Medium Sized NK Model

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The New Keynesian Model Has Become More Popular in Recent Years

- The simple NK model without capital provides an intellectual foundation for several current ideas
  - Economic risks to the economy of being at the zero lower bound (ZLB).
  - Appropriate monetary policy in the ZLB (e.g., 'forward guidance' in monetary policy).
  - Taylor principle.

- But, these things by themselves do not explain the recent popularity of the NK model.
  - Why is it taken seriously?

Why Has the New Keynesian Model Become More Popular in Recent Years?

- Model useful because it contributes to policy discussions and also because:
  - Useful for forecasting.
  - Fits data well by formal econometric criteria.
  - Receives support from recent data:
    - low inflation (despite unprecedented increases in central bank balance sheets)
    - evidence that government spending multipliers are large (see, e.g., Blanchard and Leigh, IMF WP/13/1)
    - Broad-based nature of economic weakness seems consistent with NK's emphasis on aggregate demand as a source of economic dysfunction.

- Model can easily be adapted to incorporate interesting financial and labor market frictions.

- One way to explain the good econometric fit of the model:
  - Show how (and why) it resolves an age-old puzzle in monetary economics.

Hume essay, *Of Money*

- …money… must first quicken the diligence of every individual, before it encrease the price of labour.

- The farmer and gardener, finding, that all their commodities are taken off, apply themselves with alacrity to the raising more…

- Friedman's AEA Presidential Address expresses similar view.

Early Monetary DSGE Models

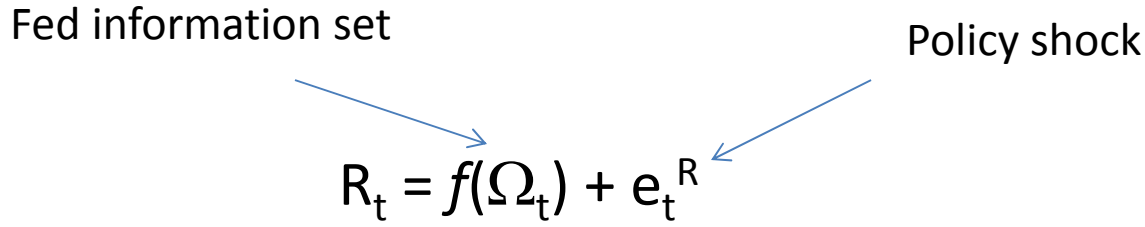
- Generally inconsistent with Hume/Friedman observation.

- In those models, monetary expansion produced an immediate rise in *P* and little rise in output.
  - Not surprisingly, early academic models little use to practical people.
  - Examples: Friedman-Lucas-Phelps 'island model', early Keynesian 'sticky wage' model.

- VARs key to quantifying Hume/Friedman observation and assessing consistency of NK model with it.

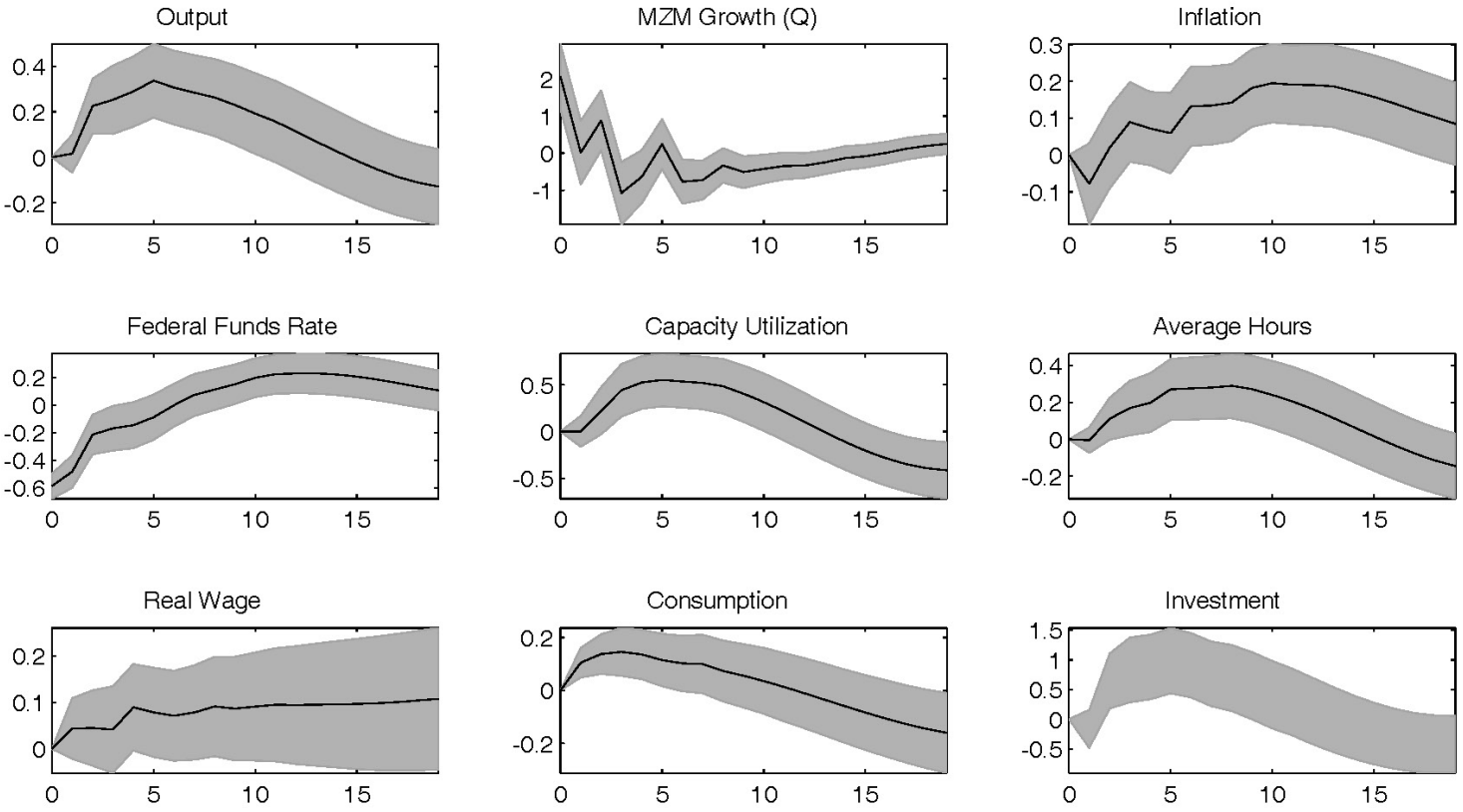
Identifying Monetary Policy Shocks

- Most influential strategy (Bernanke-Blinder): estimate parameters of Fed's feedback rule
  - Rule that relates Fed's actions to state of the economy:



