The NAIRU, Involuntary Unemployment and the Business Cycle

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Background

• Much progress building DSGE models for the purpose of analyzing monetary policy.

• Benchmark model: basic goods, labor markets, monetary policy.

• Extensions:
  – financial frictions.
  – unemployment, labor force.
What We Do:

- We investigate a particular approach to modeling unemployment.
  - Hopenhayn and Nicolini (1997), Shavell and Weiss (1979)
- We explore the implications for monetary DSGE models.
  - Simple three equation NK model
    - NAIRU, Okun’s gap, natural rate of unemployment.
  - Standard empirical NK model (e.g., CEE, SW)
    - Estimate the model.
    - Does well reproducing response of unemployment and labor force to three identified shocks.
Unemployment

• To be ‘unemployed’ in US data, must
  – want a job.
  – make efforts to find a job.

• Empirical evidence: losing your job is a bad thing.
  – consumption drops typically about 10 percent upon the
    loss of a job (Chetty and Looney, 2006)
  – Much discussion in the press about the hardship
    experienced by the unemployed in the current recession.

• Current monetary DSGE models with ‘unemployment’:
  – Utility jumps when you lose your job.
  – Finding a job requires no effort.
  – US Census Bureau employee dropped into current
    monetary DSGE models would find zero unemployment.
What we do:

• Explore the simplest possible model of unemployment, which satisfies the two key features of unemployment.

• To be unemployed:
  – Must have made recent efforts to find a job.
    • Assume households choose effort, $e$, which increases the probability, $p(e)$, of finding a job.

  – Transition from unemployment to employment makes you better off.
    • Assume household search effort, $e$, is not publicly observable.
    • Full insurance against household labor market outcomes is not possible.
    • Under perfect consumption insurance, no one would make an effort to find a job.
Outline

• Insert our model of unemployment into
  
  – Simple Clarida-Gali-Gertler (CGG) NK model.

  – CEE model: evaluate model’s ability to match US macroeconomic data, including unemployment and labor force
CGG Model

• Goods Production:

\[
Y_t = \left[ \int_0^1 Y_{i,t}^{\frac{1}{\lambda_f}} di \right]^{\lambda_f}, \quad 1 \leq \lambda_f < \infty.
\]

• Monopolists produce intermediate goods
  – Technology:

\[
Y_{i,t} = A_t h_{i,t}
\]

  – Calvo sticky prices:

\[
P_{i,t} = \begin{cases} 
  P_{i,t-1} & \text{with prob. } \xi_p \\
  \text{chosen optimally} & \text{with prob. } 1 - \xi_p
\end{cases}
\]

  – Enter competitive markets to hire labor.
CGG Model: Monetary Policy

• Taylor rule:

\[ \hat{R}_t = \rho_R \hat{R}_{t-1} + (1 - \rho_R)[r_\pi \hat{\pi}_t + r_y \hat{x}_t] + \varepsilon_t \]

• Here:

  – \( \hat{x}_t \) output gap (percent deviation of output from natural output)

• Natural equilibrium:

  – Monopoly power and inflation distortions extinguished.
Households

• This is where the new stuff takes place.....
Typical Household During Period

Draw privately observed, idiosyncratic shock, \( l \), from Uniform, \([0, 1]\), that determines utility cost of work:

\[
F + \zeta_t (1 + \sigma_L) l^{\sigma_L}.
\]

After observing \( l \), decide whether to join the labor force or stay out.

Household that stays out of labor market does not work and has utility

\[
\log c_t^{\text{out of labor force}}
\]

Household that joins labor force tries to find a job by choosing effort, \( e \), and receiving ex ante utility

\[
p(e_t) \begin{cases}
    \text{ex post utility in case household finds a job} \\
    \log(c_{t}^{w}) - F - \zeta_t (1 + \sigma_L) l^{\sigma_L} - \frac{1}{2} e_t^2 \\
\end{cases}
\begin{cases}
    \text{ex post utility in case of unemployment} \\
    \log(c_{t}^{u}) - \frac{1}{2} e_t^2
\end{cases}

p(e_t) = \eta + ae_t

\]
Household Insurance

• They need it:
  – Idiosyncratic work aversion.
  – Job-finding effort, \( e \), may or may not produce a job.

• Assume households gather into large families, like in Merz and Andolfatto
  – With no private information:
    • Households with low work aversion make big effort to find work.
    • All households have the same consumption.
    • Not feasible with private information.

