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, labor force participation, 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.

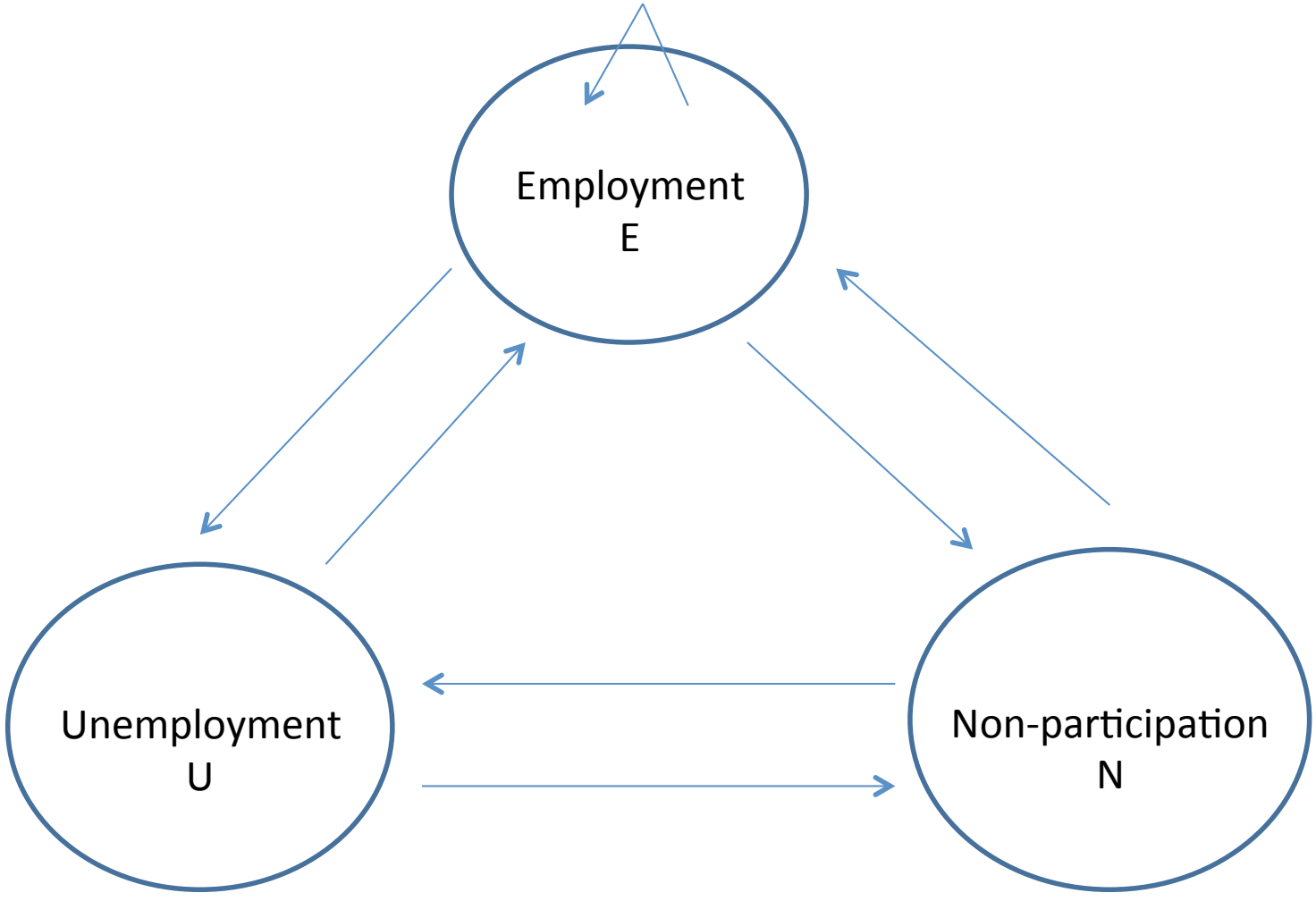
Questions and Answers

- What forces drove real quantities in the Great Recession?
  - Shocks to financial markets key drivers, even for variables like labor force participation.
  - Government shocks not important: because of size and timing (consistent with ZLB literature).
- Mismatch in the labor market?
  - Not a first order feature of the Great Recession.
  - We account for 'shift' in the Beveridge curve without resorting to structural shifts in the labor market.

Questions and Answers

- Why was the drop in inflation so moderate?
  - Prolonged slowdown in TFP growth during the Great Recession.
  - Rise in cost of firms' working capital as measured by spread between corporate-borrowing rate and risk-free interest rate.
  - Both forces exert countervailing pressure on inflation.

