Equity duration and predictability

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Motivation

- Do prices move because of changes in expected returns or changes in expected dividend growth rates?
- Understanding their relative contributions is fundamental to the (equilibrium) theory of asset prices.
- Empirical evidence is mixed and puzzling.

Motivation

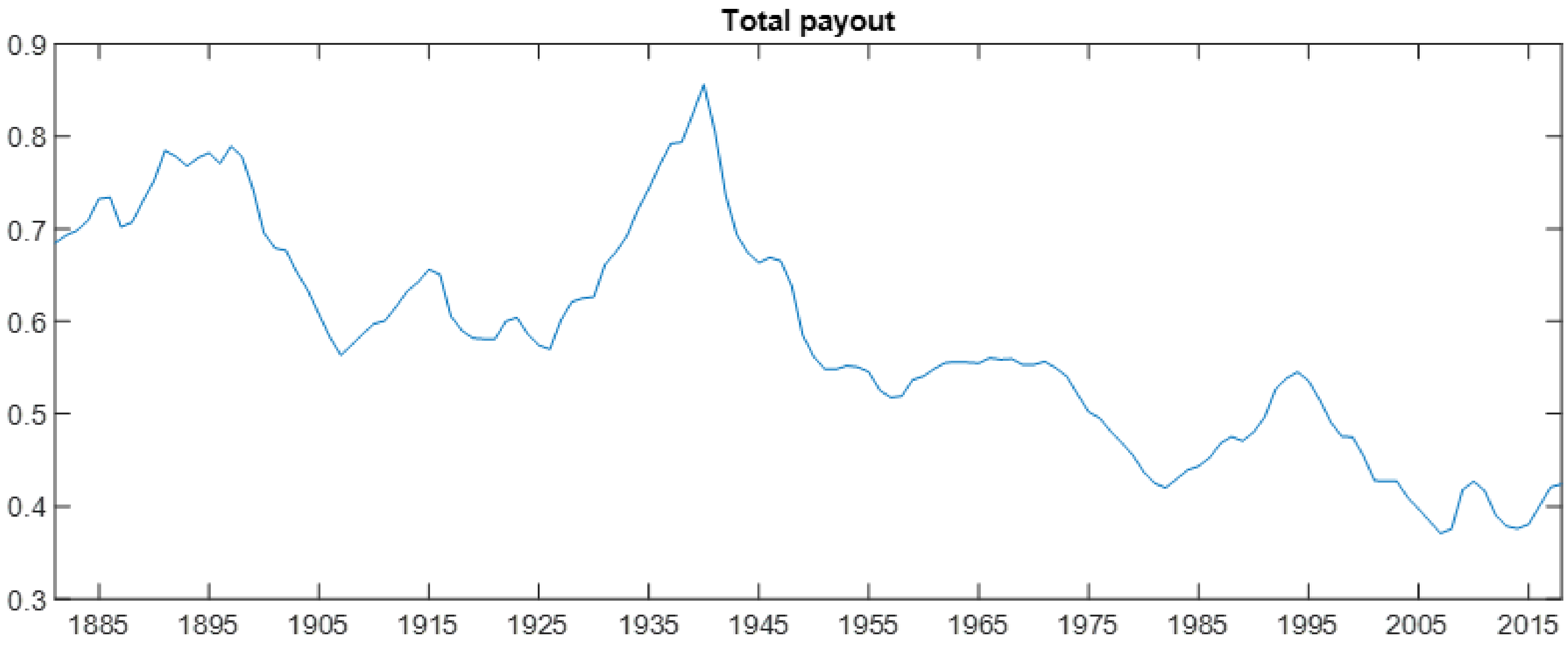
- Standard approach: Predictive regressions
  - For the U.S. after 1945, expected returns dominate (Cochrane 2011)
  - If one goes back in time, both expected returns and dividend growth rates appear equally important (Chen 2009; Golez and Koudijs 2018)

- These results are puzzling:
  - Why do expected returns dominate in modern markets? Are prices primarily driven by changes in risk appetite (Cochrane, 2011) or “animal spirits” (Keynes 1936; Shiller 1981)?
  - Why do expected returns seem to matter less in more distant past when investors were less able to diversify and transfer risk?

