

# Risk Shocks

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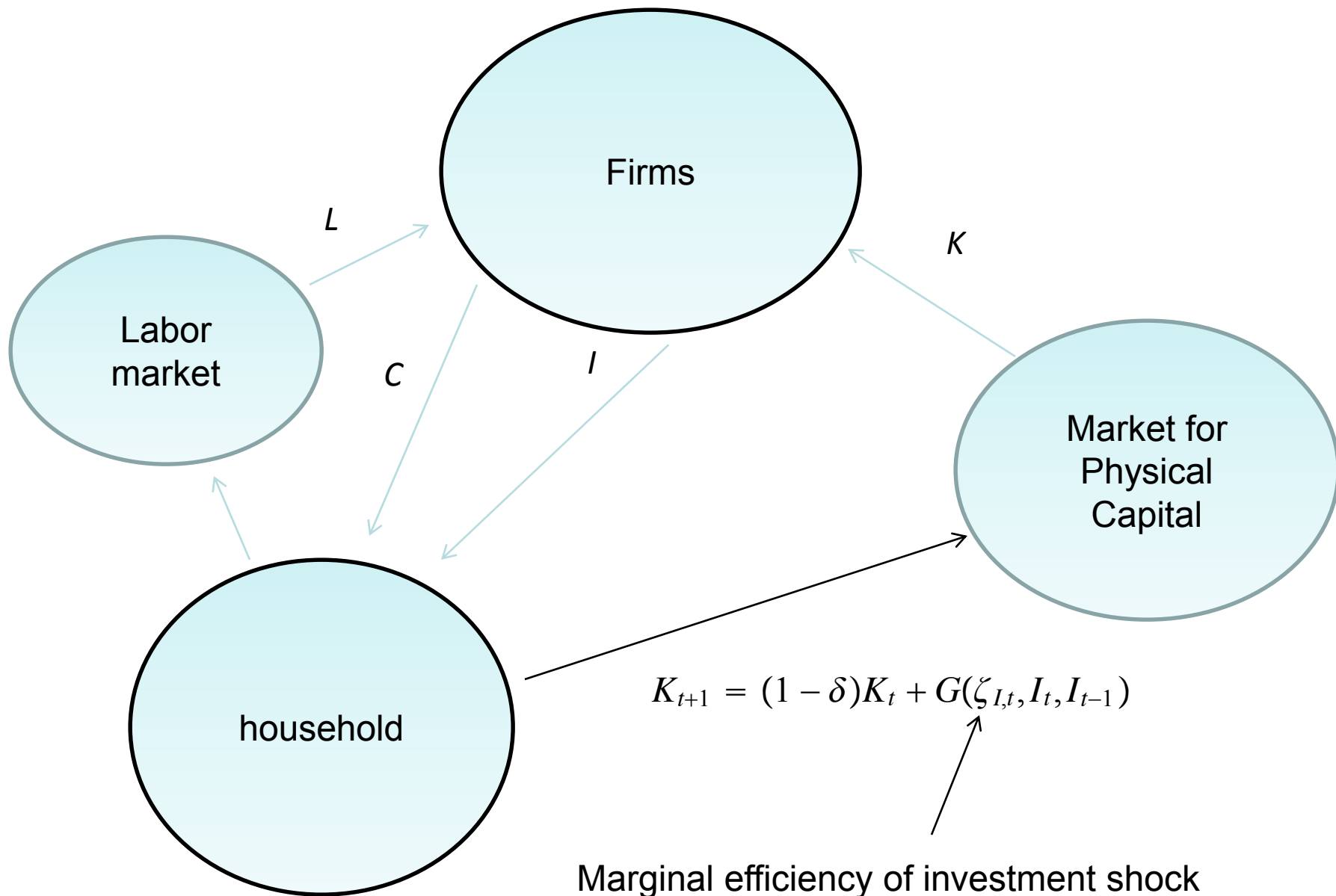
# Finding

- Countercyclical fluctuations in the cross-sectional variance of a technology shock, when inserted into an otherwise standard macro model, can account for a substantial portion of economic fluctuations.
  - Complements empirical findings of Bloom (2009) and Kehrig (2011) suggesting greater cross-sectional dispersion in recessions.
  - Complements theory findings of Bloom (2009) and Bloom, Floetotto and Jaimovich (2009) which describe another way that increased cross-sectional dispersion can generate business cycles.
- ‘Otherwise standard model’:
  - A DSGE model, as in Christiano-Eichenbaum-Evans or Smets-Wouters
  - Financial frictions along the line suggested by BGG.

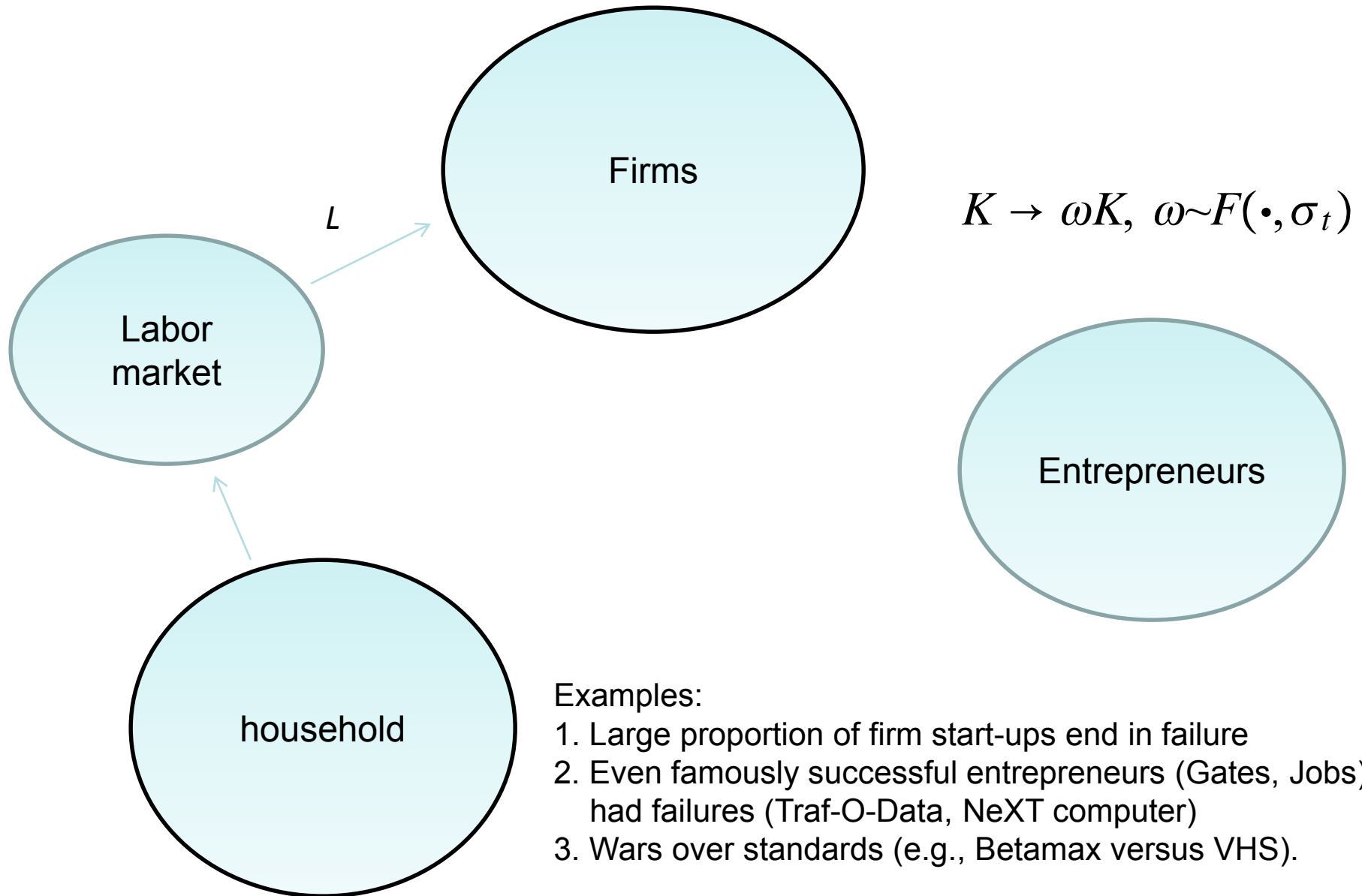
# Outline

- Rough description of the model.
- Summary of Bayesian estimation of the model.
- Explanation of the basic finding of the analysis.

