Comments on 'Mortgage Risk and the Yield Curve'

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Paper Summary

- Proposition 1: Less supply of long-duration MBS will raise prices, lower long rates, lower risk premium, expected bond excess returns.
- Proposition 2: "Negative convexity." Rates fall. People (in the US!) become likely to prepay their mortgages and refinance at a lower rate. Existing mortgages thus have lower duration. Substitution to Treasuries. Lower supply of duration $\Rightarrow$ lower long *Treasury* rates. (After people refinance, duration lengthens again .. dynamic effect.)
- Affine model with supply.
- Central evidence: Regressions

$$rx_{t+1} = a + \beta_1 \text{duration}_t + \beta_2 \text{level}_t + ... + \varepsilon_{t+1}$$

(Also volatility on convexity regressions)

Model cheers.

- Ingredients

$$dr_t = \kappa\left(\theta - r_t\right)dt + \sigma dB_t$$

$$dD_t = \kappa_D\left(\theta_D - D_t\right)dt + \eta_y d\bar{y}_t^{\bar{\tau}}$$

$$\lambda_t = -\alpha\sigma\frac{d\bar{y}_t^{\bar{\tau}}}{dr}D_t$$

  $\bar{y}_t^{\bar{\tau}}$ = "reference" treasury zero yield≈mortgage rate.
  D_t ="the aggregate *dollar* duration of outstanding mortgages"
  Dollar duration = d (total portfolio value) / dr = portfolio value × Macaualy duration.

- Key result: Supply D (only) drives market price of interest rate risk.
- Three cheers! Unexpected! Beyond supply and demand! Arbitrage-free!
- Theorem 1

$$y_t^{\tau} = A(\tau) + B(\tau)r_t + C(\tau)D_t$$

  Two state variables (r, D), one shock dB.

Model complaints.

- Why does market price of interest rate risk depend only on dollar duration?

$$\lambda_t = -\alpha\sigma \frac{d\bar{y}_t^{\bar{\tau}}}{dr} D_t ?$$

- A: *All* bonds are held by an investor with CARA mean-variance preference over bond portfolio and nothing else

$$dW_t = \left(W_t - \int x_t^\tau P_t^\tau d\tau \right) r_t dt + \int x_t^\tau P_t^\tau \frac{dP_t^\tau}{P_t^\tau} d\tau$$

$$\max_{\{x_t^\tau\}} E_t dW_t - \frac{\alpha}{2} Var_t \left[dW_t \right]$$

  and equilibrium $x_t^\tau =$ supply. (Duration supply from ad-hoc response to interest rates.)
- Four Objections: MV for bond investors?? CARA?? Nothing else?? Whole portfolio??
- Supply models artificial by keeping investors from assets. At least should model intermediary objectives and fricitons in a vaguely realistic way.
- Praise: Assumptions explicit.

Grumpy comments on supply: Institutions

- MM: term premium is independent of "supply". Why no MM?
- Segmentation simply asserted:

> *"Because households do not play an active role in bond markets and do not hedge their time-varying interest rate risk exposure, it is the position of financial institutions that determines the pricing of interest rate risk."*
>
> *"Bonds are held by financial institutions. We think about them as representing a range of investors such as investment banks, hedge funds, and fund managers, who trade actively in fixed income markets and act as marginal investors there."*

