Online Appendix to “Real Term Structure and New Keynesian Models”

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A.1 Liquidity Premium

Following Gürkaynak, Sack, and Wright (2010), I regress end-of-the-week 10-year inflation compensation (the difference between the 10-year nominal and TIPS yields) on TIPS relative trading volume among primary dealers (at weekly frequency from the Federal Reserve Bank of New York) and the 10-year on-the-run spread (at daily frequency).[1]

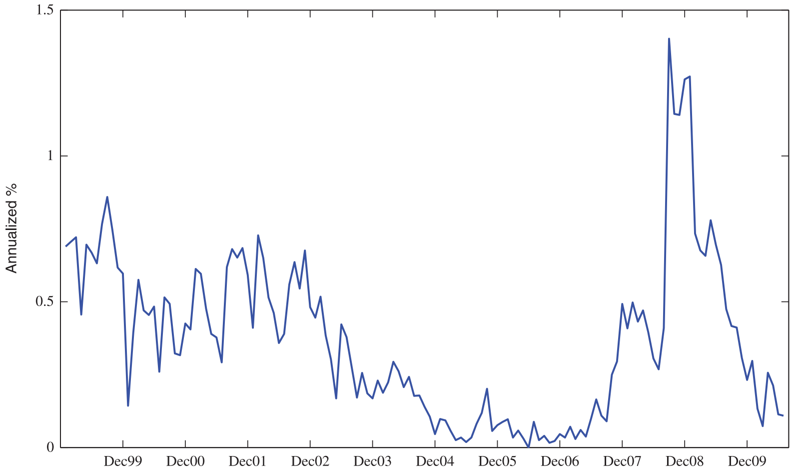
Relative trading volume is important in measuring the liquidity premium. It is generally easier for investors to adjust their portfolios in a security with a higher trading volume because it is less costly for them to do so. Hence they would be willing to pay less for a security with low liquidity. Therefore, a lower level of transaction volume implies a higher liquidity premium and a lower inflation compensation. I use the on-the-run spread as another measure of the liquidity premium because it measures the changes in the liquidity premium due to other factors than the trading volume. So, the regression is given by

$$(y_t^{(40)} - r_t^{(40)}) = \gamma_0 + \gamma_1 (TIPSTransVolume_t) + \gamma_2 (Spread_t) + \varepsilon_t. \quad (1)$$

However, this regression does not pin down the level of the liquidity effect. I assume that in July 2006 the level of the liquidity premium is zero, meaning that I am measuring the liquidity premium relative to this level. This date coincides with the date where

[1] On-the-run spread is the difference between the price of a most recently issued security and the price of the previously issued security with the same residual maturity. The newly issued security is generally more expensive and more liquid than previously issued security.

Figure A.1. Estimated Liquidity Premium



I estimate the liquidity premium to be the lowest. Figure A.1 shows the estimated liquidity premium. When TIPS were first introduced the liquidity premium was very high, but over time it decreased substantially until the recent crises. This finding is consistent with the literature. Finally, I adjust 10-year TIPS yields for liquidity by subtracting the liquidity premium from the observed 10-year TIPS.

A.2 Average Expected Real Short Rates

Following Joslin, Le, and Singleton (2012), I use principal components to obtain expected (or forecasted) future short-term yields. Specifically, I extract first three principal components of the TIPS yields. Assuming that the principal components follow a VAR(1) process, I generate forecasts of the components for 40 quarters at every t. Then, using the component loadings, I convert the forecasts of principal components into forecasts of short-term real interest rates. Finally, averaging the forecasts of the short-term real rate at every t gives time series for average expected real short rates.

A.3 Full Set of Results for the Benchmark Model with Extensions

Table A.1. Macroeconomic and Real Term Structure Moments Implied by the Benchmark New Keynesian Model with Estimated Policy Rule

	Data	**Best Fit**
sd(C)	0.79	0.74
sd(L)	1.29	2.08
sd(w^r)	1.02	1.98
sd(π)	0.93	2.08
sd(i)	1.97	2.70
sd($r^{(3)}$)	1.51	1.36
sd($y^{(40)}$)	1.73	2.45
sd($r^{(40)}$)	0.68	0.90
mean($\psi_{nom}^{(40)}$)	1.93	2.74
sd($\psi_{nom}^{(40)}$)	1.01	0.64
mean($y^{(40)} - i$)	1.77	2.47
sd($y^{(40)} - i$)	1.28	1.26
mean($x_{nom}^{(40)}$)	1.67	4.70
sd($x_{nom}^{(40)}$)	26.77	24.45
mean($\psi_{real}^{(40)}$)	1.32	0.82
sd($\psi_{real}^{(40)}$)	0.42	0.23
mean($r^{(40)} - r^{(3)}$)	1.32	0.54
sd($r^{(40)} - r^{(3)}$)	1.13	0.88
mean($x_{real}^{(40)}$)	2.90	1.69
sd($x_{real}^{(40)}$)	14.20	8.73
IES		0.06
CRRA		125
Frisch		0.23
ξ		0.71
ρ_A		0.95
σ_A		0.006
$\nu_{\pi*}$		0.14
$\rho_{\pi*}$		0.96
$\sigma_{\pi*}$		0.0008
ρ_i		0.64
g_π		0.70
g_y		0.50
σ_i		0.003

