What Drives Variation in the U.S. Debt/Output Ratio? The Dogs that Didn't Bark

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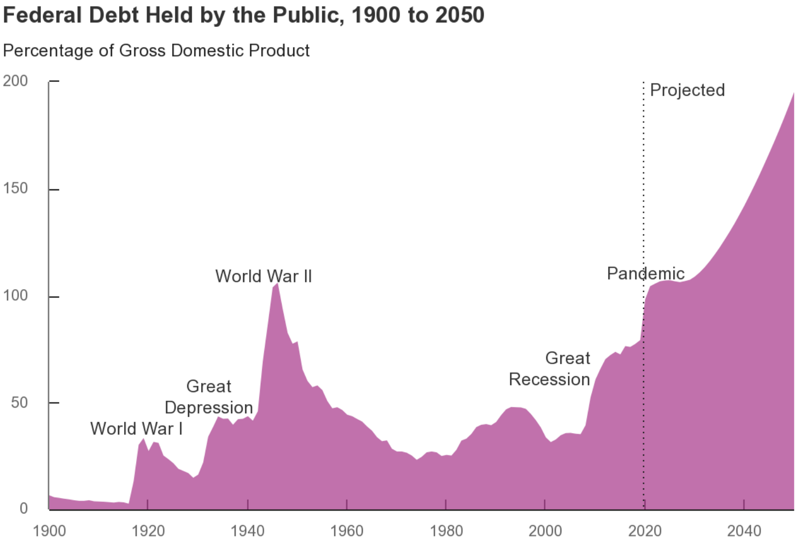
Fiscal Sustainability



Source: Congressional Budget Office

Fiscal Sustainability: Forward-looking Approach

- Ongoing debate in the U.S. about fiscal sustainability
- Current run-up in the U.S. debt/output ratio reflects:
  1. Lower future inflation-and-growth adjusted returns on government debt (Blanchard, 2019; Furman and Summers, 2020; Cochrane, 2021a) :
     - $(r - g) < 0$ debate
  2. Higher future surpluses (Bohn, 1998; Cochrane, 2020)
  3. Higher future debt/output ratio

This Paper

- Apply standard asset pricing machinery (Campbell-Shiller decomposition) to a macro question (fiscal sustainability)
- Campbell-Shiller decomposition of the U.S. debt/output ratio :
    1. **Discount rates**: No evidence that the debt/output ratio predicts real growth-adjusted returns. ✗
    2. **Cash flows**: No evidence that the debt/output ratio predicts surpluses. ✗
    3. **Residual**: higher future debt/output ratio ✓

$\Rightarrow$ Excess smoothness: Bond prices today not responsive to news about future macro fundamentals

Findings Differ From Literature

- Earlier work:
  - Bohn (1998), studying a sample that ends in the mid-1990s, finds evidence that the primary surplus increases when the debt/output ratio is high
  - Cochrane (2021a,b) finds evidence that the debt/output ratio predicts lower *nominal* returns on the government debt portfolio
  - This paper: no evidence that the debt/output ratio predicts surpluses or *real growth-adjusted* returns
- Key observation: Large small-sample bias (Stambaugh, 1999) in the slope coefficients of the return and surplus predictability regressions due to:
  1. High **persistence** of the debt/output ratio (the predictor)
  2. High **correlation** between the innovations to the predictor and the predicted variables

Related Literature

- **Stock return predictability** (Campbell and Thompson, 2007; Cochrane, 2008; Binsbergen and Koijen, 2010; Goyal and Welch, 2005; Golez and Koudijs, 2018):
  - Discount rates on stocks are remarkably volatile (Hansen and Jagannathan, 1991),
  - Valuation of stocks seems excessively volatile compared to its fundamentals (LeRoy and Porter, 1981; Shiller, 1981),
  - High valuations imply low future returns (mean reversion in valuation ratios),
- **Bond return predictability**: (Fama and Bliss, 1987; Campbell and Shiller, 1991; Cochrane and Piazzesi, 2005; Ludvigson and Ng, 2009; Cochrane, 2011) ,
  - Individual bond return predictability,
  - For entire bond portfolio: high valuations do not imply low future returns (no mean reversion in valuation ratios),
  - Valuation of bonds seems too smooth compared to its fundamentals

Other Related Literature

Variance Decomposition of Debt/Output

Campbell-Shiller Decomposition of Debt/Output Ratio

- Log-linearized return equation implied by the government budget constraint:

$$\widetilde{r}_{t+1} = r_{t+1} - \pi_{t+1} - x_{t+1} = \rho v_{t+1} - v_t + s_{t+1},$$

  where $\rho = \exp(-(r - x - \pi))$ is a constant, v_t is log of debt/output ratio, and $s_{t+j} = sy_{t+j}/e^{v}$ is a scaled measure of surplus/output.
  (see Gourinchas and Rey, 2007; Berndt, Lustig, and Yeltekin, 2012; Cochrane, 2021a)
  - Similar to log-linearized return for stocks:

$$r_{t+1} = \rho pd_{t+1} - pd_t + \Delta d_{t+1}.$$

- By iterating this forward T times and taking expectations, we obtain the debt valuation equation:

$$v_t = \mathbb{E}_t \sum_{j=1}^{T} \rho^{j-1} \left(s_{t+j} - \widetilde{r}_{t+j} \right) + \mathbb{E}_t \rho^T v_{t+T}.$$

Variance Decomposition

- We set $\rho = 1$ ("r=g").
- Debt/output ratio reflects either future surpluses or future returns after adjusting for inflation and growth.

$$v_t = \mathbb{E}_t \sum_{j=1}^{T} \left(s_{t+j} - \widetilde{r}_{t+j} \right) + \mathbb{E}_t v_{t+T}.$$

