Internet Appendix

for "Consumption Growth Persistence and the Stock-Bond Correlation"

Christopher S. Jones and Sungjune Pyun

AI. Data

We obtain quarterly consumption data from the National Income and Product Accounts (NIPA) tables, provided by the Bureau of Economic Analysis. We measure consumption at the quarterly frequency as the sum of the real personal consumption expenditure on non-durables and services on a per capita basis. Specifically, we take the quantity index of NIPA Table 2.3.3 and divide it by the total population obtained from NIPA Table 7.1. Consumption growth is defined as the first log difference and is computed from 1962 to 2019.

We supplement the NIPA data with other consumption measures that are arguably less noisy and/or less affected by time aggregation. First, we consider fourth-quarter to fourth-quarter consumption growth, as analyzed by Jagannathan and Wang (2007). They conjecture that a disproportionate fraction of the population is likely to review their consumption decisions in the fourth quarter, making fourth quarter measurements more reflective of economic conditions. Second, we use the unfiltered consumption series of Kroencke (2017). Kroencke argues that the filtering and smoothing process implemented in the NIPA data adds noise to the consumption measures that obscures their relationship to asset prices, and he proposes a method to reverse the effects of these transformations. Third, since the fourth-quarter consumption and unfiltered consumption series are both at the annual frequency, we also implement the empirical analysis using NIPA annual consumption. Each of these annual consumption measures is obtained from Tim Kroencke's website.

To proxy for expected consumption growth, we use data from the Survey of Professional

Forecasters (SPF), obtained from the Federal Reserve Bank of Philadelphia. The sample for the survey data begins in the third quarter of 1981. We use the four-quarter-ahead median forecast in real consumption expenditures.

For economic uncertainty, we use the 12-month macro and real uncertainty measures from Jurado, Ludvigson, and Ng (2015). These are obtained from Sydney Ludvigson's website and are available from 1961 to 2019. To reduce the noise that comes from the imprecise timing of these measurements, we analyze growth expectation and uncertainty estimates at the yearly frequency, using observations from the last quarter of the year.

Bond yields are obtained from the Federal Reserve Bank of St. Louis' website. Nominal one-year and ten-year yields are available from 1962 to 2019, while we analyze real yields over the period from 2003 to 2019. Real yields are constructed from ten-year Treasury Inflation-Protected Securities (TIPS). We use them starting in 2003 to avoid well-known illiquidity problems in the early years of that market (e.g., Dudley et al. (2009),Gürkaynak et al. (2010),D'Amico et al. (2018)). Excess market returns and total market returns are from Ken French's website.

The calibration in Section B required us to compute moments of real returns and yields. To compute averages of real variables, we subtract the average changes in the Consumer Price Index, obtained from the Bureau of Labor Statistics, over the entire calibration period. To compute the standard deviation of real bond yields and the stock-bond return correlation, we make several assumptions. One is that the relative variances of shocks to inflation and nominal yields remains constant over the entire sample period. Another is that inflation follows a unit-root process. That is, the change in expected inflation equals the unexpected price change in the previous period.

We first calculate the variance ratio (VR) of inflation, defined as in Duffee (2018a), which is the relative ratio of the variance of inflation shocks to the variance of nominal yields. The variance of real yields is then computed by multiplying the variance of nominal yields by $(1 - VR)$. In computing the real SB covariance $Cov(\Delta y^r_{t+1}, R^r_{m,t+1})$, we assume that the inflation expectation equals past realized inflation and compute the covariance by

$$Cov(\Delta y^r_t, R^r_{m,t}) = Cov(\Delta y_{t+1} - \Delta\pi_{t+1}, R_{m,t+1} - \Delta\pi_{t+1}) = Cov(\Delta y_{t+1}, R_{m,t+1}) - Var(\Delta\pi_{t+1}),$$

where y_{t+1} is the nominal bond yield, y^r_{t+1} is the real bond yield, $R_{m,t+1}$ is the nominal stock return, and $R^r_{m,t+1}$ is the real stock return. The variance of real stock returns is $Var(R^r_{m,t}) = Var(R_{m,t}) - Var(\Delta\pi_t)$, which is very close to the variance of nominal stock returns.

We also use several measures of wealth. In addition to the value-weighted stock market index, these are the value of assets from Sydney Ludvigson's website and used in Lettau and Ludvigson (2001), the All-Transactions Housing Price Index of the U.S. Federal Housing Finance Agency, and the net worth of households and nonprofit organizations from the Federal Reserve Bank of St. Louis.

