

Understanding the Great Recession

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Background

- GDP appears to have suffered a permanent (10%?) fall since 2008.
- Trend decline in labor force participation accelerated after the 'end' of the recession in 2009.
- Unemployment rate persistently high
 - recent fall primarily reflects the fall in labor force participation.
- Employment to population ratio fell sharply with little evidence of recovery.
- Vacancies have risen, but unemployment has fallen relatively little ('shift in Beveridge curve', 'mismatch').
- Investment and consumption persistently low.

Questions

- What were the key forces driving U.S. economy during the Great Recession?
- Mismatch in the labor market?
- Why was the drop in inflation so moderate?

To answer our questions we need a model

- Model must provide empirically plausible account of key macroeconomic aggregates
 - employment, vacancies, LFPR, job finding rate, unemployment rate, real wages
 - output, consumption, investment, ..
- Novel features of labor market
 - Endogenize labor force participation.
 - Derive wage inertia as an equilibrium outcome.
- Estimate model using pre-2008 data.
- Use estimated model to analyze post-2008 data.

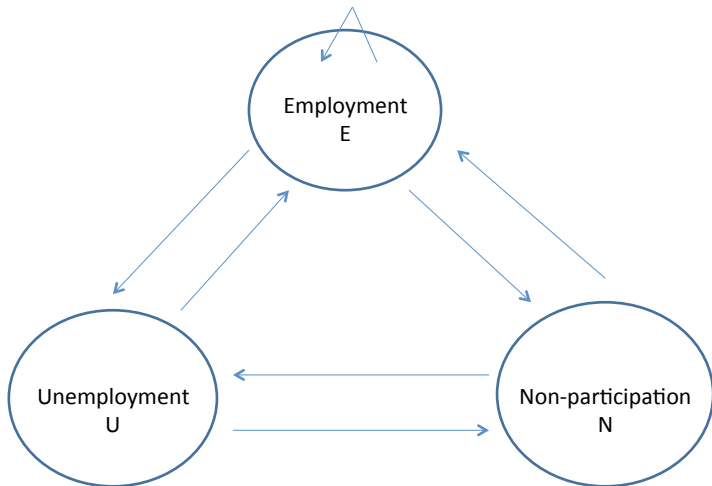
Questions and Answers

- What forces drove real quantities in the Great Recession?
 - Two shocks to financial markets were the key drivers, even for variables like labor force participation.
- *Flight to Quality Shock*
 - perturbation to agents' intertemporal Euler equation that makes them want to accumulate the risk-free asset.
- *Financial wedge*
 - perturbation to households' first order condition for optimal capital accumulation.
 - measured using the sharp increase in credit spreads observed in post-2008 period.

Questions and Answers

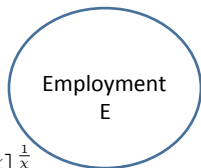
- Mismatch in the labor market?
 - Not a first order feature of the Great Recession.
 - ‘Shift’ in Beveridge curve occurs naturally, without any structural shift in the labor market (Pissarides).
- Rise in government consumption associated with ARRA had peak multiplier effect in excess of 2.
 - But, overall effect was small because of size and timing of spending.

Labor Market



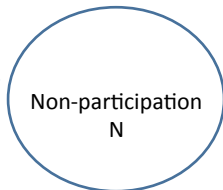
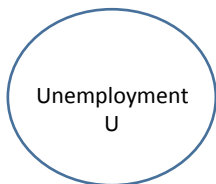
Labor Market

$$E_0 \sum_{t=0}^{\infty} \beta^t \mathcal{U}(\tilde{C}_t)$$



$$\tilde{C}_t = \left[(1 - \omega) (C_t)^x + \omega (C_t^H)^x \right]^{\frac{1}{x}}$$

$$C_t^H = 1 - L_t$$



- Household labor force decision
- Split between U and E determined by job-finding rate.

