Valuation Fundamentals

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Summary

- Determine how financial analysts perform valuations and study the drivers of fluctuations in expected valuations
- 78,509 equity reports ensures a direct measure of short and medium-term growth expectations, terminal growth expectations and discount rates.
- Terminal growth expectations and discount rates are the main drivers of valuation, yet discount rates explain the majority of variance.
- Analysts' methods largely follow theoretical recommendations

Introduction

- Limited consensus on whether future cash flows or discount rates explain most of the fluctuation in valuation prices
- DCF data on growth expectations and discount rates is needed to identify the key drivers of expected valuations
- By decomposing expected valuations into their components, it is observed the connection between subjective expectations and objective factors like discount rates
- The valuation components are also decomposed into key elements to identify their drivers

Data overview

- The dataset consists of 78,509 DCF equity reports published by analysts covering 11,171 firms from 94 countries, collected over 24 years (2000-2023) in the first months of each year (01/01 to 01/04).
- Country-level data on inflation rates and the 10-year treasury yield from Refinitiv and real GDP growth rate from the World Bank
- Direct observation of analysts' models, not just aggregated data like in many prior studies neither have estimated or “backed out” any of the variables
- Key inputs:
    - Discount rates: equity betas, risk premia, and risk-free rates
    - Terminal growth rates: effects of GDP, inflation and long-term interest rate

Methodology – DCF is the workhorse for valuation, but is non-linear (so hard to do regression analysis)

- Set the usual forecast for 3 years + terminal growth rate.
- Original DCF:
- $E_0^*[P_0] = \frac{E_0^*[CF_1]}{(1+E_0^*[r])^1} + \frac{E_0^*[CF_2]}{(1+E_0^*[r])^2} + \frac{E_0^*[CF_3]}{(1+E_0^*[r])^3} + \sum_{i=4}^{\infty} \frac{E_0^*[CF_3] * (1+E_0^*[g_T])^{i-3}}{(1+E_0^*[r])^i}$
- Terminal value multiple $= \frac{1}{(E_0^*[r] - E_0^*[g_T])}$
- By simplifying the model with a short-term focus and isolating the discount rate, the DCF can be expressed by:
- $E_0^*[P_0] \approx \frac{E_0^*[CF_1]}{(1+E_0^*[r])} + \frac{E_0^*[P_1]}{(1+E_0^*[r])} \Rightarrow 1 + E_0^*[r] = \frac{E_0^*[CF_1] + E_0^*[P_1]}{P_0}$

Methodology – Linearizing DCF

- To highlight the key inputs, the DCFs are linearized by the Campbell-Shiller decomposition:
- $1 + E_0^*[r] = \frac{E_0^*[CF_1]+E_0^*[P_1]}{P_0}$
- $\ln(E_0^*[CF_1] + E_0^*[P_1]) \approx \ln(E_0^*[CF_1]) + \rho \ln\left(\frac{E_0^*[P_1]}{E_0^*[CF_1]}\right)$
- $\ln(1 + E_0^*[r]) = \ln(E_0^*[CF_1]) + \rho \ln\left(\frac{E_0^*[P_1]}{E_0^*[CF_1]}\right) - \ln(P_0)$
- $\ln(1 + E_0^*[r]) = k - \ln(E_0^*[P_0]) + \ln(CF_0) + \ln\left(\frac{E_0^*[FCF_1]}{FCF_0}\right) + \rho \ln\left(\frac{E_0^*[P_1]}{E_0^*[CF_1]}\right) \Rightarrow$

$\Rightarrow \ln(E_0^*[P_0]) = k + \ln(CF_0) - \ln(1 + E_0^*[r]) + \ln\left(\frac{E_0^*[FCF_1]}{FCF_0}\right) + \rho \ln\left(\frac{E_0^*[P_1]}{E_0^*[CF_1]}\right)$ ρ being a normalizing constant smaller than 1 and by iterating forward:

$$\ln(E_0^*[P_0]) = k + \ln(CF_0) + \ln(1 + E_0^*[g_1]) + \rho \ln(1 + E_0^*[g_2]) + \rho^2 \ln(1 + E_0^*[g_3]) + \frac{\rho^3}{1-\rho}\ln(1 + E_0^*[g_T]) - \frac{1}{1-\rho}\ln(1 + E_0^*[r])$$

- This allows to express DFCs as a **LINEAR function** of variables that are determined and observable at the time of the forecast: growth expectations and discount rate

Valuation – Regression

- Y: valuation i, j, t: valution from company i, analyst j and forecast year t
- Both growth expectations and discount rate are associated with changes in analysts' expected valuation

Panel A: DCF	$\ln(\text{Valuation}_{i,j,t})$						
	All sample			Younger firms			All sample
	Free cash flows						Sales
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Terminal growth$_{i,j,t}$	10.48***	4.88***	6.90**	9.50***	8.45***	18.83***	11.39**
	(1.74)	(1.27)	(3.22)	(2.71)	(1.83)	(6.55)	(4.84)
Discount rate$_{i,j,t}$	-20.16***	-13.22***	-16.47***	-13.75***	-14.48***	-19.91***	-19.13***
	(1.35)	(1.06)	(3.51)	(2.00)	(1.70)	(5.39)	(3.95)
Initial value$_{i,j,t}$			0.06**			0.07	0.09
			(0.03)			(0.04)	(0.08)
Short-term growth$_{i,j,t}^{\text{Year}=1}$			0.00			0.08	-0.02
			(0.05)			(0.09)	(0.09)
Medium-term growth$_{i,j,t}^{\text{Year}=2\text{-}3}$			0.22***			0.34**	0.15
			(0.08)			(0.14)	(0.12)
Contibutor*Firm FE	No	Yes	Yes	No	Yes	Yes	Yes
Observations	18,578	12,058	413	5,934	3,507	143	384
F Statistics	120.83	83.55	5.75	28.09	53.11	6.39	6.74
R^2	0.04	0.93	0.92	0.02	0.94	0.94	0.92

