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Forecasting stock market returns

- Strong evidence that expected returns vary considerably over time with price multiples, macroeconomic variables, corporate actions, and measures of risk
- This variation has important implications for investments and corporate finance applications
  - Discount rate is opportunity cost from the market
- However, the practical gains have remained elusive since there has been no approach to forecast returns that works robustly out of

Predictive regressions

- Regression of returns on lagged predictors with data up to time *s*

$$r_{t+1} = \alpha + \beta x_t + \epsilon_{t+1}$$

Forecast return at time *s*+1 with estimated coefficients and predictive variable at time *s*

$$\hat{\mu}_s = \hat{\alpha} + \hat{\beta} x_s$$

- Roll forward until the end of the sample using a sequence of expanding windows

Measuring out-of-sample performance

- Evaluate performance with out-of-sample R^2 relative to historical mean

$$MSE_A = \frac{1}{T - s_0} \sum_{s=s_0}^{T-1} (r_{s+1} - \hat{\mu}_s)^2$$

$$MSE_M = \frac{1}{T - s_0} \sum_{s=s_0}^{T-1} (r_{s+1} - \overline{r}_s)^2$$

$$R^2 = 1 - \frac{MSE_A}{MSE_M}$$

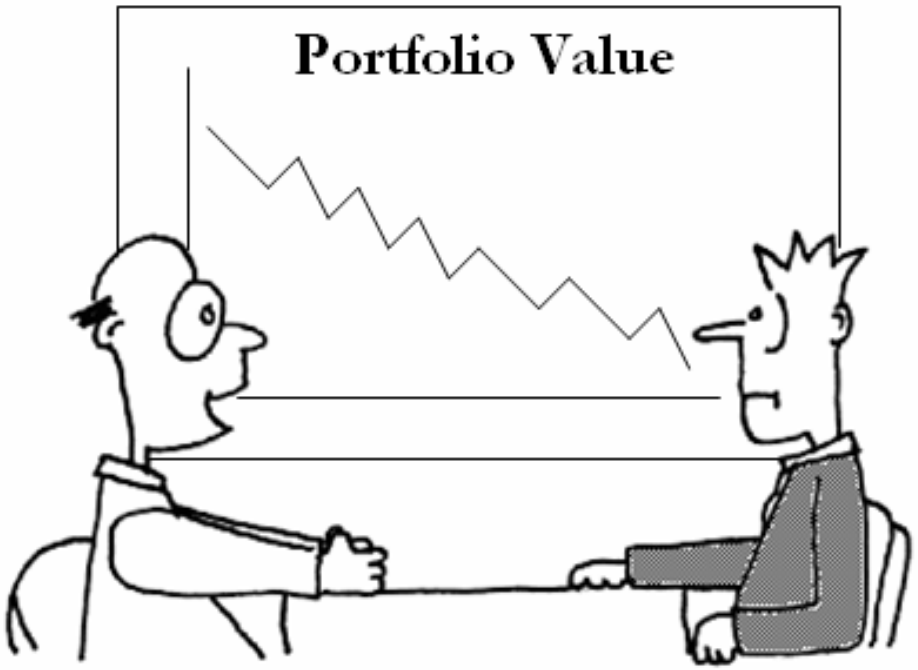
Predictive regressions

- Predictive regressions work in sample
  - Campbell (1987), Fama and French (1988), Hodrick (1992), Cochrane (2008)
- Critiques of predictive regressions
  - Biases due to persistent predictors – Nelson and Kim (1993), Stambaugh (1999), Lewellen (2004)
  - Data mining – Ferson, Sarkissian, and Simin (2003)
  - Out-of-sample performance – Goyal and Welch (2008)

Predictive regressions - annual

	Predictor	In-sample R-squared	Out-of-Sample R-squared	
			Predictive regression	Predictive regression (shrinkage)
SVAR	Stock variance	0.34	-0.15	0.00
DFR	Default return spread	1.95	1.64	0.99
LTY	Long term bond yield	0.71	-8.31	-0.85
LTR	Long term bond return	2.29	-2.94	**2.65**
INFL	Inflation	1.39	-1.04	0.53
TMS	Term spread	0.80	-7.23	-1.20
TBL	T-bill rate	0.13	-11.69	-2.09
DFY	Default yield spread	0.03	-1.13	-0.31
NTIS	Net equity expansion	**12.29**	1.06	2.30
ROE	Return on equity	0.02	-10.79	-2.40
DE	Dividend payout	1.58	-0.17	0.47
EP	Earnings price	**5.69**	**7.54**	**4.56**
SEP	Smooth earning price	**8.27**	-17.57	2.47
DP	Dividend price	1.63	-1.01	0.28
DY	Dividend yield	2.31	-17.21	1.45
BM	Book-to-market	**5.76**	-8.80	0.82

Forecasting is hard... especially the future



But it backtested so well!