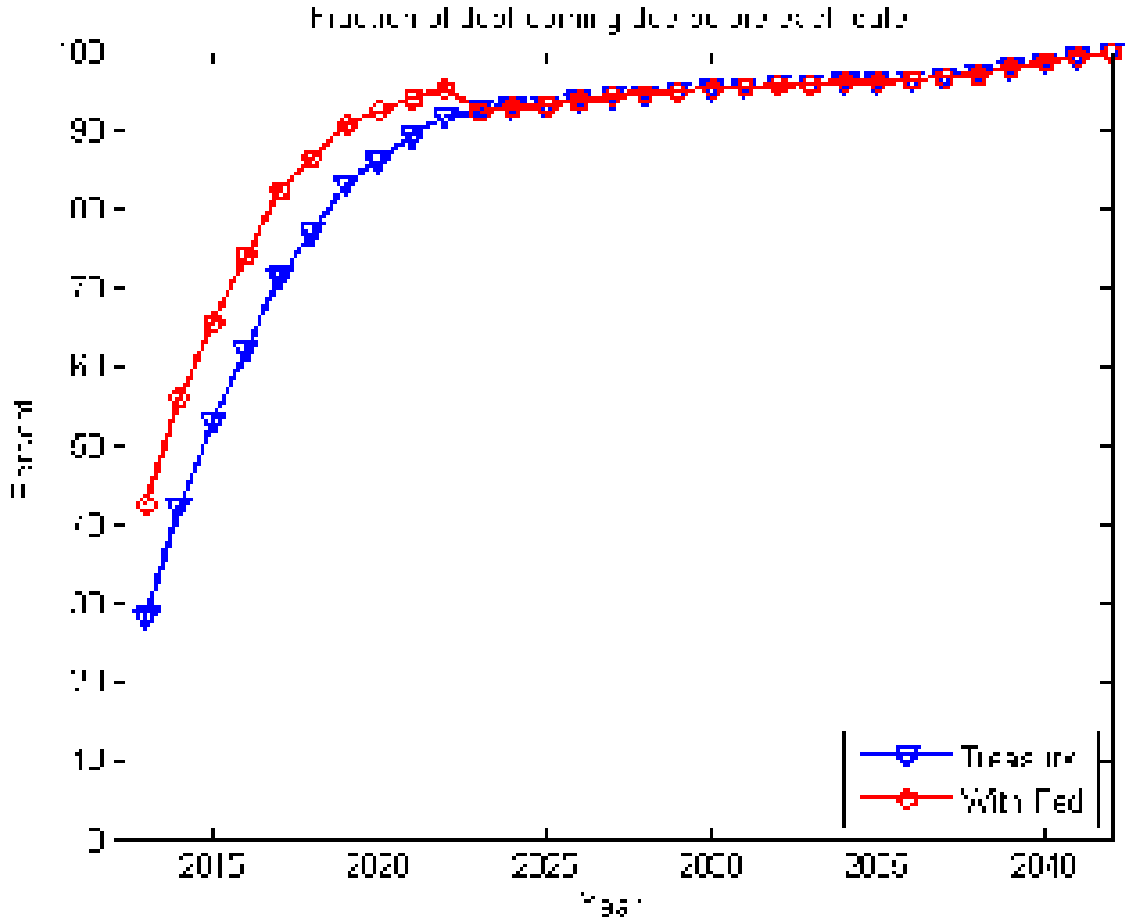
-
  - No. Treasury Bonds & MBS are *held* by funds (Vanguard, Pimco), pension funds, insurance companies, endowments, central banks, people, sovereign wealth funds, banks, family offices, etc. *not* highly leveraged intermediaries.
  - Institutions have liabilities too, and not utility functions.
  - Dealers active, but sell quickly, not *hold.*

Grumpy comments on supply: Households

- r declines, more likely to refinance. Until they refinance, people can borrow more long term (car, boat, glider, home equity), shift pensions/investments from bonds, or otherwise short duration.
  - Or their pension funds can. If pension fund is static too, no overall change!.
  - If prices change, companies, governments, etc. should supply duration. (Huge current government/corporate long issues).
- Describe MM, describe failures, realistically model, settle with data, not anecdotes!

Grumpy 2: Stock vs. flow ("price pressure") segmentation.

