Risk Shocks

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Conference in honor of Tom Sargent and Chris Sims, May 2012

Finding

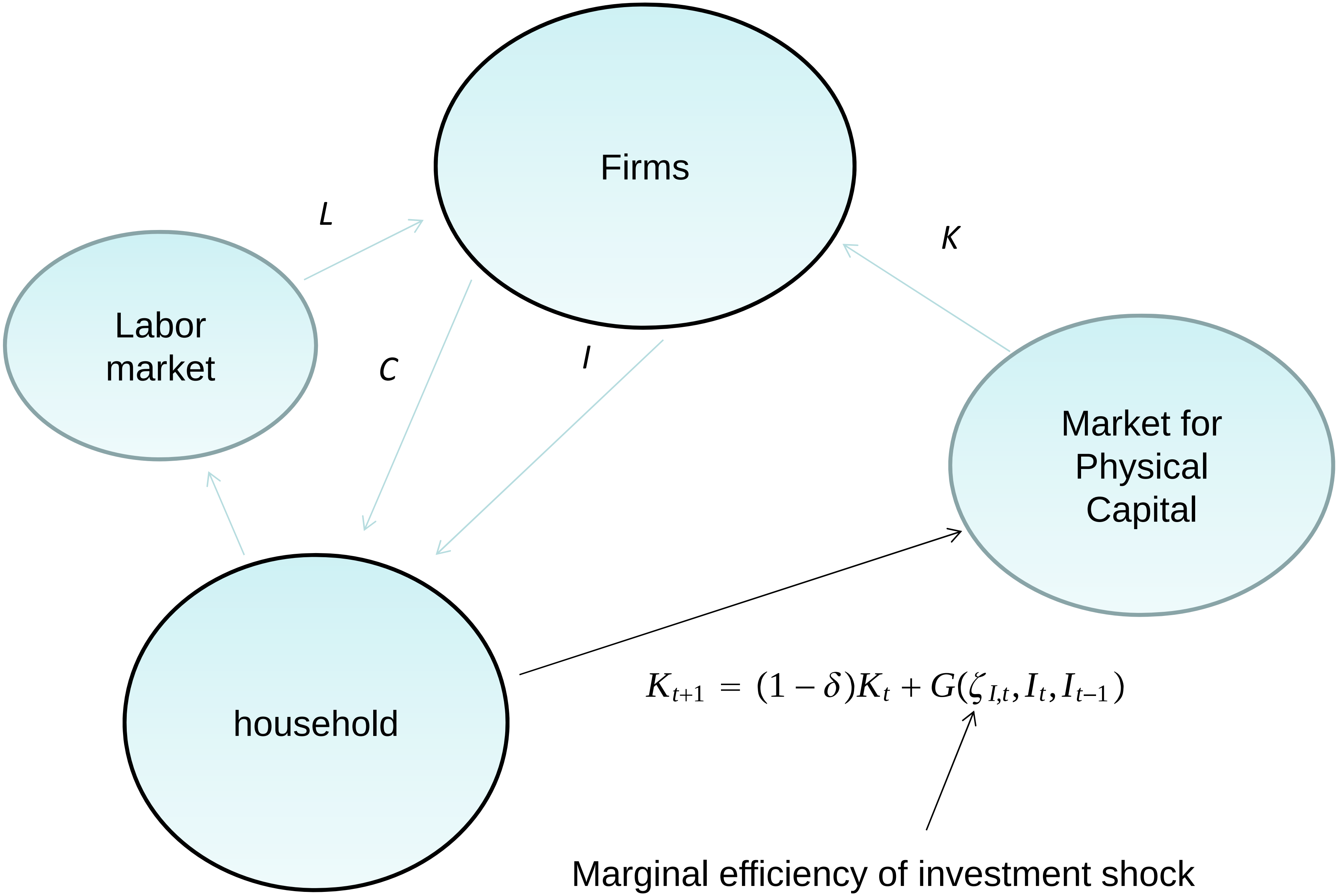
- Countercyclical fluctuations in the cross-sectional variance of a type of technology shock, when inserted into a widely-used business cycle model, can account for a substantial portion of economic fluctuations.
  - Complements empirical findings of Bloom (2009) and Kehrig (2011) suggesting greater 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. Also: Williamson (1987), Arellano-Bai-Kehoe (2011).

- Model used in analysis:
  - 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.
- Explanation of the basic results.
- Comparison with Bloom (2009)
  - Evaluation of findings using CRSP stock return data.

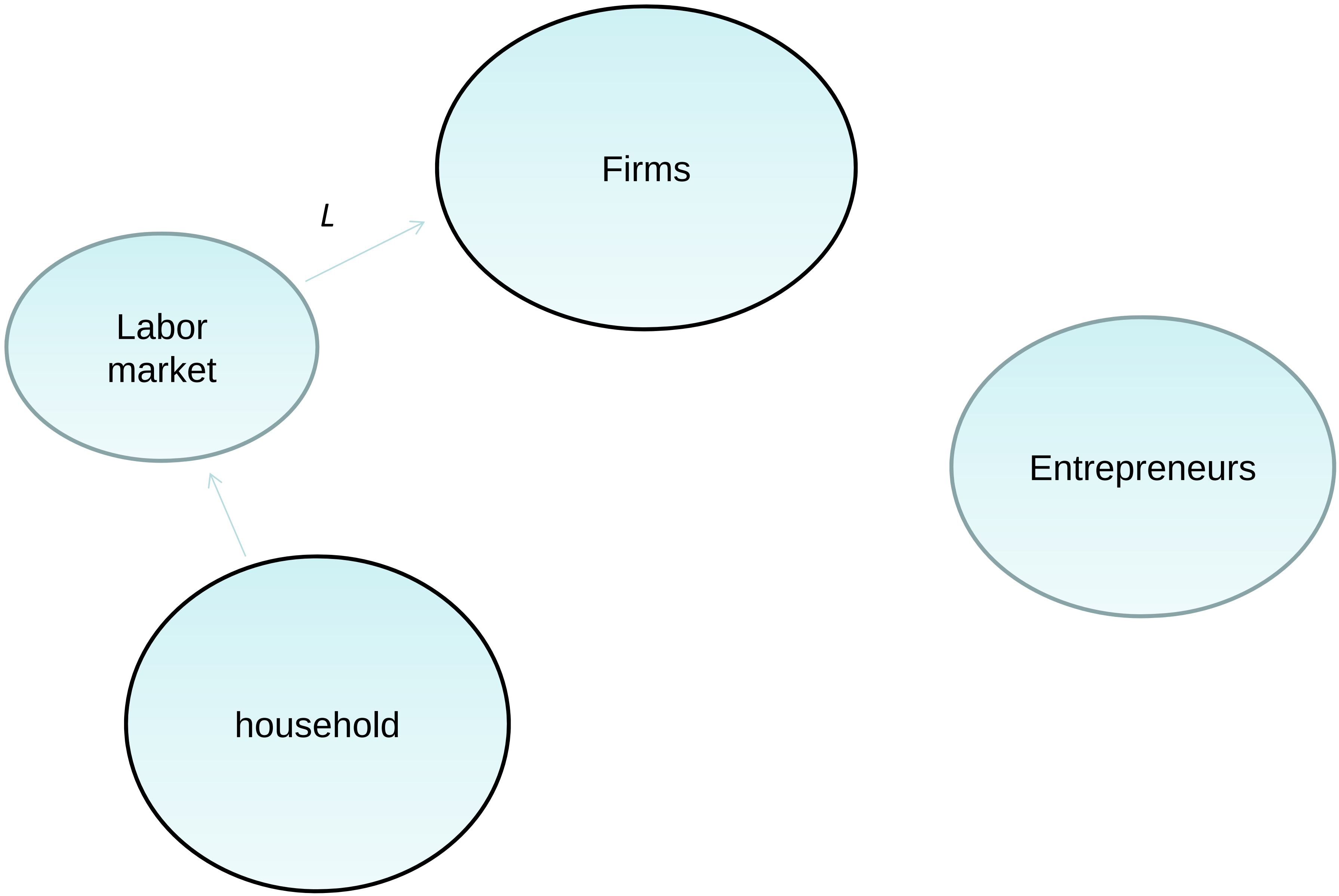
Standard Model



$$K_{t+1} = (1-\delta)K_t + G(\zeta_{I,t}, I_t, I_{t-1})$$

Marginal efficiency of investment shock

Standard Model with BGG



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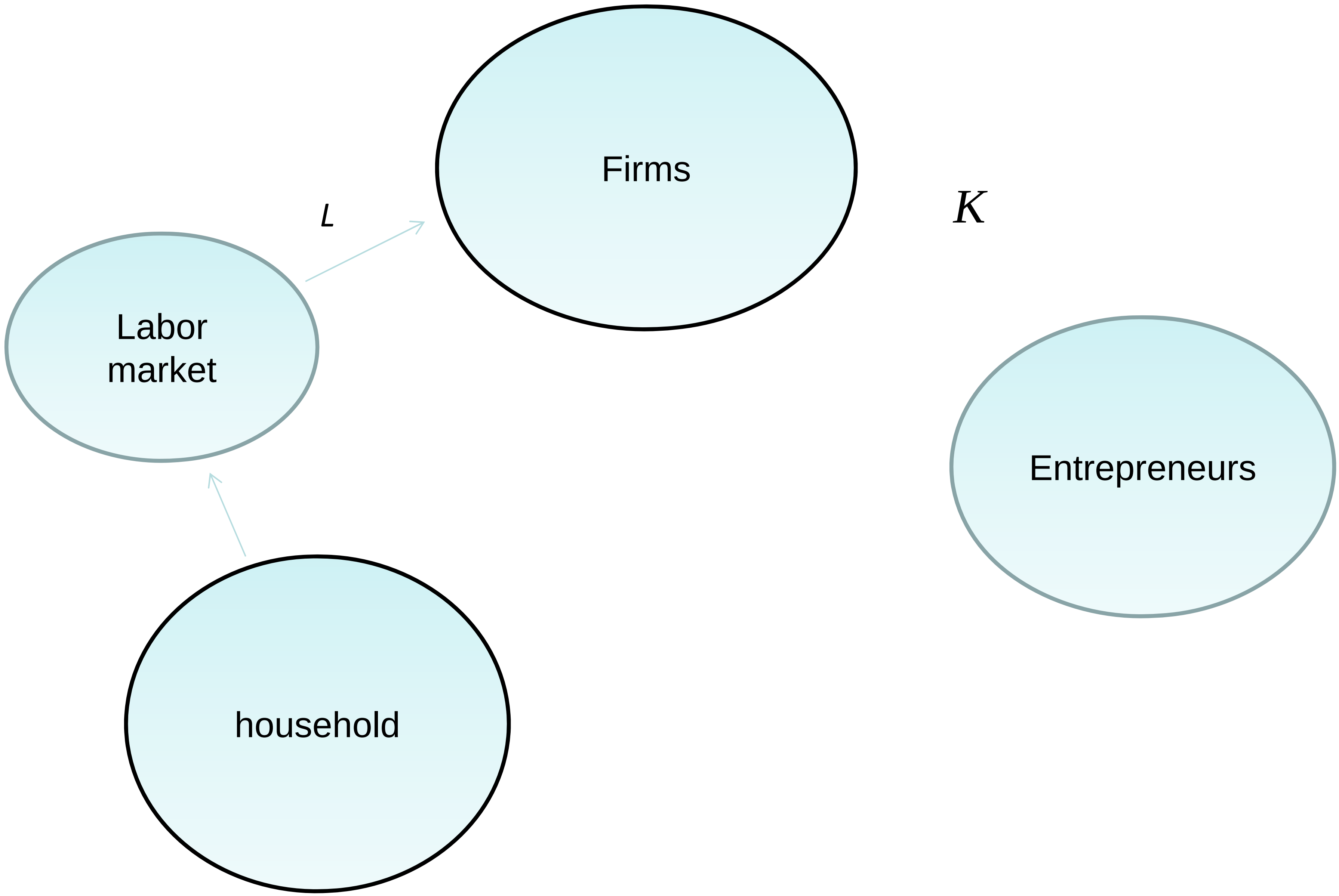

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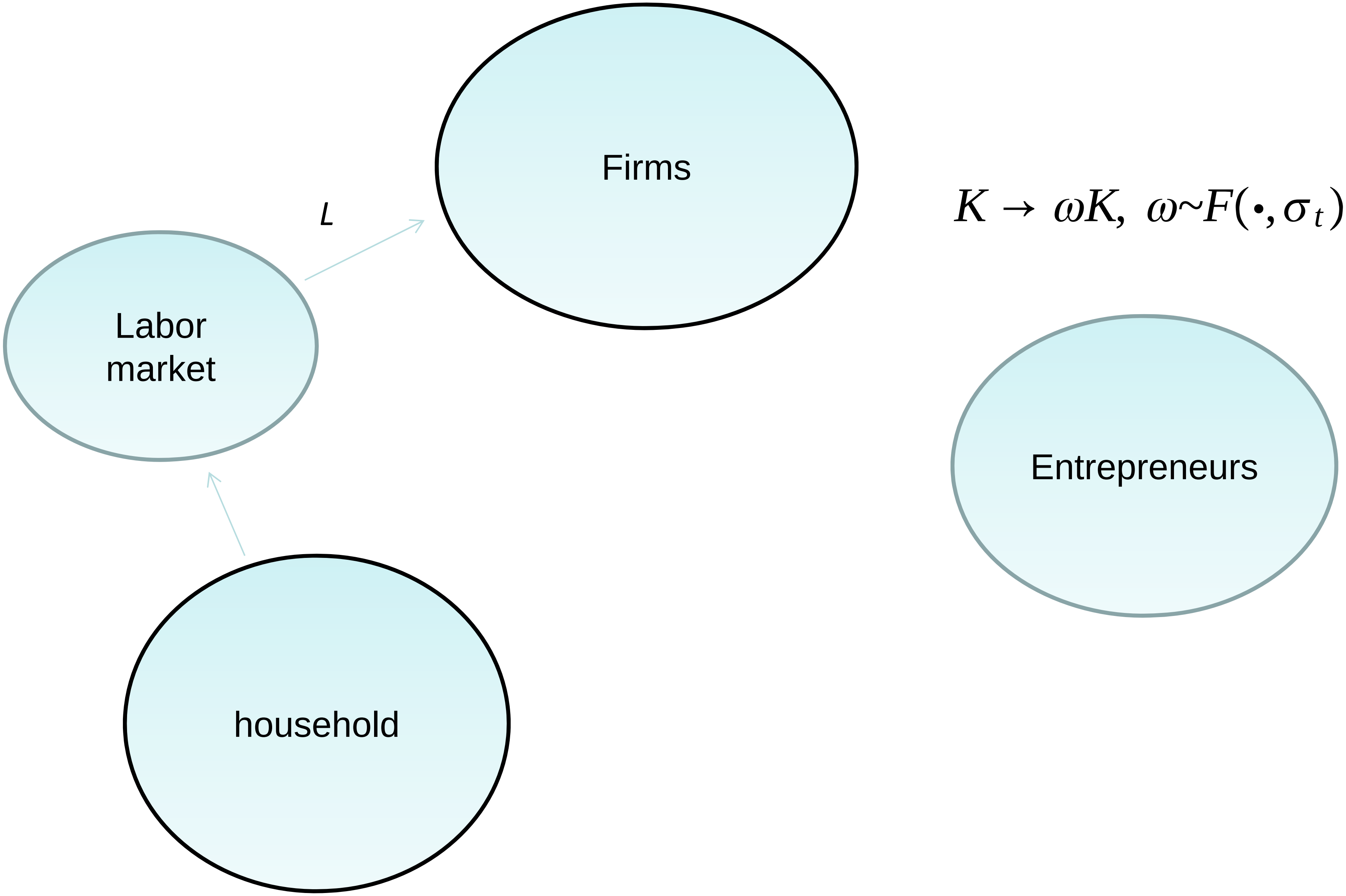
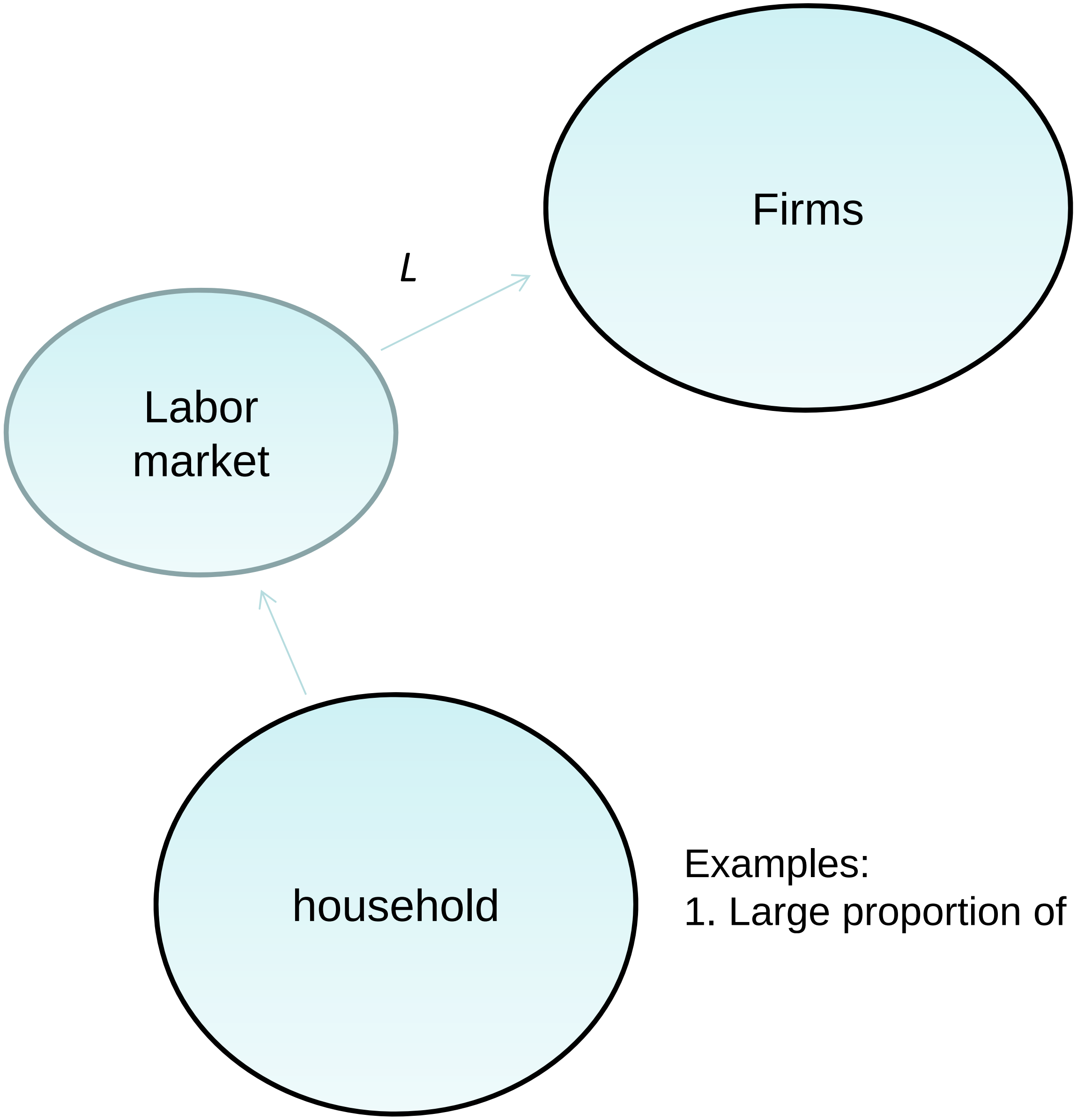


