Lecture 7: Forecasts

Mark Hendricks

Autumn 2021

FINM 36700: Portfolio Management

Outline

Forecasting Regressions

Dividend-Yield Forecasting

Risk premia across assets

The risk premium of an asset, i, is defined as the expected excess return,

$$\mathbb{E}\left[\tilde{r}^i\right]$$

- Linear Factor Models (LFM's) describe how risk premia vary across assets.
- Most theories attribute the variation to difference in risks.

Example: CAPM

The CAPM says risk premia across different assets i are:

$$\mathbb{E}\left[\tilde{r}^{i}\right] = \left(\beta^{i,m}\right)\lambda_{m}$$

All risk premia are proportional (by beta) to the market risk premium.

- But the above form does not condition on time.
- The beta and both risk premia are estimated as stationary time series averages.

Risk premia over time

So how do risk premia change over time?

$$\mathbb{E}_t\left[\tilde{r}^i_{t+1}\right]$$

- Is the expected excess return of asset i always the same, no matter what period the investor considers?

$$\mathbb{E}_t\left[\tilde{r}^i_{t+1}\right] = \mathbb{E}\left[\tilde{r}^i\right]$$

- Or is the risk premium of an asset a function of time-varying factors, x_t?

$$\mathbb{E}_t\left[\tilde{r}^i_{t+1}\right] = f\left(x_t\right)$$

THE UNIVERSITY OF CHICAGO

Linear methods

If we believe risk premia vary over time, we must specify a functional form for $f(x)$ in

$$\mathbb{E}_t\left[\tilde{r}^i_{t+1}\right] = f\left(x_t\right)$$

as well as specifying the factor(s), x_t.

- If we specify a linear function, the statistics/numerics are much easier.
- Recall that a linear regression gives the best linear estimator of such a function $f(x)$.

Regressions to measure conditional expectations

Suppose

$$y = \alpha + \beta x + \epsilon$$

Then the expectation of y conditional on x is

$$\mathbb{E}\left[y \mid x\right] = \alpha + \beta x$$

Thus, if $\beta \neq 0$, the conditional expectation varies as x varies.

Forecasting regressions

A forecasting regression for returns is of the form:

$$\tilde{r}^i_{t+1} = \alpha + \beta x_t + \epsilon_{t+1}$$

- If $\beta \neq 0$, then the conditional expectation of $\tilde{r}^i_{t+1}$ varies over time as x_t varies.

$$\mathbb{E}\left[\tilde{r}^i_{t+1} \middle| \, x_t\right] = \alpha + \beta x_t$$

- We similarly used regressions in LFM's to discover variation in risk premia across assets.

THE UNIVERSITY OF CHICAGO

Classic view

The classic view says risk premia are constant over time.

- Thus, in any forecasting regression of returns, $\beta = 0$.

$$\tilde{r}^i_{t+1} = \alpha + \beta x_t + \epsilon_{t+1}$$

- The classic view also says price growth is a random walk (with drift.)

$$\log P_{t+1} - \log P_t = \text{constant} + \epsilon_{t+1}$$

So $\mathbb{E}_t \left[\frac{P_{t+1}}{P_t} \right] = \text{constant}.$

Testing the classic view

Test the classic view on the risk premium of the market index, λ_m.

- Consider using this period's return to forecast that of next period:

$$\tilde{r}^m_{t+1} = a + \beta \tilde{r}^m_t + \epsilon_{t+1}$$

- This test of the classic view of market return predictability uses the lagged return as the predictor variable.

THE UNIVERSITY OF CHICAGO

Evidence: Is the market return autocorrelated?

$$r_{t+1} = a + \beta r_t + \epsilon_{t+1}$$

Table: Auto-regression estimates for market returns, excess market returns.

	Monthly		Annual	
	r^m	$\tilde{r}^m$	r^m	$\tilde{r}^m$
b	0.11	0.12	0.01	0.02
$t(b)$	2.02	2.05	0.09	0.15
R^2	0.01	0.01	0.00	0.00

- CRSP value-weighted equity markets, 1927-2010.
- CRSP 3-month U.S. treasury bill.
- GMM standard errors.

THE UNIVERSITY OF CHICAGO

Evidence: Is the risk-free return autocorrelated?

$$r^f_{t,t+1} = a + \beta r^f_{t-1,t} + \epsilon_{t+1}$$

Table: Auto-regression estimates for the risk-free return.

	Monthly	Annual
b	0.89	0.92
$t(b)$	30.38	13.31
R^2	0.80	0.83

- CRSP value-weighted equity markets, 1927-2010.
- CRSP 3-month U.S. treasury bill.
- GMM standard errors.

THE UNIVERSITY OF CHICAGO

Conclusions from the return auto-regressions

The excess market return has a regression coefficient near zero, which fits the classic view of risk premia.

