Business cycles and the two margins of labor adjustment
CEF conference 2009, Sydney

Francesco Furlanetto and Tommy Sveen
Norges Bank

July 15-17, 2009
Motivation: empirical evidence

- Unconditional evidence: In the data, 66% of the overall volatility of hours worked is due to variation in employment (Krause and Lubik (2009)).

<table>
<thead>
<tr>
<th>Standard Deviation in US data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment</td>
</tr>
<tr>
<td>Hours per capita</td>
</tr>
<tr>
<td>Total hours</td>
</tr>
<tr>
<td>GDP</td>
</tr>
<tr>
<td>7.71</td>
</tr>
<tr>
<td>0.30</td>
</tr>
<tr>
<td>1.10</td>
</tr>
<tr>
<td>1.41</td>
</tr>
</tbody>
</table>
Motivation: empirical evidence

- Conditional evidence: Positive neutral technology shocks contract both hours and employment, but employment reacts slightly more (Canova, Lopez-Salido and Michelacci, 2009).
  - Similar results in Baleer (2007) and Barnichon (2008).
- Conditional evidence: Expansionary monetary policy shock expand both hours and employment but employment reacts more (Trigari, 2008).
- Conditional evidence: Positive investment-specific shocks expand hours per capita whereas the employment response is not significant. (Canova et al. 2009).
Krause and Lubik (2009): the RBC model with two margins of labor adjustment has difficulty explaining the relative volatilities of hours and employment

- hours per worker are too volatile relative to employment
- the model cannot explain the volatilities of vacancies and unemployment (Shimer puzzle).

The same is true in New Keynesian models with nominal and real rigidities
Motivation: theory

- Our goal: provide a theoretical model that is able to obtain a reasonable split across the two margins.

- Important ingredients in our model:
  - Employment is not a predetermined variable (instantaneous hiring)
  - In case of separation, workers can find a job immediately
  - Firms trade-off on the use of the two margins of labor adjustment:
    - Using hours more intensively increases average wages
    - Hiring new workers is costly (hiring cost)

- These three features are useful to increase the adjustment through the employment margin.
Neutral technology shocks.

- The model implies a large response of employment and can reproduce the evidence for plausible calibrations.
- Nominal and real rigidities are essential, as in Gali (1999) and Francis and Ramey (2005).

Investment-specific shocks

- The adjustment is achieved mainly through hours in keeping with the evidence
- Little propagation in the model for a plausible labor supply elasticity

Monetary shocks

- The adjustment is achieved mainly through employment, in keeping with the evidence and confirming results in Sveen and Weinke (2007).
Our framework in perspective

- Our model relies on Ravenna and Walsh (2008) and Sveen and Weinke (2007)
  - It includes capital accumulation (potentially important for technology shocks, Shimer 2009)
  - It includes nominal and real rigidities (important for monetary shocks)
  - It includes variable capacity utilization for completeness (third margin of adjustment).

Our framework in perspective

- Canova, Lopez-Salido and Michelacci (2009) rationalize their evidence in the context of a growth model featuring a vintage structure of technology shocks and search and matching frictions in the labor market.
- Trigari (2008) studies monetary shocks in a model with endogenous separation.
- We provide an alternative explanation using a model that is close to the "standard" New Keynesian model.
Baseline Model

Households

\[ E_t \int_0^1 \left[ \sum_{k=0}^{\infty} \beta^k U(C_{t+k}, H_{t+k}(h)) \right] dh, \]  

\[ U(C_t, H_t(h)) = \ln(C_t - hC_{t-1}) - \chi \frac{H_t(h)^{1+\eta}}{1+\eta}, \]  

\[ P_t(C_t + I_t + f(UT_t)) + D_t \leq D_{t-1}R_{t-1} + P_tW_tH_tN_t + BZ_t\Psi_t^{1-\alpha} U_t + T_t + P_tR^K_tK_t. \]  

\[ \bar{K}_{t+1} = (1 - \delta)\bar{K}_t + \Psi_t \left( 1 - S \left( \frac{I_t}{I_{t-1}} \right) \right) I_t, \]  

\[ K_t = UT_t\bar{K}_t \]
Baseline Model

Firms

- Technology is Cobb-Douglas

\[ Y_t(i) = K_t(i)^\alpha (Z_t N_t(i) H_t(i))^{1-\alpha}, \]  

(6)

- We follow Blanchard and Galí (2007) in assuming restrictions on firms’ hiring decisions.