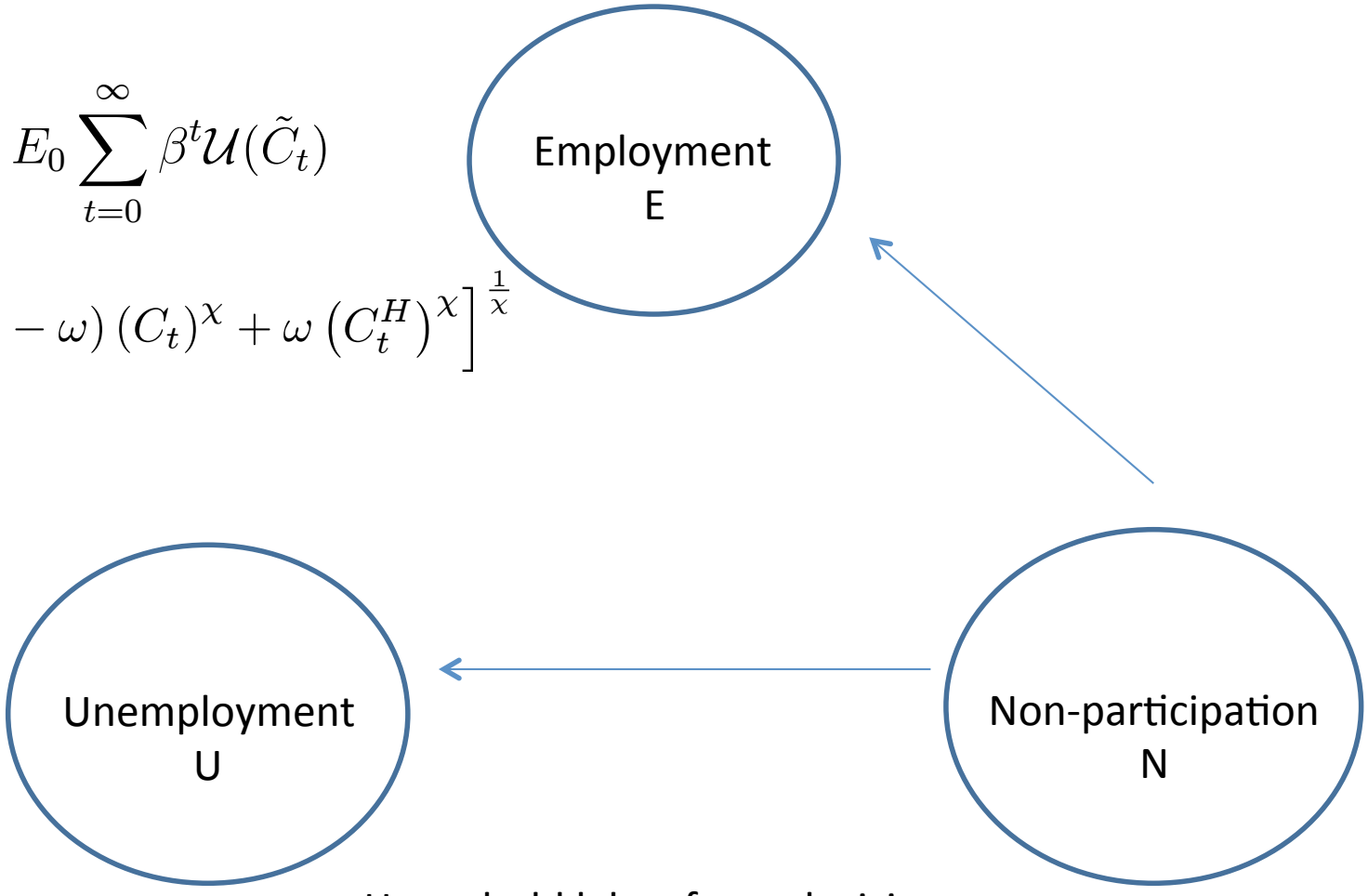
Labor Market



Labor Market

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

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



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

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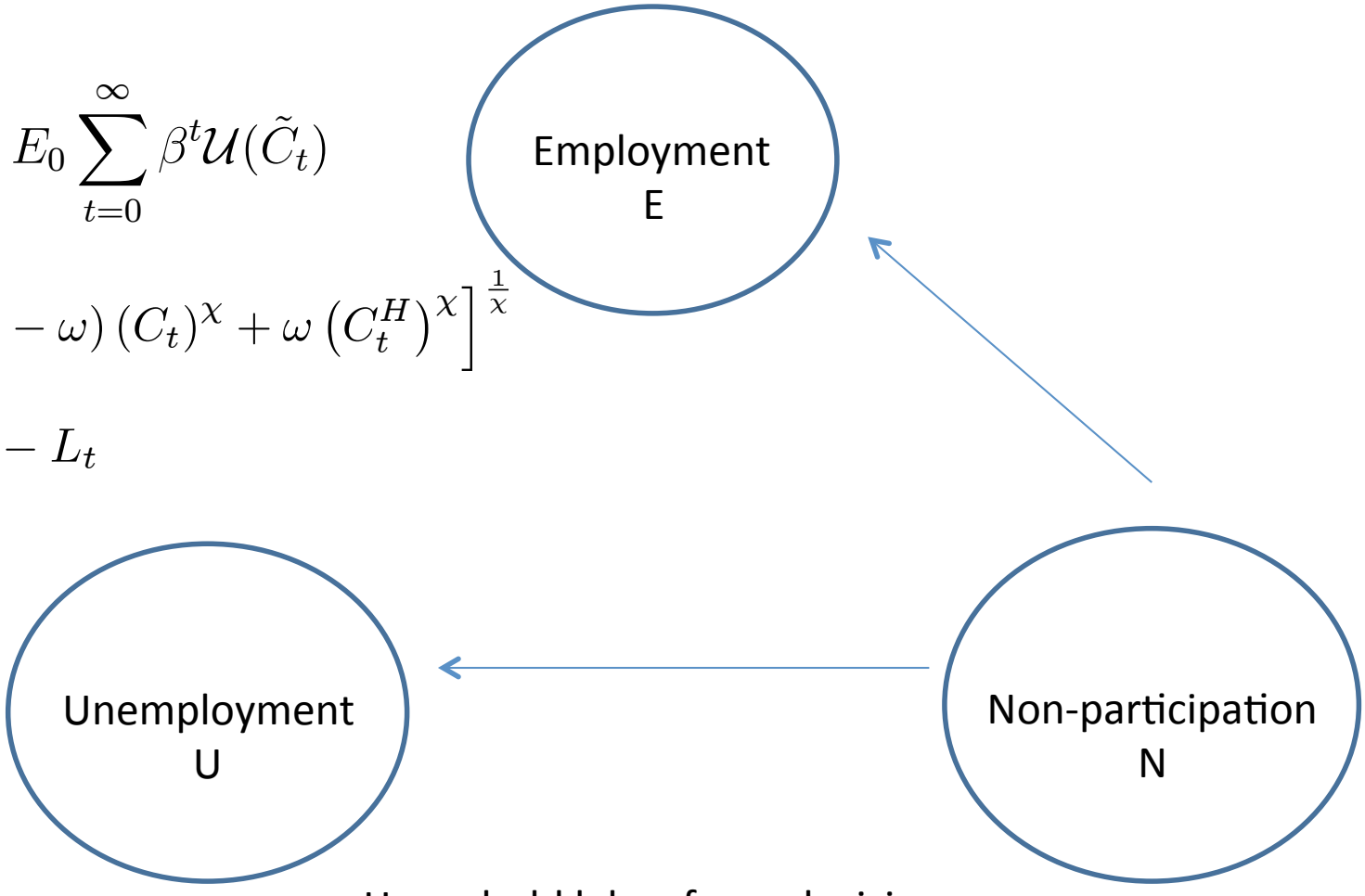
$$C_t^H = 1 - L_t$$