- Debt/output ratio varies because it either predicts future surpluses, future returns, or the future debt/output ratio:

Variance Decomposition of the Debt/Output Ratio.

$$var(v_t) = cov\left(\sum_{j=1}^{T} s_{t+j}, v_t \right) - cov\left(\sum_{j=1}^{T} \widetilde{r}_{t+j}, v_t \right) + cov(v_t, v_{t+T}).$$

Variance Decomposition: Implementation

- Estimate a system of univariate forecasting regressions for $\sum_{j=1}^{T} s_{t+j}, \sum_{j=1}^{T} \widetilde{r}_{t+j}, v_{t+j}$ using the lagged debt/output ratio as a predictor:

$$\begin{aligned}
\sum_{j=1}^{T} s_{t+j} &= a_s + b_T^s v_t + \epsilon_{t+T}^s, \\
\sum_{j=1}^{T} \widetilde{r}_{t+j} &= a_r + b_T^r v_t + \epsilon_{t+T}^r, \\
v_{t+T} &= \phi_0 + \phi_T v_t + \epsilon_{t+T}^v.
\end{aligned}$$

- More reliable estimates of long-run dynamics than VAR (Jordà, 2005)
- Cochrane (2008); Lettau and Van Nieuwerburgh (2008) adopt the same approach to implementing a Campbell-Shiller decomposition of the price/dividend ratio for stocks.

Variance Decomposition: Implementation

- Regression coefficients can be interpreted as the fraction of the variance of v_t explained by each component for a certain horizon T:

$$
\begin{aligned}
\frac{cov(\sum_{j=1}^{T} s_{t+j}, v_t)}{var(v_t)} &= b_T^s, \\
\frac{cov(-\sum_{j=1}^{T} \tilde{r}_{t+j}, v_t)}{var(v_t)} &= -b_T^r, \\
\frac{cov(v_{t+T}, v_t)}{var(v_t)} &= \phi_T.
\end{aligned}
$$

- Cross-equation restriction is satisfied: $b_T^s - b_T^r + \phi_T = 1, \forall\, T$.
- **Fiscal sustainability**: $\phi_T < 1$ for all T and $\phi_T \to 0$ as $T \to \infty$.

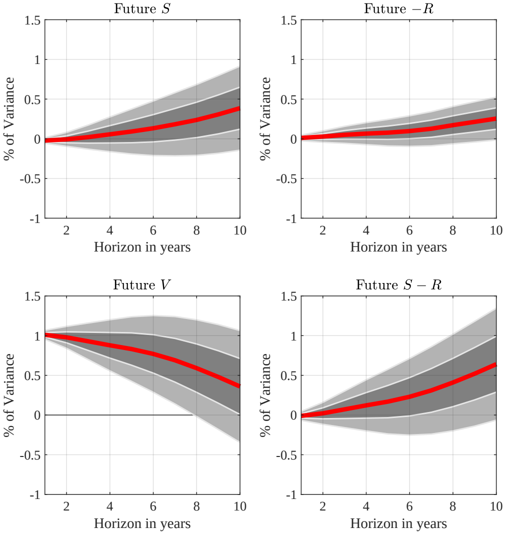
Data: Decade Averages

Variance Decomposition of v_t: No Bias Correction (1947-2020)

Horizon	1	2	3	4	5	6	7	8	9	10
					Forecasting $\sum_{j=1}^{T} -\tilde{r}_{t+j}$					
$-b_T^r$	0.01	0.03	0.05	0.07	0.08	0.1	0.13	0.17	0.21	0.25
s.e.	0.02	0.04	0.05	0.07	0.08	0.09	0.11	0.12	0.13	0.13
R^2	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.08	0.10	0.12
					Forecasting $\sum_{j=1}^{T} s_{t+j}$					
b_T^s	-0.02	-0.01	0.02	0.06	0.09	0.13	0.18	0.24	0.31	0.39
s.e.	0.02	0.04	0.08	0.11	0.14	0.17	0.2	0.22	0.24	0.26
R^2	0.02	0	0	0.01	0.02	0.03	0.05	0.06	0.09	0.11
					Forecasting v_{t+T}					
ϕ	1.01	0.98	0.93	0.88	0.83	0.77	0.69	0.59	0.48	0.36
s.e.	0.03	0.07	0.11	0.16	0.2	0.24	0.27	0.3	0.33	0.35
R^2	0.95	0.85	0.74	0.64	0.54	0.43	0.32	0.22	0.13	0.07

Nominal Return Decomposition

Variance Decomposition of v_t: No Bias Correction (1947-2020)



- Cannot reject the null of the presence of the unit root
- At the 5-yr horizon, 83% of the debt/output fluctuations can be attributed to the future debt/output
- At the 10-hr horizon, both cash flow and discount rate channels start to matter, but cannot reject the null that the fraction is zero

Small-sample Bias in Predictive Coefficients

- Small-sample bias Stambaugh (1999); Boudoukh, Israel, and Richardson (2020) for horizon T:

$$\begin{aligned} bias^r_T &= \mathbb{E}\left(\widehat{b}^r_T - b^r_T\right) = \frac{1}{N}\left[T(1+\phi) + 2\phi\frac{1-\phi^T}{1-\phi}\right] \times -\frac{cov(\epsilon^v, \epsilon^r)}{var(\epsilon^v)}, \\ bias^s_T &= \mathbb{E}\left(\widehat{b}^s_T - b^s_T\right) = \frac{1}{N}\left[T(1+\phi) + 2\phi\frac{1-\phi^T}{1-\phi}\right] \times -\frac{cov(\epsilon^v, \epsilon^s)}{var(\epsilon^v)}, \end{aligned}$$

  where ϕ is first-order autocorrelation of v_t, N sample size

- Here: $\phi = .99$, $corr(\epsilon^v, -\epsilon^r) = -0.75$ and $corr(\epsilon^v, \epsilon^s) = -0.85$.