AII. Technical Appendix

A. The wealth-consumption ratio

Following the Campbell-Shiller decomposition, returns to total wealth portfolio can be represented by

$$R_{TW,t+1} = \kappa_0 + \Delta c_{t+1} + A_0(\kappa_1 - 1) + A_x(\kappa_1 x_{t+1} - x_t) + A_v(\kappa_1 \sigma^2_{t+1} - \sigma^2_t) + A_q(\kappa_1 q_{t+1} - q_t).$$

The intertemporal marginal rate of substitution (IMRS) is

$$m_{t+1} = \theta \log \beta - \gamma \Delta c_{t+1} + (\theta - 1)\big[\kappa_0 + A_0(\kappa_1 - 1) + A_x(\kappa_1 x_{t+1} - x_t)$$
$$+ A_v(\kappa_1 \sigma_{t+1}^2 - \sigma_t^2) + A_q(\kappa_1 q_{t+1} - q_t)\big].$$

The unexpected component of the IMRS is represented by

$$m_{t+1} - \mathrm{E}_t[m_{t+1}] = \lambda_c \sigma_t \epsilon_{c,t+1} + \lambda_x \sigma_t \epsilon_{x,t+1} + \lambda_v \sigma_t \epsilon_{v,t+1} + \lambda_\delta \sigma_t \epsilon_{q,t+1},$$

where $\lambda_c = -\gamma$, $\lambda_x = (\theta - 1)\kappa_1 A_x \phi_x$, $\lambda_v = (\theta - 1)\kappa_1 A_v \sigma_v$, and $\lambda_\delta = (\theta - 1)\kappa_1 A_q \sigma_q$.

We solve for A_0, A_x, A_v, and A_q using the Euler equation

$\mathrm{E}_t[m_{t+1} + R_{TW,t+1}] + \mathrm{Var}_t[m_{t+1} + R_{TW,t+1}] = 0$. For A_x, we collect all terms associated with x_t:

$$A_x = \frac{1 - \frac{1}{\psi}}{1 - \kappa_1 \xi_1}.$$

Collecting the terms from the Euler equation that are functions of σ_t^2 and q_t, it can be seen that A_v and A_q must jointly satisfy the conditions

$$2A_v(\kappa_1 s_1 - 1) + \theta\big((A_x \kappa_1 \varphi_x)^2 + (A_v \kappa_1 \sigma_v)^2 + (A_q \kappa_1 \sigma_q)^2 + (1 - \frac{1}{\psi})^2\big) + 2(1-\gamma)\kappa_1 A_v \sigma_v \rho_{cv} = 0$$

$$A_q = Q_0 + Q_1 A_v,$$

where $Q_0 = \frac{(1-\gamma)\kappa_1 A_x \varphi_x}{1 - \kappa_1 \omega_1} < 0$ and $Q_1 = \frac{\theta \rho_{cv} \kappa_1^2 A_x \varphi_x \sigma_v}{1 - \kappa_1 \omega_1} > 0$.

A_v can be obtained by solving a quadratic equation after plugging the second equation into the first. It can also be shown that $A_v < 0$ when $\gamma > 1$ and $\psi > 1$ by evaluating the characteristics of the quadratic equation. We obtain two values for A_v. We choose the value that is closer to the baseline model. The second value generates unrealistic moments of asset returns. The negative sign of A_v also implies $A_q < 0$.

Finally, A_0 satisfies $A_0 = \frac{1}{1-\kappa_1}\left[\log \beta + \kappa_0 + (1 - \frac{1}{\psi})\mu + k_1(A_v s_0 + A_q \omega_0)\right]$.

B. The price-dividend ratio

Similar to the wealth-consumption ratio we assume that the the price-dividend ratio is an affine function, $A_{m,0} + A_{m,x}x_t + A_{m,v}\sigma_t^2 + A_{m,q}\delta_t$, and we again solve for the coefficients using the Euler equation $E_t[m_{t+1} + R_{m,t+1}] + 0.5Var_t[m_{t+1} + R_{m,t+1}] = 0$. Collecting the terms associated with x_t, σ_t^2, and q_t, we can solve for $A_{m,0}$, $A_{m,x}$, $A_{m,v}$, and $A_{m,q}$. First, we have

$$A_{m,x} = \frac{\phi_d - \frac{1}{\psi}}{1 - \kappa_1\xi_1}.$$

As in the wealth-consumption ratio, $A_{m,v}$, and $A_{m,q}$ must jointly satisfy the conditions