$$K \rightarrow \omega K,\ \omega \sim F(\bullet, \sigma_t)$$

Standard Model with BGG



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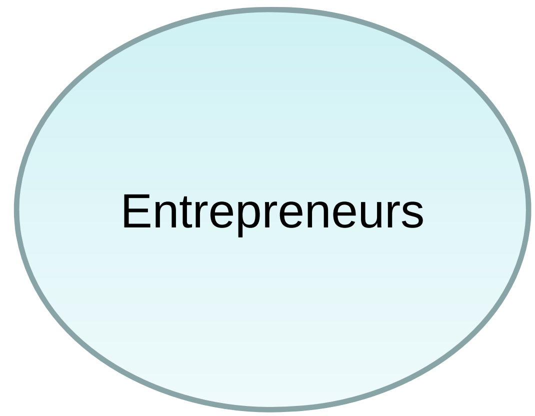
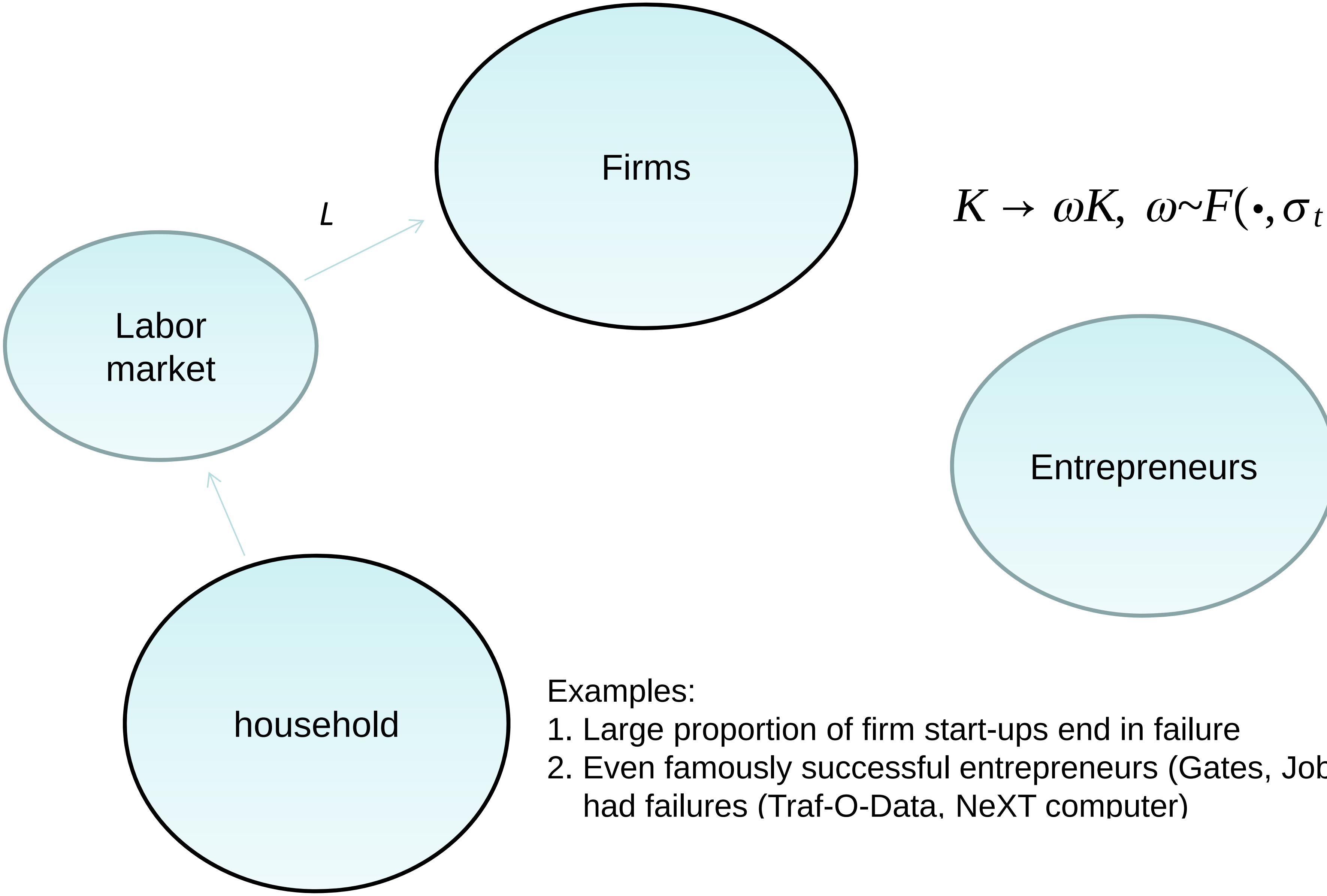


Examples:

1. Large proportion of firm start-ups end in failure

Standard Model with BGG



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Examples:

1. Large proportion of firm start-ups end in failure
2. Even famously successful entrepreneurs (Gates, Jobs) had failures (Traf-O-Data, NeXT computer)

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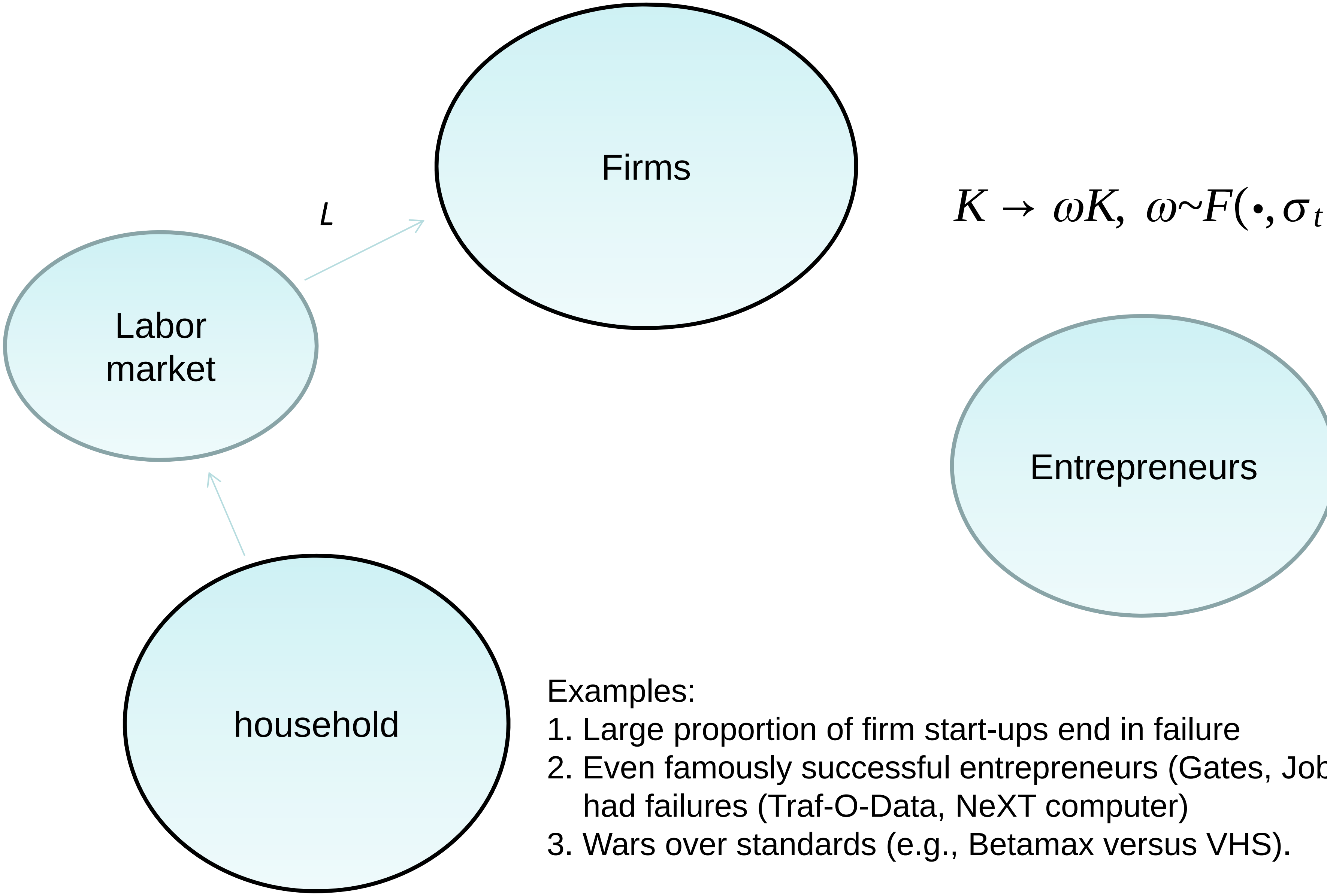

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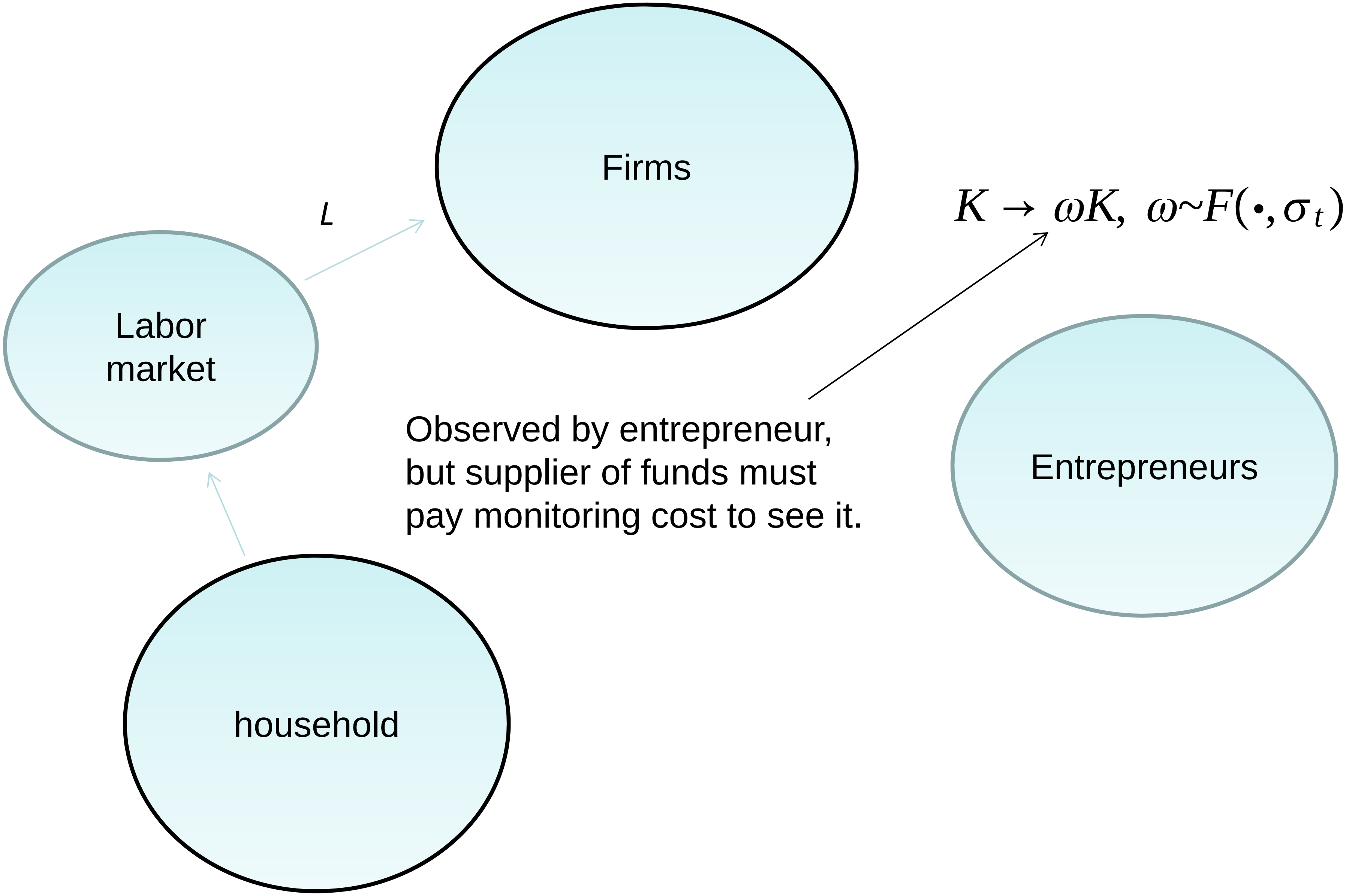
Examples:
1. Large proportion of firm start-ups end in failure
2. Even famously successful entrepreneurs (Gates, Jobs) had failures (Traf-O-Data, NeXT computer)
3. Wars over standards (e.g., Betamax versus VHS).

Standard Model with BGG



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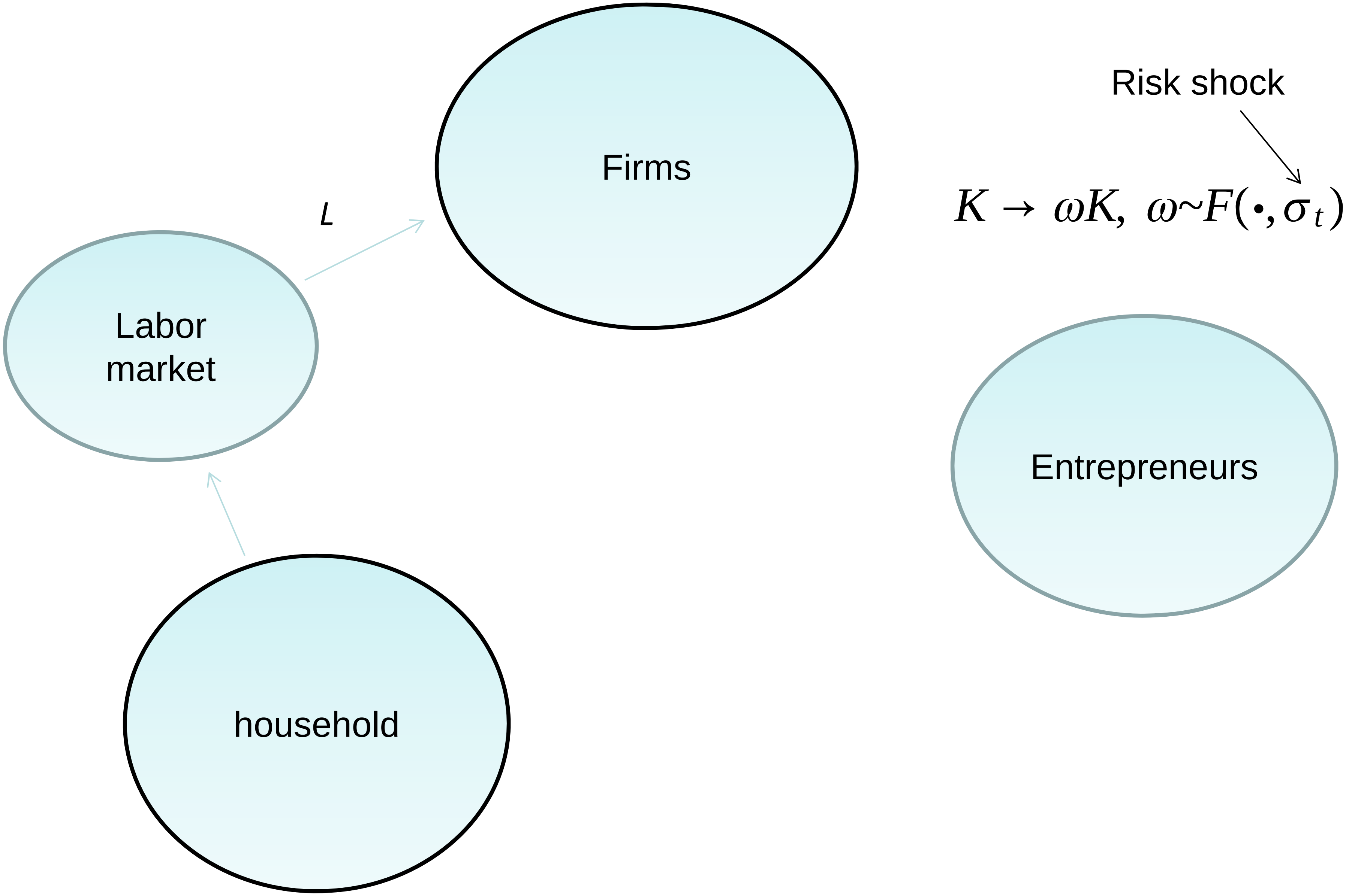