Valuation – R^2 Decomposition

- Firm expected valuation

Panel A: DCF	ln(Valuation$_{i,j,t}$)						
	All sample			Younger firms			All sample
	Free cash flows						Sales
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Contibutor*Firm FE	No	Yes	Yes	No	Yes	Yes	Yes
R^2 Decomposition							
Initial value$_{i,j,t}^{\text{Year}=0}$			8.15 %			6.32 %	8.15 %
Discount rate (DR)$_{i,j,t}$	90.07 %	81.82 %	71.04 %	83.09 %	51.59 %	42.17 %	71.04%
Short-term growth$_{i,j,t}^{\text{Year}=1}$			3.32 %			10.91%	3.32 %
Medium-term growth$_{i,j,t}^{\text{Year}=2\text{-}3}$			6.10 %			8.66 %	6.10 %
Terminal growth (TGR)$_{i,j,t}$	9.93 %	18.18 %	11.39 %	16.91 %	48.41 %	31.94 %	11.39%

- Long-term expectations are more important than short-term to explain aggregate market prices fluctuation, but discount rates are associated with the greatest amount of variations in expected prices
- The discount rate is consistently the most explanatory factor, explaining most of the variance in expected valuations across all models.
- This makes the discount rate the single most important input to understand expected prices

Valuation – Terminal Value Multiple

- The terminal value accounts for about 70% of the total equity valuation
- Two inputs: discount rate and the terminal growth rate
- Once again the bulk of variance is explained by the discount rate, yet the effect size is similar.

$$TVM_0 = \frac{1}{r - g_T}$$

$$TVM_0 = \frac{1}{(1+g_T)(e^{ln(\frac{(1+r)}{(1+g_T)}-1)})}$$

$$ln(TVM_0) \approx -ln(1+g_T) - ln(e^{ln(\frac{(1+r)}{(1+g_T)}} - 1)$$

$$ln(TVM_0) \approx k + (\theta - 1) * ln(1+g_T) - \theta ln(1+r)$$

Panel B: Terminal Multiple	$\ln(1/(DR_{i,j,t} - TGR_{i,j,t}))$	
	(1)	(2)
Terminal growth$_{i,j,t}$	10.48***	14.01***
	(1.38)	(0.92)
Discount rate$_{i,j,t}$	-15.37***	-16.38***
	(0.21)	(0.18)
Contibutor*Firm FE	No	Yes
Observations	48,857	37,617
F Statistics	15,641.63	4,868.67
R^2	0.81	0.95
R^2 Decomposition		
Discount rate$_{i,j,t}$ (%)	72.79 %	59.47 %
Terminal growth rate$_{i,j,t}$ (%)	27.21 %	40.53 %

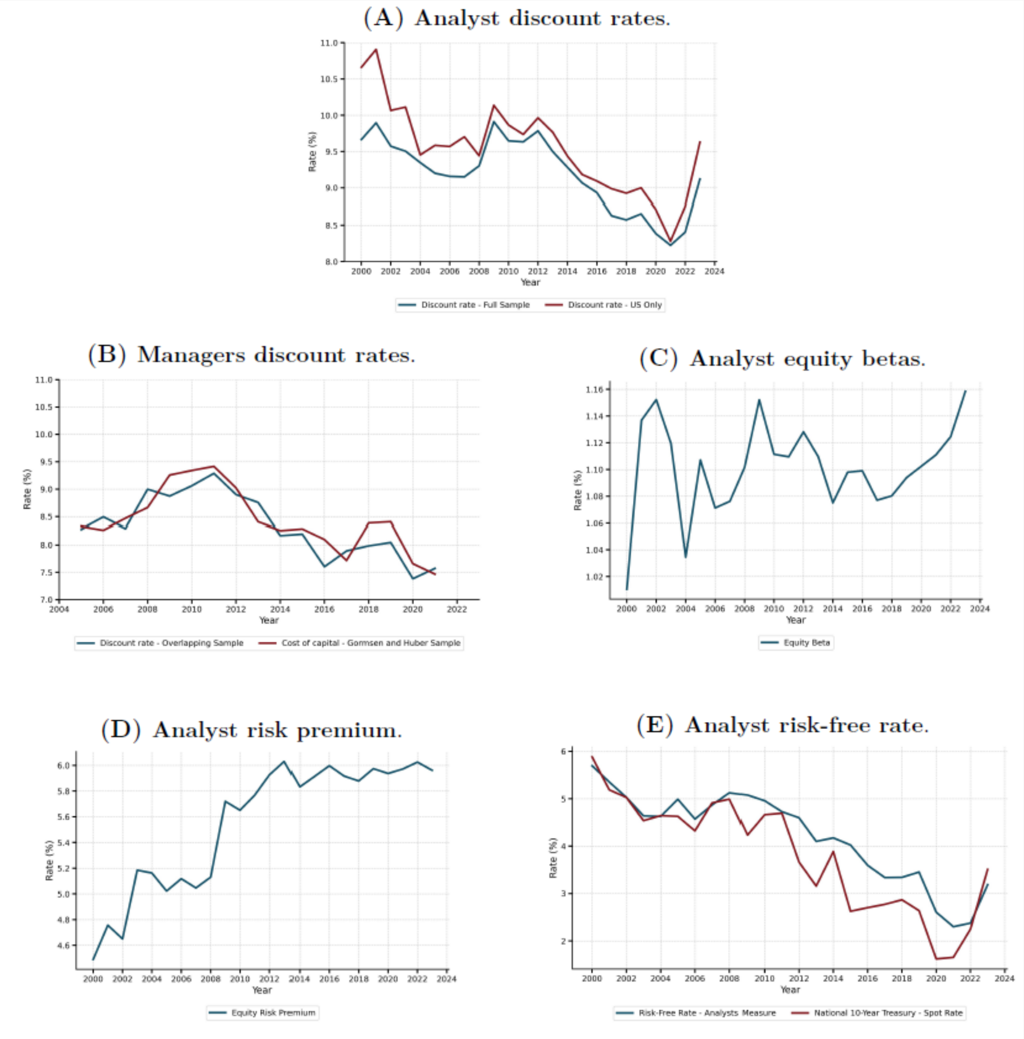
Curiosity not directly relevant for the analysis of valuation drivers:

