What Drives the Stock Market?

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Stock Price Volatility

- Stock prices are famously volatile
- What drives these fluctuations?
- Shiller (1981) proposed a simple decomposition:

$$P_t = \underbrace{P_t^\star}_{fundamental\ price} + \underbrace{\Phi_t}_{residual}$$

  - Fundamental Price $P_t^\star$: expected cash flows discounted at a constant rate

$$P_t^\star \equiv \sum_{k=1}^{\infty} \beta^k \mathbb{E}_t CF_{t+k}$$

  - Residual term Φ_t: everything else (time-varying expected returns)
- Shiller's conclusion: P_t is much more volatile than P_t^*
- We will explore the same decomposition ...
- ... but conclude that the vast majority of movements in P_t are driven by P_t^*

The Campbell and Shiller Reframing

- Campbell and Shiller (1987/88) re-framed the excess volatility question

- They asked: do fluctuations in $\frac{CF_t}{P_t}$ reflect time-varying expected cash flow growth or time-varying expected returns?

- We argue this re-framing was a mistake:

1. Division of $\frac{P_{t+1}+CF_{t+1}}{P_t}$ between $\frac{P_{t+1}}{P_t}$ and $\frac{CF_{t+1}}{P_t}$ is arbitrary and depends on "trading strategy" determining share of the market that investor holds at each date

   $\Rightarrow$ extent to which $\frac{CF_t}{P_t}$ forecasts cash flow growth is arbitrary

2. In contrast, $\frac{P_t^*}{P_t}$ is independent of the trading strategy.
3. To estimate $\frac{P_t^*}{P_t}$ all we need is a model for expected returns.
4. We are more interested in understanding fluctuations in P_t as opposed to $\frac{P_t}{CF_t}$.

Mechanics of Index Construction

- CRSP provides time series for:
  - value-weighted returns without dividends $\Rightarrow$ price index series P_t :

$$R_{t+1}^{nd} = \frac{P_{t+1}}{P_t}$$

  - value-weighted returns with dividends $\Rightarrow$ dividend series D_t :

$$\begin{aligned} R_{t+1}^{wd} &= \frac{P_{t+1} + D_{t+1}}{P_t} \\ &\Rightarrow D_{t+1} = \left(R_{t+1}^{wd} - R_{t+1}^{nd}\right) P_t \end{aligned}$$

  - market cap $Market\_Cap_t$
  - divisor S_t

- Divisor relates prices to market cap:

$$P_t = \frac{Market\_Cap_t}{S_t}$$

Corporate Actions

- Price series does not perfectly track market cap because of "corporate actions" :
  - Capital raising and distribution events: e.g., share repurchases, secondary offerings
  - Firm entry and exit from the index: adds, mergers and delists
- Corporate actions change market cap $P_t S_t$ but not the price index $P_t \Rightarrow$ they change S_t
- Thus, P_t tracks portfolio value for a "per share" investor:
  - per share investor does not put money into (out of) the market in response to corporate actions
  - per share investor owns S_t share of market at t
- Alternatively, define "aggregate" investor as one who holds constant fraction of market cap:
  - puts money in / out whenever corporate actions raise / lower aggregate market cap
  - natural macro baseline: representative investor must hold the market

Trading Strategies

- We call $S = \{S_t\}_{t=0}^{\infty}$ a "trading strategy"
  - $S_t = 1 \ \forall t$ is aggregate investor trading strategy
  - $S_t = divisor_t$ is per share investor trading strategy
  - Many additional possibilities
- Let $\bar{P}_t = Market\_Cap_t$ and $\overline{CF}_t$ denote aggregate investor price and cash flow
- For any trading strategy S

$$\begin{aligned} P_t(S) &= S_t \bar{P}_t \\ CF_t(S) &= S_{t-1}\overline{CF}_t + (S_{t-1} - S_t)\bar{P}_t \end{aligned}$$

What Statistics are Invariant to the Trading Strategy?