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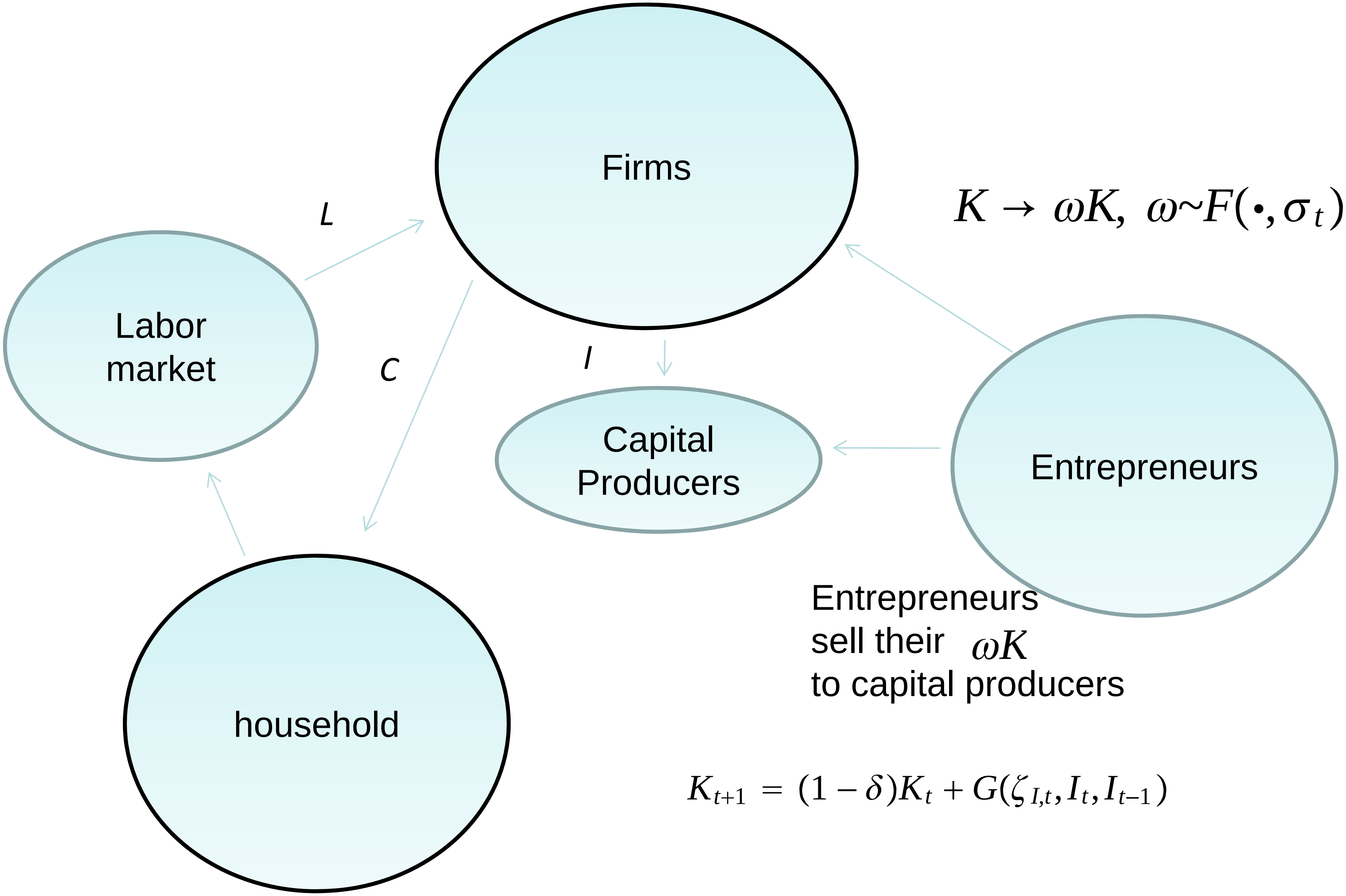

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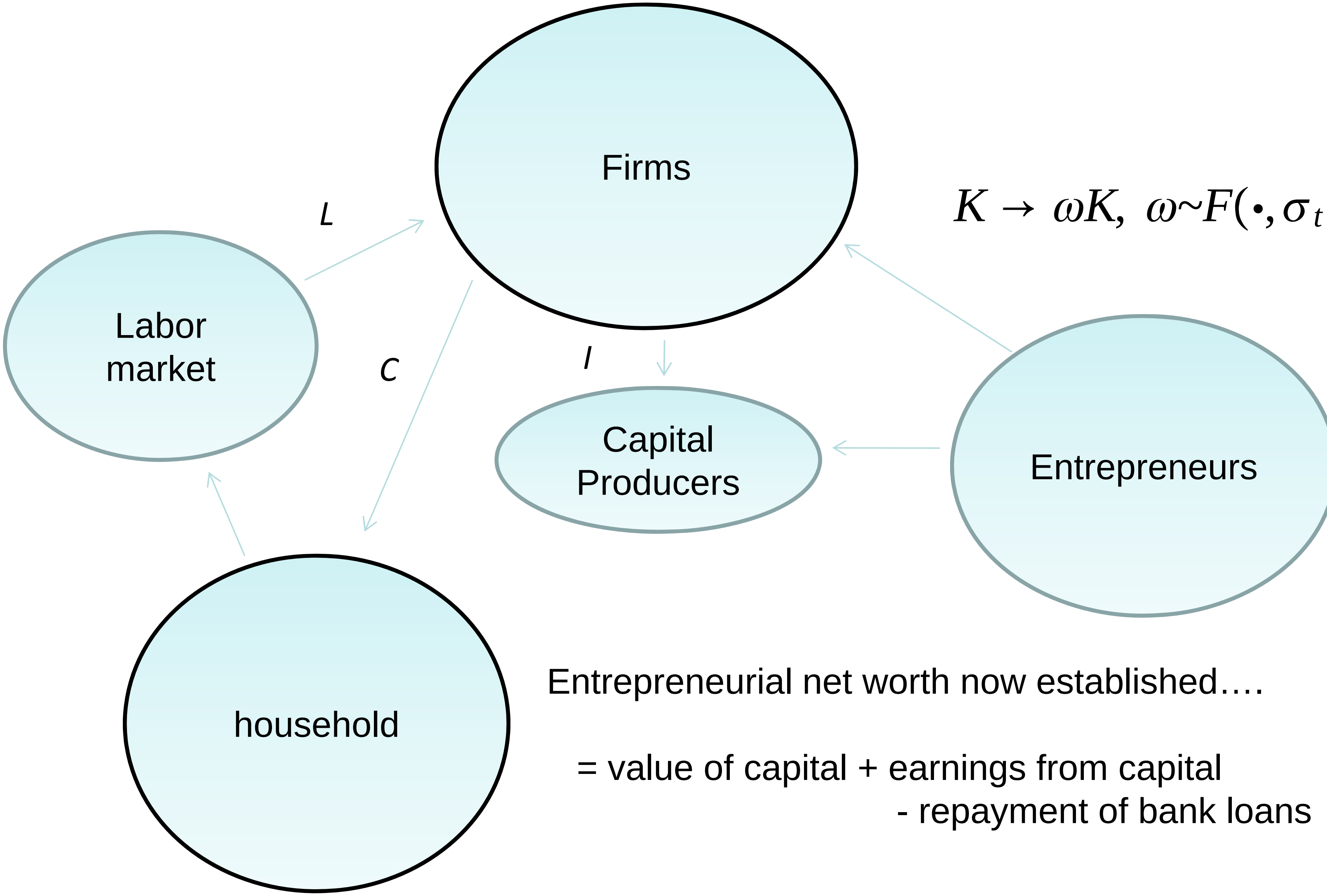
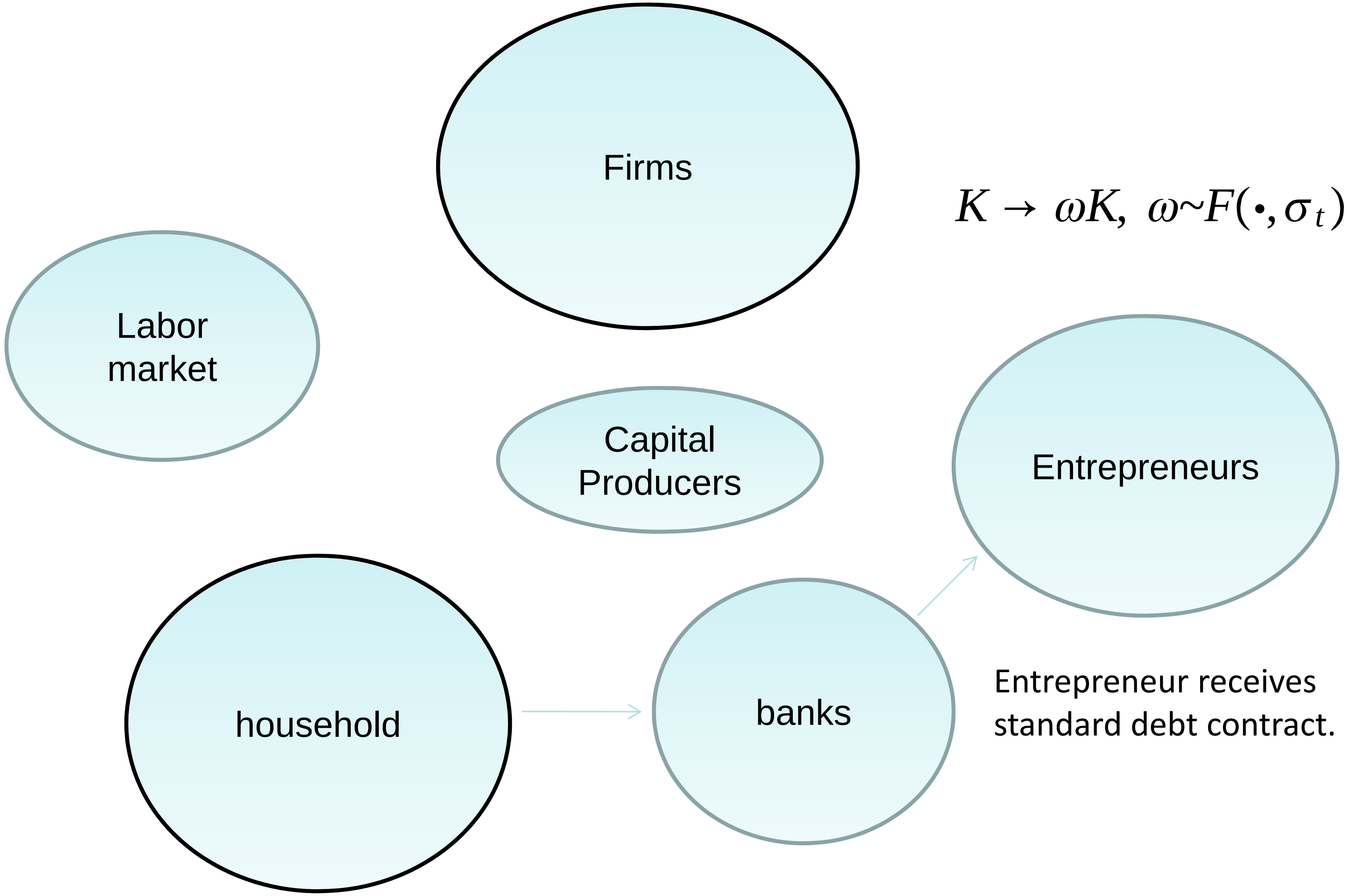


$$K \to \omega K,\ \ \omega \sim F(\bullet, \sigma_t)$$

Entrepreneurial net worth now established….

= value of capital + earnings from capital
- repayment of bank loans

Standard Model with BGG



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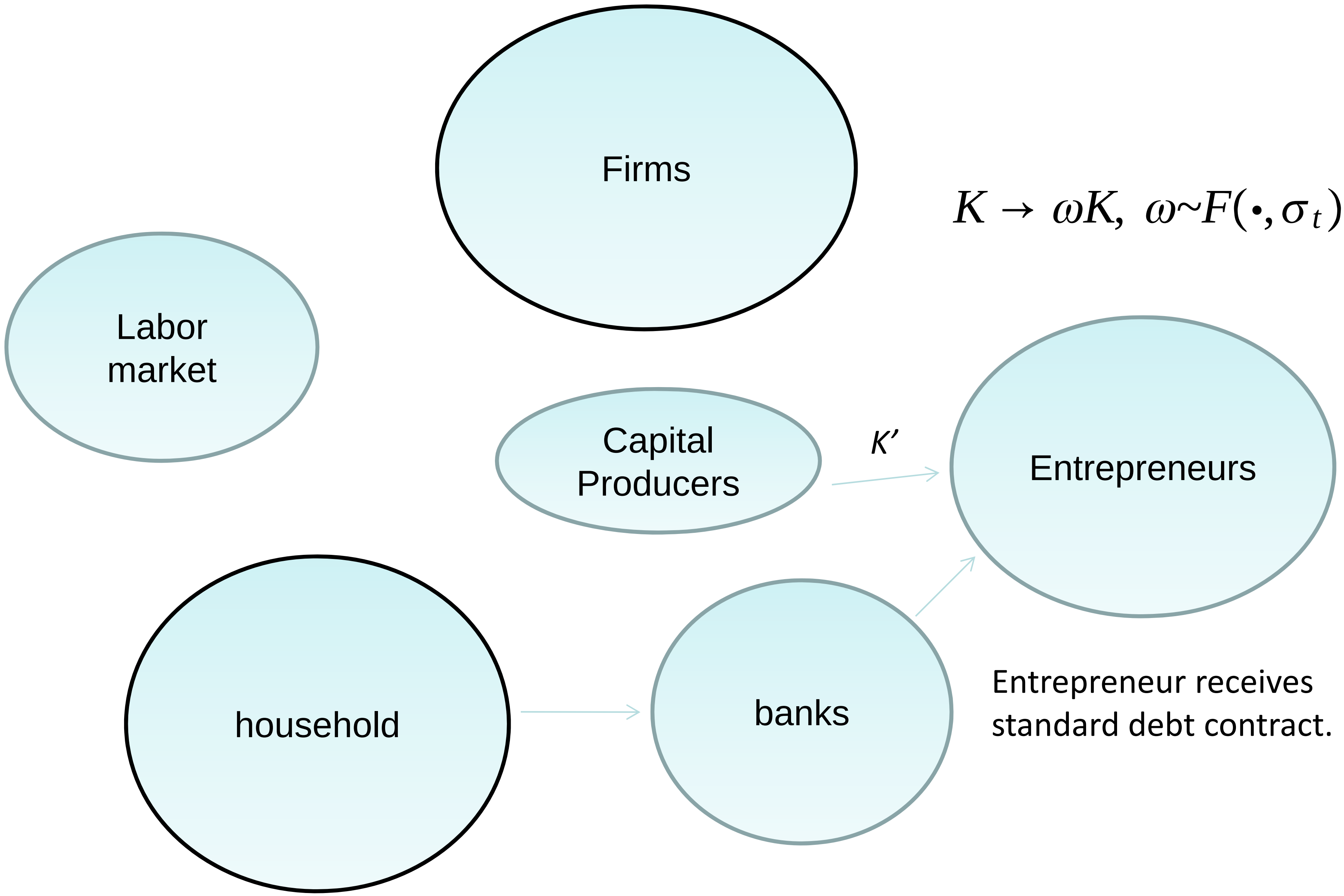
Entrepreneur receives standard debt contract.

Standard Model with BGG



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Economic Impact of Risk Shock

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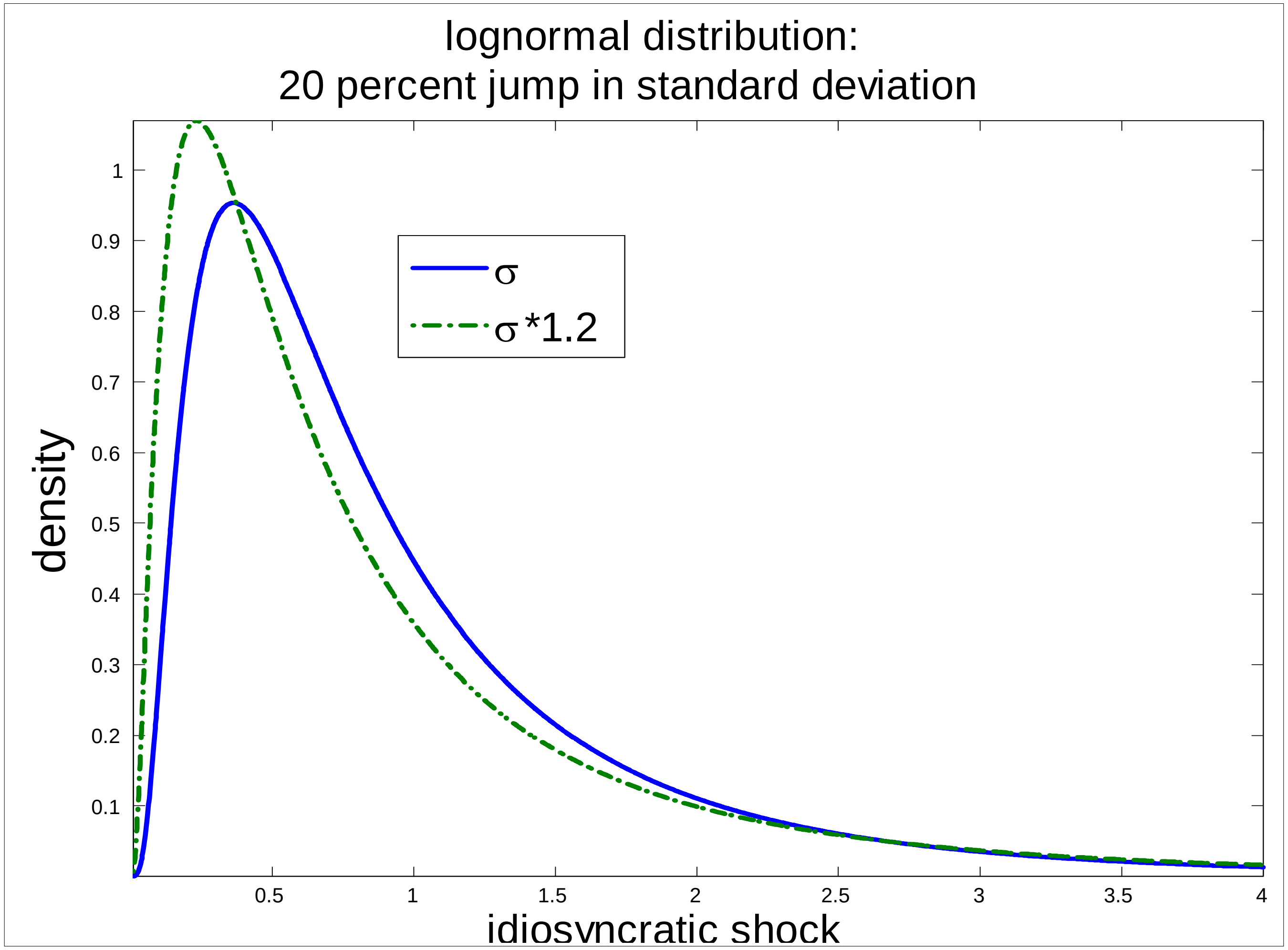