Decomposing returns

- Capital gains

$$1 + CG_{t+1} = \frac{P_{t+1}}{P_t} = \frac{P_{t+1}/E_{t+1}}{P_t/E_t}\frac{E_{t+1}}{E_t}$$
$$= \frac{M_{t+1}}{M_t}\frac{E_{t+1}}{E_t} = (1 + GM_{t+1})(1 + GE_{t+1})$$

- Dividend yield

$$DY_{t+1} = \frac{D_{t+1}}{P_t} = \frac{D_{t+1}}{P_{t+1}}\frac{P_{t+1}}{P_t} = DP_{t+1}(1 + GM_{t+1})(1 + GE_{t+1})$$

- Total returns

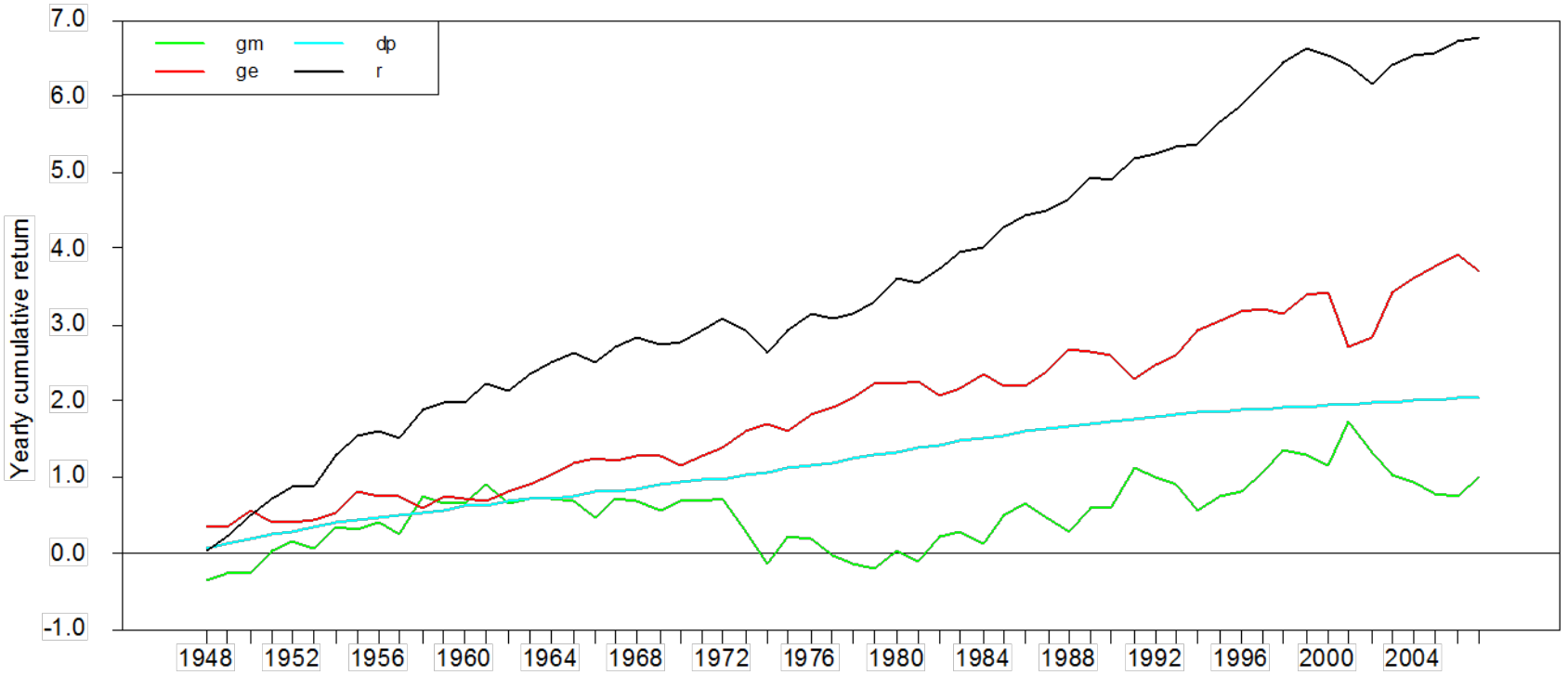
$$1 + R_{t+1} = 1 + CG_{t+1} + DY_{t+1} = (1 + GM_{t+1})(1 + GE_{t+1})(1 + DP_{t+1})$$

- In logs

$$r_{t+1} = \log(1 + R_{t+1}) = gm_{t+1} + ge_{t+1} + dp_{t+1}$$

0.5% 5% 4%

Historic return components



Historic return components

	Mean	Median	Sdt Dev	Min	Max	Skew	Kurt	AR(1)
gm	0.44	-1.44	26.33	-62.26	78.83	0.27	3.12	-0.17
ge	5.09	9.64	21.49	-70.56	56.90	-1.02	5.42	0.17
dp	3.90	3.60	1.64	1.13	9.62	0.75	3.99	0.79
rm	9.69	13.51	19.42	-60.97	43.60	-0.97	4.50	0.09

Correlations				
	gm	ge	dp	rm
gm	1.00			
ge	-0.66	1.00		
dp	-0.21	-0.16	1.00	
rm	0.60	0.19	-0.38	1.00

Sum-of-the-parts approach (SOP)

- We forecast each component of returns separately $\hat{\mu}_s = \hat{\mu}_s^{gm} + \hat{\mu}_s^{ge} + \hat{\mu}_s^{dp}$
- Expected dividend price estimated by the current dividend-price ratio
  - Assumes this ratio follows a random walk
- Expected earnings growth estimated with a 20-year past moving average
  - Earnings growth nearly impossible to forecast
  - Tried analyst consensus forecasts with worse results

Sum-of-the-parts approach (SOP)

