Dynamic Trading and Asset Pricing with Time-Inconsistent Agents

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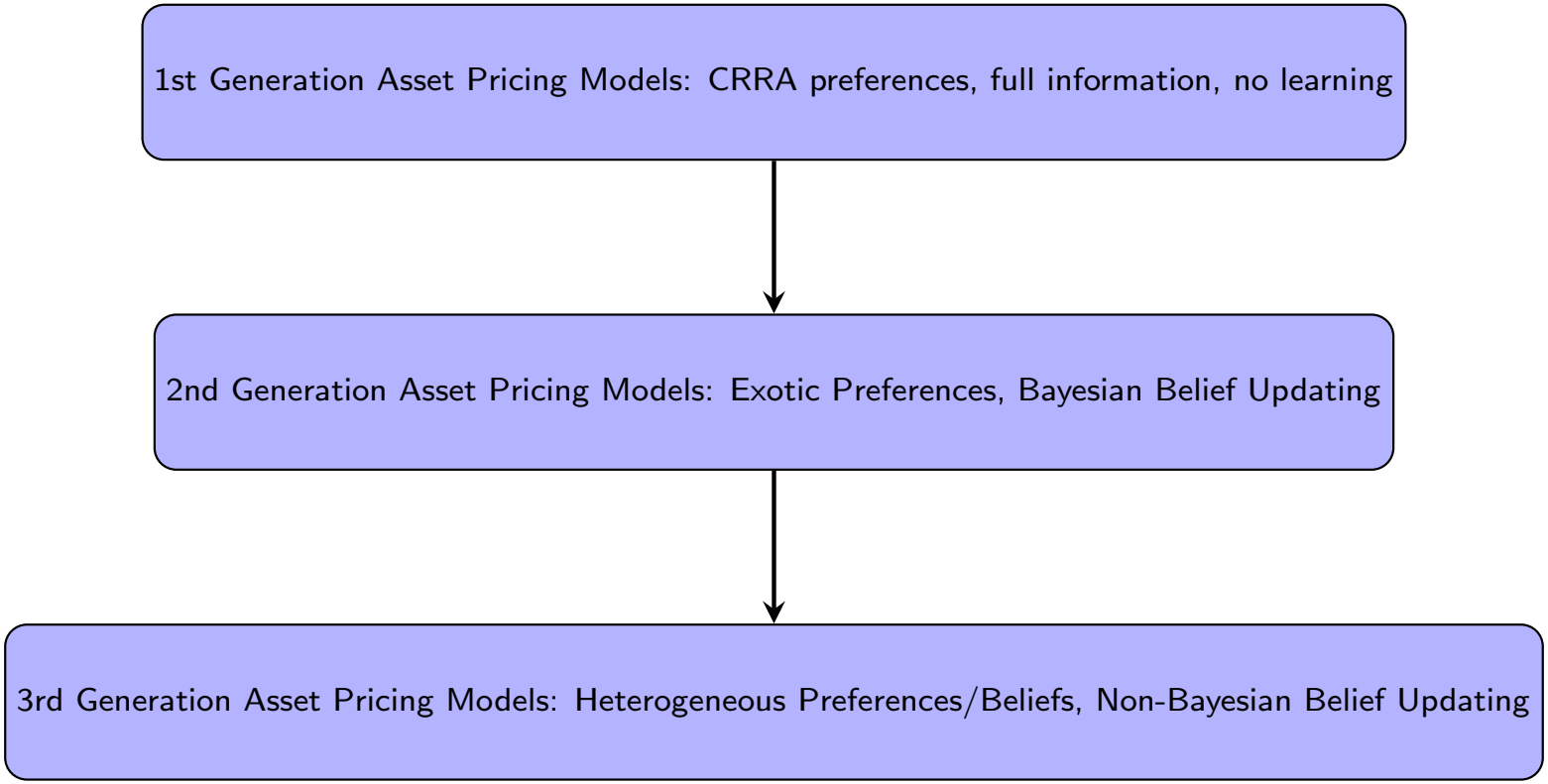
Agenda

1. Motivation and Summary
2. Model
3. Mechanisms
4. Comments
5. Conclusion

Overview


1st Generation Asset Pricing Models: CRRA preferences, full information, no learning
2nd Generation Asset Pricing Models: Exotic Preferences, Bayesian Belief Updating
3rd Generation Asset Pricing Models: Heterogeneous Preferences/Beliefs, Non-Bayesian Belief Updating

Summary

Model:

- GE consumption-based asset pricing model
- A fraction of investors exhibit time-inconsistent preferences with a time-varying degree of short-termism.
- This feature, grounded in recent survey and neuroscientific evidence, helps explain various asset pricing puzzles.