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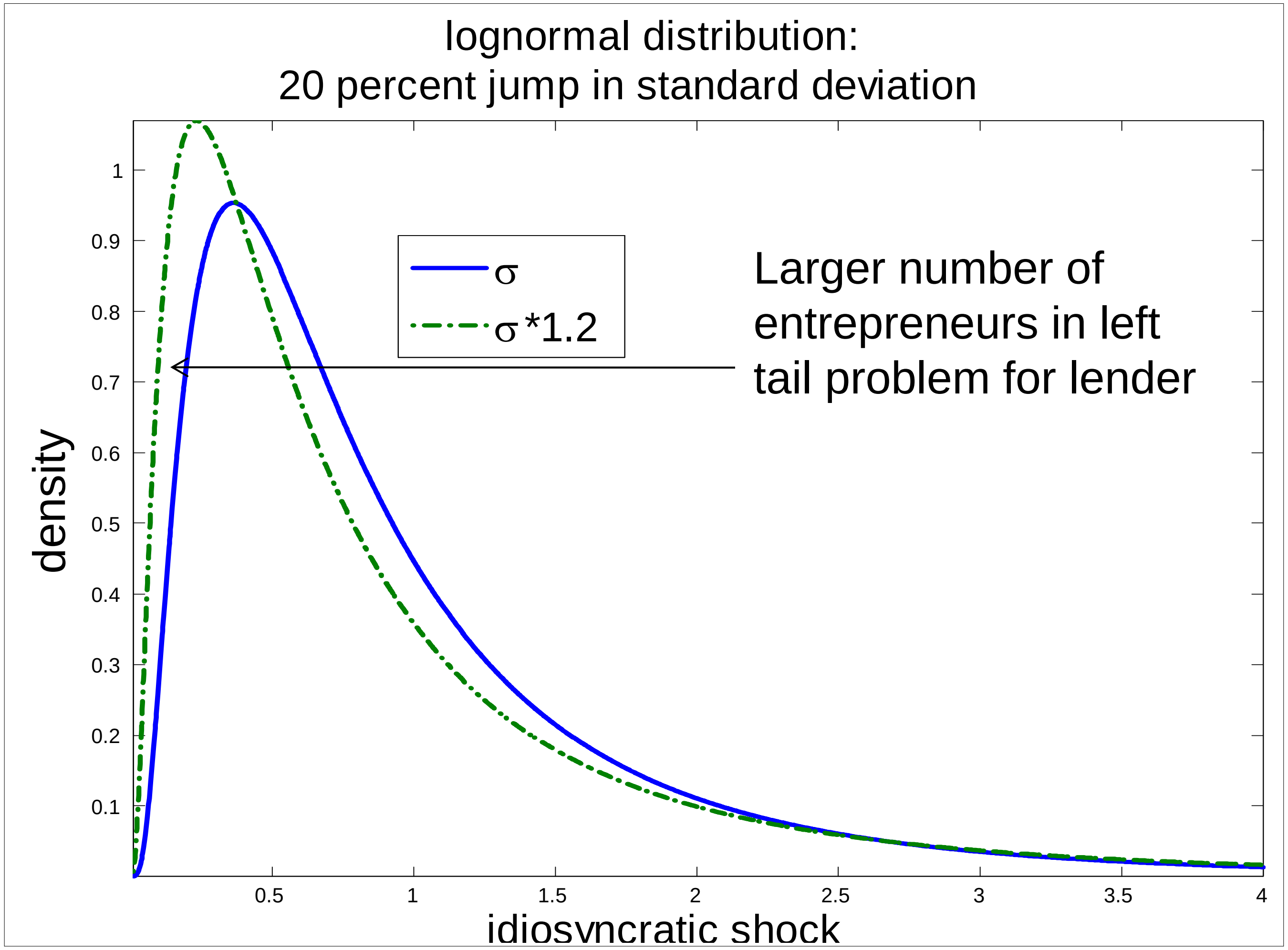

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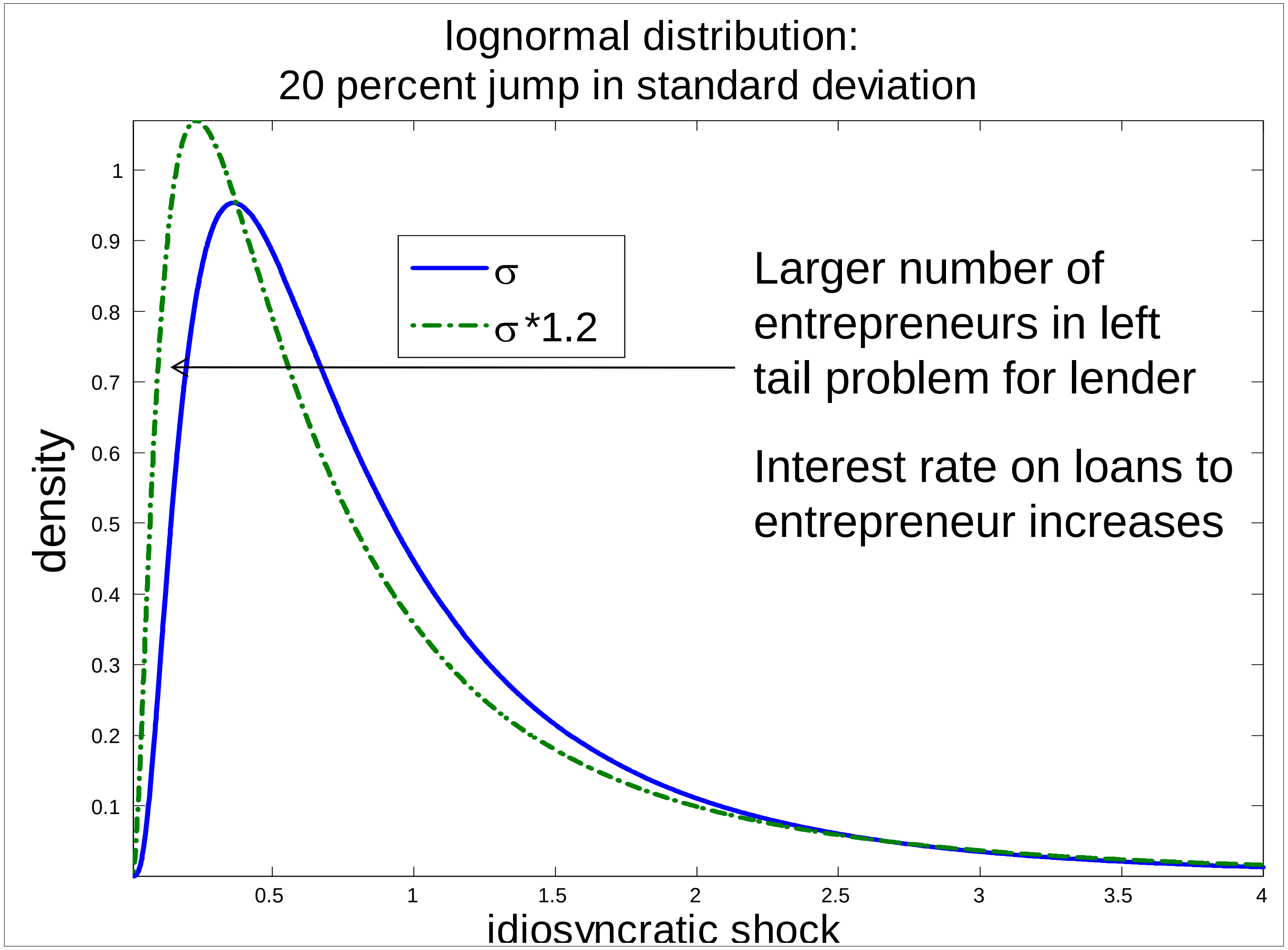

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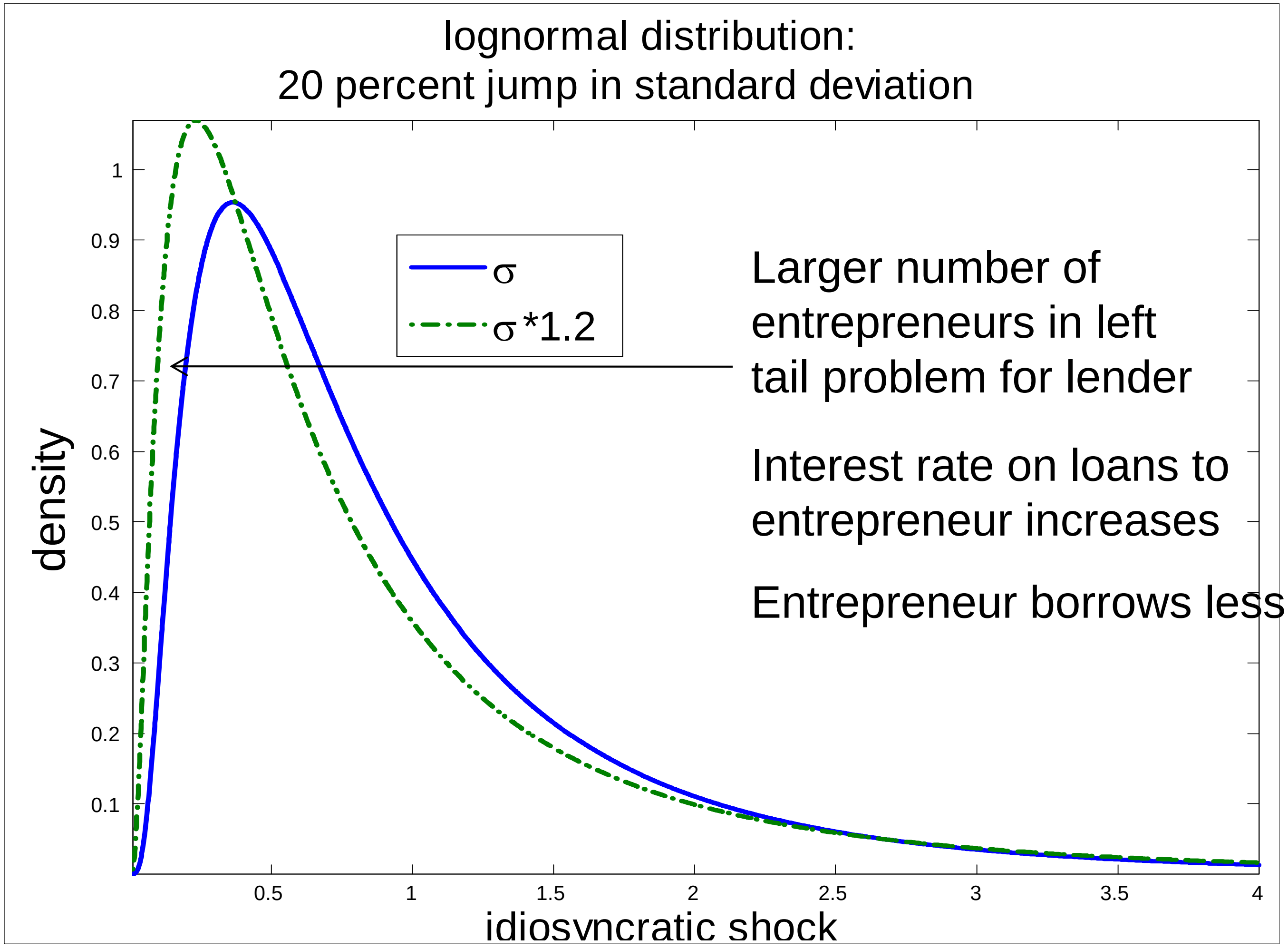

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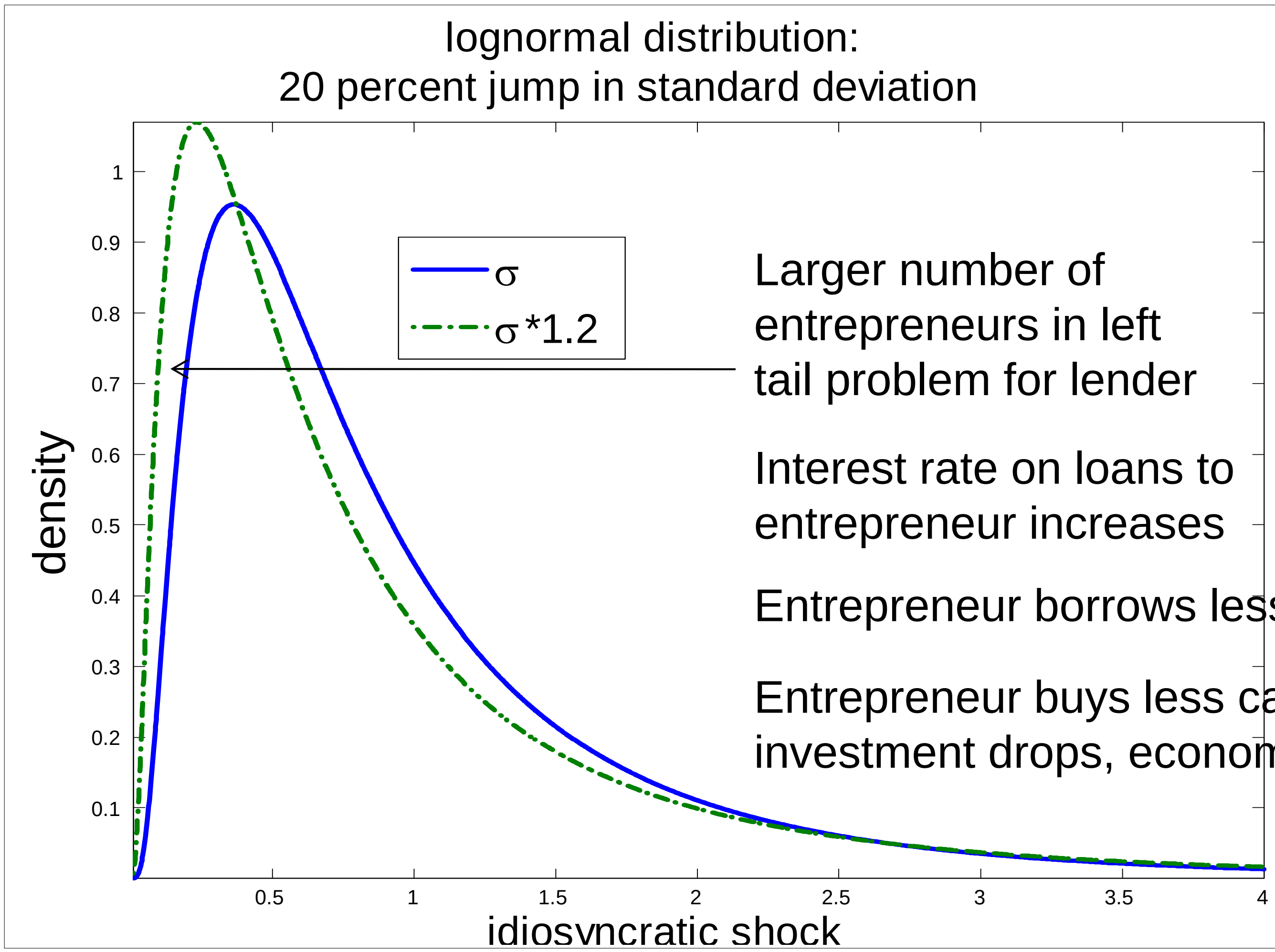

Larger number of entrepreneurs in left tail problem for lender

Interest rate on loans to entrepreneur increases

Entrepreneur borrows less

Entrepreneur buys less capital, investment drops, economy tanks

Risk Shocks

- We assume risk has a first order autoregressive representation:

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

- Standard information assumption:
  - Agents become aware of u_t when it's realized.

- We assume that agents receive early information about u_t ('news').

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.

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- Equity shock.

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- Monetary policy shock.

- Equity shock.

- Risk shock.

- 6 other shocks.

Inference

- 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.

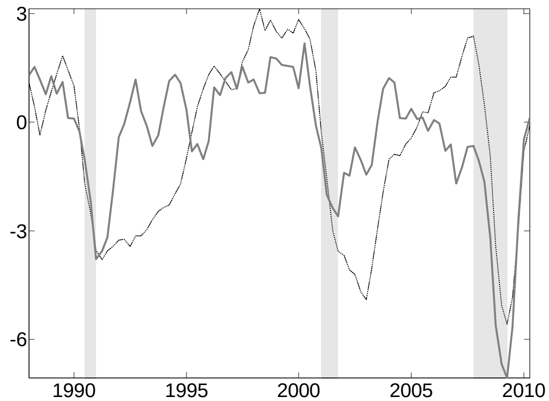
- Data: 1985Q1-2010Q2

Results

- Risk shock most important shock for business cycles.
- Quantitative measures of importance.
- *Why* are they important?
- Some Direct Evidence on Risk Shocks.

Figure 5:The Role of the Risk Shock in Selected Variables

a. GDP growth *(year-on-year %)*



Solid line: data when all shocks are fed to model.

