Risk Preferences and the Macro Announcement Premium

Hengjie Ai[1] Ravi Bansal[2]

[1]Carlson School of Management
University of Minnesota

[2]Fuqua School of Business
Duke University & NBER

May 2017

Facts on the Macro-Announcement Premium

Equity premium on macro-announcements days

- Large fraction of equity premium realized on a small number of trading days with significant macro-announcements (Savor and Wilson (2013))

Facts on the Macro-Announcement Premium

Equity premium on macro-announcements days

- Large fraction of equity premium realized on a small number of trading days with significant macro-announcements (Savor and Wilson (2013))
- In the period of 1961-2014:

	# Evts	daily prem.	daily std.	cumul. prem.
Market	252	2.5 *bps*	98.2 *bps*	6.19%
Ann.	30	11.21 *bps*	113.8 *bps*	3.36%
No Ann.	222	1.27 *bps*	95.9 *bps*	2.82%

Facts on the Macro-Announcement Premium

High-frequency returns

- Large announcement premia even on an hourly basis

Facts on the Macro-Announcement Premium

High-frequency returns

- Large announcement premia even on an hourly basis
- Pre-FOMC announcement drift(Lucca-Moench (2015));

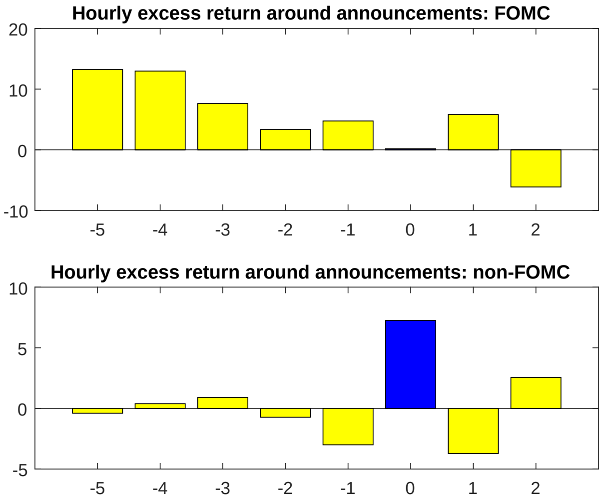
Facts on the Macro-Announcement Premium

High-frequency returns

- Large announcement premia even on an hourly basis
- Pre-FOMC announcement drift(Lucca-Moench (2015));
- No pre-announcement drift for other macro-announcements

Facts on the Macro-Announcement Premium

High-frequency returns



Summary of the Paper

Summary

A necessary and sufficient condition for the macro-announcement premium and the pre-announcement drift.

A Two-Period Model

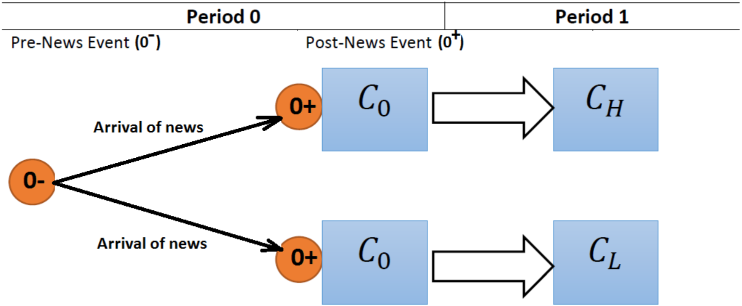


Figure 1: Consumption

Asset Markets

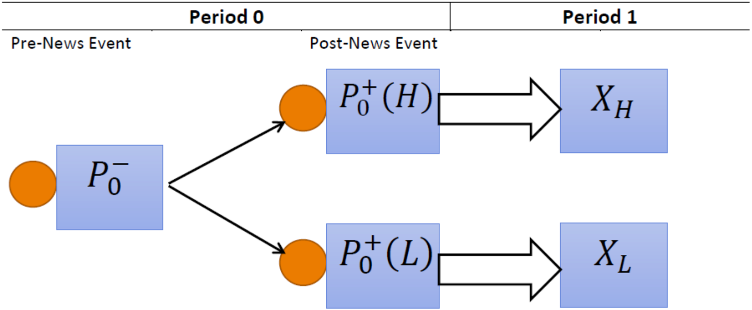


Figure 2: Asset Prices/Payoffs

- The announcement premium is positive if $\frac{E[P_0^+]}{P_0^-} > 1$

Expected Utility: No Announcement Premium

- Pre-announcement utility:

$$u\left(C_0\right)+\beta E\left[u\left(C_1\right)\right]$$

Expected Utility: No Announcement Premium

- Pre-announcement utility:

$$u\left(C_0\right) + \beta E\left[u\left(C_1\right)\right]$$

- Post-announcement utility:

$$u\left(C_0\right) + \beta u\left(C_H\right)$$
$$u\left(C_0\right) + \beta u\left(C_L\right)$$

