Involuntary Unemployment and the Business Cycle

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Background

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

- Consensus benchmark model: basic goods, labor markets, monetary policy.

- Extensions:
  - financial frictions.
    - Financing of investment, working capital, etc.
  - 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., ACEL, 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
  - be ‘willing and able’ to work.
  - recently, made 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 (Gruber, 1997, 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 two key features of unemployment.

- To be unemployed:
  - Must have made recent efforts to find a job.
    - To find a job, household must make an effort, *e*, which increases the probability, *p(e)*, of finding a job.

  - Transition from employment to unemployment makes you worse 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:

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

- 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 efficient level)

- Efficient equilibrium:
  - Monopoly power and inflation distortions extinguished.

Households

- This is where the new stuff is........

Typical Household During Period

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

$$F + \varsigma_t (1+\sigma_L) l^{\sigma_L}.$$

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

$$\log c_t^{\text{out of labor force}}$$

t

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

$t+1$

$$p(e_t)\left[\overbrace{\log(c_t^w) - F - \varsigma_t(1+\sigma_L)l^{\sigma_L} - \frac{1}{2}e_t^2}^{\text{ex post utility in case household finds a job}}\right] + (1-p(e_t))\left[\overbrace{\log(c_t^u) - \frac{1}{2}e_t^2}^{\text{ex post utility in case of unemployment}}\right]$$

$$p(e_t) = \eta + a e_t$$

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 complete information:
    - Households with low work aversion told to make big effort to find work.
    - All households given same consumption.
    - Not feasible with private information.

  - With private information
    - To give households incentive to look for work, 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: $c_t^w,\ c_t^{nw}$
  - c_t^w / c_t^{nw} must be big enough to provide incentives.
  - must satisfy family resource constraint:

$$h_t c_t^w + (1 - h_t) c_t^{nw} = C_t.$$

Family Indirect Utility Function

- Utility:

$$u(C_t, h_t, \varsigma_t) = \log(C_t) - z(h_t, \varsigma_t)$$

- Where

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

- Clarida-Gali-Gertler utility function:

$$u(C_t, h_t, \varsigma_t) = \log(C_t) - \varsigma_t h_t^{1+\sigma_L}$$

Family Problem

$$\max_{\{C_t, h_t, B_{t+1}\}} E_0 \sum_{t=0}^{\infty} \beta^t [\log(C_t) - z(h_t, \varsigma_t)]$$

– Subject to:

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

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

$$C_t z_h(h_t, \varsigma_t) = \frac{W_t}{P_t}.$$

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:

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

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

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

Observational Equivalence Result

z function: disutility of labor for family

'curvature of disutility of labor': $\sigma_z \equiv \frac{z_{hh}h}{z_h}$

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

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

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

Unemployment Gap

- Can express everything in terms of unemployment gap:

$$u_t^g = -\kappa^{okun}\hat{x}_t. \qquad \kappa^{okun} = \frac{a^2\varsigma\sigma_L^2 m^{\sigma_L}(1-u)}{1-u+a^2\varsigma\sigma_L^2 m^{\sigma_L}} > 0.$$

$$u_t^g = \overbrace{u_t}^{\text{actual rate of unemployment}} - \overbrace{u_t^*}^{\text{efficient level of unemployment}}$$

Non-accelerating rate of inflation level of unemployment, NAIRU

Unemployment Gap

$$\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} - \kappa u_t^g$$

$$u_t^g = \kappa^{okun} E_t u_{t+1}^g + \kappa^{okun} \left(\hat{R}_t - \hat{\pi}_{t+1} - \hat{R}_t^* \right)$$

$$\hat{R}_t = \rho_R \hat{R}_{t-1} + (1 - \rho_R)[r_\pi \hat{\pi}_t - \frac{r_y}{\kappa^{okun}} u_t^g] + \varepsilon_t$$

$$\kappa \equiv \frac{(1 - \beta \xi_p)(1 - \xi_p)}{\xi_p} \frac{1 + \sigma_z}{\kappa^{okun}}$$

Questions…

- A key distinguishing feature of the model is the limited information that prevents full insurance.