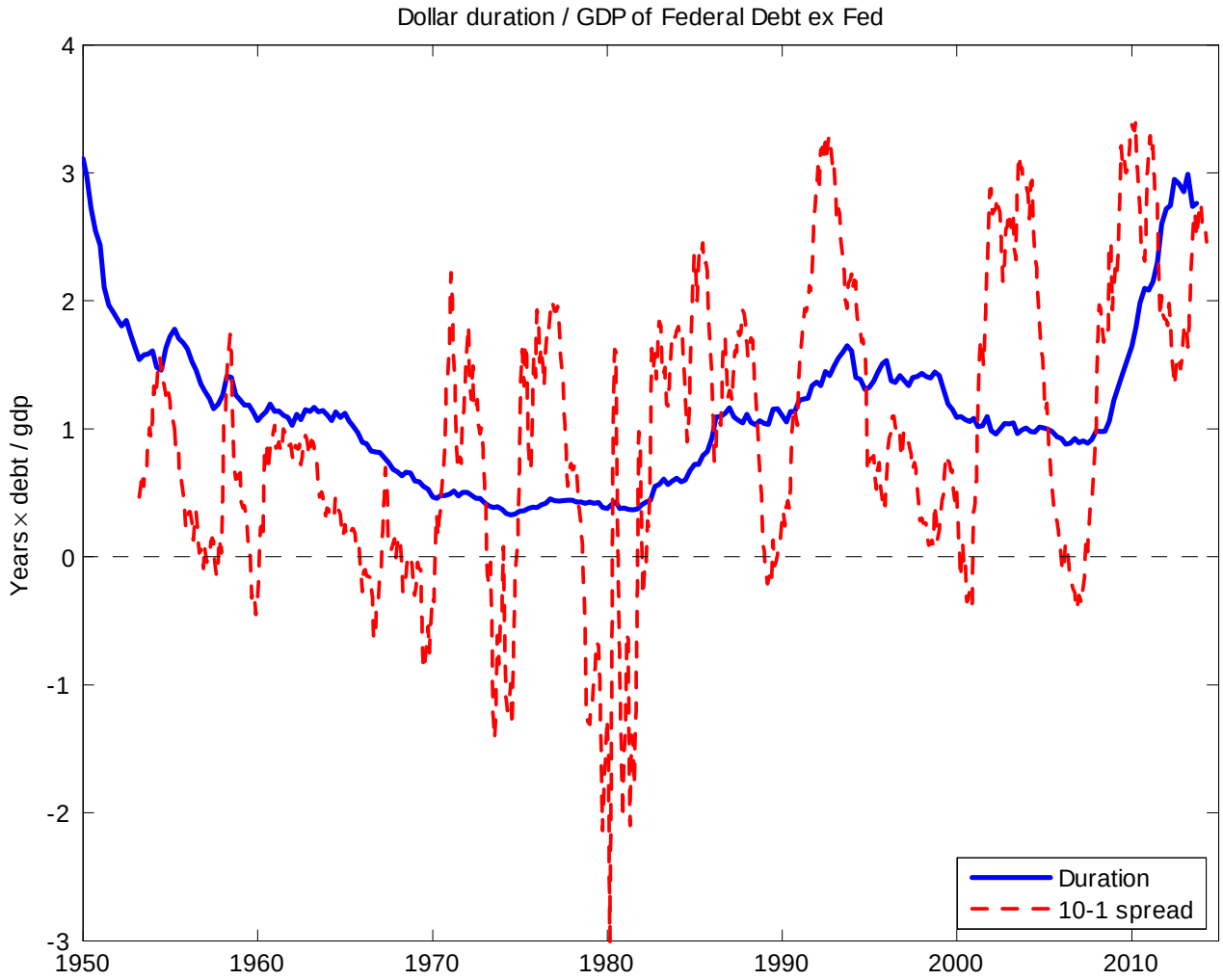
- "Fed is buying all new issues, starving the market." but



- Here, *stock* segmentation. Change in character of a security you hold prompts you to "reach for yield."
- How long does supply / price pressure last? Do constraints always bind?

Grumpy comments: Drop in bucket?.

- Markets have experienced *enormous* changes in quantity of debt held at various maturities with little effect on the term structure.



Fixed rate mortgage with prepayment option is recent, and US. MBS too.

Results: forecasting regressions

Table 1
Bond risk premia regressions: Treasuries

This table reports estimated coefficients from regressing annual bond excess returns constructed from Treasuries, rx^{τ}_{t+1}, onto a set of variables:

$$rx^{\tau}_{t+1} = \beta^{\tau}_1 \text{duration}_t + \beta^{\tau}_2 \text{level}_t + \epsilon^{\tau}_{t+1},$$

where level_t is the first principal component from bond yields. t-Statistics presented in parentheses are calculated using Newey and West (1987). All variables are standardized to have mean zero and a standard deviation of one. Data is weekly and runs from 1997 through 2011.

	2y	3y	4y	5y	6y	7y	8y	9y	10y
duration	0.116	0.167	0.212	0.251	0.285	0.314	0.340	0.362	0.381
	(1.63)	(2.28)	(2.88)	(3.38)	(3.80)	(4.16)	(4.46)	(4.72)	(4.96)
Adj. R^2	1.34%	2.78%	4.48%	6.29%	8.11%	9.87%	11.53%	13.07%	14.51%
duration	0.067	0.161	0.243	0.312	0.370	0.419	0.459	0.492	0.520
	(0.83)	(1.94)	(2.91)	(3.78)	(4.54)	(5.18)	(5.72)	(6.16)	(6.54)
level	0.133	0.014	-0.083	-0.164	-0.230	-0.282	-0.322	-0.353	-0.375
	(1.48)	(0.16)	(-0.96)	(-1.89)	(-2.63)	(-3.20)	(-3.60)	(-3.89)	(-4.07)
Adj. R^2	2.75%	2.67%	4.96%	8.50%	12.56%	16.63%	20.40%	23.71%	26.53%

Results: forecasting regressions.