- Note that

$$
\begin{aligned}
\frac{P_{t+1}(S) + CF_{t+1}(S)}{P_t(S)} &= \frac{S_{t+1}\bar{P}_{t+1} + S_t\overline{CF}_{t+1} + (S_t - S_{t+1})\bar{P}_{t+1}}{S_t\bar{P}_t} = \frac{\overline{CF}_{t+1} + \bar{P}_{t+1}}{\bar{P}_t} \\
\frac{CF_t(S)}{P_t(S)} &= \frac{S_{t-1}\overline{CF}_t + (S_{t-1} - S_t)\bar{P}_t}{S_t\bar{P}_t} = \frac{\overline{CF}_t}{\bar{P}_t} + \frac{(S_{t-1} - S_t)}{S_t}
\end{aligned}
$$

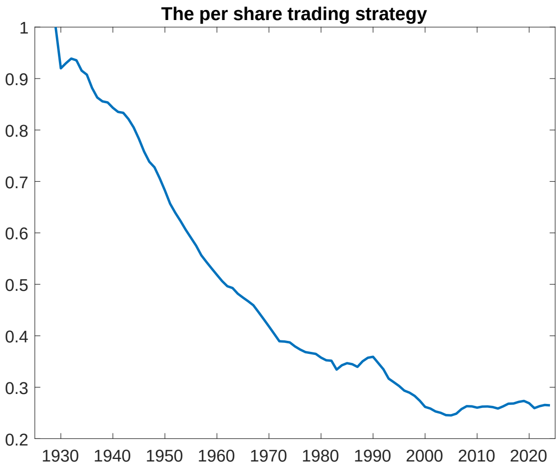
- Thus per share and aggregate investors earn identical one period returns date by date
- But the two investors:
  - have different paths for portfolio value
  - have different paths for cash flow
  - earn different long horizon returns (depending on which of them times the market better)
- Related Papers:
  - Bansal and Yaron (2007), Dichev (2007), Boudoukh, Michaely, Richardson and Roberts (2007), Larraine and Yogo (2008), Koijen and Van Nieuwerburgh (2011), Eaton and Paye (2017), Davydiuk, Richard, Shaliastovich, Yaron (2023), Pruitt (2025), Atkeson, Heathcote, Perri (2025), ...

Alternative Trading Strategies: An Example

Market Cap End t	$\bar{P}_t = P_t S_t$	100
Price Per Share End t	P_t	100
Shares Outstanding End t	S_t	1
Free Cash Flow $t+1$	$\overline{CF}_{t+1}$	20
$=$ Dividends $t+1$	D_{t+1}	10
$+$ Share Repurchases End $t+1$	$(S_t - S_{t+1})P_{t+1}$	10
Market Cap End $t+1$	$P_{t+1}S_{t+1}$	130
Price Per Share End $t+1$	$P_{t+1} = \frac{P_{t+1}S_{t+1}+(S_t-S_{t+1})P_{t+1}}{S_t}$	140
Shares Outstanding End $t+1$	$S_{t+1} = \frac{P_{t+1}S_{t+1}}{P_{t+1}}$	$\frac{130}{140}$

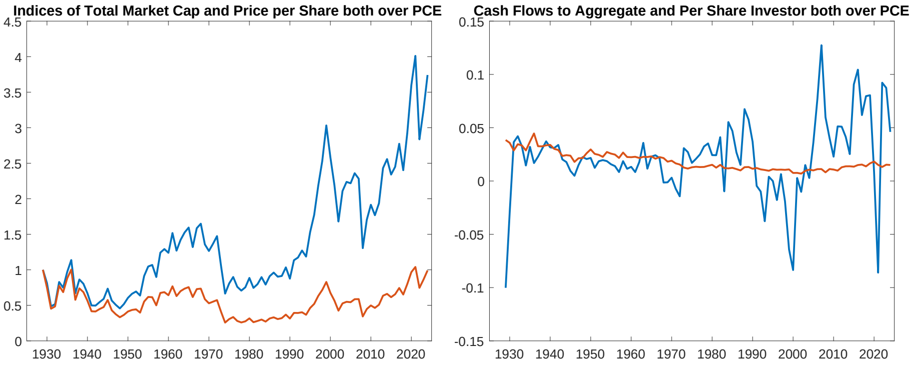
	Aggregate Investor		Per Share Investor	
price$_t$	$\bar{P}_t = P_t S_t$	100	P_t	100
cash_flow$_{t+1}$	$\overline{CF}_{t+1}$	20	D_{t+1}	10
price$_{t+1}$	$\bar{P}_{t+1} = P_{t+1}S_{t+1}$	130	P_{t+1}	140
return$_{t+1}$	$\frac{\bar{P}_{t+1}+\overline{CF}_{t+1}}{\bar{P}_t}$	$\frac{130+20}{100}$	$\frac{P_{t+1}+D_{t+1}}{P_t}$	$\frac{140+10}{100}$
$\frac{\text{cash\_flow}_{t+1}}{\text{price}_{t+1}}$	$\frac{\overline{CF}_{t+1}}{P_{t+1}S_{t+1}}$	$\frac{20}{130}$	$\frac{D_{t+1}}{P_{t+1}}$	$\frac{10}{140}$