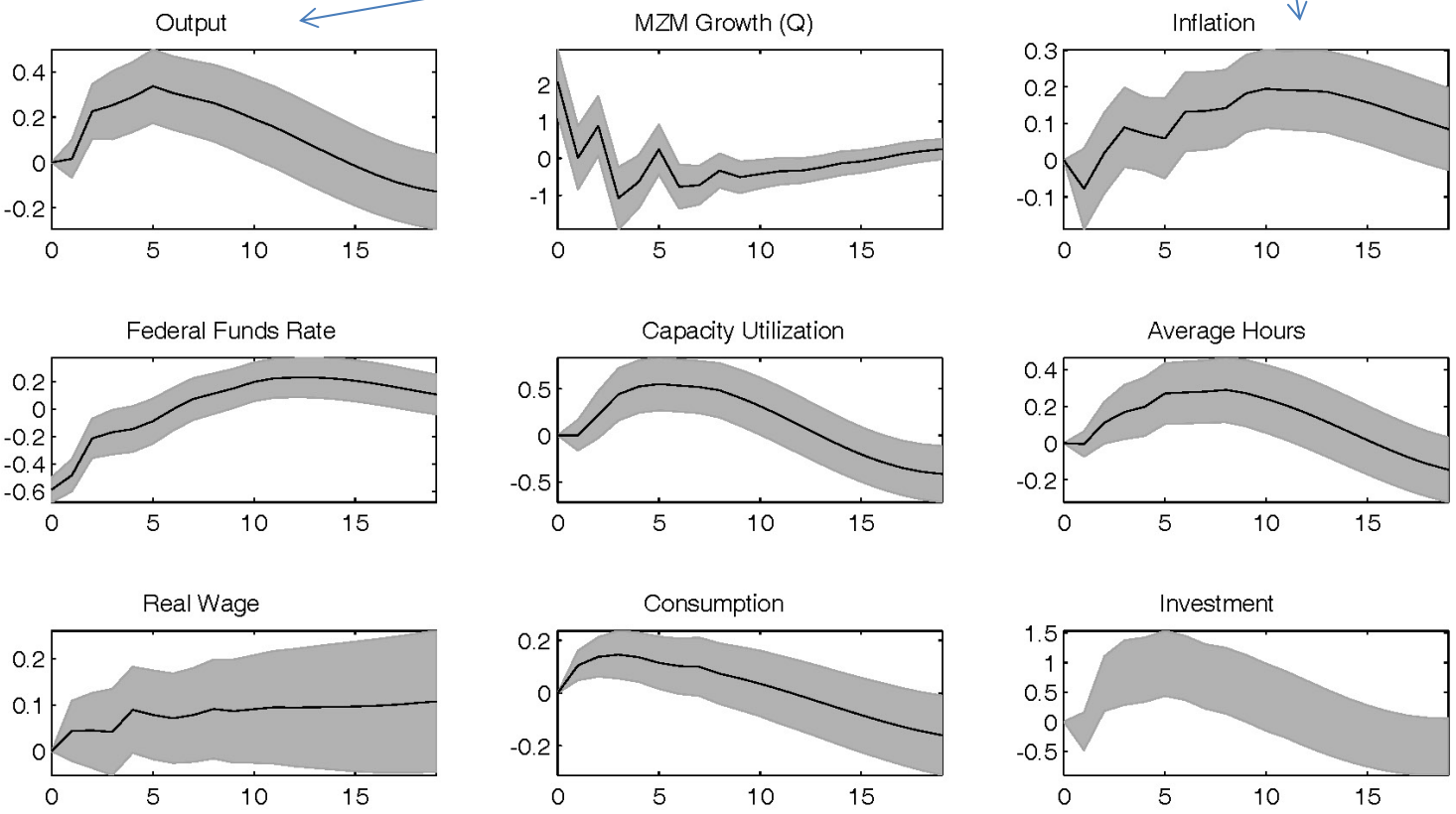
  - *f* linear
  - e_t^R orthogonal to Fed information, Ω_t
  - Ω_t contains current prices and wages, aggregate quantities, lagged stuff
  - e_t^R estimated by OLS regression
  - Regress X_t on e_t^R, e_{t-1}^R, e_{t-2}^R ,…