Expected Utility: No Announcement Premium

- Pre-announcement prices:

$$P_0^- = E\left[\frac{\beta u'(C_1)}{u'(C_0)} X\right]$$

Expected Utility: No Announcement Premium

- Pre-announcement prices:

$$P_0^- = E\left[\frac{\beta u'(C_1)}{u'(C_0)} X\right]$$

- Post-announcement prices:

$$P_0^+(H) = \frac{\beta u'(C_H)}{u'(C_0)} X_H, \quad P_0^+(L) = \frac{\beta u'(C_L)}{u'(C_0)} X_L$$

Expected Utility: No Announcement Premium

- Pre-announcement prices:

$$P_0^- = E\left[\frac{\beta u'(C_1)}{u'(C_0)} X\right]$$

- Post-announcement prices:

$$P_0^+(H) = \frac{\beta u'(C_H)}{u'(C_0)} X_H, \quad P_0^+(L) = \frac{\beta u'(C_L)}{u'(C_0)} X_L$$

- Expected return at announcement:

$$P_0^- = E\left[P_0^+\right], \quad \textit{for all assets}$$

Expected Utility: No Announcement Premium

- Pre-announcement prices:

$$P_0^- = E\left[\frac{\beta u'(C_1)}{u'(C_0)} X\right]$$

- Post-announcement prices:

$$P_0^+(H) = \frac{\beta u'(C_H)}{u'(C_0)} X_H, \quad P_0^+(L) = \frac{\beta u'(C_L)}{u'(C_0)} X_L$$

- Expected return at announcement:

$$P_0^- = E\left[P_0^+\right], \quad for \quad all \quad assets$$

- Conclusion: No announcement premium if and only if expected utility

Maxmin Expected Utility (Gilboa-Schmeidler, Hansen-Sargent)

- Agents evaluate utility using the worst-case probability (robustness):

$$u(C_0) + \beta \min_m E[mu(C_1)],$$

where m is a density chosen subject to a relative entropy constraint:

$$E[m \ln m] \leq \eta$$

Maxmin Expected Utility (Gilboa-Schmeidler, Hansen-Sargent)

- Agents evaluate utility using the worst-case probability (robustness):

$$u(C_0) + \beta \min_m E[mu(C_1)],$$

where m is a density chosen subject to a relative entropy constraint:

$$E[m \ln m] \leq \eta$$

- We can solve for the probability for the worst-case senario:

$$m^* = \frac{e^{-\frac{1}{\theta}u(C_1)}}{E\left[e^{-\frac{1}{\theta}u(C_1)}\right]},$$

where $\theta > 0$ is the Lagrangian multiplier for the relative entropy constraint (which depends on η and u).

Maxmin Expected Utility: Premium due to Uncertainty Aversion

- Pre-announcement utility:

$$u(C_0) + \beta E[m^* u(C_1)]$$

Maxmin Expected Utility: Premium due to Uncertainty Aversion

- Pre-announcement utility:

$$u\left(C_0\right) + \beta E\left[m^* u\left(C_1\right)\right]$$

- m^* over-weighs low consumption states: $m^* = \frac{e^{-\frac{1}{\theta}u\left(C_1\right)}}{E\left[e^{-\frac{1}{\theta}u\left(C_1\right)}\right]}$.

Maxmin Expected Utility: Premium due to Uncertainty Aversion

- Pre-announcement utility:

$$u(C_0) + \beta E\left[m^* u(C_1)\right]$$

- m^* over-weighs low consumption states: $m^* = \frac{e^{-\frac{1}{\theta}u(C_1)}}{E\left[e^{-\frac{1}{\theta}u(C_1)}\right]}$.
- Post-announcement utility:

$$u(C_0) + \beta u(C_H)$$
$$u(C_0) + \beta u(C_L)$$

Maxmin Expected Utility: Premium due to Uncertainty Aversion

- Post-announcement prices (same as expected utility):

$$P_0^+(H) = \frac{\beta u'(C_H)}{u'(C_0)} X_H, \quad P_0^+(L) = \frac{\beta u'(C_L)}{u'(C_0)} X_L$$

Maxmin Expected Utility: Premium due to Uncertainty Aversion

- Post-announcement prices (same as expected utility):

$$P_0^+(H) = \frac{\beta u'(C_H)}{u'(C_0)} X_H, \quad P_0^+(L) = \frac{\beta u'(C_L)}{u'(C_0)} X_L$$

- Pre-announcement prices (discounting with m^* due to robustness (uncertainty aversion)):

$$P_0^- = E\left[m^* \frac{\beta u'(C_1)}{u'(C_0)} X\right],$$

Maxmin Expected Utility: Premium due to Uncertainty Aversion

- Post-announcement prices (same as expected utility):

$$P_0^+(H) = \frac{\beta u'(C_H)}{u'(C_0)} X_H, \quad P_0^+(L) = \frac{\beta u'(C_L)}{u'(C_0)} X_L$$