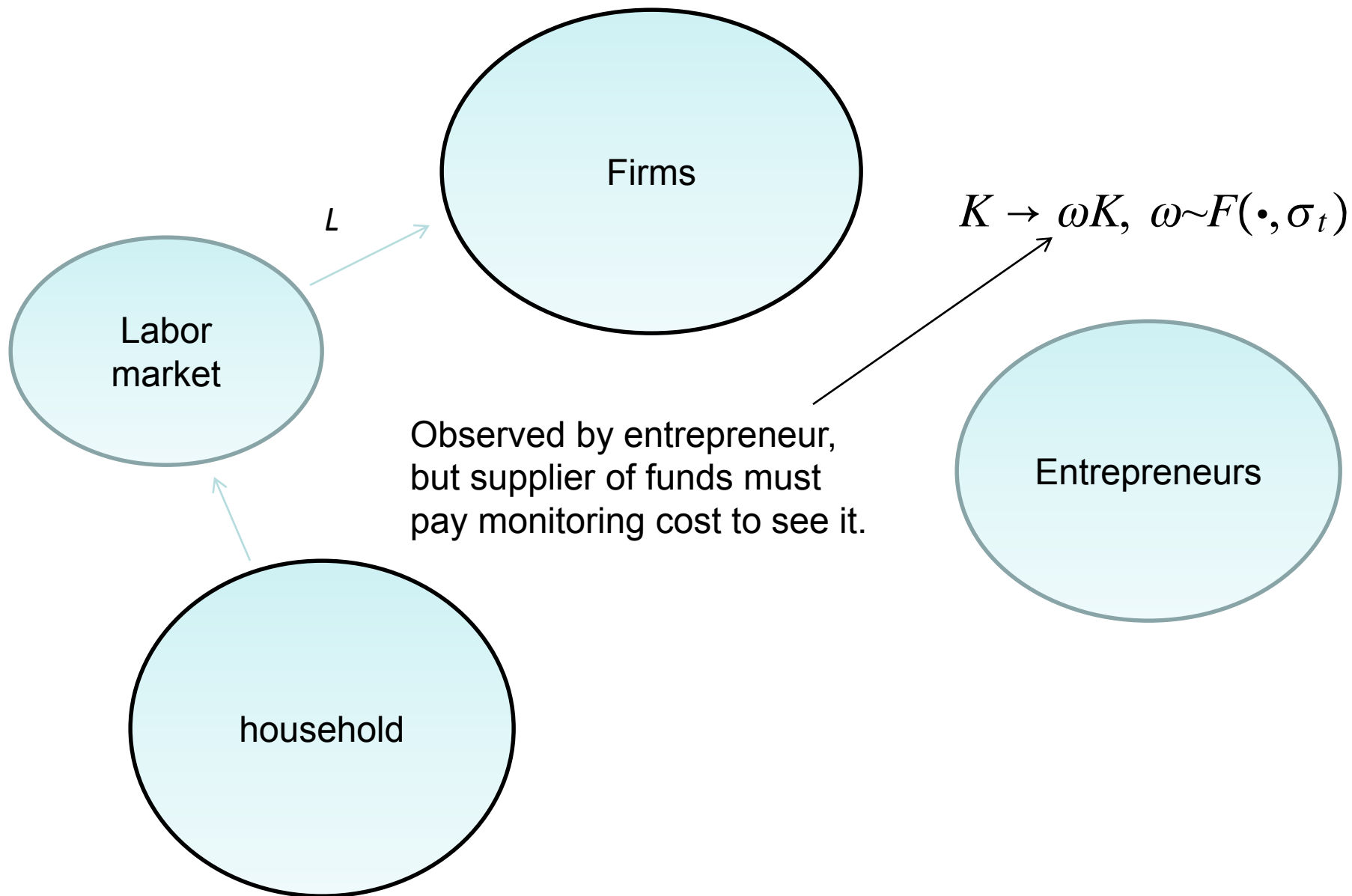
# Standard Model



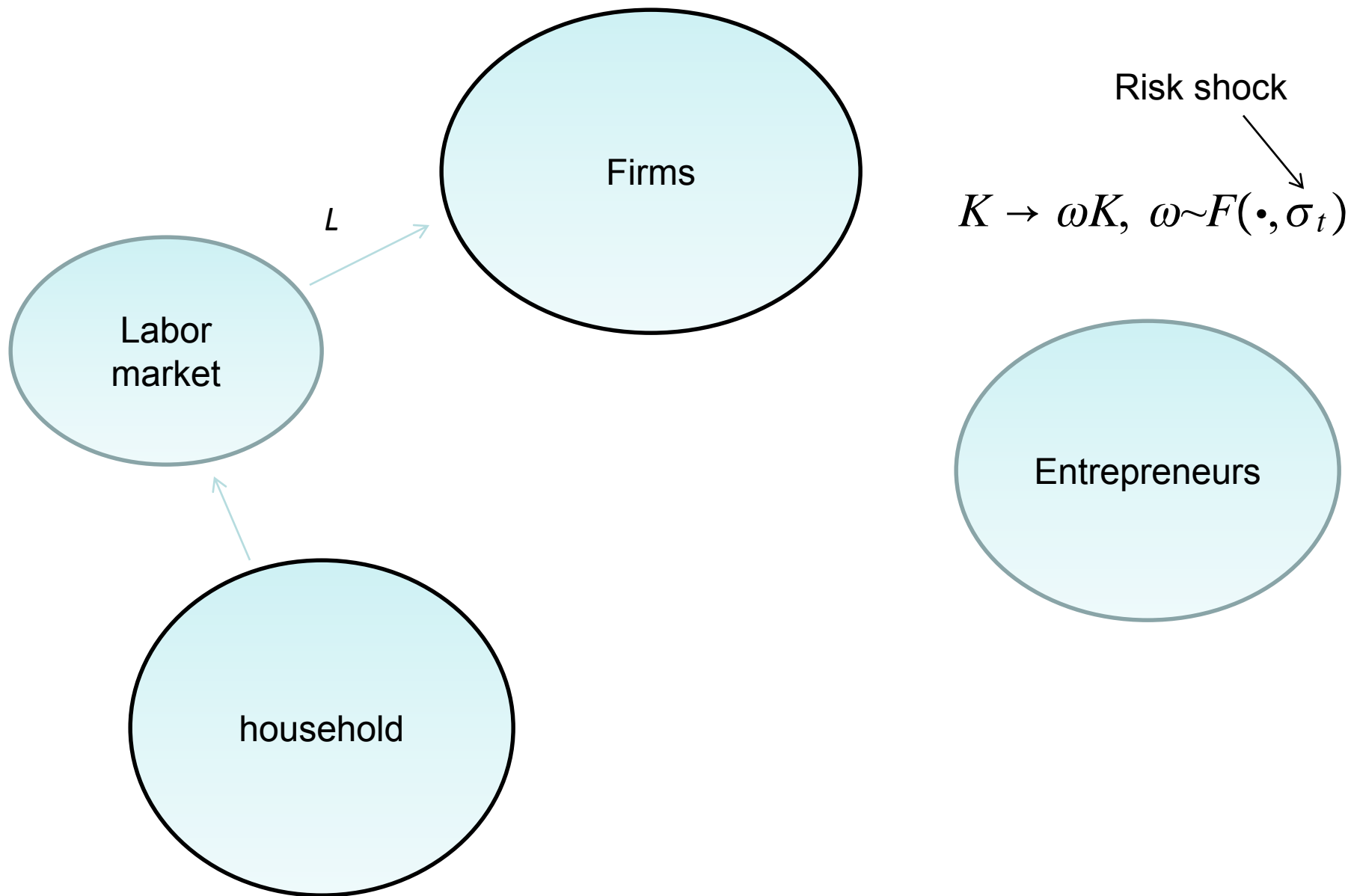
# Standard Model with BGG



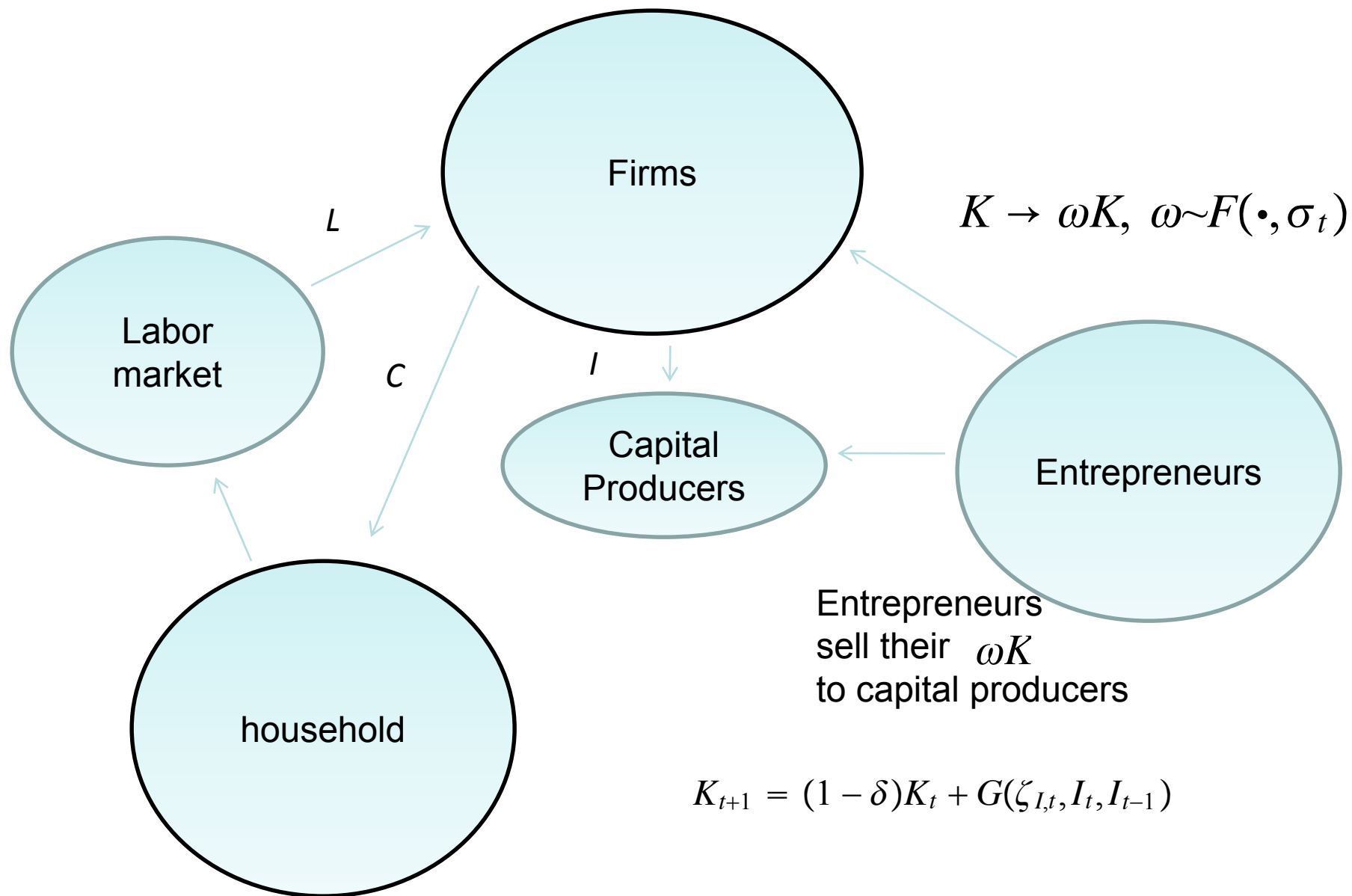
# Standard Model with BGG



# Standard Model with BGG

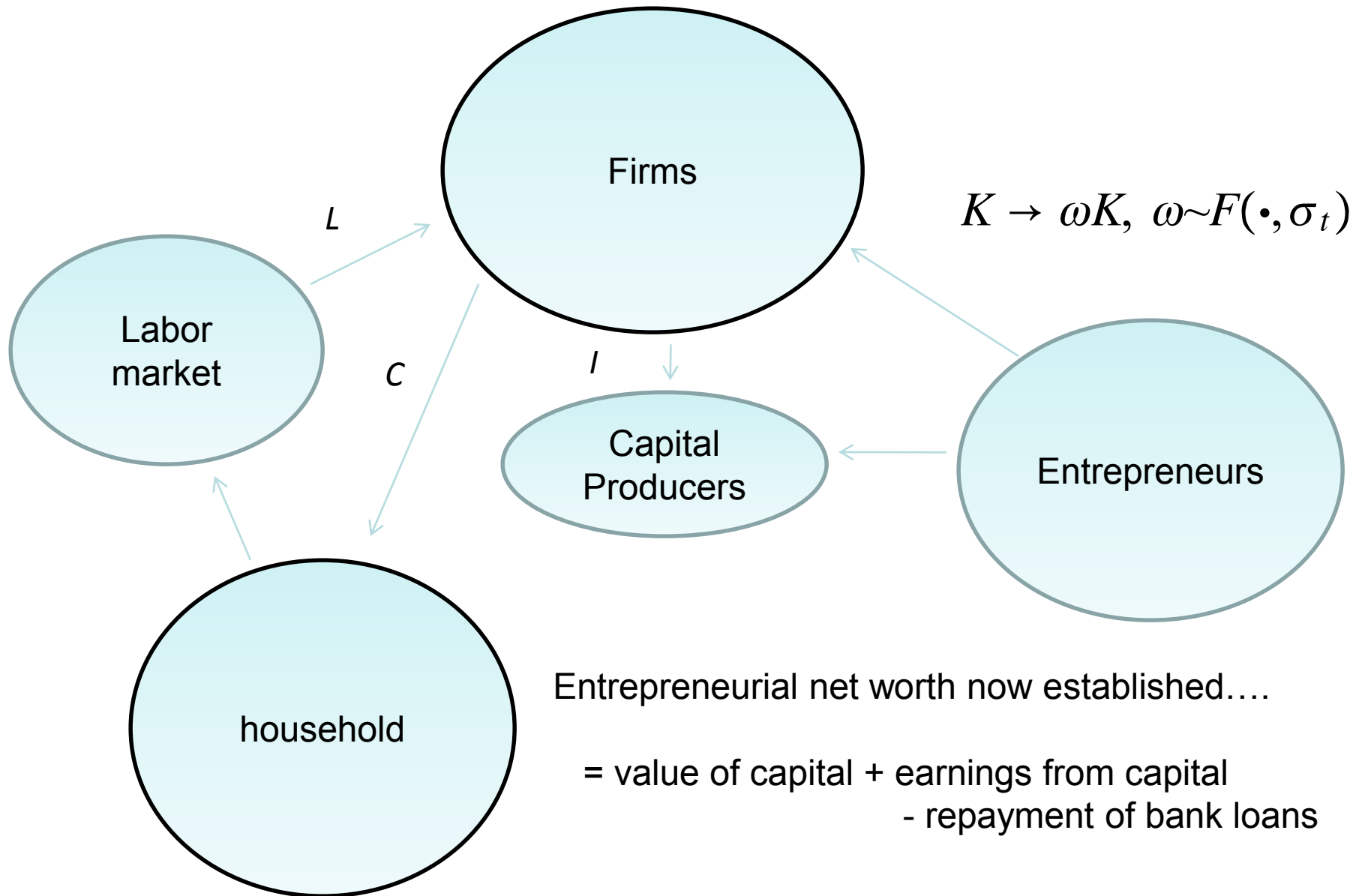


# Standard Model with BGG

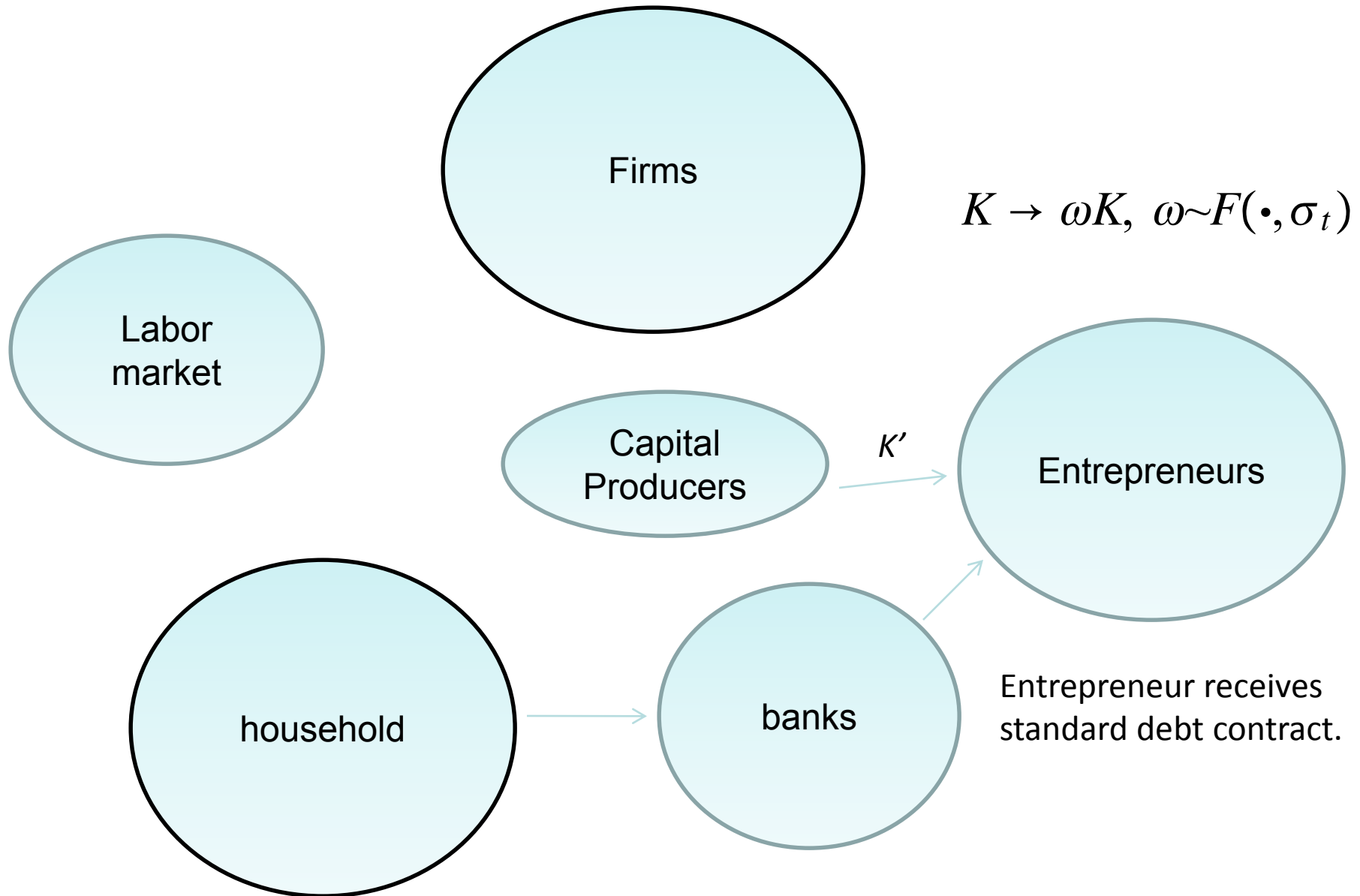




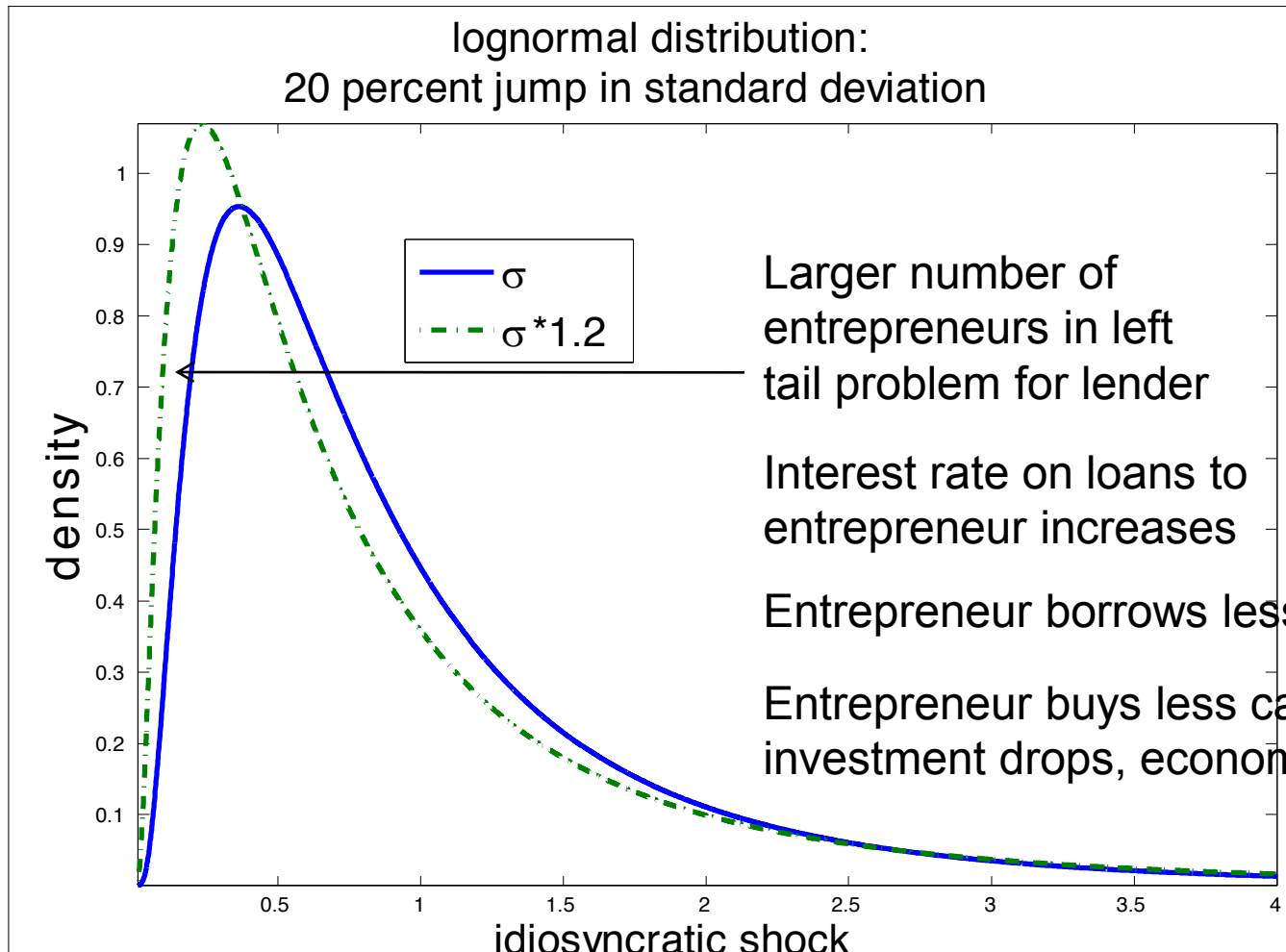
# Standard Model with BGG



# Standard Model with BGG



# Economic Impact of Risk Shock



# Five Adjustments to Standard DSGE Model for CSV Financial Frictions

- Drop: household intertemporal equation for capital.
- Add: equations that characterize the loan contract –
  - Zero profit condition for suppliers of funds.
  - Efficiency condition associated with entrepreneurial choice of contract.
- Add: Law of motion for entrepreneurial net worth (source of accelerator and Fisher debt-deflation effects).
- Introduce: bankruptcy costs in the resource constraint.