Response to a monetary policy shock

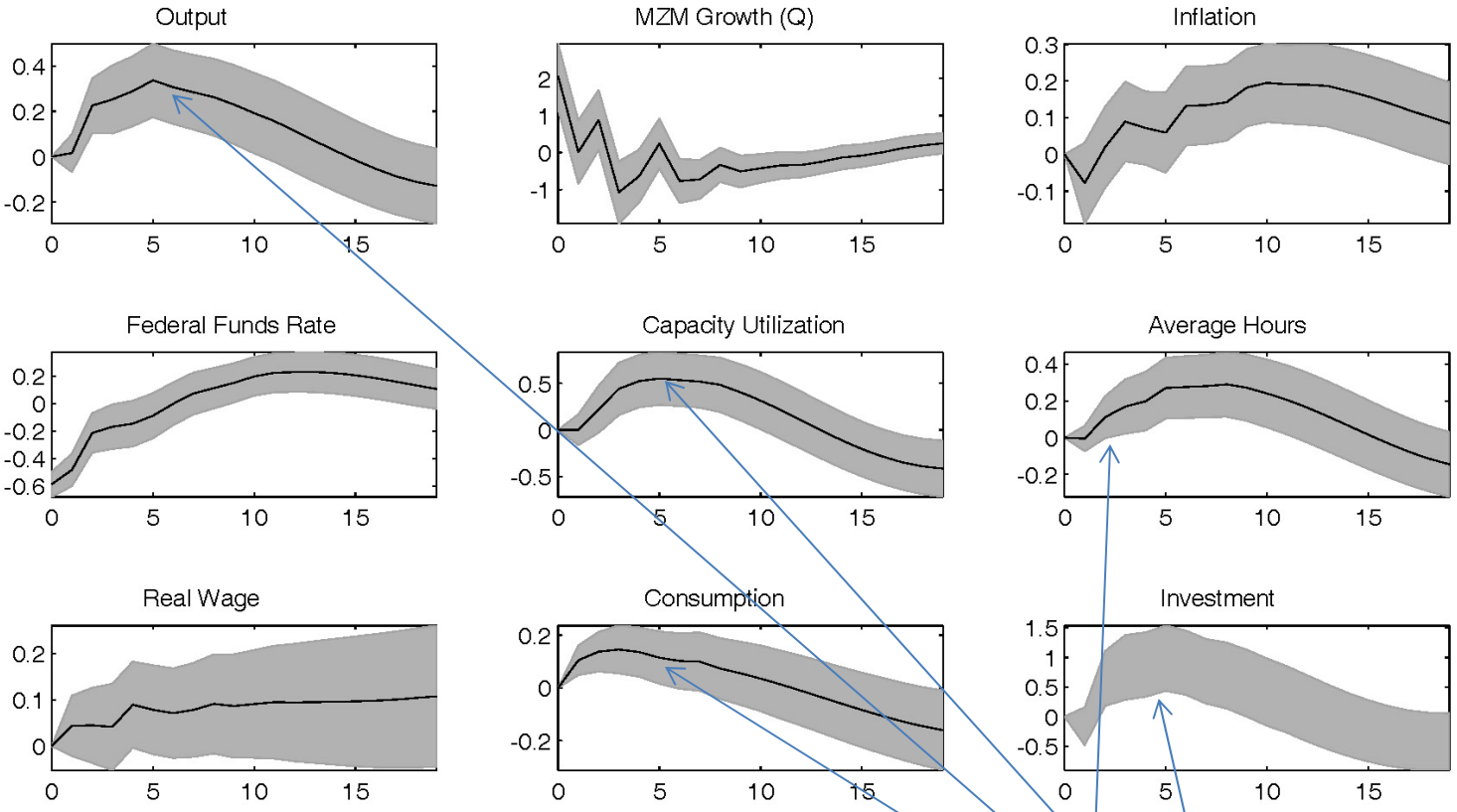


Response to a monetary policy shock

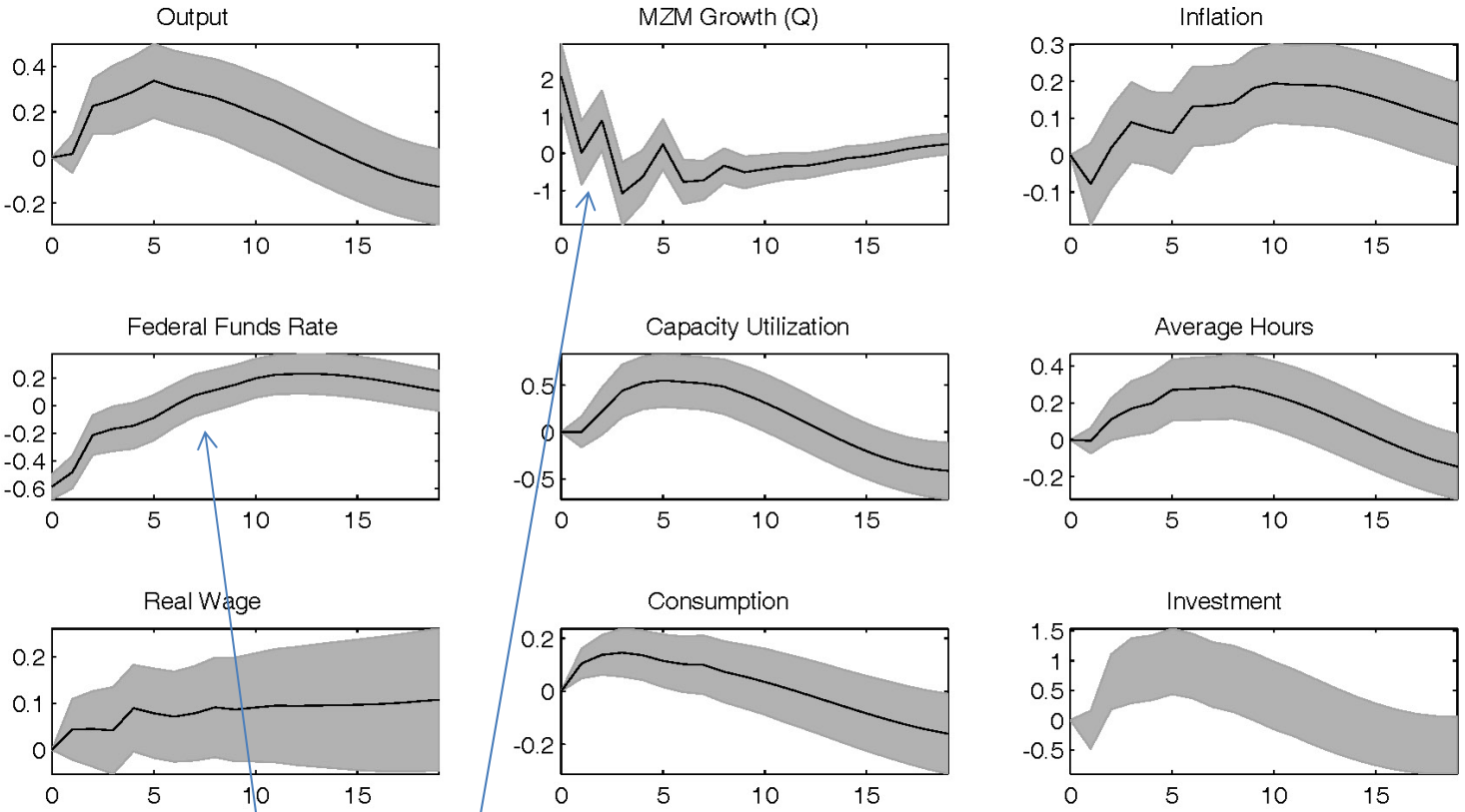
Hume/Friedman observation



Response to a monetary policy shock



Response to a monetary policy shock



The levers of monetary policy (interest rate/money growth) move for a relatively short amount of time, while the economy responds much longer.