- High returns do not indicate particularly high or low returns going forward.
- The annual data estimates suggest stock returns, particularly excess returns, are i.i.d.
- The monthly data shows some autocorrelation, but not much explanatory power.
- Furthermore, trading costs would seem to make this small predictability a novelty of no economic importance.

Other Ways to See Predictability?

For many years, academics and practitioners have found these same results.

- This reinforced classic view that returns are unpredictable—that prices are essentially a random walk.
- But even if past returns do not predict future returns, how about some other predictor, x_t?
- How about forecasting at longer horizons?

THE UNIVERSITY OF CHICAGO

Outline

Forecasting Regressions

Dividend-Yield Forecasting

Signals

Notwithstanding the “classic” view, asset managers use many signals to try to forecast returns with linear regression.

- Macroeconomic signals
- Asset return signals
- Short-term signals / forecast horizons
- Long-term signals / forecast horizons

The dividend-price ratio, (also known as the dividend-yield,) is one of the most famous examples.

THE UNIVERSITY OF CHICAGO

Dividend-yield

The dividend-yield DP_t refers to the dividend-price ratio, $\frac{D_t}{P_t}$.

- Other common cash-flow-to-value measures include earnings-price and book-price (book-market) ratios.
- Obviously, using value-to-cashflow ratios such as dividend-price works the same.
- For an individual stock, dividends are not paid continuously, but for the market index, there is a steady stream for analysis.

Returns and the dividend yield

By definition, stock returns are

$$R_{t+1} \equiv \frac{P_{t+1} + D_{t+1}}{P_t}$$

$$R_{t+1} \equiv \left(\frac{D_t}{P_t}\right) \frac{D_{t+1}}{D_t} + \frac{P_{t+1}}{P_t}$$

This identity holds for horizon, $t+k$, and in expectation:

$$\mathbb{E}_t\left[R_{t,t+k}\right] = \text{DP}_t \; \mathbb{E}_t\left[\frac{D_{t+k}}{D_t}\right] + \mathbb{E}_t\left[\frac{P_{t+k}}{P_t}\right]$$

Classic view of dividend yield

In the classic view of risk premia,

- Expected returns are constant: $\mathbb{E}_t \left[r_{t,t+k} \right] = \theta_r$.
- Price appreciation is a random walk, $\mathbb{E}_t \left[\frac{P_{t+k}}{P_t} \right] = \theta_p$.

$$\theta_r = \text{DP}_t \; \mathbb{E}_t \left[\frac{D_{t+k}}{D_t} \right] + \theta_p$$

So under the classic view,

- An increase in the dividend-yield is offset by a decrease in expected dividend growth.

THE UNIVERSITY OF CHICAGO

Evidence: Stock-market Predictability

$$\tilde{r}^{m}_{t,t+k} = a + \beta \mathrm{DP}_t + \epsilon_{t+k}$$

Table: Stock Return Predictability Regressions.

	Horizon		
	1 month	1 year	5 years
b	0.25	4.08	21.27
$t(b)$	1.01	2.45	4.43
R^2	.01	.09	.31

Regression of cumulative excess returns on dividend-price ratio.

- NYSE/AMEX/NASDAQ value-weighted equity markets.
- Monthly data, 1927-2010.
- GMM standard errors.

THE UNIVERSITY OF CHICAGO

Interpreting the regression estimates

At a one-month horizon,

- Slope coefficient is insignificant—statistically and economically.
- Agrees with the implications of the auto-regression.
- More evidence seemingly supportive of the classic view.

At longer horizons,

- Coefficient is economically significant.
- At one-year, a one-point increase in dividend-price forecasts a four-point increase in returns!