Table A.2. Macroeconomic and Real Term Structure Moments Implied by the New Keynesian Model with Quadratic Labor Adjustment Costs

	Data	Baseline Calibration	Best Fit
sd(C)	0.79	1.81	1.76
sd(L)	1.29	1.88	5.20
sd(w^r)	1.02	12.14	6.08
sd(π)	0.93	3.28	6.36
sd(i)	1.97	2.98	7.36
sd($r^{(3)}$)	1.51	0.99	2.94
sd($y^{(40)}$)	1.73	2.08	6.34
sd($r^{(40)}$)	0.68	0.28	1.58
mean($\psi_{nom}^{(40)}$)	1.93	0.59	3.46
sd($\psi_{nom}^{(40)}$)	1.01	0.40	3.13
mean($y^{(40)} - i$)	1.77	0.53	3.15
sd($y^{(40)} - i$)	1.28	1.05	2.73
mean($x_{nom}^{(40)}$)	1.67	1.03	6.32
sd($x_{nom}^{(40)}$)	26.77	16.64	57.31
mean($\psi_{real}^{(40)}$)	1.32	0.04	0.51
sd($\psi_{real}^{(40)}$)	0.42	0.01	0.55
mean($r^{(40)} - r^{(3)}$)	1.32	-0.10	0.10
sd($r^{(40)} - r^{(3)}$)	1.13	0.96	1.32
mean($x_{real}^{(40)}$)	2.90	0.13	1.48
sd($x_{real}^{(40)}$)	14.20	1.30	9.09
IES		0.5	0.07
CRRA		75	115
Frisch		0.66	0.28
ξ		0.75	0.78
ρ_A		0.95	0.96
σ_A		0.005	0.007
$\nu_{\pi*}$		0.01	0.014
$\rho_{\pi*}$		0.99	0.97
$\sigma_{\pi*}$		0.0005	0.0007
κ		50	10

Note: The calibration of quadratic labor adjustment costs follows Rudebusch and Swanson (2008).

Table A.3. Macroeconomic and Real Term Structure Moments Implied by the New Keynesian Model with Real Wage Rigidities

	Data	Baseline Calibration	Best Fit
sd(C)	0.79	1.67	0.84
sd(L)	1.29	1.79	3.26
sd(w^r)	1.02	1.04	1.57
sd(π)	0.93	1.92	3.71
sd(i)	1.97	1.76	4.29
sd($r^{(3)}$)	1.51	1.33	1.79
sd($y^{(40)}$)	1.73	2.25	4.13
sd($r^{(40)}$)	0.68	0.24	0.94
mean($\psi_{nom}^{(40)}$)	1.93	0.57	2.33
sd($\psi_{nom}^{(40)}$)	1.01	0.33	1.54
mean($y^{(40)} - i$)	1.77	0.52	2.12
sd($y^{(40)} - i$)	1.28	1.07	0.93
mean($x_{nom}^{(40)}$)	1.67	1.01	4.29
sd($x_{nom}^{(40)}$)	26.77	15.46	37.31
mean($\psi_{real}^{(40)}$)	1.32	-0.03	0.33
sd($\psi_{real}^{(40)}$)	0.42	0.02	0.28
mean($r^{(40)} - r^{(3)}$)	1.32	-0.02	0.12
sd($r^{(40)} - r^{(3)}$)	1.13	1.28	1.67
mean($x_{real}^{(40)}$)	2.90	0.06	0.99
sd($x_{real}^{(40)}$)	14.20	1.02	6.20
IES		0.5	0.05
CRRA		75	130
Frisch		0.66	0.25
ξ		0.75	0.77
ρ_A		0.95	0.96
σ_A		0.005	0.005
$\nu_{\pi*}$		0.01	0.014
$\rho_{\pi*}$		0.99	0.98
$\sigma_{\pi*}$		0.005	0.0008
μ		.8	.75

Note: The calibration of real wage rigidities follows Rudebusch and Swanson (2008).