$$2A_{m,v}(\kappa_{m,1}s_1 - 1) + 2(\theta - 1)(\kappa_1 s_1 - 1)A_v + 2(\varphi_{cd} + \lambda_c)(\kappa_{m,1}A_{m,v}\sigma_v + \lambda_v)\rho_{cv}$$
$$+ (\kappa_{m,1}A_{m,x}\varphi_x + \lambda_x)^2 + (\kappa_{m,1}A_{m,v}\sigma_v + \lambda_v)^2 + (\kappa_{m,1}A_{m,q}\sigma_q + \lambda_\delta)^2 + (\varphi_{cd} + \lambda_c)^2 + \varphi_d^2 = 0$$
$$A_{m,q} = Q_{m,0} + Q_{m,1}A_{m,v},$$

where

$Q_{m,0} = \frac{1}{1-\kappa_1\omega_1}\big((\varphi_{cd} + \lambda_c)(\kappa_1 A_{m,x}\varphi_x + \lambda_x) + (\theta - 1)(\kappa_1\omega_1 - 1)A_q + \lambda_v(\kappa_1 A_{m,x}\varphi_x + \lambda_x)\rho_{cv}\big)$

and $Q_{m,1} = \frac{1}{1-\kappa_1\omega_1}\kappa_1\sigma_v(\kappa_1 A_{m,x}\varphi_x + \lambda_x)\rho_{cv}$. Evaluating the characteristics of the quadratic function, similar to the earlier case, we find that $A_{m,v} < 0$ when $\gamma > \varphi_{cd} > 1$, which is consistent with the general long-run risk specification. Also, one can show that $A_{m,30} <$ and $A_{m,32} > 0$ under the condition of $\gamma > \phi_d$ and $\varphi_{cd} > 1$, which implies that $A_{m,q} < 0$.

Finally, $A_{m,0}$ satisfies

$$A_{m,0} = \frac{1}{1 - \kappa_{m,1}}\big(\theta \log\beta + (\theta - 1)\kappa_0 + \kappa_{m,0} + (1 - \gamma)\mu$$
$$+ \kappa_1 A_v s_0(\theta - 1) + \kappa_{m,1}A_{m,v}s_0 + \kappa_1 A_q\omega_0(\theta - 1) + \kappa_{m,1}\omega_0 A_{m,q} + (\theta - 1)(\kappa - 1)A_0\big).$$

C. Bond yields

Denote the state vector as

$$\Sigma_t = \begin{bmatrix} \Delta C_t & x_t & \sigma_t^2 & q_t \end{bmatrix}'$$

We can write the conditional mean as

$$\mathrm{E}_t \left[\Sigma_{t+1} \right] = K_0 + K \Sigma_t,$$

where

$$K_0 = \begin{bmatrix} \mu & 0 & s_0 & \omega_0 \end{bmatrix}'$$

and

$$K = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & \xi_1 & 0 & 0 \\ 0 & 0 & s_1 & 0 \\ 0 & 0 & 0 & \omega_1 \end{bmatrix}$$

The conditional covariance matrix is

$$\mathrm{Cov}_t \left(\Sigma_{t+1}, \Sigma'_{t+1} \right) = \begin{bmatrix} \sigma_t^2 & \phi_x q_t & \rho_{cv} \sigma_v \sigma_t^2 & 0 \\ \phi_x q_t & \phi_x^2 \sigma_t^2 & \sigma_v \rho_{cv} q_t & 0 \\ \rho_{cv} \sigma_v \sigma_t^2 & \sigma_v \rho_{cv} q_t & \sigma_v^2 \sigma_t^2 & 0 \\ 0 & 0 & 0 & \sigma_q^2 \sigma_t^2 \end{bmatrix} = \Omega_1 \sigma_t^2 + \Omega_2 q_t,$$

where

$$\Omega_1 = \begin{bmatrix} 1 & 0 & \rho_{cv}\sigma_v & 0 \\ 0 & \phi_x^2 & 0 & 0 \\ \rho_{cv}\sigma_v & 0 & \sigma_v^2 & 0 \\ 0 & 0 & 0 & \sigma_q^2 \end{bmatrix} \quad \text{and} \quad \Omega_2 = \begin{bmatrix} 0 & \phi_x & 0 & 0 \\ \phi_x & 0 & \phi_x\rho_{cv}\sigma_v & 0 \\ 0 & \phi_x\rho_{cv}\sigma_v & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}.$$