Higher terminal growth rates are associated with lower realized returns.

Dependent variable	Realized return$_{i,t+1}$		
	(1)	(2)	(3)
Terminal growth rate$_{i,j,t}$	-0.80***		-1.12***
	(0.29)		(0.31)
Discount rate$_{i,j,t}$		0.62***	0.85***
		(0.16)	(0.22)
Constant	5.58***	-0.96	-1.36
	(0.72)	(1.40)	(1.85)
Observations	16,717	26,726	16,024
F Statistics	7.39	14.59	11.89
R^2	0.00	0.00	0.00

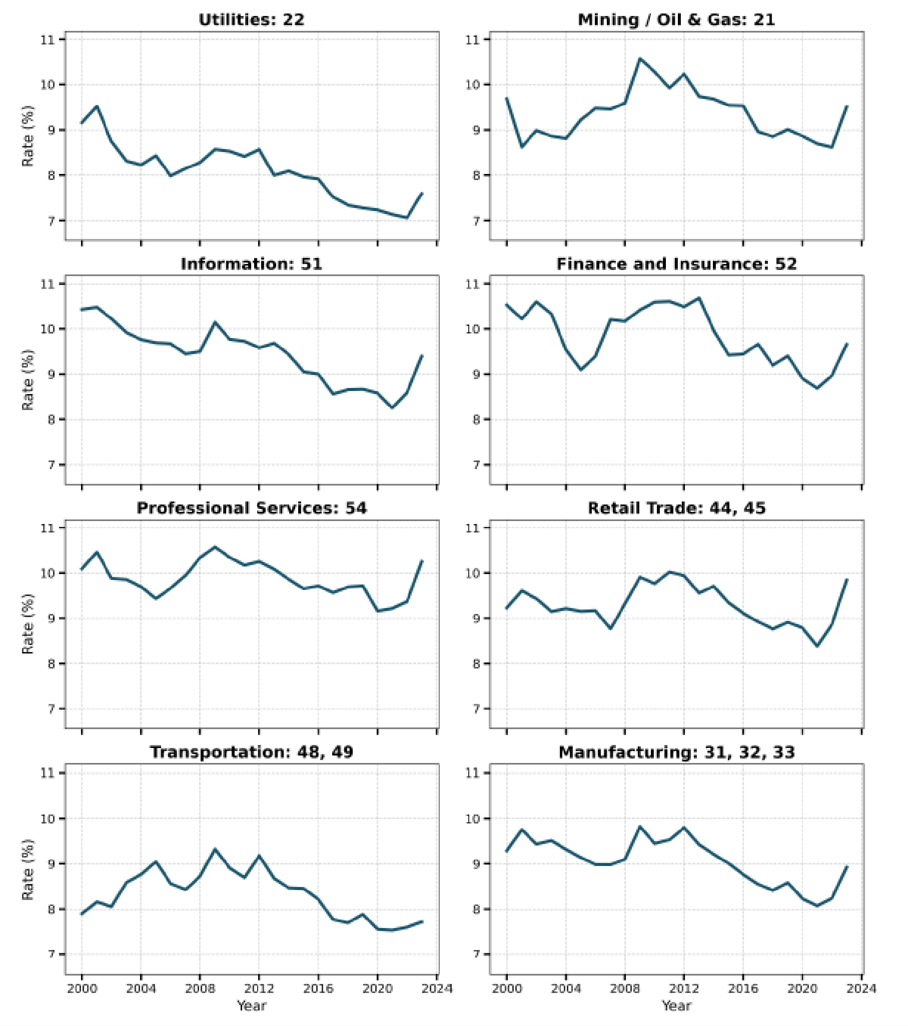
Discount Rates – Descriptive Analysis

- Benchmark
  - The discount rates used by the analysts are consistent with the secular decline in the risk-free rate
  - Analysts discount rates, on average, track the discount rates used by the management.
  - Their similarities suggest that firm managers and equity analysts measure the cost of capital with comparable methods



Discount Rate – Descriptive Analysis

- There are systematic differences on discount rates of different industries yet follow roughly similar trends.
- Utilities, tech, manufacturing and transportation saw some decline on discount rates.
- Comdty, retail, professional services and manufacturing did not.