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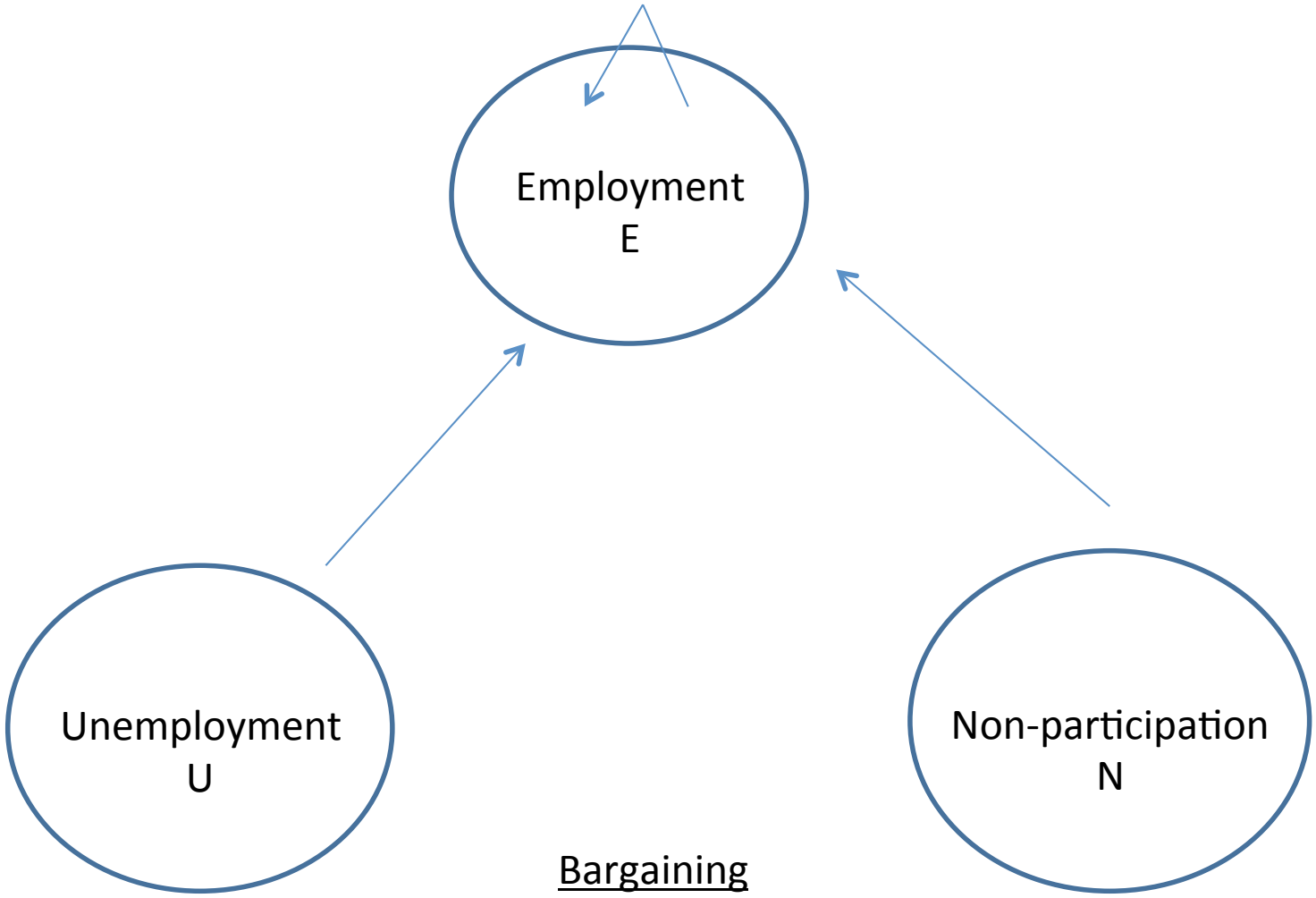


<u>Bargaining</u>

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.
  - bargaining 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.

Estimated Medium-Sized DSGE Model

- Standard empirical NK model (e.g., CEE, ACEL, SW):
  - Calvo price setting frictions, but no indexation.
  - Habit persistence.
  - Variable capital utilization.
  - Working capital.
  - Adjustment costs: investment, labor force.
  - Taylor rule.

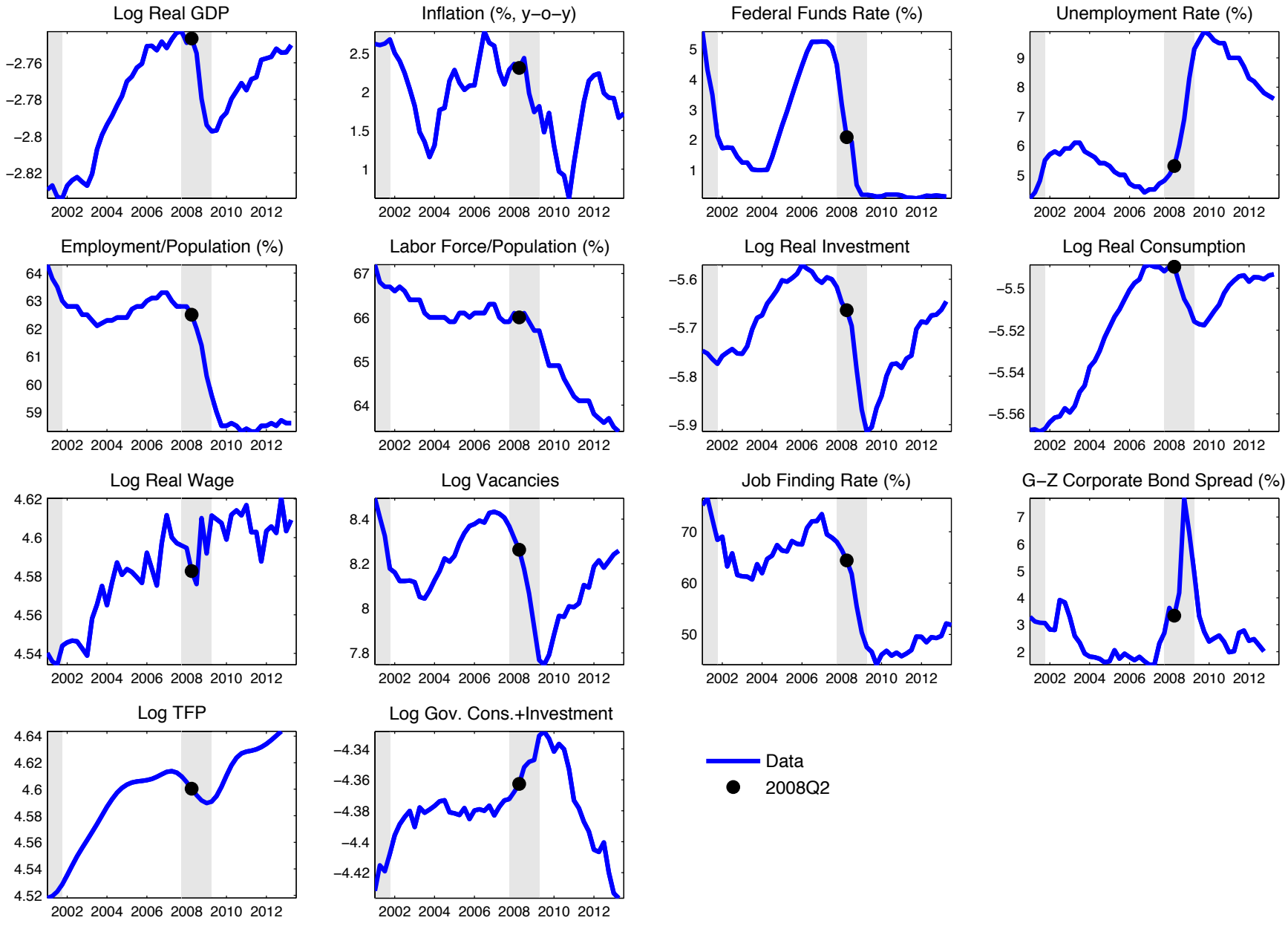
- Our labor market structure.