$\Rightarrow$ Biases for b^s_T and $-b^r_T$ are positive and large.

$\Rightarrow$ We are overstating the surplus and return predictability in small samples.

Variance Decomposition of v_t: Bias Correction (1947-2020)

Horizon	1	2	3	4	5	6	7	8	9	10
					Forecasting $\sum_{j=1}^{T} -\widetilde{r}_{t+j}$					
$-b_T^r$	0.01	0.03	0.05	0.07	0.08	0.1	0.13	0.17	0.21	0.25
s.e.	0.02	0.04	0.05	0.07	0.08	0.09	0.11	0.12	0.13	0.13
R^2	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.08	0.1	0.12
unbiased	-0.01	-0.02	-0.02	-0.03	-0.04	-0.04	-0.04	-0.01	0	0.02
					Forecasting $\sum_{j=1}^{T} s_{t+j}$					
b_T^s	-0.02	-0.01	0.02	0.06	0.09	0.13	0.18	0.24	0.31	0.39
s.e.	0.02	0.04	0.08	0.11	0.14	0.17	0.2	0.22	0.24	0.26
R^2	0.02	0	0	0.01	0.02	0.03	0.05	0.06	0.09	0.11
unbiased	-0.05	-0.07	-0.08	-0.07	-0.07	-0.06	-0.05	-0.03	0.01	0.05
					Forecasting v_{t+T}					
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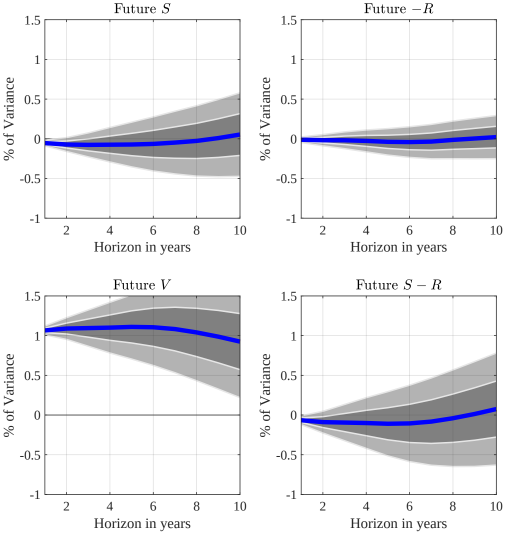
R^2	0.95	0.85	0.74	0.64	0.54	0.43	0.32	0.22	0.13	0.07
unbiased	1.07	1.09	1.1	1.1	1.11	1.11	1.08	1.04	0.99	0.92

Variance Decomposition of v_t: Bias Correction (1947-2020)

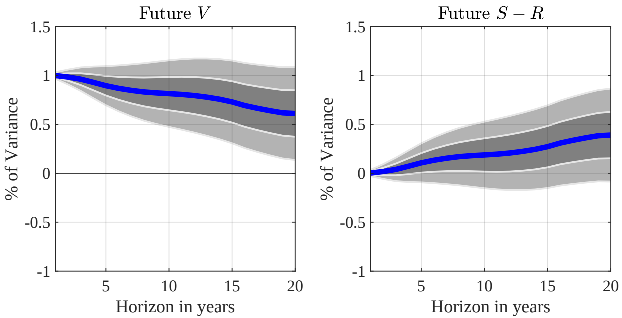


- The bias-corrected variance decomposition attributes -4% and -7% of the debt/output ratio variance to the discount rate and cash flow channel respectively at the 5-year horizon.
- As a result, 111% is accounted for by the future debt/output ratio at the 5-year horizon.
- At the 10-year horizon, we still attribute 92% of the variance to the future debt/output ratio, after correcting for the small-sample bias.

Variance Decomposition: Robustness

- Longer U.S. Hall-Payne-Sargent sample: 1842–2020
  - Same conclusion after small-sample bias correction
  - Now have more power to reject the null of no return predictability

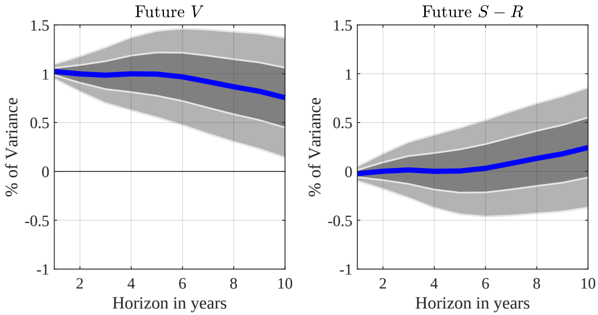
After Bias Correction



Variance Decomposition: Robustness

- Longer U.S. Hall-Payne-Sargent sample: 1842–2020 ✓
- Shorter Bohn Sample 1948—1995 ✓

After Bias Correction

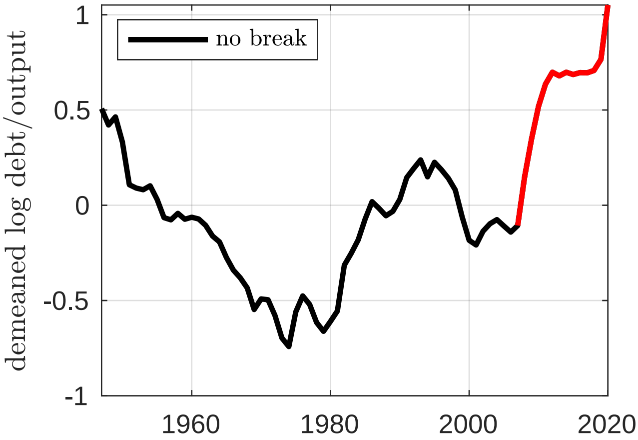


Permanent Shocks to the Debt/Output Ratio

1. Simulation under Null of Unit Root simulation
2. Structural Break

Structural Breaks

- A major contributor to the small role of fundamentals is the large run-up in debt/output ratio during the GFC