This paper

- We argue that this seemingly puzzling observations can be explained by an **increase in duration of the equity market**.
- **Equity duration:** timing of dividends / inverse of the payout ratio

$$Payout_t = \frac{\sum_{t-10}^{t} D_t}{\sum_{t-10}^{t} E_t}$$



This paper

- The longer equity duration, the more important the more persistent shocks.
- Expected returns more persistent than expected growth rates (Binsbergen and Koijen 2010; Koijen and Van Nieuwerburgh 2011; Golez 2014; and Piatti and Trojani 2017)

→ **The longer equity duration, the more important expected returns.**

This paper

- Three pieces of empirical evidence in support of our hypothesis:
    1. **Motivating example: Dividends strips:** Expected returns are more important for the aggregate market than for dividend strips.
    2. **Time series evidence, 1629 until today:** As the payouts (inverse measure of duration) decrease, expected returns become more important.
    3. **Cross-sectional evidence, post 1945:** Expected returns are more important for portfolios with low payouts (high duration).

Related literature

- Literature on equity duration:
  - Binsbergen, Brandt, and Koijen (2012); Binsbergen, Hueskes, Koijen and Vrugt (2013); Gormsen (2020); Bansal, Miller, Song and Yaron (2020); Dechow, Sloan and Soliman (2004); Lettau and Wachter (2007); Da (2009); Weber (2018); Gormsen and Lazarus (2020); Chen and Li (2019); Goncalves (2020); and Li and Wang (2019)
- Literature on return and dividend growth predictability (see Cochrane 2011 and Koijen and Van Nieuwerburgh 2011 for overviews):
  - Menzley, Santos and Veronesi (2004); Lettau and Ludwigson (2005); Binsbergen and Koijen (2010); Chen, Da, and Priestley (2012); Chen, Da, and Zhao (2013); Greenwood and Shleifer (2014); De la O and Meyers (2019)

The role of duration: Motivating example

- **Long duration asset:**
  - Aggregate stock market (e.g. S&P 500)
- **Short duration asset:**
  - Dividend strip on the same market (e.g. asset that entitles you to the dividends that S&P 500 pays out over the next year)

- Use present value relations to link duration to return / dividend growth predictability.

The role of duration: Motivating example

- Let expected returns and dividend growth rates follow AR(1) processes:

$$\mu_{t+1} = \delta_0 + \delta_1(\mu_t - \delta_0) + \varepsilon_{t+1}^{\mu}$$

$$g_{t+1} = \gamma_0 + \gamma_1(g_t - \gamma_0) + \varepsilon_{t+1}^{g}$$

- Define:
  - *ER* - the fraction of the variance of the dividend-to-price ratio that is explained by expected returns
  - *EDG* - the fraction of the variance of the dividend-to-price ratio that is explained by expected growth rates

The role of duration: Motivating example

- Dividend-price ratio for the aggregate stock market:

$$\underbrace{\mathrm{var}(dp_t) = \left(\frac{1}{1-\rho\delta_1}\right)^2 \mathrm{var}(\mu_t)}_{ER} + \underbrace{\left(\frac{1}{1-\rho\gamma_1}\right)^2 \mathrm{var}(g_t)}_{EDG} \rightarrow \frac{ER}{EDG} = \left(\frac{1-\rho\gamma_1}{1-\rho\delta_1}\right)^2 \frac{\mathrm{var}(\mu_t)}{\mathrm{var}(g_t)}$$

- Dividend-price ratio for a one-period dividend strip:

$$\mathrm{var}(dp_t) = \underbrace{\mathrm{var}(\mu_t)}_{ER} + \underbrace{\mathrm{var}(g_t)}_{EDG} \rightarrow \frac{ER}{EDG} = \frac{\mathrm{var}(\mu_t)}{\mathrm{var}(g_t)}$$

The role of duration: Motivating example

- Empirical methodology: Standard predictive regressions
  - Aggregate stock market:

$$\begin{bmatrix} ret_{t+1} \\ dg_{t+1} \\ dp_{t+1} \end{bmatrix} = \begin{bmatrix} \beta_{ret} \\ \beta_{dg} \\ \beta_{dp} \end{bmatrix} dp_t + \begin{bmatrix} \varepsilon_{t+1}^{ret} \\ \varepsilon_{t+1}^{dg} \\ \varepsilon_{t+1}^{dp} \end{bmatrix}$$

$$ER = \frac{\beta_{ret}}{(1-\rho\beta_{dp})}$$

$$EDG = \frac{\beta_{dg}}{(1-\rho\beta_{dp})}$$

$$\frac{ER}{EDG} = \frac{\beta_{ret}}{\beta_{dg}}$$

  - Dividend strips:

$$\begin{bmatrix} ret_{t+1} \\ dg_{t+1} \end{bmatrix} = \begin{bmatrix} \beta_{ret} \\ \beta_{dg} \end{bmatrix} dp_t + \begin{bmatrix} \varepsilon_{t+1}^{ret} \\ \varepsilon_{t+1}^{dg} \end{bmatrix}$$

$$ER = \beta_{ret}$$

$$EDG = \beta_{dg}$$

$$\frac{ER}{EDG} = \frac{\beta_{ret}}{\beta_{dg}}$$

The role of duration: Motivating example

- Dividend strips (options data, 1.5 year maturity): Jan 1996 – Dec 2017
  - From Binsbergen, Brandt, and Koijen (2012): Jan 1996 – Oct 2009
  - Carefully follow their methodology to extend the data to 2017
- Aggregate stock market: Jan 1996 – Dec 2017
  - S&P 500 price index and dividends from Datastream