- $$\begin{aligned} rx_{t+1}^{(5)} &= a + 0.25(t = 3.4) \times \text{duration}_t + \varepsilon_{t+1},\ R^2 = 8.1\% \\ rx_{t+1}^{(10)} &= a + 0.38(t = 4.96) \times \text{duration}_t + \varepsilon_{t+1},\ R^2 = 14.5\% \\ \text{with level, } t &= 6.54, \mathrm{R}^2 = 26.55\%! \end{aligned}$$
- t = 4.96-6.54 with 14 data points?
- Too good to be true?
- Get duration data from authors + GSW, run the regressions...

Replicate regressions

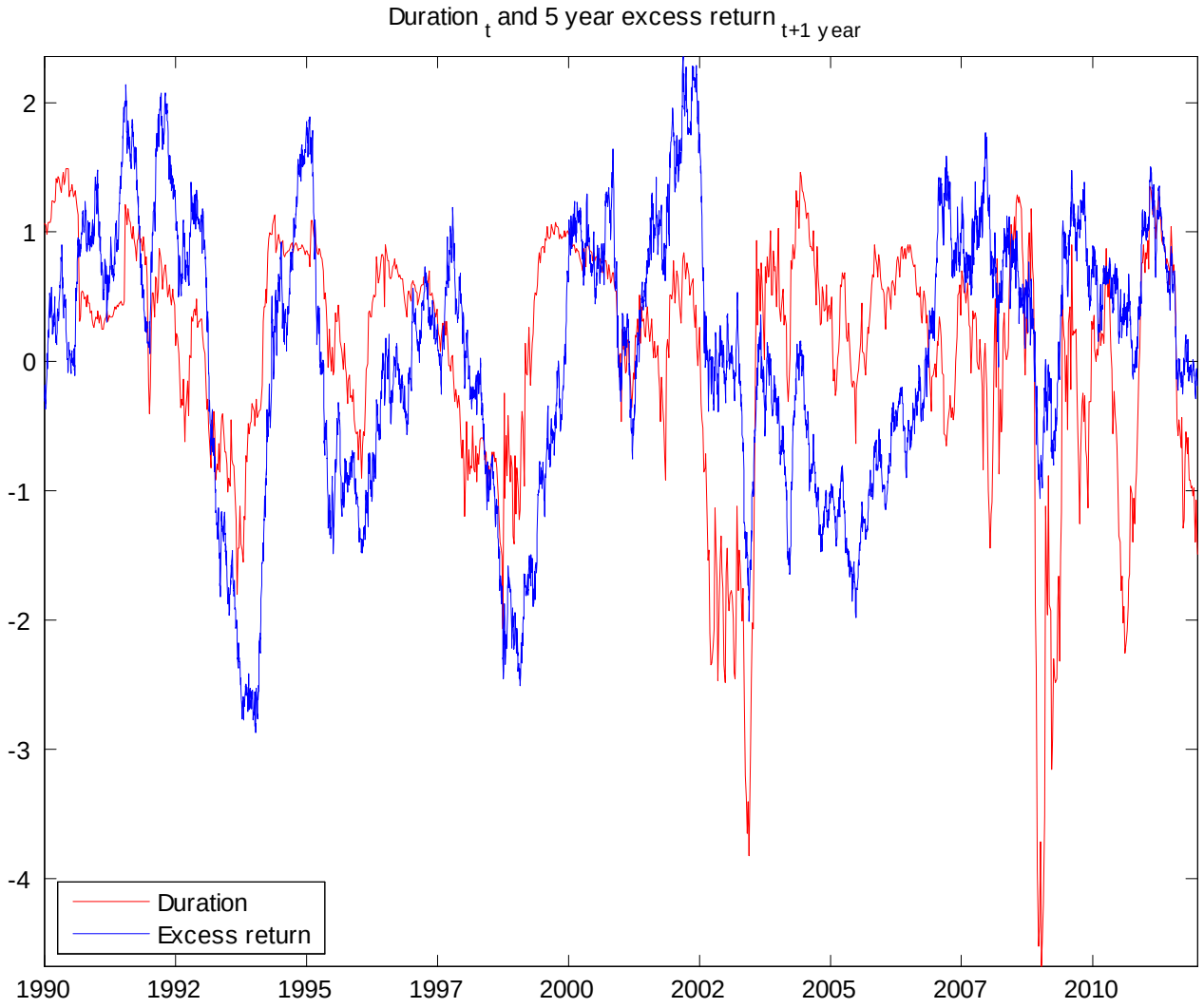
Regressions of GSW Treasury bond excess returns on duration