Structural Breaks

- A major contributor to the small role of fundamentals is the large run-up in debt/output ratio during the GFC
- Structural break in the log debt/output ratio (Lettau and Van Nieuwerburgh (2008)): demean the log debt/output ratio $\widetilde{v}_t = v_t - \bar{v}_t$ with a lower pre-2007 sample mean $(\bar{v}_t, t < 2007)$ and a higher post-2007 sample mean $(\bar{v}_t, t \geq 2007)$.
  - This structural break introduces a 78 log point permanent increase in the debt/output ratio; we 'delete' this increase from the variance decomposition.
  - Decrease in ϕ has to increase surplus/return predictability (cross-equation restriction): $(b^s_T - b^r_T) \nearrow = (1 - \phi_T) \nearrow$.
- Variance of the transitory component of debt/output ratio:

$$var(\widetilde{v}_t) = cov\left(\sum_{j=1}^{T} s_{t+j}, \widetilde{v}_t\right) - cov\left(\sum_{j=1}^{T} \widetilde{r}_{t+j}, \widetilde{v}_t\right) + cov(\widetilde{v}_t, \widetilde{v}_{t+T}).$$

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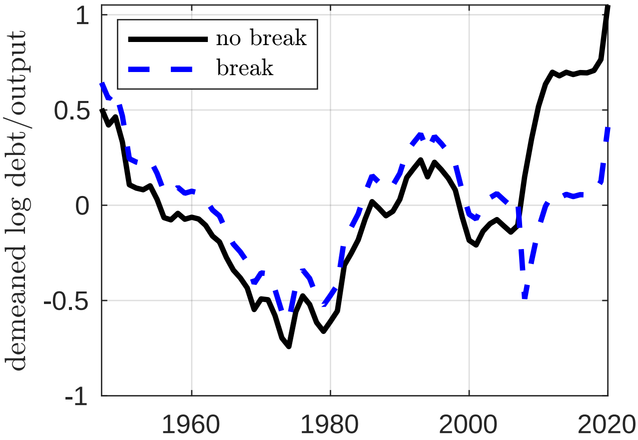

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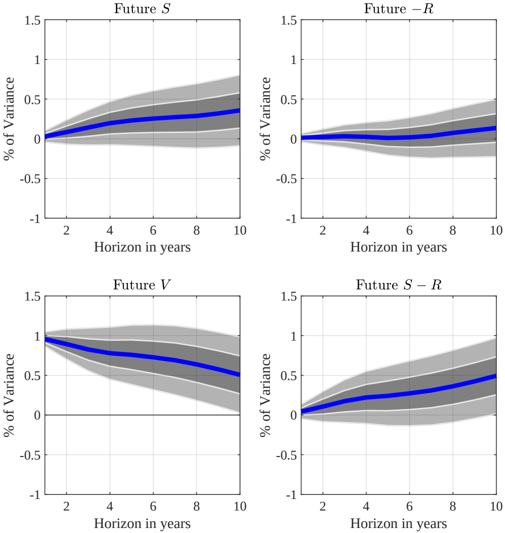
Variance Decomposition of $\widetilde{v}_t$ with Break



- Stronger evidence for surplus, but not return predictability
- Fundamentals now account for about 50% of the variation in the transitory component of the debt/output ratio at the 10-year horizon
- Still leave the large, permanent increase in the debt/output ratio (as well as its timing) unexplained

Structural Break Candidate 1: Biased Beliefs

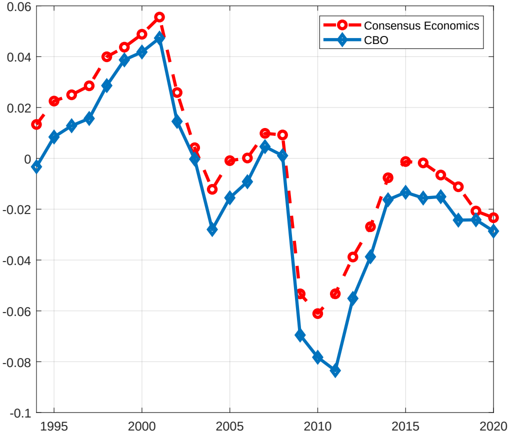
- Econometrician does not predict higher surpluses or lower returns when the debt/output ratio rises, but bond investors may.
- If investors systematically *over-predict* surpluses and *under-predict* returns when the debt/output ratio increases, their forecast error can impute a unit root in the debt/output ratio under the actual measure $\mathbb{E}$, while the debt/output ratio is stationary under the subjective beliefs measure $\mathbb{F}$

$$v_t = \mathbb{E}_t \sum_{j=1}^{T} \left(s_{t+j} - \widetilde{r}_{t+j}\right) + \underbrace{\left(\mathbb{F}_t v_{t+T} + \overbrace{(\mathbb{F}_t - \mathbb{E}_t) \sum_{j=1}^{T} (s_{t+j} - \widetilde{r}_{t+j})}^{ForcErr} \right)}_{\mathbb{E}_t v_T},$$

- $Cov(v_t, \mathbb{E}_t v_T)$ large and $Cov(v_t, \mathbb{F}_t v_T)$ small if $Cov(v_t, ForcErr) >> 0$