- Estimation strategy: Bayesian impulse response matching.
  - Shocks to monetary policy, neutral and investment-specific technology.
  - Our model performs well relative to this metric.

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 0.6 times one day's production.
- Posterior mode of hiring cost: 0.5% of GDP; replacement ratio: 30% of wage.
- Elasticity of substitution between home and market goods: 3.
  - set *a priori*, see Aguiar-Hurst-Karabarbounis (2012).

The U.S. Great Recession



Quantifying the Great Recession

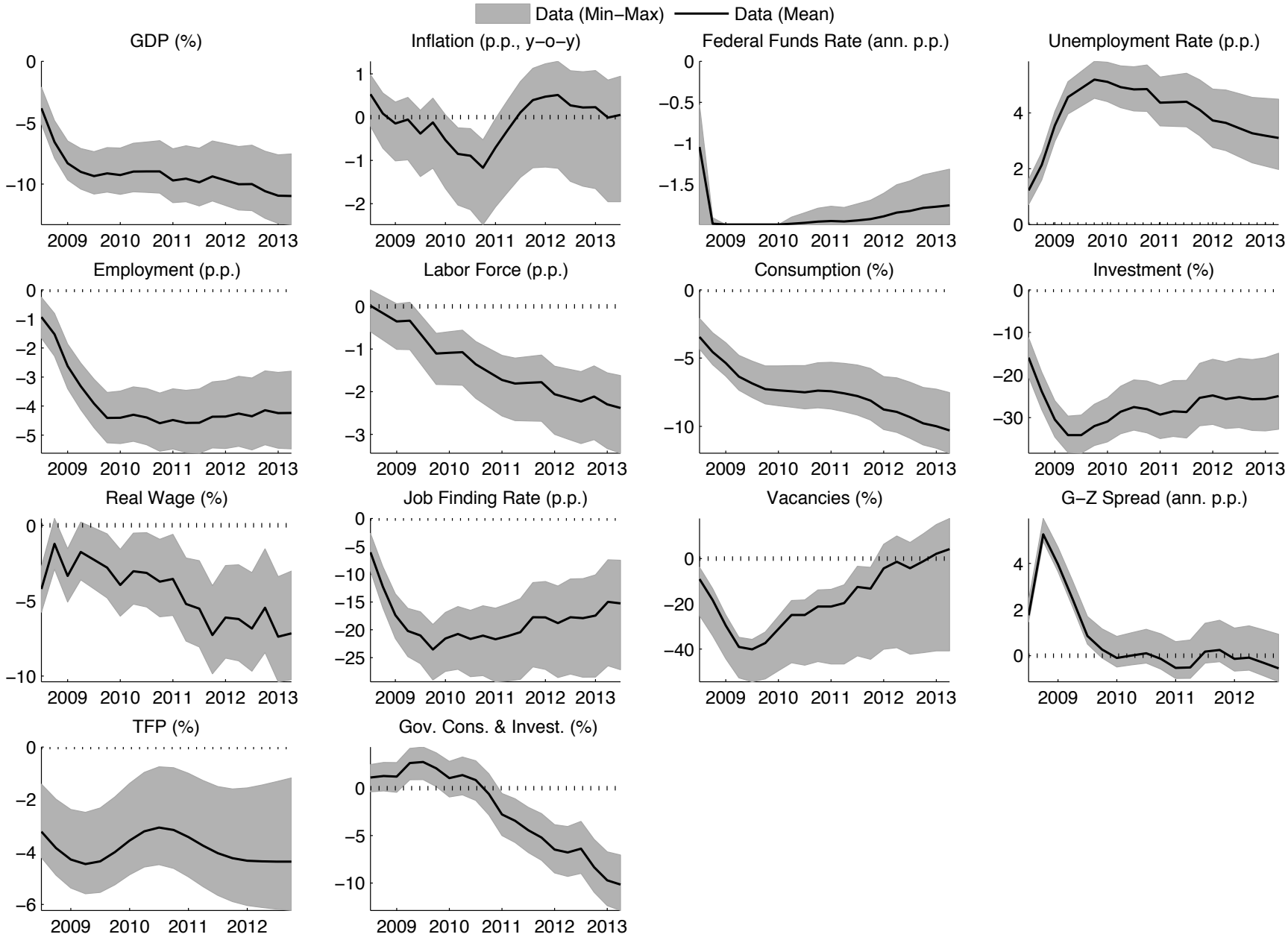
- Want a quantitative characterization of the *Great Recession*
  - the part of the post-2008 data that did not simply involve an unwinding of pre-2008 forces.
  - we seek to understand the difference between what *would have happened* absent Great Recession shocks and *what did happen*.
  - want the procedure to be as simple and transparent as possible.

- For each variable, we fit a linear trend from date x to $2008Q2$, where $x \in \{1985Q1; 2003Q1\}$.

- We extrapolate the resulting trend lines for each variable from $2008Q3$ to $2013Q2$.

- We calculate the *target gaps* as the differences between the projected values of each variable and its actual value.

U.S. Great Recession: Target Gap Ranges



Two Financial Market Shocks

1. *Consumption wedge,* Δ_t^b*:* Shock to demand for safe assets ('Flight to safety', see e.g. Fisher 2014):

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

2. *Financial wedge,* $\tilde{\Delta}_t^k$*:* Reduced form of 'risk shock', Christiano-Davis (2006), Christiano-Motto-Rostagno (2014):

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

- Financial wedge also applies to working capital loans:
  - Interest charge on working capital: $R_t \left(1 + \hat{\Delta}_t^k\right)$
  - Estimated share of labor inputs financed with loans: 0.56.
  - Higher financial wedge directly increases cost to firms.