THE UNIVERSITY OF CHICAGO

Illustration of return predictability

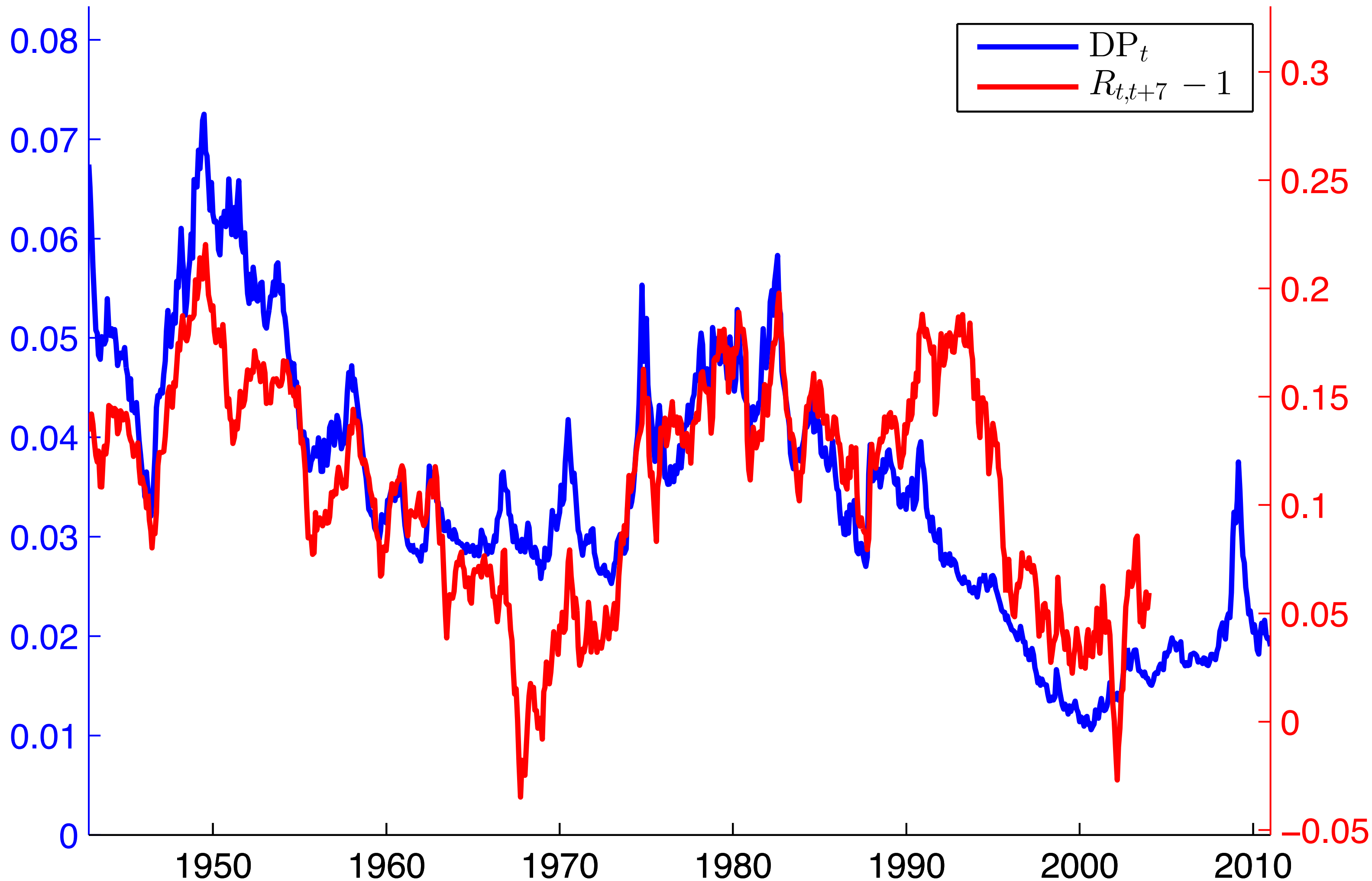


Figure: Market dividend-price ratio plotted against the next seven years cumulative return. CRSP monthly data, 1927-2010.