In vector notation, we can write the log pricing kernel as

$$m_{t+1} = m_0 + M_1'\Sigma_{t+1} - M_2'\Sigma_t$$

with

$$m_0 = \theta \log \beta + (\theta - 1)\left(\kappa_0 + A_0(\kappa_1 - 1)\right),$$

$$M_1 = \begin{bmatrix} -\gamma & (\theta-1)\kappa_1 A_x & (\theta-1)\kappa_1 A_v & (\theta-1)\kappa_1 A_q \end{bmatrix}',$$

and

$$M_2 = \begin{bmatrix} 0 & (\theta-1)A_x & (\theta-1)A_v & (\theta-1)A_q \end{bmatrix}',$$

where A_x, A_v, and A_q are as defined earlier.

The log price of a riskless one-period bond ($B_{1,t}$) is given by

$$\begin{aligned} B_{1,t} =& \mathrm{E}_t\left[m_{t+1}\right] + 0.5\mathrm{Var}_t\left(m_{t+1}\right) \\ =& m_0 + M_1'K_0 + \left(M_1'K - M_2'\right)\Sigma_t + 0.5M_1'\mathrm{Cov}_t\left(\Sigma_{t+1}, \Sigma_{t+1}'\right)M_1 \\ =& m_0 + M_1'K_0 + \left(M_1'K - M_2'\right)\Sigma_t + 0.5M_1'\Omega_1 M_1\sigma_t^2 + 0.5M_1'\Omega_2 M_1 q_t \\ =& m_0 + M_1'K_0 + \left(M_1'K - M_2'\right)\Sigma_t + 0.5\Psi'\Sigma_t \\ =& m_0 + M_1'K_0 + \left(M_1'K - M_2' + 0.5\Psi'\right)\Sigma_t, \end{aligned}$$

where

$$\Psi' = \begin{bmatrix} 0 & 0 & M_1'\Omega_1 M_1 & M_1'\Omega_2 M_1 \end{bmatrix}'.$$

Therefore, the yield of a one-period bond is equal to

$$y_t = Y_0 + Y\Sigma_t,$$

where

$$Y_0 = -m_0 - M_1' K_0$$

and

$$Y = -M_1' K + M_2' - 0.5\Psi'.$$

It can be shown that for

$$Y = \begin{bmatrix} 0 & Y_x & Y_v & Y_p \end{bmatrix}'$$

we have $Y_x > 0$ and $Y_v, Y_p < 0$.

Now suppose that the n-period bond has a log price

$$B_{n,t} = D_{n,0} + D_n' \Sigma_t.$$

Then the $(n+1)$-period bond has a price that is equal to the conditional expectation of

$$\mathrm{E}_t \left[m_{t+1} + B_{n,t+1} \right] + 0.5 \mathrm{Var}_t \left(m_{t+1} + B_{n,t+1} \right),$$

where

$$m_{t+1} + B_{n,t+1} = m_0 + D_{n,0} + (M_1 + D_n)' \Sigma_{t+1} - M_2' \Sigma_t.$$

The log price of the bond can be solved as

$$\begin{aligned} B_{n,t+1} =& m_0 + D_{n,0} + (M_1 + D_n)'(K_0 + K\Sigma_t) - M_2'\Sigma_t + 0.5(M_1 + D_n)'\text{Cov}_t\left(\Sigma_{t+1}, \Sigma_{t+1}'\right)(M_1 + D_n) \\ =& m_0 + D_{n,0} + (M_1 + D_n)'K_0 + \left((M_1 + D_n)'K - M_2'\right)\Sigma_t + 0.5\Psi_n'\Sigma_t, \end{aligned}$$

where

$$\Psi_n = \begin{bmatrix} 0 & 0 & (M_1 + D_n)'\Omega_1(M_1 + D_n) & (M_1 + D_n)'\Omega_2(M_1 + D_n) \end{bmatrix}'.$$

The log of $(n+1)-$period bond price is therefore

$$B_{n+1,t} = D_{n+1,0} + D_{n+1}'\Sigma_t,$$

where

$$D_{n+1,0} = m_0 + D_{n,0} + (M_1 + D_n)'K_0$$

and

$$D_{n+1} = K'(M_1 + D_n) - M_2 + \frac{1}{2}\Psi_n.$$

The $(n+1)-$period yield is therefore equal to

$$y_{n+1,t} = Y_{n+1,0} + Y_{n+1}\Sigma_t,$$

where $Y_{n+1,0} = -D_{n+1,0}$ and $Y_{n+1} = -D_{n+1}'$.