The role of duration: Motivating example

	Market	Dividend strips
	(1)	(2)
Dependent variable: $ret_{t,t+12}$		
dp_t	**0.36**	**0.73**
t-stat. (N-W)	(3.12)	(5.29)
t-stat. (Non. Overlap.)	[2.48]	[4.39]
R2	0.19	0.43
Dependent variable: $dg_{t,t+12}$		
dp_t	**-0.01**	**-0.37**
t-stat. (N-W)	(-0.08)	(-3.39)
t-stat. (Non. Overlap.)	[0.00]	[-3.77]
R2	0.00	0.42
Dependent variable: dp_{t+12}		
dp_t	0.65	
t-stat. (N-W)	(4.68)	
t-stat. (Non. Overlap.)	[4.01]	
R2	0.43	
ER	**0.98**	**0.73**
EDG	0.03	0.37
ER/EDG	**33.36**	**1.98**

The role of duration: Time-series: 1629 - 2017

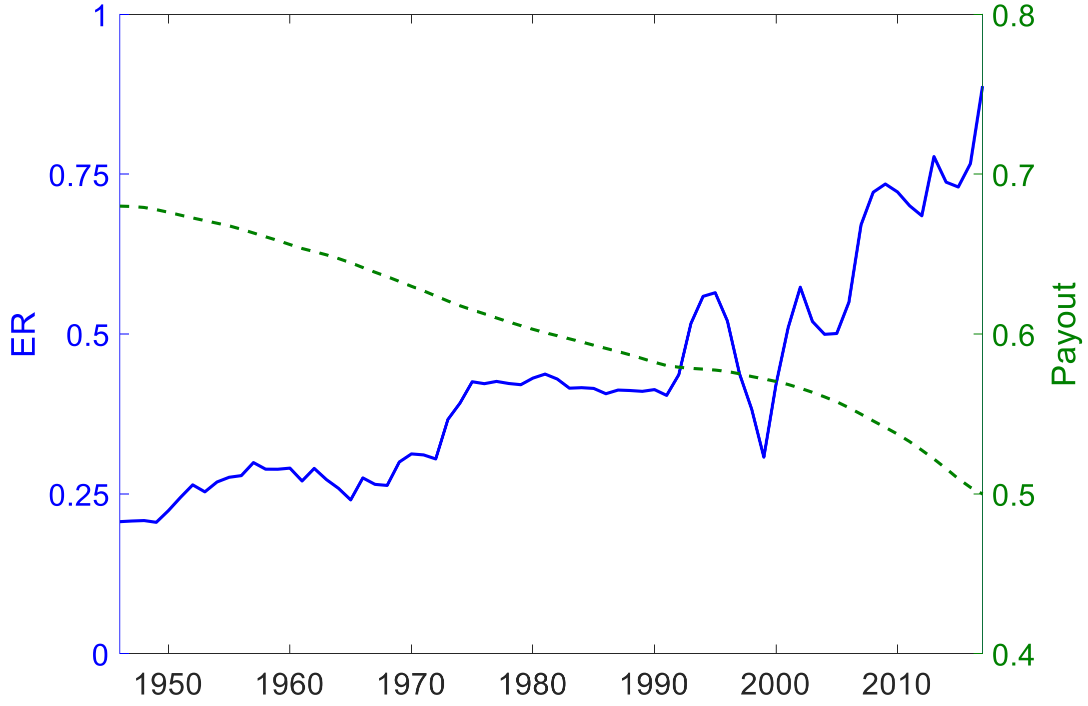
- Data from Golez and Koudijs (2018): The most important equity markets of the last four centuries:
    - The Netherlands and UK (1629-1812)
    - UK (1813-1870)
    - US (1871-extended to 2017)