$$rx_{t+1}^{(n)} = a + b \times \text{duration}_t + \varepsilon_{t+1}$$

n	b	se	t	R2
5	2.4	0.65	3.8	0.13
10	5.4	1.1	5.0	0.20
avg	4.1	0.84	5.0	0.20

avg $= \frac{1}{15} \sum_{n=1}^{15} rx^{(n)}$
standard errors use Hansen-Hodrick correction with 52 lags.

Replicate regressions



- Wow! TGTBT! *All treasury risk premia derive from interest/prepayment induced variation in MBS duration????*

Discussant whining

- So what's in this magic duration measure? "Supply" or "proxy for macro risk premium?"
- Model: "We take r_t as exogenous." Data: r_t is the #1 business cycle indicator, reacting to S&D in housing and its finance.
- Model: Bond supply = constant. Only change in duration comes from r_t. Data: D is measured duration of MBS portfolio. Affected by flow of new (longer than average) mortgages, #2 cycle indicator.
- Model: *Dollar* duration of *entire bond portfolio* (MBS, bank-held, Treasury, Corporate, Foreign. Data: *Macaualy* duration of *MBS* portfolio only. (And coverage?)
  - \$ Duration *leaves out* direct supply change!
  - Rate-induced changes in MBS duration, a drop in the bucket of overall dollar duration?
- Duration measure in data = proprietary Barclays time series
  - Computed how? Really no future information? What ingredients? $D_t = D(X_t)$, fit in sample (to forecast?)
- Model: β is a *derived parameter* from structure of the model $(\kappa, \lambda, \eta, \sigma, \alpha..)$. Empirics: β is a *free parameter*.
  - $\Rightarrow$What is the point of a model? Does β make any sense – plausible structural parameters? Is the regression not way too good to be supply effect?

Bottom line

- Powerful suggestive ad-hoc bond return forecaster.
- Good first step to right modeling strategy: no arbitrage, not supply and demand. Needs vaguely realistic intermediary objective, intermediary structure, grounded MM violations.
- Model not well connected to empirical work.
- $\Rightarrow$Not convinced power of D says anything about supply channel vs. proxy for macroeconomic risk premium.

The end

The End

Grumpy comments on supply models.

- Plea: Name and take seriously MM failure
- MM: Bond risk premium is determined by durability / risk of capital, preferences/demographics. Financing structure is irrelevant.
- MM Here:
  1. Interest rate decline.
  2. Duration of indebted household liabilities falls.
  3. Until they refinance, they should borrow more long term (car, boat, glider, home equity), shift pensions/investments from bonds, or otherwise short duration.
  4. Or their pension fund should buy less bonds. If pension fund is static too, no overall change, about distributions/insurance.
  5. If prices change, companies, governments, etc. should supply duration. (Huge current government/corporate long issues).

NOTES

Supply s_t^τ
Bonds are held by financial institutions. We think about
them as representing a range of investors such as investment banks, hedge funds, and
fund managers, who trade actively in fixed income markets and act as marginal investors
there. Financial institutions are competitive and have mean-variance preferences over
the instantaneous change in the value of their bond portfolio
Λ_t^τ =price of bond at t with maturity τ

$$dW_t = \left(W_t - \int x_t^\tau \Lambda_t^\tau d\tau \right) r_t dt + \int x_t^\tau \Lambda_t^\tau \frac{d\Lambda_t^\tau}{\Lambda_t^\tau} d\tau$$

(note typo? $\frac{d\Lambda_t^\tau}{\Lambda_t^\tau}$)

$$\max E_t dW_t - \frac{\alpha}{2} var_t dW_t$$

Equilibrium

$$x_t^\tau = s_t^\tau$$

Supply:

$$dD_t = \kappa_D \left(\theta_D - D_t \right) dt + \eta_y d\bar{y}_t^{\bar{\tau}}$$