Per share trading strategy S_t



- Persistent declines early on as new firms enter
- Stabilization and growth later as share repurchases increase

P_t and CF_t for Aggregate and Per Share Investors



- $\bar{P}_t$ over PCE and $\overline{CF}_t$ over PCE for aggregate investor
- $P_t(S)$ per share over PCE and $CF_t(S)$ per share over PCE
- Next: show that P_t^*/P_t is invariant to the choice of measurement

Revisit Shiller 1981

- Shiller's decomposition

$$P_t = P_t^\star + \Phi_t \qquad \text{where} \qquad P_t^\star \equiv \sum_{k=1}^{\infty} \beta^k \mathbb{E}_t CF_{t+k}$$

- We will estimate a time series for

$$\frac{P_t^\star(S)}{P_t(S)} = \sum_{k=1}^{\infty} \beta^k \mathbb{E}_t \frac{CF_{t+k}(S)}{P_t(S)}$$

- Key result:

$$\sum_{k=1}^{\infty} \beta^k \frac{CF_{t+k}(S)}{P_t(S)} = 1 + \sum_{k=0}^{\infty} \beta^{k+1} \left[R_{t+k+1}^{wd} - \frac{1}{\beta} \right] \frac{P_{t+k}(S)}{P_t(S)}$$

Main Result

- Implies solution

$$\frac{P_t^\star(S)}{P_t(S)} = 1 + \sum_{k=0}^{\infty} \beta^{k+1} \mathbb{E}_t \left[\mathbb{E}_{t+k} R_{t+k+1}^{wd} - \frac{1}{\beta} \right] \frac{P_{t+k}(S)}{P_t(S)}$$

  - $P_t^\star(S) = P_t$ + DPV of value-weighted expected excess returns

- Log linearly approximate around

$$\mathbb{E}_{t+k} R_{t+k+1}^{wd} = \frac{1}{\beta}, \qquad \beta \mathbb{E}_t \frac{P_{t+k+1}(S)}{P_{t+k}(S)} = \rho(S)$$

$$\frac{P_t^\star(S)}{P_t(S)} \approx 1 + \sum_{k=0}^{\infty} \rho(S)^k \mathbb{E}_t \left[r_{t+k+1}^{wd} - \log\left(\frac{1}{\beta}\right) \right]$$

- this is invariant to the trading strategy up to $\rho(S)$

$\Rightarrow$ Shiller's measure $\frac{P_t^\star(S)}{P_t(S)}$ is a good way to frame the "what drives valuations" question

What About Campbell and Shiller 1988?

- Recent literature typically focuses on cash flow-price ratios $\frac{CF_t(S)}{P_t(S)}$
- Consider the decomposition

$$\frac{CF_t(S)}{P_t(S)} = \frac{P_t^\star(S)}{P_t(S)} \times \frac{CF_t(S)}{P_t^\star(S)}$$

$$P_t^\star(S) = \sum_{k=1}^{\infty} \beta^k \mathbb{E}_t CF_{t+k}(S)$$

- Different trading strategies imply very different dynamics for $\frac{CF_t(S)}{P_t(S)}$ ...
- ... but $\frac{P_t^\star(S)}{P_t(S)}$ approximately independent of the trading strategy
- ... so different trading strategies simply translate to different future cash flow dynamics

$\Rightarrow$ Not surprising that different price / cash flow measures $\Rightarrow$ different variance decompositions

- Statements about the dynamics of particular measures of cash flows and cash flow to price ratios do not help answer *What Drives the Stock Market?*