# Risk Shocks

- We assume risk has a first order autoregressive representation:

$$\hat{\sigma}_t = \rho_1 \hat{\sigma}_{t-1} + \underbrace{u_t}_{\text{iid, univariate innovation to } \hat{\sigma}_t}$$

- We assume that agents receive early information about movements in the innovation ('news').

# Risk Shock and News

- Assume

iid, univariate innovation to  $\hat{\sigma}_t$

$$\hat{\sigma}_t = \rho_1 \hat{\sigma}_{t-1} + \underbrace{u_t}$$

- Agents have advance information about pieces of  $u_t$

$$u_t = \xi_t^0 + \xi_{t-1}^1 + \dots + \xi_{t-8}^8$$

'signals' or 'news'

$$\xi_{t-i}^i \sim \text{iid}, E(\xi_{t-i}^i)^2 = \sigma_i^2$$

$\xi_{t-i}^i \sim$  piece of  $u_t$  observed at time  $t - i$

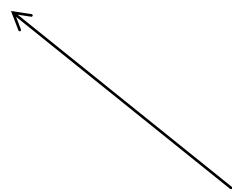
# Monetary Policy

- Nominal rate of interest function of:
  - Anticipated level of inflation.
  - Slowly moving inflation target.
  - Deviation of output growth from ss path.
  - Monetary policy shock.