The role of duration: Time-series: 1629 - 2017

	1629-1945	1945-2017	1629-2017
	(1)	(2)	(3)
Dependent variable: ret_{t+1}			
dp_t	**0.11**	**0.09**	0.07
t-stat.	(3.22)	(1.94)	(2.70)
Diff. (t-stat.)		[-0.41]	
R2	0.04	0.05	0.03
Dependent variable: dg_{t+1}			
dp_t	**-0.20**	**-0.01**	-0.10
t-stat.	(-5.30)	(-0.43)	(-4.14)
Diff. (t-stat.)		[4.13]	
R2	0.14	0.01	0.07
Dependent variable: dp_{t+1}			
dp_t	0.72	0.93	0.86
t-stat.	(15.75)	(20.81)	(25.87)
Diff. (t-stat.)		[3.38]	
R2	0.52	0.85	0.73
ER	**0.34**	**0.89**	0.40
EDG	0.63	0.11	0.56
ER/EDG	**0.55**	**7.76**	0.71

The role of duration: Time-series: 1872 - 2017

Fraction of expected return variation (ER) and total payout
(75-year rolling windows)



The role of duration: Cross-section: 1945 - 2017

- Data sources:
  - From CRSP and Compustat
  - For the time before 1950s, we calculate earnings using the clean surplus approach, following Chen, Da, and Priestley (2012)
- Form portfolios based on 10 year payouts (non-missing earnings and non-zero dividends)

The role of duration: Cross-section: 1945 - 2017

	All	Low	Medium	High	Below 0.5	Above 0.5
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: ret_{t+1}						
dp_t	0.10	**0.10**	**0.11**	**0.10**	0.12	0.09
t-stat.	(2.38)	(2.34)	(2.32)	(2.11)	(2.56)	(1.78)
R2	0.06	0.07	0.05	0.04	0.08	0.04
Dependent variable: dg_{t+1}						
dp_t	-0.03	**-0.01**	**-0.04**	**-0.08**	-0.02	-0.07
t-stat.	(-1.09)	(-0.37)	(-1.57)	(-2.11)	(-0.77)	(-2.06)
R2	0.02	0.00	0.03	0.08	0.01	0.07
Dependent variable: dp_{t+1}						
dp_t	0.90	0.92	0.89	0.86	0.89	0.89
t-stat.	(19.11)	(21.09)	(17.31)	(13.99)	(19.14)	(17.15)
R2	0.81	0.85	0.77	0.73	0.79	0.78
ER	0.83	**0.96**	**0.77**	**0.58**	0.93	0.60
EDG	0.21	0.09	0.27	0.46	0.12	0.45
ER/EDG	4.03	**10.19**	**2.90**	**1.27**	7.80	1.33