D. The stock-bond return correlation

The stock-bond return correlation is the negative of the correlation between stock returns and changes in the bond yield. Unexpected stock market returns are derived using the

Campbell-Shiller decomposition:

$$R_{m,t+1} - \mathrm{E}_t[R_{m,t+1}] = \kappa_{m,1}\phi_x A_{m,x}\sigma_t\epsilon_{x,t+1} + \kappa_{m,1}\sigma_v A_{m,v}\sigma_t\epsilon_{v,t+1} + \kappa_{m,1}\sigma_q A_{m,q}\epsilon_{q,t+1} + \varphi_{cd}\sigma_t\epsilon_{c,t+1} + \varphi_d\sigma_t\epsilon_{d,t+1}$$

We can then compute the stock-bond return correlation by taking the negative of the conditional correlation between market returns and bond yields.

The conditional covariance between a n-period bond yield and stock returns can be expressed as

$$\begin{aligned} \mathrm{Cov}_t(R_{m,t+1}, y_{n,t+1}) &= \left(Y_{n,x}S_x\varphi_x + Y_{n,v}S_v\sigma_v + Y_{n,q}S_q\sigma_q + Y_{n,v}S_c\sigma_v\rho_{cv}\right)\sigma_t^2 \\ &\quad + \left((Y_{n,x}\varphi_x S_v + Y_{n,v}S_x\sigma_v)\rho_{cv} + Y_{n,x}S_c\varphi_x\right)q_t, \end{aligned}$$

in which the terms $Y_{n,\cdot}$ are elements of the 1×4 vector Y_{n+1}:

$$Y_{n+1} = \begin{bmatrix} 0 & Y_{n+1,x} & Y_{n+1,v} & Y_{n+1,p} \end{bmatrix},$$

and S_x, S_v, S_v, and S_q are defined as:

$$S_x = \kappa_{m,1}\phi_x A_{m,x}, \qquad S_v = \kappa_{m,1}\sigma_v A_{m,v}, \qquad S_q = \kappa_{m,1}\sigma_q A_{m,q}, \qquad S_c = \varphi_{cd}, \qquad S_d = \varphi_d.$$

The conditional variance of the bond yield is

$$\mathrm{Var}_t\left(y_{n,t+1}\right) = \left(Y_n\Omega_1 Y_n' + Y_n\Omega_2 Y_n'\rho_t\right)\sigma_t^2.$$

Similarly, the conditional variance of the wealth portfolio/market returns is

$$\mathrm{Var}_t\left(R_{m,t+1}\right) = \sigma_{m,t}^2 = (V_v + V_q\rho_t)\sigma_t^2,$$

where $V_v = S_x^2 + S_v^2 + S_q^2 + S_c^2 + S_d^2 + 2S_cS_v\rho_{cv}$ and $V_q = 2S_xS_v\rho_{cv} + 2S_cS_x$.

E. The market risk premium

The risk premium of the wealth/market portfolio can be expressed as

$$\text{Cov}_t(-m_{t+1}, R_{j,t+1}) = \big(- \lambda_c(S_c + S_v\rho_{cv}) - \lambda_x S_x - \lambda_v S_v - \lambda_\delta S_q - S_c\lambda_v\rho_{cv}\big)\sigma_t^2$$

$$+ (-\lambda_x S_v\rho_{cv} - \lambda_v S_x\rho_{cv} - \lambda_c S_x - \lambda_x S_c)q_t.$$

AIII. Additional figures and Tables

A. Consumption growth persistence and stock-bond correlations

We show the model-implied relationship between consumption growth persistence and stock-bond correlations for different parameter specifications. Figure A1 describes the results. Similar to Figure 2, the relationship between CGP correlation and SB correlation is almost unaffected by the risk-aversion coefficient, inter-temporal elasticity of substitution, and persistence of the CGP parameter.

B. Consumption growth autocorrelation using overlapping longer horizon rates

Figure A2 examines consumption growth autocorrelation using overlapping longer-horizon growth rates. These regressions are identical to equation (6), except that the dependent variable is the average consumption growth rate from quarter $t+1$ to quarter $t+k$. Each panel plots the coefficient on the interaction term (α_2) for different horizons (k), as well as 68%, 90%, and 95% confidence intervals, where the panels differ with respect to the SB correlation series used and the sample period. While we present results only for the ten-year nominal SB correlation, corresponding results based on 1-year nominal yields are very similar.