Labor Market

$$\max_{\{C_t, L_t, C_t^H, B_{t+1}, K_{t+1}, I_t, l_t\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t \mathcal{U}(\tilde{C}_t)$$

Employment
E

$$P_t C_t + P_{I,t} I_t + B_{t+1}$$

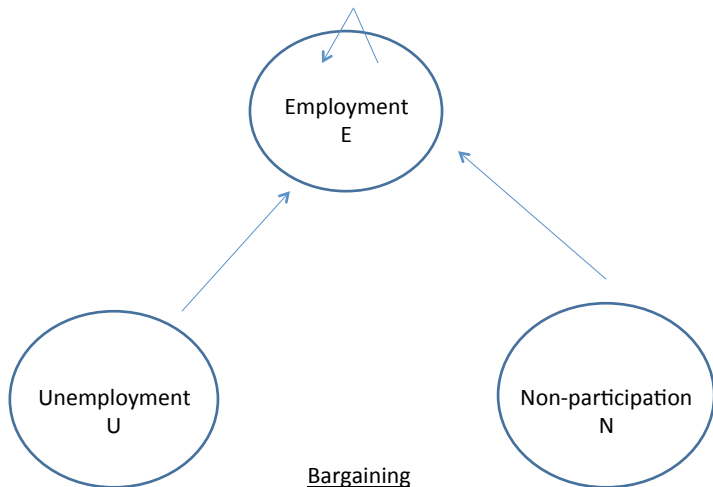
$$\leq R_{K,t} K_t + (L_t - l_t) P_t D_t + l_t W_t + R_{t-1} B_t - T_t$$

Unemployment
U

Non-participation
N

- Household labor force decision
- Split between U and E determined by job-finding rate.

Labor Market



Bargaining

Three types of worker-firm meetings:

i) E to E , ii) U to E, iii) N to E

Modified version of Hall-Milgrom

- Firms pay a fixed cost to meet a worker (must post vacancies, but these are costless).
- Then, workers and firms engage in alternating-offer bargaining.
 - Better off reaching agreement than parting ways.
 - Disagreement leads to continued negotiations.
- If bargaining costs don't depend too sensitively on state of economy, neither will wages.
 - firms suffer cost, γ , when they reject an offer by the worker and make a counteroffer.
 - costs somewhat sensitive to state of business cycle:
 - protracted negotiations mean lost output/wages.
 - rejection of an offer risks, with probability δ , that negotiations break down completely.
- After expansionary shock, rise in wages is relatively small.

Value functions for Workers and Firms

- Value to firm of a match:

$$J_t = \vartheta_t - w_t + \beta E_t m_{t+1} J_{t+1}$$

- Worker value functions:

$$\begin{aligned} V_t = & w_t + E_t m_{t+1} [\rho V_{t+1} \\ & + (1 - \rho) s (f_{t+1} \bar{V}_{t+1} + (1 - f_{t+1}) U_{t+1}) \\ & + (1 - \rho) (1 - s) N_{t+1}]. \end{aligned}$$

$$\begin{aligned} U_t = & D + E_t m_{t+1} [s f_{t+1} V_{t+1} \\ & + s (1 - f_{t+1}) U_{t+1} + (1 - s) N_{t+1}] \end{aligned}$$

$$\begin{aligned} N_t = & VMP_t + E_t m_{t+1} [e_{t+1} (f_{t+1} V_{t+1} + (1 - f_{t+1}) U_{t+1}) \\ & + (1 - e_{t+1}) N_{t+1}] \end{aligned}$$

Rest of Model: Medium-Sized DSGE

- Competitive final goods production: $Y_t = \left[\int_0^1 Y_{j,t}^{\frac{1}{\lambda_f}} dj \right]^{\lambda_f}$.
- j^{th} input produced by monopolist:
 - Production: $Y_{j,t} = k_{j,t}^\alpha (z_t h_{j,t})^{1-\alpha} - \phi$.
 - Homogeneous good, $h_{j,t}$, purchased in competitive markets for real price, ϑ_t .
 - Monopolist sets price, $P_{j,t}$, subject to Calvo sticky price frictions (no price indexation).
- Homogeneous input good h_t produced by the firms in our labor market model.
- Taylor rule.

