Business Valuation, Inflation and Cost of Capital

Mauro Bini – Bocconi University

AGENDA

1. **Inflation rates, Interest rates and Stock indexes**
2. **Past experiences vs. current experience**
3. **Conditions of Inflation Neutrality**
4. **Inflation in the valuation context and current myth**
5. **TV calculation and inflation (Bradley- Jarrell)**
6. **Wacc and inflation (Miles-Ezzel better than Modigliani-Miller)**
7. **Cash Flows and inflation**

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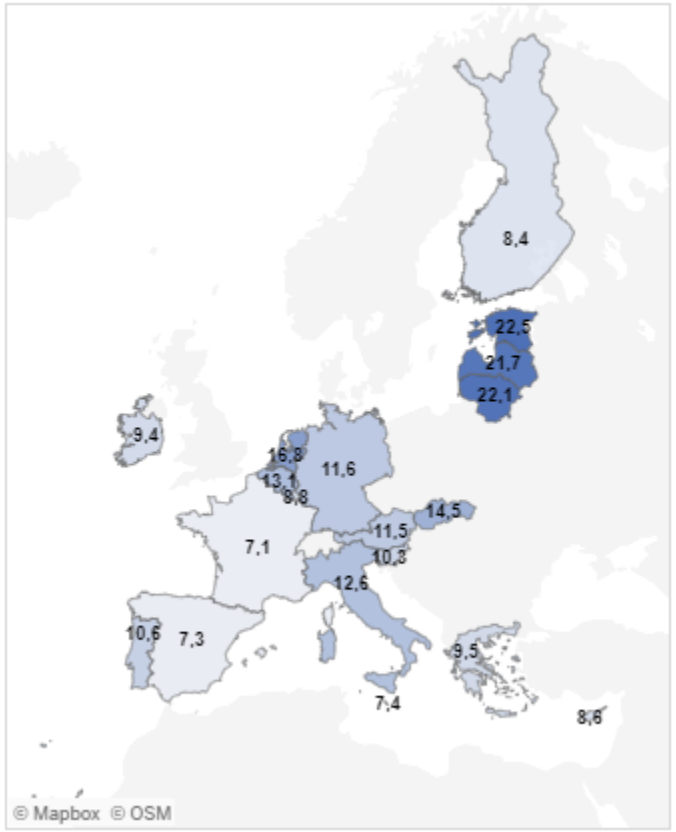
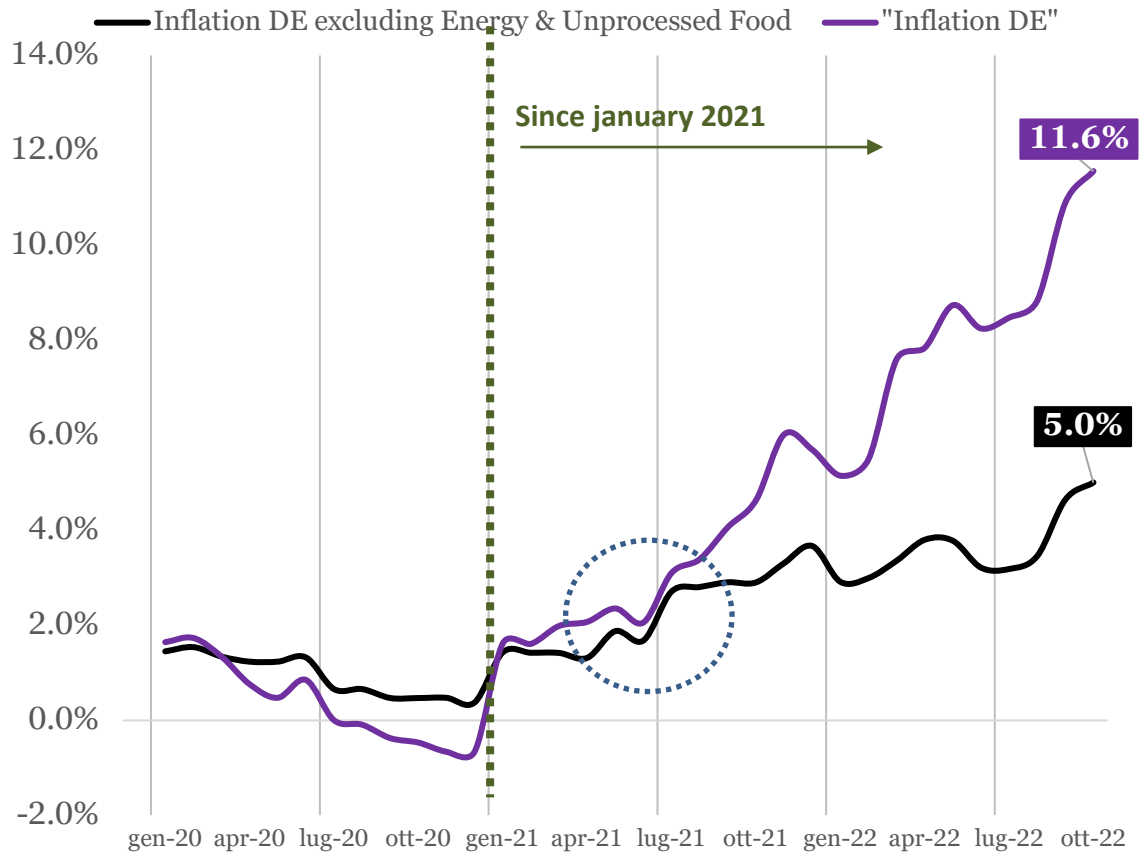
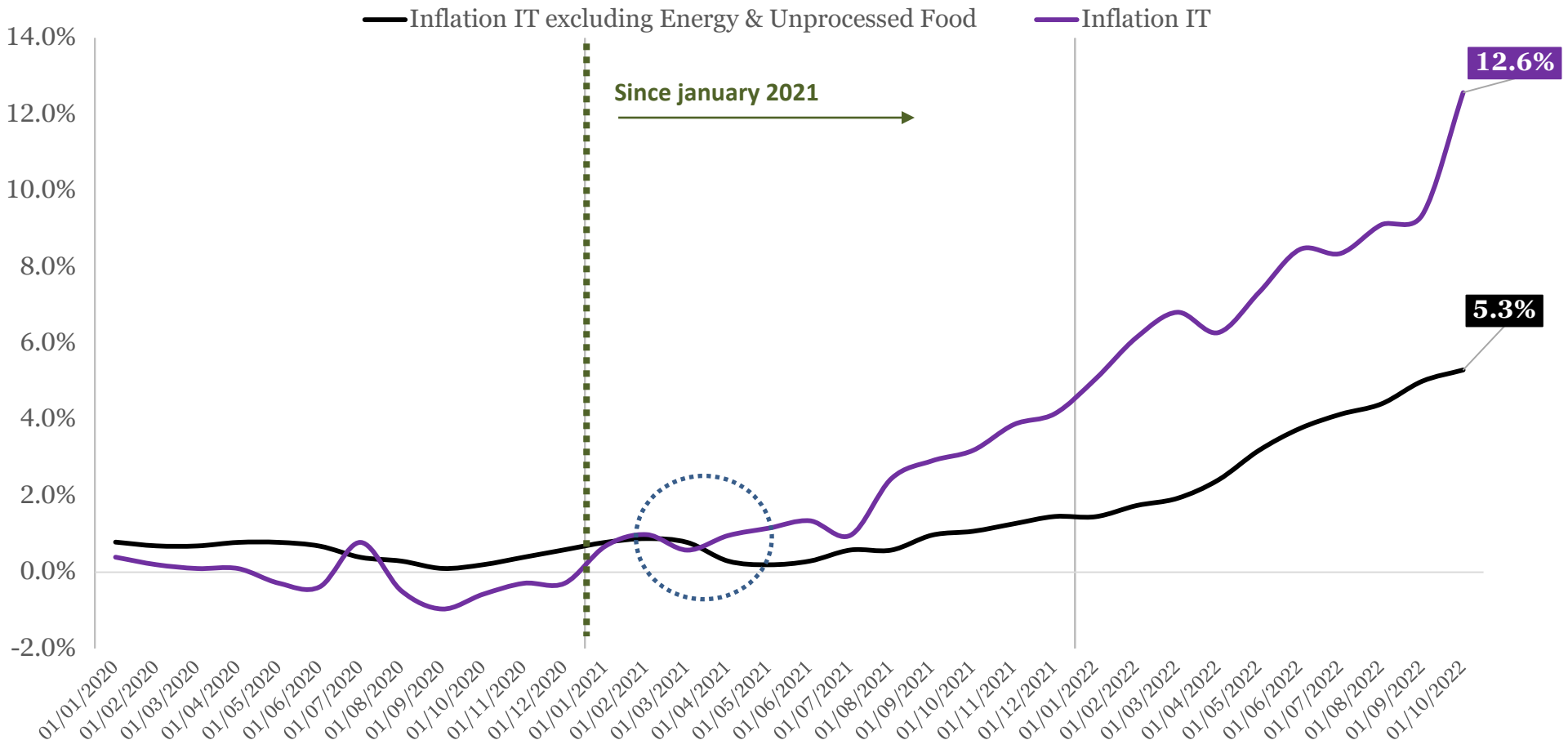
Germany: inflation and core inflation