The role of duration: Cross-section: 1945 - 2017

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R2	0.06	0.07	0.05	0.04	0.08	0.04
Dependent variable: dg_{t+1}						
dp_t	-0.03	-0.01	-0.04	-0.08	**-0.02**	**-0.07**
t-stat.	(-1.09)	(-0.37)	(-1.57)	(-2.11)	(-0.77)	(-2.06)
R2	0.02	0.00	0.03	0.08	0.01	0.07
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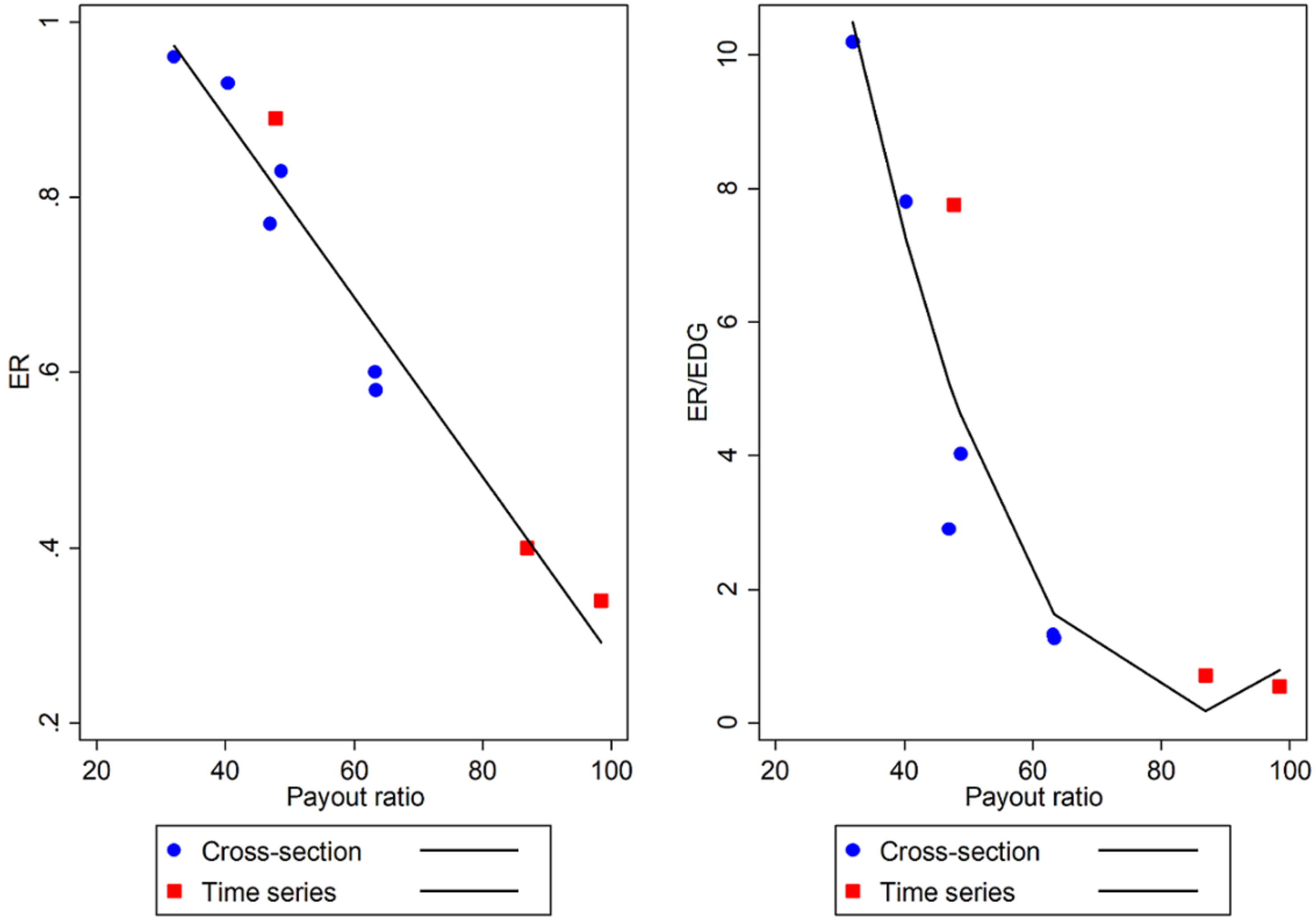
Time-series versus cross-sectional results



Robustness / discussion

- Repurchases:
  - Important only after change in regulation in 1982
  - Expected returns dominate already in 1945-1981 period
  - Cross-sectional results robust to sorting on total payouts
- “Excessive” dividend smoothing (Chen, Da, and Priestley, 2012)
  - Complementary
  - Cannot explain dividend strip results
  - Smoothing parameters not aligned with results in the cross-section

Full model

- Infinitely lived firms that pay dividends in each period
- Firms face trade-off between paying out dividends or reinvesting
- Assume that:
  - The long run earnings-to-price ratio $\overline{NP}$ is the same regardless of the exact payout policy.
  - Firms pay out a fixed fraction π of their earnings.
- Average expected dividend growth rate as a function of the payout policy:

$$\gamma_0 \simeq \delta_0 - \pi \overline{NP}$$

- Hence, π is an (inverse) measure of duration: a lower payout ratio means that growth rates are high and that payments to investors are pushed into the future.

Full model

- The average dividend-to-price ratio (in logs) is given by:

$$\overline{dp} = \log \pi + \overline{np}$$

- According to Campbell and Shiller (1988), and imposing AR(1) processes, we can express:

$$\frac{ER}{EDG} = \left(\frac{1-\rho\gamma_1}{1-\rho\delta_1}\right)^2 \frac{\mathrm{var}(\mu_t)}{\mathrm{var}(g_t)}, \quad where \quad \rho = \frac{\exp\{-\overline{dp}\}}{1+\exp\{-\overline{dp}\}}$$

- Holding $\overline{NP}$ constant, low payouts are associated with low average dividend-to-price ratio, and consequently, high rho.
- Then $\partial(ER/EDG)/\partial\rho > 0$, as long as $\delta_1 > \gamma_1$.
- In words: as long as expected returns are more persistent than expected growth rates, expected returns become relatively more important when duration increases.

Conclusions

- The impact of expected returns on equity prices increases with equity duration:
  - Simple present value model
  - Three pieces of empirical evidence:
    - Dividend strips
    - Time-series evidence
    - Cross-sectional evidence
- The impact of expected growth rates on equity prices in the recent U.S. period is masked by the increased duration of the equity market.

Thank you!