Present Bias, Asset Allocation and the Yield Curve

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Bond premium puzzle

Definition: For reasonable risk aversion levels, standard representative agent general equilibrium models cannot match the sign, magnitude and variability of excess long-term bond returns (as found in the data) nor produce an average upward-sloping term structure of interest rates (Backus et al., 1989; Campbell and Shiller, 1991; Bansal and Coleman, 1996; Rudebusch and Swanson, 2008)

- **What we know:**
  - Need high risk aversion (Piazzesi and Schneider, 2007; Van Binsbergen et al., 2012; Bansal and Shaliastovich, 2013), or need multiple mechanisms (Gomez-Cram and Yaron, 2020), or explain short-term (Wachter, 2006)
- **What we don't know:** Can only present bias explain key features of bond behavior up to long maturities with reasonable risk aversion?

3 KEY FINDINGS

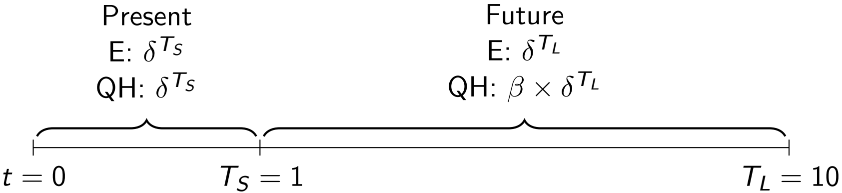
(1) **Asset allocation** Present-biased investors increase (decrease) short-term (long-term) hedge demands compared to standard preferences

(2) **Bond premium puzzle** Present bias drives up (down) short-term bond prices (yields) and drives down (up) long-term bond prices (yields)

(3) **Duration present** Bond behavior is best explained for a present-bias interval of at most 1 year
$\Rightarrow$ Estimate investor's duration of the present (Benartzi and Thaler, 1995)

Present bias

- Important feature of how people evaluate time (Thaler, 1981; Frederick et al., 2002; O'Donoghue and Rabin, 2015)
  $\Rightarrow$ Extensively used outside finance, but in finance so far little attention (Barberis, 2018)
- Quasi-hyperbolic discounting captures present bias (Laibson, 1997; O'Donoghue and Rabin, 1999)



Intertemporal consumption problem

- 2-factor affine term structure model
- Price-taking representative agent solves, with $\gamma = 10$,

$$\max_{W_{t,T_j},\ j=1,\dots,n} \mathbb{E}_t \left[\sum_{j=1, t \le T_j}^{n} D(T_j - t) \frac{W_{t,T_j}^{1-\gamma}}{1-\gamma} \right]$$

such that

$$\mathbb{E}_t \left[\sum_{j=1, t \le T_j}^{n} W_{t,T_j} M_{T_j} \right] = W_t M_t$$

- **Solution:** Optimal investment demand for asset i

$$\omega_{i,t}^* = \frac{\sum_{j,j>t}^{n} \pi_{i,t,T_j}^* W_{t,T_j}^*}{\sum_{j,j>t}^{n} W_{t,T_j}^*}$$

where π_{i,t,T_j}^* follows from Brennan and Xia (2002) and W_{t,T_j}^* is the optimal distribution of wealth.

Asset allocation

	3-year bond	10-year bond	Stock	Cash
Panel A: Present-biased investor ($\beta = 0.35, \delta = 0.97$)				
Hedge demand	0.48	0.04		
Speculative demand	2.44	-0.63	0.27	
Total demand	2.92	-0.59	0.27	-1.61
Panel B: Time-consistent investor ($\beta = 1, \delta = 0.97$)				
Hedge demand	0.39	0.21		
Speculative demand	2.44	-0.63	0.27	
Total demand	2.83	-0.42	0.27	-1.68

Table: Optimal fraction of total wealth invested in a 3-year bond, a 10-year bond, a stock and cash.

Supply and demand

- **Definition:** The market is in equilibrium if:
  1. The representative investor solves the intertemporal consumption problem.
  2. Bond markets clear continuously, such that for all $t \in [0, T]$ we have

$$\omega^*_{B,t} = \hat{w}_{B,t}$$

  where $\omega^*_{B,t}$ is the bond demand and $\hat{w}_{B,t}$ is the bond supply, given by monthly U.S. government debt data from October 1976 to January 2019.

- Match bond supply with demand by solving for the two prices-of-risk $\boldsymbol{\lambda}_F$ each year

1. Bond returns in excess of the short rate

	Data	Time consistency ($\beta = 1, \delta = 0.97$)	Present bias ($\beta = 0.35, \delta = 0.97$)
3-year bond			
Mean	1.90	1.06	1.59
Sharpe	0.48	0.27	0.41
10-year bond			
Mean	4.10	2.79	4.45
Sharpe	0.38	0.26	0.42
Stock			
Mean	7.27	7.01	7.48
Sharpe	0.48	0.46	0.49

Table: Mean returns $r_B(\tau_j) = -(B(\tau_j)\iota)'\boldsymbol{\sigma}_F\hat{\boldsymbol{\lambda}}_F$ and Sharpe ratios (annual values).

2. Slope yield curve

Maturity n	Data	Time consistency ($\beta = 1, \delta = 0.97$)	Present bias ($\beta = 0.35, \delta = 0.97$)
5 years			
Mean	1.33	0.61	1.03
Standard deviation	0.97	0.96	0.97
10 years			
Mean	1.78	1.04	1.88
Standard deviation	1.22	1.28	1.30

Table: Mean and standard deviation of the yield spread. The yield spread is the difference in yields between the long-term n-year bond and the 3-month bond: $y_t(n) - y_t(3 \text{ month})$, where yields follow from the vector: $\boldsymbol{Y}_t(\tau) \equiv -\ln \boldsymbol{P}_t(\tau)/\tau = -A(\tau)/\tau + \boldsymbol{\iota}'\boldsymbol{B}(\tau)\boldsymbol{F}_t/\tau$.

3. Risk premia and 4. Predictability

- 3. The **bond risk premium**, or term premium, equals:
  $y_t(n) - \tilde{y}_t(n)$, where $\tilde{y}_t(n)$ is the risk-neutral yield ($\hat{\boldsymbol{\lambda}}_F = \mathbf{0}$)
  $\Rightarrow$ Present-biased model closer to the data than time-consistent model
- 4. **"Long-rate" regressions** (Campbell and Shiller, 1991)
  $\Rightarrow$ Present-biased model closer to the data than time-consistent model

Duration of the present: Excess bond returns

	Data	Duration present		
		3 months ($\beta = 0.7$, $\delta = 0.97$)	1 year ($\beta = 0.35$, $\delta = 0.97$)	3 years ($\beta = 0.05$, $\delta = 0.97$)
3-year bond				
Mean	1.90	1.66	1.59	1.05
Sharpe	0.48	0.42	0.41	0.27
10-year bond				
Mean	4.10	4.39	4.45	3.11
Sharpe	0.38	0.41	0.42	0.29
Stock				
Mean	7.27	7.50	7.48	7.05
Sharpe	0.48	0.49	0.49	0.46

Conclusions

(1) We explain the bond-premium puzzle in a general equilibrium model by introducing present bias, in line with the experimental literature

(2) Present-biased investors overvalue the present and, therefore, care less about hedging opportunities for the long run
$\Rightarrow$ Drives up (down) short-term bond prices (yields) and drives down (up) long-term bond prices (yields) compared to standard preferences

(3) Bond behavior is best explained for a present-bias interval of at most 1 year
$\Rightarrow$ Excess bond returns, slope yield curve, bond risk premia, predictability

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