HICP inflation rate - **Overall index**
ottobre 2022, Euro area countries

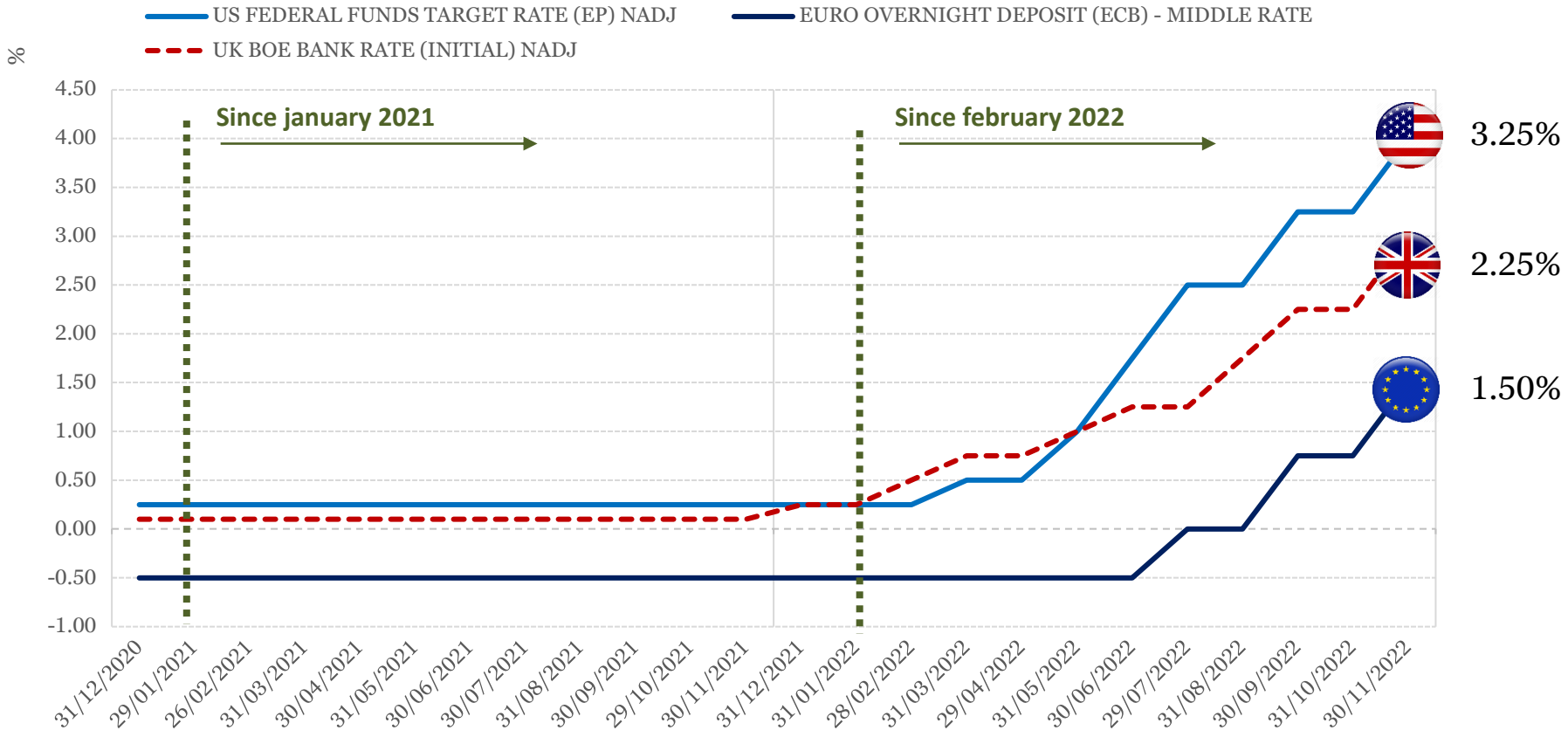




Italy: inflation and core inflation



Central Banks have been laggards…



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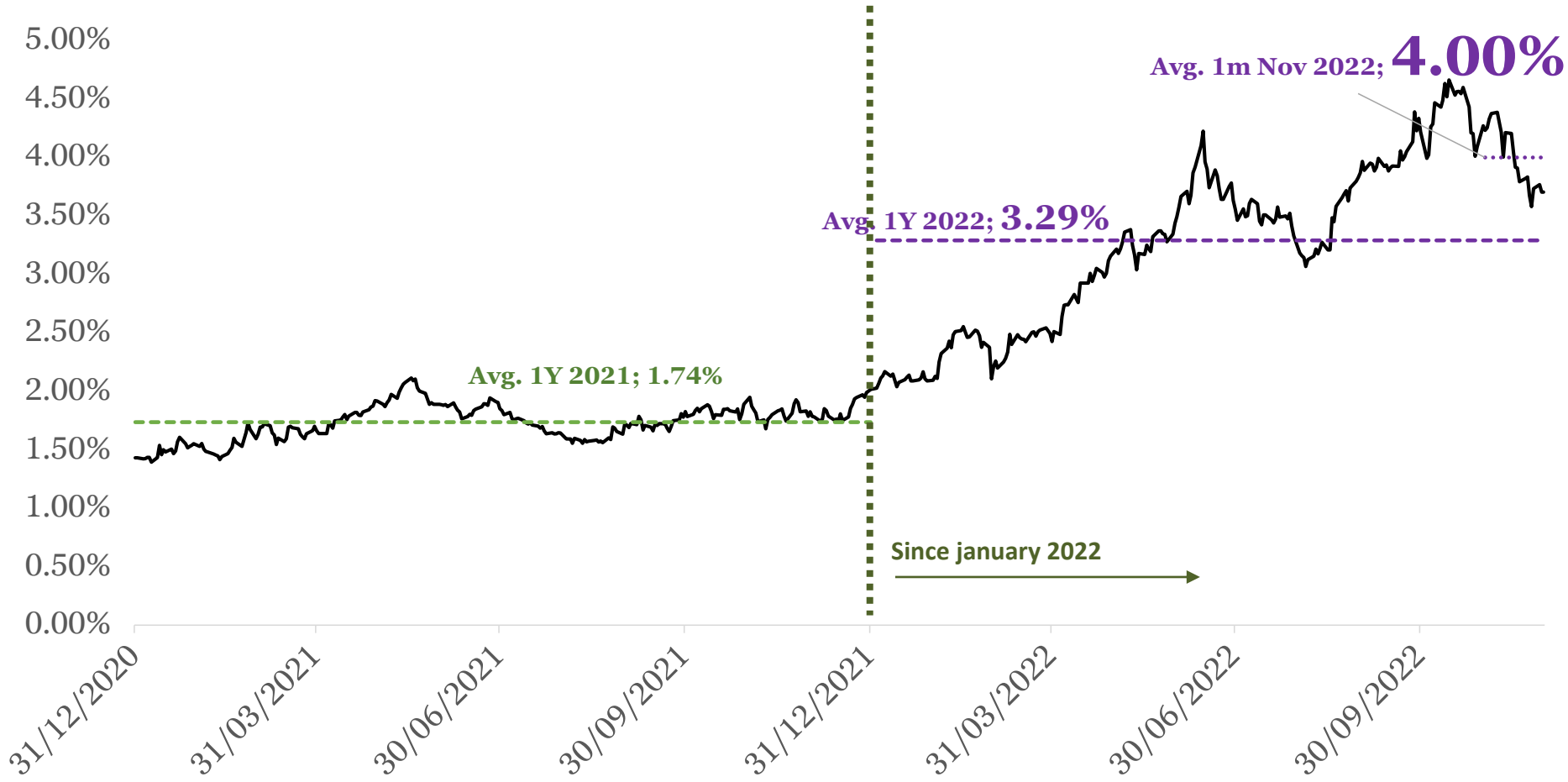
10Y IT benchmark bond



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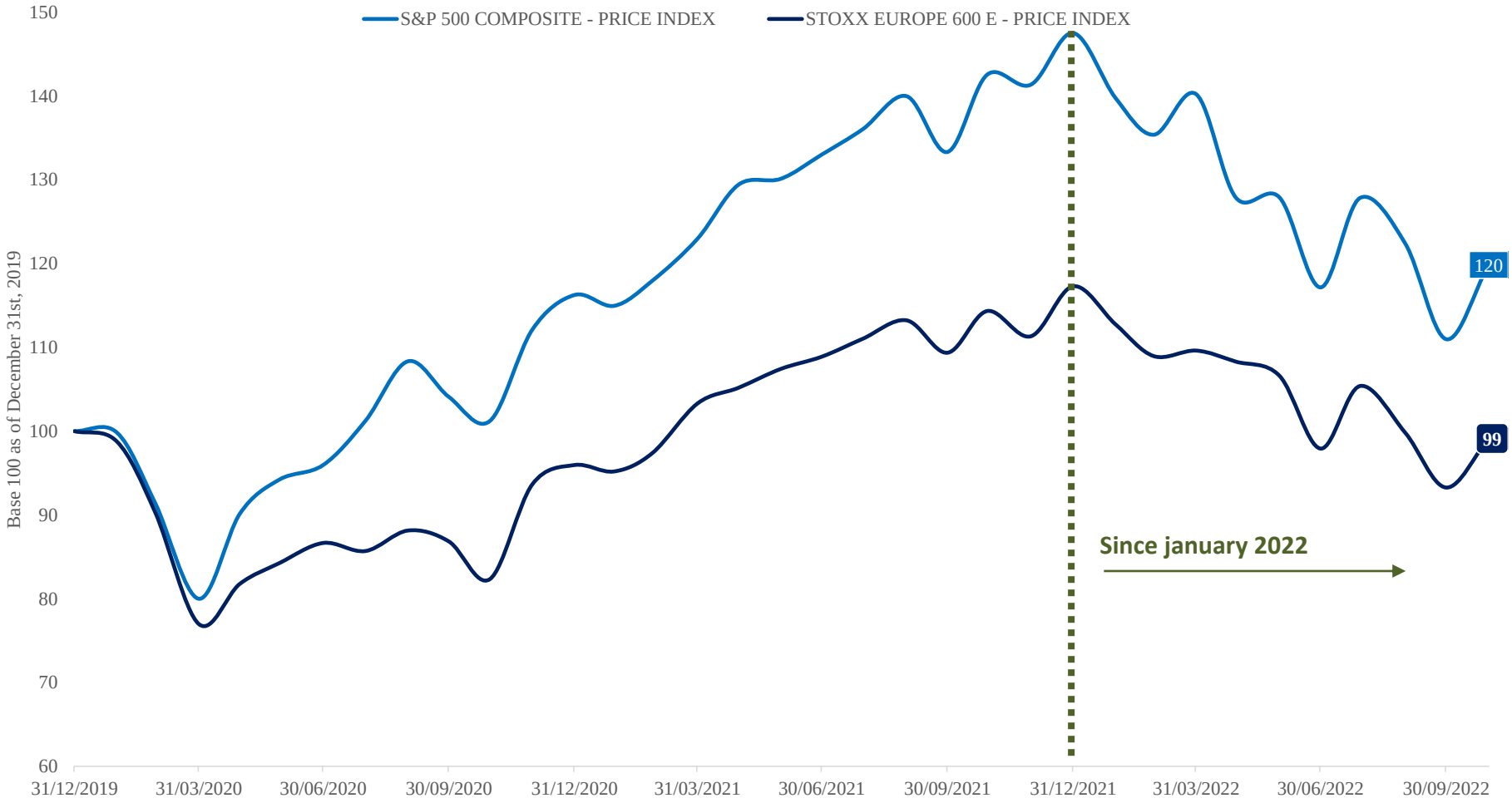
S&P500 vs STOXX 600 [31.12.2019 _ 30.11.2022]



