Productivity, Hours and Unemployment in a New Keynesian Model with Hiring Costs
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Canova, Lopez-Salido and Michelacci (2008a and b): analyze the effect of neutral technology shocks and investment specific shocks on hours worked and unemployment in a VAR with trends.

Positive neutral technology shocks contract both hours and employment, but employment reacts more. Similar results in Baleer (2007) and Barnichon (2008).

Positive investment-specific shocks expand both hours and employment but the hours response is larger.
Can the canonical New Keynesian (NK) model augmented with labor market frictions account for the empirical facts?

Yes!

Canova, Lopez-Salido and Michelacci (2008a) 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.

We give an alternative (and not incompatible) interpretation.
Our framework in perspective

- Essential ingredients in our analysis
  - Two margins of labor adjustment (hours and unemployment) (Trigari (2005 and 2006), Sveen and Weinke (2008))
  - Capital accumulation in a model with labor market frictions (Gertler, Sala, Trigari (2008), Andres, Domenech and Ferri (2006), Silva and Toledo (2007), Mandelman and Zanetti (2008), Andolfatto (1996), Merz (1996)).

- But few, if any, papers having two margins of labor adjustment and capital accumulation in a New Keynesian model.

- Labor market friction: **hiring costs** (as in Blanchard and Gali (2008)) vs search and matching
Baseline Model

Households

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

(1)

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

(2)

\[ P_t(C_t + I_t) + D_t \leq D_{t-1} R_{t-1} + P_t W_t H_t N_t \]
\[ + BZ_t U_t + T_t + P_t R^K_t K_t. \]  

(3)

\[ K_{t+1} = (1 - \delta) K_t + \Psi_t \left( 1 - S \left( \frac{l_t}{l_{t-1}} \right) \right) l_t, \]  

(4)
Baseline Model

Firms

- Technology is Cobb-Douglas

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

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

- The law of motion of employment

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

- Hiring costs (per unit of employment)

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

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.

$$ Y_{t+k}(i) = \left( \frac{P_{t+k}(i)}{P_{t+k}} \right)^{-e} Y_{t+k}, $$

$$ Y_{t+k}(i) = K_{t+k}(i)^{\alpha} (Z_{t+k} N_{t+k}(i) H_{t+k}(i))^{1-\alpha}, $$

$$ N_{t+k}(i) = (1 - s) N_{t+k-1}(i) + L_{t+k}(i), $$

$$ P_{t+k+1}(i) = \begin{cases} P^*_t(i) & \text{with prob. } (1 - \theta) \\ P_{t+k}(i) & \text{with prob. } \theta \end{cases}. $$
The remaining first-order conditions read

\[
W_t(i) + \frac{\partial W_t(i)}{\partial H_t(i)} H_t(i) = \frac{(1 - \alpha) MC_t Y_t(i)}{H_t(i) N_t(i)}, \tag{8}
\]

\[
W_t(i) H_t(i) + G_t = (1 - \alpha) \frac{MC_t Y_t(i)}{N_t(i)} + \Lambda_t^R \Lambda^{t+1}_{t+1} + (1 - s) E_t \left\{ \Lambda^R_{t,t+1} G_{t+1} \right\}. \tag{9}
\]

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.
As in Blanchard and Galí (2007) the value of a match for firm $i$ corresponds to the cost of hiring a worker

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

(10)

which is independent of the firm.

Surplus splitting implies

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

(11)

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

- The wage resulting from the bargain is then

\[ W_t(i) = \frac{\chi C_t H_t(i)^{1+\eta}}{1+\eta} + \Psi_t, \quad (12) \]

where

\[ \Psi_t \equiv B\Psi_t^\alpha Z_t + \frac{1-\phi}{\phi} G(F_t) \]

\[ -\frac{1-\phi}{\phi} E_t \left\{ \Lambda_{t,t+1}^R (1-s) (1-F_{t+1}) G(F_{t+1}) \right\}. \quad (13) \]

- Monetary policy rule as in Gali and Rabanal (2005)

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

Calibration

<table>
<thead>
<tr>
<th>$\beta$</th>
<th>$\eta$</th>
<th>$\chi$</th>
<th>$\epsilon$</th>
<th>$\delta$</th>
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<th>$\theta$</th>
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<th>$\phi$</th>
<th>$\rho_R$</th>
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<th>$\phi_Y$</th>
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<td>$\frac{1}{2}$</td>
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<table>
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<tr>
<th>$B$</th>
<th>$U$</th>
<th>$N = 1 - U$</th>
<th>$F$</th>
<th>$s = \frac{F \times U}{(1 - F) \times N}$</th>
<th>$U^s = 1 - (1 - s) \times N$</th>
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<td>0.4</td>
<td>0.057</td>
<td>0.943</td>
<td>0.71</td>
<td>0.148</td>
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Impulse responses following a permanent neutral technology shock in the baseline model
Results

- **Flexible price model**: We are very close to the *neutrality result* recovered by Blanchard and Gali (2008) and Shimer (2009). Employment and hours are (almost) invariant to technology shocks.

- **Sticky price model**: We obtain a significant drop in employment and the right split across the two margins. This is due to:
  - Instantaneous hiring assumption.
  - Labor market friction: hiring costs vs cost of posting a vacancy.
The contractionary effect would be greatly amplified by habit persistence and would be preserved having variable capacity utilization.

The split across the two margins is affected (but not reversed) by

- Form of the monetary policy rule.
- Labor supply elasticity.
- Bargaining power.

As in Gali (1999), the result depends on a sub-optimal monetary policy. However, here there is an endogenous response by the central bank.
Results

Putting the result into perspective

- Productivity shocks in the "canonical" NK model with search-and-matching (e.g., Trigari 2006)
Impulse responses following a permanent investment specific shock in the benchmark model
Empirical evidence: investment specific shocks are very expansionary on both labor margins (but more on hours).

In the model:
- slow and very persistent increase in output and consumption.
- expansion in hours (due to the investment boom) and employment.
- little negative impact on consumption as in other papers...even in Justiniano, Primiceri and Tambalotti (2008).
Conclusion

- We investigate the effects of TFP and investment specific shocks in a New-Keynesian model with hiring costs and two margins of labor adjustment.

- First result: we can replicate the empirical evidence proposed by Canova, Lopez-Salido and Michelacci (2008) in the context of a "simple" New-Keynesian model.

- Second result: we show that these results are not obvious in models with labor market frictions and we show what assumptions are crucial to obtain our results.
  - We obtain sizeable fluctuations in employment, unlike the standard search and matching model.
  - The model reproduce a plausible transmission mechanism for technology and investment specific shocks. The split across the two margins is in keeping with empirical evidence for both shocks.
  - The Shimer puzzle may be is not a puzzle or at least is very different in models with sticky or flexible prices (see Furlanetto and Sveen 2008b).