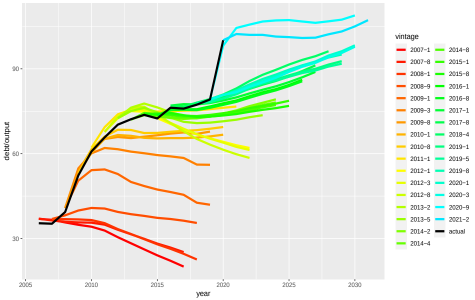
Private Forecasts Align with CBO Forecasts

Figure: Comparing CBO and Private-Sector Surplus Forecasts

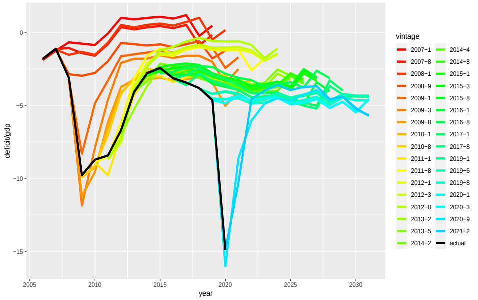


Ten-year CBO Projections

Debt/Ouput



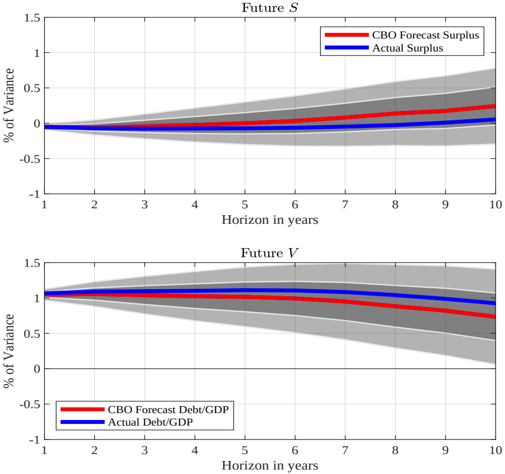
Surplus/Ouput



- CBO systematically over-predicts future surpluses when debt rises and underpredicts future debt/output, especially since GFC.
- Forecast errors were close to zero from 1980 to 1997.

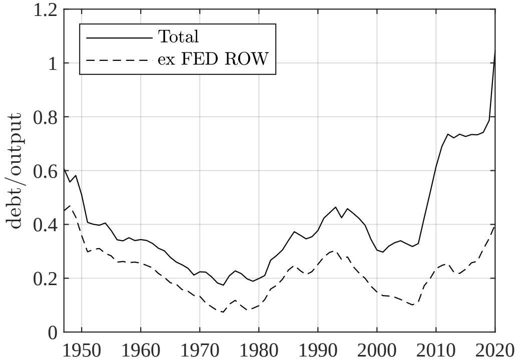
Predictability Under Subjective Measure

- Estimate the CS decomposition under subjective beliefs
  - Using the CBO forecast for the surplus/GDP ratio after 2007.



Structural Break Candidate 2: Fed & ROW

- Fed and Foreign holdings of Treasurys accelerated after GFC (QE)
- Private domestic holdings (ex-Fed, ex-ROW) are candidate transitory component $\tilde{v}_t$



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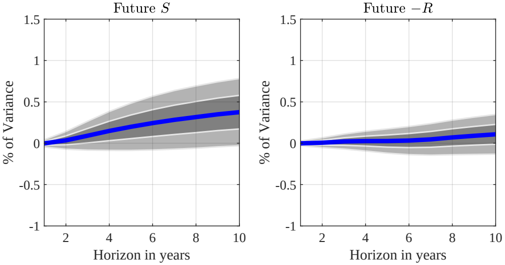


- We still cannot reject the null that surpluses are not predictable

Conclusion

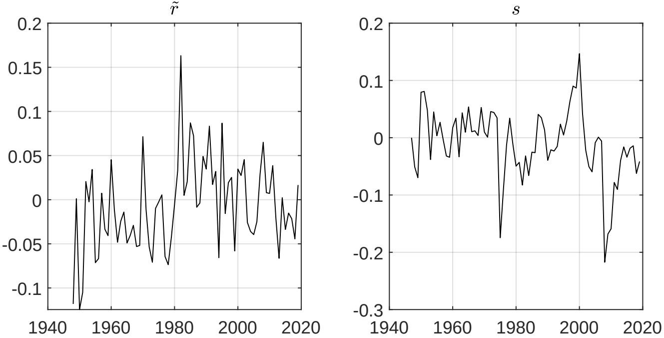
- The U.S. bond market's valuation surprisingly insensitive to news about future surpluses or returns
- Difficult to reject null hypothesis of unit root in debt/output once small-sample bias is addressed
- Interpretations: persistent component in debt/ouput ratio (structural break after 2007) imputed by
  1. Fed and ROW purchases
  2. Bond market investors' (overly optimistic) beliefs about future fiscal rectitude

Data: Decade Averages

	$\tilde{r}$	r	x	π	$x+\pi$	s/y
1947-1949	-7.8%	-1.8%	0.6%	5.4%	6.0%	1.5%
1950-1959	-3.8%	2.7%	4.1%	2.4%	6.5%	1.4%
1960-1969	-2.8%	3.9%	4.4%	2.3%	6.7%	1.4%
1970-1979	-2.5%	7.0%	3.2%	6.3%	9.5%	-0.6%
1947-1979	-3.5%	3.9%	3.6%	3.8%	7.4%	0.8%
1980-1989	4.1%	11.8%	3.0%	4.6%	7.6%	0.1%
1990-1999	1.6%	6.9%	3.2%	2.2%	5.3%	1.5%
2000-2009	0.8%	4.9%	1.9%	2.2%	4.1%	0.0%
2010-2020	-0.4%	2.9%	1.7%	1.6%	3.3%	-0.4%
1980-2020	1.5%	6.5%	2.4%	2.6%	5.1%	-0.6%
1947-2020	-0.7%	5.4%	3.0%	3.2%	6.1%	0.1%

- Note that $r < g$ or $\tilde{r} < 0$ only in first half of post-war sample
- Surpluses came down over time
- Does variation in v_t predict this secular variation in $\tilde{r}_{t\to t+10}$ or $s_{t\to t+10}$?