- Pre-announcement prices (discounting with m^* due to robustness (uncertainty aversion)):

$$P_0^- = E\left[m^* \frac{\beta u'(C_1)}{u'(C_0)} X\right],$$

- Announcement SDF (A-SDF) is probability distortion:

$$P_0^- = E\left[m^* P_0^+\right]$$

Maxmin Expected Utility: Summary

- A-SDF is the probability distortion w.r.t. rational expectation

Maxmin Expected Utility: Summary

- A-SDF is the probability distortion w.r.t. rational expectation
- Positive announcement premium: if $P_0^+(H) > P_0^+(L)$, then

$$\frac{E\left[P_0^+\right]}{P_0^-} = \frac{E\left[P_0^+\right]}{E\left[m^* P_0^+\right]} > 1$$

Maxmin Expected Utility: Summary

- A-SDF is the probability distortion w.r.t. rational expectation
- Positive announcement premium: if $P_0^+(H) > P_0^+(L)$, then

$$\frac{E\left[P_0^+\right]}{P_0^-} = \frac{E\left[P_0^+\right]}{E\left[m^* P_0^+\right]} > 1$$

- In general, announcement premium reflects "generalized risk-sensitivity".

The General Theorem: Setup

- Dynamic preferences under uncertainty can represented as:

$$V(t) = u(C_t) + \beta \mathcal{I}[V(t+1)]$$

The General Theorem: Setup

- Dynamic preferences under uncertainty can represented as:

$$V(t) = u(C_t) + \beta \mathcal{I}[V(t+1)]$$

- Examples:

The General Theorem: Setup

- Dynamic preferences under uncertainty can represented as:

$$V(t) = u(C_t) + \beta \mathcal{I}[V(t+1)]$$

- Examples:
  - Expected utility:

$$\mathcal{I}[V(t+1)] = E[V(t+1)].$$

The General Theorem: Setup

- Dynamic preferences under uncertainty can represented as:

$$V(t) = u(C_t) + \beta \mathcal{I}[V(t+1)]$$

- Examples:
  - Expected utility:

$$\mathcal{I}[V(t+1)] = E[V(t+1)].$$

  - Recursive utility (Epstein and Zin (1989)):

$$\mathcal{I}[V(t+1)] = \left\{ E\left[V(t+1)^{\frac{1-\gamma}{1-1/\psi}} \right] \right\}^{\frac{1-1/\psi}{1-\gamma}}.$$

The General Theorem: Setup

- Dynamic preferences under uncertainty can represented as:

$$V(t) = u(C_t) + \beta \mathcal{I}[V(t+1)]$$

- Examples:
  - Expected utility:

$$\mathcal{I}[V(t+1)] = E[V(t+1)].$$

  - Recursive utility (Epstein and Zin (1989)):

$$\mathcal{I}[V(t+1)] = \left\{ E\left[V(t+1)^{\frac{1-\gamma}{1-1/\psi}} \right] \right\}^{\frac{1-1/\psi}{1-\gamma}}.$$

  - Maxmin expected utility (Gilboa and Schmeidler (1989)):

$$\mathcal{I}[V(t+1)] = \min_m E[mV(t+1)].$$

More Examples

- Recursive multiple prior (Chen and Epstein (2002), Epstein and Schneider (2003))

More Examples

- Recursive multiple prior (Chen and Epstein (2002), Epstein and Schneider (2003))
- Smooth Ambiguity Aversion (Klibanoff, Marinacci, and Mukerji (2005, 2009))

More Examples

- Recursive multiple prior (Chen and Epstein (2002), Epstein and Schneider (2003))
- Smooth Ambiguity Aversion (Klibanoff, Marinacci, and Mukerji (2005, 2009))
- Variational preference (Maccheroni, Marinacci, and Rustichini (2006a, 2006b))

More Examples

- Recursive multiple prior (Chen and Epstein (2002), Epstein and Schneider (2003))
- Smooth Ambiguity Aversion (Klibanoff, Marinacci, and Mukerji (2005, 2009))
- Variational preference (Maccheroni, Marinacci, and Rustichini (2006a, 2006b))
- Robust Control Preference (Hansen and Sargent, Strzalecki (2011))

More Examples

- Recursive multiple prior (Chen and Epstein (2002), Epstein and Schneider (2003))
- Smooth Ambiguity Aversion (Klibanoff, Marinacci, and Mukerji (2005, 2009))
- Variational preference (Maccheroni, Marinacci, and Rustichini (2006a, 2006b))
- Robust Control Preference (Hansen and Sargent, Strzalecki (2011))
- Disappointment Aversion (Gul (1991))

The General Theorem

Theorem

Assuming non-atomic probability space and differentiability, then, positive announcement premium if and only if $\mathcal{I}[X]$ *is increasing in second order stochastic dominance*

The General Theorem

Theorem

Assuming non-atomic probability space and differentiability, then, positive announcement premium if and only if $\mathcal{I}[X]$ is increasing in second order stochastic dominance

Definition

Intermporal preference satisfies **generalized risk sensitivity** if $\mathcal{I}[X]$ is increasing in second order stochastic dominance

Interpretation of the main theorem

- What do asset prices say about preferences?