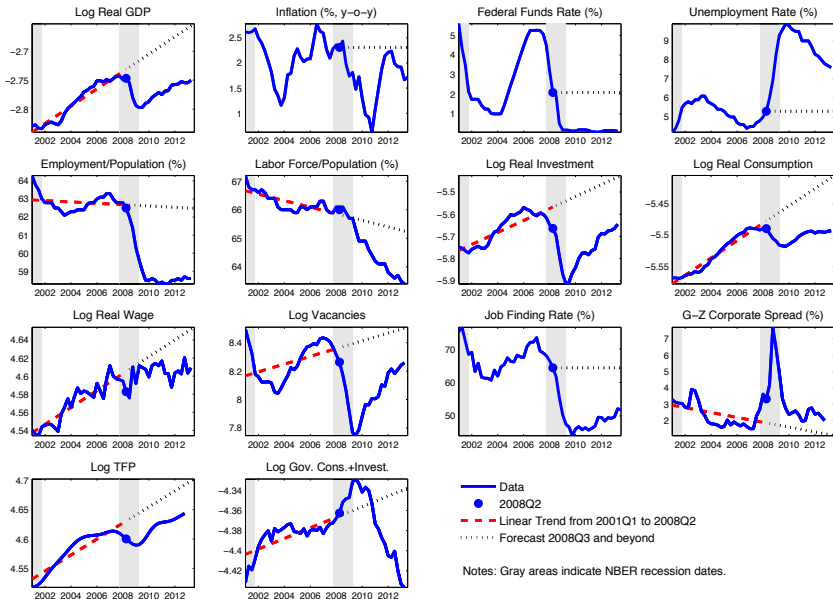
Estimated Parameters, Pre-2008 Data

- Estimation by impulse response matching, Bayesian methods.
- Prices change on average every 4 quarters.
- δ : roughly 0.1% chance of a breakup after rejection.
- γ : cost to firm of preparing counteroffer roughly 1 day's production.
- Posterior mode of hiring cost: 0.49% of GDP; replacement ratio: 17% of wage.
- Elasticity of substitution between home and market goods: 3.
 - set *a priori*, see Aguiar-Hurst-Karabarbounis (2012).

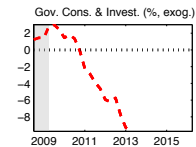
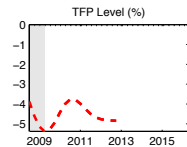
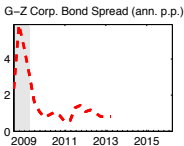
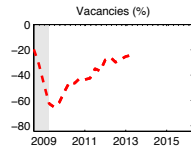
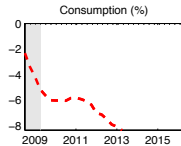
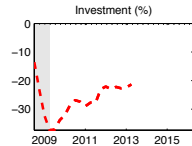
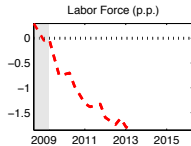
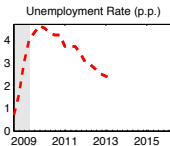
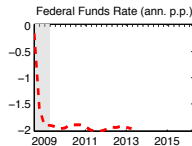
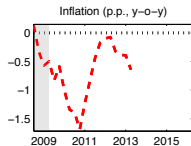
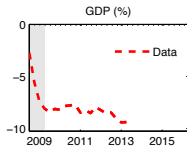
Accounting for the Great Recession

- Quantitative characterization of Great Recession
 - gap between:
 - what actually happened.
 - what would have happened in the absence of the shocks that launched the Great Recession
- Use model to assess which shocks account the gap

The U.S. Great Recession



The U.S. Great Recession: Data Targets



Two Financial Market Shocks

- ① *Flight to Quality Shock*, Δ_t^b : Shock to demand for safe assets (Jonas Fisher 2014):

$$1 = (1 + \Delta_t^b) E_t m_{t+1} R_t / \pi_{t+1}$$

- ② *Financial wedge*, Δ_t^k : Reduced form of 'risk shock', Christiano-Davis (2006), CKM (2006):

$$1 = (1 - \Delta_t^k) E_t m_{t+1} R_{t+1}^k / \pi_{t+1}$$

- Financial wedge also applies to working capital loans:
 - Interest charge on working capital: $R_t (1 + \Delta_t^k)$