Discount Rates – Key Determinants Regression

- Key determinants: risk-free rates, equity beta and equity premium

Panel A: Discount rate	Discount $\text{rate}_{i,j,t}$ (%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Discount $\text{rate}_{i,j,t}$ (%)	0.73***					
	(0.01)					
Analysts' risk-free $\text{rate}_{i,j,t}$ (%)		0.46***			0.58***	0.48***
		(0.01)			(0.02)	(0.03)
Analysts' equity $\text{beta}_{i,j,t}$ (%)			2.56***		3.12***	2.52***
			(0.07)		(0.08)	(0.14)
Analysts' equity risk $\text{premium}_{i,j,t}$ (%)				0.18***	0.41***	0.35***
				(0.02)	(0.02)	(0.03)
Contibutor*Firm FE	No	No	No	No	No	Yes
Observations	32,798	18,466	20,966	18,868	13,328	8,789
F Statistics	3,930.60	1,238.49	1,171.29	132.75	787.38	190.76
R^2	0.52	0.15	0.13	0.02	0.39	0.82

- All three key determinants are significant, both together and individually
- The discount rate's autocorrelation (0.73) is less than the 10-year Treasury yield's (0.86), indicating that analysts' discount rates change more frequently than the risk-free benchmark

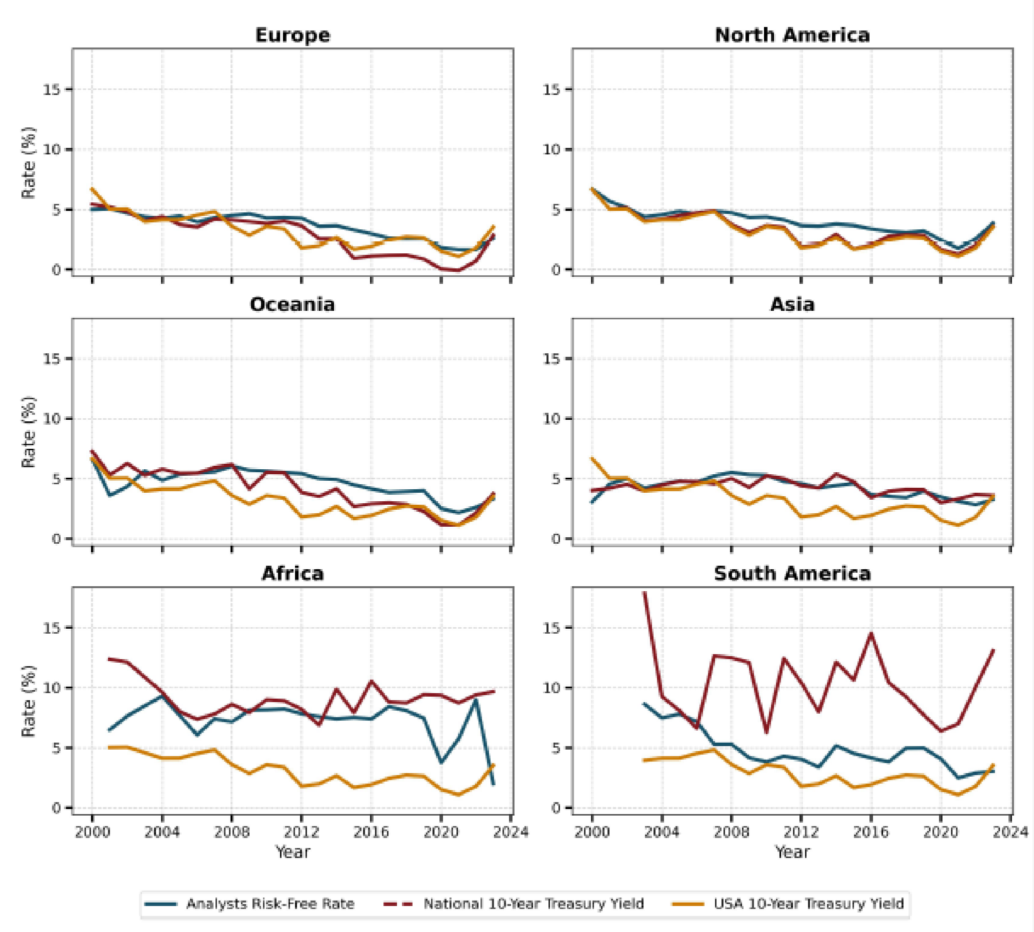
Discount Rates – Key Determinants R^2 decomposition

Panel A: Discount rate	Discount rate$_{i,j,t}$ (%)	
	(5)	(6)
Contibutor*Firm FE	No	Yes
R^2 Shapley Decomposition		
Analysts' risk-free rate$_{i,j,t}$ (%)	47.86 %	45.74 %
Analysts' equity beta$_{i,j,t}$ (%)	40.55 %	42.37 %
Analysts' equity risk premium$_{i,j,t}$(%)	11.58 %	11.89 %

- Risk-free and equity beta consistently explain a significant portion of the discount rate variance,
- Systematic risk (risk-free and beta) explains 4x more of the discount rate process than the equity risk premium.
- To understand better each key determinant, they are analyzed one by one

Risk-free Rate – Descriptive

- Analysts' risk-free rate and the treasury yield follow the same pattern over the sample.
- Risk-free rates change over regions, making the local-specific 10-year treasury yield better to track the risk-free.