An empirically successful model must deliver a lot of **internal persistence.**

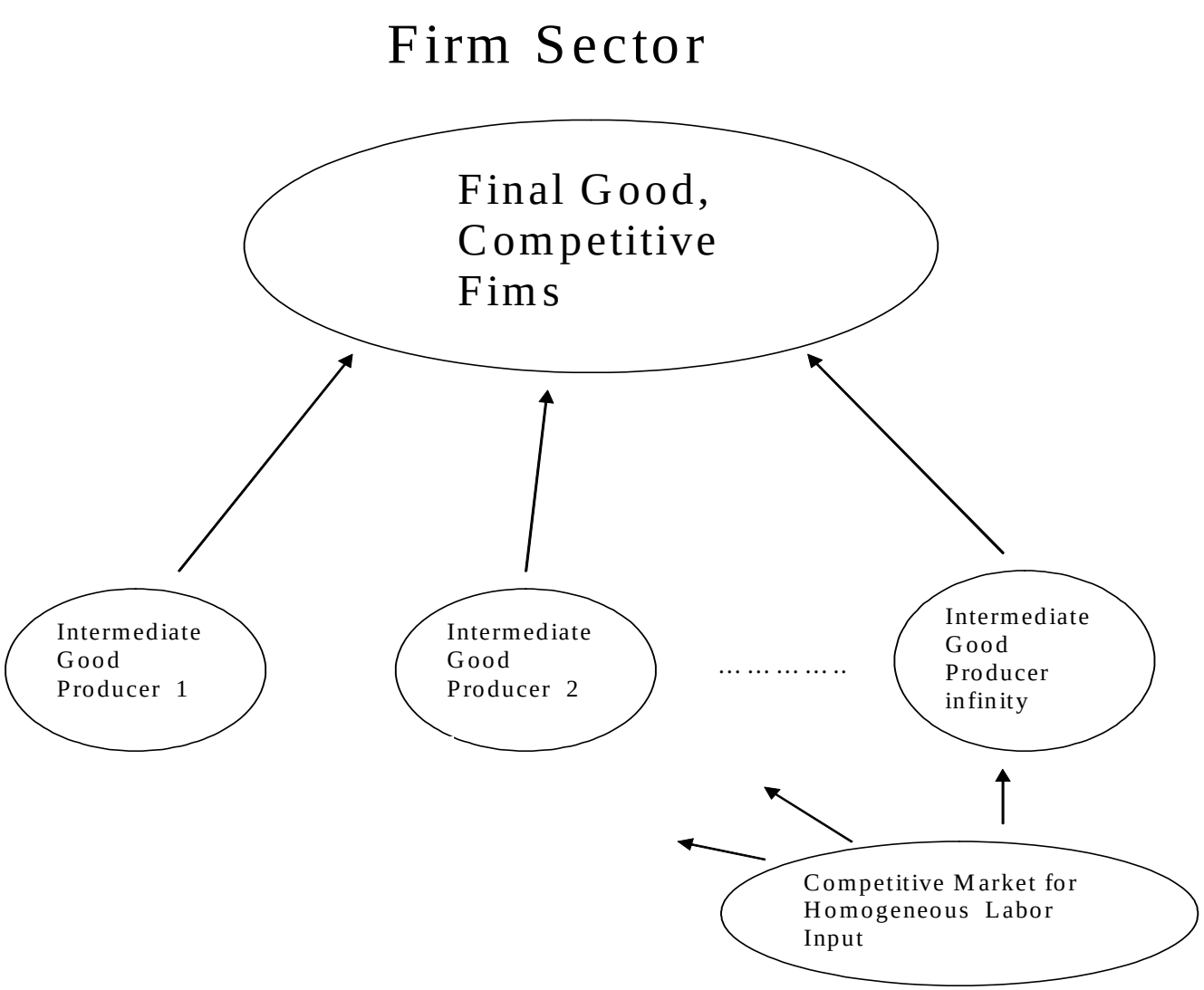
Modifications to Simple NK Model to Bring it to Data

- Introduce capital.
  - Fluctuations in investment are a quantitatively important feature of business cycles.
- To confront data, must have some additional features/modifications:
  - Sticky wages play a key role in the success of NK model.
    - Sticky wages have brought a lot of criticism down on the model, but there's good news…
  - Must adopt habit persistence in preferences ('*C*-dot' model utility)
  - Must adopt '*I*-dot' model of investment.

Introduction of Sticky Wages

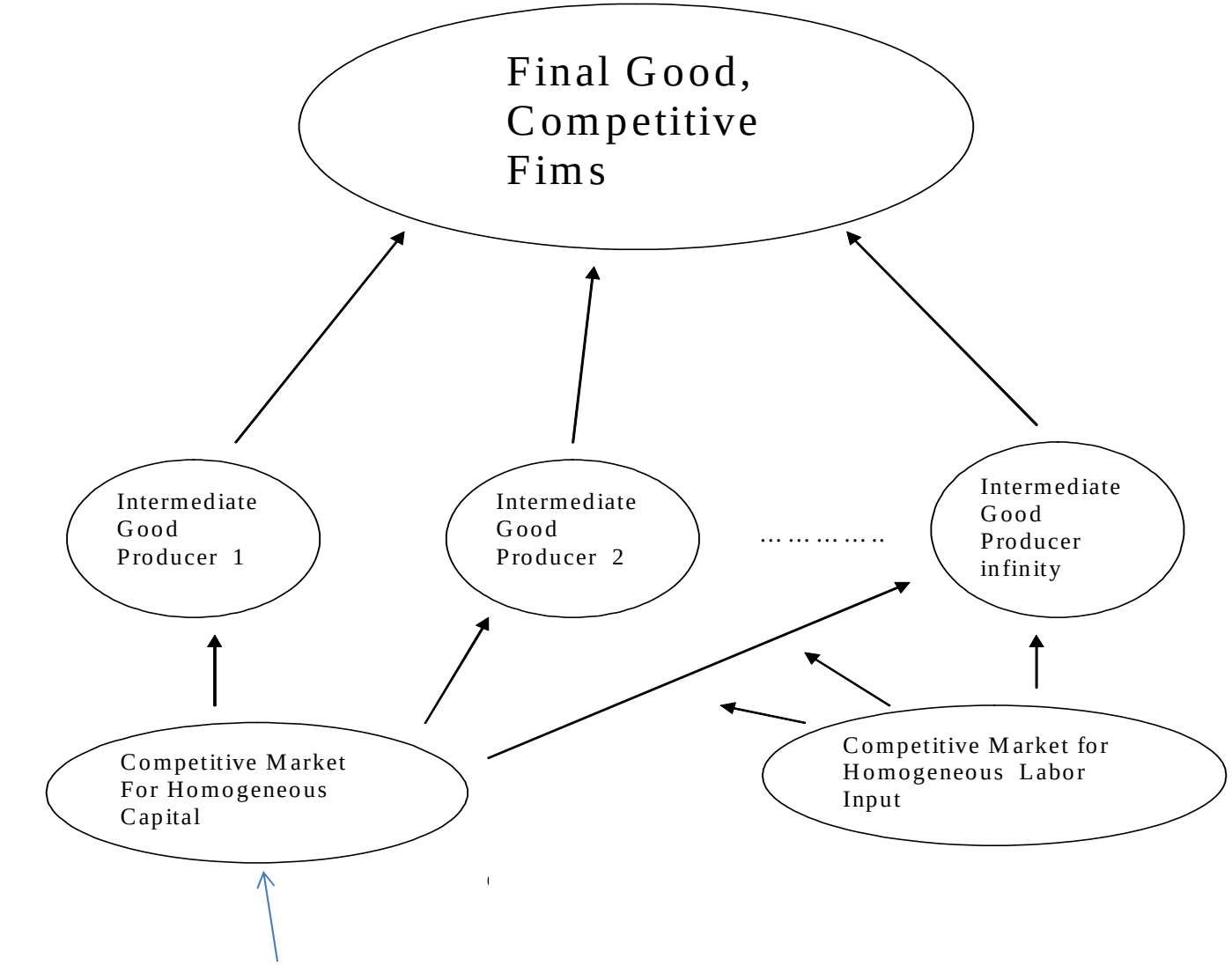
- Follows Erceg, Henderson and Levin…….