- 3 alternatives to estimate expected multiple growth
  - No multiple growth
  - Multiple gro[illegible]kage)

$$gm_{t+1} = \alpha + \beta x_t + \epsilon_{t+1}$$

  - Multiple reve[illegible])

$$m_t = a + bx_t + u_t$$

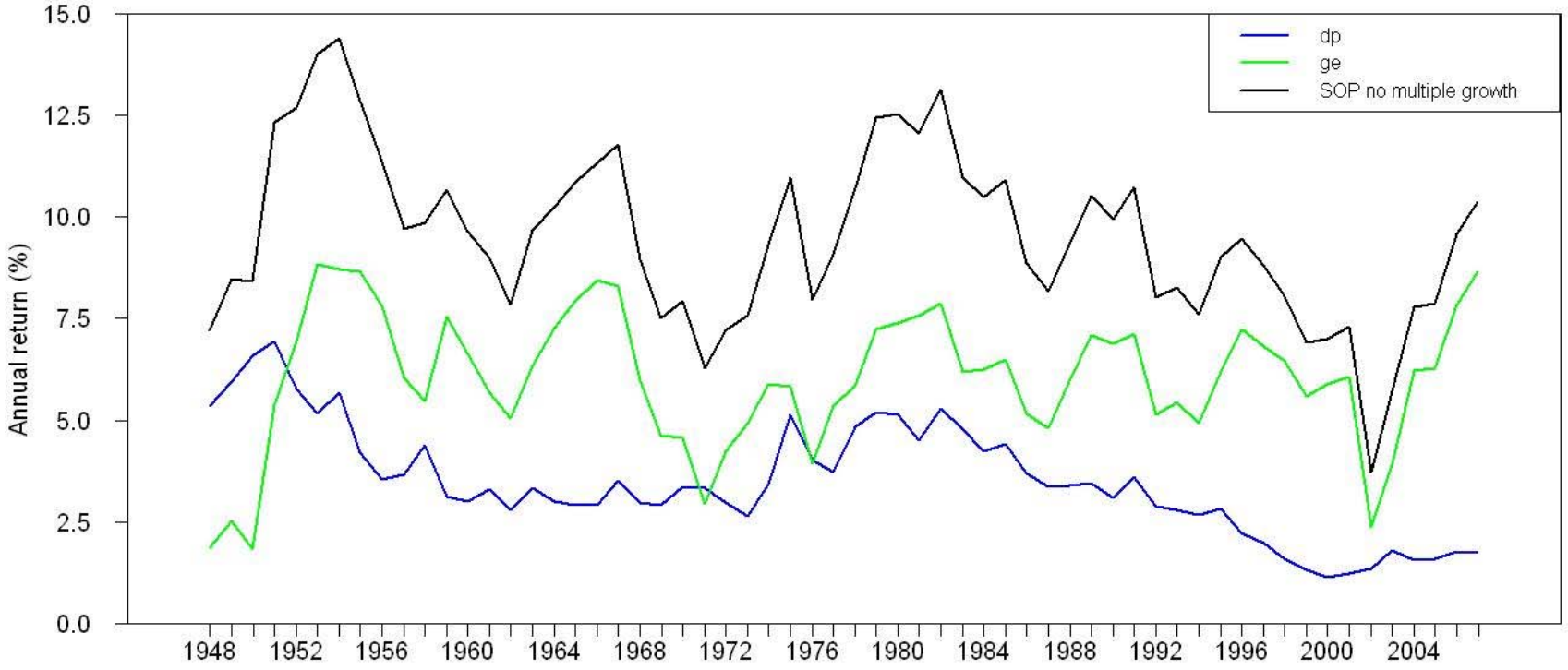
$$\hat{m}_s = \hat{a} + \hat{b}x_s$$

$$-\hat{u}_s = \hat{m}_s - m_s = \hat{\mu}_s^{gm}$$

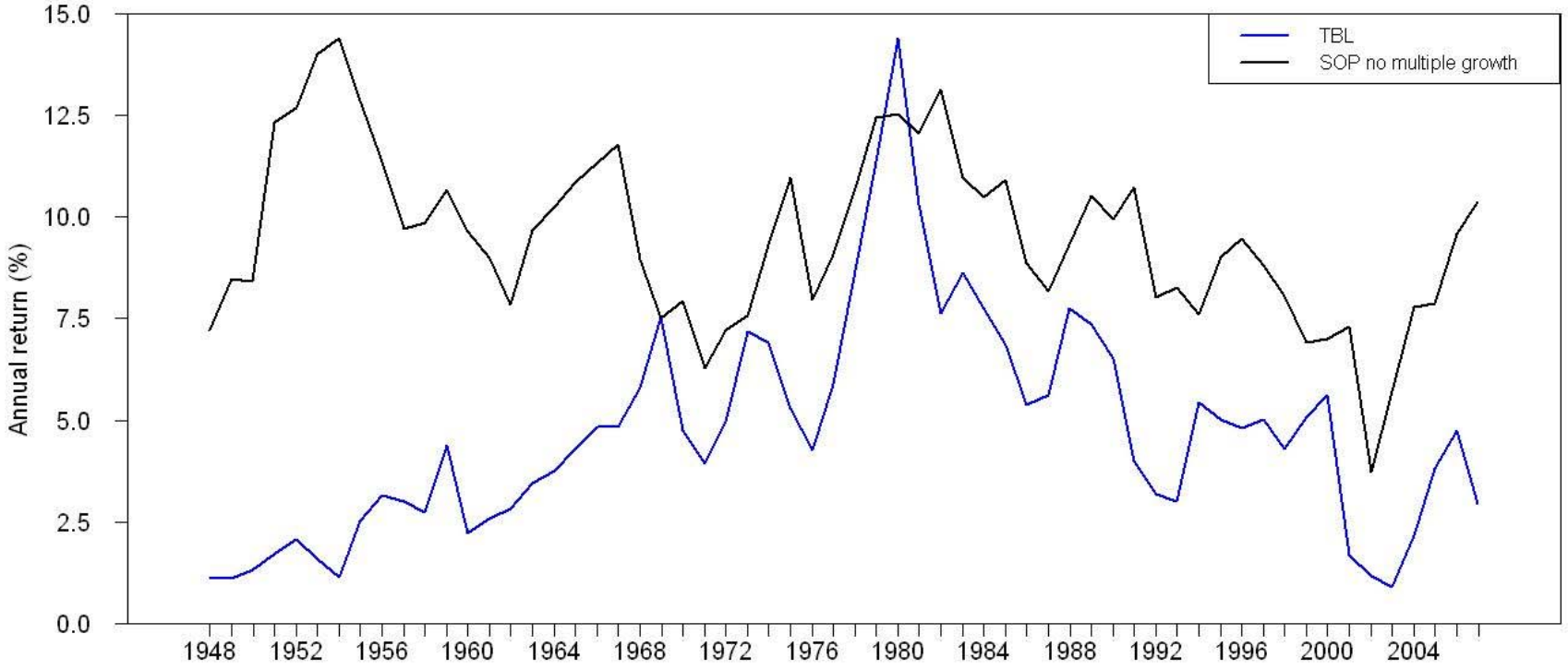
Sum-of-the-parts approach - annual

Variable	Predictor	Out-of-Sample R-square		
		SOP no multiple multiple	SOP multiple growth regression	SOP multiple reversion
		13.43		
SVAR	Stock variance		**12.74**	**13.65**
DFR	Default return spread		**14.40**	**12.98**
