

Discussion of "Risk Shocks" by Larry Christiano

Conference Celebrating Tom Sargent & Chris Sims

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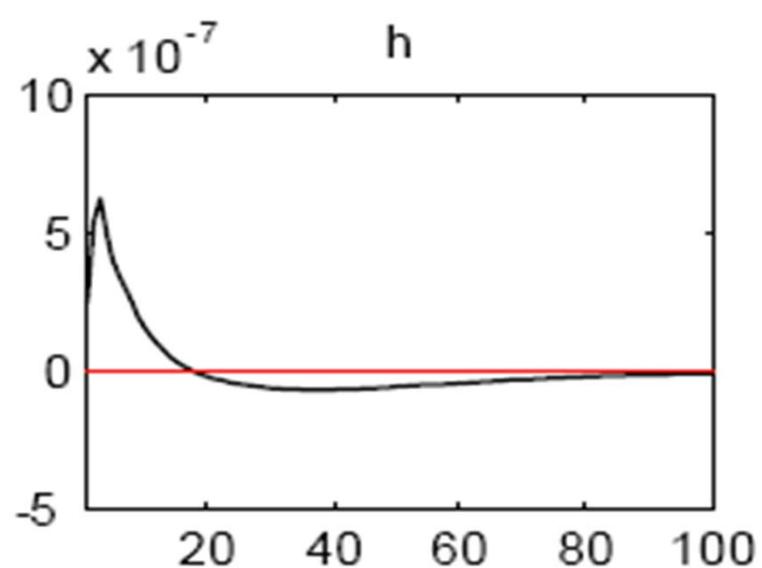
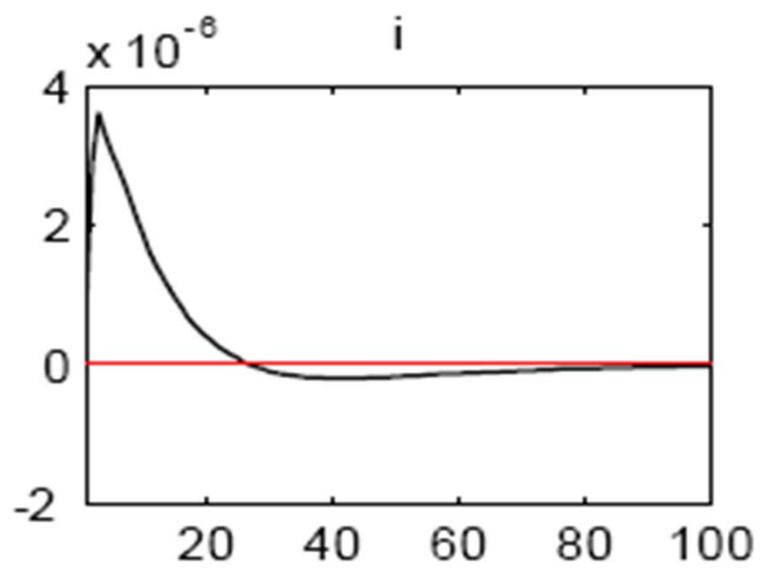
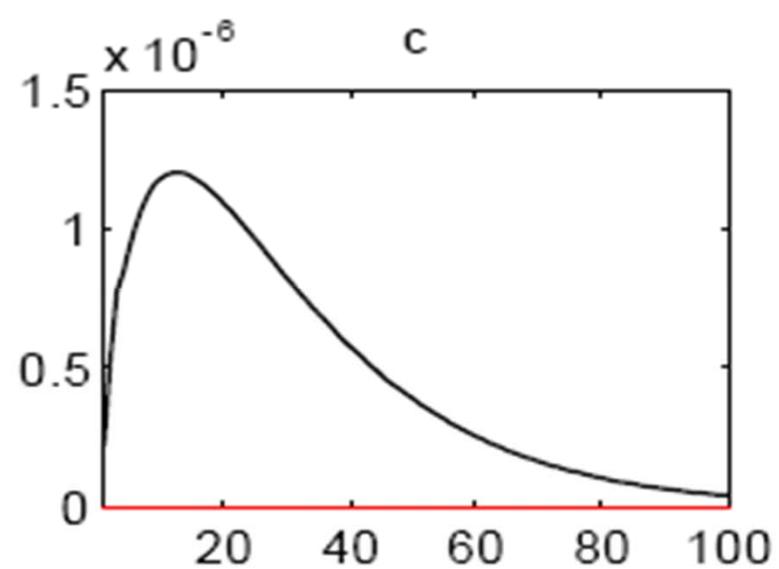
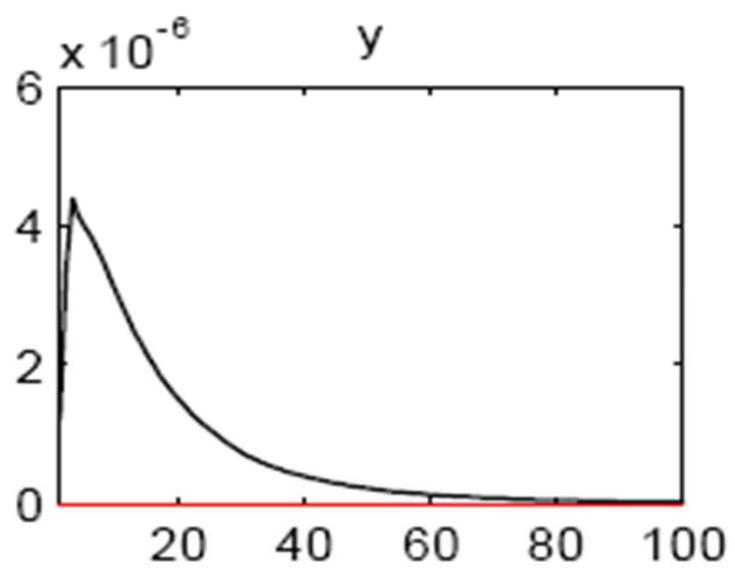
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Firm-Level Shifts in Variance of Capital

