Disaster Risk and Business Cycles
by Francois Gourio

Discussed by Urban Jermann
Contribution

- Introduces *Time-varying Disaster Risk* into *Real Business Cycle* model
- Analytical results
- Quantitative findings:
  - Calibrated model matches key asset pricing and business cycle moments:
    - Unconditional moments for stock market and risk-free rate
    - Predictability regressions
    - Std($\Delta Y, \Delta I, \Delta C, \Delta N$) and Corr($\Delta Y, [\Delta I, \Delta C, \Delta N]$)
  - Disaster probability shocks measured to match actual P/D ratios produce reasonable business cycles

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Model

\[ W(K, z, p) = \]
\[
\max_{C, I, N} \left \{ \left( C^\upsilon (1 - N)^{1 - \upsilon} \right)^{1 - \gamma} + \beta \left( E_{p', \varepsilon', x'} W(K', z', p') \right)^{\frac{1 - \theta}{1 - \gamma}} \right \} \]

s.t.:

\[ C + I = z^{1 - \alpha} K^\alpha N^{1 - \alpha} \]

\[ K' = ((1 - \delta) K + \phi \left( \frac{I}{K} \right) K) (1 - x' b_k) \]

\[ \log z' = \log z + \mu + \sigma \varepsilon' + x' \log (1 - b_{tp}) \]
Analytical results

1. With $b_k = b_{tfp}$, a disaster leads to equal declines in $K$, $Y$, $C$ and $I$, with $N$ unchanged. (Also in Gabaix)

2. With $b_k = b_{tfp}$ economy with disasters is the same as one without disasters with different and time–varying discount factor

$$\beta^* = \beta \left(1 - p + p (1 - b_{tfp})^\nu(1-\theta) \right)^{\frac{1-\gamma}{1-\theta}}$$

(as long as no disaster is realized)
Quantitative results 1

\[
\begin{array}{cccc}
E(R_{e,lev} - R_b) & E(R_b) & \sigma(R_{e,lev}) & \sigma(R_b) \\
\hline
\text{Data} & 1.70 & 0.21 & 8.14 & 0.81 \\
\text{No disaster} & 0.03 & 0.71 & 1.59 & 0.04 \\
\text{Benchmark} & 1.51 & 0.42 & 7.14 & 0.85 \\
\end{array}
\]

\[
\begin{array}{cccccccc}
\frac{\sigma(\Delta \log C)}{\sigma(\Delta \log Y)} & \frac{\sigma(\Delta \log I)}{\sigma(\Delta \log Y)} & \frac{\sigma(\Delta \log N)}{\sigma(\Delta \log Y)} & \sigma(\Delta \log Y) & \rho_{C,Y} & \rho_{I,Y} & \rho_{N,Y} & \rho_{I,C} \\
\hline
\text{Data} & 0.57 & 2.68 & 0.92 & 0.98 & 0.45 & 0.68 & 0.71 & 0.49 \\
\text{No disaster} & 0.66 & 1.86 & 0.24 & 0.78 & 1.00 & 1.00 & 0.99 & 0.99 \\
\text{Benchmark} & 0.73 & 3.03 & 0.54 & 0.83 & 0.66 & 0.85 & 0.72 & 0.21 \\
\end{array}
\]
Quantitative results 2

1. $D/P$ forecasts excess returns and dividend growth at 4 quarters with similar $R^2$s as in the data

2. $\text{Cov}(\tilde{y}_t, R^e_{t+k} - R^f_{t+k})$ matches roughly the data

3. VAR evidence of relationship between VIX and GDP matches roughly the data

4. $\text{Cov}(i_{t+k}, \log(P_t/D_t))$ matches roughly the data

5. IES estimated with model data is 0.38 (IES is 2 in the model)
output


data
RBC model


data
RBC + \( p \) model

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Definition of dividends in the model

- "Benchmark"
  \[ D_t = Y_t^\lambda, \quad \text{with } \lambda = 2 \]

- Unlevered payout to capital stock
  \[ D_{t}^{\text{unlev}} = Y_t - w_t N_t - I_t = \alpha Y_t - I_t, \quad \text{with } \alpha = .34 \]

<table>
<thead>
<tr>
<th>Data</th>
<th>( E(R_{e,lev} - R_b) )</th>
<th>( \sigma(R_{e,lev}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benchmark, ( D_t = Y_t^\lambda )</td>
<td>1.51</td>
<td>7.14</td>
</tr>
<tr>
<td>( D_{t}^{\text{unlev}} = \alpha Y_t - I_t )</td>
<td>0.46</td>
<td>0.4</td>
</tr>
</tbody>
</table>

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Possible solutions

\[ D_{t}^{unlev} = Y_t - w_t N_t - I_t = \alpha Y_t - I_t \]

Capital adjustment cost
Explicit financial leverage
Operational leverage (Gourio (2007), Danthine and Donaldson (2002))
2008/2009 Recession

Investment

Output

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Responses to a shock in the disaster probability

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\[ Y \equiv z^{1-\alpha} K^\alpha N^{1-\alpha} = C + I \]

\[ - \frac{u_N(C, N)}{u_C(C, N)} = w_t = F_N(z, K, N) \]

Labor Supply  \hspace{2cm}  \text{Labor Demand}
Labor efficiency wedge

\[- \frac{u_N(C, N)}{u_C(C, N)} = F_N(z, K, N) \cdot X\]

\[X = (1 - \tau)\]

\[- \frac{u_N(C, N)}{u_C(C, N)} = (1 - \alpha) \frac{Y}{N} \cdot X\]
Potential drivers of labor wedge

- Tax increase
- Countercyclical markups
- Labor search frictions
- Financial frictions
Conclusion

- Very nice paper!
- Work to be done
  - Production models with realistic dividends
  - Richer business cycles