LTY	Long term bond yield		**10.92**	**7.61**
LTR	Long term bond return		**12.62**	**16.94**
INFL	Inflation		**12.91**	**14.05**
TMS	Term spread		**11.28**	**15.57**
TBL	T-bill rate		**11.51**	**11.67**
DFY	Default yield spread		**12.57**	**14.46**
NTIS	Net equity expansion		**13.31**	**14.21**
ROE	Return on equity		**13.66**	**9.02**
DE	Dividend payout		**12.60**	**9.72**
EP	Earnings price		**14.31**	
SEP	Smooth earning price		**11.07**	
DP	Dividend price		**8.99**	
DY	Dividend yield		**12.51**	
BM	Book-to-market		**10.20**	
	Constant			**14.40**

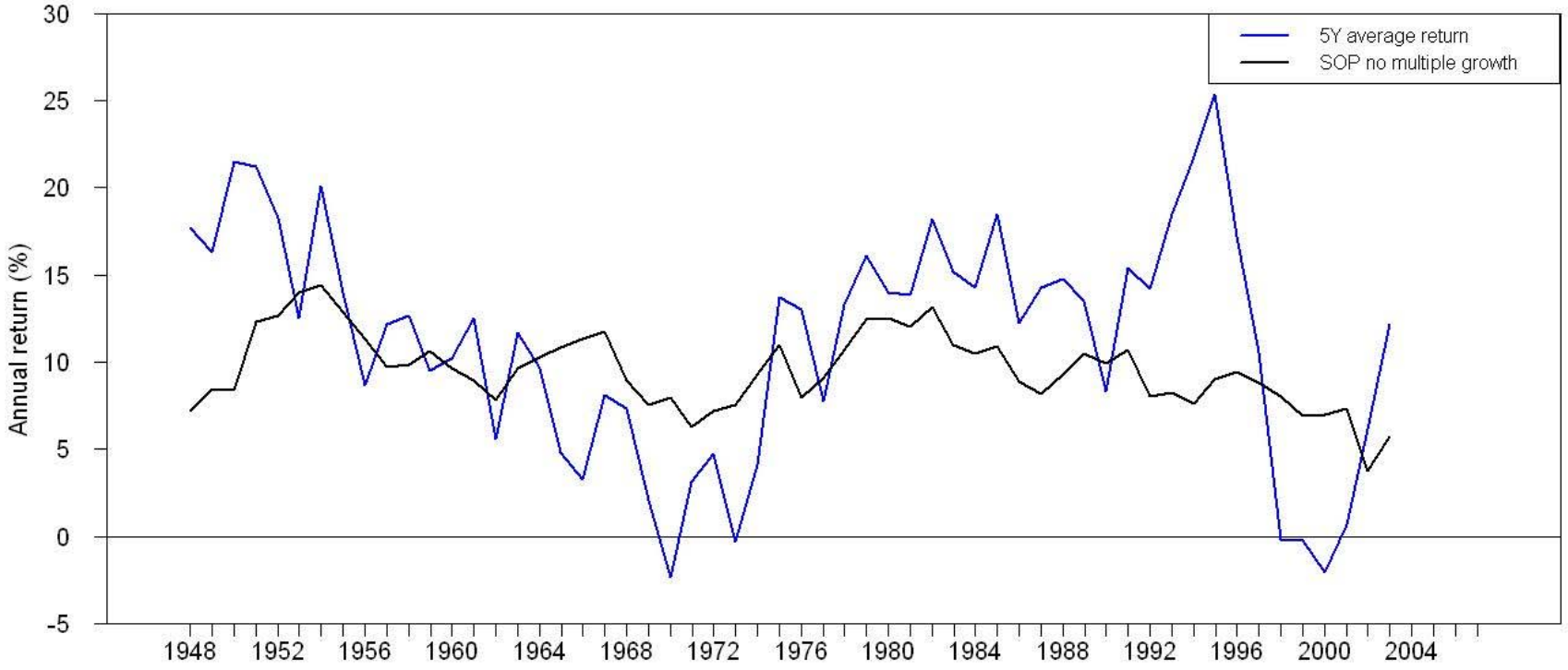
SOP return forecast (no multiple growth)