[Insert Figure A2 approximately here]

Graph A of Figure A2 reports the results obtained using the full sample period at horizons of one to ten quarters. The graph shows that predictability is observed even over very long horizons, consistent with the premise that the SB correlation is associated with the correlation between long-run growth and current consumption growth.

Graph B shows the same result, still based on nominal yields, for the shorter sample in which TIPS data are available, while Graph C shows the corresponding results using real yields. While the results based on TIPS are somewhat stronger, both graphs indicate more long-term persistence in consumption growth in low SB correlation environments.

The final panel of Figure A2 examines the role of the stock-inflation correlation at longer horizons. As in Table III, a lower stock-inflation correlation decreases the persistence of consumption growth[12], an effect that becomes statistically significant over longer horizons. This is again inconsistent with the hypothesis that inflation effects are responsible for the relation between CGP and the SB correlation. While the interpretation of this result is difficult given that inflation falls outside the scope of our model, the results reinforce the conclusion that the SB correlation is related to consumption persistence due to the behavior of real rates.

C. Expected consumption growth and uncertainty

Several recent studies (e.g., Nakamura et al. (2017),Bollerslev, Xu, and Zhou (2015)) document the unconditionally negative relationship between economic uncertainty and future expected consumption growth. Our model implies that this relationship also varies with CGP.

[Insert Table A1 approximately here]

We test this hypothesis in Table A1 using expected consumption growth from the SPF and

[12]Note that we take the negative sign of inflation to compute the correlation. If our results are driven by the correlation between stock returns and the expected inflation component of bond yields, we would expect the opposite of what we find.

the macro and real uncertainty measures of Jurado et al. (2015). Each panel in the table uses a different measure of uncertainty. Similar to Table V, we use fourth-quarter data for this analysis.

We first test whether the relationship between expected consumption growth and uncertainty is more negative during the period beginning 1999. If CGP increases in this sample, we expect a stronger negative relationship between expected consumption growth and uncertainty. We use the contemporaneous regression

$$\Delta\hat{x}_t = \beta_0 + \beta_1 \Delta UNC_t + \beta_2 1_{99+,t} \times \Delta UNC_t + \beta_3 1_{99+,t} + \epsilon_t, \tag{11}$$

where 1_{99+} is a dummy variable that takes a value of 1 starting in 1999 and 0 before, $\hat{x}_t$ is the long-run SPF forecast of consumption growth, and UNC_t is a measure of economic uncertainty. If our hypothesis is true, we expect β_2 to be negative.

The first two columns of each panel summarize the results and provide strong support for our hypothesis. For both uncertainty measures, we find that the relationship between expected consumption growth and uncertainty is more negative in the later sample.

We also test the hypothesis by replacing the dummy variable with the SB correlation, or

$$\Delta\hat{x}_t = \beta_0' + \beta_1' \Delta UNC_t + \beta_2' \hat{\rho}_{SB,t} \times \Delta UNC_t + \beta_3' \hat{\rho}_{SB,t} + \epsilon_t, \tag{12}$$

where $\hat{\rho}_{SB,t}$ is one of the SB correlation estimates. If the SB correlation is negatively related to CGP, we should obtain positive estimates for the β_2' parameter.

Overall, the table provides reasonably strong support for our hypothesis. Using the nominal one-year or ten-year SB correlation in Panels A and B, we find a positive β_2 in every regression, which are statistically significant in most cases. The last two columns of the panels instead use the real SB correlation. These results are somewhat weaker, which is likely due to the shorter sample period and collinearity.

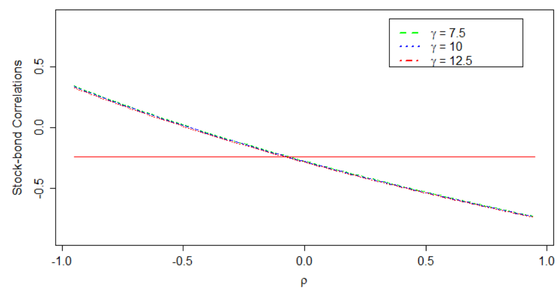
Taken together, these results paint a consistent picture that the negative relationship between consumption growth and economic uncertainty is stronger when the SB correlation is negative or when CGP is positive, confirming a key prediction of our model.