Returns and Surpluses

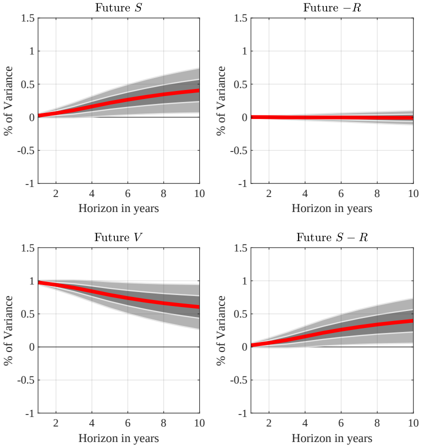


This figure plots the inflation-and-growth-adjusted log returns $\tilde{r}_t$ and the surplus/output ratio s_t.

Variance Decomposition of v_t: Longer Sample 1842—2020

- Robustness to longer U.S. Hall-Payne-Sargent sample

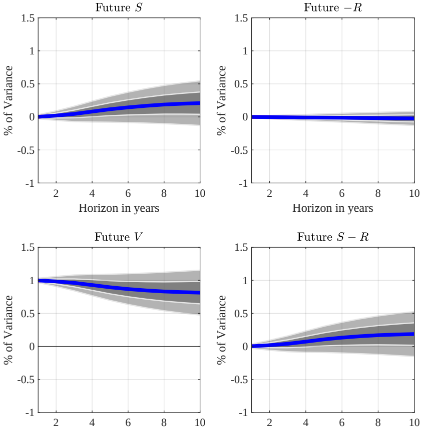
Panel A: Before Bias Correction



Variance Decomposition of v_t: Longer Sample 1842—2020

- Same conclusion after small-sample bias correction
- Now have more power to reject the null of no return predictability

Panel B: After Bias Correction



Variance Decomposition of v_t: Shorter Bohn Sample 1948—1995

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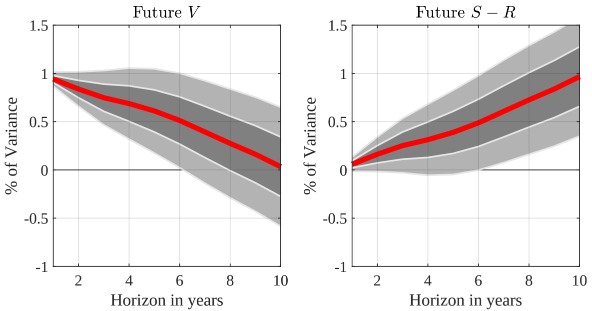
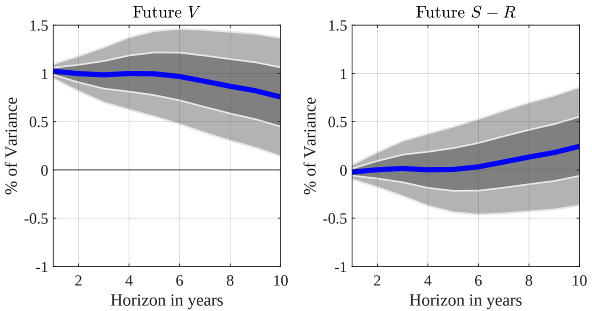


Variance Decomposition of v_t: Shorter Bohn Sample 1948—1995

Panel B: After Bias Correction



Forecasting Nominal Returns and Inflation with v_t

Horizon	1	2	3	4	5	6	7	8	9	10
					Forecasting $\sum_{j=1}^{T} r_{t+j}$					
b_T^r	-0.05	-0.11	-0.16	-0.22	-0.28	-0.35	-0.43	-0.52	-0.6	-0.69
s.e.	[0.02]	[0.03]	[0.05]	[0.06]	[0.07]	[0.08]	[0.09]	[0.1]	[0.11]	[0.13]
					Forecasting $\sum_{j=1}^{T} x_{t+j}$					
b_T^x	0	0	0.01	0	0	0	0.01	0.01	0.02	0.03
s.e.	[0.01]	[0.02]	[0.03]	[0.04]	[0.05]	[0.06]	[0.06]	[0.07]	[0.08]	[0.08]
					Forecasting $\sum_{j=1}^{T} \pi_{t+j}$					
b_T^π	-0.04	-0.08	-0.12	-0.16	-0.21	-0.26	-0.31	-0.37	-0.42	-0.48
s.e.	[0.01]	[0.01]	[0.02]	[0.02]	[0.03]	[0.04]	[0.05]	[0.06]	[0.08]	[0.09]
					Forecasting $\sum_{j=1}^{T} \tilde{r}_{t+j}$					
$b_T^{\tilde{r}}$	-0.01	-0.03	-0.05	-0.06	-0.07	-0.09	-0.13	-0.16	-0.2	-0.25
s.e.	[0.01]	[0.02]	[0.03]	[0.04]	[0.05]	[0.06]	[0.06]	[0.07]	[0.08]	[0.09]