Measurement of Shocks

1. Financial wedge, $\tilde{\Delta}_t^k$, measured using GZ spread data.

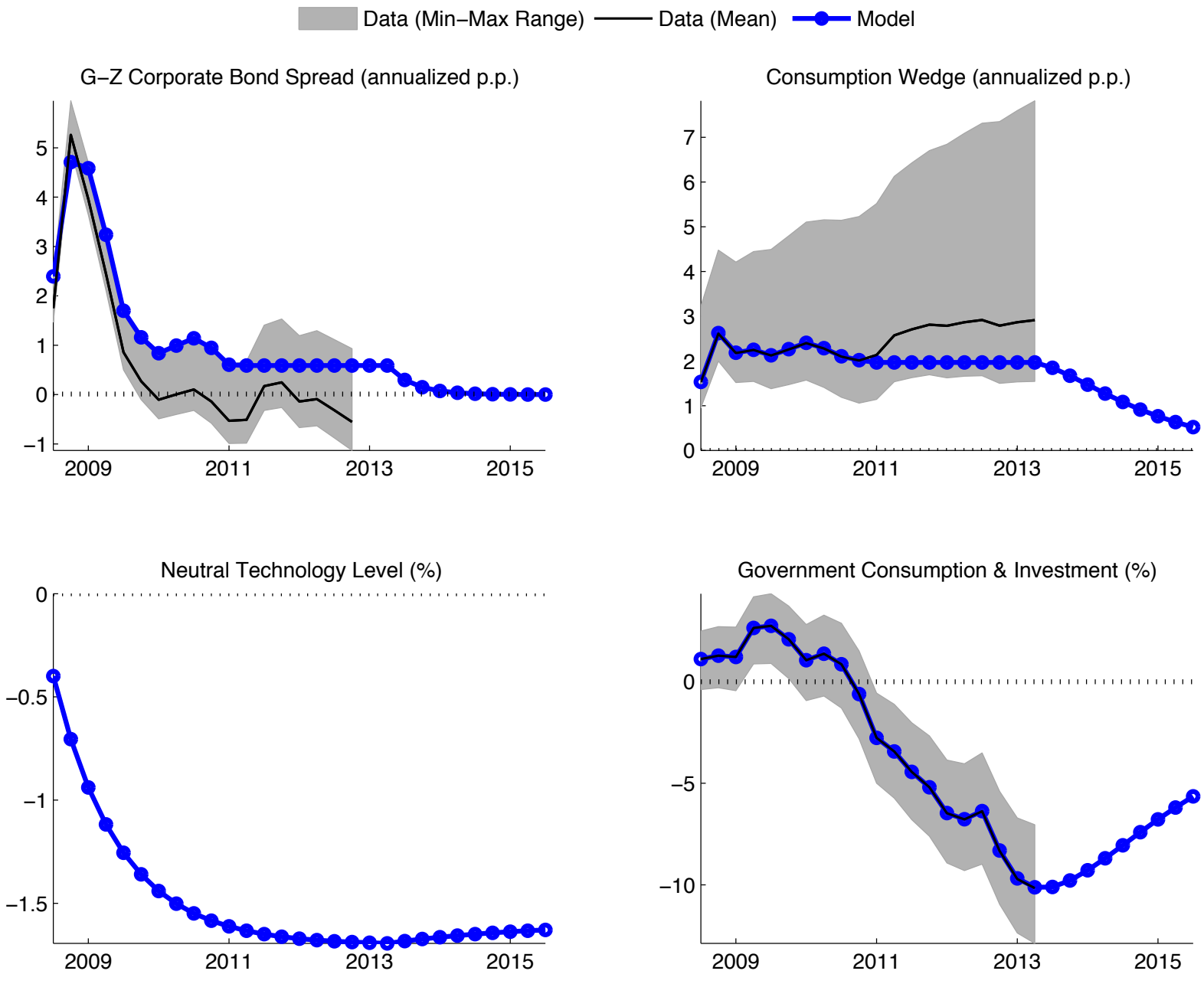
2. Consumption wedge, Δ_t^b, measured using the Euler equation for the risk-free asset and $E_t\pi_{t+1}$ and R_t data.

3. Neutral technology shock based on TFP data.

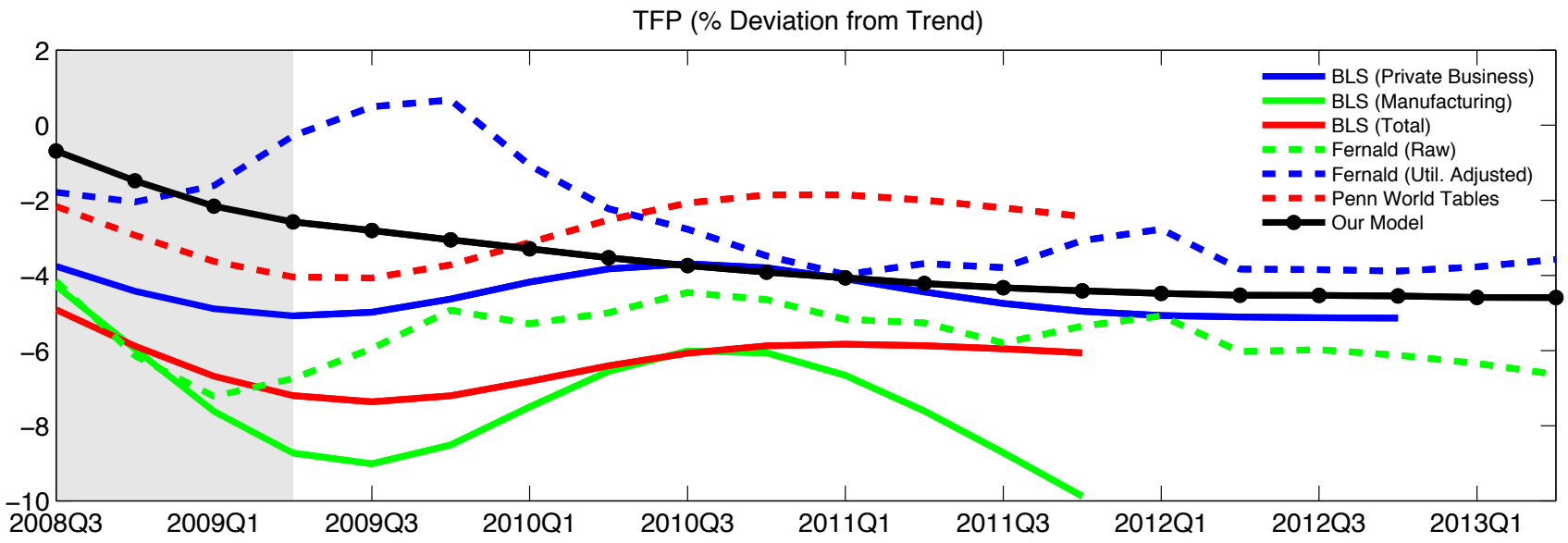
4. Government shock measured using G data.

- Stochastic simulation starting 2008Q3 (nonlinear model, no perfect foresight).