- Idea is completely parallel to sticky prices in simple NK models.



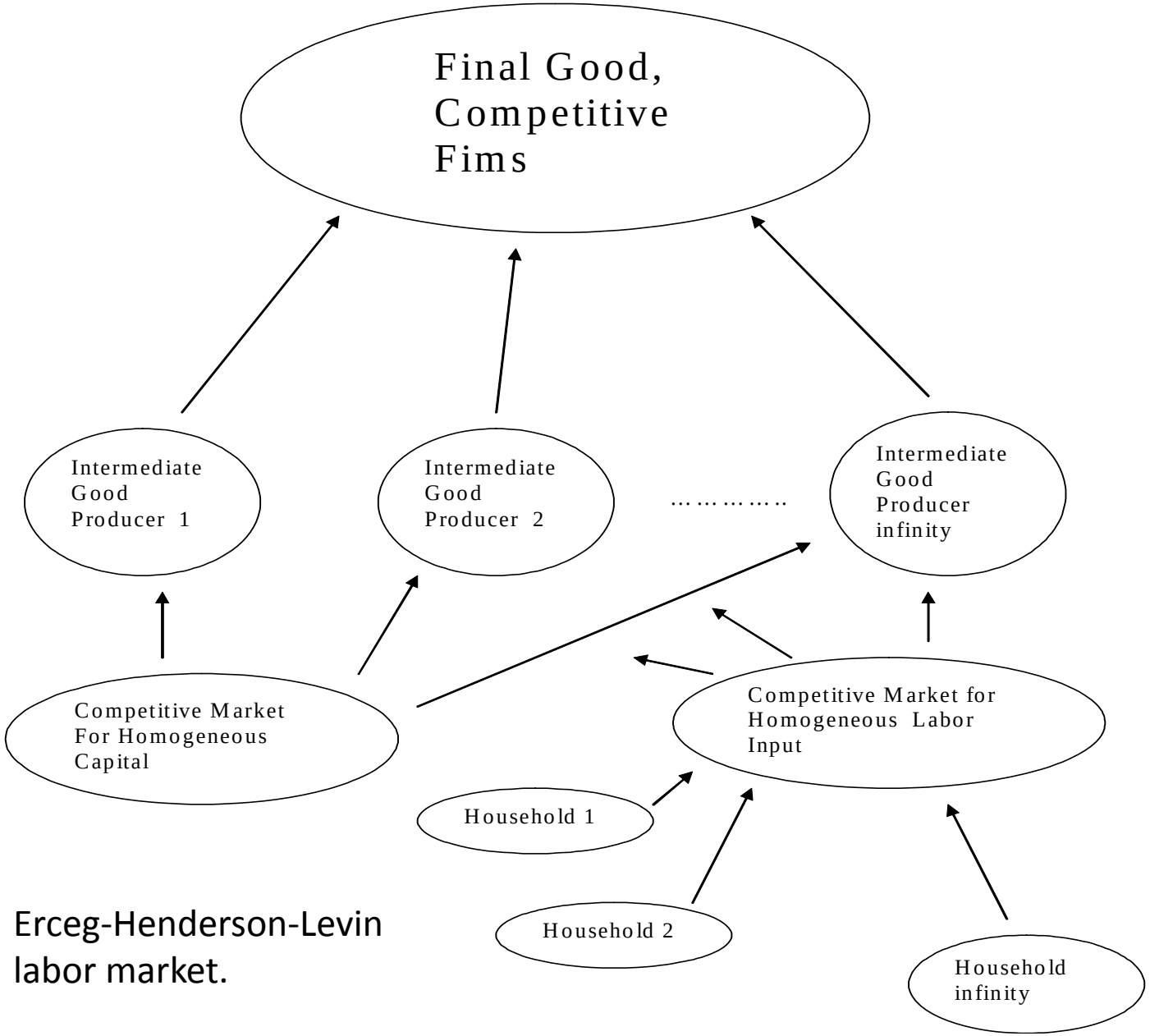
This is a picture of the simple NK model without capital.