Estimating $P_t^\star / P_t$

$$\frac{P_t^\star}{P_t} = 1 - \frac{\Phi_t}{P_t} \approx 1 + \sum_{k=0}^{\infty} \rho^k \mathbb{E}_t \left[r_{t+k+1}^{wd} - \bar{r} \right]$$

- All we need to answer what drives valuations is a model for expected returns
- Unfortunately, little consensus on dynamics of expected returns (Goyal and Welch 2008, 2024)
- For Φ_t to drive significant fluctuations in P_t, long horizon returns must be forecastable. Are they?
- Many classic return predictors are quite transitory $\Rightarrow$ cannot predict long horizon returns
- But others (e.g., $\frac{D_t}{P_t}$ = dividends per share / price per share) are very persistent
- Low $\frac{D_t}{P_t}$ today $\Rightarrow$ likely low $\frac{D_t}{P_t}$ in the distant future $\Rightarrow$ persistently low returns?
- Perhaps, but forecasting long horizon returns using persistent regressors in short samples treacherous (spurious regression, Stambaugh (1999) bias)
- We argue that persistence in $\frac{D_t}{P_t}$ driven by corporate actions that are unrelated to expected returns

$\Rightarrow$ additional reason to be skeptical of long run return predictability

How Predictable Are Returns?

- If $\mathbb{E}_t\left[r^{wd}_{t+1} - \bar{r}\right]$ AR1 with persistence ψ, then

$$\frac{P^\star_t}{P_t} \approx 1 + \sum_{k=0}^{\infty} \rho^k \mathbb{E}_t\left[r^{wd}_{t+k+1} - \bar{r}\right] = 1 + \frac{1}{1-\rho\psi}\mathbb{E}_t\left[r^{wd}_{t+1} - \bar{r}\right]$$

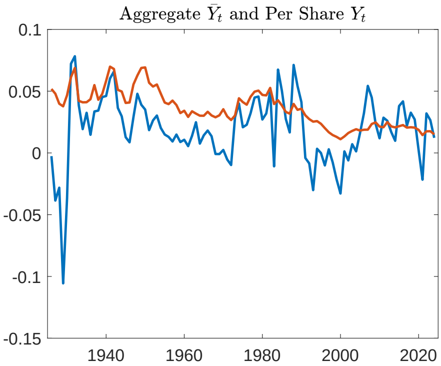
- Two conditions for time-varying expected returns to drive significant price volatility:
  1. $\mathbb{V}ar\left(\mathbb{E}_t\left[r^{wd}_{t+1} - \bar{r}\right]\right)$ must be large (high R^2 for one step ahead return forecasts)
  2. Persistence ψ of expected returns must be high

- Forecast log returns in excess of PCE growth using regressions of the form:

$$r_{t+s} = \sum_{k=0}^{s-1} r^{wd}_{t+k+1} = \alpha_s + \gamma_s Predictor_t + error_t$$

- Compare $Predictor_t = \bar{Y}_t = \log\left(1 + \frac{\overline{CF}_t}{\bar{P}_t}\right)$ versus $Predictor_t = Y_t = \log\left(1 + \frac{D_t}{P_t}\right)$

Forecasting Using Per Share Yield



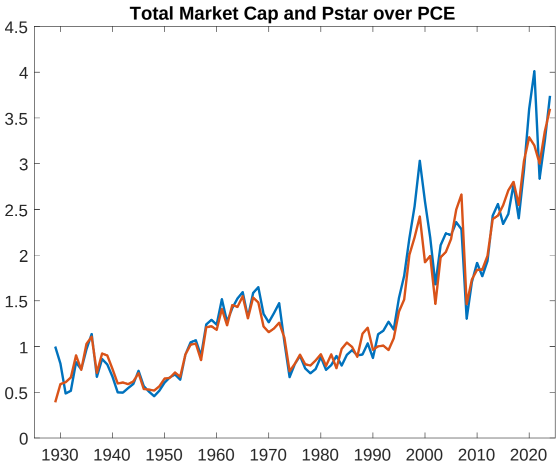
- Using $\bar{Y}_t$ for aggregate investor to forecast returns

horizon	one-year	five-year	ten-year
coefficient γ_s	2.60	3.85	6.67
t-stat.	3.72	3.06	3.99
R^2	0.13	0.10	0.16