Interpretation of the main theorem

- What do asset prices say about preferences?
  - Positive announcement premium $\Leftrightarrow$ generalized risk sensitivity

Interpretation of the main theorem

- What do asset prices say about preferences?
  - Positive announcement premium $\Leftrightarrow$ generalized risk sensitivity
  - No announcement for any asset $\Leftrightarrow$ expected utility

Interpretation of the main theorem

- What do asset prices say about preferences?
  - Positive announcement premium $\Leftrightarrow$ generalized risk sensitivity
  - No announcement for any asset $\Leftrightarrow$ expected utility
- A "revealed preference" approach to asset pricing

Interpretation of the main theorem

- What do asset prices say about preferences?
  - Positive announcement premium $\Leftrightarrow$ generalized risk sensitivity
  - No announcement for any asset $\Leftrightarrow$ expected utility
- A "revealed preference" approach to asset pricing
  - Calibration: preferences $\rightarrow$ asset prices

Interpretation of the main theorem

- What do asset prices say about preferences?
  - Positive announcement premium $\Leftrightarrow$ generalized risk sensitivity
  - No announcement for any asset $\Leftrightarrow$ expected utility
- A "revealed preference" approach to asset pricing
  - Calibration: preferences $\rightarrow$ asset prices
  - Decision theory: choice behavior (axioms) $\rightleftharpoons$ preferences

Interpretation of the main theorem

- What do asset prices say about preferences?
  - Positive announcement premium $\Leftrightarrow$ generalized risk sensitivity
  - No announcement for any asset $\Leftrightarrow$ expected utility
- A "revealed preference" approach to asset pricing
  - Calibration: preferences $\rightarrow$ asset prices
  - Decision theory: choice behavior (axioms) $\rightleftharpoons$ preferences
  - Our approach: asset prices $\rightleftharpoons$ preferences

Using asset prices to recover preferences

- Asset prices put restriction on marginal utilities

Using asset prices to recover preferences

- Asset prices put restriction on marginal utilities
- Integrating derivatives to recover the property of the utility function

Using asset prices to recover preferences

- Asset prices put restriction on marginal utilities
- Integrating derivatives to recover the property of the utility function
- Premium associated with resolution of uncertainty is informative about how investors aggregate across states to compute certainty equivalence

Intuition for the theorem: A-SDF

- Pre-announcement price:

$$P^{-} = \sum_{s=1}^{N} \left(\frac{\frac{\partial}{\partial V_s}\mathcal{I}\left[V\right]}{\sum_{s=1}^{N} \frac{\partial}{\partial V_s}\mathcal{I}\left[V\right]} \right) \beta \frac{u'\left(C_1\left(s\right)\right)}{u'\left(C_0\right)} X_s,$$

Intuition for the theorem: A-SDF

- Pre-announcement price:

$$P^{-} = \sum_{s=1}^{N} \left(\frac{\frac{\partial}{\partial V_s} \mathcal{I}[V]}{\sum_{s=1}^{N} \frac{\partial}{\partial V_s} \mathcal{I}[V]} \right) \beta \frac{u'(C_1(s))}{u'(C_0)} X_s,$$

- Therefore:

$$P^{-} = \sum_{s=1}^{N} \left(\frac{\frac{\partial}{\partial V_s} \mathcal{I}[V]}{\sum_{s=1}^{N} \frac{\partial}{\partial V_s} \mathcal{I}[V]} \right) P^{+}(s)$$

Intuition for the theorem: A-SDF

- Pre-announcement price:

$$P^{-} = \sum_{s=1}^{N} \left(\frac{\frac{\partial}{\partial V_s} \mathcal{I}[V]}{\sum_{s=1}^{N} \frac{\partial}{\partial V_s} \mathcal{I}[V]} \right) \beta \frac{u'(C_1(s))}{u'(C_0)} X_s,$$

- Therefore:

$$P^{-} = \sum_{s=1}^{N} \left(\frac{\frac{\partial}{\partial V_s} \mathcal{I}[V]}{\sum_{s=1}^{N} \frac{\partial}{\partial V_s} \mathcal{I}[V]} \right) P^{+}(s)$$

- A-SDF is determined by the properties of the certainty equivalence functional

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space
  - allow general information structure

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space
  - allow general information structure
- "Partial derivatives" of the certainty equivalence functional

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space
  - allow general information structure
- "Partial derivatives" of the certainty equivalence functional
  - In general, $\mathcal{I}$ is a mapping from L^2 to the real line.