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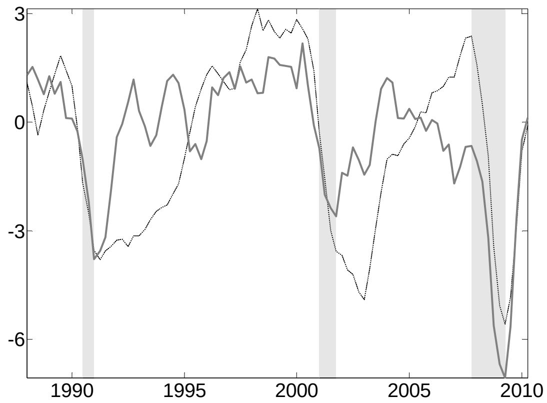

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Dashed line: data when only disturbances to risk are fed to model.

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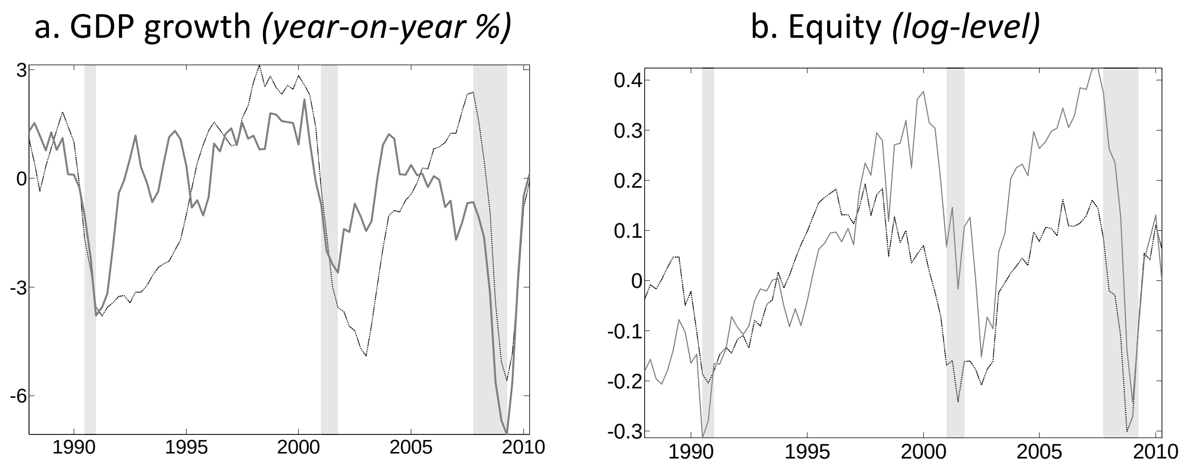

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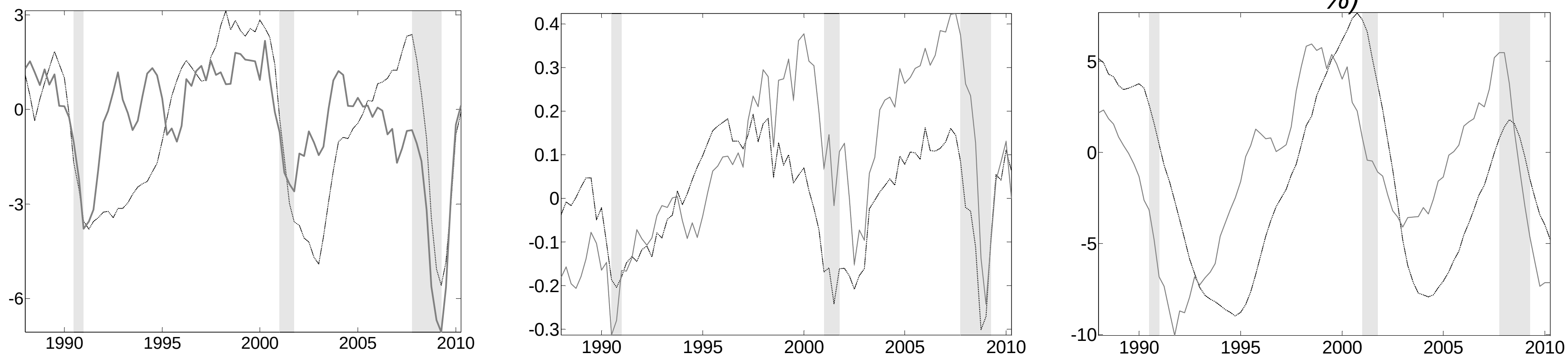
Figure 5:The Role of the Risk Shock in Selected Variables

a. GDP growth *(year-on-year %)* b. Equity *(log-level)* c. Credit growth *(year-on-year %)*



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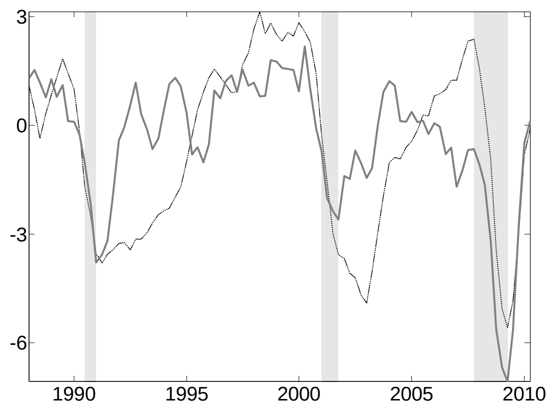
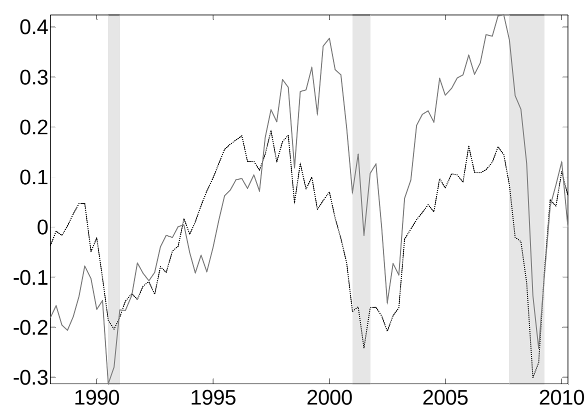
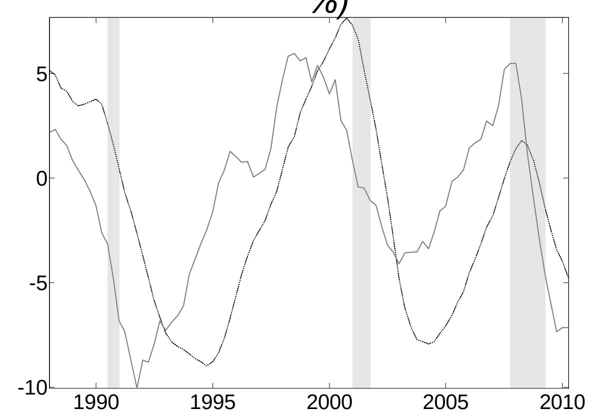


b. Equity *(log-level)*



c. Credit growth *(year-on-year %)*



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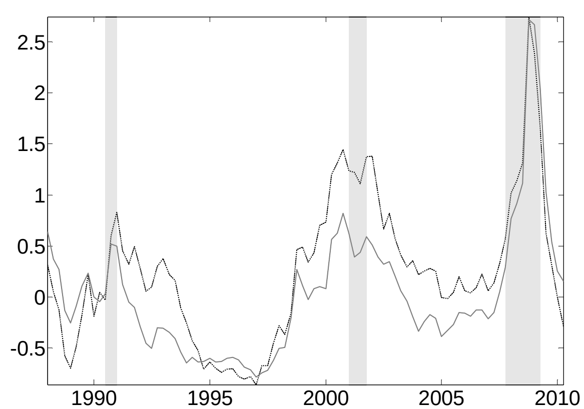
e. Credit spread *(p.p. per annum)*



Percent Variance in Business Cycle Frequencies Accounted for by Risk Shock

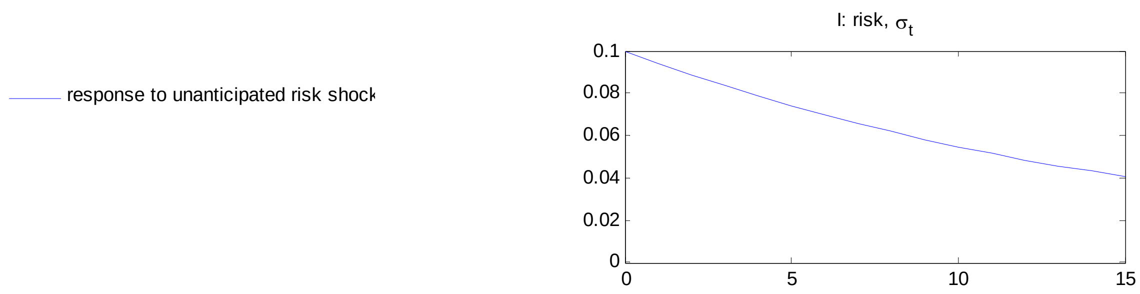
variable	*Risk*, σ_t
GDP	62
Investment	73
Consumption	16
Credit	64
Premium $(\mathbf{Z}-\mathbf{R})$	95
Equity	69
$R^{10\text{ year}} - R^{1\text{ quarter}}$	56

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

Why Risk Shock is so Important

- In the model:
  - jump in risk, σ_t, generates a response that resembles a recession

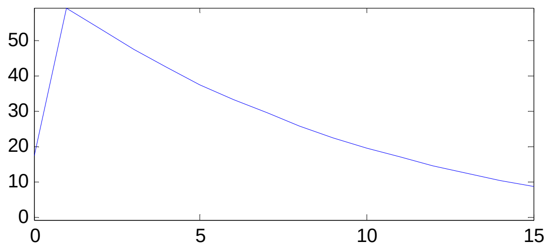
Figure 3: Dynamic Responses to Unanticipated and Anticipated Components of Risk Shock



Looks like a business cycle

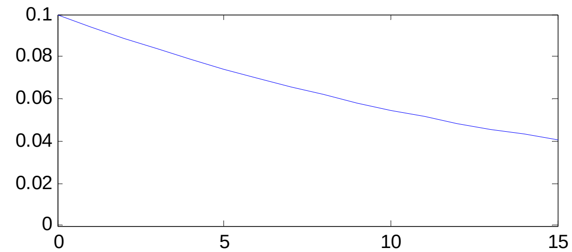
Figure 3: Dynamic Responses to Unanticipated and Anticipated Components of Risk Shock

A: interest rate spread (Annual Basis Points)



response to unanticipated risk shock

I: risk, σ_t



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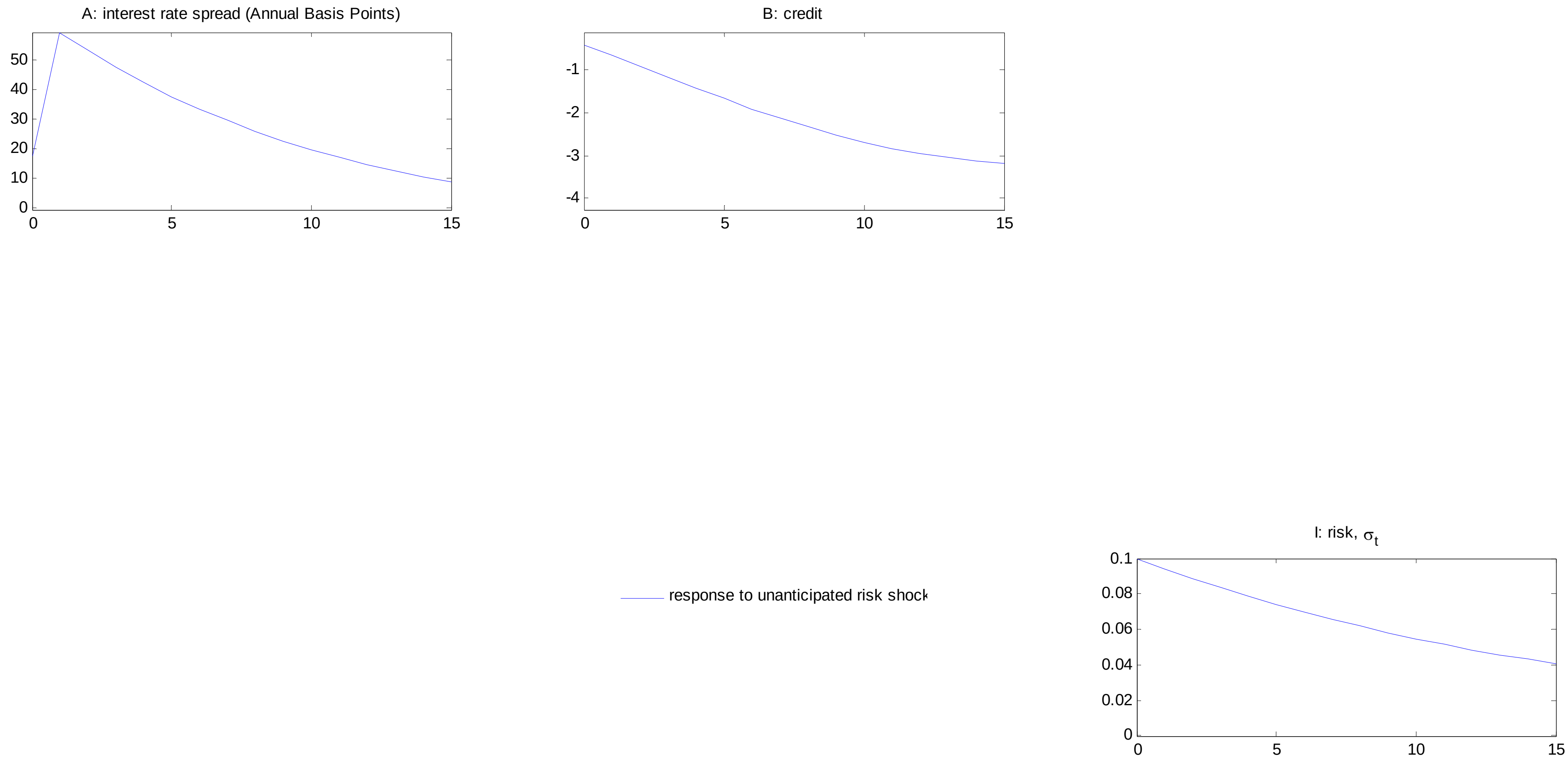

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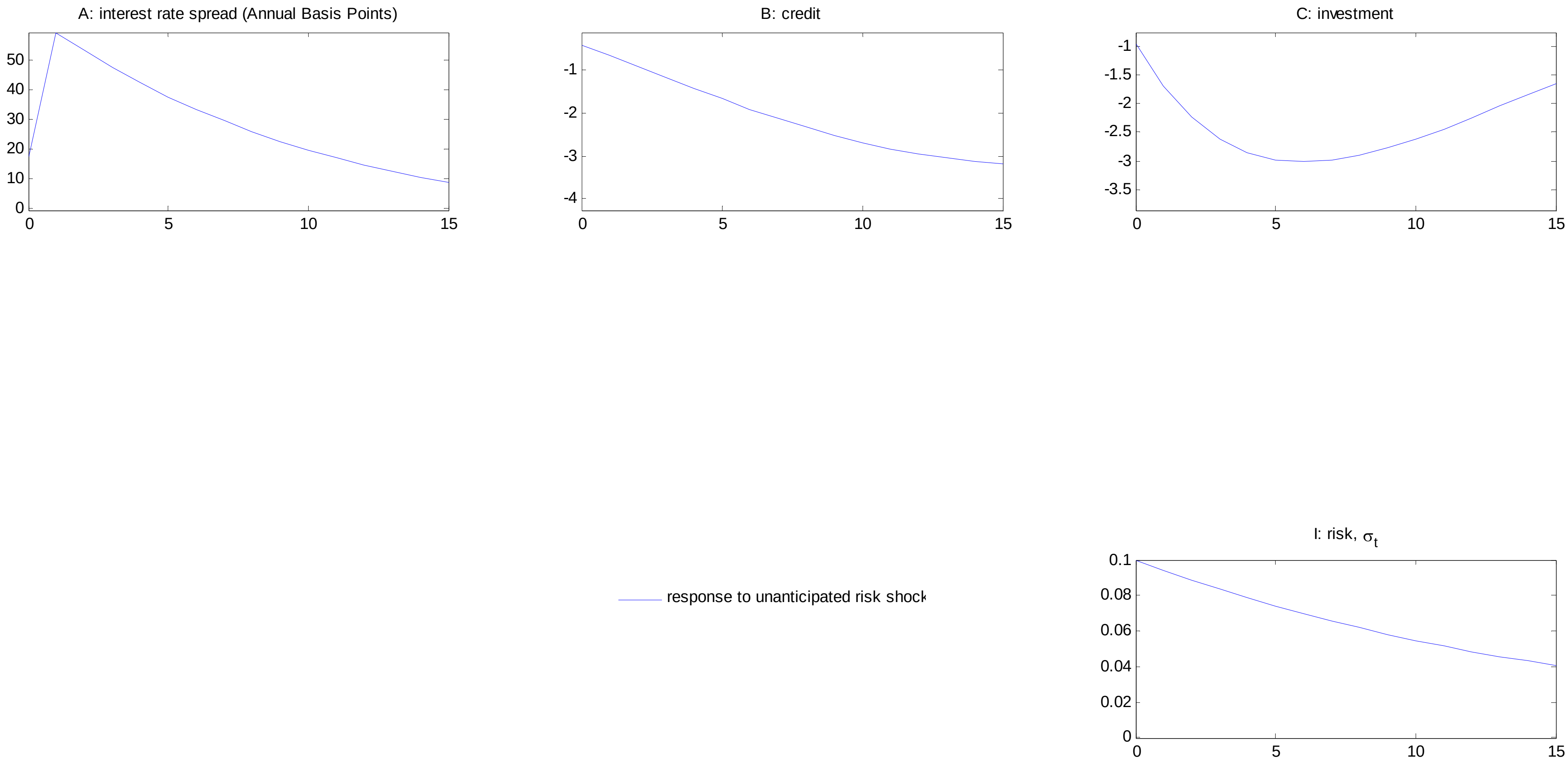