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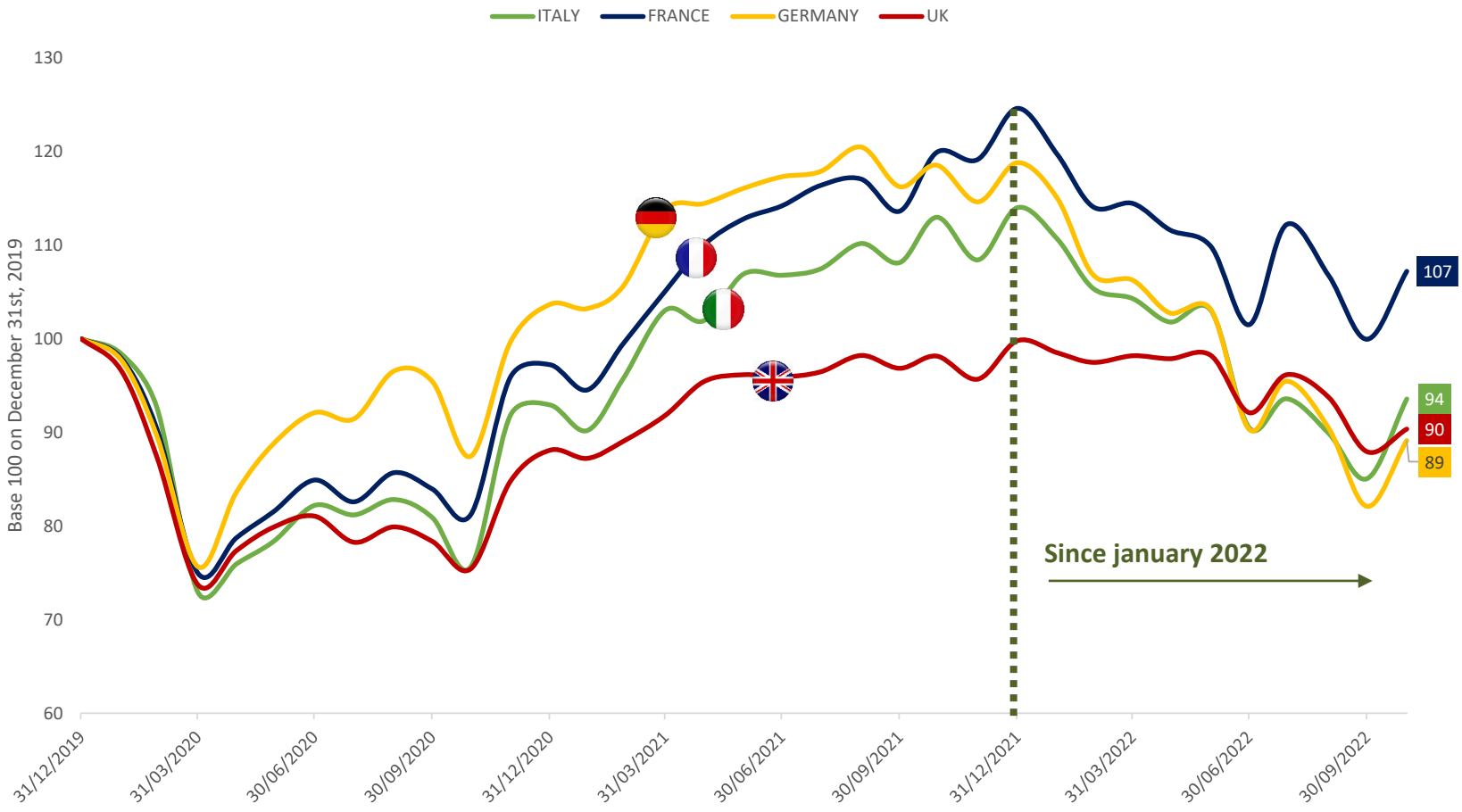
European Equity Indexes by country



Based on country-level Datastream Index

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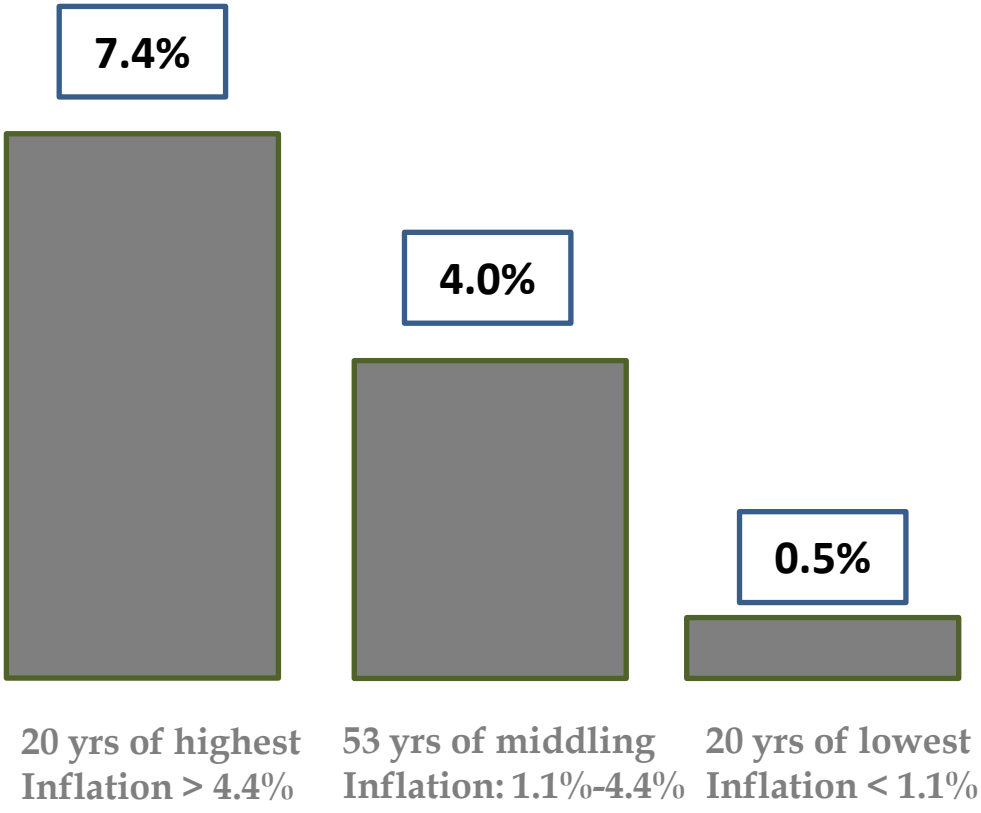
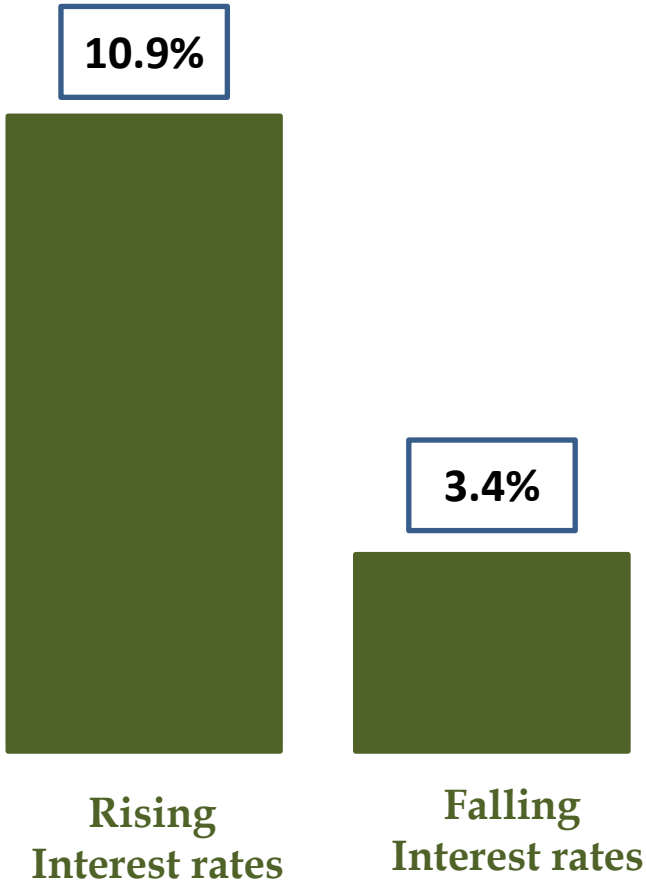
Value stocks have been outperformers in high inflation regime

Value outperformance (average excess return) by inflation regime, 1927 -2020 (93 yrs)



Value factors returns amid rising vs. falling rates 1978- 2020



Source: An equity investor's guide to inflation – BlackRock

Top and bottom performers in 1970s

Top performers in the 1970s	Bottom performers in the 1970s
Energy: global supply disruptions	**Consumer discretionary/staples**: higher input costs, reduced demand amid high price
Healthcare: highly innovative period	**Utilities**: regulators reluctant to fully pass inflation to consumers
Banks: largely insulated from inflation	**Materials**: many producers were energy intensive