Risk-free Rate – Regression

- Also considering the monthly standard deviation of the 10-year Treasury yield during the previous year, the analysis on how analysts create their risk-free rate is shown below:

Panel B: Risk-Free Rate Volatility	Analysts' risk-free rate$_{i,j,t}$ (%)		
	(1) Full Sample	(2) 10-Year Only	(3) US Only
Analysts' risk-free rate$_{i,j,t-1}$ (%)	0.66***	0.70***	0.69***
	(0.02)	(0.05)	(0.03)
10-year treasury yield$_{i,j,t}$ (%)	0.21***	0.29***	0.50***
	(0.02)	(0.06)	(0.06)
10-year treasury yield$_{i,j,t}$*Volatility$^{RF}_{i,j,t-1}$ (%)	-0.01***	-0.08**	-0.22***
	(0.00)	(0.03)	(0.04)
Volatility$^{RF}_{i,j,t-1}$	0.13***	0.56***	0.57***
	(0.02)	(0.18)	(0.12)
Observations	6,051	607	1,407
F Statistics	1782.00	186.29	480.98
R^2	0.71	0.72	0.64

- As the 10-year treasury yield coefficient is consistently lower than the previous analyst risk-free rate, changes in 10-year treasury yield are not directly reflected in the choice of the risk-free rate

- The volatility interaction means that volatile times are associated with a reduction in the weight analysts put on the 10-year Treasury yield

Risk-free Rate – Regression

- Just like with discount rates, expectations also explain more the risk-free rates rather than current and historical average inflation

Panel D: Risk-free rate and Inflation	Analysts' risk-free rate$_{c,t}$ (%)			**US 10-year treasury yield**$_{c,t}$ (%)
	(1)	(2)	(3)	(4)
Inflation$_{c,t}$ (%)	-0.00***			
	(0.00)			
10-year hist. avg. inflation$_{c,t}$ (%)		-0.00***		
		(0.00)		
SPF 10-year forecast inflation$_{c,t}$ (%)			5.19***	7.59***
			(1.69)	(1.65)
Country FE	Yes	Yes	No	No
Observations	1,053	1,013	24	24
F Statistics	463.49	136.14	9.42	21.11
R^2	0.00	0.00	0.42	0.52

- By and large, the choice of risk-free rate is based on the region the analyst is in, expectations are their drivers and analysts filter out the noise so that the risk-free rate is more persistent in periods of high volatility

Equity Betas – Descriptive

- Average daily beta suggests the firms face a reasonable range of exposure to systematic risk
- To illustrate the choice of betas, the analysts' beta value is regressed on 6 different CAPM betas calculated with monthly returns for 2, 3, 4, 5, 6 and 7-years horizon.
- The 5-year one is the one that mostly explain the variance, **showing that analysts prefer to use 5-year betas**

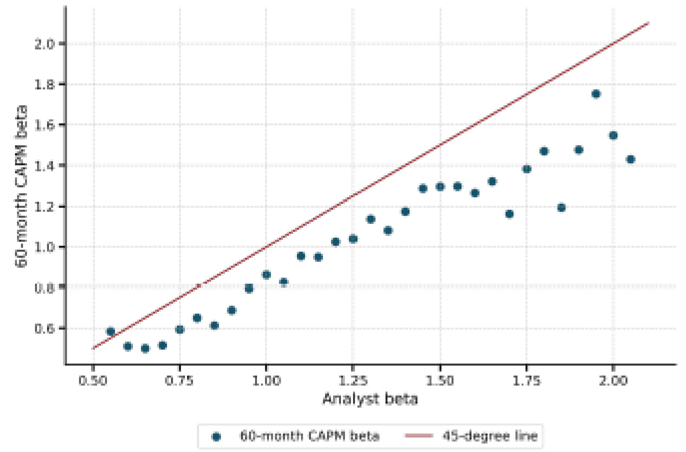
(C) Analyst equity betas.

Panel A: Decomposition	Analyst $\text{beta}_{i,j,t}$ (1)
24-month CAPM $\text{beta}_{i,j,t}$	-0.01** (0.01)
36-month CAPM $\text{beta}_{i,j,t}$	0.04*** (0.01)
48-month CAPM $\text{beta}_{i,j,t}$	0.04*** (0.01)
60-month CAPM $\text{beta}_{i,j,t}$	0.11*** (0.01)
72-month CAPM $\text{beta}_{i,j,t}$	0.02*** (0.01)
Observations	15,934
F Statistics	607.50
R^2	0.16
R^2 Shapley Decomposition	
24-month CAPM $\text{beta}_{i,j,t}$	11.79%
36-month CAPM $\text{beta}_{i,j,t}$	19.37%
48-month CAPM $\text{beta}_{i,j,t}$	23.68%
60-month CAPM $\text{beta}_{i,j,t}$	27.59%
72-month CAPM $\text{beta}_{i,j,t}$	17.57%

Equity Betas – Regression

- **Analysts track the CAPM betas well**, but the relation is weaker with larger values of betas
- However, when the 1-year realized returns are regressed on analysts' betas and CAPM betas, the noise is not as prevalent showing a sharper and steeper relation:

(A) Analyst betas versus CAPM 60-month betas.

