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 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

Firms

Labor market

C

Marginal efficiency of investment shock

K

I

Market for Physical Capital

household

L

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

- Firms
- Labor market
- Household
- Entrepreneurs

\[ K \to \omega K, \quad \omega \sim F(\cdot, \sigma_t) \]

Observed by entrepreneur, but supplier of funds must pay monitoring cost to see it.
Standard Model with BGG

- Firms
- Labor market
- Household
- Entrepreneurs

Risk shock: $K \rightarrow \omega K, \ \omega \sim F(\cdot, \sigma_t)$
Standard Model with BGG

Entrepreneurs sell their $\omega K$ to capital producers

$$K_{t+1} = (1 - \delta)K_t + G(\zeta_{t,t}, I_t, I_{t-1})$$
Entrepreneurial net worth now established…. 

\[ \text{value of capital} + \text{earnings from capital} - \text{repayment of bank loans} \]
Standard Model with BGG

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

Entrepreneur receives standard debt contract.
Economic Impact of Risk Shock

lognormal distribution:
20 percent jump in standard deviation

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
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:

\[ \hat{\sigma}_t = \rho_1 \hat{\sigma}_{t-1} + u_t \]

• We assume that agents receive early information about movements in the innovation (‘news’).
Risk Shock and News

• Assume

\[ \hat{\sigma}_t = \rho_1 \hat{\sigma}_{t-1} + u_t \]

\[ \hat{\sigma}_t \text{ iid, univariate innovation to } \hat{\sigma}_t \]

• Agents have advance information about pieces of \( u_t \)

\[ u_t = \xi^0_t + \xi^1_{t-1} + \ldots + \xi^8_{t-8} \]

\[ \xi^i_{t-i} \text{ iid, } E(\xi^i_{t-i})^2 = \sigma_i^2 \]

\[ \xi^i_{t-i} \text{ piece of } u_t \text{ observed at time } t - i \]
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.
12 Shocks

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

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

- 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?
Role of the Risk Shock in Macro and Financial Variables

A. GDP growth (y-o-y %)

B. Equity (log-level)

C. Premium

D. Credit growth (y-o-y %)

E. Slope ($R_{t}^{\text{Long}} - R_{t}^{\text{shat}}$)

Notes: The grey solid line represents the (two-sided) fitted data. The dotted black line is the model simulations.
<table>
<thead>
<tr>
<th>variable</th>
<th>Risk, $\sigma_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>62</td>
</tr>
<tr>
<td>Investment</td>
<td>73</td>
</tr>
<tr>
<td>Consumption</td>
<td>16</td>
</tr>
<tr>
<td>Credit</td>
<td>64</td>
</tr>
<tr>
<td>Premium ($Z - R$)</td>
<td>95</td>
</tr>
<tr>
<td>Equity</td>
<td>69</td>
</tr>
<tr>
<td>$R^{10\text{ year}} - R^{1\text{ quarter}}$</td>
<td>56</td>
</tr>
</tbody>
</table>

Note: ‘business cycle frequencies means’ Hodrick-Prescott filtered data.
Why Risk Shock is so Important

- A. Our econometric estimator ‘thinks’ risk spread ~ 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.
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.
Figure 3: Dynamic Responses to Unanticipated and Anticipated Components of Risk Shock

Surprising, from RBC perspective

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

<table>
<thead>
<tr>
<th>shock</th>
<th>Risk $\sigma_t$</th>
<th>Equity $\gamma_t$</th>
<th>M.E.I. $\zeta_{t,t}$</th>
<th>Technol. $\varepsilon_t, \mu_{z,t}$</th>
<th>Markup $\lambda_{f,t}$</th>
<th>M.P. $\epsilon_t$</th>
<th>Demand $\zeta_{c,t}$</th>
<th>Exog. Spend.</th>
<th>Term</th>
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<td>2</td>
<td>4</td>
<td>3</td>
<td>0</td>
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<td>CEE</td>
<td>[–]</td>
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<td>[39]</td>
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Baseline model mostly ‘steals’ explanatory power from m.e.i., but also from other shocks:

Variance Decomposition of GDP at Business Cycle Frequency (in percent)

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Why does Risk Crowd out Marginal Efficiency of Investment?

Demand shifters: risk shock, \( \sigma_t \);

Supply shifter: marginal efficiency of investment, \( \zeta_{i,t} \);

Price of capital

Quantity of capital
• 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.
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 is countercyclical
Cross-sectional standard deviation, quarterly rate of return on non-financial firm equity, CRSP data

- **data**
- **model prediction for data**
- **HP filtered per capita real GDP**

Graph shows fluctuations over time from 1985 to 2010.
Challenge for Intertemporal Shocks

• CKM argue that risk shocks (actually, any intertemporal shock) cannot be important in business cycles.

• Idea: a shock that hurts the intertemporal margin induces substitution away from investment to other margins, such as consumption and leisure.

• CKM argument has some appeal in RBC model.
  – Although, argument fails when marginal utility of consumption increasing in labor.

• Not valid in New Keynesian models.
Closer Look at RBC Mechanism

• In RBC model, jump in risk discourages investment.

• Reduction in investment demand would, unless replaced by other demand, lead to wasteful underutilization of resources.

• RBC model avoids this through drop in current price of goods relative to future price of goods, i.e., real interest rate.

• Real interest rate decline induces surge in demand, partially offsetting drop in investment.

• This mechanism does not necessarily work in NK model because real rate not fully market determined there.

\[
\frac{1 + R_t}{1 + \pi_{t+1}} \leftarrow \frac{1}{1 + \pi_{t+1}}
\]

Controlled by central bank

Sluggish due to wage/price frictions, anticipated behavior of future monetary policy.
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 inflation targeting would be an improvement.
Policy

• The discussion of the CKM critique included a policy experiment….

• How should the monetary authority respond to a jump in interest rate spreads?
  – Depends on why the spread jumped.
  – If the jump is because of an increase in risk (uncertainty), then cut policy rate more than simple Taylor rule would dictate.
Conclusion

• Incorporating financial frictions and financial data changes 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?