  – With private information
    • To give low work aversion households the incentive to look for jobs, must make them better off in case they find work.
Optimal Insurance

• Relation of family to household standard principal/agent relationship.
  – family receives wage from working households
  – family observes current period employment status of household.

• For family with given $C, h$:
  – allocates consumption: $c_t^w, c_t^u$
  – $c_t^w / c_t^u$ must be big enough to provide incentives.
  – must satisfy family resource constraint:
    \[ h_t c_t^w + (1 - h_t) c_t^u = C_t. \]
Family Indirect Utility Function

• Utility:

\[ u(C_t, h_t, \zeta_t) = \log(C_t) - z(h_t, \zeta_t), \]

• Where

\[
z(h_t, \zeta_t) = \log[h_t(e^{F+\zeta_t(1+\sigma_L)f(h_t, \zeta_t)^{\sigma_L} - 1) + 1] - \frac{a^2 \xi_t^2(1 + \sigma_L)^2\sigma_L^2}{2\sigma_L + 1}f(h_t, \zeta_t)^{2\sigma_L + 1} - \eta \xi_t \sigma_L f(h_t, \zeta_t)^{\sigma_L + 1}.
\]
Family Problem

\[
\max_{\{C_t, h_t, B_{t+1}\}} \sum_{t=0}^{\infty} \beta^t [\log(C_t) - z(h_t, \zeta_t)]
\]

— Subject to:

\[P_t C_t + B_{t+1} \leq B_t R_{t-1} + W_t h_t + \text{Transfers and profits}_t.\]

• Family takes market wage rate as given and tunes incentives so that marginal cost of extra work equals marginal benefit:

\[C_t z_h(h_t, \zeta_t) = \frac{W_t}{P_t}.\]
Observational Equivalence Result

• Because of the simplicity of the assumptions, the model is observationally equivalent to standard NK model, when represented in terms of output, interest rate, inflation:

\[
\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} + \frac{(1-\beta \xi_p)(1-\xi_p)}{\xi_p} (1 + \sigma_z) \hat{x}_t
\]

\[
\hat{x}_t = E_t \hat{x}_{t+1} - (\hat{R}_t - \hat{\pi}_{t+1} - \hat{R}_t^*).
\]

\[
\hat{R}_t = \rho_R \hat{R}_{t-1} + (1 - \rho_R)[r_\pi \hat{\pi}_t + r_y \hat{x}_t] + \varepsilon_t,
\]

Different from household curvature with respect to leisure.
Unemployment Gap

• Can express everything in terms of unemployment gap:

\[ u^g_t = -\kappa^{okun}_t \hat{x}_t. \]

\[ \kappa^{okun} = \frac{a^2 \zeta \sigma^2_L m^{\sigma_L} (1 - u)}{1 - u + a^2 \zeta \sigma^2_L m^{\sigma_L}} > 0. \]

\[ u^g_t = u_t - u^*_t \]

Non-accelerating inflation rate of unemployment, NAIRU
Unemployment Gap

\[ \hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} - \kappa u^g_t \]

\[ u^g_t = \kappa^{okun} E_t u^g_{t+1} + \kappa^{okun} \left( \hat{R}_t - \hat{\pi}_{t+1} - \hat{R}^*_t \right) \]

\[ \hat{R}_t = \rho_R \hat{R}_{t-1} + (1 - \rho_R) \left[ r_\pi \hat{\pi}_t - \frac{r_y}{\kappa^{okun}} u^g_t \right] + \varepsilon_t \]

\[ \kappa \equiv \frac{(1 - \beta \xi_p)(1 - \xi_p)}{\xi_p} \frac{1 + \sigma_z}{\kappa^{okun}} \]
Put this all into a big DSGE Model

• Habit persistence in preferences

• Variable capital utilization.

• Investment adjustment costs.

• Wage setting frictions as in Erceg-Henderson-Levin.
Figure 4: Dynamic Responses of Labor Market Variables to Three Shocks

Unemployment Rate

Labor Force

Monetary Shock

Neutral Tech. Shock

Invest. Tech. Shock

VAR 95%  VAR Mean  Involuntary Unemployment Model
Conclusion

• Integrated a model of ‘involuntary unemployment’ into DSGE models.

• Findings:
  – Obtained a theory of the NAIRU
  – Able to match responses of unemployment and labor force to macro shocks.
  – Observational equivalence result:
    • useful for pedagogic purposes
    • unlikely to satisfy more empirically grounded specification.

• Questions raised by the analysis:
  – Model prediction: consumption inequality bigger in booms.