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space
  - allow general information structure
- "Partial derivatives" of the certainty equivalence functional
  - In general, $\mathcal{I}$ is a mapping from L^2 to the real line.
  - $D\mathcal{I}$ is a linear functional on L^2 and has a representation in L^2.

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space
  - allow general information structure
- "Partial derivatives" of the certainty equivalence functional
  - In general, $\mathcal{I}$ is a mapping from L^2 to the real line.
  - $D\mathcal{I}$ is a linear functional on L^2 and has a representation in L^2.
- **Lemma:** The following statements are equivalent:

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space
  - allow general information structure
- "Partial derivatives" of the certainty equivalence functional
  - In general, $\mathcal{I}$ is a mapping from L^2 to the real line.
  - $D\mathcal{I}$ is a linear functional on L^2 and has a representation in L^2.
- **Lemma:** The following statements are equivalent:
  - $\mathcal{I}[\cdot]$ is increasing in second order stochastic dominance.

Intuition for the theorem: monotonicity w.r.t. SSD

- Assuming continuous probability space
  - allow general information structure
- "Partial derivatives" of the certainty equivalence functional
  - In general, $\mathcal{I}$ is a mapping from L^2 to the real line.
  - $D\mathcal{I}$ is a linear functional on L^2 and has a representation in L^2.
- **Lemma:** The following statements are equivalent:
  - $\mathcal{I}[\cdot]$ is increasing in second order stochastic dominance.
  - $\{D\mathcal{I}[V](\omega) - D\mathcal{I}[V](\omega')\}\{V(\omega) - V(\omega')\} \leq 0,\ a.s.$

Generalized Risk Sensitivity and Uncertainty Aversion

- Uncertainty aversion is sufficient, but not necessary for generalized risk sensitivity

Generalized Risk Sensitivity and Uncertainty Aversion

- Uncertainty aversion is sufficient, but not necessary for generalized risk sensitivity
- Assume $\mathcal{I}[V] = \phi^{-1}(E[\phi(V)])$, then uncertainty aversion is equivalent to generalized risk sensitivity

Generalized Risk Sensitivity and Uncertainty Aversion

- Uncertainty aversion is sufficient, but not necessary for generalized risk sensitivity
- Assume $\mathcal{I}[V] = \phi^{-1}(E[\phi(V)])$, then uncertainty aversion is equivalent to generalized risk sensitivity
- For the class of smooth ambiguity preferences, uncertainty aversion is equivalent to generalized risk sensitity

Generalized Risk Sensitivity and Preference for Early Resolution of Uncertainty

- Concavity of $\mathcal{I}[V]$ implies both g-risk sensitivity and PER

Generalized Risk Sensitivity and Preference for Early Resolution of Uncertainty

- Concavity of $\mathcal{I}[V]$ implies both g-risk sensitivity and PER
- In general, PER is neither necessary nor sufficient for g-risk sensitivity

Generalized Risk Sensitivity and Preference for Early Resolution of Uncertainty

- Concavity of $\mathcal{I}[V]$ implies both g-risk sensitivity and PER
- In general, PER is neither necessary nor sufficient for g-risk sensitivity
- For Kreps-Porteus preference, PER is equivalent to g-risk sensitivity

Generalized Risk Sensitivity and Preference for Early Resolution of Uncertainty

- Concavity of $\mathcal{I}[V]$ implies both g-risk sensitivity and PER
- In general, PER is neither necessary nor sufficient for g-risk sensitivity
- For Kreps-Porteus preference, PER is equivalent to g-risk sensitivity
- The only class of preference that satisfies g-risk sensitivity and is indifferent between timing of resolution of uncertainty is the max-min expected utility.

Generalized Risk Sensitivity and Preference for Early Resolution of Uncertainty

- Concavity of $\mathcal{I}[V]$ implies both g-risk sensitivity and PER
- In general, PER is neither necessary nor sufficient for g-risk sensitivity
- For Kreps-Porteus preference, PER is equivalent to g-risk sensitivity
- The only class of preference that satisfies g-risk sensitivity and is indifferent between timing of resolution of uncertainty is the max-min expected utility.
- Provides sufficient conditions under which PER implies g-risk sensitivity

Asset Pricing Implications: qualitative

- G-risk sensitivity $\Leftrightarrow$ m^* decreasing in continuation utility

Asset Pricing Implications: qualitative

- G-risk sensitivity $\Leftrightarrow$ m^* decreasing in continuation utility
- Announcement premium $\Leftrightarrow$ generalized risk sensitivity

$$E\left[m^* \cdot R_A\right] = 1$$

Asset Pricing Implications: qualitative

- G-risk sensitivity $\Leftrightarrow$ m^* decreasing in continuation utility
- Announcement premium $\Leftrightarrow$ generalized risk sensitivity

$$E\left[m^* \cdot R_A\right] = 1$$

- Aversion to "long-run risk" $\Leftrightarrow$ generalized risk sensitivity:

$$E\left[m^* \frac{\beta u'\left(C_{t+1}\right)}{u'\left(C_t\right)} \cdot R_{t+1}\right] = 1$$