Source: An equity investor's guide to inflation – BlackRock

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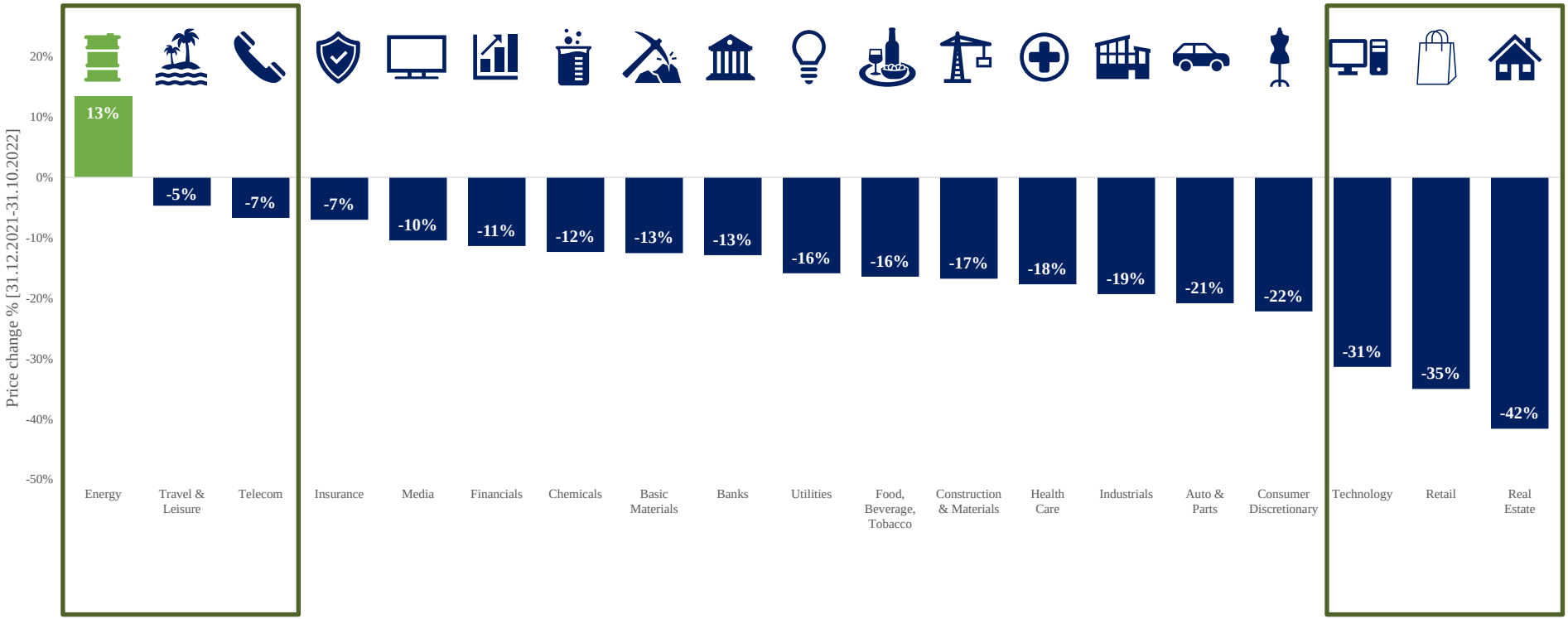
Market value dynamics by sector

Horizon: 31.12.2021-31.10.2022
Index: STOXX 600 (sectors)



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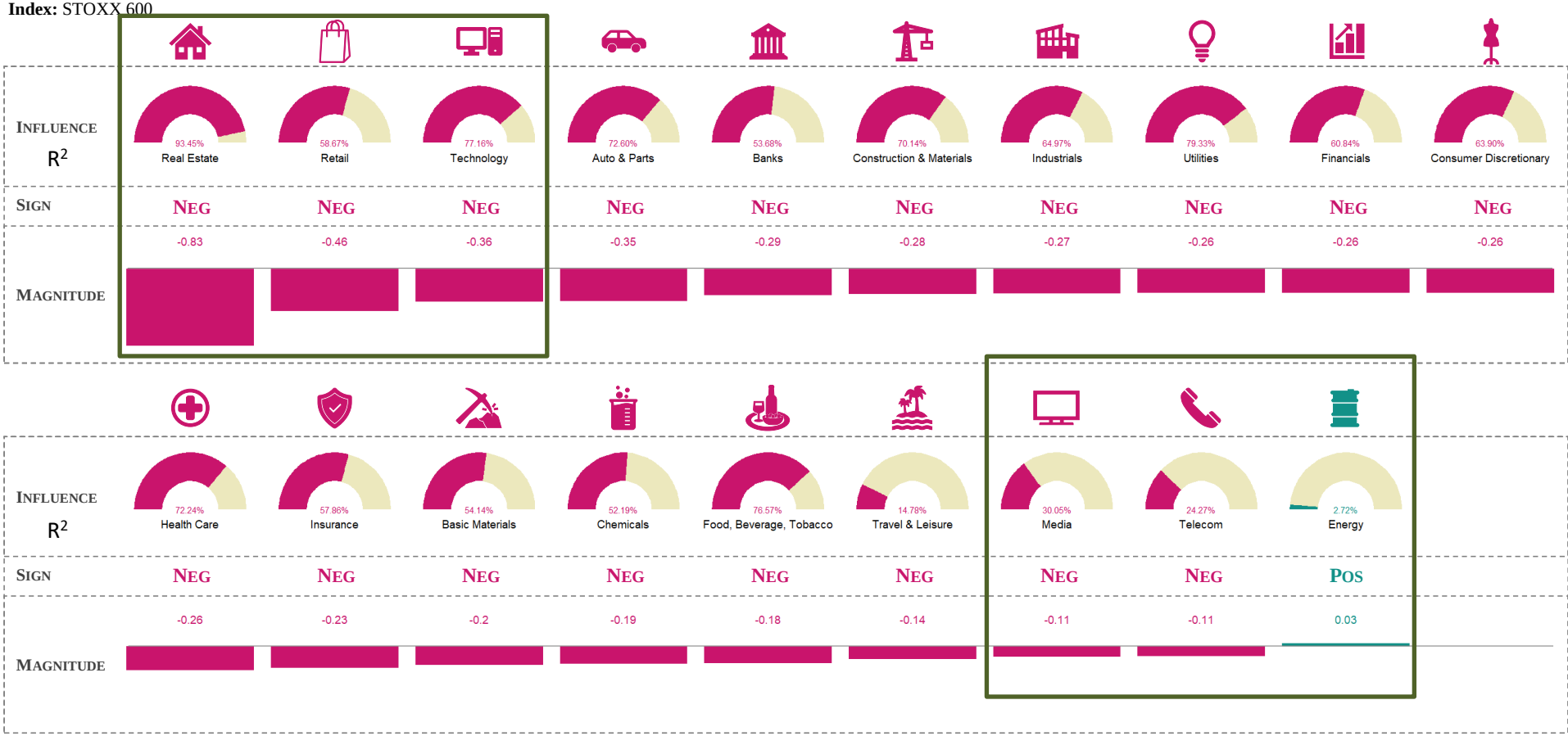
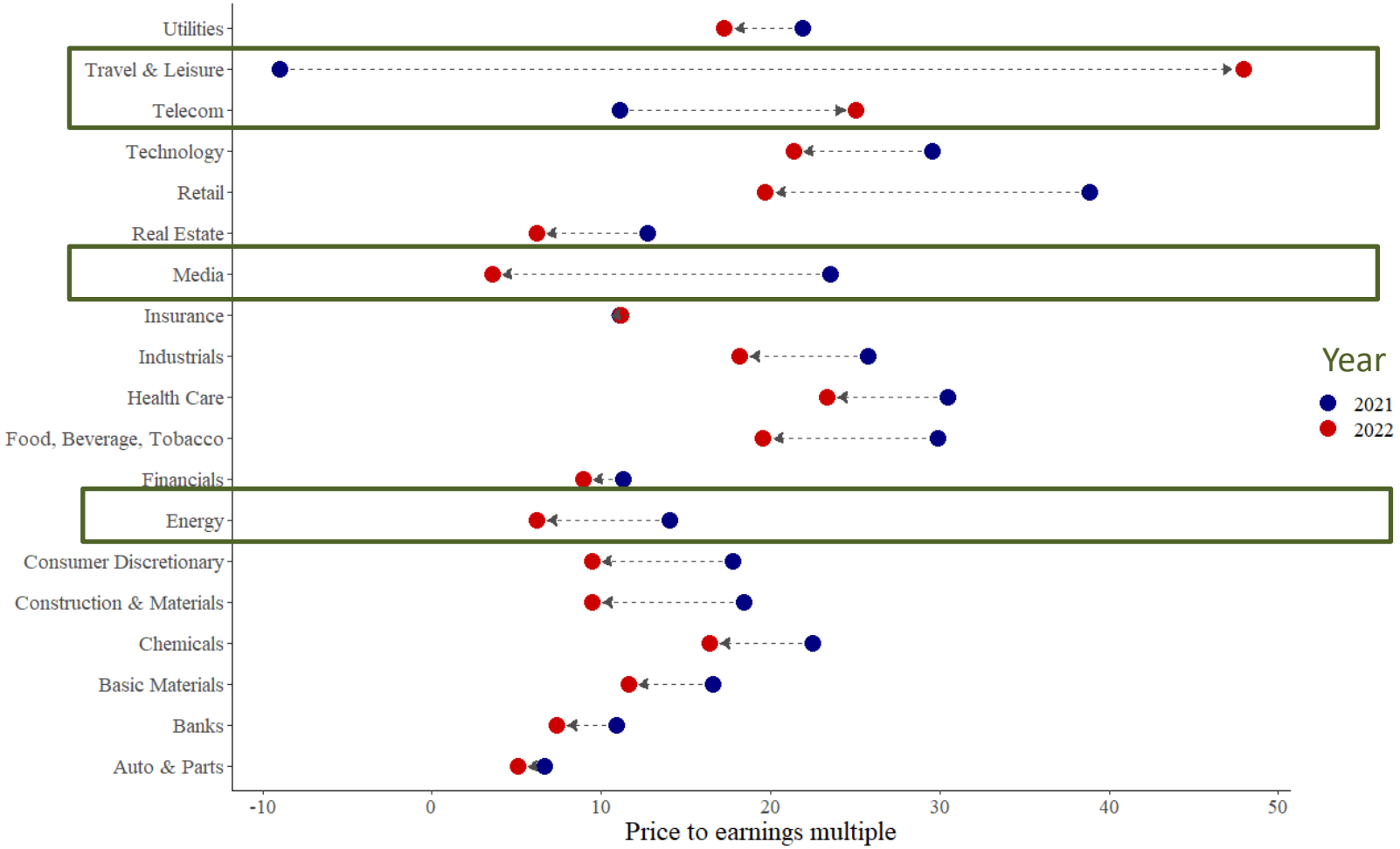
The effect of inflation on market value of european listed companies [2022]

Horizon: 31.12.2021-31.10.2022
Index: STOXX 600



STOXX 600: Price to Earnings multiples by industries (2021-2022)



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Conditions under which the equity values are inflation neutral

In the context of DDM:

$$P_0 = \frac{D_0 \times (1+g)}{r-g}$$

where: r = (1+R)(1+i) g = (1+G)(1+i) and

R = real interest rate;

G= real growth rate

i = inflation rate

If :

1) ***Inflation is correctly anticipated by market participants.***
2) ***Expected inflation affects nominal required return and nominal dividend growth in a similar manner.***
3) ***The real required rate of return and the real dividend growth rate are unaffected by changes in expected inflation.***

then:

$$P_0 = \frac{D_0 \times (1+g)}{r-g} = \frac{D_0 \times (1+G) \times (1+\cancel{i})}{[(1+R)x\ (1+\cancel{i}) - 1] - [(1+G) \times (1+\cancel{i}) - 1]} = \frac{D_0 \times (1+G)}{R-G}$$

Violation of the three conditions

1) ~~Inflation is correctly anticipated by market participants~~. **Unexpected inflation**
2) ~~Expected inflation affects nominal required return and nominal dividend growth in a similar manner.~~ **Money illusion**
3) ~~The real required rate of return and the real dividend growth rate are unaffected by changes in expected inflation~~. **Impact on real rate of return and real growth rate**

Why does unexpected inflation matter ?