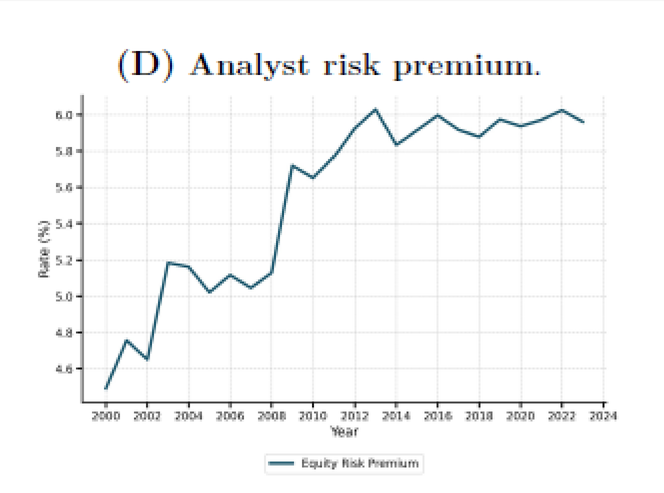


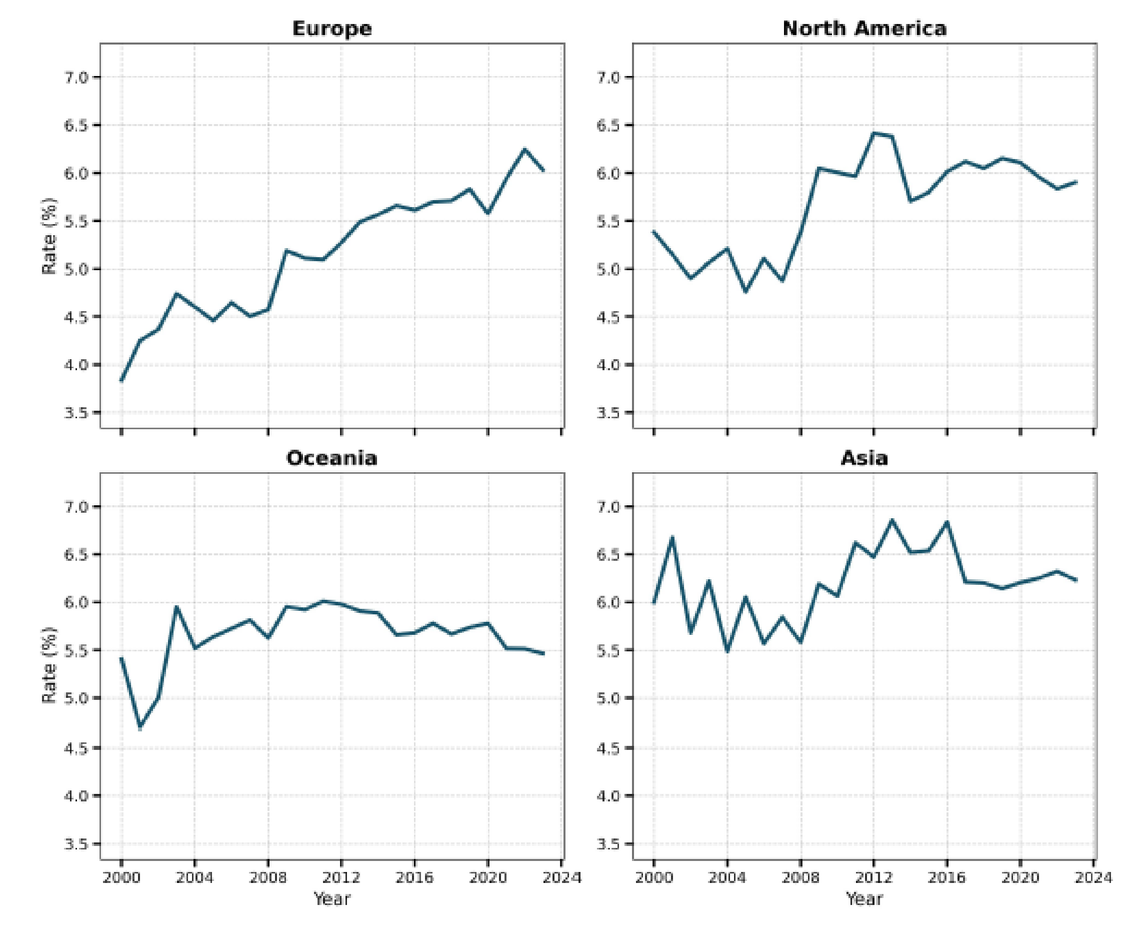
Panel B: SML regression:	1-year realized return$_{i,j,t}$					
	(1) Analyst beta	(2) 24-month	(3) 36-month	(4) 48-month	(5) 60-month	(6) 72-month
Beta$_{i,j,t}$	7.89***	2.65***	2.07**	4.29***	3.05***	2.43***
	(1.57)	(0.72)	(0.81)	(0.83)	(0.87)	(0.76)
Constant	0.69	7.12***	7.52***	5.54***	6.53***	6.78***
	(1.64)	(0.68)	(0.75)	(0.76)	(0.79)	(0.73)
Observations	15,143	13,749	13,212	12,650	12,083	11,584
F Statistics	25.12	13.75	6.59	26.79	12.32	10.30
R^2	0.00	0.00	0.00	0.00	0.00	0.00