Asset Pricing Implications: qualitative

- G-risk sensitivity $\Leftrightarrow$ m^* decreasing in continuation utility
- Announcement premium $\Leftrightarrow$ generalized risk sensitivity

$$E\left[m^* \cdot R_A\right] = 1$$

- Aversion to "long-run risk" $\Leftrightarrow$ generalized risk sensitivity:

$$E\left[m^* \frac{\beta u'\left(C_{t+1}\right)}{u'\left(C_t\right)} \cdot R_{t+1}\right] = 1$$

- uncertainty aversion? preference for early resolution of uncertainty?

Asset Pricing Implications: quantitative

- SDF for announcement returns:

$$E\left[m^{*}\cdot R_{A}\right]=1\quad\Rightarrow\sigma\left(m^{*}\right)\geq 88\%$$

Asset Pricing Implications: quantitative

- SDF for announcement returns:

$$E\left[m^{*}\cdot R_{A}\right]=1 \quad \Rightarrow \sigma\left(m^{*}\right)\geq 88\%$$

- SDF for non-expected utility:

$$E\left[m^{*}\frac{\beta u'\left(C_{t+1}\right)}{u'\left(C_{t}\right)}\cdot R_{t+1}\right]=1 \quad \Rightarrow \sigma\left(SDF\right)\geq 40\%$$

Asset Pricing Implications: quantitative

- SDF for announcement returns:

$$E\left[m^{*}\cdot R_{A}\right]=1\quad\Rightarrow\sigma\left(m^{*}\right)\geq 88\%$$

- SDF for non-expected utility:

$$E\left[m^{*}\frac{\beta u'\left(C_{t+1}\right)}{u'\left(C_{t}\right)}\cdot R_{t+1}\right]=1\quad\Rightarrow\sigma\left(SDF\right)\geq 40\%$$

- Most of the volatility of SDF must come from G-risk sensitivity

A Dynamic Model with Learning

Model Setup

- Consumption dynamics

$$
\begin{aligned}
\frac{dC_t}{C_t} &= x_t dt + \sigma dB_{C,t}, \\
dx_t &= a\left(\bar{x} - x_t\right) dt + \sigma_x dB_{\theta,t}
\end{aligned}
$$

A Dynamic Model with Learning

Model Setup

- Consumption dynamics

$$\begin{aligned} \frac{dC_t}{C_t} &= x_t dt + \sigma dB_{C,t}, \\ dx_t &= a(\bar{x} - x_t) dt + \sigma_x dB_{\theta,t} \end{aligned}$$

- Dividend dynamics

$$\frac{dD_t}{D_t} = [x_D + \phi(x_t - \bar{x})] dt + \phi\sigma dB_{C,t},$$

A Dynamic Model with Learning

Model Setup

- Consumption dynamics

$$\begin{aligned} \frac{dC_t}{C_t} &= x_t dt + \sigma dB_{C,t}, \\ dx_t &= a(\bar{x} - x_t) dt + \sigma_x dB_{\theta,t} \end{aligned}$$

- Dividend dynamics

$$\frac{dD_t}{D_t} = [x_D + \phi(x_t - \bar{x})] dt + \phi\sigma dB_{C,t},$$

- Epstein-Zin preference with unit IES and risk aversion of γ

A Dynamic Model with Learning

Two source of information about x_t:

- Aggregate consumption itself contains information about x_t:

$$\frac{dC_t}{C_t} = x_t dt + \sigma dB_{C,t},$$

A Dynamic Model with Learning

Two source of information about x_t:

- Aggregate consumption itself contains information about x_t:

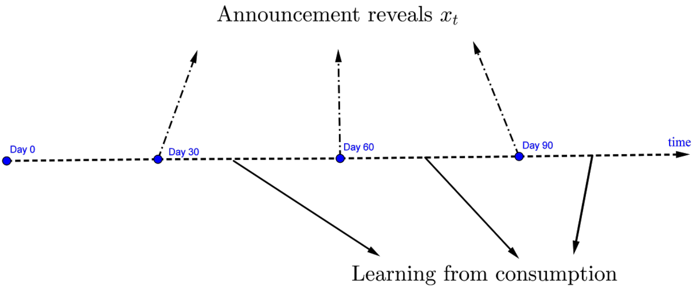
$$\frac{dC_t}{C_t} = x_t dt + \sigma dB_{C,t},$$

- A signal of x_t is revealed to the agent at time 0, T, $2T$, $3T$, $\cdots$.