FIGURE A1

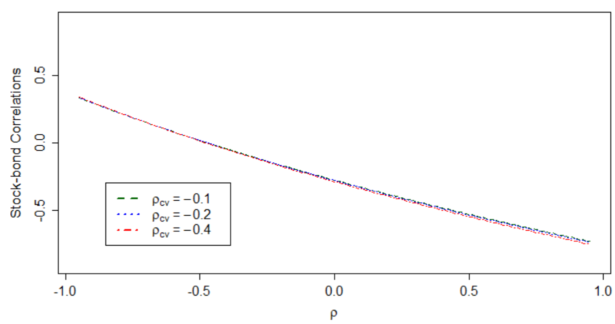
Consumption Persistence and Model-Based Correlations (II)

This figure shows the relationships between CGP and the stock-bond return correlation for different bond maturities and parameter assumptions. The value of the baseline model is shown in solid horizontal lines. The relationship for the full model is drawn in dashed lines. The panels show the relationship for different risk-aversion coefficient (A), correlation between consumption growth and volatility (B), and values of the persistence of the CGP process (C). In Graph C, we also vary the standard deviation parameter σ_ω so that the unconditional standard deviation of the CGP process is identical to its value under the baseline parameterization.

A. **SB correlations for different values of** γ



B. **SB correlations for different values of** ρ_{cv}



C. **SB correlations for different values of** ω_1

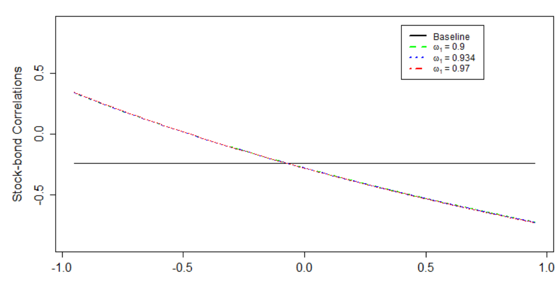


FIGURE A2

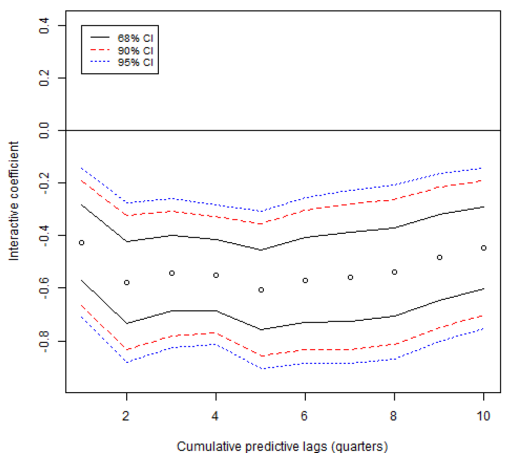
Interactive Beta of Consumption Growth Regressions For Multiple Lags

This figure plots the slope coefficient estimates $(\hat{\alpha}_{3,k})$ from the interactive regression

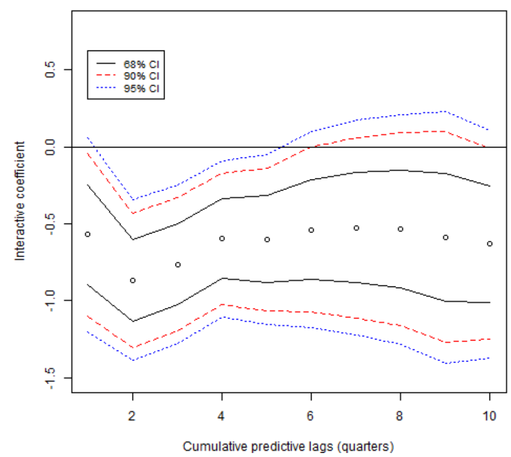
$$\sum_{k=1}^{K} \Delta c_{t+k} = \alpha_{0,K} + \alpha_{1,K}\Delta c_t + \alpha_{2,K}\hat{\rho}_{SB,t} + \alpha_{3,K}\hat{\rho}_{SB,t} \times \Delta c_t + \epsilon_{t+K}$$

for different values of the interval (K). In Graphs A and B, $\hat{\rho}_{SB,t}$ represents the correlation between stock returns and nominal 10-year bond returns. Graph C uses the correlation with real 10-year bond returns instead, while Graph D uses the negative of the correlation between stock returns and inflation shocks. The lines show the 68%, 90%, and 95% confidence intervals computed using Newey-West standard errors with 12 lags. Graph A is based on the full 1962-2019 sample period, while other graphs use the 2003-2019 sample.