- What is the quantitative impact of limited information on the model?

Must Parameterize the Model

- Parameterization informal.
  - Subset of parameters standard.
  - Five parameters (search function and work aversion) novel.

Table 1: Structural Parameters of Small Model Held Fixed Across Numerical Experiments

Parameter	Value	Description
β	$1.03^{-.25}$	Discount factor
g_A	1.0047	Technology growth
ξ_p	0.75	Price stickiness
λ_f	1.2	Price markup
ρ_R	0.8	Taylor rule: interest smoothing
r_π	1.5	Taylor rule: inflation
r_y	0.2	Taylor rule: output gap
η_g	0.2	Government consumption share on GDP

‘New’ Parameters

- Disutility of work:

$$F + \varsigma_t (1 + \sigma_L) l^{\sigma_L}$$

- Probability of finding work:

$$p(e_t) = \eta + a e_t$$

- Parameters:

$$F, \varsigma, a, \eta, \sigma_L.$$

- Pin down 5 parameters by imposing 5 properties of steady state:

$$m,\ u,\ \sigma_z,\ \kappa^{okun},\ \bar{p}$$

Quantitative Impact of Limited Information

- Impact on:
  - total employment, labor force, welfare?

- What is the value of information?

Table 2: The Impact of Imperfect Information in the Small Model

Variable	Involuntary Unemp. (Imperfect Info.)	Fixed Structual Params Full Info[b].	Description
	Steady State Properties		
m	0.67	0.69	Labor force
h	0.63	0.68	Employment
u	0.056	0.015	Unemployment rate
c^{nw}/c^{w}	0.18	1.0	Replacement ratio
	0.189		Price (% of C) of info.[a]
	Structural Parameters[d]		
a	0.53	0.53	Slope, $p(e)$
η	0.86	0.86	Intercept, $p(e)$
ς	4.64	4.64	Slope, labor disutility
F	1.39	1.39	Intercept, labor disutility
σ_L	13.31	13.31	Power, labor disutility
	Welfare Cost of Business Cycles		
	Technology shock only		
λ	0.520684131141325	0.566191290230633	% of consumption
	Government consumption shock only		
λ	0.112215458271869	0.125326644511370	% of consumption
	Monetary policy shock only		
λ	0.071331553871046	0.100111000086489	% of consumption

Put this all into a medium-sized DSGE Model

- Habit persistence in preferences
- Variable capital utilization.
- Investment adjustment costs.
- Wage setting frictions as in Erceg-Henderson-Levin.

Figure 1: Dynamic Responses of Non−Labor Market Variables to a Monetary Policy Shock