$$s_{n,T} = x_{nT} + \epsilon_n, n = 1, 2, \cdots$$

A Dynamic Model with Learning

Time line of information



The Stochastic Discount Factor

- SDF for intertemporal cash flow:

$$SDF_{t,t+\Delta} = e^{-\rho\Delta} \frac{e^{(1-\gamma)V(z_{t+\Delta})}}{E\left[e^{(1-\gamma)V(z_{t+\Delta})} \middle| z_t \right]} \frac{u'\left(C_{t+\Delta}\right)}{u'\left(C_t\right)}.$$

The Stochastic Discount Factor

- SDF for intertemporal cash flow:

$$SDF_{t,t+\Delta} = e^{-\rho\Delta} \frac{e^{(1-\gamma)V(z_{t+\Delta})}}{E\left[e^{(1-\gamma)V(z_{t+\Delta})} \middle| z_t \right]} \frac{u'\left(C_{t+\Delta}\right)}{u'\left(C_t\right)}.$$

- Equity premium on non-announcement days (vanishes as $\Delta \to 0$)

$$\left[\gamma\sigma + \frac{\gamma - 1}{a_x + \rho}\frac{q_t}{\sigma}\right]\left[\sigma + \frac{\phi - 1}{a_x + \rho}\frac{q_t}{\sigma}\right]\Delta$$

The Stochastic Discount Factor

- SDF for intertemporal cash flow:

$$SDF_{t,t+\Delta} = e^{-\rho\Delta} \frac{e^{(1-\gamma)V(z_{t+\Delta})}}{E\left[e^{(1-\gamma)V(z_{t+\Delta})} \middle| z_t \right]} \frac{u'(C_{t+\Delta})}{u'(C_t)}.$$

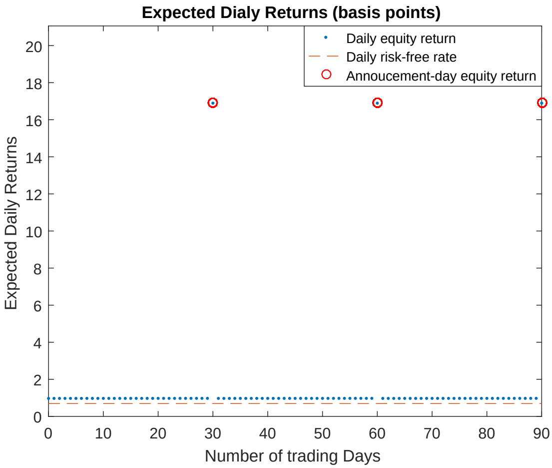
- Equity premium on non-announcement days (vanishes as $\Delta \to 0$)

$$\left[\gamma\sigma + \frac{\gamma - 1}{a_x + \rho} \frac{q_t}{\sigma}\right] \left[\sigma + \frac{\phi - 1}{a_x + \rho} \frac{q_t}{\sigma}\right] \Delta$$

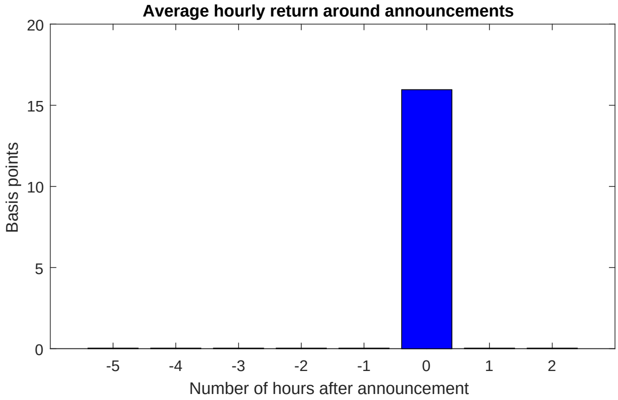
- Equity premium on announcement days (does not vanish as $\Delta \to 0$)

$$\ln \frac{E[p^+]}{p^-} = (\phi - 1) \frac{\gamma - 1}{(a_x + \beta)^2} \left(q_T^- - q_T^+\right).$$

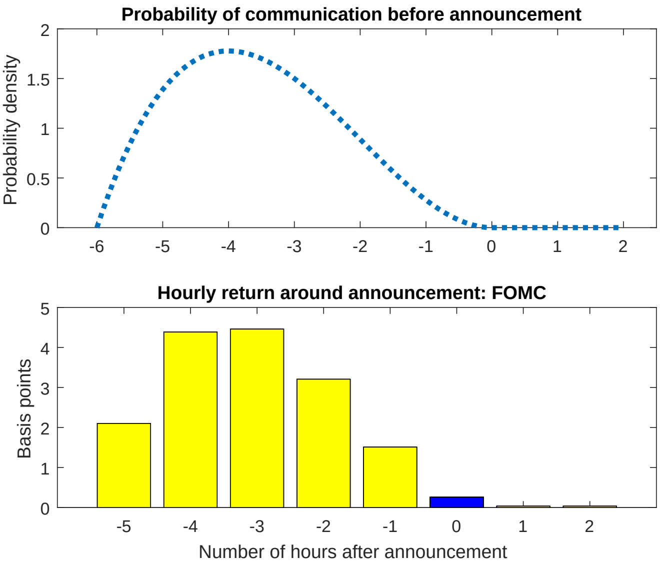
Market return on announcement and non-announcement days