- 3 episodes: 1990-91, 2000-01, 2008-present
- Fluctuations largely due to pure increase in shock variance
- Source: how capital markets manage this volatility
- Significant amount of risk is predictable
- Model is accurate forecasting tool - competitive with BVAR for some series

Risk and Economic Activity

- What is the source of risk? **Society chooses risk**
 - CMR: *Primitive*
- How do we measure risk? **Depends on environment**
 - CMR: *Latent stochastic process*
- Can we forecast future risk at business cycle frequencies? **Unclear**
 - CMR: *Yes - society receives signals up to 2 years in advance*
- What are consequences of risk? **Risk taking essential for growth**
 - CMR: Higher risk depresses economy through capital market imperfection
- How does society manage risk? **Tremendous growth in risk-sharing technologies**
 - *Debt contracts - omits other risk-sharing arrangements*



- Building blocks:
 - CEE (predetermined prices and wages,)
 - BGG/Carlstrom Fuerst (costly state verification)
- Capital market imperfection
 - "middleman" - uses assets and loan to buy physical capital
 - Before capital used in production, shock to middleman's capital:
 - $K \rightarrow \omega K, \omega \geq 0, E(\omega) = 1, \text{var}(\ln(\omega_t)) \equiv \sigma_t^2$ - "Risk Shocks" that destroy or create capital
- ω observed by middleman - lender pays monitoring cost to observe

Impact of Higher Variance

- Cutoff value of $\omega = \bar{\omega}$ such that middleman cannot repay date t loan at date t+1: B_{t+1}

$$R_{t+1}^k Q_{\bar{K},t} \bar{\omega}_{t+1} \bar{K}_{t+1}^N = B_{t+1}^N Z_{t+1}$$