- These patterns show that analysts' betas contain additional information missed in standard CAPM estimation

Equity Risk Premium – Descriptive

- The equity risk premium has increased over time, creating a doubt on whether analysts use a fixed value as their estimate
- Even though it has increased, analysts use different prices of systematic risk across regions over time
- The measure displays volatility in most regions suggesting that subjective risk premia are relatively flat





Discount Rates – Growth Expectations

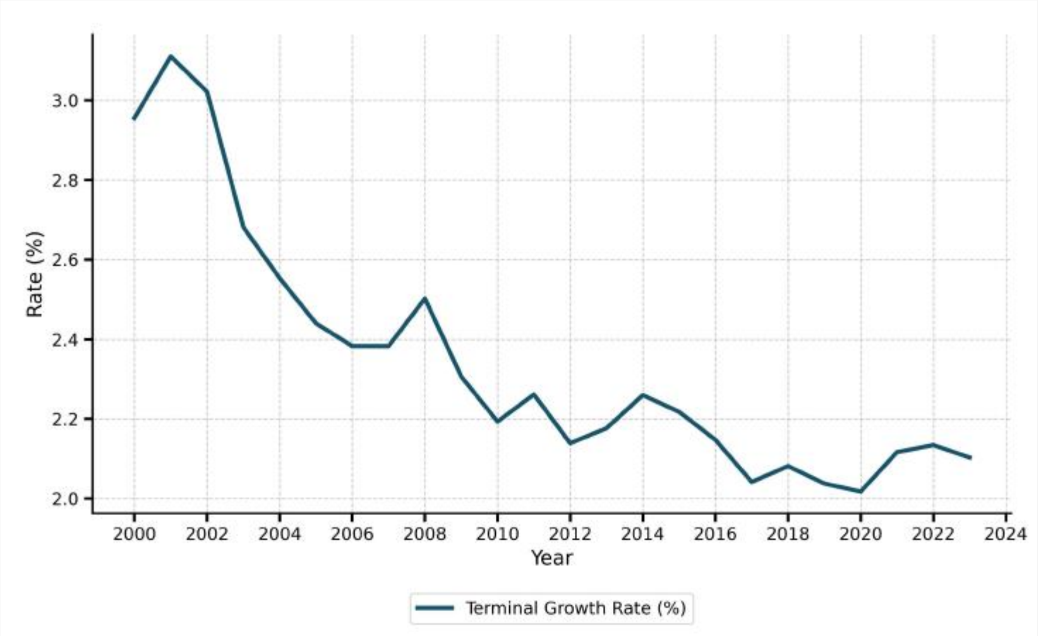
- Check whether discount rates offset optimistic terminal growth rate

Dependent variable:	Discount $\text{rate}_{i,j,t}$ (%)	
	(1)	(2)
$\text{TGR}_{i,j,t}$ (%)	0.27***	0.03**
	(0.01)	(0.01)
Analyst*Firm FE	No	Yes
Year FE	No	Yes
Observations	48,927	37,662
F Statistics	487.53	6.21
R^2	0.03	0.76

- When it comes to within-analyst (2), even though the TGR is significant, its coefficient is of negligible economic magnitude
- **Analysts do not adjust their discount rates to balance growth expectations**

