The Federal Reserve and the Cross Section of Stock Returns

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Question

How do monetary policy and price rigidities affect the equity premium and the cross section of stock returns?
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Motivation

- Real Business Cycle models with nominal rigidities successfully capture the dynamics of output, inflation and monetary policy.
- Do stocks hedge against inflation?
- What are the economic factors driving the cross section of returns?
Price Rigidities

Infrequent adjustments to prices of goods and services.

- Evidence (Bils and Klenow, 2004).
  Mean frequency of price changes: 4 - 6 months.
  Standard deviation of the frequency: 3 months.

<table>
<thead>
<tr>
<th>Good</th>
<th>Annual Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>3.3</td>
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<tr>
<td>Paint and supplies</td>
<td>13.3</td>
</tr>
<tr>
<td>Truck rental</td>
<td>25.7</td>
</tr>
<tr>
<td>Fuel oil</td>
<td>52.5</td>
</tr>
</tbody>
</table>

- Potential sources (Blinder, Canetti, Lebow and Rudd, 1998).
  - Nature of costs
  - Demand
  - Contracts
  - Market interactions
  - Imperfect information
Findings

Theory
- Price rigidities increase the equity premium.
- Industries with low price rigidities earn higher expected returns than industries with high price rigidities.
- More responsive monetary policies reduce the effect of price rigidities on the equity premium and the cross section of returns.

Empirical
- Firms in industries with low price rigidities earn higher average returns than firms in industries with high price rigidities.
- The difference vanishes after 1980.
Empirical Evidence

Methodology:

- Assign a degree of price rigidity to the Fama - French industry portfolios based on Bils and Klenow, 2004.
- Form ten portfolios based on the degree of price rigidity.
- Form a zero-investment portfolio (rigidity portfolio) that longs firms with low rigidities and shorts firms with high rigidities.
- Regress the return of the rigidity portfolio on Carhart four factors.
<table>
<thead>
<tr>
<th>Industry Number</th>
<th>Industry</th>
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<th>Avg. Freq.</th>
<th>STD of Freq.</th>
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<td>Beer and Liquor</td>
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<td>Tobacco Product</td>
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<tr>
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<td>11.63</td>
<td>10.77</td>
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<td>45</td>
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<table>
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<th>Portfolio</th>
<th>Value-weighted</th>
<th>Equal-weighted</th>
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<tr>
<td></td>
<td>( \alpha )</td>
<td>( RMRF )</td>
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<tr>
<td>1(H)</td>
<td>0.33 1.07 0.24 0.06 -0.03</td>
<td>0.44 0.94 1.17 0.37 -0.08</td>
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<tr>
<td>10(L)</td>
<td>1.10 0.97 -0.34 -0.02 0.16</td>
<td>1.61 1.09 0.62 0.03 0.32</td>
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<tr>
<td>L-H</td>
<td>0.77 0.97 -0.58 -0.08 0.16</td>
<td>2.32 1.4 5.47 0.72 2.12</td>
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<tr>
<td></td>
<td>L-H</td>
<td>1.17</td>
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</table>

- \( \alpha \): Alpha
- \( RMRF \): Risk Premium
- \( SMB \): Size
- \( HML \): Value
- \( Momentum \): Momentum
## Performance-Attribution Regressions for Portfolios with Different Price Rigidities (1980-2006)

### Value-weighted

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>α</th>
<th>RMRF</th>
<th>SMB</th>
<th>HML</th>
<th>Momentum</th>
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<tr>
<td>1(H)</td>
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<td>10(L)</td>
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<tr>
<td>L - H</td>
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<td>-0.18</td>
<td>-0.48</td>
<td>0.57</td>
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<td>0.12</td>
<td>-2.24</td>
<td>-3.65</td>
<td>3.81</td>
<td>0.62</td>
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</table>