- Using Y_t for per share investor to forecast returns

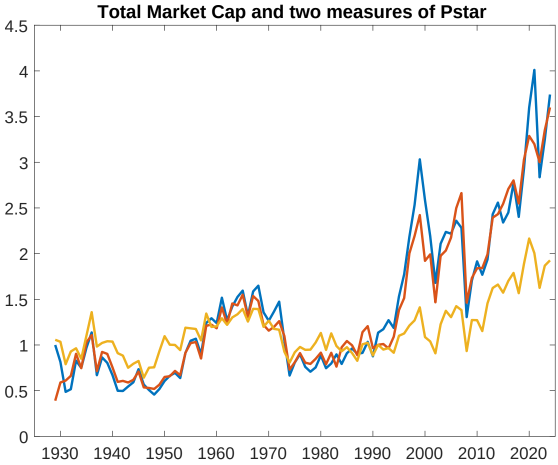
horizon	one-year	five-year	ten-year
coefficient γ_s	2.28	6.66	11.26
t-stat.	1.74	2.90	3.56
R^2	0.03	0.09	0.13

P_t^* using $\bar{Y}_t$



- $\bar{P}_t =$ CRSP total market cap over PCE
- $P_t^\star = \bar{P}_t \left(1 + \frac{1}{1-\rho\psi}\left(\gamma_1 \bar{Y}_t - \bar{r}\right)\right)$ with $\rho = 0.98,\ \psi = 0.47,\ \gamma_1 = 2.60$
- Fluctuations in expected returns not important driver of price

Implications of Different Predictors



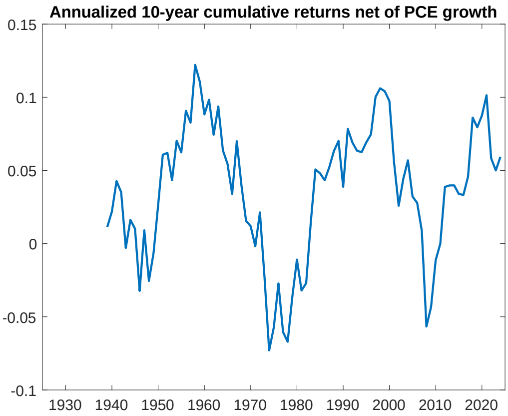
- $P_t =$ CRSP total market cap over PCE
- $P^\star_t = \bar{P}_t(1 + \frac{1}{1-\rho\psi}\left(\gamma_1 \bar{Y}_t - \bar{r}\right))$
  $\gamma_1 = 2.60,\ \rho = 0.98,\ \psi = 0.47$
- $P^\star_t = \bar{P}_t(1 + \frac{1}{1-\rho\psi}\left(\gamma_1 Y_t - \bar{r}\right))$
  $\gamma_1 = 2.28,\ \rho = 0.98,\ \psi = 0.92$
- Falling expected returns explain a large part of stock market runup

Different views on what drives the stock market

- The aggregate yield $\bar{Y}_t$ seems to be a better predictor of returns
- But per share model attributes larger share of price movements to time-varying expected returns
- Mechanically, this is because the per share yield predictor is much more persistent – near unit root
- Thus low current yield $\Rightarrow$ low expected yield far into the future $\Rightarrow$ persistent low expected returns in excess of consumption growth

- Which model should we believe?

Long Horizon Realized Returns net of PCE Growth



- No evidence of a trend in realized returns in excess of consumption growth

Our Hypothesis and Strategy

- Recall that

$$\frac{D_t}{P_t} = \frac{\overline{CF}_t}{\bar{P}_t} + \frac{(S_{t-1} - S_t)}{S_t}$$

- Posit that $\frac{\overline{CF}_t}{\bar{P}_t}$ drives true expected returns

- Posit that $\frac{(S_{t-1} - S_t)}{S_t}$ is a persistent process reflecting corporate actions (e.g. share repurchases) that add persistence to dividend-price ratio

- These corporate actions add noise to signal about expected returns
  - high frequency: firms smoothing dividend payments
  - low frequency: more equity repurchases following regulatory changes that reduced fear of being charged with stock price manipulation

- Estimate a model with these properties, show that in simulations Y_t appears to forecast long horizon returns even though, by construction, long horizon returns are not forecastable

- Conclude that price fluctuations almost entirely driven by time-varying expected cash flows.