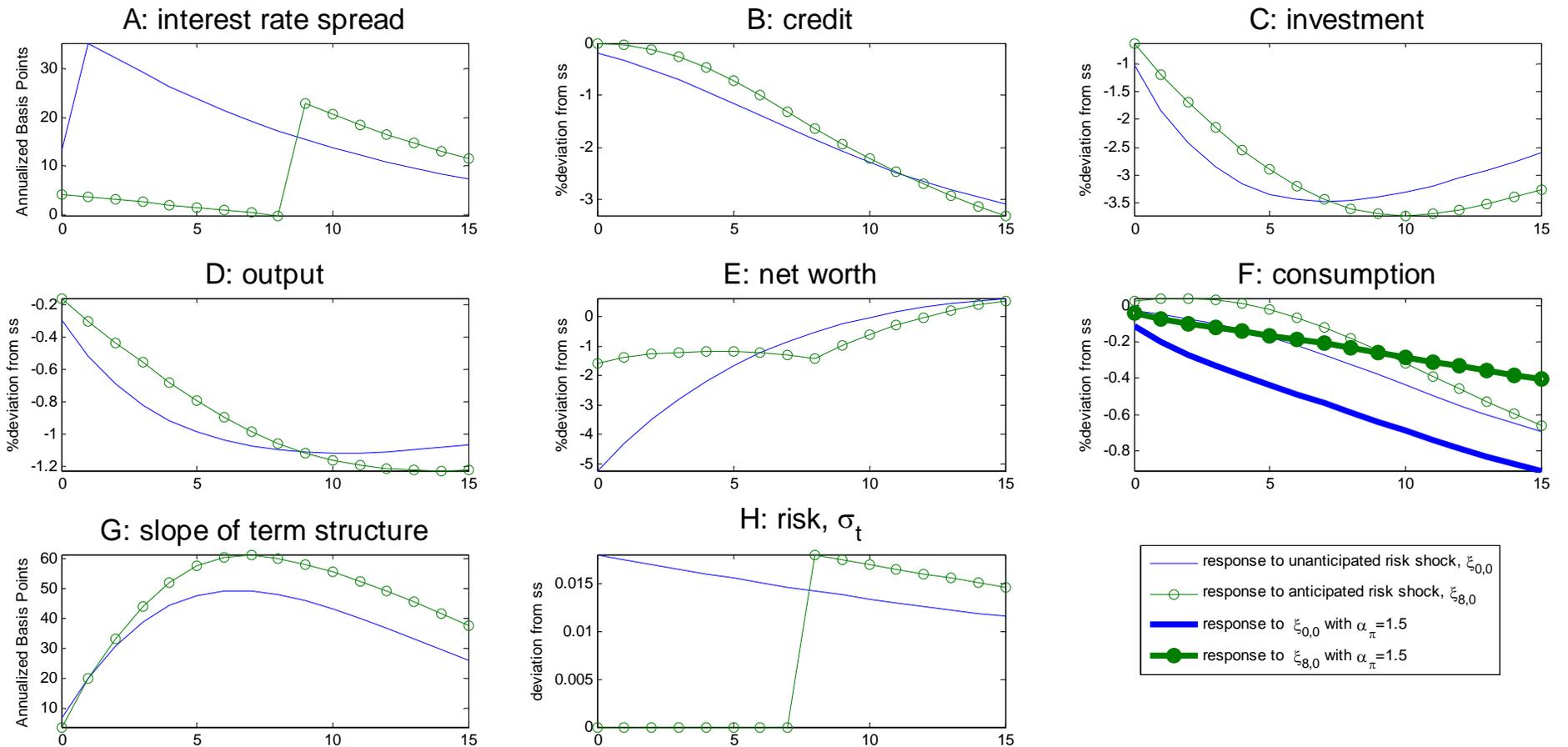
- If σ_t^2 rises, $\bar{\omega}$ falls as more firms shifted into left tail and because right tail doesn't enter into contract
- Depresses economy

- Both episodes feature enormous equity declines
- Not much productivity change (conventionally measured), so....
- Increase in σ_t^2 generates equity decline, lower investment, and lower output

Anticipated Component of Stochastic Variance

- Can we forecast volatility this far in future?
- Empirical analogue - use option prices & implied volatility to forecast future volatility
- Alternative interpretation - anticipated component may reflect misspecified stochastic process
 - Stochastic Volatility Model (smooth autoregression)
 - Suppose true process has large discrete changes (Markov Switching)
 - Likelihood penalizes large discrete changes
 - Likelihood may load on anticipated component to smooth out discreteness

Figure 6: Dynamic Responses to Unanticipated and Anticipated Components of Risk Shock



Borrowing Constraints May Be Less Important Than in Model

- Cash and equivalents in business sector almost as large as investment
- Stock market fluctuations may not be best measure of net worth changes in model
- Allowing middlemen to hedge will dampen impact of shocks

Business Cash Equal to Investment

- Gross Private Domestic Investment \approx \$2 Trillion
- Business sector cash & equivalents less commercial paper liabilities \approx 1.8 Trillion

Stock Fluctuations as Measure of Net Worth

- Stock values change enormously - big run-up of 1990s and 50% declines in 2000-01 and 2008-09 episodes
- Model doesn't have intangible investment, but stock fluctuations significantly reflect intangible investment and revaluation