Motivation:

- Traditional asset pricing models with rational, time-consistent agents struggle to explain empirical observations like high equity premiums and volatile market returns.
- Existing models with time-inconsistent preferences typically assume a constant degree of short-termism, which limits their ability to capture real-world dynamics.
- Recent evidence suggests that individuals' impatience levels and present bias can fluctuate over time, influenced by factors like personal experiences and economic conditions.

Empirical Evidence

New York Fed's Survey of Consumer Expectations Data:

- **Consumption Growth Forecast Errors:** Individuals, on average, underestimate their future consumption growth, consistent with hyperbolic discounting.
- **Demographics and Forecast Errors:** This bias is stronger among less financially sophisticated individuals (proxied by lower education and income).
- **Stress and Forecast Errors:** The short-termism bias is amplified during times of economic stress, with more biased individuals exhibiting larger forecast errors.

Empirical Findings Support the Notion of Time-Varying Short-Termism

Key Components of the Model: Agents

Agents:

- **Time-Consistent (TC) agents:** They use standard exponential discounting with a constant time preference factor β.
- **Time-Inconsistent (TI) agents:** They employ quasi-hyperbolic discounting, where their degree of short-termism varies over time, represented by θ_t.

Time-Varying Short-Termism (θ_t):

- Follows a discrete Markov process, capturing the subjective belief of TI agents about their future impatience level.
- $\theta_t = 0$: TI agent believes they will become long-term-oriented in the next period.
- $\theta_t = 1$: TI agent believes they will remain short-term-oriented in the next period.

Key Components of the Model: Utility Functions

Utility Functions:

- **TC Agent:** The value function for the TC agent is:

$$V_{TC,t} = \max_{C_{TC,t}} \left[C_{TC,t}^{\rho} + \beta E_t \left[V_{TC,t+1}^{\alpha} \right]^{\rho/\alpha} \right]^{1/\rho}$$

- **TI Agent:** The TI agent's value function accounts for the belief that they may become long-term-oriented in the future:

$$V_{TI,t} = \max_{C_{TI,t}} \left[C_{TI,t}^{\rho} + \beta\delta E_t \left[\theta_t V_{TI,t+1}^{\alpha} + (1-\theta_t) V_{TC,t+1}^{\alpha} \right]^{\rho/\alpha} \right]^{1/\rho}$$

Key Components of the Model: Time-Varying Short-Termism

Time-Varying Short-Termism:

- The degree of short-termism θ_t follows a discrete Markov process:

$$P(\theta_{t+1} = \theta_l | \theta_t = \theta_k) = \Pi_{\theta,k,l}$$

- $\Pi_{\theta,k,l}$ represents the probability of transitioning from state θ_k to θ_l.

Key Components of the Model: Wealth Consumption Ratios

Wealth Consumption Ratios:

- **For the TC agent:**

$$\phi_{TC,t} = 1 + \beta E_t \left[\phi^{\alpha}_{TC,t+1} R^{\alpha}_{TC,t+1} \right]^{\rho/\alpha}$$

- **For the TI agent:**

$$\phi_{TI,t} = 1 + [(1-\lambda)\beta\delta] E_t \left[\theta_t \phi^{\alpha}_{TI,t+1} + (1-\theta_t) \phi^{\alpha}_{TC,t+1} \right]^{\rho/\alpha}$$

Key Components of the Model: Stochastic Discount Factor (SDF)

Stochastic Discount Factor (SDF):

- **For TC agents:**

$$M_{TC,t+1} = (1-\lambda)\beta \left(\frac{C_{TC,t+1}}{C_{TC,t}} \right)^{\rho-1} V_{TC,t+1}^{\alpha-\rho}$$

- **For TI agents:**

$$M_{TI,t+1} = (1-\lambda)\beta\delta \left(\frac{C_{TI,t+1}}{C_{TI,t}} \right)^{\rho-1} \left(\theta_t V_{TI,t+1}^{\alpha-\rho} + (1-\theta_t) V_{TC,t+1}^{\alpha-\rho} \right)$$

Additional Components

Consumption Forecast Error:

$$E_t(C_{TI,t+1}) = C_{TI,t} + \text{Bias}(\theta_t)$$

- The bias in forecast error depends on the current short-termism parameter θ_t.