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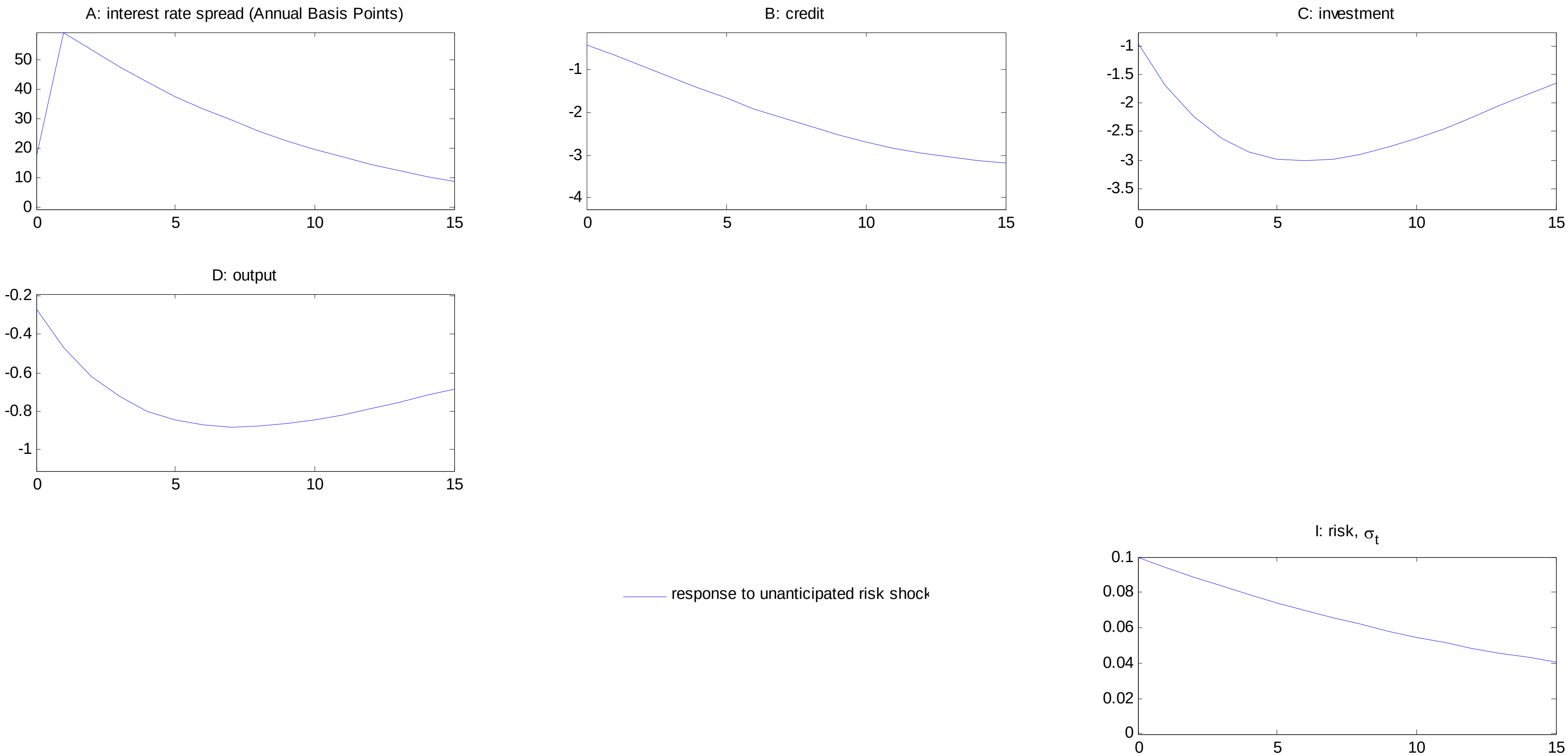

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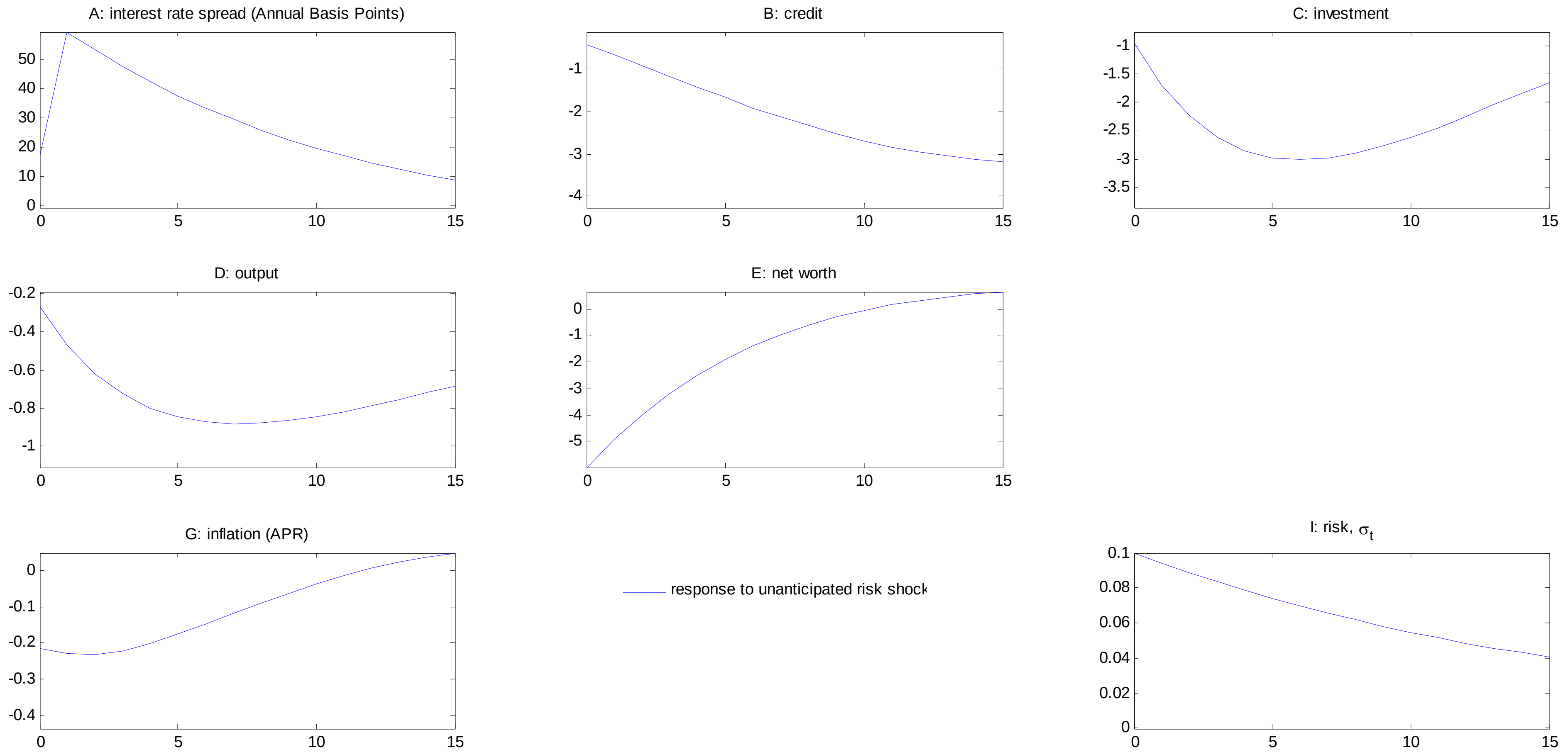

Looks like a business cycle

Surprising, from RBC perspective

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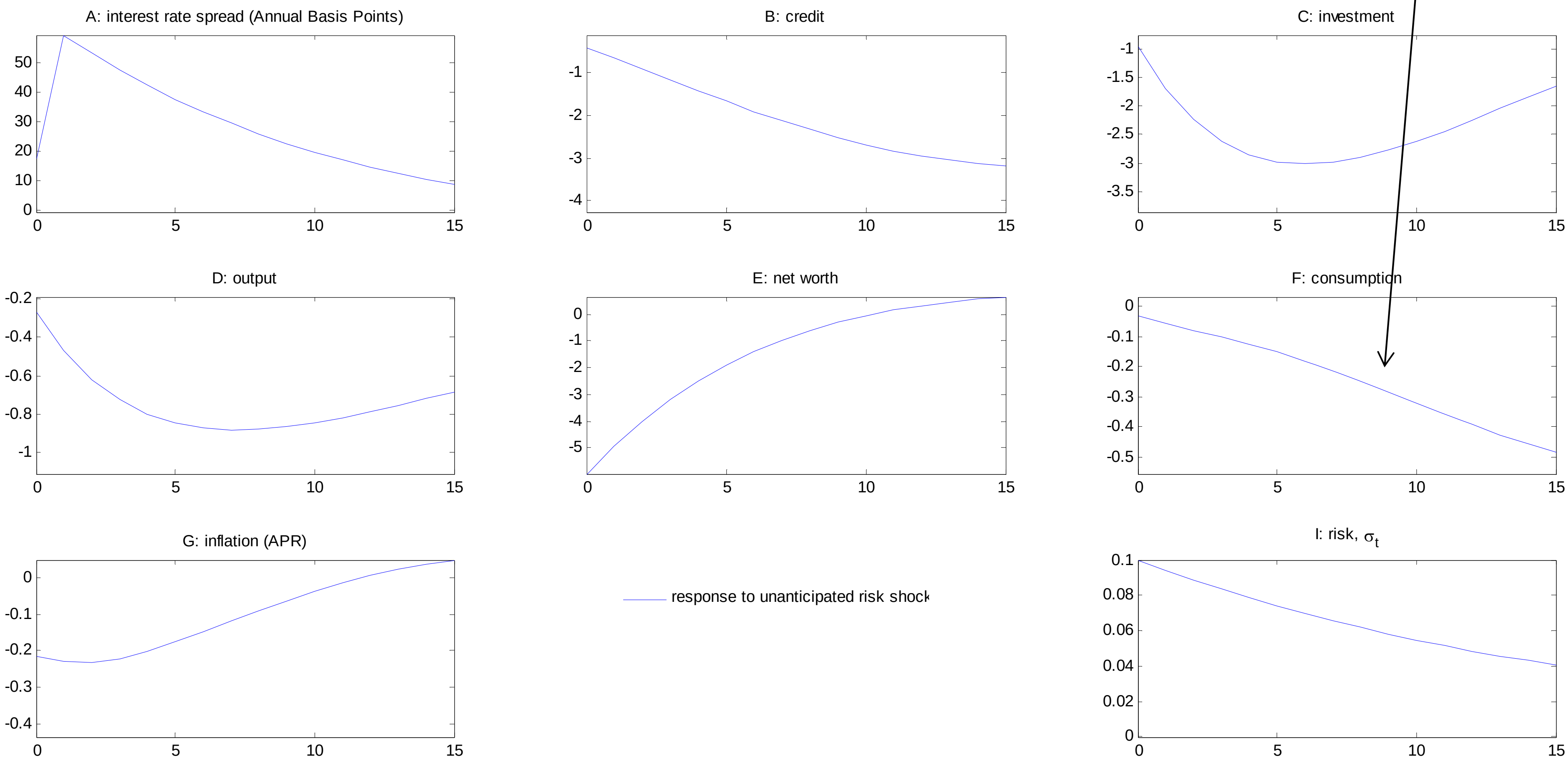

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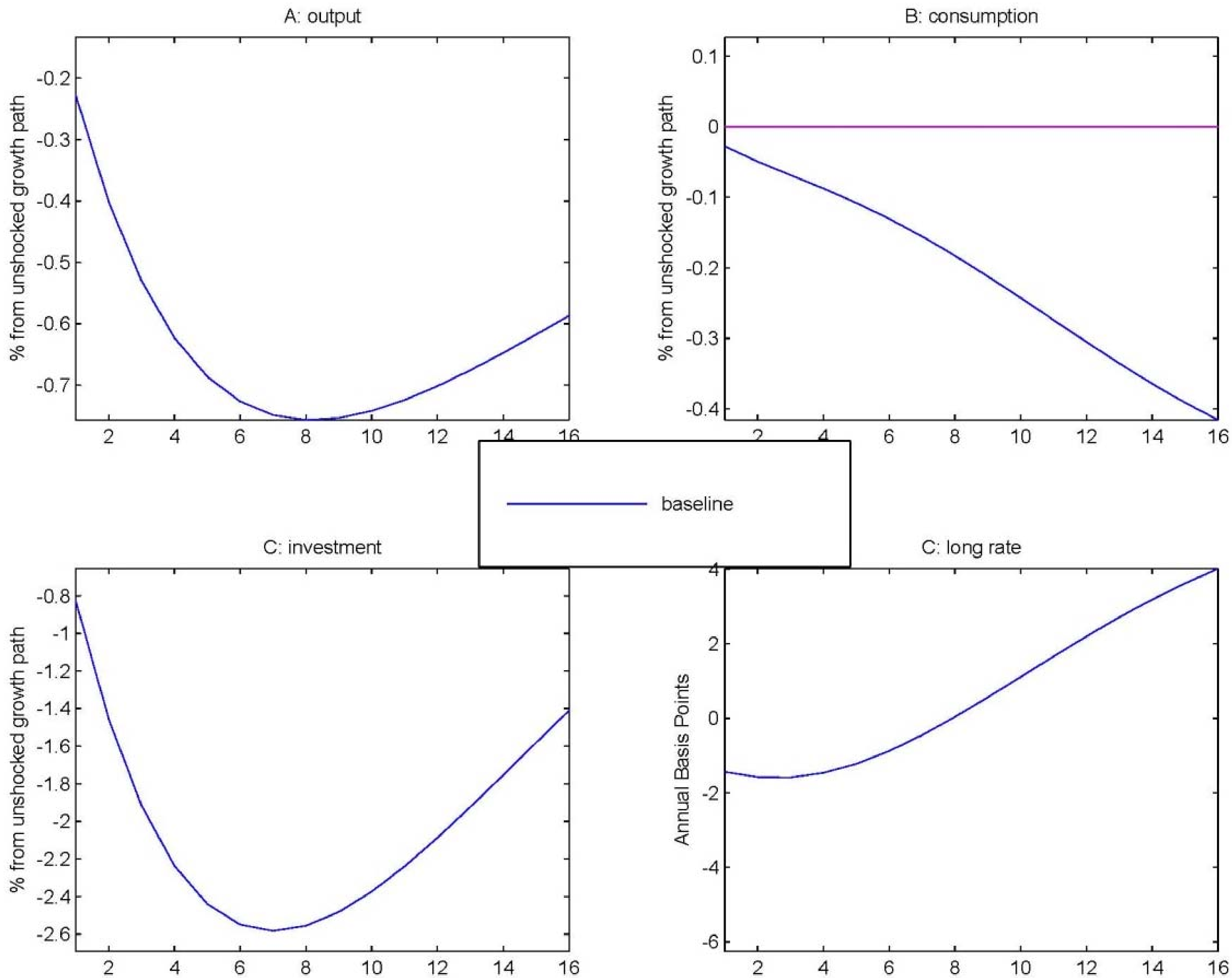
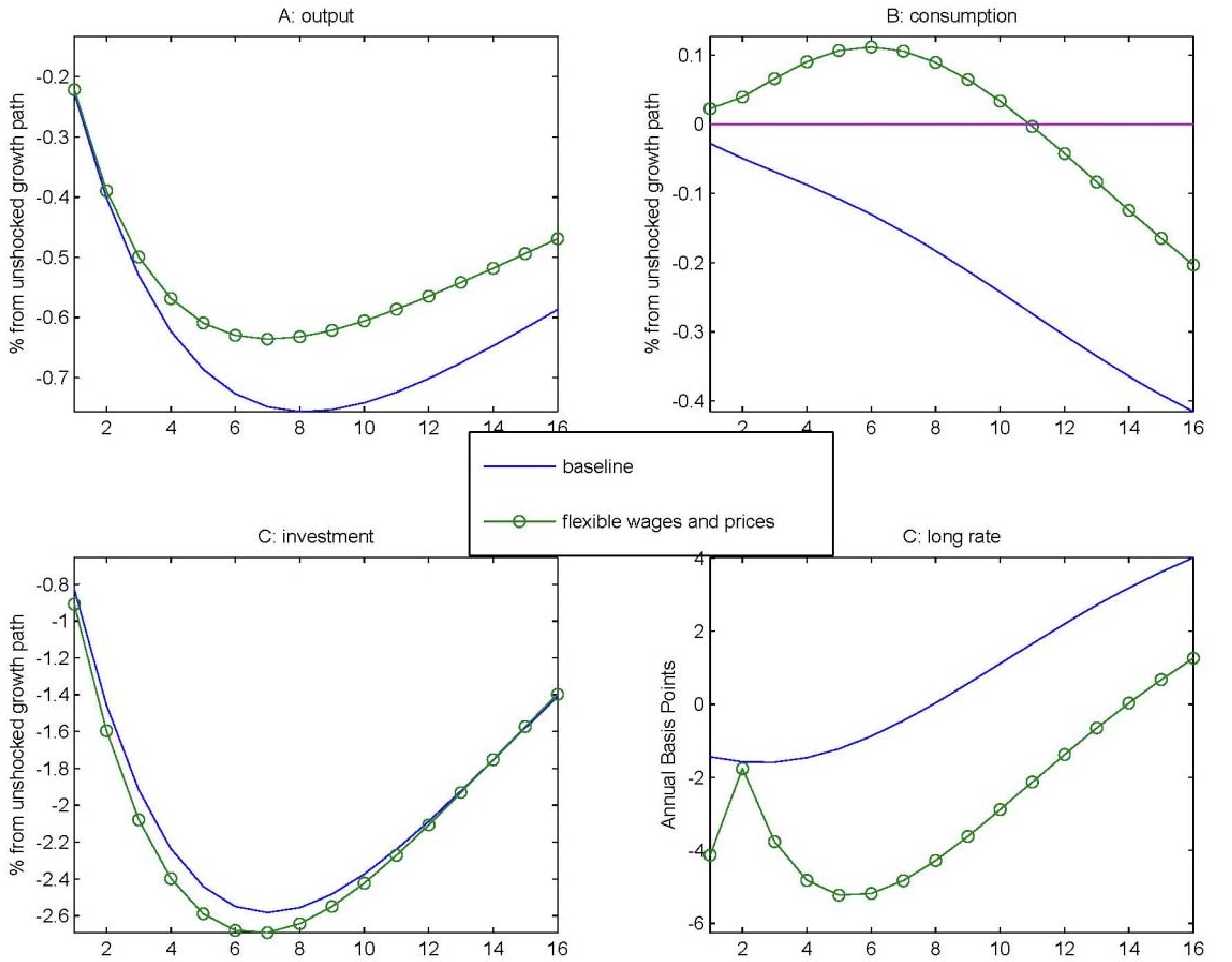