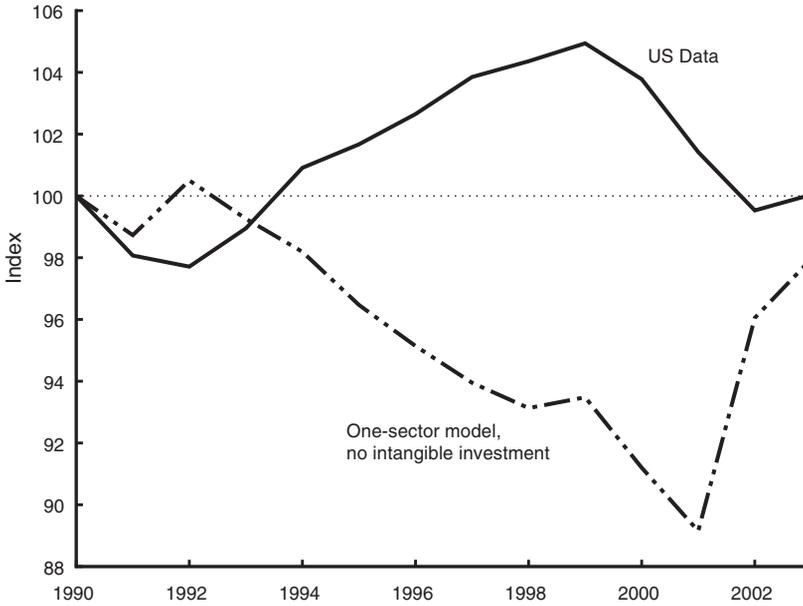


FIGURE 1. US AND BASIC MODEL PER CAPITA HOURS WORKED
(Annual, 1990 = 100, 1990–2003)

capital is derived by applying the perpetual inventory method to data on tangible investment. The tax rate changes we consider are variations in the labor tax rates τ_{ht} and consumption tax rates τ_{ct} , as constructed in Prescott (2004) with data from US national accounts. During the 1990s, there was little change in legislation affecting capital taxation, and therefore we simply fix the rates τ_{kt} , τ_{pt} , and τ_{dt} .

The utility flow function is

$$U(c, h) = \log(c) + \psi \log(1 - h),$$

which is standard in the business cycle literature. We choose the level of capital tax rates, the depreciation rate δ , and the utility parameter ψ so that the model's consumption share, investment share, factor inputs, and tax revenues are consistent with US levels in 1990. (See Appendices A and B for details.)

In Figure 1, we plot the model's predicted per capita hours of work along with the US actual per capita hours, indexed so that 1990 equals 100. The difference between the series is striking. Actual per capita hours rose 8 percent between 1992 and 1999, whereas the predicted series falls significantly during the same period.

In Figure 2, we plot the model's predicted output along with US real GDP. Both series are adjusted for population and a secular trend of 1.02^t . Although the boom in output was not quite as large as the boom in hours, the model predicts that the economy should have been depressed. This counterfactual prediction arises from the fact that the tax rates on labor rose during the 1990s and economy-wide TFP was below trend during most of the decade.

The basic model has neutral TFP change with respect to the business and non-business sectors. In fact, TFP change was non-neutral for these sectors. A question

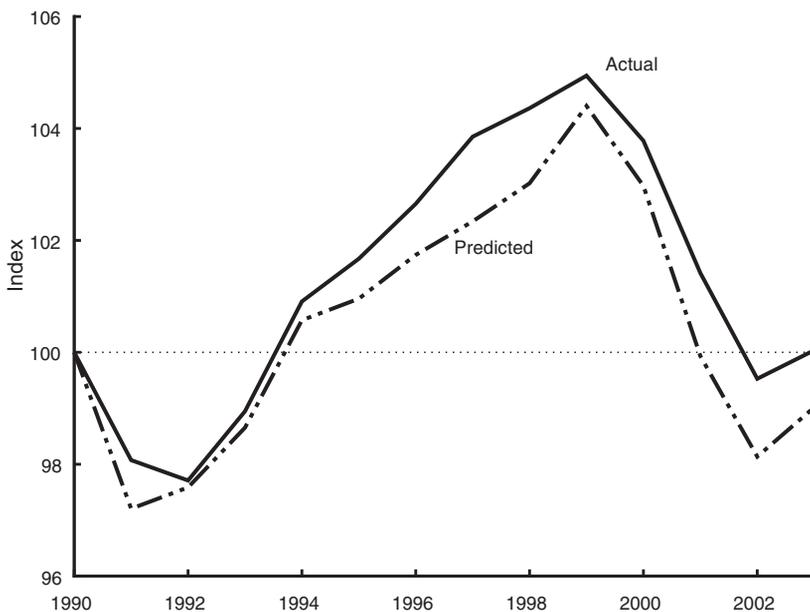


FIGURE 9. US AND EXTENDED MODEL PER CAPITA HOURS WORKED
(Annual, 1990 = 100, 1990–2003)