### Equal-weighted

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>α</th>
<th>RMRF</th>
<th>SMB</th>
<th>HML</th>
<th>Momentum</th>
</tr>
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<tbody>
<tr>
<td>1(H)</td>
<td>0.42</td>
<td>0.92</td>
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<td>10(L)</td>
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<td>0.14</td>
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<td>3.24</td>
<td>3.36</td>
<td>0.99</td>
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<tr>
<td>L-H</td>
<td>0.02</td>
<td>-0.07</td>
<td>-0.43</td>
<td>0.26</td>
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<td>0.07</td>
<td>-0.7</td>
<td>-2.77</td>
<td>1.47</td>
<td>1.52</td>
</tr>
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</table>
Model - Assumptions

- CRRA preferences.
- Monopolistic competition and price rigidities in production.
- Two industries with different price rigidities, $I = \{H, L\}$.
- Monetary policy: nominal interest rate rule.
- Uncertainty: Policy shocks.
- No productivity shocks, no growth $\Rightarrow$ flexible-price production is constant.
Model - Households

Preferences:

\[ \mathbb{E} \left[ \sum_{t=0}^{\infty} \beta^t \left( \frac{C_t^{1-\gamma}}{1-\gamma} - \frac{N_t^{1+\omega}}{1+\omega} \right) \right] \]

where

\[ C_t = \left[ \varphi^{1/\theta} C_{H,t}^{\theta^{-1}} + (1-\varphi)^{1/\theta} C_{L,t}^{\theta^{-1}} \right]^{\theta^{-1}}. \]

Pricing kernel:

\[ M_{t,t+1} = \beta \left( \frac{C_{t+1}}{C_t} \right)^{-\gamma} = \beta \left( \frac{X_{t+1}}{X_t} \right)^{-\gamma}. \]

\( X_t \): output gap (deviations from “flexible-price” output).
\( \theta \): elasticity of substitution across goods.
Model - Production

Price is set equal to the sum of expected markup-adjusted marginal costs.

\[
\max_{P_{l,t(i)}} \mathbb{E}_t \left[ \sum_{T=t}^{\infty} \alpha_I T^{-t} M^S_{t,T} \left( P_{l,t(i)} Y_{l,T|t(i)} - w_{l,T|t(i)} N_{l,T|t(i)} \right) \right].
\]

FOC:

\[
\pi_{l,t} = \kappa_I x_t + \frac{\kappa_I \varphi - I}{\zeta} p_{R,t} + \beta \mathbb{E}_t [\pi_{l,t+1}].
\]

\(\alpha_I\): probability of not adjusting prices in industry \(l\).
\(\pi_{l,t}\): inflation in industry \(l\).
\(p_{R,t}\): relative price between the two goods.
Policy rule:

$$i_t = \bar{i} + \nu_\pi \pi_t + \nu_x x_t + u_t.$$ 

Policy shocks:

$$u_t = \phi_u u_{t-1} + \sigma_u \epsilon_{u,t+1}.$$ 

$i_t$: nominal interest rate.
Model - Equilibrium

System:

\begin{align*}
e^{-i_t} &= \mathbb{E}_t [\exp(\log \beta - \gamma \Delta x_{t+1} - \pi_{t+1})] & \text{ (household),} \\
\pi_t &= \bar{\kappa} x_t + b_\varphi p_{R,t} + \beta \mathbb{E}_t [\pi_{t+1}] & \text{ (production),} \\
b_R p_{R,t} &= \bar{\kappa} x_t + p_{R,t-1} + \beta \mathbb{E}_t [p_{R,t+1}] & \text{ (production),} \\
i_t &= \bar{l} + \bar{\gamma}_\pi \pi_t + \bar{\gamma}_x x_t + u_t & \text{ (policy),} \\
u_t &= \phi_u u_{t-1} + \sigma_u \varepsilon_{u,t}. & \\
\end{align*}

Solution:

\begin{align*}
\pi_{l,t} &= \bar{\pi}_l + \pi_{l,p} p_{R,t-1} + \pi_{l,u} u_t. \\
x_{l,t} &= \bar{x}_l + x_{l,p} p_{R,t-1} + x_{l,u} u_t. \\
p_{R,t} &= \bar{\rho} + \rho_{p} p_{R,t-1} + \rho_{u} u_t. \\
\end{align*}
Model - Implication 1

Equilibrium with no price rigidities ($\alpha_H = \alpha_L = 0$).