A: output
B: consumption
C: investment
C: long rate
% from unshocked growth path
Annual Basis Points
baseline



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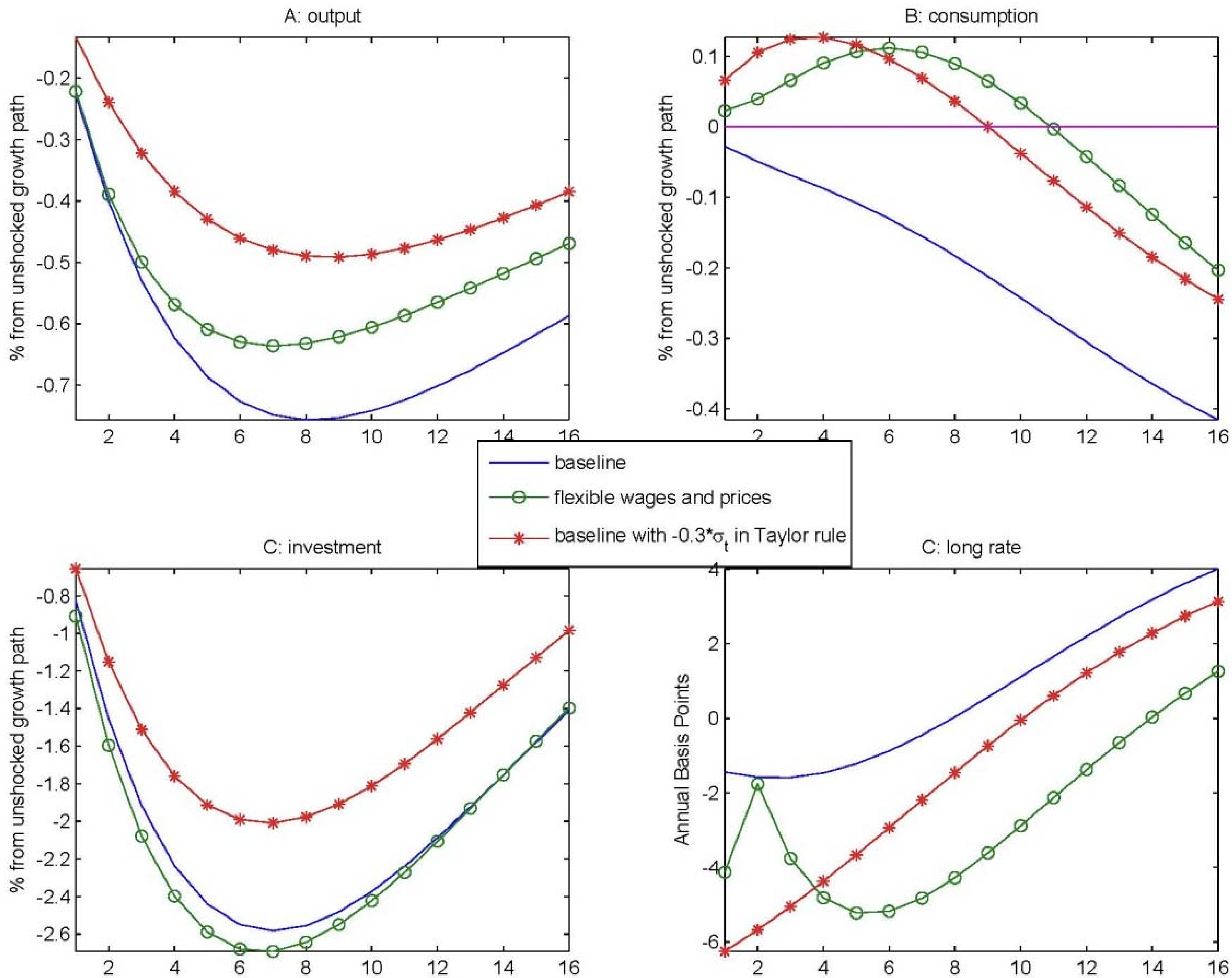
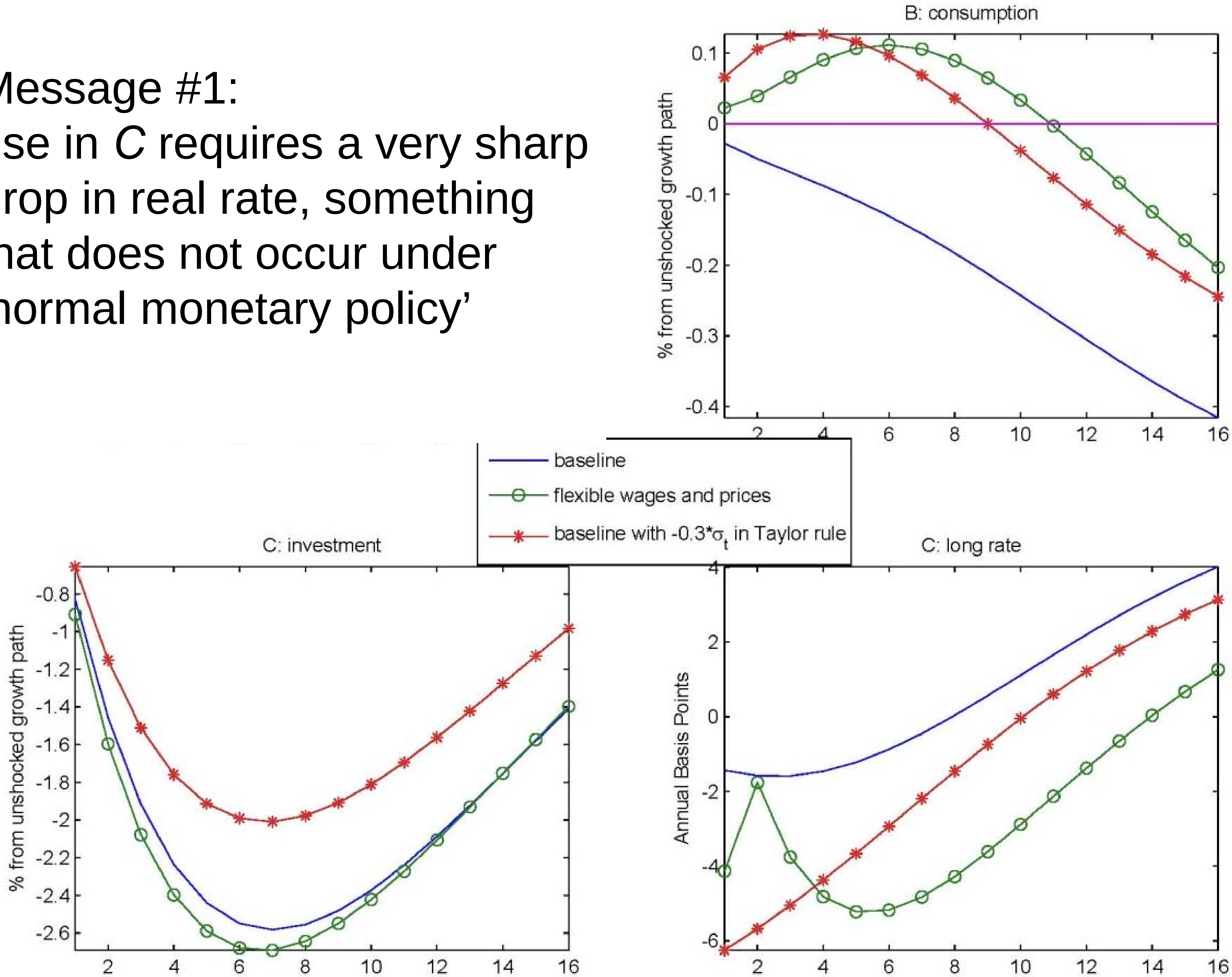
flexible wages and prices

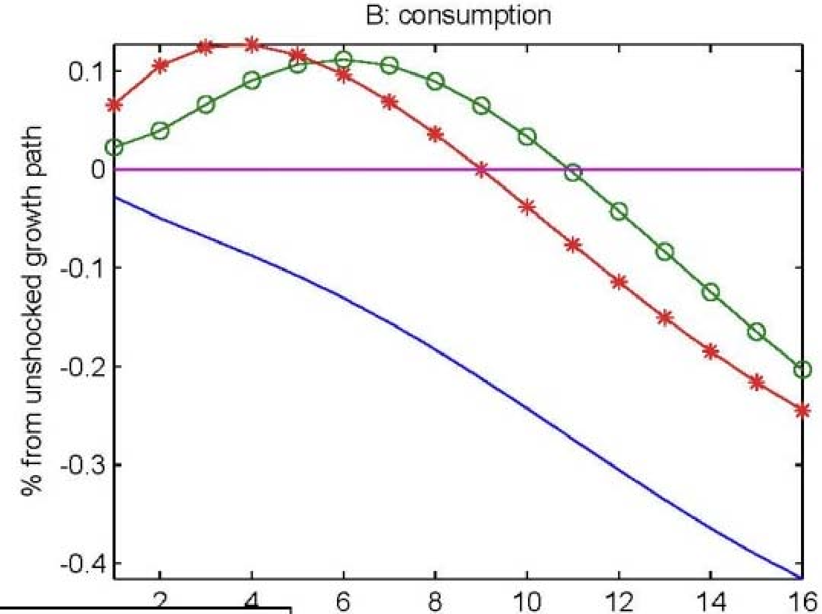


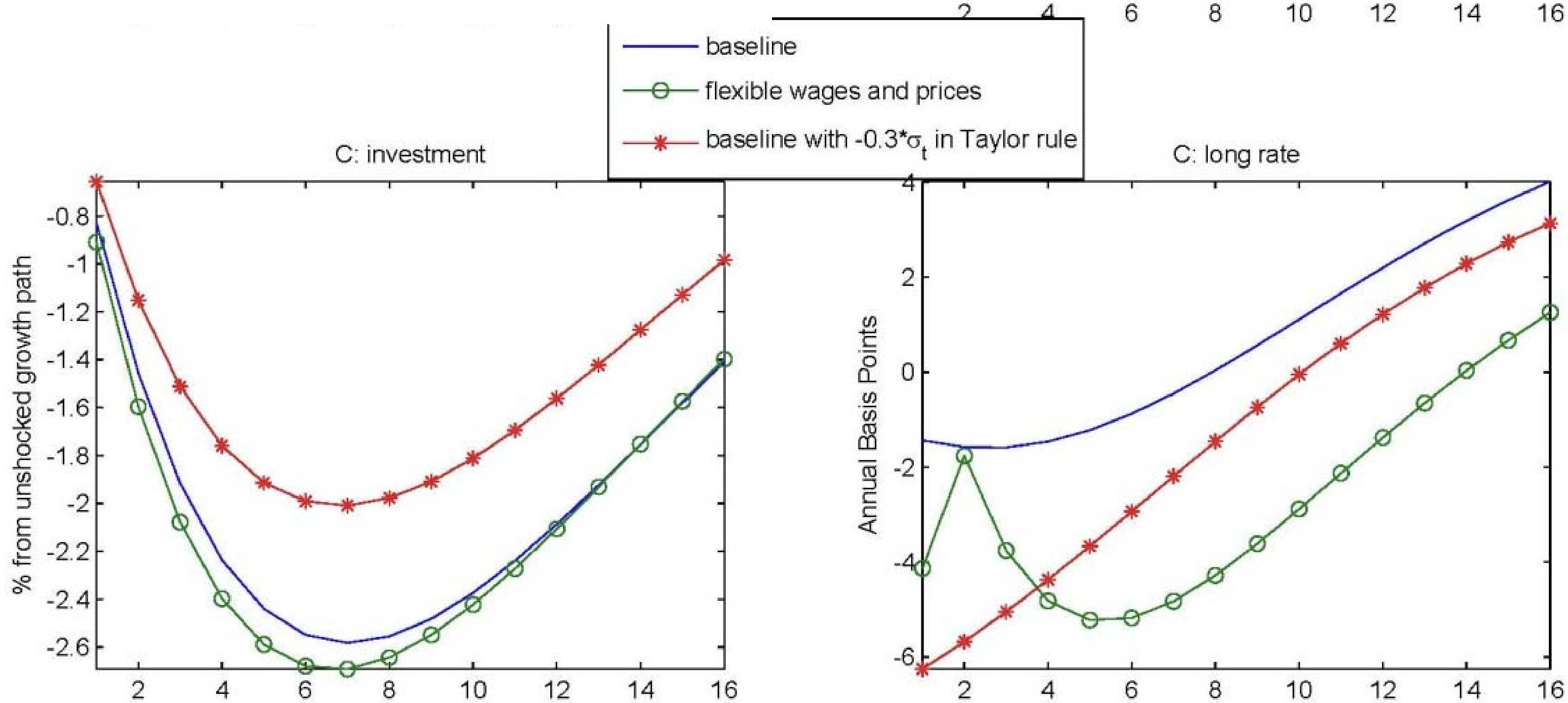
A: output
B: consumption
C: investment
C: long rate
% from unshocked growth path
Annual Basis Points
baseline
flexible wages and prices
baseline with -0.3*σt in Taylor rule

Message #1:
rise in *C* requires a very sharp drop in real rate, something that does not occur under 'normal monetary policy'



Message #2:
a bigger cut in the interest rate than implied under 'normal monetary policy' would be an improvement

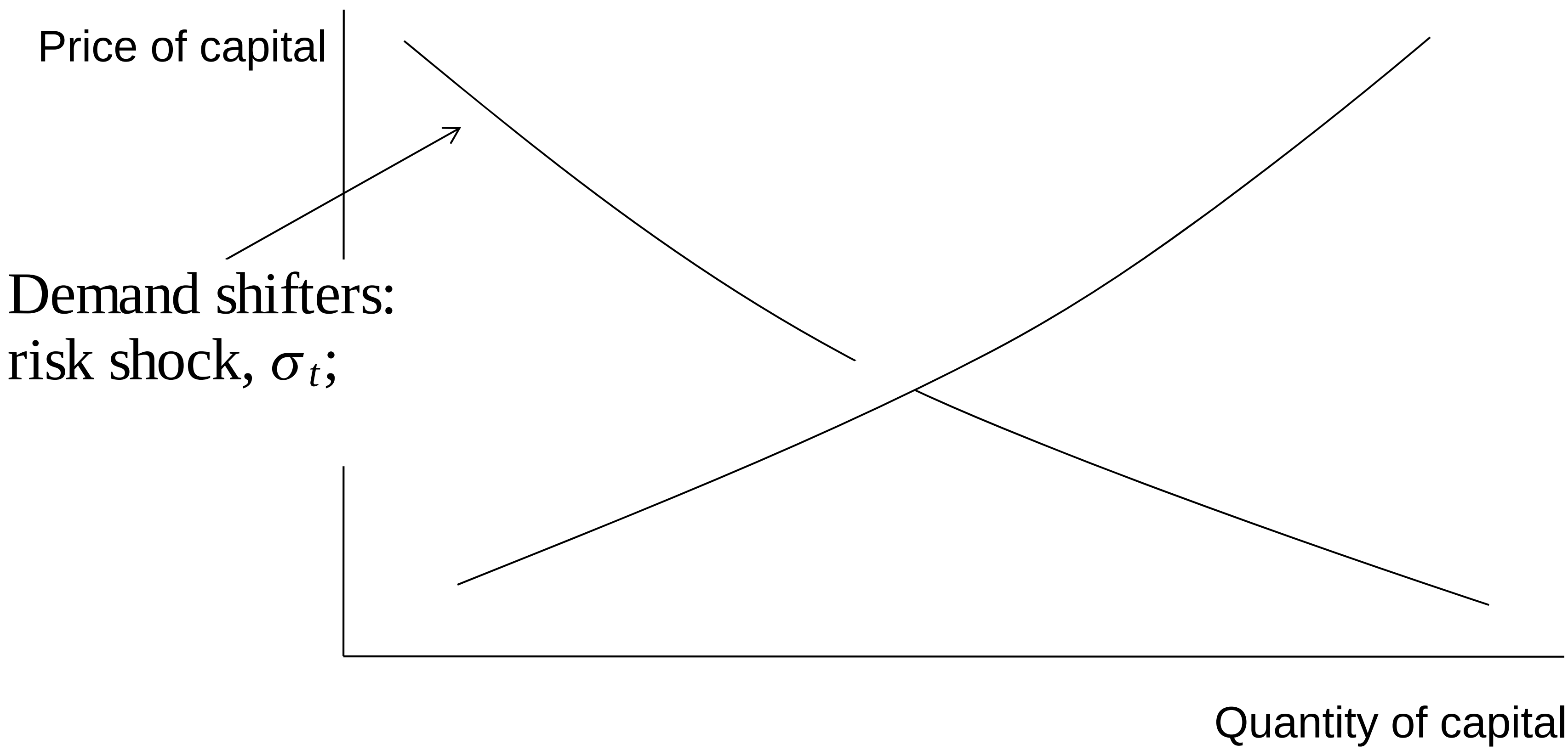




What Shock Does the Risk Shock Displace, and why?

- The risk shock mainly crowds out the marginal efficiency of investment.

Why does Risk Crowd out Marginal Efficiency of Investment?