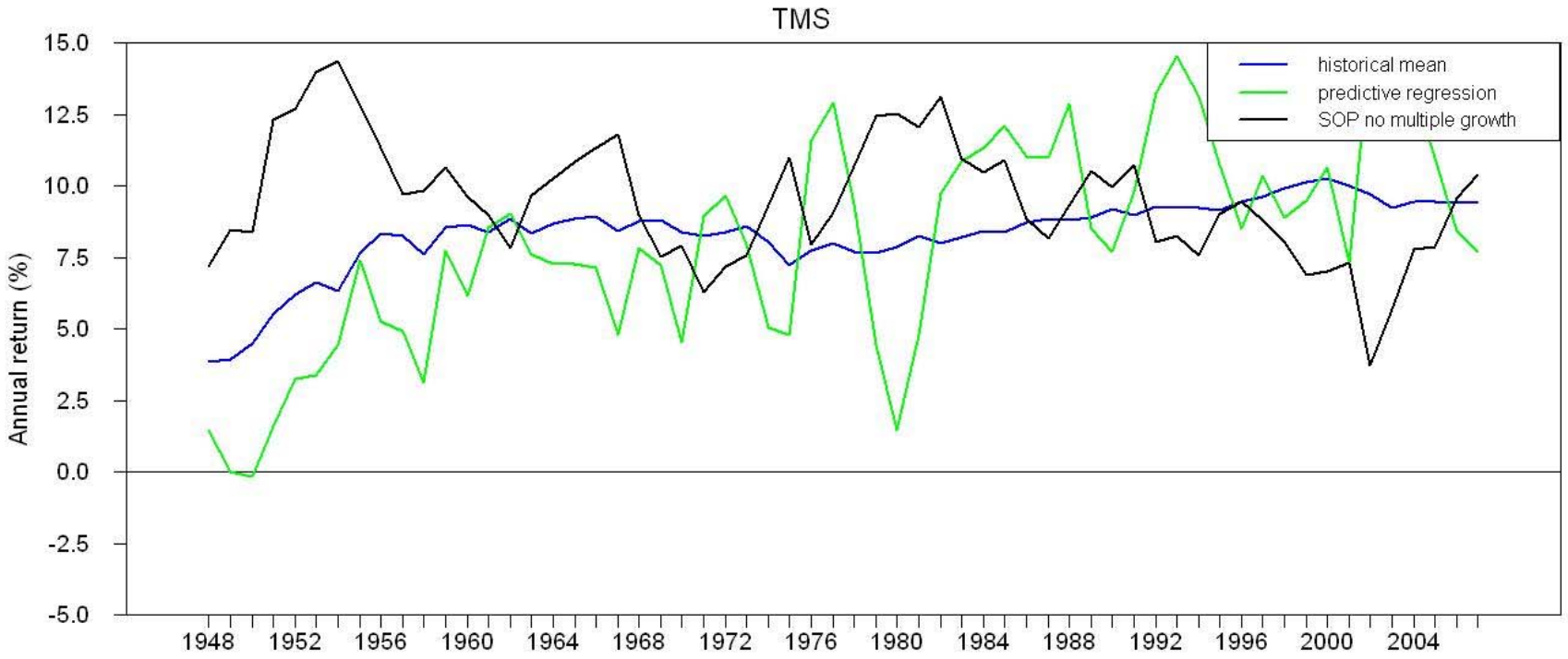
SOP return forecast vs T-bill rate



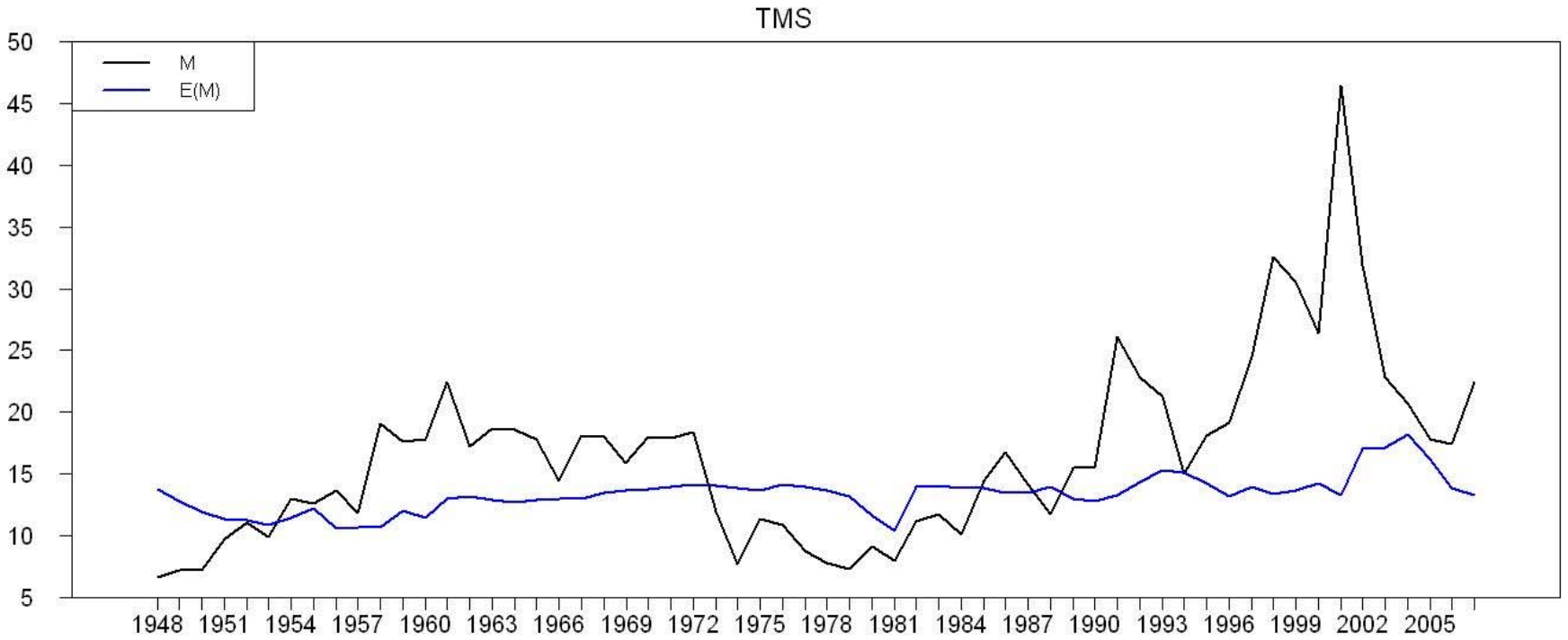
SOP forecast vs realized returns