Hourly return without communication



Hourly return around announcements with communication



Time-non-separable preferences

Summary

- External habit (Campbell and Cochrane (1999)): zero announcement premium

Time-non-separable preferences

Summary

- External habit (Campbell and Cochrane (1999)): zero announcement premium
- Internal habit (Constantinides (1990), Boldrin, Christiano, and Fisher (2000)): negative announcement premium

Time-non-separable preferences

Summary

- External habit (Campbell and Cochrane (1999)): zero announcement premium
- Internal habit (Constantinides (1990), Boldrin, Christiano, and Fisher (2000)): negative announcement premium
- Consumption substitutability (Dunn and Singlteon (1993), Heaton (1986)): positive announcement premium

Time-non-separable preferences

Preferences

- The general setup:

$$E\left[\int_0^\infty e^{-\rho t} u\left(C_t + bH_t\right) dt\right], \tag{1}$$

with habit defined by:

$$H_t = \left(1 - \int_0^t \xi\left(t, s\right) ds\right) H_0 + \int_0^t \xi\left(t, s\right) C_s ds, \tag{2}$$

where $\left\{\xi\left(t, s\right)\right\}_{s=0}^{t}$ is a non-negative weighting function

Time-non-separable preferences

External habit

- Habit is exogenous (choice of C_t does not affect future habit).

Time-non-separable preferences

External habit

- Habit is exogenous (choice of C_t does not affect future habit).
- The pricing kernel:

$$\pi_t = e^{-\beta t} u' \left(C_t - H_t \right)$$

Time-non-separable preferences

External habit

- Habit is exogenous (choice of C_t does not affect future habit).
- The pricing kernel:

$$\pi_t = e^{-\beta t} u' \left(C_t - H_t \right)$$

- Pricing kernel does not depend on announcement (x_t), no announcement premium

Time-non-separable preferences

Internal habit

- The pricing kernel, $\pi_t =$

$$e^{-\beta t}\left\{u'\left(C_t + bH_t\right) + bE\left[\left.\int_0^{\infty} e^{-\beta s}\xi_{t+s,t}u'\left(C_{t+s} + bH_{t+s}\right)ds\right|\hat{x}_t\right]\right\}.$$

Time-non-separable preferences

Internal habit

- The pricing kernel, $\pi_t =$

$$e^{-\beta t}\left\{u'\left(C_t + bH_t\right) + bE\left[\int_0^{\infty} e^{-\beta s}\xi_{t+s,t}u'\left(C_{t+s} + bH_{t+s}\right)ds\middle|\,\hat{x}_t\right]\right\}.$$

- Observation: $u'\left(C\right)$ decreasing in C and therefore in $\hat{x}_t$

Time-non-separable preferences

Internal habit

- The pricing kernel, $\pi_t =$

$$e^{-\beta t}\left\{u'\left(C_t + bH_t\right) + bE\left[\int_0^\infty e^{-\beta s}\xi_{t+s,t}u'\left(C_{t+s} + bH_{t+s}\right)ds \middle| \hat{x}_t\right]\right\}.$$

- Observation: $u'(C)$ decreasing in C and therefore in $\hat{x}_t$
- Internal habit: $b < 0 \Rightarrow$ marginal utility increasing in announcements $\Rightarrow$ negative announcement premium

Time-non-separable preferences

Internal habit

- Habit: high past consumption lowers current period utility, $b < 0$.

Time-non-separable preferences

Internal habit

- Habit: high past consumption lowers current period utility, $b < 0$.
- Consumption substitutability: high past consumption increases current period utility, $b > 0$.

Time-non-separable preferences

Internal habit

- Habit: high past consumption lowers current period utility, $b < 0$.
- Consumption substitutability: high past consumption increases current period utility, $b > 0$.
- For the same reason, positive announcement premium

Time-non-separable preferences

Internal habit

- Habit: high past consumption lowers current period utility, $b < 0$.
- Consumption substitutability: high past consumption increases current period utility, $b > 0$.
- For the same reason, positive announcement premium
- However, lowers risk aversion, and make asset puzzles worse (Gallant, Hansen, and Tauchen (1990))

Conclusion

- Revealed preference approach for the macro-announcement premium

Conclusion

- Revealed preference approach for the macro-announcement premium
- Model accounts for announcement premium as well as pre-announcement drift

Conclusion

- Revealed preference approach for the macro-announcement premium
- Model accounts for announcement premium as well as pre-announcement drift
- Theoretical foundation for pricing kernels sensitive to news about future