Unexpected inflation entails:

- Increased need to raise external financing
- Anticipated fiscal and monetary actions
- Stronger negative relationship for large stocks

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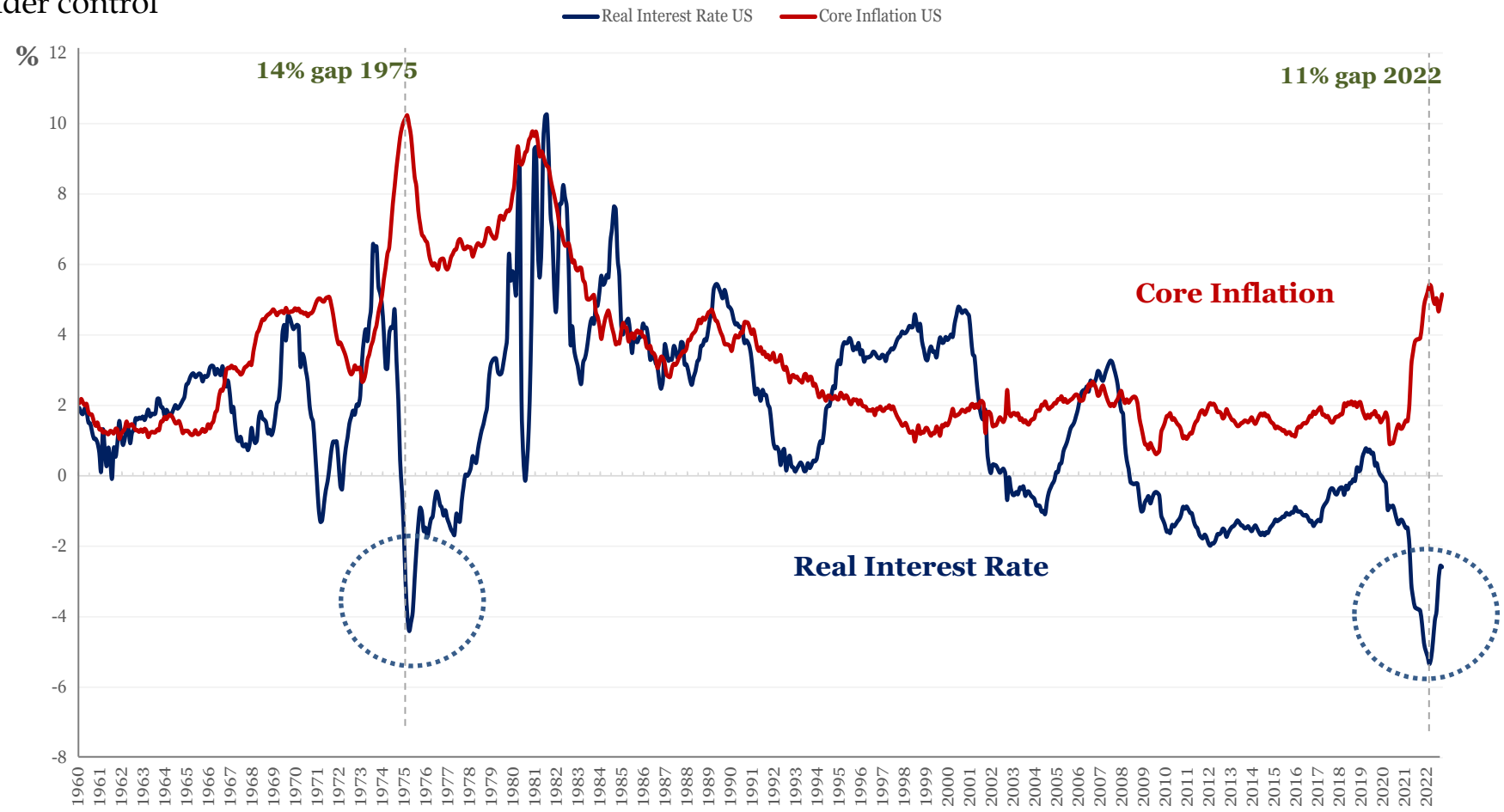
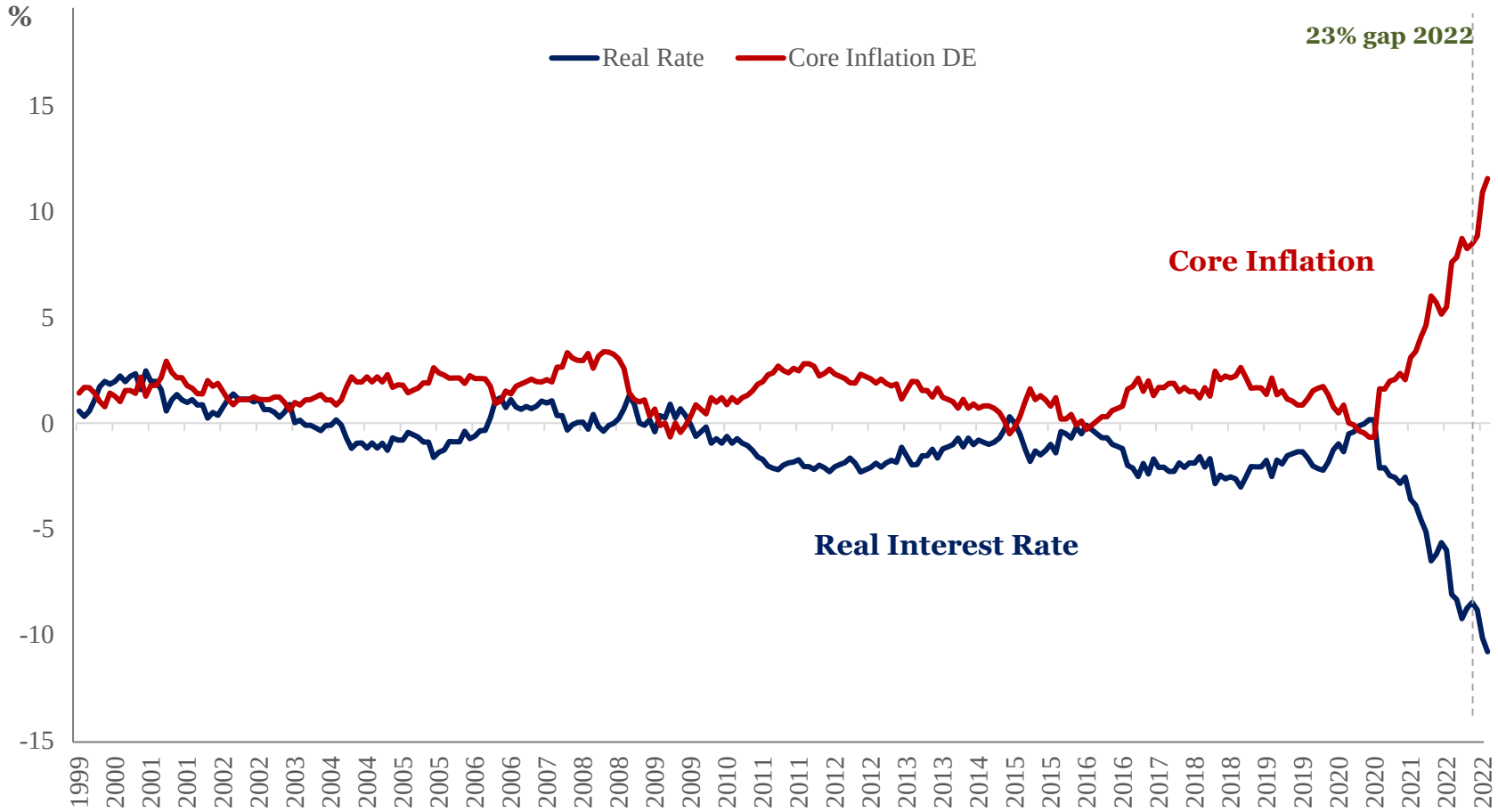
USA: Core Inflation and Real Interest Rate GAP

The last time the FED fell this far behind the curve on inflation was in 1975 and it took 8 years to bring it under control



Germany
Core Inflation and Real Interest Rate GAP



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Revision of consensus forecasts: October 2022-October 2021;

October 2021 forecasts

Germany	2021	2022	2023	2024	2025	2026	2027-2031
10Y Treasury Bond Yield	-0.10%	0.00%	0.20%	0.50%	0.80%	1.00%	1.60%
Consumer Prices	3.00%	2.20%	1.80%	1.90%	2.00%	2.00%	2.00%