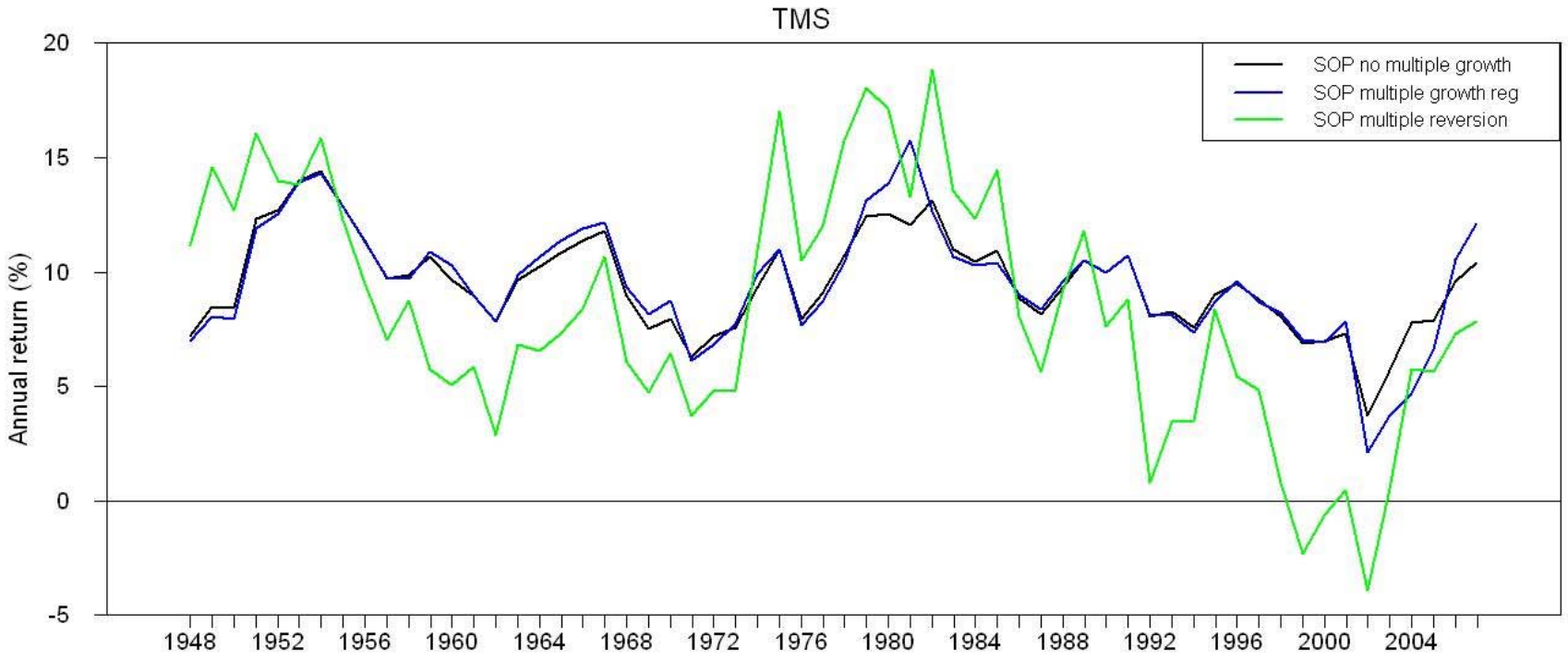
SOP vs predictive regression vs mean



Multiple reversion



SOP forecast (all variants)