Firm Sector



Adding capital

Firm Sector

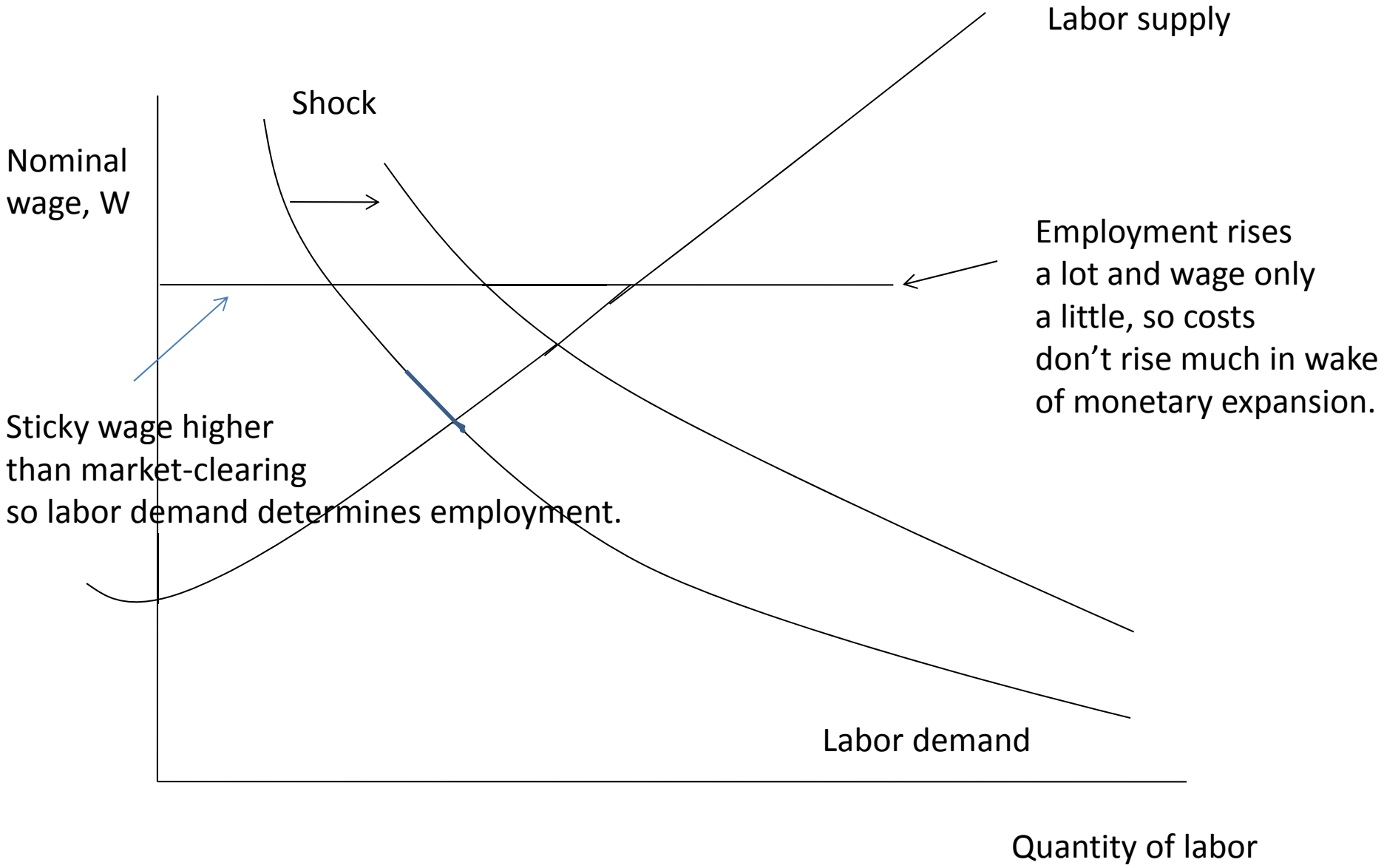


Erceg-Henderson-Levin labor market.

Wage Decisions

- Each household is a monopoly supplier of a specialized, differentiated labor service.
  - Sets wages subject to Calvo frictions.
  - Given specified wage, household must supply whatever quantity of labor is demanded.
- Alternative, equivalent setup: wages of each differentiated labor type set by a labor union subject to Calvo.
- Household differentiated labor service is aggregated into homogeneous labor by a competitive labor 'contractor'.

$$l_t = \left[\int_0^1 (h_{t,j})^{\frac{1}{\lambda_w}} dj\right]^{\lambda_w}, \; 1 \leq \lambda_w < \infty.$$


Labor supply
Shock
Nominal
wage, W
Employment rises
a lot and wage only
a little, so costs
don't rise much in wake
of monetary expansion.
Sticky wage higher
than market-clearing
so labor demand determines employment.
Labor demand
Quantity of labor

Criticism of Sticky Wages

- Numerous criticisms of this part of the model.
  - Crucial sticky wage achieved simply by assumption.
  - In practice, good econometric fit requires indexation and this contradicts micro evidence.
  - Indicators of labor power have decreased over the past decades (e.g., union density) and we have not seen unemployment fall over time.

- Worst: cannot use the model to study employment and output effects of extending unemployment insurance
  - The model simply had to `pass' on a crucial recent policy debate.

Recent Labor Market Developments

- In recent times, Diamond-Mortentsen-Pissarides (DMP) search/matching approach has been brought into DSGE models.
  - Carl Walsh (2003) was an early contributor.

- Potentially very important, because these models can address consequences of interesting labor market interventions.

- But, first wave of contributions fell prey to the Shimer critique:
  - When a shock launches an economic expansion and firms' incentive to hire increases, wages rise a lot in the DMP model.
  - As a result, firms' incentive to hire workers does not rise a lot.
    - Volatility of employment/unemployment too low.

- DMP-style DSGE models required sticky wages after all.
  - Unfortunately, sticky wage assumption on shaky ground in DMP.

Some Good News on the Labor Market

- Hall and Milgrom (HM, 2008) showed that an apparently plausible modification to how wages are set in the DMP environment makes wages sluggish as an equilibrium phenomenon.

- Work introducing the HM ideas into DSGE models seem to confirm their intuition.
  - DMP style DSGE models that make use of HM perspective avoid the Shimer critique without resorting to sticky wages (Christiano-Eichenbaum-Trabandt, NBER working paper, 2013).
  - These models can be used to think about effects of unemployment insurance.

Debate About Unemployment Insurance

- One view:
  - "If you pay people to be unemployed, they will substitute away from employment. Employment and output will fall"
  - This is a problem in times (like now!) when employment and output are already low.

- Another view:
  - "The low number of jobs reflects low aggregate demand. Improved unemployment benefits will not reduce demand and so will not reduce the number of jobs. If anything, improved unemployment benefits, by placing money in the hands of severely constrained households, will *raise* demand and employment."