back

Forecasting Returns and Surpluses with $\tilde{v}_t$

Horizon	1	2	3	4	5	6	7	8	9	10
	Structural Break									
	Forecasting $\sum_{j=1}^{T} -\tilde{r}_{t+j}$									
$-b^r_T$	0.03	0.05	0.07	0.07	0.07	0.08	0.11	0.16	0.2	0.24
s.e.	0.03	0.05	0.07	0.09	0.11	0.13	0.14	0.16	0.17	0.18
R^2	0.02	0.03	0.04	0.03	0.02	0.02	0.04	0.06	0.08	0.1
unbiased	0.01	0.02	0.03	0.02	0.01	0.02	0.04	0.07	0.11	0.14
	Forecasting $\sum_{j=1}^{T} s_{t+j}$									
b^s_T	0.07	0.16	0.25	0.34	0.41	0.46	0.51	0.56	0.62	0.68
s.e.	0.03	0.07	0.11	0.13	0.16	0.17	0.19	0.2	0.21	0.23
R^2	0.04	0.12	0.2	0.29	0.36	0.42	0.47	0.5	0.53	0.57
unbiased	0.03	0.08	0.14	0.2	0.23	0.25	0.27	0.29	0.32	0.36
	Forecasting v_{t+T}									
ϕ	0.91	0.79	0.68	0.59	0.53	0.45	0.38	0.29	0.19	0.08
s.e.	0.05	0.09	0.13	0.16	0.19	0.2	0.22	0.23	0.23	0.24
R^2	0.86	0.7	0.55	0.44	0.35	0.27	0.19	0.11	0.05	0.01
unbiased	0.96	0.89	0.83	0.78	0.76	0.73	0.69	0.64	0.58	0.51

Simulation from Unit Root Model

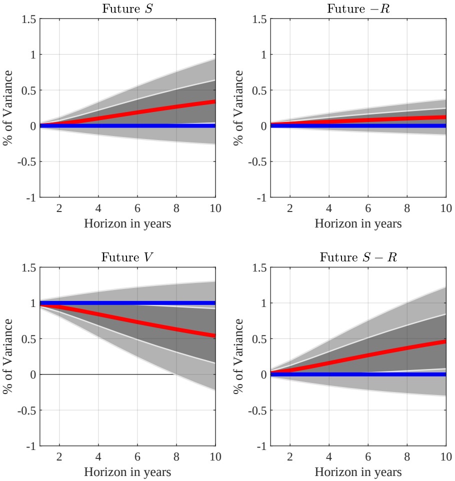
- Evidence is consistent with a unit root in the debt/output ratio.
- Simulate under the null that there is unit root in the debt/output ratio:

$$
\begin{aligned}
v_{t+1} &= v_t + \Delta v_{t+1} \\
\Delta v_{t+1} &= \psi_0 + \psi_1 \Delta v_t + \epsilon^v_{t+1} \\
\tilde{r}_{t+1} &= r_0 + \epsilon^r_{t+1}
\end{aligned}
$$

  - Estimate $(\epsilon^v_{t+1}, \epsilon^r_{t+1})$ in historical data
  - Draw 10,000 samples of length N with replacement from observed $(\epsilon^v_{t+1}, \epsilon^r_{t+1})$
- There is no contribution from return/surplus predictability (fundamentals): $b^s_T = b^r_T = 0 = 1 - \phi_T$ at all horizons T.
- Simulate and estimate predictability regressions on simulated data
- Evaluate accuracy of small-sample bias correction

back

Variance Decomposition of v_t under Unit Root

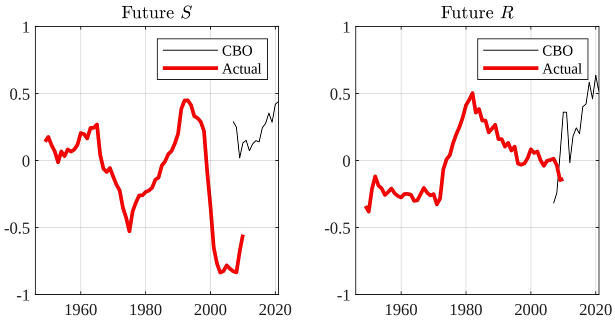


The mean of the small-sample slope coefficients in red; the long-sample slope coefficients in blue

- The average slope coefficients obtained from the unit root model imply variance decomposition close to our point estimates in the case without bias correction.
- Spurious evidence of mean reversion that creates a large role for fundamentals over longer horizons, in cases where there is no mean-reversion.

CBO Projections vs. Realized

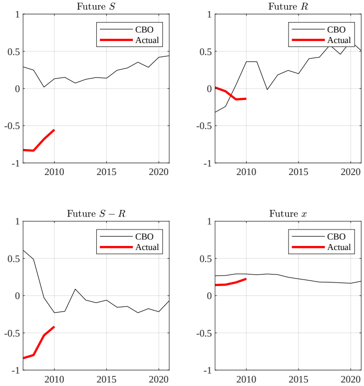
$$v_t = \mathbb{F}_t \sum_{j=1}^{10} \left(s_{t+j} - \widetilde{r}_{t+j}\right) + \mathbb{F}_t v_{t+10}$$



Decomposition of the log debt/output ratio v_t into components due to CBO-projected (and realized) future government surpluses $\sum_{j=1}^{T} s_{t+j}$, future discount rates $\sum_{j=1}^{T} \widetilde{r}_{t+k}$, for $T = 10$.

CBO Projections vs. Realized

$$v_t = \mathbb{F}_t \sum_{j=1}^{10} \left(s_{t+j} - \widetilde{r}_{t+j}\right) + \mathbb{F}_t v_{t+10}$$



Decomposition of the log debt/output ratio v_t into components due to CBO-projected (and realized) future government surpluses $\sum_{j=1}^{T} s_{t+j}$, future discount rates $\sum_{j=1}^{T} \widetilde{r}_{t+k}$, for $T = 10$. We also report future real growth $\sum_{j=1}^{T} \widetilde{x}_{t+k}$.