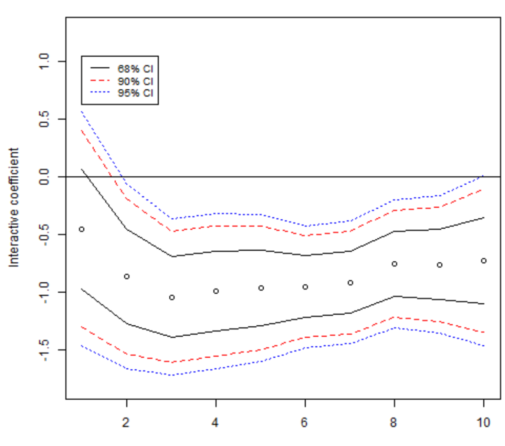
A. **Stock-bond correlations**



B. **Stock-bond correlations (shorter sample)**



C. **Real stock-bond correlation**



D. **Stock-inflation correlation**

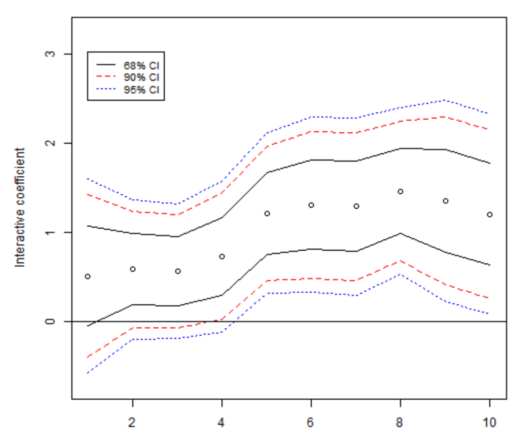


TABLE A1

Uncertainty and Expected Growth

This table summarizes the slopes and Newey-West-adjusted (3 lags) t-statistics from regressing the first-difference in the SPF long-run consumption growth forecast on the first difference of uncertainty. Some regressions also include interactions with a 1999+ year dummy or with the SB correlation, which is estimated using 1-year or 10-year nominal yields or with the 10-year real yield, as well as main effects for these variables. In Panel A, UNC denotes macro uncertainty, while in panel B it is real uncertainty, both from Jurado et al. (2015). There are 38 observations (1981-2018), except for when the 10-year real SB correlation is used (2003-2018, 16 observations) for the analysis.

Panel A. Using Macro Uncertainty for UNC

	Dependent Variable: $\Delta\hat{x}_t$							
Bond maturity:			1Y		10Y		10Y Real	
Δ UNC$_t$	-0.042	0.007	-0.023	-0.023	-0.027	-0.028	-0.055	-0.017
	(-1.92)	(0.22)	(-1.61)	(-1.62)	(-0.61)	(-1.70)	(-4.28)	(-1.42)
Δ UNC$_t \times 1_{99+}$		-0.069						
		(-2.05)						
Δ UNC$_t \times \hat{\rho}_{SB,t}$			0.133	0.130	0.089	0.085	0.052	0.061
			(4.00)	(4.36)	(1.98)	(2.03)	(0.87)	(0.82)
1_{99+}		0.001						
		(0.57)						
$\hat{\rho}_{SB,t}$				-0.003		-0.001		-0.004
				(-1.81)		(-0.89)		(-1.09)
Adj-R^2	0.175	0.250	0.301	0.305	0.260	0.242	0.516	0.499

Panel B. Using Real Uncertainty for UNC

	Dependent Variable: $\Delta\hat{x}_t$							
Bond maturity:			1Y		10Y		10Y Real	
Δ UNC$_t$	-0.083	-0.008	-0.056	-0.063	-0.064	-0.067	-0.059	-0.058
	(-2.32)	(-0.18)	(-2.80)	(-3.71)	(2.88)	(-3.17)	(-1.05)	(-0.04)
Δ UNC$_t \times 1_{99+}$		-0.110						
		(-2.49)						
Δ UNC$_t \times \hat{\rho}_{SB,t}$			0.205	0.197	0.138	0.129	0.385	0.419
			(3.94)	(4.44)	(2.46)	(2.53)	(1.62)	(2.83)
1_{99+}		0.001						
		(0.68)						
$\hat{\rho}_{SB,t}$				-0.003		-0.001		0.003
				(-1.62)		(-0.90)		(0.66)
Adj-R^2	0.197	0.249	0.296	0.302	0.262	0.244	0.546	0.518