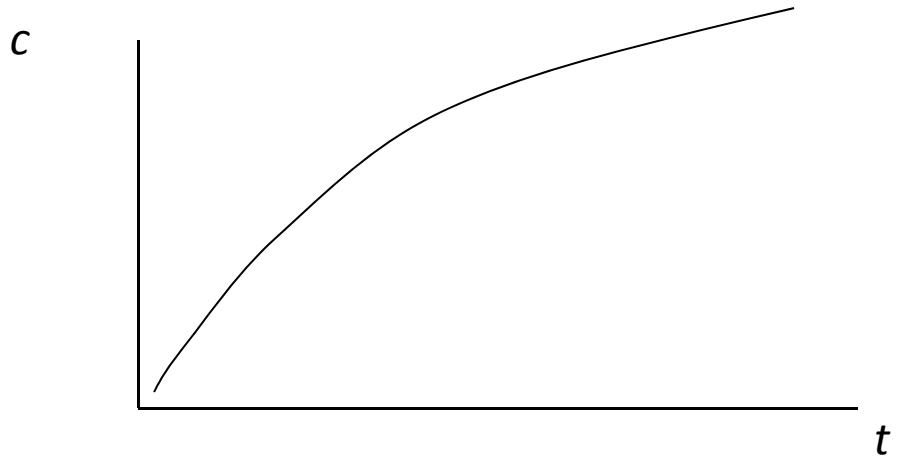
- Role of a DSGE model analysis
  - develop a case in favor of one or the other view.
  - The model must be one in which unemployment benefits enter the picture!
  - Standard sticky wage DSGE models cannot contribute to the above debate

Consumption 'Puzzle'

- In Estimated Impulse Responses:
  - Real Interest Rate Falls

$$R_t/\pi_{t+1}$$

  - Consumption Rises in Hump-Shape Pattern:

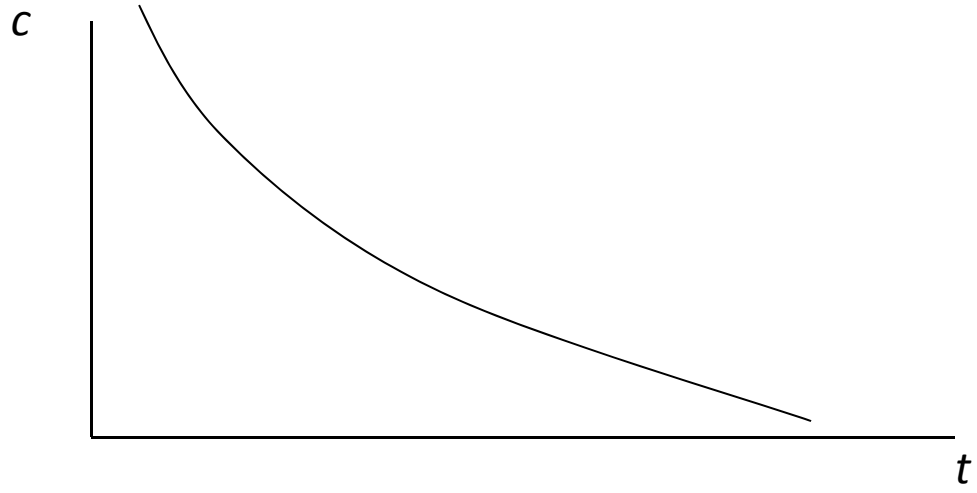


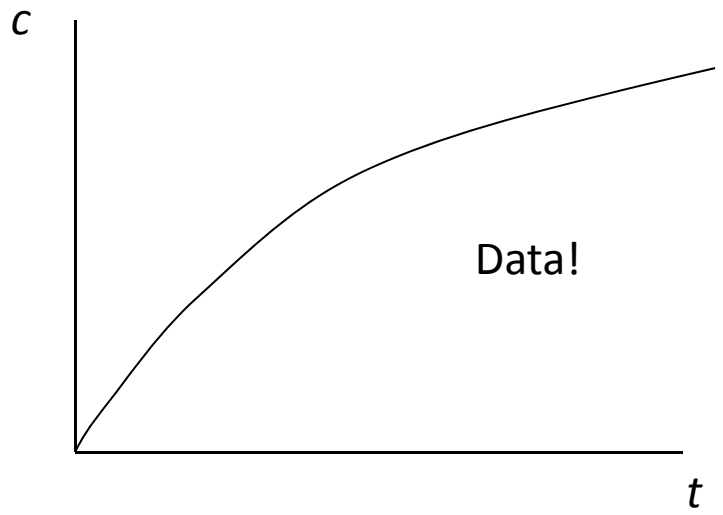
Consumption 'Puzzle'

- Intertemporal First Order Condition:

'Standard' Preferences $\longrightarrow$ $\dfrac{c_{t+1}}{\beta c_t} = \dfrac{MU_{c,t}}{\beta MU_{c,t+1}} \approx R_t/\pi_{t+1}$

- With Standard Preferences:





One Resolution to Consumption Puzzle

- Concave Consumption Response Displays:
  - Rising Consumption (problem)
  - Falling Slope of Consumption

Habit parameter

- Habit Persistence in Consumption

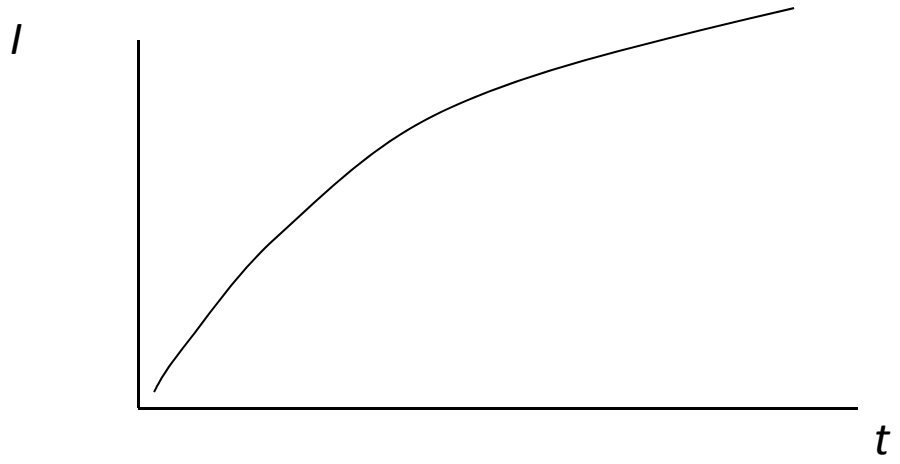
$$U(c) = \log(c - b \times c_{-1})$$

  - Marginal Utility Function of *Slope* of Consumption
  - Hump-Shape Consumption Response Not a Puzzle