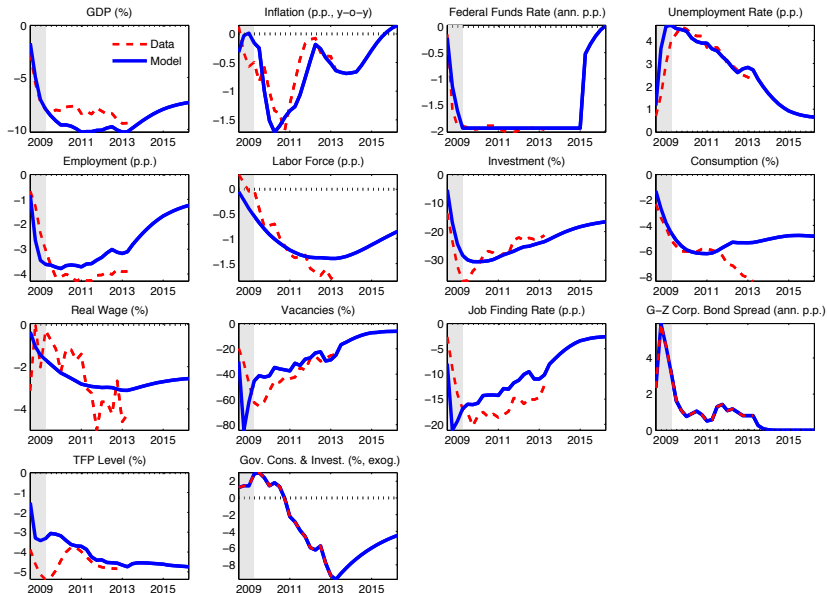
Measurement of Shocks

- ① Financial wedge, $1 - \Delta_t^k$, measured using GZ spread data.
 - ② Government shock measured using G data.
 - ③ Neutral technology shock based on TFP data.
 - ④ We don't have data on the flight to quality shock, Δ_t^b .
 - In 2008Q3, agents expect Δ_t^b to jump from 0 to 0.33%.
 - Initially, expect jump to last until 2013Q2.
 - In 2012Q3 revise expectation and believe Δ_t^b will remain up until 2014Q3 (stand-in for fiscal cliff, sequester).
- Stochastic simulation starting 2008q3 (nonlinear model, no perfect foresight).

Monetary Policy in the Great Recession

- From 2008Q3 to 2011Q2:
 - Taylor-type feedback rule subject to the ZLB.
- After 2011Q2: 'forward guidance'
 - following 1 year transition, 'Evans rule'
 - keep funds rate at zero until either unemployment falls below 6.5% or inflation rises above 2.5%.

The U.S. Great Recession: Data vs. Model



Decomposing What Happened into Shocks

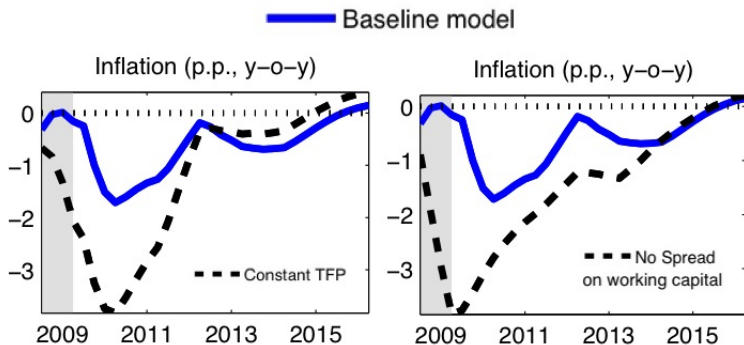
- We investigate the effect of each shock by shutting it off.
- Results:
 - *Financial wedge* - accounts for the biggest effect on real quantities.
 - *Flight to quality shock* - drives economy into lower bound, pushes down inflation.
 - *Government spending shock* - relatively small role.
 - *TFP shock* - plays an important role in preventing drop in inflation.

Inflation

- At first, seems puzzling that inflation decline is so modest, given the magnitude of the economic slowdown in the Great Recession.
- One response: Phillips curve got flat or always was very flat (e.g. Christiano, Eichenbaum and Rebelo, JPE 2011).
- Alternative: standard Phillips curve misses sharp rise in costs
 - Unusually high cost of credit to finance working capital.
 - Fall in TFP.