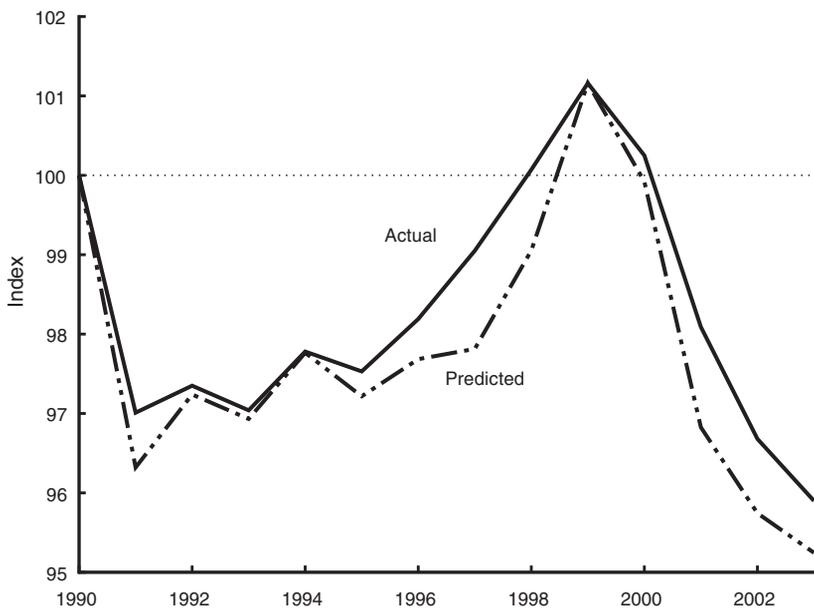


FIGURE 10. US AND EXTENDED MODEL PER CAPITA REAL GDP
(Annual, series divided by 1.02', 1990 = 100, 1990–2003)

Limited Risk-Sharing Arrangements

- Inability of middlemen to hedge
- Large fluctuations in model net worth across states (see risk graph)
- Society benefits by smoothing fluctuations - provide net worth (capital) when in scarce supply
- Because of linearity in middleman's problem, hedging would allocate capital across states so that return is constant
 - Business sheds cash during downturns