- Econometric Estimation Strategy Given the Option, *b>0*

Dynamic Response of Investment to Monetary Policy Shock

- In Estimated Impulse Responses:
  - Investment Rises in Hump-Shaped Pattern:



One Solution to Investment Puzzle…

- Cost-of-Change Adjustment Costs:

$$k' = (1 - \delta)k + F\left(\frac{I}{I_{-1}}\right)I$$

- This Does Produce a Hump-Shape Investment Response
  - Other Evidence Favors This Specification
  - Empirical: Matsuyama, Smets-Wouters, Topel-Rosen*
  - Theoretical: Matsuyama, David Lucca

*Topel, Robert and Sherwin Rosen, 1988, "Housing Investment in the United States," Journal of Political Economy, Vol. 96(4), pages 718-740, August. Matsuyama, http://faculty.wcas.northwestern.edu/~kmatsu/ALearningEffectModel.pdf

Estimation

- Choose model parameters (most importantly, degree of stickiness in prices and wages), so that impulse responses from the model resemble the ones estimated in the data.
  - Do this for monetary and two other shocks.
  - Advantage of approach – can focus on key object of interest (Hume/Friedman observation), and need not take a stand on a lot of other shocks.

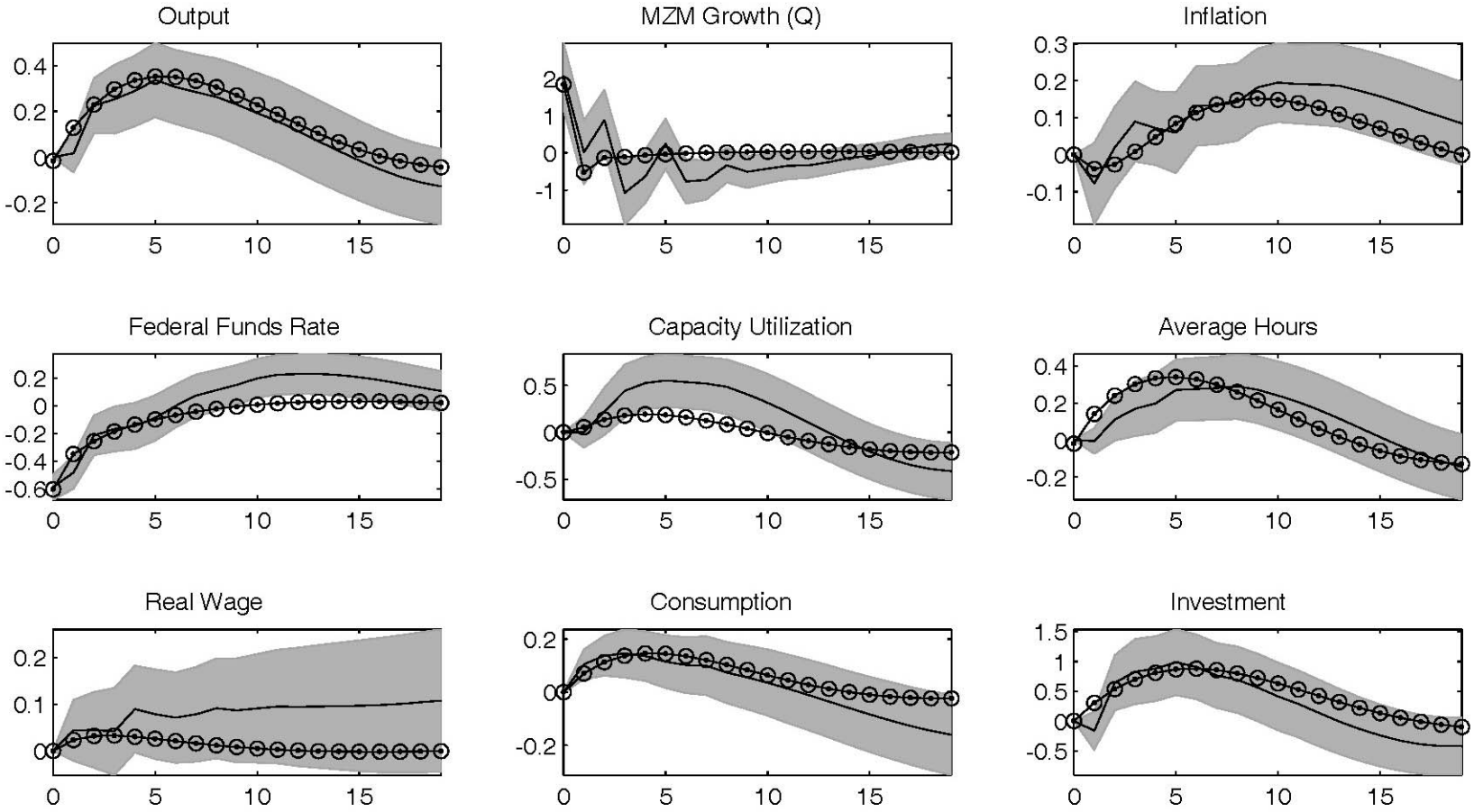
- Altig-Christiano-Eichenbaum-Linde, (RED 2011), Christiano-Eichenbaum-Evans (JPE 2005), Christiano-Trabandt-Walentin (Handbook, 2011).

Results for Monetary Policy Shock

- Key findings:
  - Can account for sluggish aggregate response to monetary policy shock without a lot of price stickiness*
    - Prices stuck on average 2.38 quarters
    - Wages stuck on average 1 year.
  - Can account for the observed effects of monetary policy on consumption, investment, output, etc.
  - Same model does well accounting for other shocks too*.

*For more details, see http://faculty.wcas.northwestern.edu/~lchrist/course/Gerzensee_2011/lectureACELhandout.pdf

Figure 1: Response to a monetary policy shock (o - Model, - VAR, grey area - 95 % Confidence Interval)



Conclusion

- About 10 years ago, it looked like the Hume/Friedman observation wouldn't be resolved anytime soon.
  - Mankiw (2000), "The Inexorable and Mysterious Tradeoff Between Inflation and Unemployment," National Bureau of Economic Research Working Paper 7884.

- Absent consistency with the Hume/Friedman observation, model unlikely to be of interest to monetary policymakers.

- Finding that NK models are consistent helped to take them from the realm of 'toys' into a tool for grownups to use in serious policy analysis.
  - VAR analysis is an important part of this story.