# 12 Shocks

- Trend stationary and unit root technology shock.
- Marginal Efficiency of investment shock (perturbs capital accumulation equation)

$$\bar{K}_{t+1} = (1 - \delta)\bar{K}_t + G(\zeta_{i,t}, I_t, I_{t-1})$$

- Monetary policy shock.
  - Equity shock.
  - Risk shock.
  - 6 other shocks.
- 



# Estimation

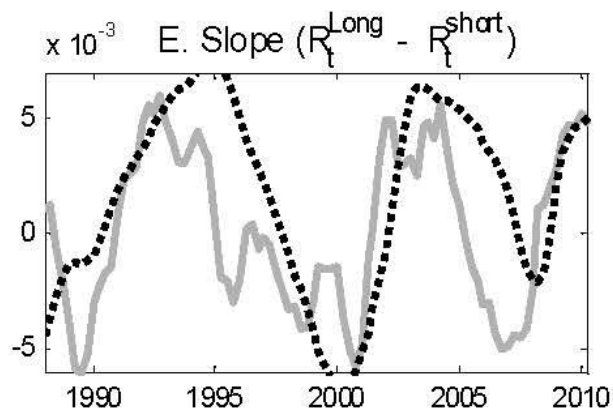
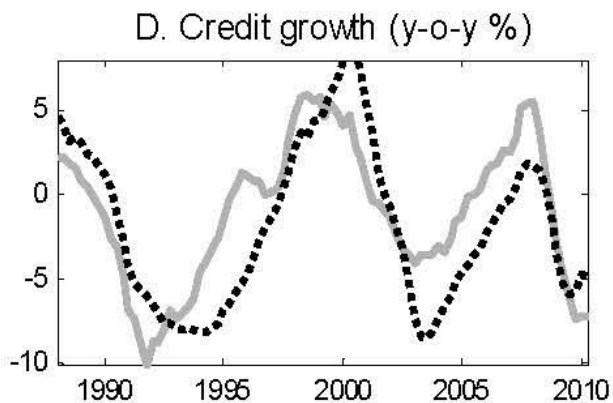
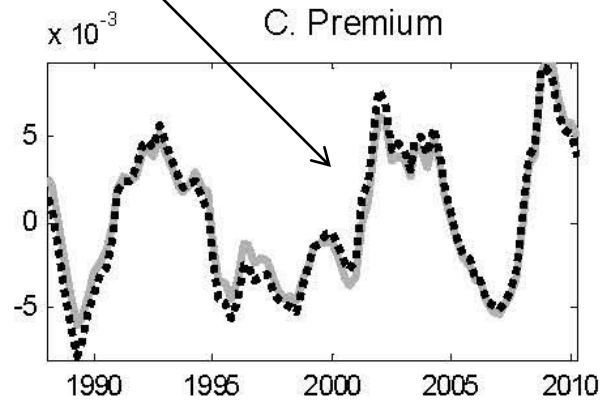
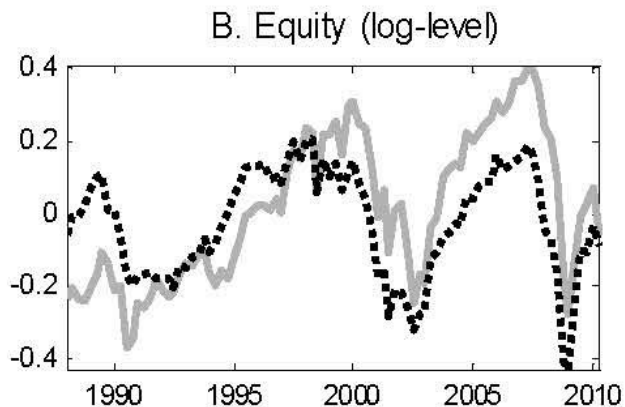
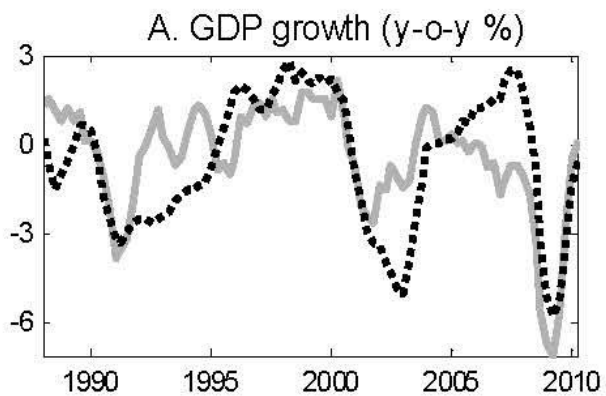
- Use standard macro data: consumption, investment, employment, inflation, GDP, price of investment goods, wages, Federal Funds Rate.
- Also some financial variables: BAA - 10 yr Tbond spreads, value of DOW, credit to nonfinancial business, 10 yr Tbond – Funds rate.
- Data: 1985Q1-2010Q2

# Results

- Risk shock most important shock for business cycles.
- Quantitative measures of importance.
- Why are they important?
- What shock do they displace, and why?