Exogenous Processes



Assessing model's implication for TFP

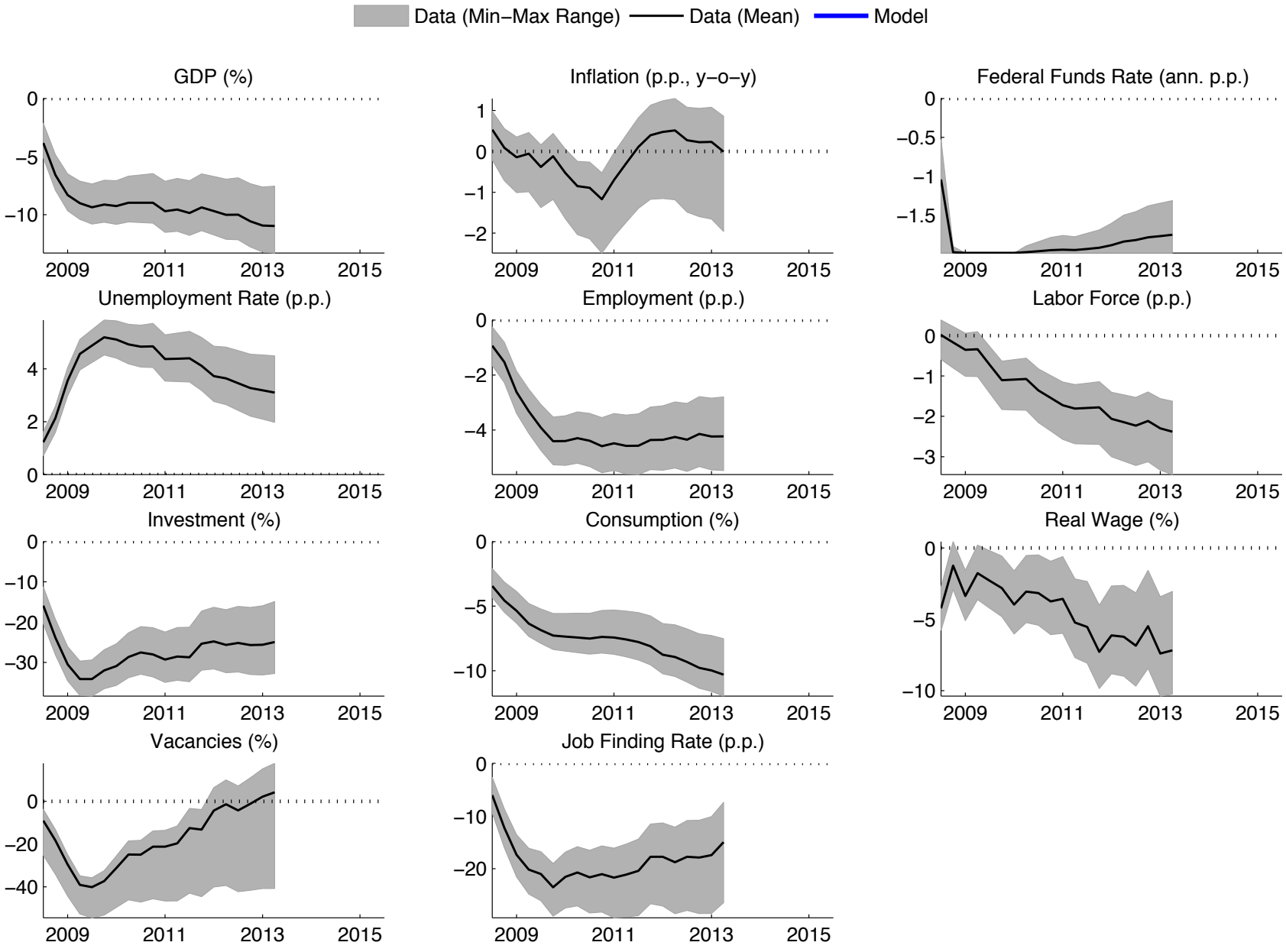


Monetary Policy in the Great Recession

- 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



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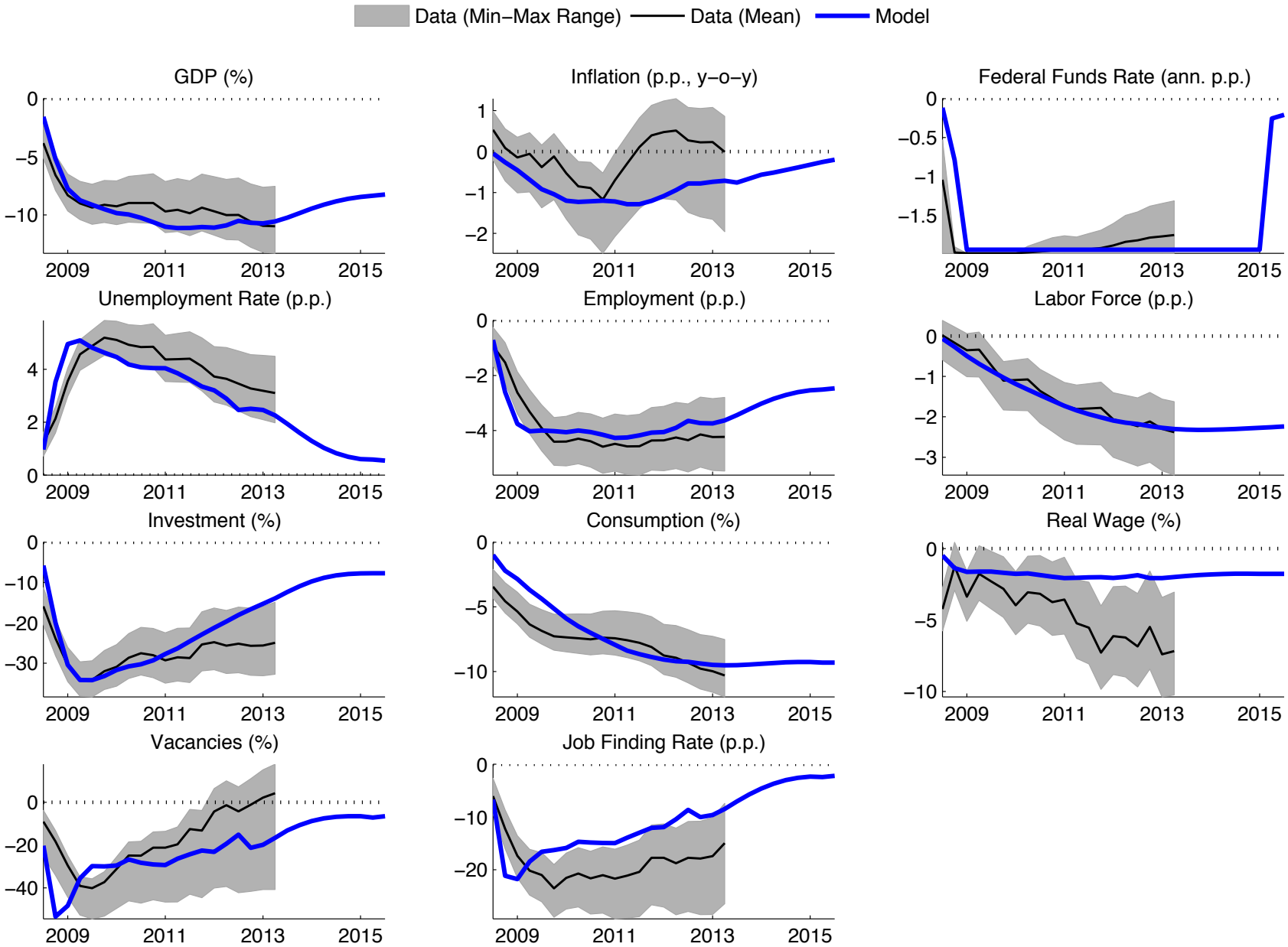


Decomposing What Happened into Shocks

- Our shocks roughly reproduce the actual data.