⇒ *Both raise countervailing pressure on inflation.*

Decomposition for Inflation

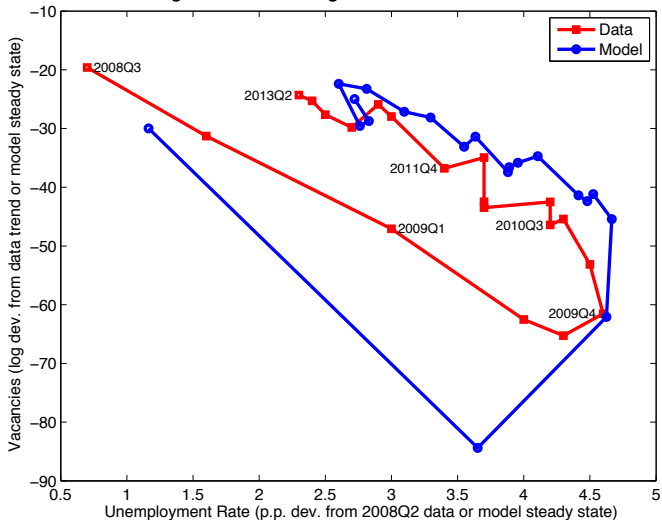


Beveridge Curve

- Much attention focused on 'sharp' rise in vacancies and relatively small fall in unemployment ('Fish Hook')
 - It has been claimed that the fish hook shape is evidence of 'shift' in matching function.
- Our model has no difficulty accounting for the fish hook pattern.
 - yet, no shift occurs in the matching technology.

The Beveridge Curve: Data vs. Model

Figure 15: Beveridge Curve: Data vs. Model



Model Predicts Fish Hook, Why?

- Simplest DMP style model

$$U_{t+1} - U_t = (1 - \rho)(1 - U_t) - f_t U_t$$

solving for f_t :

$$f_t = (1 - \rho) \frac{(1 - U_t)}{U_t} - \frac{U_{t+1} - U_t}{U_t} \underbrace{\quad}_{\text{matching function}} \sigma_t \left(\frac{V_t}{U_t} \right)^\alpha$$

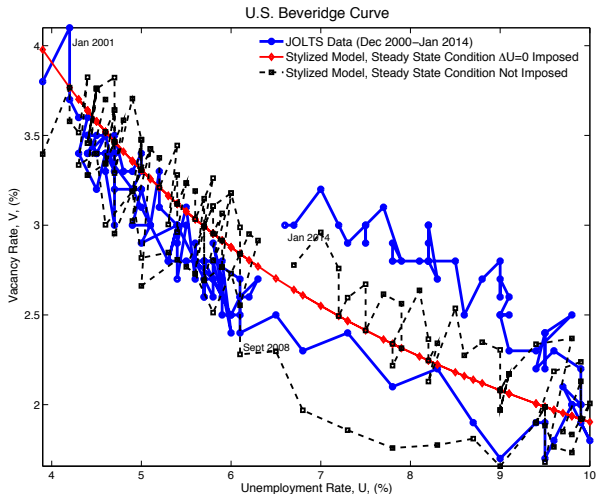
solving for V_t :

$$V_t = \left[(1 - \rho) \frac{(1 - U_t)}{\sigma_t U_t^{1-\alpha}} - \frac{U_{t+1} - U_t}{\sigma_t U_t^{1-\alpha}} \right]^{1/\alpha}$$

standard approximation sets this to zero

- Naturally implies a 'fish hook' pattern (Pissarides).

Magnitude of Fish Hook in DMP Model



$$(\rho = 0.97, \alpha = 0.6, \sigma = 0.84, \text{ monthly})$$

Conclusion

- Bulk of movements in economic activity during the Great Recession due to financial frictions interacting with the ZLB.
 - ZLB has caused negative spending shocks to push the economy into a prolonged recession.
- Findings based on looking through lens of a NK model:
 - firms face moderate degrees of price rigidities,
 - no sticky wages.
- No (or little) evidence for ‘mismatch’ in labor market.
- Modest fall in inflation is not a puzzle once fall in TFP and risky working capital channel are taken into account.