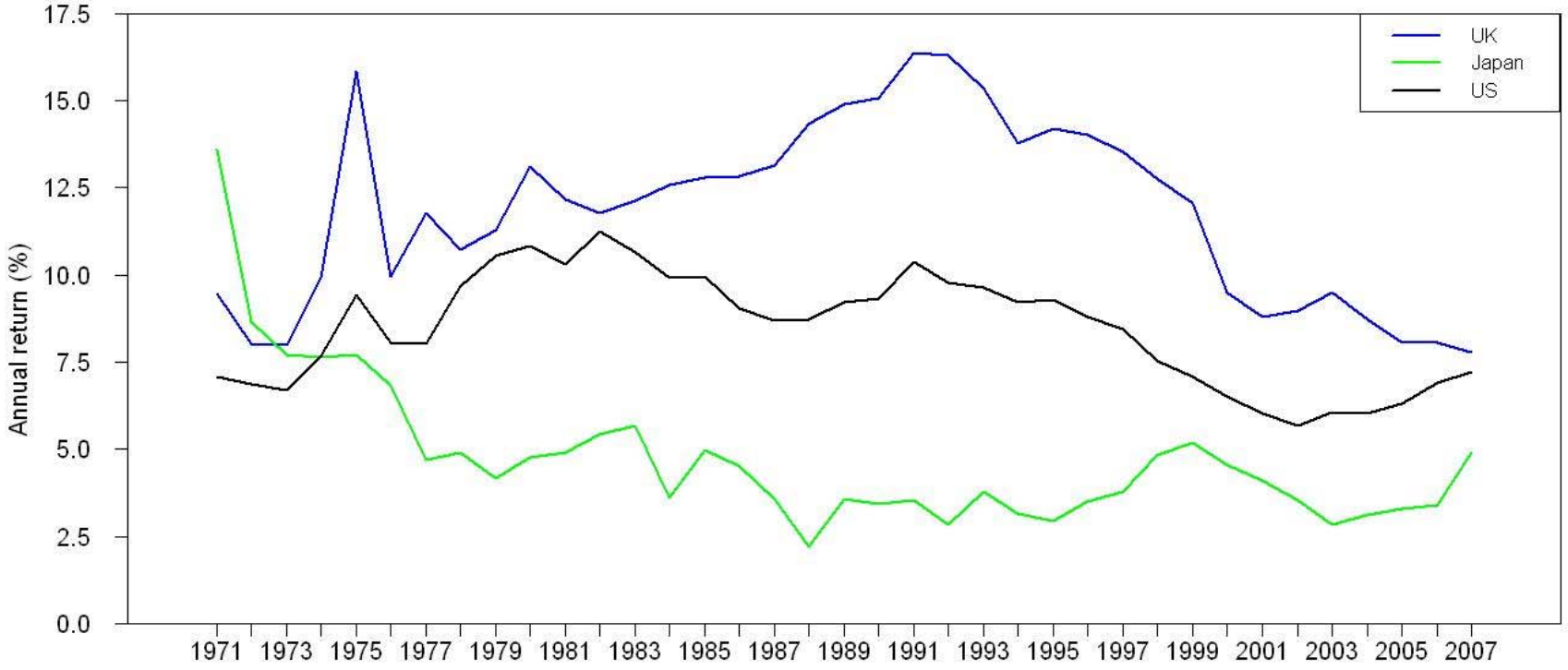
Sharpe ratio gain

	Predictor	SOP no multiple multiple	SOP multiple growth regression	SOP multiple reversion
		0.22		
SVAR	Stock variance		0.23	0.11
DFR	Default return spread		0.23	0.12
LTY	Long term bond yield		0.19	0.02
LTR	Long term bond return		0.23	0.15
INFL	Inflation		0.21	0.09
TMS	Term spread		0.18	0.15
TBL	T-bill rate		0.19	0.08
DFY	Default yield spread		0.24	0.13
NTIS	Net equity expansion		0.22	0.12
ROE	Return on equity		0.16	0.03
DE	Dividend payout		0.21	0.04
EP	Earnings price		0.12	
SEP	Smooth earning price		0.06	
DP	Dividend price		0.04	
DY	Dividend yield		0.20	
BM	Book-to-market		0.09	
Constant				0.13

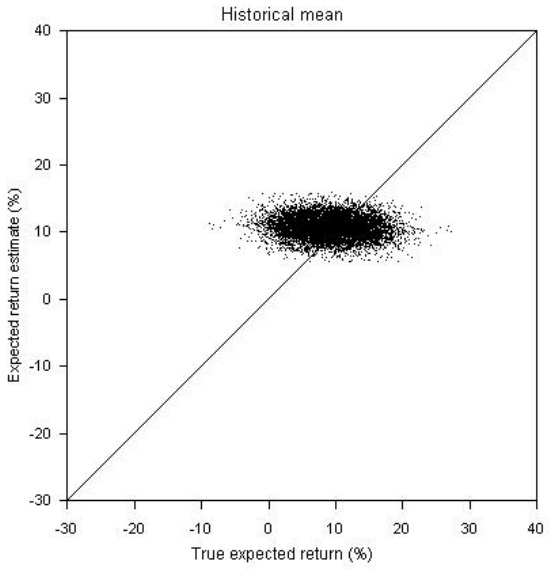
International evidence

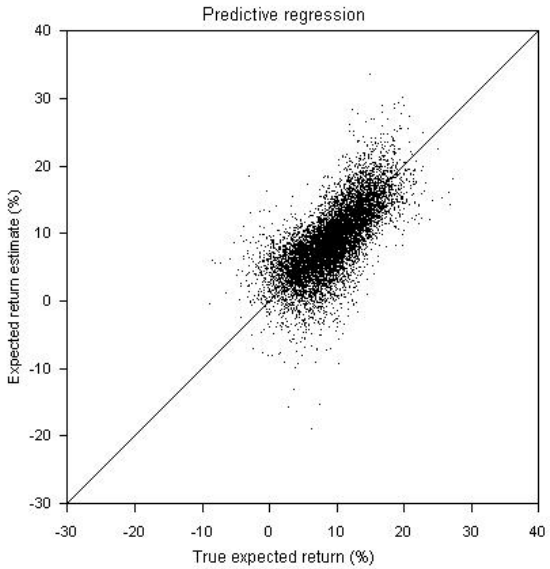
	Predictor	Out-of-Sample R-square				
		Predictive regression	Predictive regression (shrinkage)	SOP no multiple multiple	SOP multiple growth regression	SOP multiple reversion
			U.K.			
				10.73		
LTY	Long term bond yield	-47.54	-5.61		**4.16**	**11.27**
TMS	Term spread	-14.71	-1.13		**9.26**	**11.60**
TBL	T-bill rate	-20.87	-3.07		**6.39**	**11.51**
DY	Dividend yield	-9.19	**5.07**		**13.28**	**10.78**
	Constant					**11.75**
			Japan			
				12.14		
LTY	Long term bond yield	-11.01	-1.86		**12.11**	**11.87**
TMS	Term spread	-5.46	-0.89		**5.75**	**5.82**
TBL	T-bill rate	-7.57	-0.62		5.14	**5.62**
DY	Dividend yield	3.12	6.63		**10.25**	**11.99**
	Constant					**11.91**
			U.S.			
				7.75		
LTY	Long term bond yield	-20.73	-1.51		**4.47**	3.12
TMS	Term spread	-12.05	-0.99		**8.24**	**5.50**
TBL	T-bill rate	-21.18	-2.00		**5.06**	3.40
DY	Dividend yield	0.96	2.68		**6.64**	**5.73**
	Constant					**5.92**