- We investigate the effect of a shock by shutting it off.
  - Resulting decomposition is not additive because of nonlinearity.

- Results:
  - *Financial wedge* - accounts for the biggest effects on real quantitites.
  - *Consumption wedge* - less important than financial wedge.
  - *Government spending* - relatively small role.
  - *TFP* - plays an important role in preventing drop in inflation.

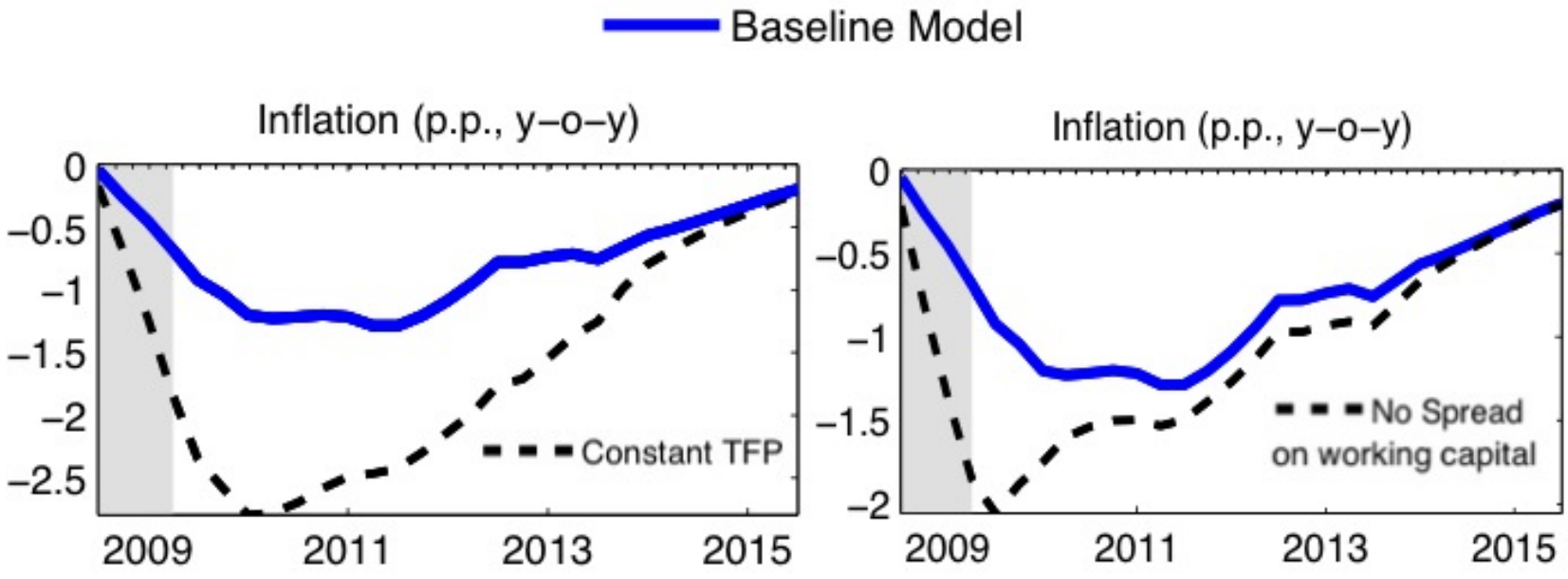
Phillips Curve

- Widespread skepticism that NK model can account for modest decline in inflation during the Great Recession.

- One response: Phillips curve got flat or always was very flat (e.g. Christiano, Eichenbaum and Rebelo, 2011).

- Alternative: standard Phillips curve misses sharp rise in costs
  - Unusually high cost of credit to finance working capital.
  - Fall in TFP.
    $\Rightarrow$*Both raise countervailing pressure on inflation*.