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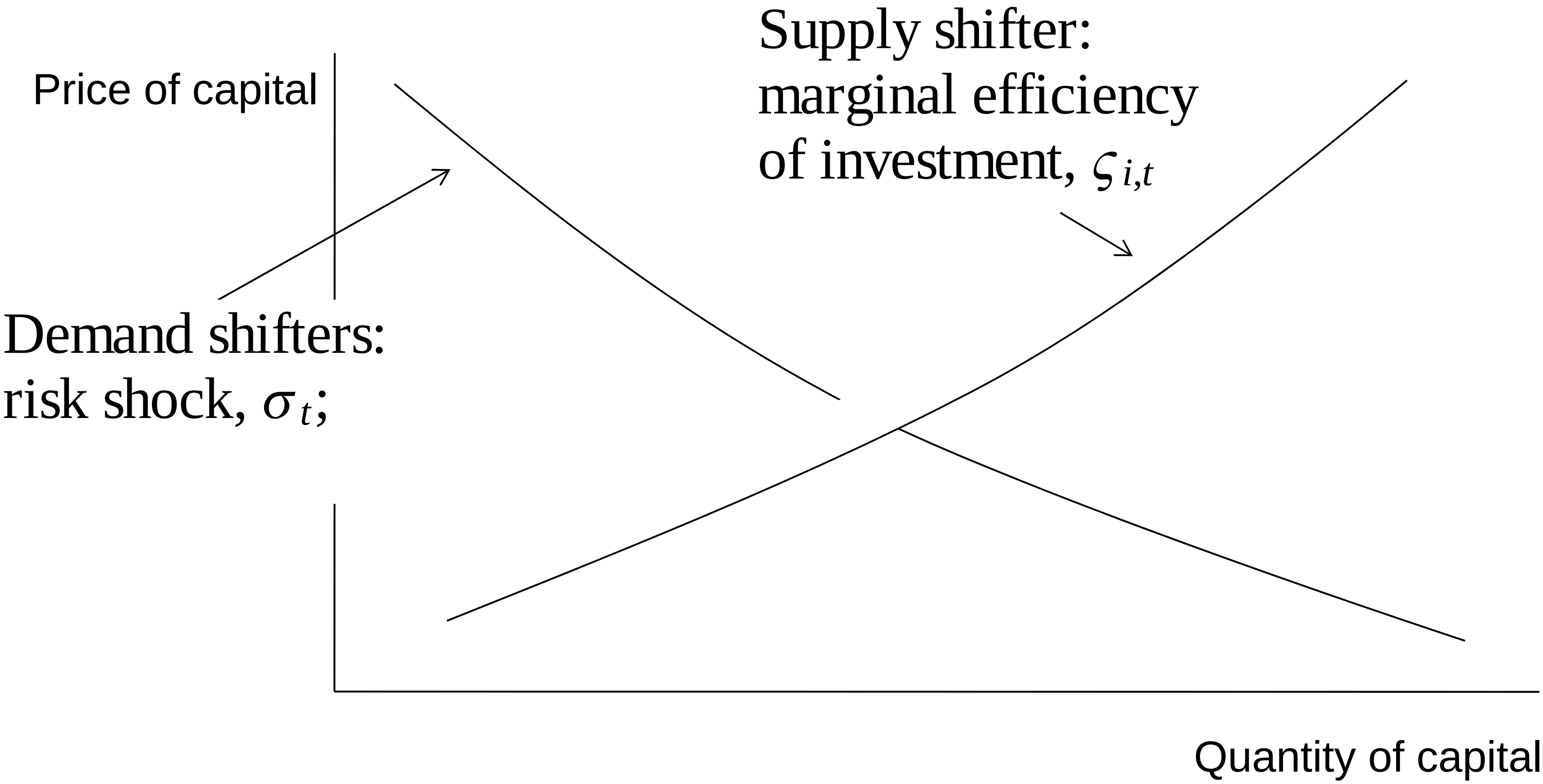

- Marginal efficiency of investment shock can account well for the surge in investment and output in the 1990s, *as long as the stock market is not included in the analysis.*

- 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.

Comparison with Bloom (2009)

- Return of entrepreneur *i* at time *t*:

$$r_{i,t+1} = \log(1 + R_{t+1}^{k}) + \log\omega_{it}, \;\; \log\omega_{it} \sim \text{Normal with variance, } \sigma_t$$

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- Go to CRSP data set, 1985 – 2010

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$$\hat{\sigma}_t = \left(\frac{1}{N_t} \sum_{i=0}^{N_t} [r_{it} - \log(1+R^k_t)]^2 \right)^{1/2}$$

CRSP measure of uncertainty

$$1 + R^k_t = \frac{1}{N_t} \sum_{i=0}^{N_t} \exp(r_{it})$$

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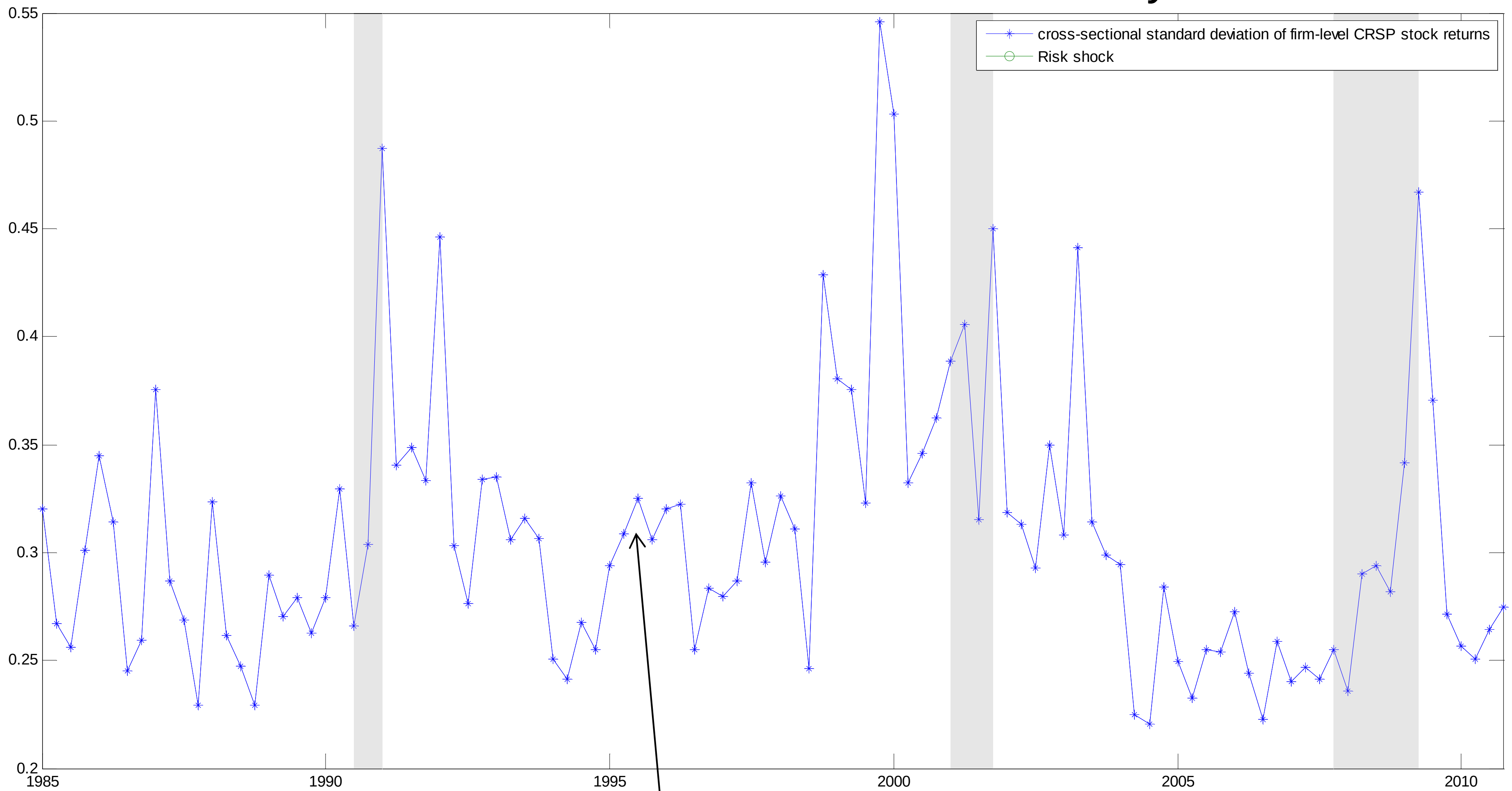
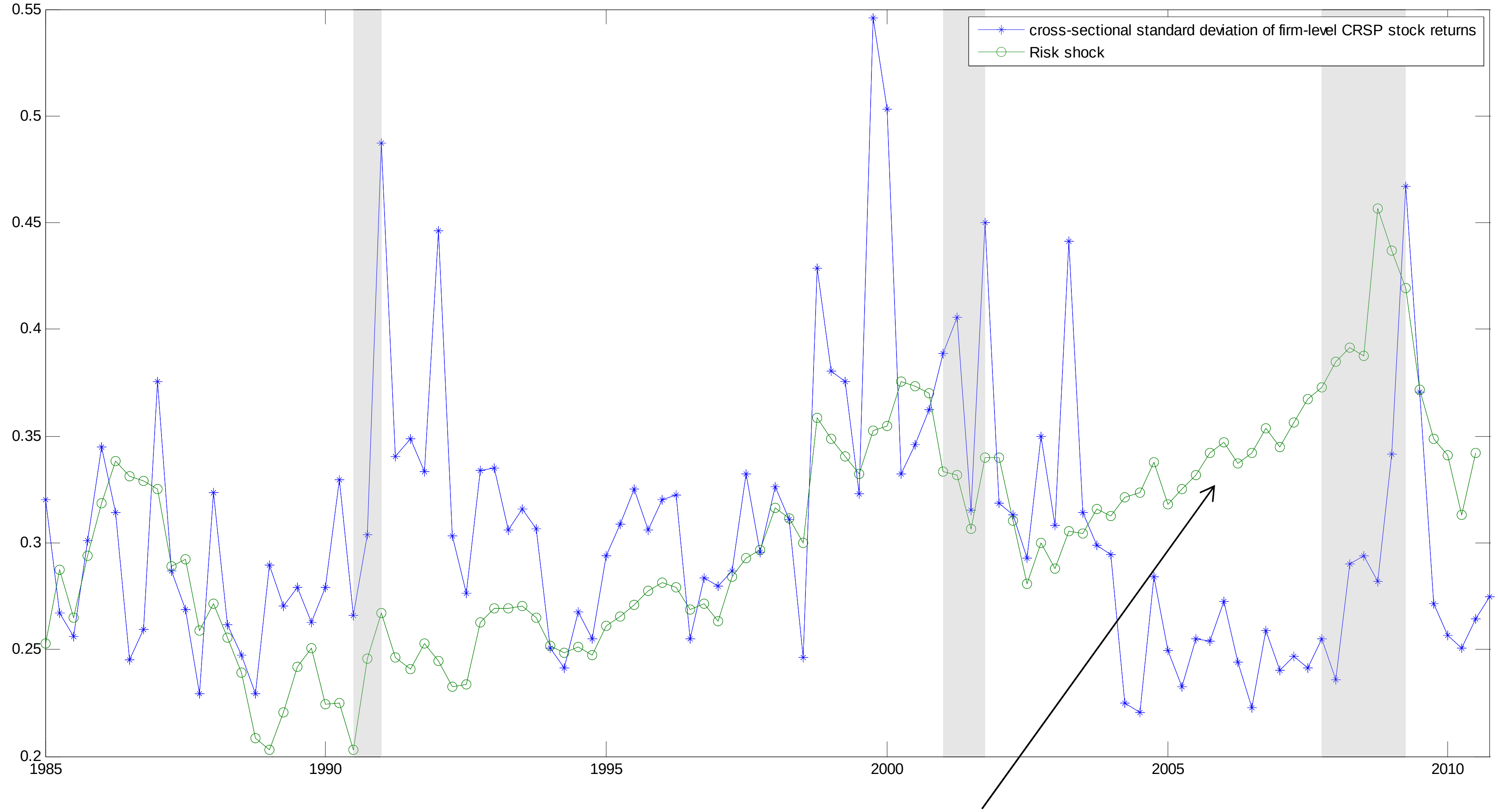
CRSP-based Measure of Uncertainty and Risk



Cross-sectional standard deviation of CRSP stock returns, as in Bloom (2009)

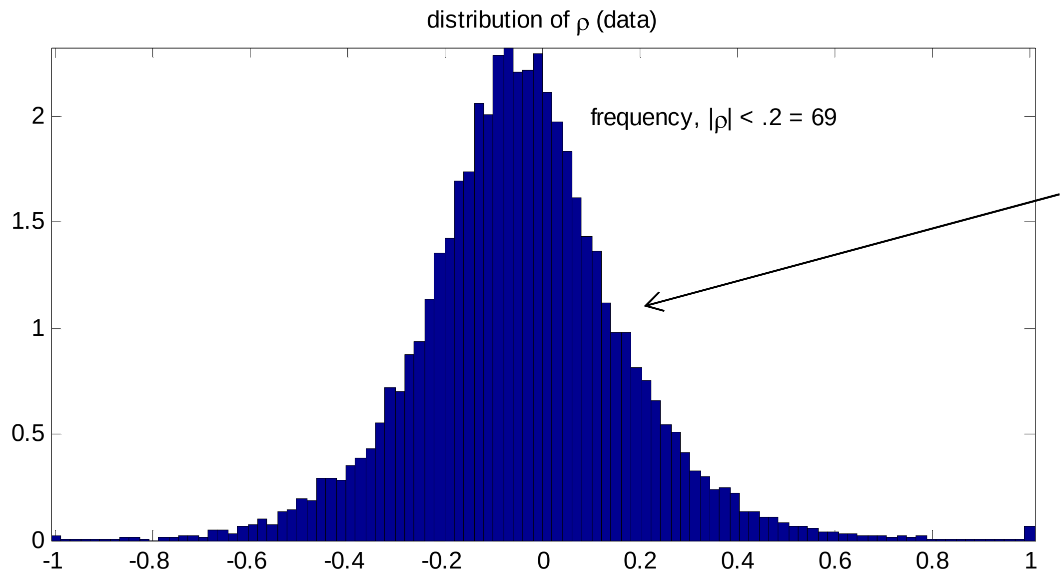
CRSP-based Measure of Uncertainty and Risk



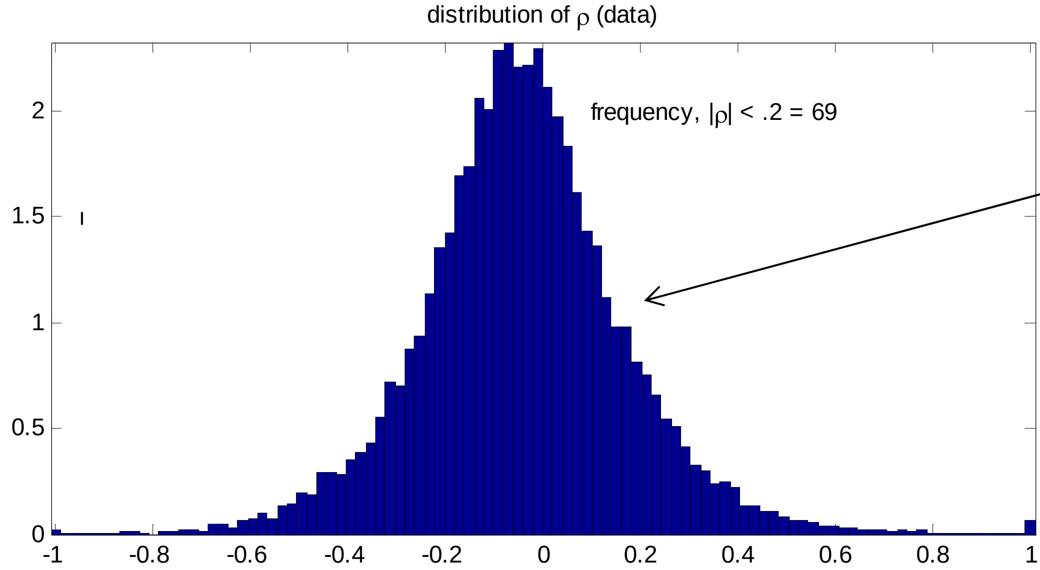
Smoothed estimate of the risk shock

CRSP Data

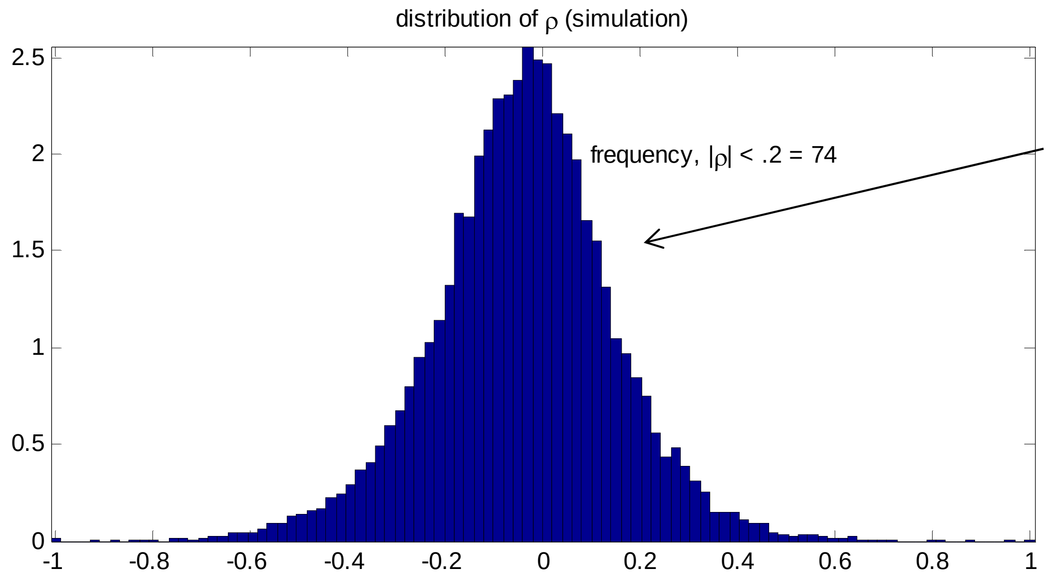
- What do they say about the assumed temporal independence of idiosyncratic shocks?
  - Data consistent with very small autocorrelation of shocks.



Top panel: distribution of first order autocorrelation of idiosyncratic shocks for 17,757 firms in the data set.



Top panel: distribution of first order autocorrelation of idiosyncratic shocks for 17,757 firms in the data set.



Bottom panel: what the distribution would be if in fact the autocorrelation is zero in each firm.

Conclusion

- Incorporating financial frictions and financial data changes inference about the sources of business cycle shocks:
  - risk shock.

- Evaluated model by looking at implications for data not in the estimation sample:
  - Measure of loan delinquency rates.
  - Out-of-sample forecasts.
  - Firm-level stock return data in CRSP.