Risk shock closely identified with interest rate premium.

## Role of the Risk Shock in Macro and Financial Variables



Notes: The grey solid line represents the (two-sided) fitted data. The dotted black line is the model simulations.

# Percent Variance in Business Cycle Frequencies Accounted for by Risk Shock

| <i>variable</i>                               | <i>Risk, <math>\sigma_t</math></i> |
|---|------------------------------------|
| <b>GDP</b>                                    | 62                                 |
| <b>Investment</b>                             | 73                                 |
| <b>Consumption</b>                            | 16                                 |
| <b>Credit</b>                                 | 64                                 |
| <b>Premium (<math>Z - R</math>)</b>           | 95                                 |
| <b>Equity</b>                                 | 69                                 |
| $R^{10 \text{ year}} - R^{1 \text{ quarter}}$ | 56                                 |

Risk shock closely identified with interest rate premium

Note: 'business cycle frequencies means' Hodrick-Prescott filtered data.

# Why Risk Shock is so Important

- A. Our econometric estimator ‘thinks’  
risk spread  $\sim$  risk shock.
- B. In the data: the risk spread is strongly negatively correlated with output.
- C. In the model: bad risk shock generates a response that resembles a recession
- A+B+C suggests risk shock important.

# Correlation (risk spread(t),output(t-j)), HP filtered data, 95% Confidence Interval

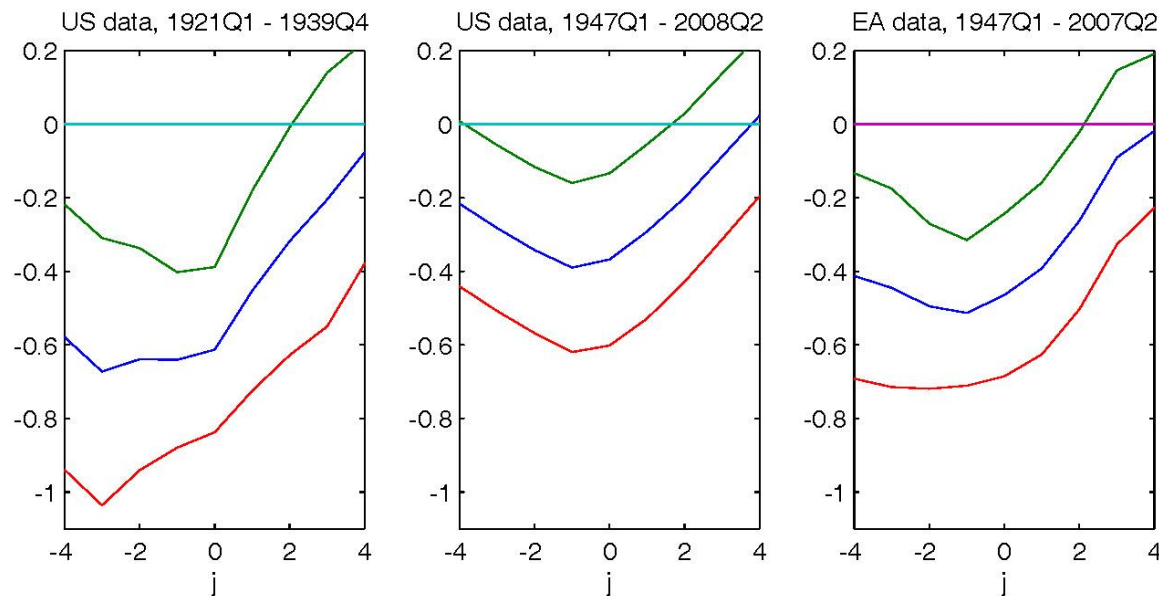


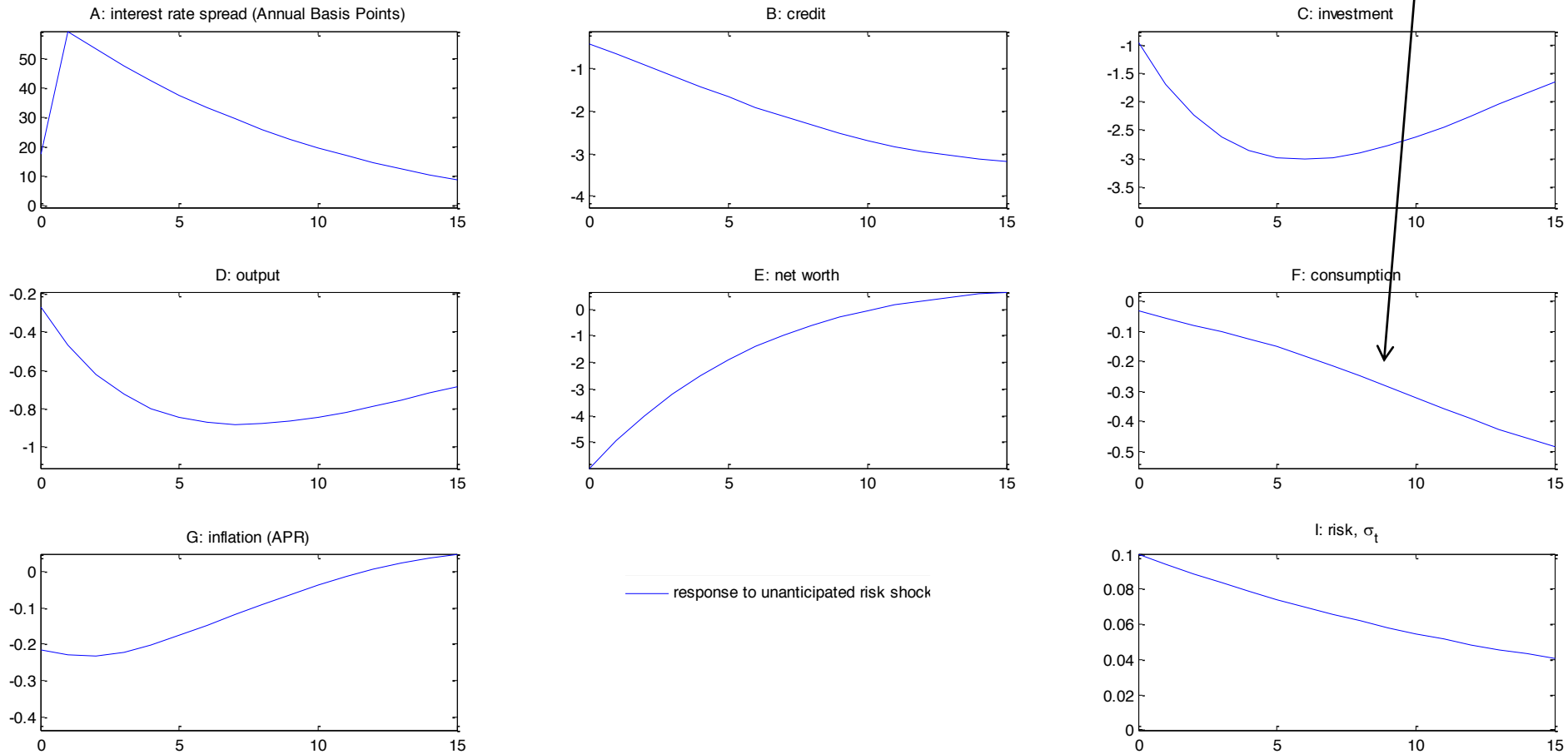
Figure 10.10

The risk spread is significantly negatively correlated with output and leads a little.

Notes: Risk spread is measured by the difference between the yield on the lowest rated corporate bond (Baa) and the highest rated corporate bond (Aaa). Bond data were obtained from the St. Louis Fed website. GDP data were obtained from Balke and Gordon (1986). Filtered output data were scaled so that their standard deviation coincide with that of the spread data.