Model Estimated

- Model for log returns in excess of consumption growth

$$\begin{aligned} r_{t+1} &= \gamma \bar{Y}_t + (1-\gamma)\bar{r} + \varepsilon_{r,t+1} \\ \bar{Y}_{t+1} &= \psi \bar{Y}_t + (1-\psi)\bar{r} + \varepsilon_{Y,t+1} \end{aligned}$$

  - γ controls predictability of one period returns
  - ψ controls persistence of expected returns

- Model for corporate actions

$$\begin{aligned} Y_t &= \bar{Y}_t - \Delta s_t \\ \Delta s_t &= \chi(\bar{Y}_t - \bar{r}) + z_t \\ z_{t+1} &= \rho_z z_t + \varepsilon_{z,t+1} \end{aligned}$$

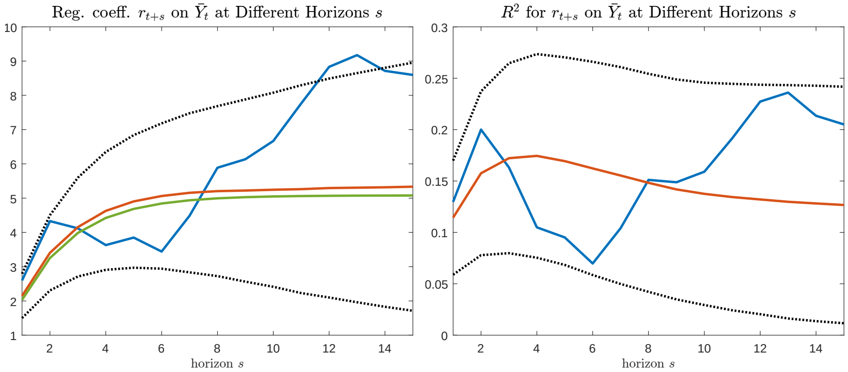
  - Δs_t is log change in S_t
  - $\chi > 0$ allows for yield smoothing: $\chi = 1$ and $\rho_z = 1 \Rightarrow Y_t$ follows a random walk

- Parameters to estimate: γ, $\bar{r}$, ψ, χ, ρ_z, Σ

Moments Targeted in Estimation

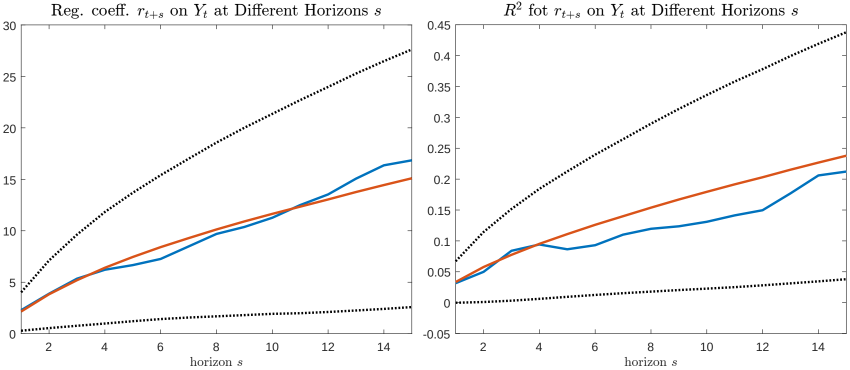
- Average log returns in excess of PCE growth r_t
- Mean and variance of aggregate and per share yields $\bar{Y}_t$ and Y_t
- $\mathbb{V}ar\left(r_{t+s}\right)$ at horizons s up to 15 years
- $\mathbb{V}ar\left(\bar{Y}_{t+s}-\bar{Y}_t\right)$ and $\mathbb{V}ar\left(Y_{t+s}-Y_t\right)$ for $s=1,...,15$
- $\mathbb{C}ov\left(r_{t+s},\bar{Y}_{t+s}-\bar{Y}_t\right)$ and $\mathbb{C}ov\left(r_{t+s},Y_{t+s}-Y_t\right)$ for $s=1,...,15$
- Regression coefficients from regressing
  - r_{t+s} on $\bar{Y}_t$ for $s=1,...,15$
  - r_{t+s} on Y_t for $s=1,...,15$
  - $\left(\bar{Y}_{t+s}-\bar{Y}_t\right)$ on $\bar{Y}_t$ for $s=1,...,15$
  - $\left(Y_{t+s}-Y_t\right)$ on Y_t for $s=1,...,15$