Source: Consensus Economic - Long Term Forecasts - October 2021

October 2022 forecasts

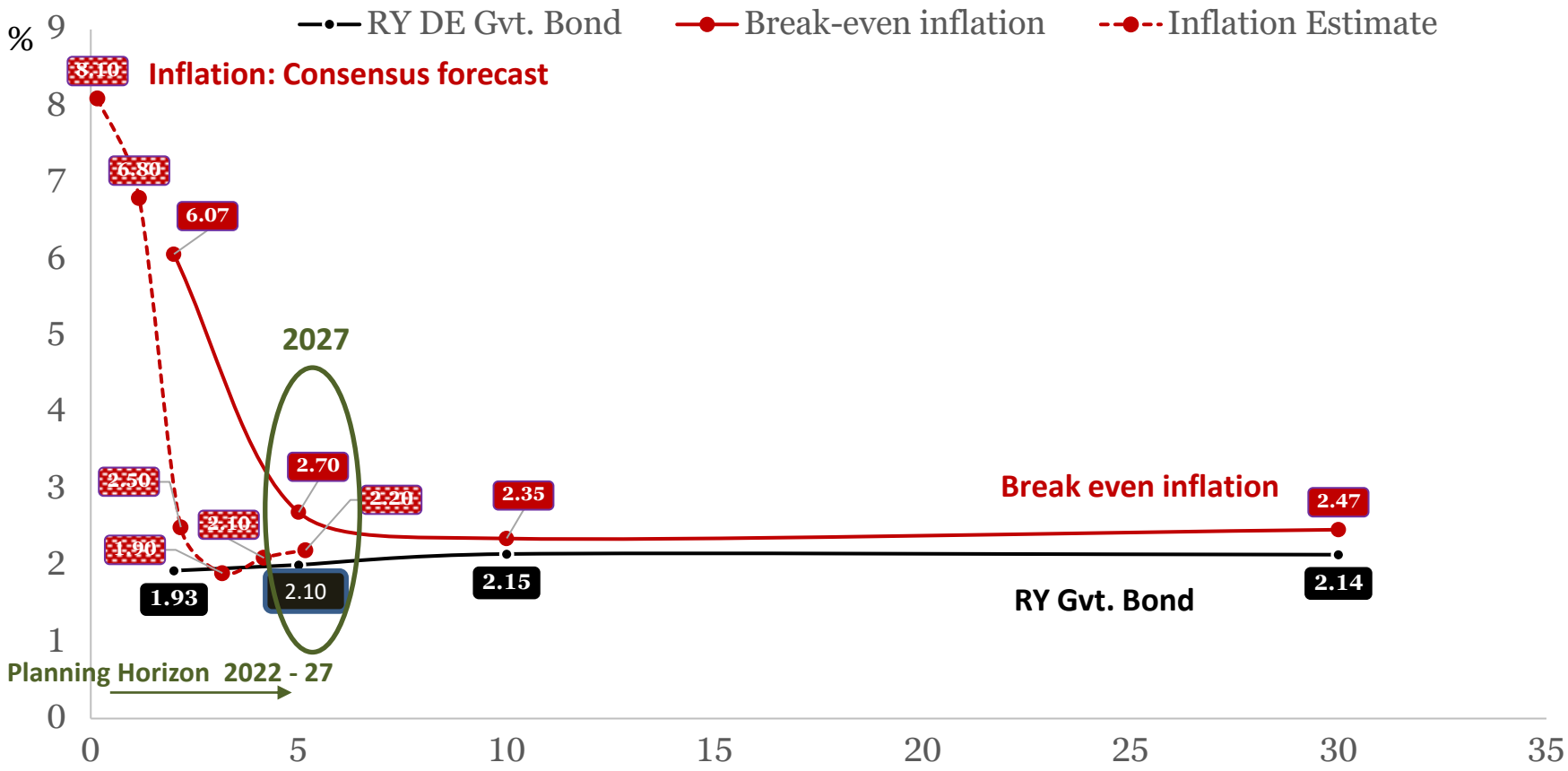
Germany	2021	2022	2023	2024	2025	2026	2027	2028-2032
10Y Treasury Bond Yield	-0.20%	2.10%	2.20%	2.20%	2.10%	2.10%	2.00%	1.90%
Consumer Prices	3.10%	8.10%	6.80%	2.50%	1.90%	2.10%	2.20%	2.10%

Source: Consensus Economic - Long Term Forecasts - October 2022

Italy	2021	2022	2023	2024	2025	2026	2027	2028-2032
10Y Treasury Bond Yield	1.20%	4.50%	4.30%	4.10%	4.20%	4.20%	4.20%	4.20%
Consumer Prices	1.90%	7.60%	5.00%	1.60%	1.50%	1.60%	1.60%	1.80%

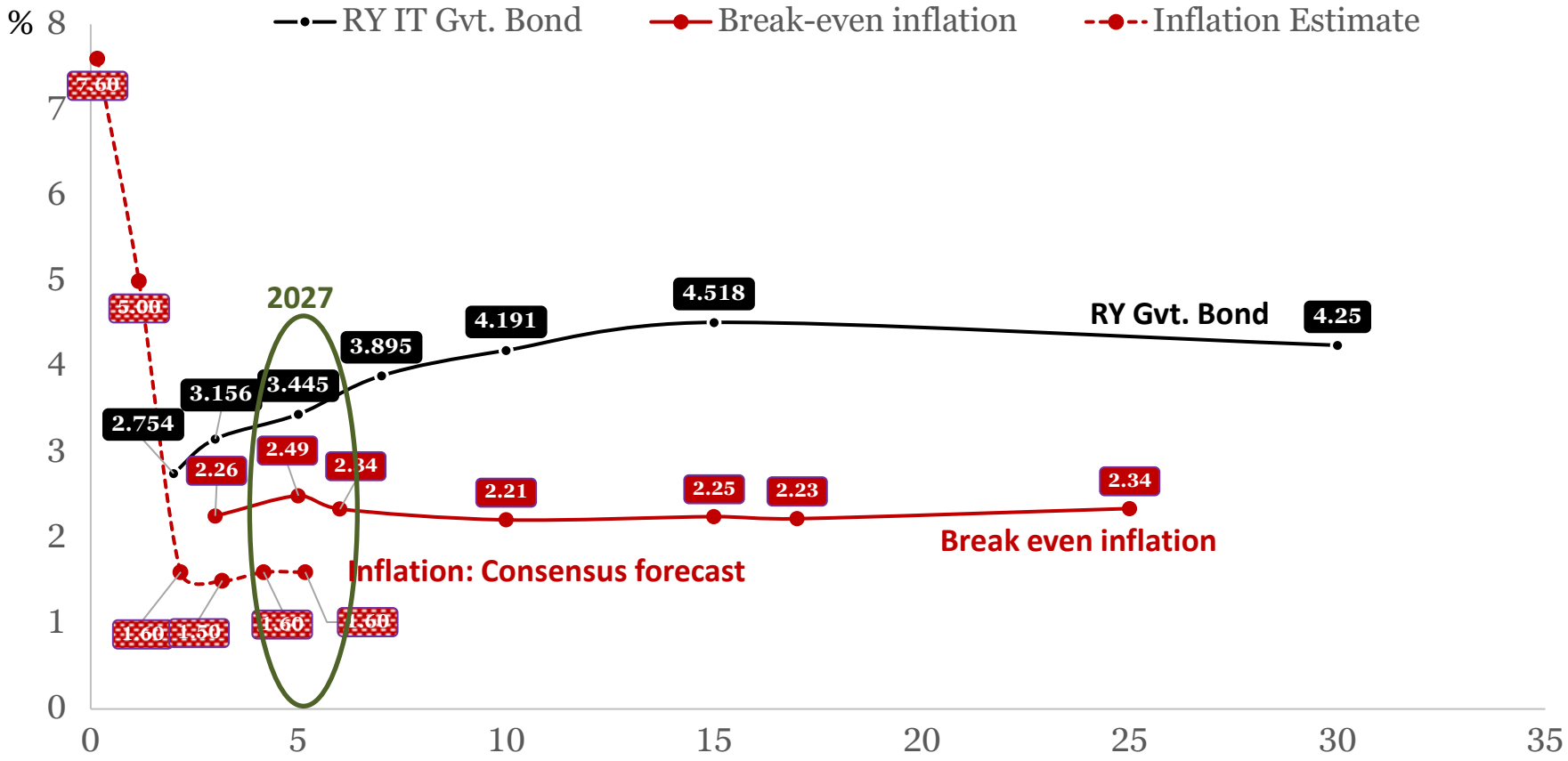
Source: Consensus Economic - Long Term Forecasts - October 2022

Risk free rate and expected inflation in Germany



Source: Datastream [RY DE Gvt. Bond (German benchmark) and break-even inflation]; Consensus Forecasts oct-2022

Risk free rate and expected inflation in Italy



Source: Datastream [RY IT Gvt. Bond (italian benchmark) and break-even inflation; Consensus Forecasts oct-2022

Money illusion (Modigliani- Cohn)

- «**Equities** are claims against physical assets, whose real returns **should remain unaffected by inflation**. Furthermore, many equities represent claim against levered assets, and **inflation is supposed to benefit debtors**»
- «**Investors**, at least in presence of unaccustomed and fluctuating inflation, **are unable to free themselves from certain forms of «money illusion»** and, as a result, price equities in a way that fails to reflect their true economic value»

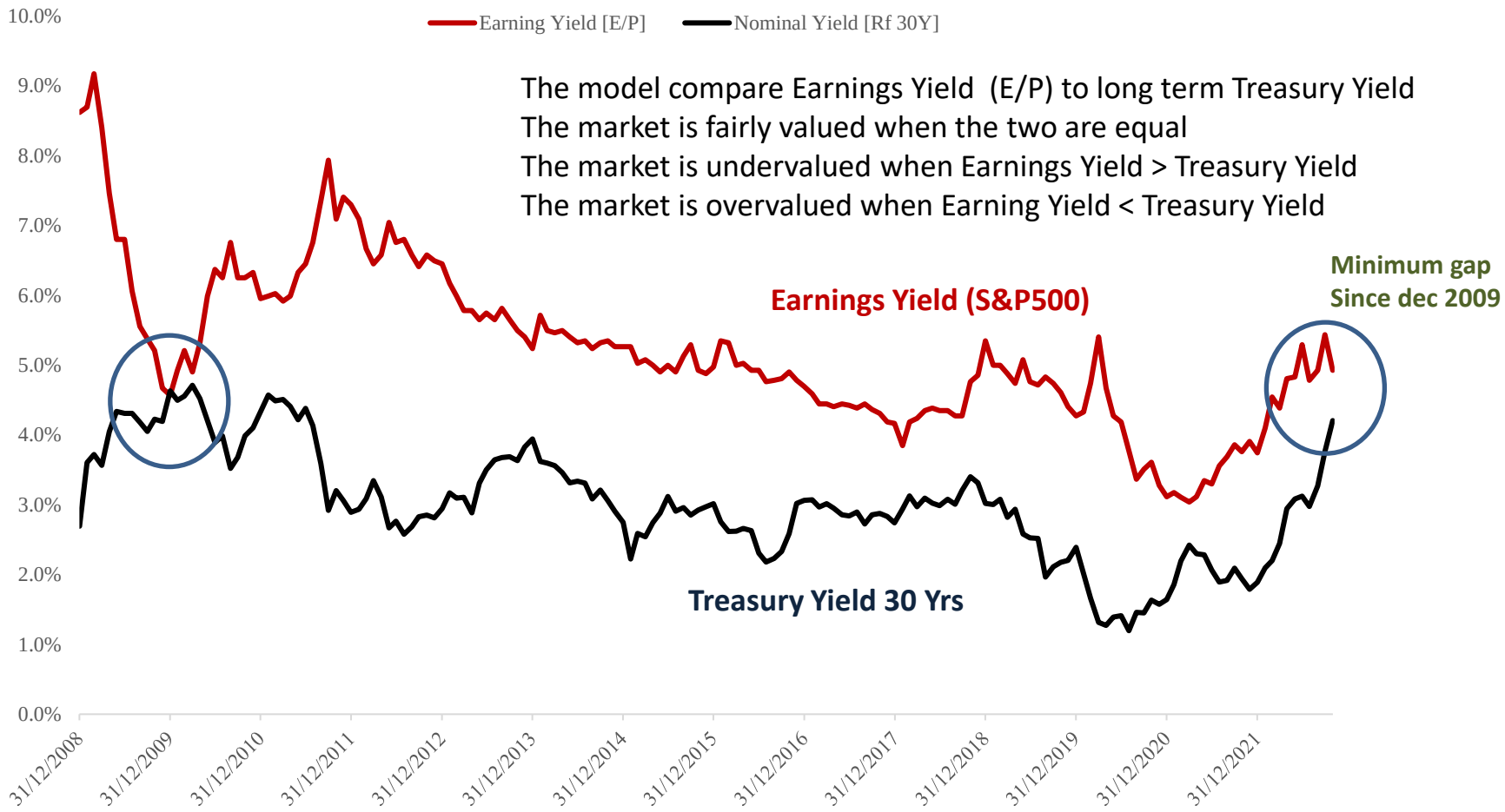
Franco Modigliani And Richard A. Cohn, Inflation, Rational Valuation and the Market, Financial Analyst Journal, march-april 1979