- There is no equity premium in the absence of price rigidities.

\[ \mathbb{E}_t[r_{H,t+1}^S] = \mathbb{E}_t[r_{L,t+1}^S] = r_t = -\log \beta. \]

$r_t$ : risk-free rate.
Model - Implication 2

Equilibrium with homogeneous price rigidities ($\alpha_H = \alpha_L \neq 0$).

- The equity premium increases as the price rigidity increases ($\kappa \to 0$).
- The equity premium declines as the policy response to inflation increases ($\iota_\pi \uparrow$).
Model - Implication 2

Equilibrium with homogeneous price rigidities ($\alpha_H = \alpha_L \neq 0$).

- The equity premium increases as the price rigidity increases ($\kappa \rightarrow 0$).
- The equity premium declines as the policy response to inflation increases ($i_{\pi} \uparrow$).

Comparative statics:
Equilibrium with homogeneous price rigidities ($\alpha_H = \alpha_L \neq 0$).

- The equity premium increases as the price rigidity increases ($\kappa \to 0$).
- The equity premium declines as the policy response to inflation increases ($\iota_\pi \uparrow$).

Particular case ($\phi_u = 0$, $\iota_x = 0$).

- Price of risk:
  $$\lambda = \frac{\gamma}{\gamma + \kappa \iota_\pi} \sigma_u.$$
Model - Implication 3

Equilibrium with heterogeneous price rigidities \((\alpha_H > \alpha_L)\)

- Industries with low rigidities earn higher expected returns than industries with high rigidities.
- The difference in expected returns across industries decreases as the policy response to inflation increases.
Model - Implication 3

Excess stock returns:

\[ \mathbb{E}_t [r_{L,t+1}^S - r_{H,t+1}^S] = -\text{cov}_t (\log M_{t,t+1}, r_{L,t+1}^S - r_{H,t+1}^S) > 0 \]

\[ -\log M_{t,t+1} = -\log \beta + \gamma \Delta x_{t+1} \]
Model - Implication 3

Excess stock returns:

\[ \mathbb{E}_t[r_{L,t+1}^S - r_{H,t+1}^S] = -\text{cov}_t(\log M_{t,t+1}, r_{L,t+1}^S - r_{H,t+1}^S) > 0 \]

\[ -\log M_{t,t+1} = -\log \beta + \gamma \Delta x_{t+1} \]

Impulse Responses:
Model - Implication 3

Claim on profits ($S$) = Claim on Output ($C$) - Claim on labor income ($N$).

$$\mathbb{E}_t[r^S_{L,t+1} - r^S_{H,t+1}] > 0 \iff \mathbb{E}_t[r^C_{H,t+1} - r^C_{L,t+1}] < \mathbb{E}_t[r^N_{H,t+1} - r^N_{L,t+1}].$$
Model - Implication 3

Claim on profits \((S)\) = Claim on Output \(\text{(C)}\) - Claim on labor income \((N)\).

\[
\mathbb{E}_t[r_{L,t+1}^S - r_{H,t+1}^S] > 0 \iff \mathbb{E}_t[r_{H,t+1}^C - r_{L,t+1}^C] < \mathbb{E}_t[r_{H,t+1}^N - r_{L,t+1}^N].
\]

Impulse Responses:
Model - Implication 3

A more inflation-responsive policy reduces distortions in output and labor and the difference in distortions across industries.

⇒ There are lower differences in expected returns across industries.

Comparative statics:
Model - Relative Price

Expected returns conditional on the relative price

\[ p_{R,t} = p_{H,t} - p_{L,t}. \]
Conclusions

- Policy shocks affect real activity and profits in the same direction generating an equity premium.

- Investors demand an additional compensation for holding stocks of firms with low rigidities.
  - Profits of firms with high rigidities are less risky because they are “hedged” by distortions in labor income.
  - Markups of firms with low rigidities are more sensitive to policy shocks.

- The difference in returns across industries is lower for more inflation-responsive policies.
Future Work

- Analysis of markup shocks and capital.
- Relative prices as a pricing factor due to price rigidities.
- Quantitative implications (recursive preferences).
- Robustness test of the difference in returns.