bigcup \bigcap Y_{jt}$

Rent capital: $Y_{jt} \equiv \left[ Y_{jt} \bigcap \frac{1}{0} Y_{jt} \bigcup dj \right] \bigcap F_{jt}$

Households

Backyard capital accumulation: $R^k_{jt} \equiv \left[ R^k_{jt} \bigcap \frac{1}{0} R^k_{jt} \bigcup F_{jt}, I_{jt} \right] \bigcup \bigcup F_{jt}$

Consumption: $C_t \equiv G_t \bigcap Y_t \bigcup \bigcup Y_t$
Impulse Response Matching

• We estimate and evaluate models by matching SVAR and model impulse responses.

• Advantages of this approach:
  – Focus
  – Transparency

• We give that procedure a Bayesian interpretation.
Impulse Response Matching

• Would like to make use of Bayesian concepts of priors, posteriors, marginal densities...

• Posterior:

\[
\text{posterior} \propto \text{likelihood of data, } Y \cdot \text{prior distribution over parameters}
\]

• But, what if ‘data’ is not actual time series data, but observations on impulse response functions?
Impulse Response Matching

• Approximately (for large $T$):

$$\text{posterior}(\lambda, V) \sim \frac{L(\lambda, V)}{p(\lambda)}$$

Consistent estimate of $V_{0, 0}$, $\lambda$.
Next, Estimate the Baseline Model

• Data: 1952-2008

• Three identified shocks: monetary policy, neutral and embodied technology

• Key Issue:
  – can you account for
    • Gradual, delayed response of inflation to monetary policy shock?
    • Using model without crazy parameters?
Response to a Monetary Policy Shock

Baseline DSGE model
Neutral tech shock

Real GDP

Inflation (GDP deflator)

Ouch!

Real Consumption

Real Investment

Federal Funds Rate

Rel. Price of Investment
Conclusion about Baseline Model

• Gradual, delayed response of inflation after monetary policy shock can be reconciled with rapid response after technology shock.

• Need to drop price indexation for this.

• Wage stickiness in these results needs to be studied more closely (not seen in previous studies, but we use longer data set).
• But, no unemployment.....!
Gali Showed that Standard Macro Model Naturally Delivers a Theory of Unemp.  

• In standard model:
  
  – household is a monopoly supplier of a differentiated labor service.  
  
  – Posts wage above marginal cost of providing labor.  
  
  • If you ask a worker, ‘would you work more, if offered a job at the current wage’, answer is ‘yes’ (like any monopolist)  
  
  • So, theory has a flavor of unemployment in it, due to wages being too high.
Each labor type is one person, living in their own household.
• Household utility in Lagrangian form:
• Household utility in Lagrangian form:

\[
E_t \left( \sum_{i} \left( w_i \times \int_{0}^{1} \frac{1}{\bar{w}_j} \times dj \right) \right)
\]

multiplier on household budget constraint

Gali showed how to interpret \( h_{j,t} \) as a quantity of type \( j \) workers
Unemployment and Labor Force

• Type $j$ labor force: number of type $j$ workers who would like to work at the market wage rate.

\[
W_{j,t} \equiv \frac{\mathcal{A}_L Q_{j,t}^\circ}{m^j} \otimes l_j^{\circ} \otimes \left[ \frac{m W_{j,t}}{\mathcal{A}_L} \right]^{\frac{1}{2L}}
\]

• Unemployment rate:

\[
u_{n,t} \equiv \frac{\mathcal{A}_L Q_{j,t}^\circ \otimes h_{j,t} \otimes \mathcal{A}_j}{l_j^{\circ} \otimes dj}.
\]
Issue

• Labor force solves static equation, likely to jump around a lot:

\[ l_{j,t} \leq \left[ \frac{mpW_{j,t}}{\tau A_L} \right]^{1/\rho} \]

• Worse, with a monetary expansion, as consumption rises, \( m \) falls and people don’t want to work (too much insurance!)

• After an expansionary monetary policy shock, labor force drops sharply (counterfactual), unemployment collapses
Monopoly Wage and Unemployment

- Monopoly wage
- Labor demand
- Labor supply (marginal cost)
- Markup
- Unemployment
A Quick Fix, to Quantify the Problem

• Let \( \hat{\tau} \) be an inverse function of aggregate employment

\[
\hat{\tau} \left( \frac{h_t}{h} \right) \left( \frac{h_t}{h_{t-1}} \right)
\]

• Now, when an expansionary monetary policy shock drives up employment, labor force increases:

\[
l_{j,t} \left[ \frac{npw_{j,t}}{\hat{\tau}_A} \right] \frac{1}{\sigma_L}
\]
• Simple extension of standard model to unemployment runs into serious challenge.