THE UNIVERSITY OF CHICAGO

Modern view of dividend yield

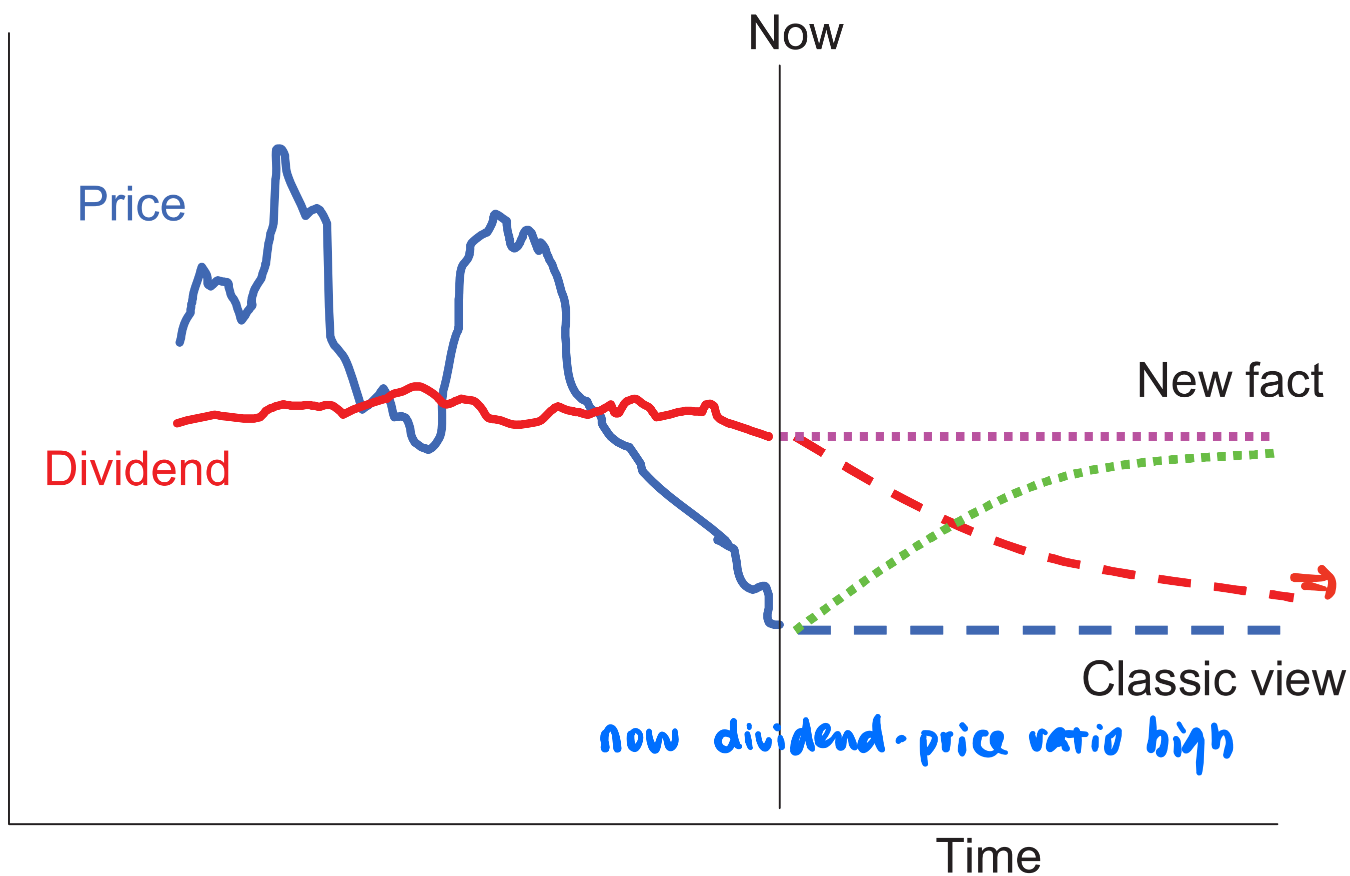
The empirical evidence above shows:

- Expected returns increase one-for-one with the dividend-yield.
- This is not offset by dividend growth or price appreciation.
- Instead, estimates show prices move the wrong way—increase expected returns even more.

$$\mathbb{E}_t\left[R_{t,t+k}\right] = \mathrm{DP}_t \, \mathbb{E}_t\left[\frac{D_{t+k}}{D_t}\right] + \mathbb{E}_t\left[\frac{P_{t+k}}{P_t}\right]$$

THE UNIVERSITY OF CHICAGO

When prices are low, we (used to / now) expect...



→ classic view

now dividend-price ratio high

Classic view: [illegible] expected dividend growth↓

Figure: Source: Cochrane (2012)

THE UNIVERSITY OF CHICAGO

Long Horizons as a Way to See Predictability

Predictability of market returns by dividend-yield only seen in long horizons regressions.

- Due to persistent nature of the forecasting variable, DP_t.
- Autoregressive coefficient at a monthly frequency is about .98!

$$\mathrm{DP}_t t = a + b\,\mathrm{DP}_t + \epsilon_{t+1}$$

当 dividend price ratio 增加

one-month return：增加 little

one-year return：因为 DP stays high，return 增加很多

THE UNIVERSITY OF CHICAGO

Other Forecasting Variables?

If autoregressive is high, 说明 one-month 可能不 obvious, 但 longer horizon 更 impressive

Other variables seem to have similar ability to forecast returns.

- Cyclically-adjusted price-earnings ratios
- Macro-economic indicators. (Investment, consumption, etc.)
- Inflation and rates. (The "Fed Model")

THE UNIVERSITY OF CHICAGO

Statistical concerns

The dividend-price predictability is controversial.

- DP is a persistent variable, (high autocorrelation.)
- Regressions where x has high autocorrelation can be biased or mis-specified.

This is a very active area of research to find the best predicting variables and models.

if misunderstand, misunderstand in longer term

缺点: easily lose statistical power

autoregressive signals 有好有坏

References

- Campbell, John. *Financial Decisions*. 2016. Chapter 5.
- Cochrane, John. *Asset Pricing*. 2005. Chapters 12, 20.1.
- Cochrane, John. *Discount Rates*. 2011.
- Tsay, Ruey. *Analysis of Financial Time Series.* 2010. Chapters 1, 7.

THE UNIVERSITY OF CHICAGO