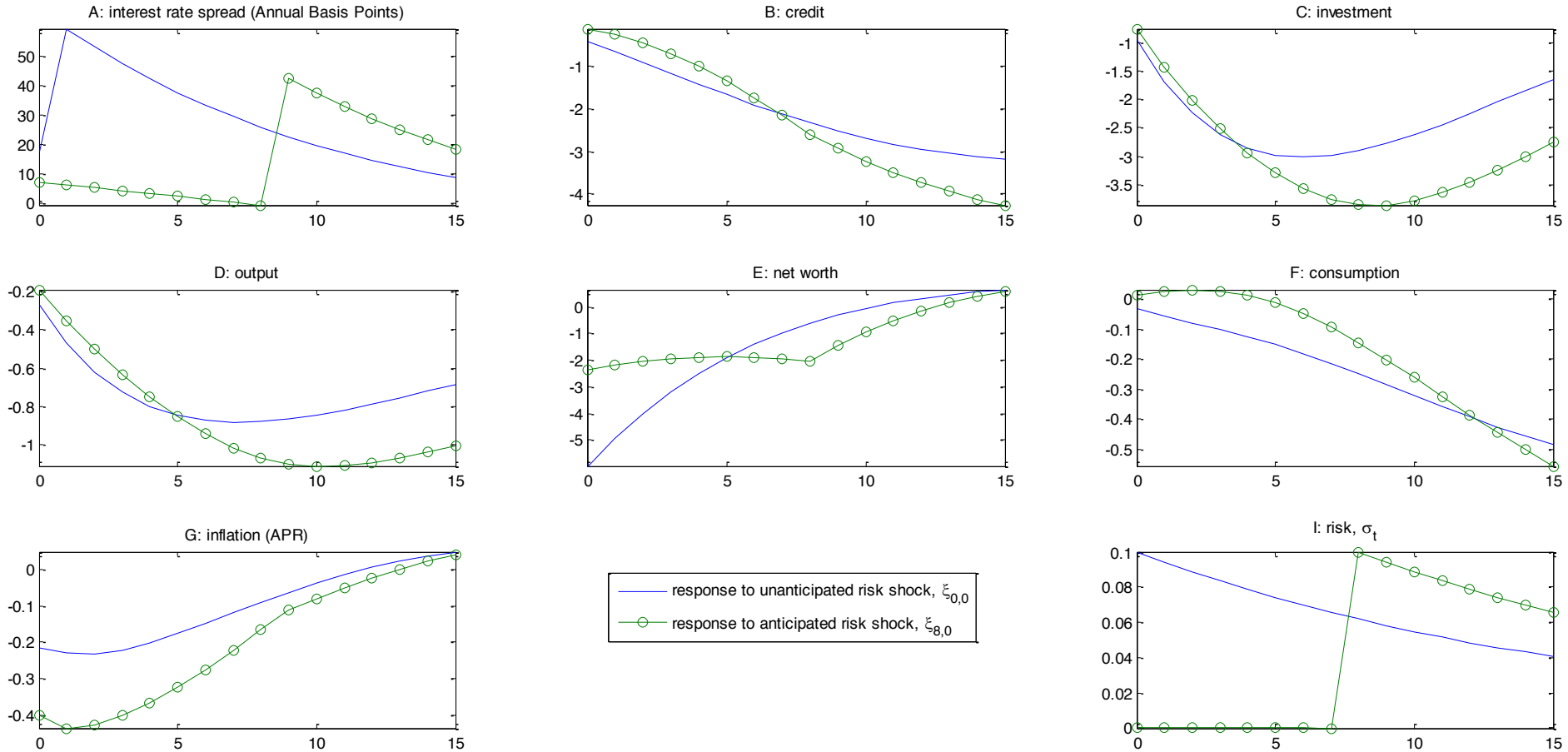
# Surprising, from RBC perspective

Figure 3: Dynamic Responses to Unanticipated and Anticipated Components of Risk Shock



Looks like a business cycle

Figure 3: Dynamic Responses to Unanticipated and Anticipated Components of Risk Shock



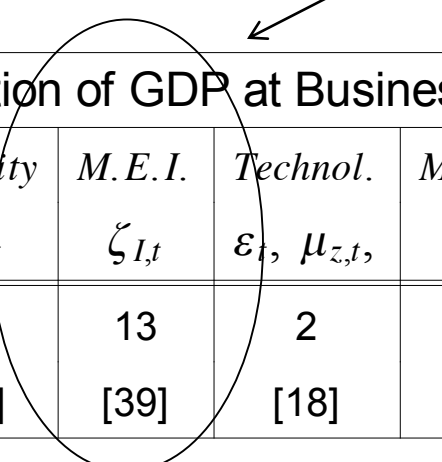


# What Shock Does the Risk Shock Displace, and why?

- The risk shock mainly crowds out the marginal efficiency of investment.
  - But, it also crowds out other shocks.
- Compare estimation results between our model and model with no financial frictions or financial shocks (CEE).

- Baseline model mostly ‘steals’ explanatory power from m.e.i., but also from other shocks:

big drop in marginal efficiency of investment



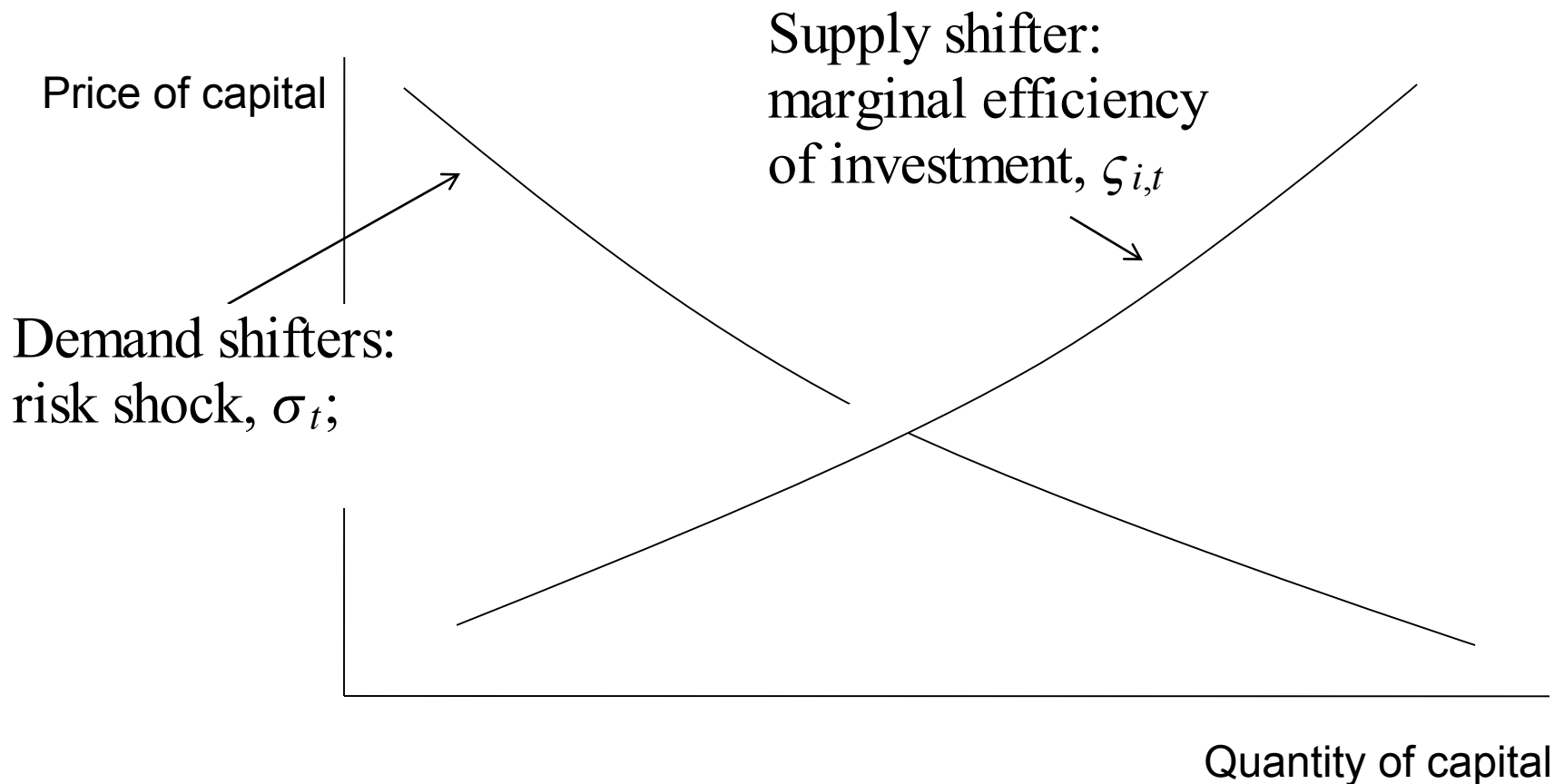
| Variance Decomposition of GDP at Business Cycle Frequency (in percent) |             |               |               |                            |                 |              |               |                    |             |
|--|-------------|---------------|---------------|----------------------------|-----------------|--------------|---------------|--------------------|-------------|
| <i>shock</i>   | <i>Risk</i> | <i>Equity</i> | <i>M.E.I.</i> | <i>Technol.</i>            | <i>Markup</i>   | <i>M.P.</i>  | <i>Demand</i> | <i>Exog.Spend.</i> | <i>Term</i> |
|  | $\sigma_t$  | $\gamma_t$    | $\zeta_{I,t}$ | $\varepsilon_t, \mu_{z,t}$ | $\lambda_{f,t}$ | $\epsilon_t$ | $\zeta_{c,t}$ | $g_t$              |             |
| <b>Baseline model</b>  | 62          | 0             | 13            | 2                          | 12              | 2            | 4             | 3                  | 0           |
| <b>CEE</b>   | [-]         | [-]           | [39]          | [18]                       | [31]            | [4]          | [3]           | [5]                | [-]         |