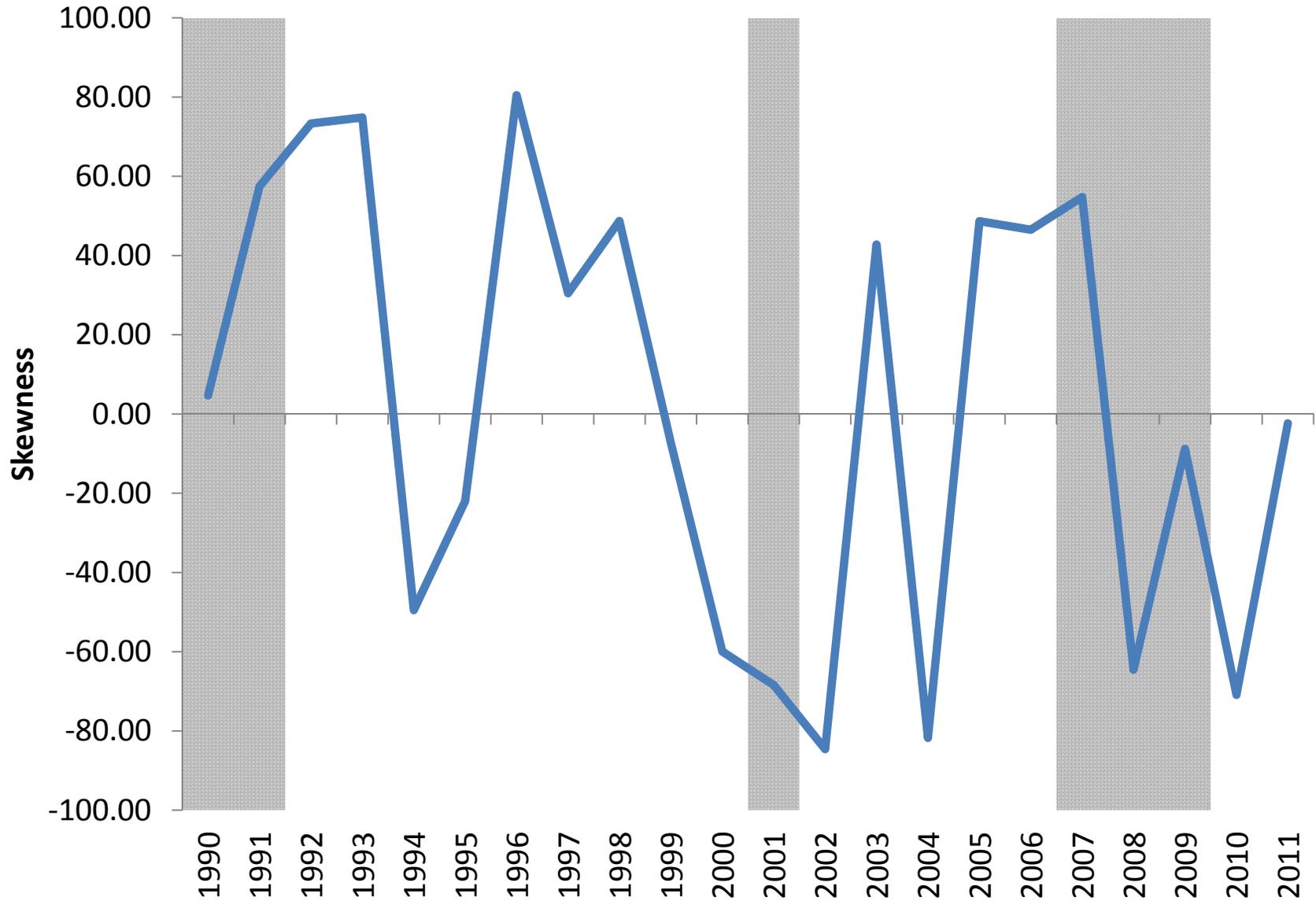
Society's Incentive to Engage the "Right Tail" of Distribution

- Financing constraint turns a positive (higher variance) into a depression because only left tail matters
- Venture capital, private equity,...- risk sharing involves other stakeholders to have equity positions
 - "Pivoting" - get funding, try out idea for a couple of months, if it doesn't take, try another idea with additional funding
- Riskiest enterprises - salaries low, compensation in form of stock options (1000 facebook workers to become multi-millionaires)

Shocks Dont Look Like Pure Dispersion Shocks

- Nick Bloom's approach - identify events associated with stock market volatility
 - Cuban missile crisis, Arab-Israeli war, 9/11...
- Larry's approach - infer latent process by fitting observables
- Larry's model implies right skewness during downturns

Annual EPS cross-sectional skewness (COMPUSTAT Non-financial, domestic corps.)



Investment Creators Aren't the Major Job Creators

- About 3/4 of market value is large firms (> 500 workers)
 - Apple - \$1.5 million in capital per worker
- But 55% of employment share in small business (≤ 500 workers)
- 27% of job creation at businesses with 10 workers or less
 - Restaurant - \$25,000 in capital per worker
 - Lots of job creation in business with very little physical capital

Similar Risk Increases but Different Downturns Across Countries

- International Comparison for 2008-09 Episode
- Stock market declines (risk) very similar, but declines different (Ohanian, *Journal of Economic Perspectives*, 2010)

Stock Market Indexes (deflated by CPI indexes)