- The law of motion of employment

\[ N_t(i) = (1-s) N_{t-1}(i) + L_t(i). \]  

(7)

- Hiring costs (per unit of employment)

\[ G_t = Y Z_t \Psi_{t}^{\frac{\alpha}{1-\alpha}} \left( \frac{L_t}{U_t^S} \right)^\vartheta, \]  

(8)

where \( U_t^S \equiv 1 - (1-s) N_{t-1}. \)
Each firm $i$ maximizes the following problem:

$$
\sum_{k=0}^{\infty} E_t \left\{ \Lambda^R_{t,t+1} \left[ \begin{array}{c}
Y_{t+k}(i) \frac{P_{t+k}(i)}{P_{t+k}} - R^K_{t+k} K_{t+k}(i) \\
- W_{t+k}(i) N_{t+k}(i) H_{t+k}(i) - G_{t+k} L_{t+k}(i)
\end{array} \right] \right\}
$$

s.t.

- $Y_{t+k}(i) = \left( \frac{P_{t+k}(i)}{P_{t+k}} \right)^{-\epsilon} Y_{t+k}$,
- $Y_{t+k}(i) = K_{t+k}(i)^{\alpha} \left( Z_{t+k} N_{t+k}(i) H_{t+k}(i) \right)^{1-\alpha}$,
- $N_{t+k}(i) = (1-s) N_{t+k-1}(i) + L_{t+k}(i)$,
- $P_{t+k+1}(i) = \begin{cases} P^*_t(i) & \text{with prob. } (1-\theta) \\ P_{t+k}(i) & \text{with prob. } \theta \end{cases}$.
The remaining first-order conditions read

\[ W_t(i) + \frac{\partial W_t(i)}{\partial H_t(i)} H_t(i) = \frac{(1 - \alpha) MC_t Y_t(i)}{H_t(i) N_t(i)}, \]  
\[ W_t(i) H_t(i) + G_t = (1 - \alpha) \frac{MC_t Y_t(i)}{N_t(i)} \]
\[ + (1 - s) E_t \left\{ \Lambda_{t,t+1}^R G_{t+1} \right\}. \]  

The two equations have similar interpretations:

- On the LHS is the cost of increasing the use of hours or hiring an additional worker.
- On the RHS is the benefit of the marginal hour or worker.
Baseline Model
Wage Bargaining and Monetary Policy

- The wage resulting from the bargain is then

$$W_t(i)H_t(i) = \chi C_t \frac{H_t(i)^{1+\eta}}{1+\eta} + \Psi_t$$  \hspace{1cm} (11)

where

$$\Psi_t \equiv BZ_t \Psi_t^{\frac{\alpha}{1-\alpha}} + \frac{1-\phi}{\phi} G(F_t)$$

$$-\frac{1-\phi}{\phi} E_t \left\{ \Lambda_{t,t+1}^R (1-s)(1-F_{t+1}) G(F_{t+1}) \right\}.$$  \hspace{1cm} (12)

- Monetary policy rule

$$\frac{R_t}{R} = \left( \frac{R_{t-1}}{R} \right)^{\rho_R} \left[ \left( \frac{\Pi_t}{\Pi} \right)^{\phi_{\pi}} \right]^{1-\rho_R},$$

where $\rho_R$ denotes the degree of interest rate smoothing.
Baseline Model

Calibration

\( \eta = 7 \) (inverse of labor supply elasticity)
\( \theta = 0.66 \) (price rigidity, slightly more than 3 quarters)
\( h = 0.8 \) (habit persistence)
\( \phi = 1/2 \) (bargaining power)
\( B = 0.4 \) (unemployment benefits)

\[
\begin{array}{ccccccccccc}
\beta & \chi & \epsilon & \delta & \alpha & \lambda_1 & \lambda_2 & \theta & \phi_\pi & \rho_R \\
0.99 & H = \frac{1}{3} & 7 & 0.025 & 0.33 & 0.33 & 1 & 1 & 1.5 & 0.9 \\
\end{array}
\]

\[
\begin{array}{cccccc}
U & N = 1 - U & F & s = \frac{F*U}{(1-F)*N} & U^s = 1 - (1 - s) \cdot N \\
0.057 & 0.943 & 0.71 & 0.148 & 0.197 \\
\end{array}
\]
Results

Furlanetto and Sveen (NB)  
Hours vs. Employment  
July 15-17, 2009  
15 / 27
Results: Volatility