Modigliani- Cohn: the valuation errors

- «**They [*investors*] fail to correct** reported accounting profits **for the gain** accruing to stockholders as a result **of the real depreciation in nominal corporate liabilities**»
- «**They [*investors*] tend to capitalize equity earnings at a rate that follows the nominal rate**, whereas the economically sound procedures is to capitalize them at the real rate – that is , at the nominal rate less that portion of it representing the inflation premium or, alternatively, the compensation due to creditors for the expected real devaluation of their debt claims»

Franco Modigliani And Richard A. Cohn, Inflation, Rational Valuation and the Market, Financial Analyst Journal, march-april 1979

USA: FED Model



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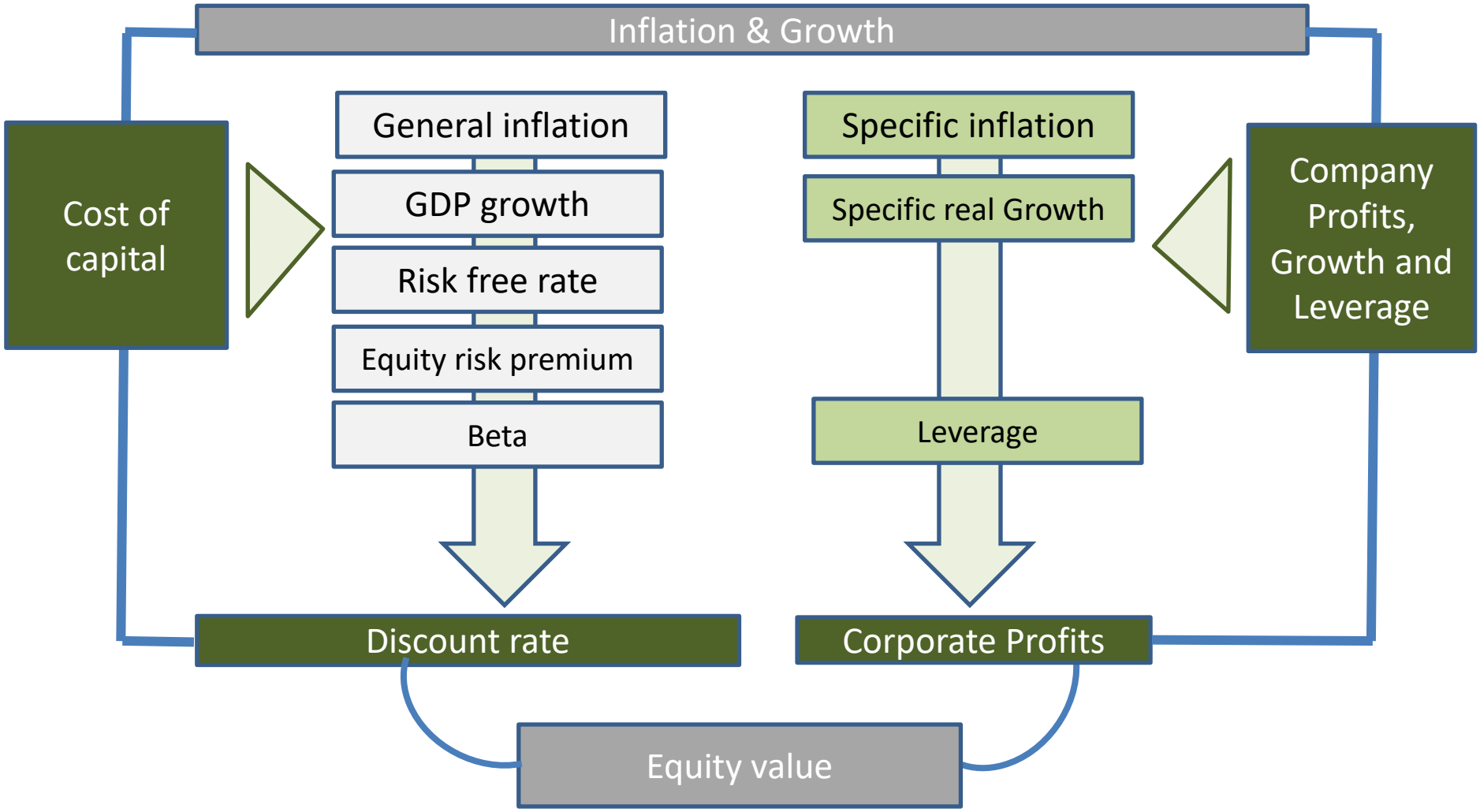
Inflation in the valuation framework



False Myths: Accounting data and Cash flows

Following the previous framework most managers believe that inflation neutrality means:

Earnings growth rate = Inflation rate

But this is not correct. An example can explain why.

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Steady state company; no inflation [no taxes; Ebit = FCFF]

Year	1	2	3	4	5	6	7	8	9	10	Cagr%
Sales	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	**0%**
Inflation	0%										
EBIT margin	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	
EBIT	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	**0%**
PPE	200,0										
Life	10,0										
Depreciation	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	
EBITDA	35,0	35,0	35,0	35,0	35,0	35,0	35,0	35,0	35,0	35,0	
Capex	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	
Delta NWC	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
FCFF	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	**0%**
FCFF/NOPAT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	**0%**
PPE	200,0	200,0	200,0	200,0	200,0	200,0	200,0	200,0	200,0	200,0	**0%**
Depreciation	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	**0%**
Capex	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	**0%**
NWC	30,0	30,0	30,0	30,0	30,0	30,0	30,0	30,0	30,0	30,0	**0%**
Delta NWC		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	

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Inflation suddendly increases from zero to 10%and stays at that level for 10 years (steady inflation long term)

Year	1	2	3	4	5	6	7	8	9	10	Cagr%
Sales	100,0	110,0	121,0	133,1	146,4	161,1	177,2	194,9	214,4	235,8	**10%**
Inflation	10%										
EBIT margin	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	
EBIT	15,0	16,5	18,2	20,0	22,0	24,2	26,6	29,2	32,2	35,4	**10%**
PPE	200,0										
Life	10,0										
Depreciation	20,0	20,0	20,2	20,6	21,2	22,0	23,0	24,3	25,7	27,5	
EBITDA	35,0	36,5	38,4	40,6	43,2	46,2	49,6	53,5	57,9	62,8	
Capex	20,0	22,0	24,2	26,6	29,3	32,2	35,4	39,0	42,9	47,2	
Delta NWC	0,0	3,0	3,3	3,6	4,0	4,4	4,8	5,3	5,8	6,4	
FCFF	15,0	11,5	10,9	10,3	9,9	9,6	9,3	9,2	9,2	9,2	**-5%**
FCFF/NOPAT	100%	70%	60%	52%	45%	40%	35%	32%	29%	26%	**-14%**
PPE	200,0	200,0	202,0	206,0	212,0	220,1	230,3	242,7	257,4	274,5	**4%**
Depreciation	20,0	20,0	20,2	20,6	21,2	22,0	23,0	24,3	25,7	27,5	**4%**
Capex	20,0	22,0	24,2	26,6	29,3	32,2	35,4	39,0	42,9	47,2	**10%**
NWC	30,0	33,0	36,3	39,9	43,9	48,3	53,1	58,5	64,3	70,7	**10%**
Delta NWC		3,0	3,3	3,6	4,0	4,4	4,8	5,3	5,8	6,4	

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Ebit growth must be much higher than inflation rate to mantain the real value of cash flows

Year	1	2	3	4	5	6	7	8	9	10	Cagr%
Sales	100,0	110,0	121,0	133,1	146,4	161,1	177,2	194,9	214,4	235,8	**10%**
Inflation	10%										
EBIT growth	17%										
EBIT	15,0	17,6	20,6	24,1	28,3	33,2	38,9	45,6	53,4	62,6	**17%**
PPE	200,0										
Life	10,0										
Depreciation	20,0	20,0	20,2	20,6	21,2	22,0	23,0	24,3	25,7	27,5	
EBITDA	35,0	37,6	40,8	44,7	49,5	55,2	61,9	69,8	79,1	90,0	
Capex	20,0	22,0	24,2	26,6	29,3	32,2	35,4	39,0	42,9	47,2	
Delta NWC	0,0	3,0	3,3	3,6	4,0	4,4	4,8	5,3	5,8	6,4	
FCFF	15,0	12,6	13,3	14,5	16,2	18,6	21,6	25,5	30,4	36,4	**10%**
FCFF/NOPAT	100%	72%	65%	60%	57%	56%	56%	56%	57%	58%	**-6%**
PPE	200,0	200,0	202,0	206,0	212,0	220,1	230,3	242,7	257,4	274,5	**4%**
Depreciation	20,0	20,0	20,2	20,6	21,2	22,0	23,0	24,3	25,7	27,5	**4%**
Capex	20,0	22,0	24,2	26,6	29,3	32,2	35,4	39,0	42,9	47,2	**10%**
NWC	30,0	33,0	36,3	39,9	43,9	48,3	53,1	58,5	64,3	70,7	**10%**
Delta NWC		3,0	3,3	3,6	4,0	4,4	4,8	5,3	5,8	6,4	

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Terminal value calculation: two main errors

- **McKinsey manual:**
  - » g rate = ROIIC x IR
  - » IR = reinvested Nopat ➔ IR = g/ROIIC
  - » TV = NOPAT x (1-IR)/(wacc – g)
  - » FCFF = NOPAT x (1 –IR)

In inflation regime, this rule doesn't work, because:

Inflation generates FCFF growth without reinvestment (it doesn't require cash plowback). The growth is just the decline of the value of the currency.