Model Accounts for Return Predictability with Aggregate Yield



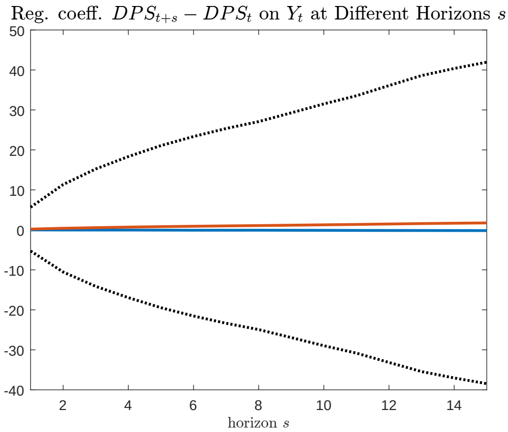
- estimate $\gamma = 2.03$ and $\psi = 0.60 \Rightarrow$ time-varying expected returns explain little of movements in P_t
- green line is theoretical regression coefficient $\gamma + \psi\gamma + ... + \psi^{s-1}\gamma$
- dotted lines are simulated one standard error bands

Also Accounts for Return Forecasts with Per Share Yield



- Simulated model replicates large coefficients and high R^2 values at long horizons
- But return forecastability with Y_t entirely disappears in 1,000 year simulations
    - Low frequency trends in Δs_t come to dominate, which are uninformative about returns

Reproduces that growth in dividends per share not forecastable



- Cochrane's (2008) dog is not barking

Where Does Illusion of Long Horizon Return Predictability Come From?

- Sampling error $\Rightarrow$ regression coefficients and R^2 rise with the return horizon when the predictor variable is very persistent (Boudoukh, Richardson and Whitelaw, 2008)
  - Long horizon returns are naturally very persistent
  - Corporate actions make Y_t very persistent
- Shocks to returns and to Δs_t are positively correlated $\Rightarrow$ when r_t goes up Y_t goes down $\Rightarrow$ Stambaugh (1999) short sample bias
- These potential biases are understood
- Our contributions:
  - trace persistence in Y_t to trading strategy / dividend smoothing
  - reconcile disparate results on return predictability using different predictors

Conclusion

- To answer *What Drives the Stock Market*, we must estimate

$$\frac{P_t^\star}{P_t} = 1 + \sum_{k=0}^{\infty} \beta^{k+1} \mathbb{E}_t \left[R_{t+k+1}^{wd} - \frac{1}{\beta} \right] \frac{P_{t+k}}{P_t}$$

- This summarizes all relevant information.
- Dynamics of a particular measure of cash flows (approximately) does not add information.
- $P_t^\star$ is close to P_t unless expected returns over very long horizons are quite variable.
- $\frac{D_t}{P_t}$ looks persistent, but persistence reflects mechanical corporate actions:
    1. Dividend smoothing (firms repurchase equity when cash flow high)
    2. Declining new firm entry + increasing stock repurchases
       $\Rightarrow \Delta s_t < 0 \to \Delta s_t > 0 \Rightarrow$ persistent decline in $\frac{D_t}{P_t}$
- Thus, we are skeptical that there is a large predictable component to long run returns

A Thought Experiment

- data from N investors in an index fund
  - end of month balance $P_{i,t}$
  - withdrawals that month $CF_{i,t}$
  - same returns with cash flows for everyone

$$R^{wd}_{t,t+1} = \frac{P_{i,t+1} + CF_{i,t+1}}{P_{i,t}}$$

- Present value relation holds for each investor

$$P_{i,t} = \sum_{k=1}^{\infty} \mathbb{E}_t \frac{1}{R^{wd}_{t,t+k}} CF_{i,t+k}$$

- What drives fluctuations in $P_{i,t}$?
  - Fluctuations in expected returns (discount rates)?
  - Fluctuations in expected future cash flows?

- Does the answer depend on the choice of P_{it} and CF_{it}?