• ...unless there is a way to interpret the externality....
Adding Labor Market Frictions

- Employment agency
- Firms
- Households
- Labor Market
- Employment agency
- Unemployment

Undirected search
endogenous vacancies

Endogenous
and exogenous separation
Timeline – labor market

- Stock of employees in each agency reduced by exogenous separations increased by new arrivals
- Each worker experiences idiosyncratic, iid productivity shock. Least efficient are cut:
  - Unilateral firm decision
  - Cut determined by total surplus criterion
- Vacancies posted
- Agency employees sent to work

Wages set
- If it’s a time to bargain, choose wage to solve a Nash bargaining problem
- Otherwise, do simple updating

Hours worked set according to an efficiency criterion:
Marginal value of worker to agency = marginal cost of labor for worker
Details About the Labor Market

• Household Preferences

\[ E_t \circ \eta \quad \log(C_t) \approx b C_t \circ \rho \quad \sum_{i} A_L \]

\[ \frac{\sum_{i} (\frac{1}{L} \cdot \rho_i)}{1} \]

(hours per worker in cohort \( i \))

(quantity of people working in cohort \( i \))

• Worker finances

\[ \sum_{i} W_i \in \mathbb{F} \quad \sum_{i} \mathbb{Z}_i \quad \sum_{i} \mathbb{I}_i \]
• Value function of employed worker

Value function of unemployed worker

Utility loss from working, In currency units

Next period’s value function in case the worker is employed in the next period

Next period’s value function in case the worker is unemployed in the next period
• Employment agency value function:
  – just after bargaining, in bargaining period
  – conditional on nominal wage, $\gamma_c$
  – taking productivity cutoff, $\tilde{a}_{t_1}$, as given

\[
F_0, \gamma_c, \ldots \max_{t \in \mathcal{T}} \mathcal{W}_{i,j} a \quad \gamma_c \mathcal{T}_{t_1} \quad \frac{\mathcal{N}_{J_1} - \mathcal{N}_{J_2}}{2} \quad (\mathcal{V}_i)^2 \quad (1 - \mathcal{F}_{i,j})
\]

‘fraction’ of $i_{t_1}$ with productivity $a$

\[
P_{i,j} \quad \max_{t \in \mathcal{T}} \frac{m_{i,j}}{m_p} \quad \mathcal{F}_{i,n} \quad \mathcal{W}_{i,n} \quad \mathcal{F}_{i,n} \quad \mathcal{W}_{i,n}
\]

costs are proportional to workforce after current period separations
Monetary Policy

- Taylor Rule:

\[
\log\left(\frac{R_t}{R}\right) + \kappa \log\left(\frac{R_{t-1}}{R}\right) + \zeta \left[\gamma \log\left(\frac{\pi_t}{\pi^*}\right) + \rho y \log\left(\frac{y_{t-1}}{y}\right)\right] \rightarrow \log\left(\frac{R_t}{R}\right) + \kappa \log\left(\frac{R_{t-1}}{R}\right) + \zeta \left[\gamma \log\left(\frac{\pi_t}{\pi^*}\right) + \rho y \log\left(\frac{y_{t-1}}{y}\right)\right].
\]
Search and Matching

• Wealth effects on labor make people not want to work hard after positive monetary shock that drives up consumption.

• Wages rise a lot to satisfy expanded expenditures after monetary shock.

• Employment expands only a little.

• Model puts in a lot of price stickiness to compensate.

• Put in externality in labor supply, like in Gali model.
# Results

- **Key parameters of search and matching model**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>replacement ratio</td>
<td>$0.7$</td>
</tr>
<tr>
<td>separation rate (%)</td>
<td>$100$</td>
</tr>
<tr>
<td>recruitment costs/output (%)</td>
<td>$0.5$</td>
</tr>
<tr>
<td>share in matching function</td>
<td>$0.6$</td>
</tr>
<tr>
<td>bargaining power of workers</td>
<td>$0.4$</td>
</tr>
<tr>
<td>mean quarters between price reoptimization</td>
<td>$9$</td>
</tr>
</tbody>
</table>

A big problem!
Carlos Thomas might help us.
'money Beveridge curve', slope = 20
Neutral, ct’d

- **Hours Worked Per Capita**
  - VAR 95%
  - VAR Mean
  - Baseline
  - Base.+Unemp.
  - Emp. Surplus

- **Real Wage**

- **Unemployment Rate**

- **Vacancies**

- **Labor Force**
Summary

• There is a baseline DSGE model, that fits data nicely.

• It misses labor market variables.

• We tried to integrate such variables in two ways, but in each case needed to kill wealth effects to make the model work.

• When you integrate unemployment and the labor force into New Keynesian model, all the old problems with labor supply come back.