- Baseline model mostly ‘steals’ explanatory power from m.e.i., but also from other shocks:

technology goes from small to tiny

| Variance Decomposition of GDP at Business Cycle Frequency (in percent) |             |               |               |                            |                 |              |               |                    |             |
|--|-------------|---------------|---------------|----------------------------|-----------------|--------------|---------------|--------------------|-------------|
| <i>shock</i>   | <i>Risk</i> | <i>Equity</i> | <i>M.E.I.</i> | <i>Technol.</i>            | <i>Markup</i>   | <i>M.P.</i>  | <i>Demand</i> | <i>Exog.Spend.</i> | <i>Term</i> |
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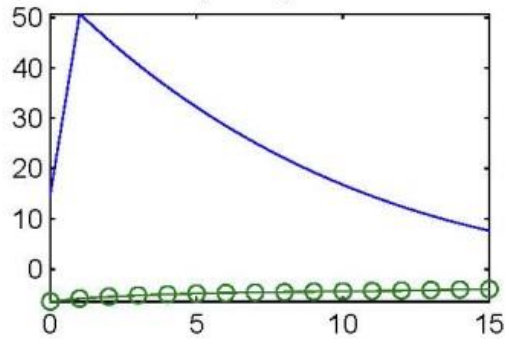
# Why does Risk Crowd out Marginal Efficiency of Investment?



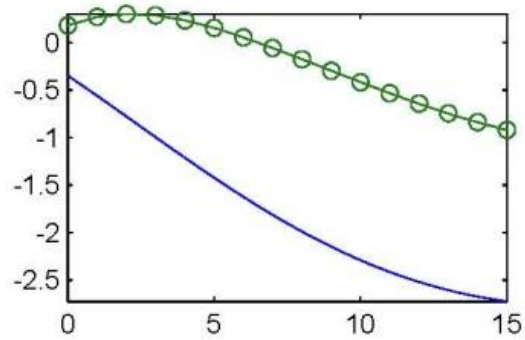
- Marginal efficiency of investment shock can account well for the surge in investment and output in the 1990s, *as long as the stock market is not included in the analysis.*
- When the stock market is included, then explanatory power shifts to financial market shocks.
- When we drop ‘financial data’ – slope of term structure, interest rate spread, stock market, credit growth:
  - Hard to differentiate risk shock view from marginal efficiency of investment view.

Figure 6: Dynamic Responses to Two Shocks

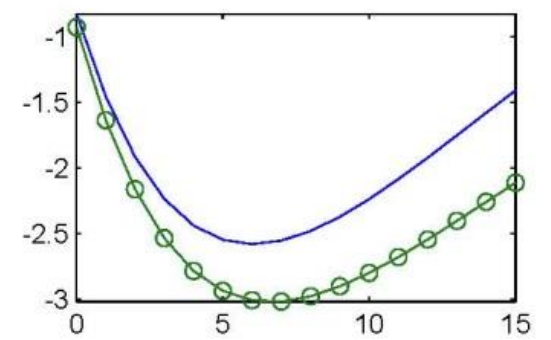
A: interest rate spread (Annual Basis Points)



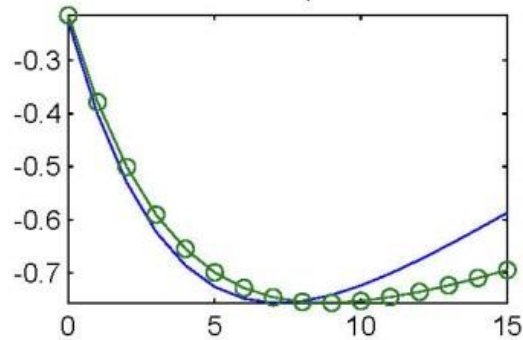
B: credit



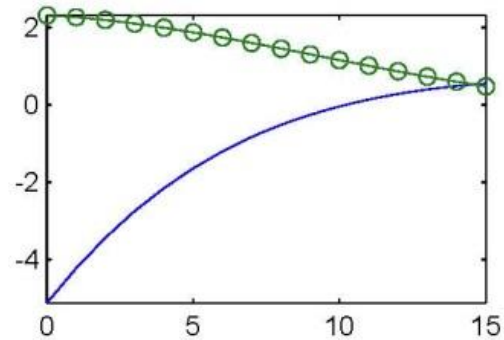
C: investment



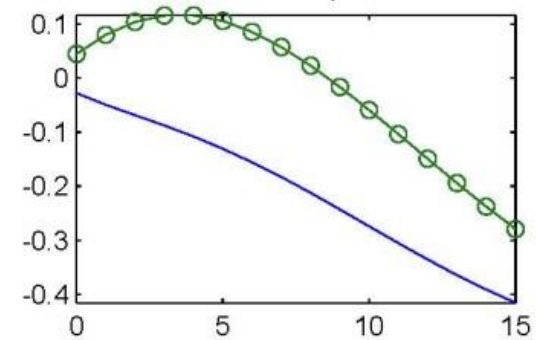
D: output



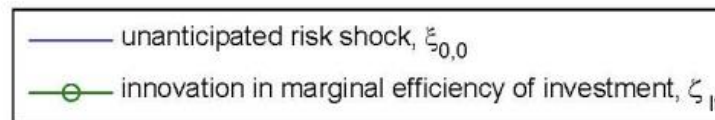
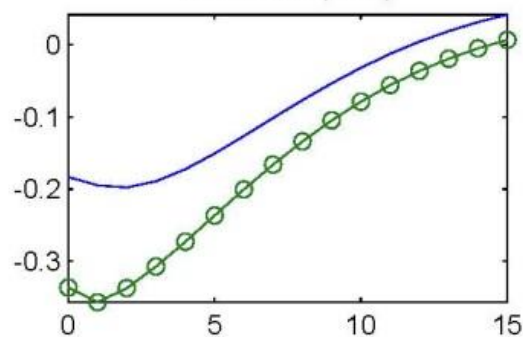
E: net worth



F: consumption



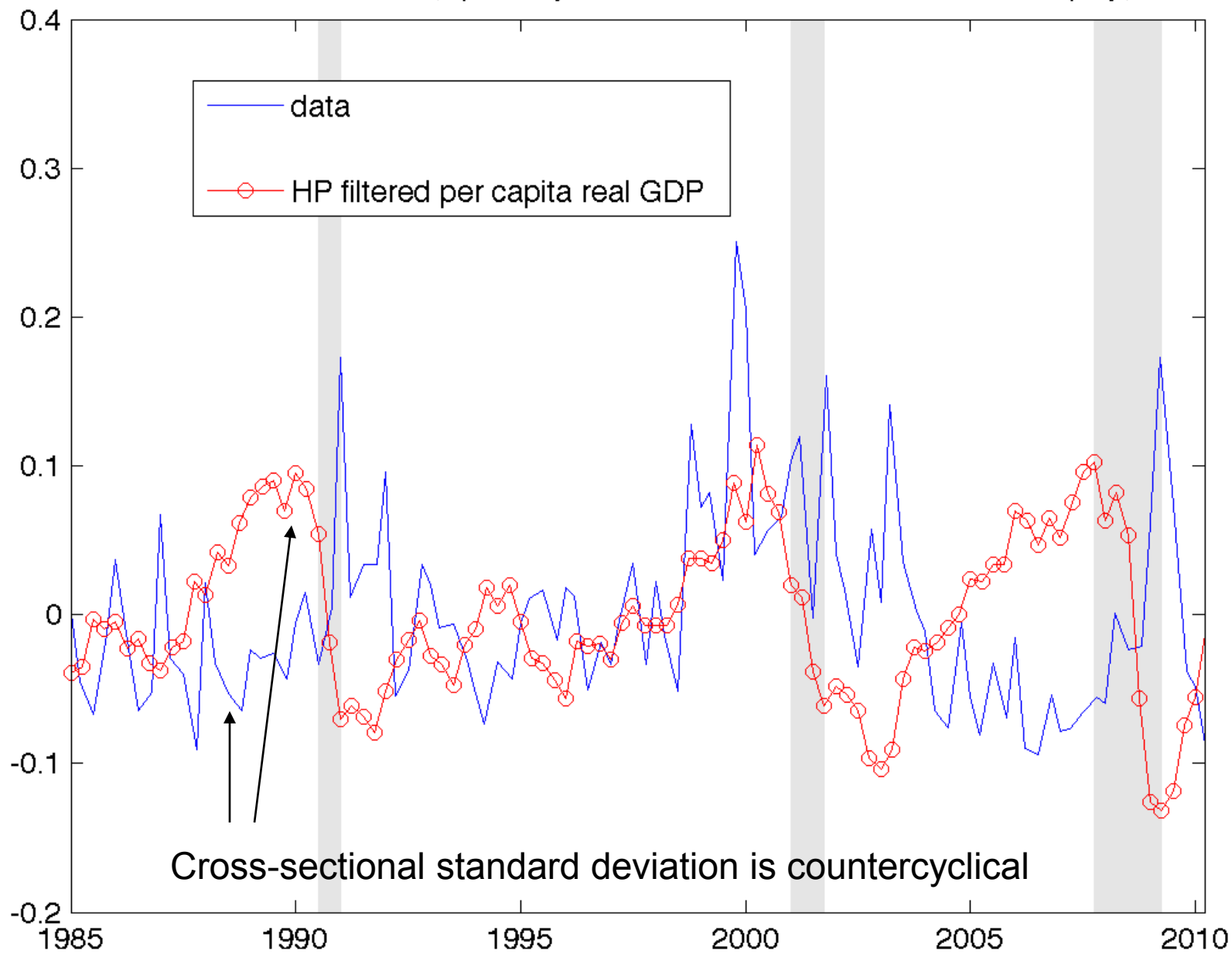
G: inflation (APR)