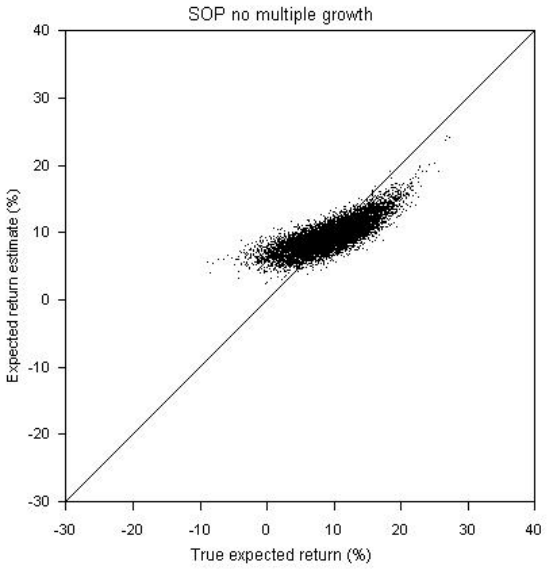
International expected returns



Monte Carlo simulation

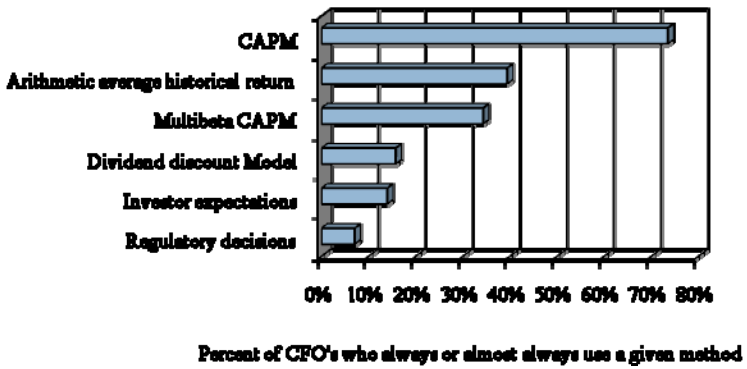






Cost of capital for corporate finance

- CAPM most used (Graham and Harvey, 2007)



- 60% of corporations and 80% of financial advisers use historical market risk premium in the CAPM
- 86% of Textbooks/Tradebooks advise to use the historical average market risk premium

The CAPM

- Doesn't work very well out of sample...

Out-of-sample R-square (Sample: 1929-2008)

		CAPM
Small	Growth	-9.17
	Value	-3.21
Big	Growth	0.73
	Value	0.85

The Fama-French model

- Also doesn't work...

Out-of-sample R-square (Sample: 1929-2008)		
		Fama-French 3-Factor Model
Small	Growth	-3.33
	Value	-0.46
Big	Growth	0.92
	Value	-2.18

The SOP model

- Is what you should use!

		Out-of-sample R-square (Sample: 1929-2008)				
		Sum-of-the-parts (SOP)	Fama-French 3-Factor Model	CAPM	Fama-French 3-Factor Model (*SOP estimates*)	CAPM (*SOP estimates*)
Small	Growth	7.18***	-3.33	-9.17	7.29***	7.18***
	Neutral	10.09***	1.20	-1.26	7.38***	6.81***
	Value	6.00**	-0.46	-3.21	5.29**	2.96**
Big	Growth	12.62***	0.92	0.73	10.29***	13.99***
	Neutral	13.35***	-0.79	0.83	13.79***	12.05***
	Value	11.94***	-2.18	0.85	11.19***	9.61***

Industry portfolios

	Historical Mean		SOP	
	CAPM	FF 3-Factor	CAPM	FF 3-Factor
Books	4.38**	8.07***	11.30***	8.75***
Hshld	5.84**	8.71***	11.80***	5.10**
BldMt	-3.08	1.08	9.18***	5.86
Util	-4.42	-4.50	11.12***	13.39***
Telcm	-9.85	-12.89	5.69**	3.03**
Trans	-4.51	-6.22	8.16***	7.42***
Whlst	-1.04	-3.98	10.28***	9.03***
Rtail	0.60	-0.48	6.34***	7.62***
Meals	2.01*	1.89*	7.03***	8.61***
Banks	-6.60	-6.86	2.23*	3.14**
Insur	-6.36	-8.37	5.85**	3.41**
RlEst	-0.75	-2.79	6.07**	5.24**
Fin	-2.02	-1.03	6.19***	6.36***
Average 40 Industry	-2.61	-1.44	5.71	4.49

Concluding remarks

- We show that forecasting components of returns works better than traditional predictive regressions
  - Instability of coefficients in predictive regressions
  - Estimation error
  - We combine a steady-state forecast for earnings growth with the market's current valuation

- Our results revive the long literature on market predictability showing it holds robustly out of sample

Concluding remarks

- There are important implications for investments
  - Tactical asset allocation
- And for corporate finance
  - Time-varying discount rates for project valuation
- An open question is whether our results correspond to excessive predictability or time-varying risk premia?