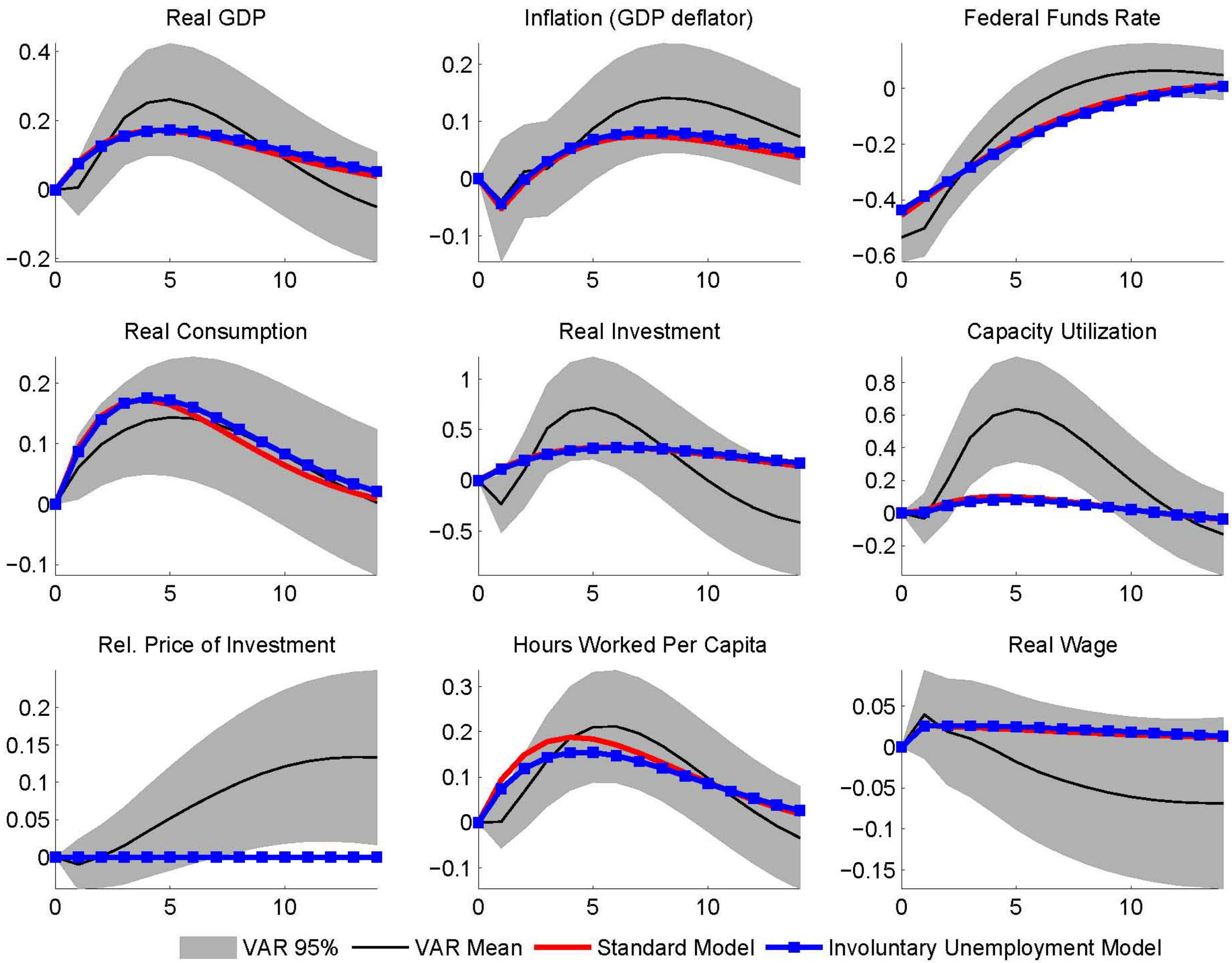


Figure 2: Dynamic Responses of Non−Labor Market Variables to a Neutral Technology Shock