Table A.4. Macroeconomic and Real Term Structure Moments Implied by the New Keynesian Model with Long-Run Productivity Risks

	Data	Baseline Calibration	Best Fit
sd(C)	0.79	2.87	0.61
sd(L)	1.29	1.80	2.11
sd(w^r)	1.02	2.44	0.36
sd(π)	0.93	3.97	2.22
sd(i)	1.97	3.51	2.52
sd($r^{(3)}$)	1.51	1.34	1.09
sd($y^{(40)}$)	1.73	2.46	2.56
sd($r^{(40)}$)	0.68	0.16	0.50
mean($\psi_{nom}^{(40)}$)	1.93	0.52	1.43
sd($\psi_{nom}^{(40)}$)	1.01	0.44	0.90
mean($y^{(40)} - i$)	1.77	0.47	1.32
sd($y^{(40)} - i$)	1.28	1.19	0.69
mean($x_{nom}^{(40)}$)	1.67	0.90	2.68
sd($x_{nom}^{(40)}$)	26.77	18.99	22.92
mean($\psi_{real}^{(40)}$)	1.32	-0.07	0.20
sd($\psi_{real}^{(40)}$)	0.42	0.06	0.07
mean($r^{(40)} - r^{(3)}$)	1.32	-0.15	0.06
sd($r^{(40)} - r^{(3)}$)	1.13	1.31	1.05
mean($x_{real}^{(40)}$)	2.90	-0.03	0.61
sd($x_{real}^{(40)}$)	14.20	1.19	3.62
IES		1.5	0.06
CRRA		75	140
Frisch		0.66	0.27
ξ		0.75	0.78
ρ_A		0.95	0.96
σ_A		0.005	0.004
$\nu_{\pi *}$		0.01	0.01
$\rho_{\pi *}$		0.99	0.99
$\sigma_{\pi *}$		0.0005	0.0005
ρ_{A*}		0.95	0.96
σ_{A*}		0.005	0.008

Note: The calibration of long-run productivity risks follows Bansal and Yaron (2005) and Croce (2014).

Table A.5. Macroeconomic and Real Term Structure Moments Implied by the New Keynesian Model with Preference Shocks

	Data	Baseline Calibration	Best Fit
sd(C)	0.79	1.73	1.18
sd(L)	1.29	1.66	5.80
sd(w^r)	1.02	2.82	4.09
sd(π)	0.93	3.08	5.53
sd(i)	1.97	3.16	6.53
sd($r^{(3)}$)	1.51	1.55	2.30
sd($y^{(40)}$)	1.73	2.06	7.24
sd($r^{(40)}$)	0.68	0.42	1.53
mean($\psi_{nom}^{(40)}$)	1.93	2.09	4.09
sd($\psi_{nom}^{(40)}$)	1.01	0.25	3.83
mean($y^{(40)} - i$)	1.77	1.98	3.74
sd($y^{(40)} - i$)	1.28	1.38	2.61
mean($x_{nom}^{(40)}$)	1.67	3.27	7.61
sd($x_{nom}^{(40)}$)	26.77	19.02	64.43
mean($\psi_{real}^{(40)}$)	1.32	0.64	0.59
sd($\psi_{real}^{(40)}$)	0.42	0.03	0.68
mean($r^{(40)} - r^{(3)}$)	1.32	0.37	0.22
sd($r^{(40)} - r^{(3)}$)	1.13	1.44	2.20
mean($x_{real}^{(40)}$)	2.90	1.14	1.77
sd($x_{real}^{(40)}$)	14.20	4.01	9.77
IES		0.5	0.04
CRRA		75	125
Frisch		0.66	0.28
ξ		0.75	0.79
ρ_A		0.95	0.96
σ_A		0.005	0.007
$\nu_{\pi*}$		0.01	0.016
$\rho_{\pi*}$		0.99	0.98
$\sigma_{\pi*}$		0.0005	0.0007
ρ_λ		0.9	0.93
σ_λ		0.02	0.01

Note: The calibration of the preference shock follows Basu and Bundick (2017).

References

Bansal, R., and A. Yaron. 2005. "Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles." *Journal of Finance* 59 (4): 1481–1509.

Basu, S., and B. Bundick. 2017. "Uncertainty Shocks in a Model of Effective Demand." *Econometrica* 85 (3): 937–58.

Croce, M. 2014. "Long-Run Productivity Risk: A New Hope for Production-Based Asset Pricing?" *Journal of Monetary Economics* 66 (September): 13–31.

Gürkaynak, R. S., B. Sack, and J. Wright. 2010. "The TIPS Yield Curve and Inflation Compensation." *American Economic Journal: Macroeconomics* 2 (1): 70–92.

Joslin, S., A. Le, and K. J. Singleton. 2013. "Why Gaussian Macrofinance Term Structure Models are (nearly) Unconstrained Factor-VARs." *Journal of Financial Economics* 109 (3): 604–22.

Rudebusch, G., and E. Swanson. 2008. "Examining the Bond Premium Puzzle with a DSGE Model." *Journal of Monetary Economics* 55 (Supplement): S111–S126.