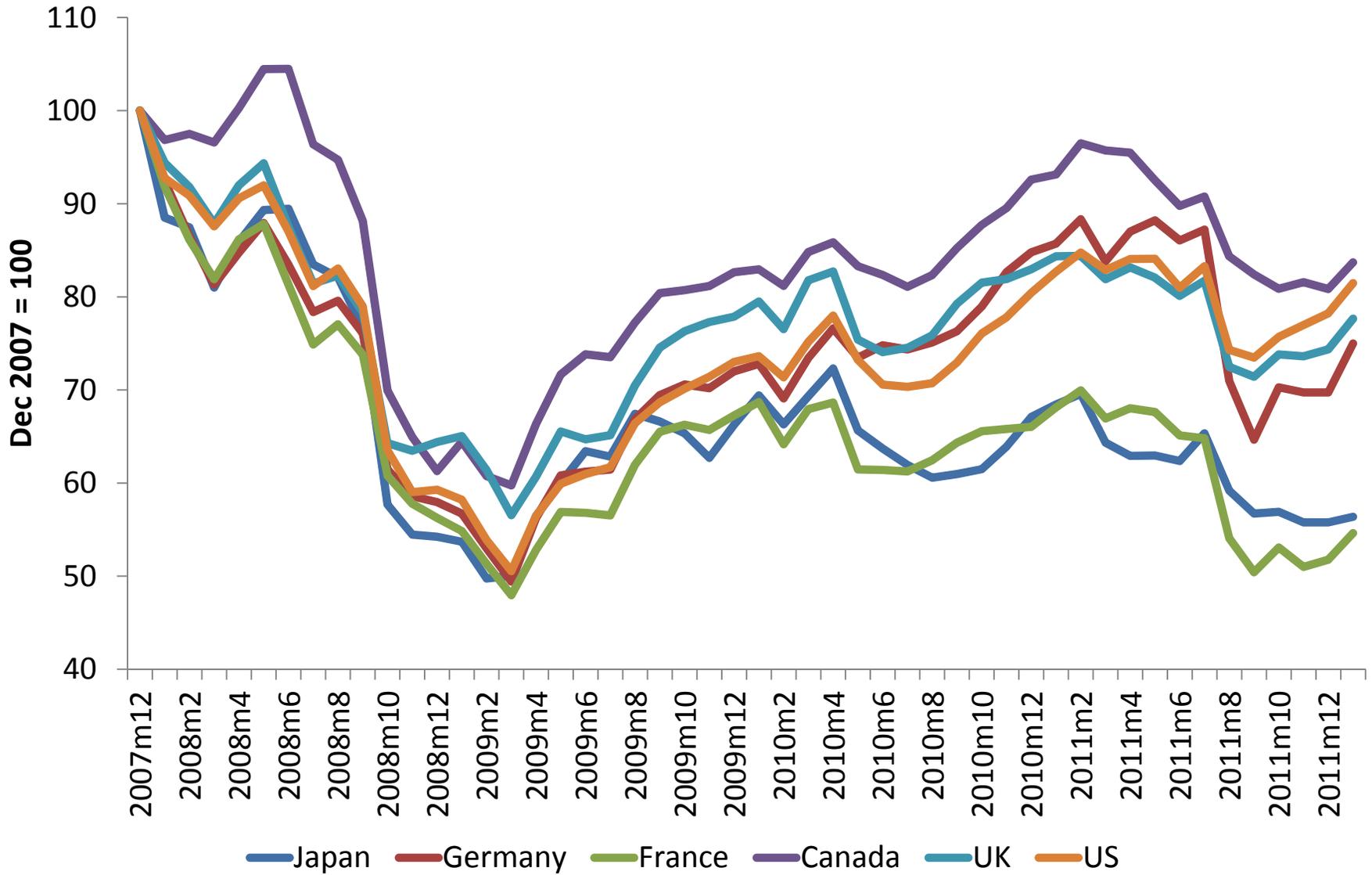


TABLE 1: PERCENT CHANGES IN PER CAPITA VARIABLES
FOR EACH NBER PEAK-TO-TROUGH EPISODE

Panel A: US, Postwar Recessions vs. 2007-2009 Recession

	Output	Consumption	Investment	Employment	Hours
Average postwar recessions	-4.4	-2.1	-17.8	-3.8	-3.2
2007-09 recession (2007:4 to 2009:3)	-7.2	-5.4	-33.5	-6.7	-8.7

Panel B: 2007-2009 Recession, US vs. Other High Income Countries

	Output	Consumption	Investment	Employment	Hours
US	-7.2	-5.4	-33.5	-6.7	-8.7
Canada	-8.6	-4.6	-14.1	-3.3	
France	-6.6	-3.4	-12.6	-1.1	
Germany	-7.2	-2.9	-10.2	0.1	
Italy	-9.8	-6.6	-19.6	-3.0	
Japan	-8.9	-3.6	-19.0	-1.6	
United Kingdom	-9.8	-7.7	-22.9	-2.9	
Average other high income countries	-8.5	-4.8	-16.4	-2.0	

Conclusions

- Inspiring paper
- Looking forward to seeing more