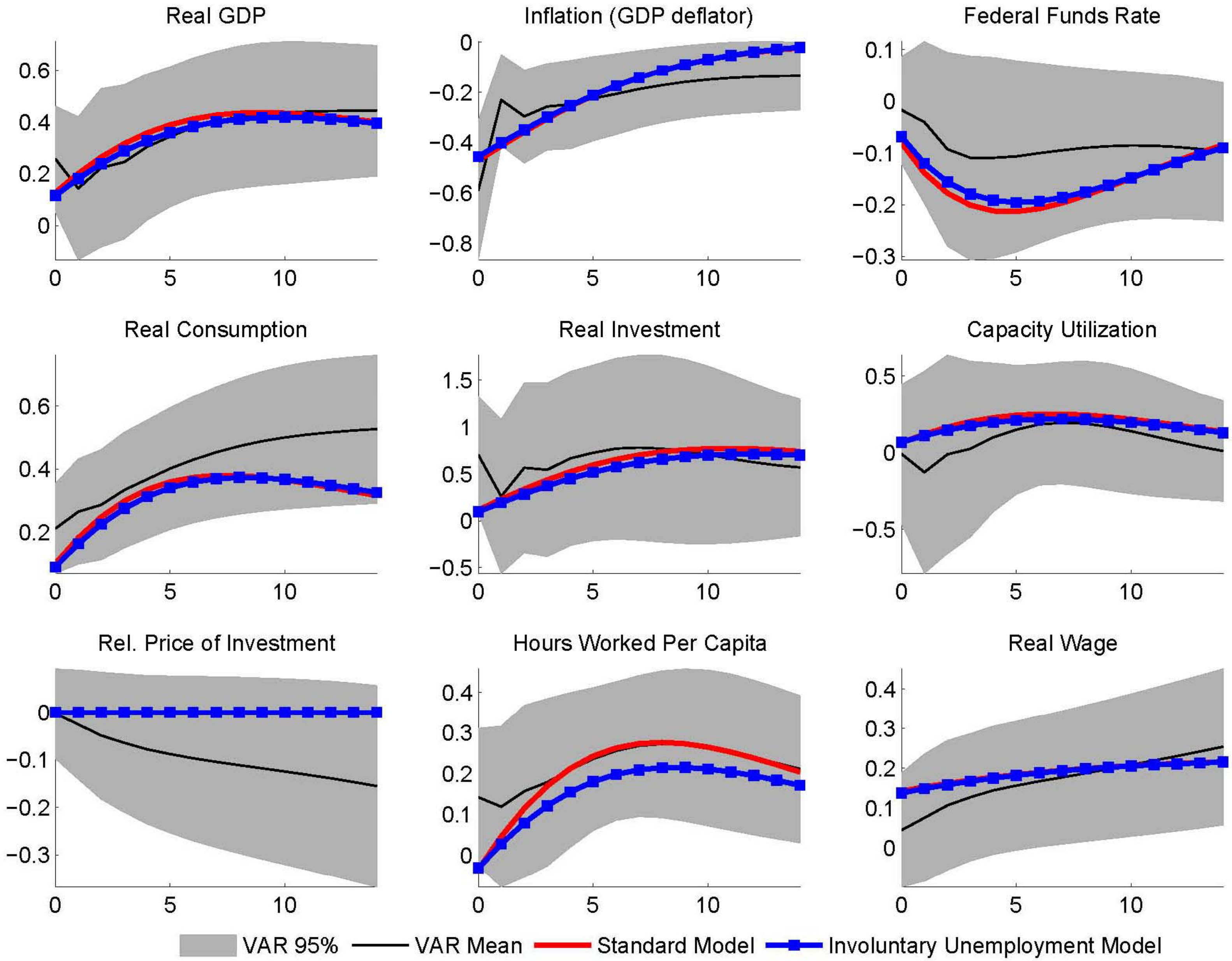


Figure 3: Dynamic Responses of Non−Labor Market Variables to an Investment Specific Technology Shock