Decomposition for Inflation

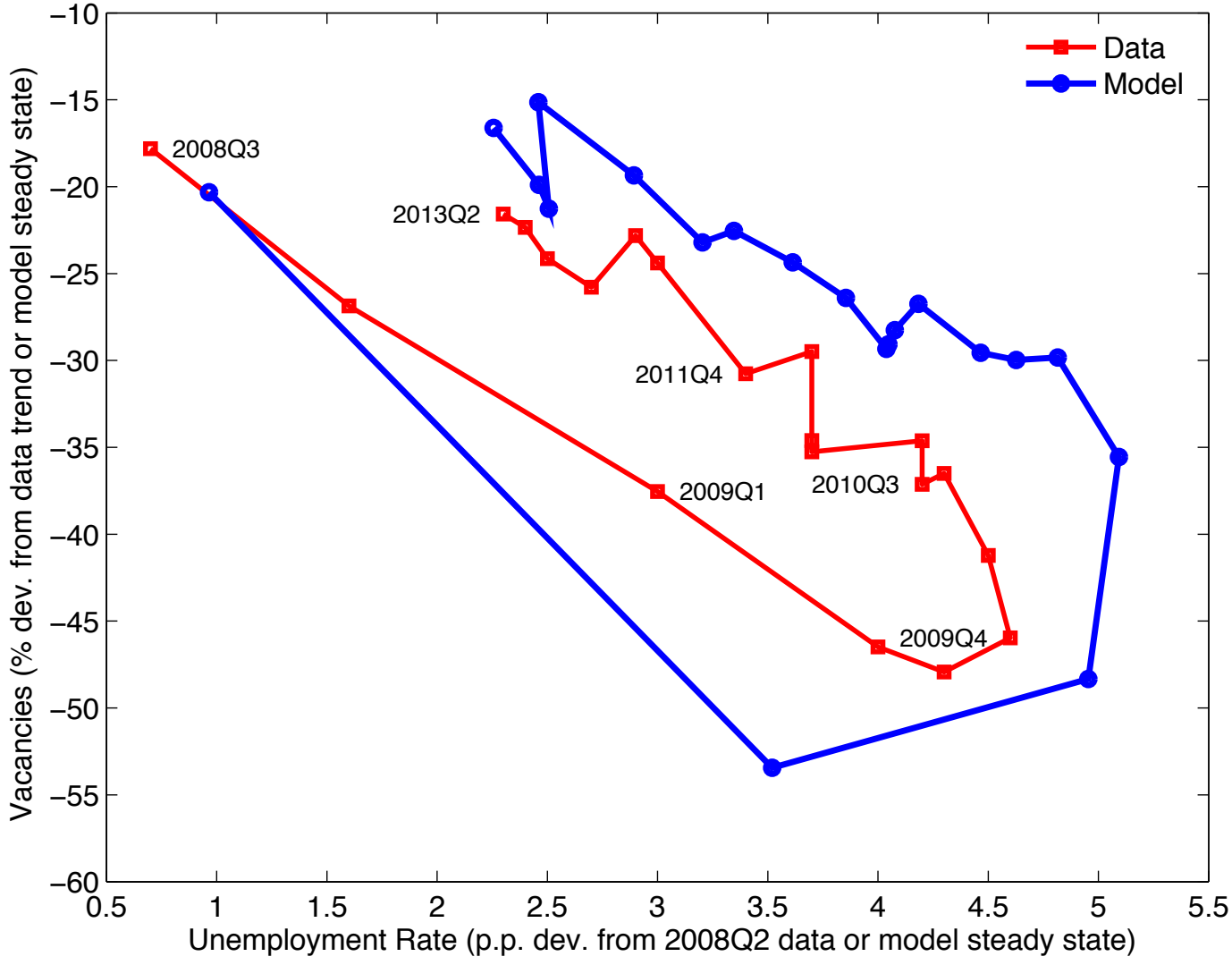


Beveridge Curve

- Much attention focused on 'sharp' rise in vacancies and relatively small fall in unemployment
  - It is argued that 'fish hook' shape is evidence of a 'shift' in matching function.
  - Argument based on assumption that unemployment is at steady state – misleading in the context of the Great Recession.
- In our model, no shift occurs in the matching technology.
  - Still, our model accounts for the 'fish hook' shape of the Beveridge curve.

The Beveridge Curve: Data vs. Model

Figure 9: 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 :

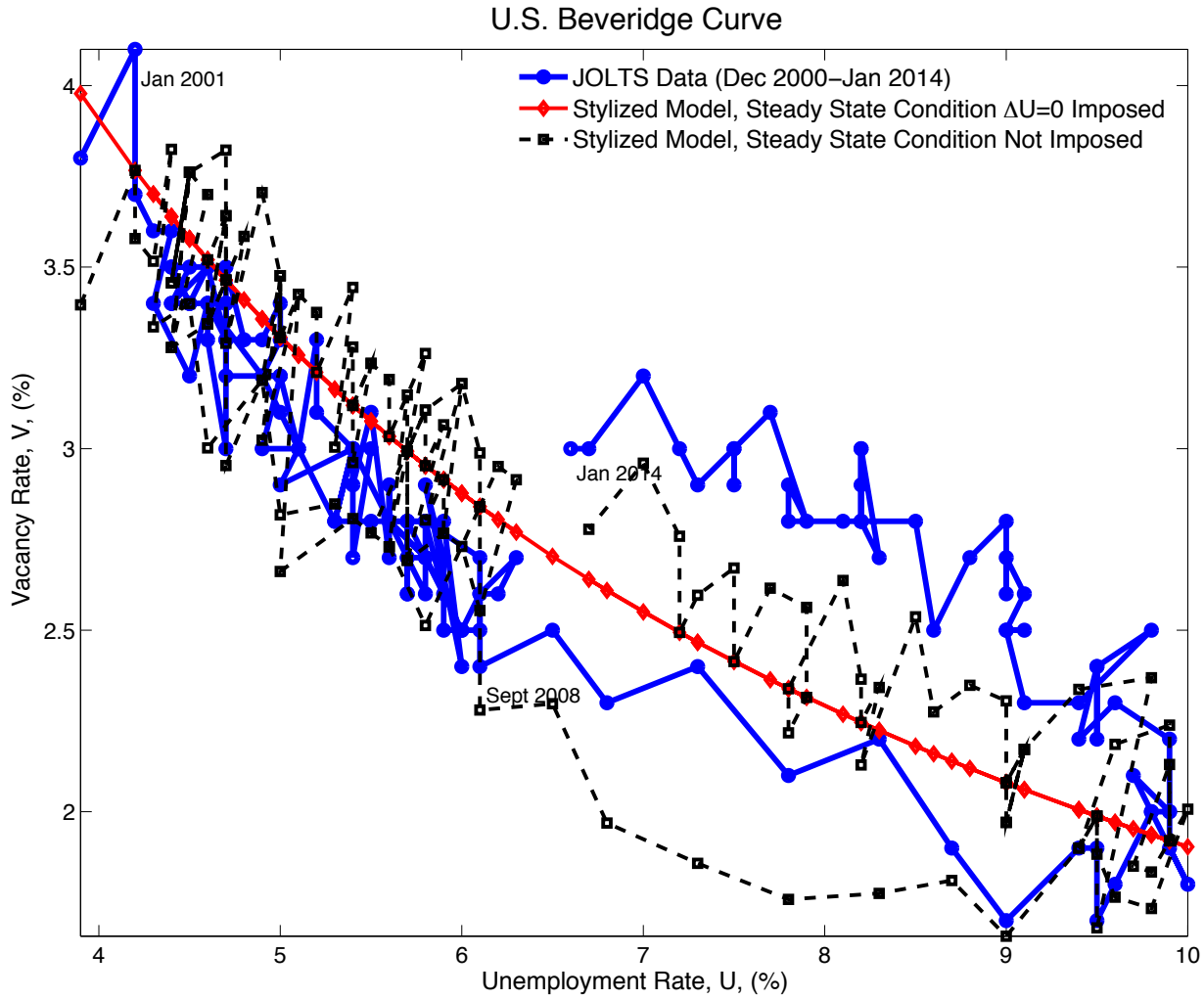
$$f_t = (1-\rho)\frac{(1-U_t)}{U_t} - \frac{U_{t+1}-U_t}{U_t} \overbrace{=}^{\text{matching function}} \sigma_t(\frac{V_t}{U_t})^{\alpha}$$

solving for V_t :

$$V_t = \left[(1-\rho)\frac{(1-U_t)}{\sigma_t U_t^{1-\alpha}} - \overbrace{\frac{U_{t+1}-U_t}{\sigma_t U_t^{1-\alpha}}}^{\text{standard approximation sets this to zero}} \right]^{1/\alpha}$$

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

Magnitude of Fish Hook in DMP Model



$(\rho = 0.97, \alpha = 0.6, \sigma = 0.84,$ 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.
  - endogenous labor force participation, standard labor market variables.

- 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.