Related Literature

- **Statistical issues with persistent predictors** (Nelson and Kim, 1993; Hamilton, 1994; Stambaugh, 1999; Lewellen, 2004; Torous, Valkanov, and Yan, 2004; Campbell and Yogo, 2006; Boudoukh, Israel, and Richardson, 2020; Bauer and Hamilton, 2017)
- **Fiscal policy and budget constraints**: Hansen, Roberds, and Sargent (1991); Hamilton and Flavin (1986); Trehan and Walsh (1988, 1991); Bohn (1998, 2007); D'Erasmo, Mendoza and Zhang (2016); Blanchard (2019); Barro (2020), Reis (2020), Brunnermeier, Merkel and Sannikov (2020), Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2019, 2020, 2021a,b,c).
- **Safe asset supply**: Gourinchas and Rey (2007); Caballero, Farhi, and Gourinchas (2008); Caballero and Krishnamurthy (2009); Maggiori (2007); He, Krishnamurthy, and Milbradt (2018); Jiang, Krishnamurthy and Lustig (2018, 2019).

Related Literature

Bauer, M. D., and J. D. Hamilton, 2017, “Robust Bond Risk Premia,” *Review of Financial Studies*, 31(2), 399–448.

Berndt, A., H. Lustig, and Ş. Yeltekin, 2012, “How Does the US Government Finance Fiscal Shocks?,” *American Economic Journal: Macroeconomics*, 4(1), 69–104.

Binsbergen, J. H. V., and R. S. J. Koijen, 2010, “Predictive Regressions: A Present-Value Approach,” *Journal of Finance*, 65(4), 1439–1471.

Blanchard, O., 2019, “Public Debt and Low Interest Rates,” *American Economic Review*, 109(4), 1197–1229.

Bohn, H., 1998, “The Behavior of US Public Debt and Deficits,” *Quarterly Journal of Economics*, 113(3), 949–963.

Boudoukh, J., R. Israel, and M. P. Richardson, 2020, “Biases in Long-Horizon Predictive Regressions,” NBER Working Paper 27410.

Campbell, J. Y., and R. J. Shiller, 1991, “Yield Spreads and Interest Rate Movements: A Bird’s Eye View,” *Review of Economic Studies*, 58, 495–514.

Campbell, J. Y., and S. B. Thompson, 2007, “Predicting Excess Stock Returns Out of Sample: Can Anything Beat the Historical Average?,” *Review of Financial Studies*, 21(4), 1509–1531.

Campbell, J. Y., and M. Yogo, 2006, “Efficient Tests of Stock Return Predictability,” *Journal of Financial Economics*, 81, 27–60.

Cochrane, J. H., 2008, "The Dog That Did Not Bark: A Defense of Return Predictability," *Review of Financial Studies*, 21(4), 1533–1575.

——— , 2011, "Presidential Address: Discount Rates," *Journal of Finance*, 66(4), 1047–1108.

——— , 2020, "The Surplus Process," Accessed: 2020-10-24.

Cochrane, J. H., 2021a, "The Fiscal Roots of Inflation," *Review of Economic Dynamics*.

——— , 2021b, "A Fiscal Theory of Monetary Policy with Partially-Repaid Long-Term Debt," *Review of Economic Dynamics*.

Cochrane, J. H., and M. Piazzesi, 2005, "Bond Risk Premia," *American Economic Review*, 95(1), 138–160.

Fama, E. F., and R. H. Bliss, 1987, "The Information in Long-Maturity Forward Rates," *American Economic Review*, 77(4), 680–692.

Furman, J., and L. Summers, 2020, "A Reconsideration of Fiscal Policy in the Era of Low Interest Rates," `https://www.brookings.edu/wp-content/uploads/2020/11/furman-summers-fiscal-reconsideration-discussion-draft.pdf`, Accessed: 2020-12-27.

Golez, B., and P. Koudijs, 2018, "Four Centuries of Return Predictability," *Journal of Financial Economics*, 127(2), 248–263.

Gourinchas, and Rey, 2007, "International Financial Adjustment," *Journal of Political Economy*, 115(4), 665–703.

Goyal, A., and I. Welch, 2005, "A Comprehensive Look at The Empirical Performance of Equity Premium Prediction," *Review of Financial Studies*, 21(4), 1455–1508.

Hamilton, J. D., 1994, *Time Series Analysis*. Princeton University Press, Princeton, NY.

Hansen, L. P., and R. Jagannathan, 1991, "Restrictions on Intertemporal Marginal Rates of Substitution Implied by Asset Returns," *Journal of Political Economy*, 99, 225–262.

Jordà, Ò., 2005, "Estimation and Inference of Impulse Responses by Local Projections," *American Economic Review*, 95(1), 161–182.

LeRoy, S. F., and R. D. Porter, 1981, "The Present-Value Relation: Tests Based on Implied Variance Bounds," *Econometrica*, 49(3), 555–574.

Lettau, M., and S. Van Nieuwerburgh, 2008, "Reconciling the Return Predictability Evidence," *Review of Financial Studies*, 21(4), 1607–1652.

Lewellen, J., 2004, "Predicting Returns with Financial Ratios," *Journal of Financial Economics*, 74(2), 209–235.

Ludvigson, S. C., and S. Ng, 2009, "Macro Factors in Bond Risk Premia," *Review of Financial Studies*, 22(12), 5027–5067.

Nelson, C. R., and M. J. Kim, 1993, "Predictable Stock Returns: The Role of Small Sample Bias," *Journal of Finance*, 48(2), 641–661.

Shiller, R. J., 1981, "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?," *American Economic Review*, 71, 421–436.

Stambaugh, R. F., 1999, "Predictive Regressions," *Journal of Financial Economics*, 54, 375–421.

Torous, W., R. Valkanov, and S. Yan, 2004, "On Predicting Stock Returns with Nearly Integrated Explanatory Variables," *The Journal of Business*, 77(4), 937–966.