St.Dev. (relative to GDP)

<table>
<thead>
<tr>
<th>St.Dev.</th>
<th>U</th>
<th>N</th>
<th>H</th>
<th>Tot. H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>5.46</td>
<td>0.21</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>3.85</td>
<td>0.22</td>
<td>0.17</td>
<td>0.39</td>
</tr>
<tr>
<td>Inv.Spec.</td>
<td>1.46</td>
<td>0.08</td>
<td>0.2</td>
<td>0.19</td>
</tr>
<tr>
<td>Monetary</td>
<td>7.58</td>
<td>0.45</td>
<td>0.23</td>
<td>0.69</td>
</tr>
</tbody>
</table>

- Monetary shocks produce large employment fluctuations, comparable to the unconditional data.
- Neutral technology shocks imply a fair amount of employment volatility.
- Investment-specific shocks barely affect the labor market.
Results: neutral technology shocks

- Productivity shock
- Hours
- Unemployment
- Output
- Utilization

Nominal and real rigidities
No rigidities
With flexible prices, no habits and no investment adjustment costs, the model is close to reproduce the Blanchard-Gali (2009) "neutrality result", although capital accumulation is modeled explicitly.

With nominal and real rigidities the model achieves an equal split on the two margins and rationalizes the evidence by Canova et al. (2009).

When $\eta > 7$ the employment response is larger.
Results: investment-specific shocks

- Investment-specific shock
- Hours
- Employment
- Unemployment
- Output
- Consumption
- Utilization
- Investment

- Nominal and real rigidities
- No rigidities
Results: investment-specific shocks

- Employment almost does not move in keeping with the evidence.
- Hours move more but still very little propagation.
- Nominal and real rigidities barely affect the transmission mechanism.
Results: monetary shocks

Adjustment is larger on the employment margin as in Sveen and Weinke (2007)
Results: sensitivity to labor supply elasticity
Results: sensitivity to labor supply elasticity

Furlanetto and Sveen (NB)
Several papers (Jaimovich and Rebelo (2009), Ravn and Simonelli (2008), Schmitt-Grohe and Uribe (2008)) study investment-specific shocks

- Large propagation
- Positive comovement between consumption and investment

All these papers use $\eta$ around 0.4 arguing that it refers to variations across both margins.

Here we model explicitly the two margins but we still need $\eta$ around 0.4 to obtain propagation.

No propagation and the impact consumption response is at most zero for plausible values of $\eta$ (see Furlanetto, Gomes and Seneca (2009)).
We present a New Keynesian model that obtains a reasonable split across the two margins of labor adjustment.

Large employment variations in response to technology shocks and monetary shocks.

Relatively larger response of hours in response to investment shocks. However, no propagation.

The use of a very elastic labor supply in models with one margin is not justified.
Baseline Model

Wage Bargaining

- The household’s value of a match with firm $i$

$$
\tilde{W}_t (i) = W_t (i) H_t (i) - \chi_t C_t \frac{H_t (i)^{1+\eta}}{1+\eta} \\
+ E_t \left\{ \Lambda^R_{t,t+1} \left[ (1 - s) \tilde{W}_{t+1} (i) \\
+ s \left( F_{t+1} \tilde{W}_{t+1} + (1 - F_{t+1}) \tilde{U}_{t+1} \right) \right] \right\}. \quad (13)
$$

where $\tilde{W}_t \equiv \int_0^1 \tilde{W}_t (i) \frac{L_t (i)}{L_t} dL_t$ and $F_t \equiv \frac{L_t}{U_t}$.

- The value of being unemployed

$$
\tilde{U}_t = B Z_t \Psi^\alpha_t \frac{1}{1-\alpha} + E_t \left\{ \Lambda^R_{t,t+1} \left[ F_{t+1} \tilde{W}_{t+1} + (1 - F_{t+1}) \tilde{U}_{t+1} \right] \right\}. \quad (14)
$$
As in Blanchard and Galí (2009) the value of a match for firm $i$ corresponds to the cost of hiring a worker

$$
\tilde{J}_t (i) = G (F_t),
$$

(15)

which is independent of the firm.

Surplus splitting implies

$$(1 - \phi) \tilde{J}_t = \phi \left( \tilde{W}_t (i) - \tilde{U}_t \right),$$

(16)

where $(1 - \phi)$ denotes the weight of workers in the bargain.