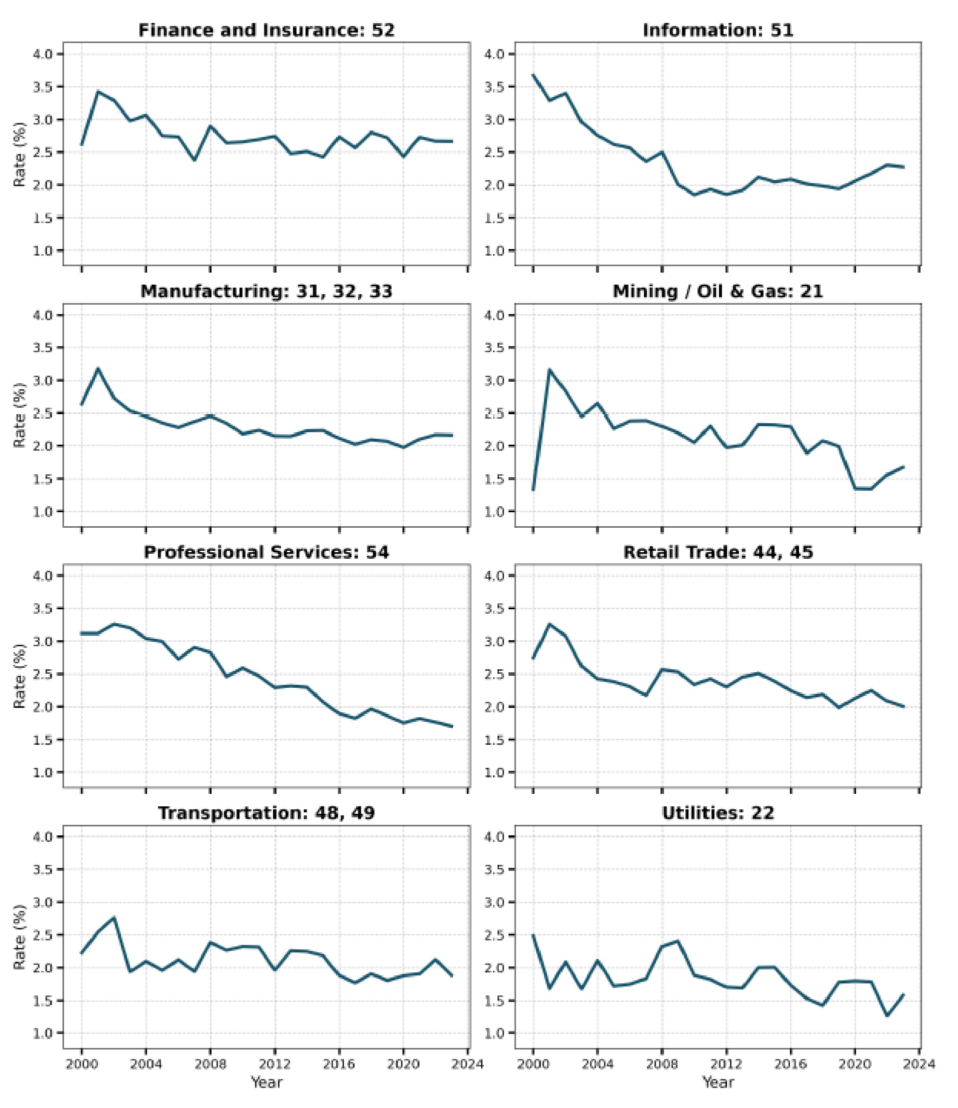
Terminal Growth Rate – Descriptive

- The average growth rate has steadily declined over the years



Terminal Growth Rate – Descriptive

- But the decrease has happened differently across the different industries
- Commodities and retail have even recovered from the decrease



Terminal Growth Rate – Regression

Terminal growth rates and Macroeconomic Variables	Terminal growth rate$_{c,t}$ (%)				
	(1) Current	(2) 10-year hist. avg.	(3) SPF 10-year forecast	(4) Current	(5) 10-year hist. avg.
	US Only			Full Sample	
Inflation$_{c,t}$ (%)	0.00	-0.15	0.60	0.00	0.01
	(0.03)	(0.18)	(0.49)	(0.01)	(0.04)
Real GDP growth$_{c,t}$(%)	0.01	0.35***	0.63***	0.01***	0.09***
	(0.03)	(0.09)	(0.17)	(0.00)	(0.03)
10-year treasury yield$_{c,t}$ (%)	0.35***	0.25***	0.25***	0.03**	0.05*
	(0.06)	(0.08)	(0.07)	(0.01)	(0.02)
Country FE	No	No	No	Yes	Yes
Observations	23	23	23	605	605
F Statistics	9.88	68.12	47.26	5.45	4.34
R^2	0.74	0.92	0.83	0.64	0.66
Within R^2	0.74	0.92	0.83	0.03	0.07
R^2 Shapley Decomposition					
Inflation$_{c,t}$ (%)	0.29 %	17.05 %	23.99 %	4.67 %	13.76 %
Real GDP growth$_{c,t}$ (%)	1.49 %	40.92 %	39.73 %	45.09 %	41.72 %
10-year treasury yield$_{c,t}$ (%)	98.23 %	42.03 %	36.28 %	50.24 %	44.51 %

- When it comes to current levels, 10-year historical average or 10-year forecast, the mean shows more explanatory power due to its bigger R²
- Analysts anchor their long-term expectations on historical GDP and 10-year treasury yield realizations, which aligns with the risk-free and discount rates components

Discount Rates – Key Macroeconomic Values Regression

- Key macroeconomic values: current inflation rate and 10-year inflation expectations

Panel B: Inflation & Treasury yield	Discount rate$_{c,t}$ (%)			
	(1)	(2)	(3)	(4)
		US Only		
Inflation rate$_{c,t}$ (%)	0.02	-0.22***		
	(0.02)	(0.04)		
10-Year inflation expectations$_{c,t}$(%)		3.90***		
		(0.74)		
Analyst risk-free rate$_{c,t}$(%)			0.29***	
			(0.04)	
10-year treasury yield$_{c,t}$ (%)				0.20***
				(0.04)
Country FE	Yes	No	Yes	Yes
Observations	1,195	23	871	871
F Statistics	1.06	18.98	69.27	24.56
Within R^2	0.01	0.60	0.25	0.24

- By (1) and (2), current inflation rates have limited explanatory power on discount rates
- (3) and (4) show that risk-free and 10-year Treasury yield benchmark have a similar coefficient, suggesting that changes in monetary policies are readily reflected in the analysts' discount rate

Main Conclusions

- **Discount Rate as a Key Driver:** The discount rate is a primary determinant in explaining variations in expected firm valuations, often as impactful as growth expectations
- **Components and Fluctuations:** The primary drivers of discount rate variations are the risk-free rate and equity beta. Both components contain internal factors — such as long-term economic trends and systematic risk — that align with the study’s broader conclusions on how discount rates respond to economic conditions
- **Alignment with Market Requirements:** Analysts' discount rates closely mirror the real-world return expectations, suggesting they capture inherent market requirements accurately
- **Independence from Growth Expectations:** Analysts do not systematically adjust discount rates to offset optimistic growth expectations
- **Influence of Economic Conditions:** Discount rates are affected by long-term economic variables such as inflation expectations and GDP growth but exhibit little responsiveness to short-term inflation fluctuations.

Obrigado

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