Wealth Dynamics:

- **Total Wealth:** $W_t = W_{TI,t} + W_{TC,t}$
- **Wealth Evolution for TI agents:**

$$W_{TI,t+1} = (W_{TI,t} - C_{TI,t})R_{TI,t+1}$$

- **Wealth Evolution for TC agents:**

$$W_{TC,t+1} = (W_{TC,t} - C_{TC,t})R_{TC,t+1}$$

Equilibrium Conditions:

- Market clearing ensures:

$$C_t = C_{TI,t} + C_{TC,t}$$

Model Implications

Time-Varying Short-Termism Introduces a New Source of Risk:

- Aggregate consumption risk is not the key risk here.
- As θ_t fluctuates, so does the TI agent's perceived systematic risk and portfolio choices.
- This creates uncertainty for TC agents, leading to fluctuations in discount rates.

The Model Can Generate:

- Substantial and time-varying equity premium
- Positive and persistent variance premium
- Upward-sloping yield curve
- Cross-sectional predictability
- High trading volume

Discount Rate Channel

- Time-inconsistent (TI) agents exhibit time-varying short-termism.
- Their impatience influences their future discount rate, generating time-varying discount rate risk.
- The degree of short-termism (θ_t) evolves stochastically:
  - When θ_t is high, TI agents overconsume today, expecting low future consumption.
  - Time-consistent (TC) agents demand compensation for this discount rate risk, leading to a higher risk premium.
- Results in a negative correlation between TC agents' consumption and discount rates.
- Implication: Drives variation in equity risk premia and upward-sloping yield curves.

Risk Sharing Channel

- Risk-sharing depends on the beliefs of TI agents:
  - When TI agents underestimate their future short-termism, they overestimate their risk exposure, leading to suboptimal risk sharing.
  - When TI agents correctly estimate future short-termism, their risk exposure is negatively correlated with TC agents, improving risk-sharing.
- This interaction influences:
  - The return volatility and the price of risk.
  - The overall equity premium and variance premium.
- Conclusion: Time-varying short-termism significantly impacts risk premia and trading volume in equilibrium markets.

Time Inconsistency

There are three ways to handle time inconsistency:

1. pre-commitment: commit to control law at time 0
2. myopia: update the pre-commited problem every period
3. game-theoretic perspective: view the problem as an intrapersonal game and look for Nash subgame-perfect equilibrium

This paper takes the third approach

Game-theoretic perspective

- When you decide on a control action at time t, account for fact that at future times will have a different objective functional – "our tastes are changing over time."
- Noncooperative game, with one player for each time t,
- Player t can be viewed as the future incarnation of ourselves (or rather of our preferences) at time t.
- Player t chooses a control law
- Look for Nash equilibria for the game (no participant can gain by a unilateral change of strategy if the strategies of the others remain unchanged)

How do we know the paper takes game-theoretic perspective?

I had to ask one of the authors.
Did I ask this guy?

No! We discussed other matters....

How do we know the paper takes game-theoretic perspective?

Where is Stig?

How do we know the paper takes game-theoretic perspective?

I asked Zhaneta

Why does the paper take a game-theoretic perspective?

- It's quite hard to solve for the Nash equilibrium
- Do real people do this?
- Is myopia more realistic?
- Some discussion is needed

Which Benchmark Model?

- Different one? Compare with more than one model?
- Bekaert, Hoerova and Lo Duca (2013): variance risk premium has information about risk aversion.
- Natural Benchmark: Model with Heterogeneous Risk Aversion
  - Gârleanu, N. and Panageas, S. (2015): two agents
  - Bhamra & Uppal (2014): two agents
  - Bhamra, Francischello & Martínez-Toledano (2023): continuum
  - Veronesi (2023): continuum
- It would be interesting to compare variance risk premium in this paper with a model with heterogeneity in risk aversion.
- Bekaert, Engstrom & Xu (2021): model with exogenous time-varying risk aversion and study variance risk premium (and other things)

Portfolio Choices

- Time Inconsistent Agents: Sophisticated about Portfolio Choice!
  - The risk sharing channel depends on this
- Portfolio Choice is harder for households than Consumption Choice!
- Is there evidence time-inconsistent agents are that sophiscated in their portfolio choices?

Conclusion I

Key Contributions:

- Provides empirical support for the concept of time-varying short-termism.
- Develops a general equilibrium model incorporating this feature into agents' preferences.
- Demonstrates that the model can explain a wide range of asset pricing puzzles that traditional models struggle to capture.

Implications:

- Highlights the importance of considering time-varying behavioral biases in asset pricing models.
- Offers a potential explanation for the observed dynamics in financial markets, including risk premiums, volatility, and trading activity.

Conclusion II

- Interesting paper
- Sensible assumptions – great use of consumption data
- Challenging to solve
- Already in good shape
- Clarity: time inconsistency
- Benchmark Model: which one?
- Consumption choice TI agents: more justification
- Portfolio Choice of TI agents: more justification