# Is There Independent Evidence for Risk Shocks?

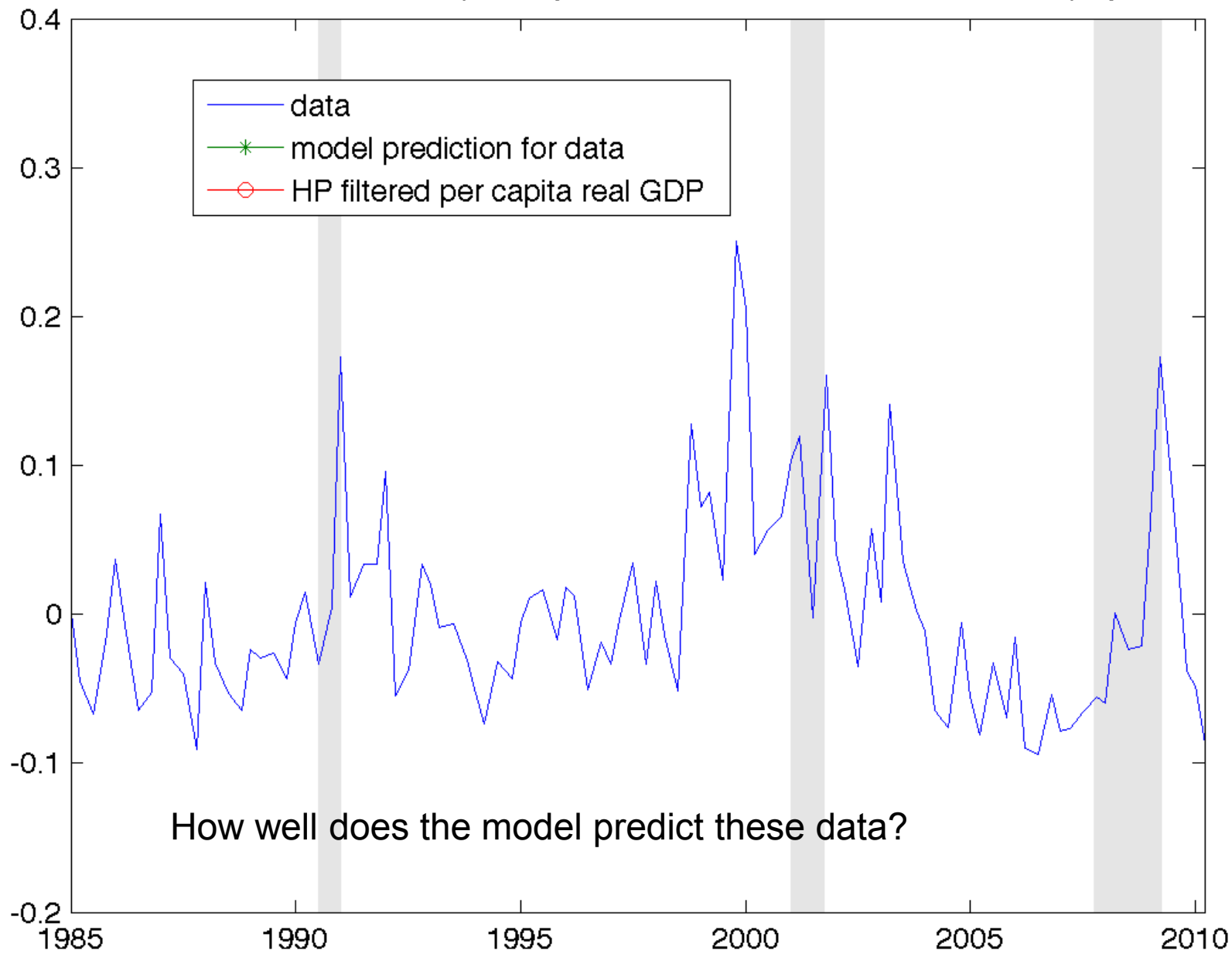
- Cross-sectional standard deviation of rate of return on equity in CRSP rises in recessions (Bloom, 2009).
- This observation played no role in the construction or estimation of the model.
- Compute the model's best guess (Kalman Smoother) about the cross-sectional standard deviation of equity returns, and compare with data.

Cross-sectional standard deviation, quarterly rate of return on non-financial firm equity, CRSP data

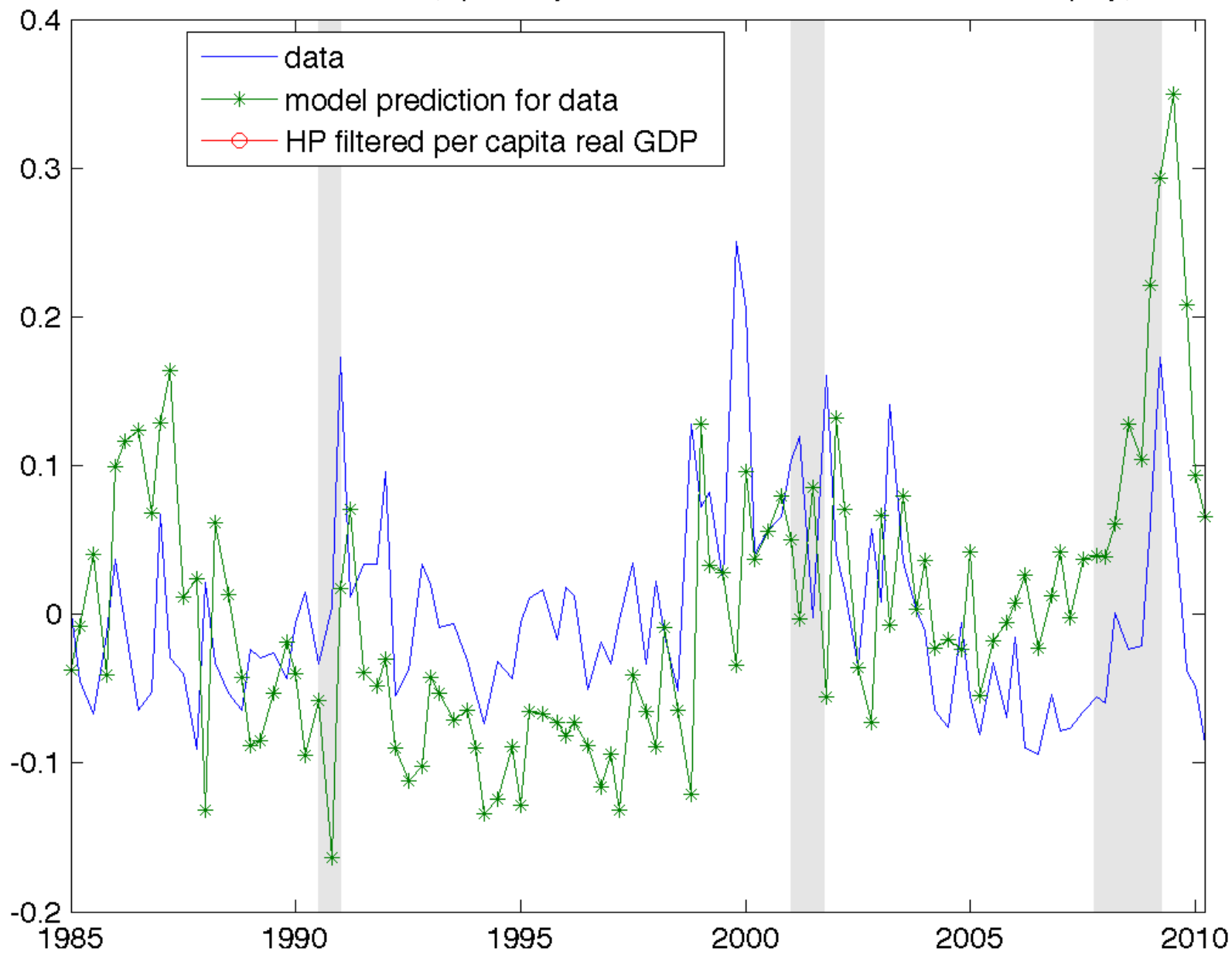




Cross-sectional standard deviation, quarterly rate of return on non-financial firm equity, CRSP data



Cross-sectional standard deviation, quarterly rate of return on non-financial firm equity, CRSP data



# Conclusion

- Incorporating financial frictions and financial data changes inference about the sources of shocks:
  - risk shock.
- Interesting to explore mechanisms that make risk shock endogenous.
- Models with financial frictions can be used to ask interesting policy questions:
  - When there is an increase in risk spreads, how should monetary policy respond?