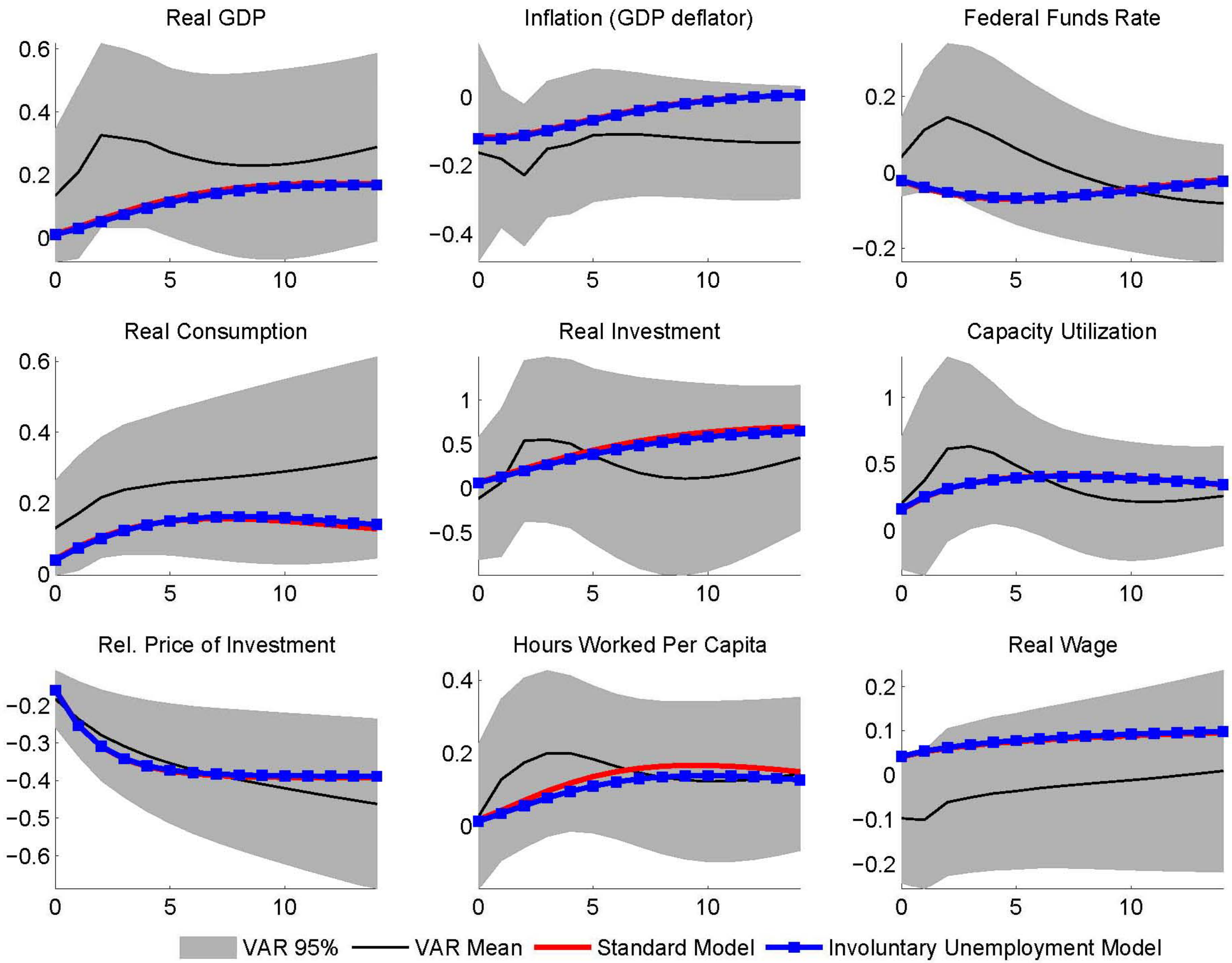
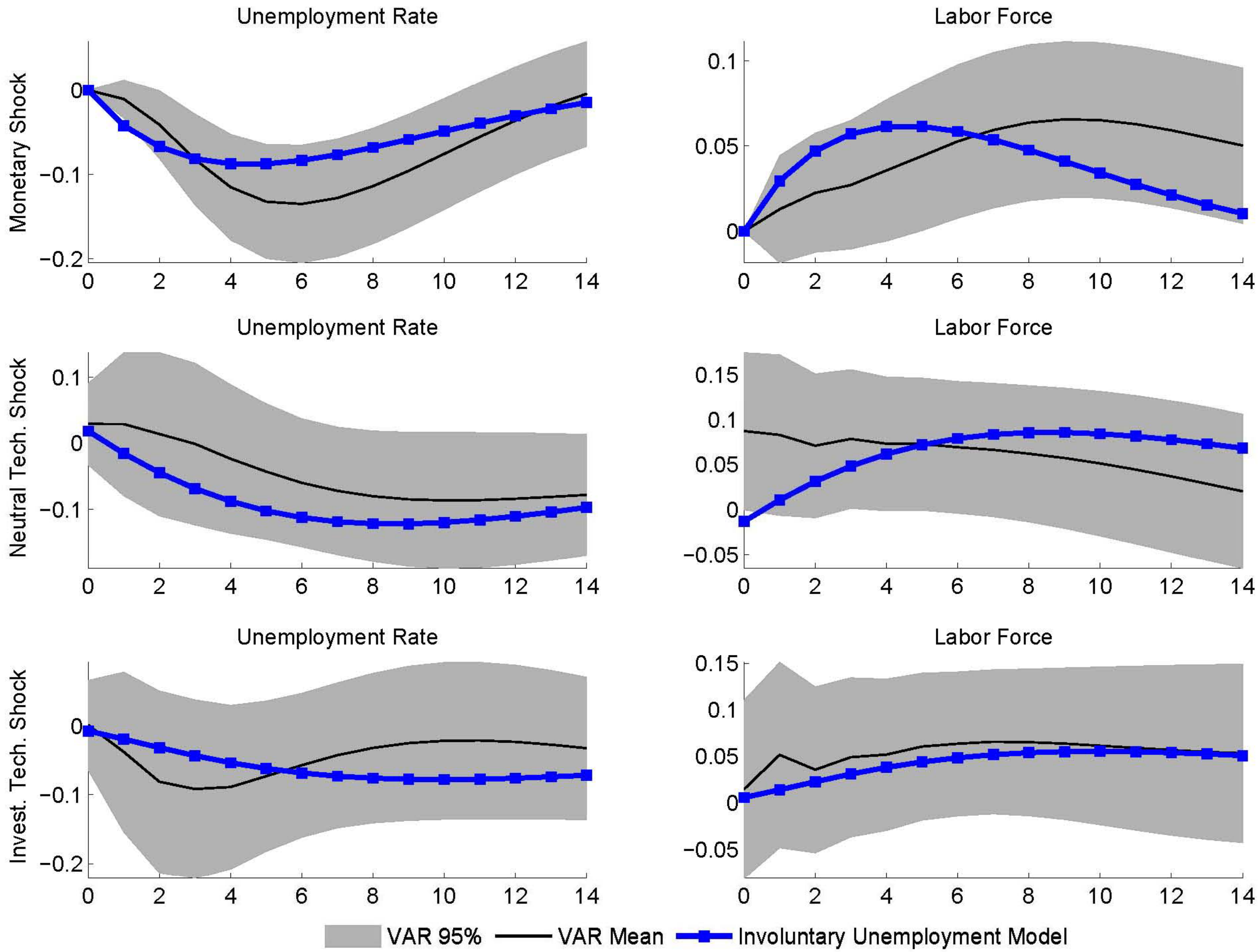


Figure 4: Dynamic Responses of Labor Market Variables to Three Shocks



Model Prediction that Consumption Premium for Employed Households is Bigger in Boom

- Don’t have direct evidence on this (but, could get it!)
- Have time series on cross section variance of log, household consumption.

$$V_t = (1-h_t)h_t\left(\log\left(\frac{c_t^w}{c_t^{nw}}\right)\right)^2.$$

- Heathcote, Perri and Violante (2010) show *V* is procyclical in three of past 5 recessions.

Another Question Raised by Analysis

- Does higher unemployment in recessions reflect reduced search intensity?
  - Maybe…
  - discouraged workers: people 'available to work' but are not currently looking because they think there are no jobs.
  - number jumped 70 percent, 2008Q1 to 2009Q1.

Conclusion

- Integrated a model of ‘involuntary unemployment’ into monetary DSGE model.

- Results:
  - Obtained a theory of the NAIRU
  - Able to match responses of unemployment and labor force to macro shocks.
  - Raises several empirical questions.

- Why introduce unemployment?
  - A policy variable of direct interest.
  - By bringing in more data, get a more precise read on output gap and real rate (Basistha and Startz (2004))
  - By bringing in more data, get a better read on unobserved shocks and may improve forecasts.