- **Practitioners approach:**
  - » g rate = inflation
  - » TV = NOPAT/(wacc – g)

This rule doesn't work because:

Growth rate NOPAT ≠ growth rate FCFF because:

Replacement cost > Depreciation

and Δ NWC

Bradley –Jarrell (2008)

Steady State Valuation

(Zero Investment or Zero Net Present Value Investment)

$$EV = \frac{FCFF}{Wacc - i}$$

Where: FCFF < NOPAT due to:

Δ NWC and Replacement Investment > Depreciation

and i =Steady inflation long term

Growth State Valuation

$$EV = \frac{FCFF \times (1 - IR)}{Wacc - nominal\ g}$$

IR ≠ nominal g/ROIIC; IR = implicit real g/real ROIIC

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Terminal value calculation with inflation and real growth (McKinsey model undervaluation; Practitioners overvaluation)

Steady state inflation rate (i)	2%
Steady state nominal growth (g)	4%
Implicit real growth =(1+g)/(1+i)-1	1,96%
Discount rate (wacc) = ROIC	8%
Real wacc = (1+wacc)/(1+i) -1	5,88%
Nopat(t+1)	1.000
Depreciation (t)	303,1
Average Life of assets (years)	5
Ratio Replacement cost/Depreciation	1,06
FCFF (t+1) = Nopat - Ratio Repl. Cost/Dep *Depreciation	981,8
Plowback McKinsey	50%
Plowback real	33,33%
Plowback practitioners	0%

	Replacement cost	Dep
1	1545,7	
0	1515,4	303,1
-1	1485,7	297,1
-2	1456,6	291,3
-3	1428,0	285,6
-4	1400,0	280,0
Total		1457,1
Repl. Cost/Depr.	1,06	=1545,7/1.457,1

		It doesn't consider inflation
TV McKinsey	12.500	=Nopat * (1- g/ROIC)/(wacc - g)
TV Bradley-Jarrel	16.364	=FCFF * (1- real growth/real ROIC)/(wacc -g)
Delta vs Bradley -Jarrel %	-24%	**It considers inflation and real growth**
TV practitioners	25.000	= Nopat/(wacc-g) **It doesn't consider reinvestment for real growth**
Delta vs. Bradley-Jarrel%	53%	

Terminal value calculation (zero inflation)

Steady state inflation rate (i)	0%
Steady state nominal growth (g)	4%
Implicit real growth =(1+g)/(1+i)-1	4%
Discount rate (wacc) = ROIC	8%
Real wacc = (1+wacc)/(1+i) -1	8%
Nopat(t+1)	1.000
Depreciation (t)	280
Average Life of assets (years)	5
Ratio Replacement cost/Depreciation	1
FCFF (t+1) = Nopat - Ratio Repl. Cost/Dep *Depreciation	1000
Plowback McKinsey	50%
Plowback real	50%
Plowback practitioners	0%

	Replacement cost	Depreciation
1	1400	
0	1400	280
-1	1400	280
-2	1400	280
-3	1400	280
-4	1400	280
Total		1400
Repl. Cost/Depr.		1

		It doesn't consider inflation
TV McKinsey	12.500	=Nopat * (1- g/ROIC)/(wacc - g)
TV Bradley-Jarrel	12.500	=FCFF * (1- real growth/real ROIC)/(wacc -g)
Delta vs Bradley -Jarrel %	0	**It considers inflation and real growth**
TV practitioners	25.000	= Nopat/(wacc-g) **It doesn't consider**
Delta vs. Bradley-Jarrel%	100%	**reinvestment for real growth**

Terminal value (w/high inflation)

Steady state inflation rate (i)	10%
Steady state nominal growth (g)	14%
Implicit real growth =(1+g)/(1+i)-1	3,64%
Discount rate (wacc) = ROIC	16%
Real wacc = (1+wacc)/(1+i) -1	5,45%
Nopat(t+1)	1.000
Depreciation (t)	380,1
Average Life of assets (years)	5
Ratio Replacement cost/Depreciation	1,27
FCFF (t+1) = Nopat - Ratio Repl. Cost/Dep *Depreciation	899,2
Plowback McKinsey	88%
Plowback real	66,67%
Plowback practitioners	0%

	Replacement cost	Dep	
t+1	2.090,7		
t	1.900,7	380,1	
t-1	1.727,9	345,6	
t-2	1.694,0	338,8	
t-3	1.540,0	308,0	
t-4	1.400,0	280,0	
	Total	1.652,5	
Ratio Repl. Cost/Dep	1,27	=2.090,7/1.625,5	

		It doesn't consider inflation
TV McKinsey	6.250	=Nopat * (1- g/ROIC)/(wacc - g)
TV Bradley-Jarrel	16.485	=FCFF * (1- real growth/real ROIC)/(wacc - g)
Delta vs Bradley -Jarrel %	-62%	**It considers inflation and real growth**
TV practitioners	50.000	= Nopat/(wacc-g)
Delta vs. Bradley-Jarrel%	203%	**It doesn't consider reinvestment for real growth**

Terminal value calculation w/ zero real growth

Steady state inflation rate (i)	2%
Steady state nominal growth (g)	2%
Implicit real growth =(1+g)/(1+i)-1	0,00%
Discount rate (wacc) = ROIC	8%
Real wacc = (1+wacc)/(1+i) -1	5,88%
Nopat(t+1)	1.000
Depreciation (t)	303,1
Average Life of assets (years)	5
Ratio Replacement cost/Depreciation	1,06
FCFF (t+1) = Nopat - Ratio Repl. Cost/Dep *Depreciation	981,6
Plowback McKinsey	25%
Plowback real	0%
Plowback practitioners	0%

	Replacement cost	Dep
1	1.545,7	
0	1.515,4	303,1
-1	1.485,7	297,1
-2	1.456,6	291,3
-3	1.428,0	285,6
-4	1.400,0	280,0
Total		1.457,1

Repl. Cost/Depr. 1,06 =1.545,7/1.457,1

It doesn't consider inflation

TV McKinsey	12.500	=Nopat * (1- g/ROIC)/(wacc - g)
TV Bradley-Jarrel	16.360	=FCFF * (1- real growth/real ROIC)/(wacc - g)
Delta vs Bradley -Jarrel %	-24%	
TV practitioners	16.667	= Nopat/(wacc-g)
Delta vs. Bradley-Jarrel%	2%	

It considers inflation and real growth

It doesn't consider reinvestment for real growth

AGENDA

1. Inflation rates, Interest rates and Stock indexes
2. Past experiences vs. current experience
3. Conditions of Inflation Neutrality
4. Inflation in the valuation context and current myth
5. TV calculation and inflation (Bradley- Jarrell)
6. **Wacc and inflation (Miles-Ezzel better than Modigliani-Miller)**
7. Cash Flows and inflation

Wacc and Inflation

Modigliani Miller calculation of wacc:

$$Wacc = W_{Unlevered} \times (1 - T_C \times \frac{B}{EV})$$

This calculation implies fixed cash flows and a fixed amount of debt outstanding. The M&M model systematically understates the firm's true nominal wacc when expected inflation is positive. The true nominal wacc under M&M model is:

$$Wacc = Wacc^{M\&M} + \boldsymbol{i \times Tc \times \frac{B}{EV}}$$

Miles- Ezzel model doesn't suffer of the same

$$Wacc = W_{Unlevered} \frac{\left[T_C \times W_d \times \frac{B}{EV} \times (1 + W_{Unlevered})\right]}{1 + W_d}$$

Wacc MM increase due to inflation (tax rate = 25%; i x tc x L)

Leverage =Debt to Enterprise Value	Inflation rate 5%	6%	7%	8%	9%	10%	11%	12%
10%	0,13%	0,15%	0,18%	0,20%	0,23%	0,25%	0,28%	0,30%
20%	0,25%	0,30%	0,35%	0,40%	0,45%	0,50%	0,55%	0,60%
30%	0,38%	0,45%	0,53%	0,60%	0,68%	0,75%	0,83%	0,90%
40%	0,50%	0,60%	0,70%	0,80%	0,90%	1,00%	1,10%	1,20%
50%	0,63%	0,75%	0,88%	1,00%	1,13%	1,25%	1,38%	1,50%
60%	0,75%	0,90%	1,05%	1,20%	1,35%	1,50%	1,65%	1,80%
70%	0,88%	1,05%	1,23%	1,40%	1,58%	1,75%	1,93%	2,10%
80%	1,00%	1,20%	1,40%	1,60%	1,80%	2,00%	2,20%	2,40%

Modigliani-Miller (M&M) vs. Miles and Ezzel (M&E) formula and riconciliation

INPUT		Models: WACC calculation		
Wu	10%	M&M	8,75%	=Wu *(1 -tc *L)
Inflation	3,75%	M&E	9,22%	= Wu - [tc*Wd*L*(1+Wu)]/(1+Wd)
Wd	6%	delta	0,47%	
L =B/EV	50%	i x tc x L	0,47%	
tax rate	25%	M&M w/infl.adjustment	9,22%	=Wu *(1 -tc *L) + i*tc*L

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7. **Cash Flows and inflation**

When it rains, it pours

2008-2020 (post-GFC Era): consumers repairing balance sheets, low economic growth, low inflation and interest rates

2020-2021 Pandemic Era: massive policy stimulus, expanded monetary base, stay at home world

2022 - ? Post Pandemic Era and War: energy crisis, rising inflation and interest rates, uncertain growth

+ **few key secular trends:**

1) lingering supply chain issues;

2) deglobalization, including an onshoring of supply chains and an end of the era of cheap goods from China as its workforce shrinks;

3) the spending required to decarbonize and finance the energy transition

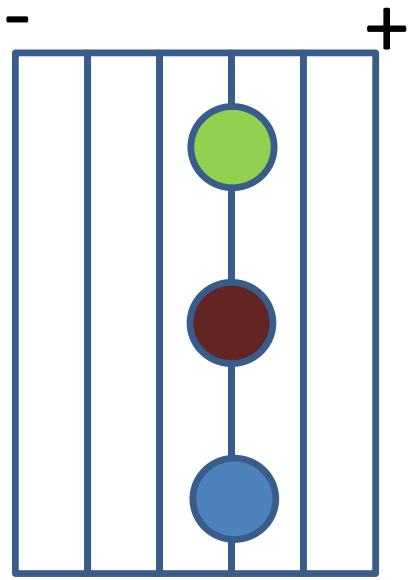
Relative prices dynamics (turbulence)

Positioning

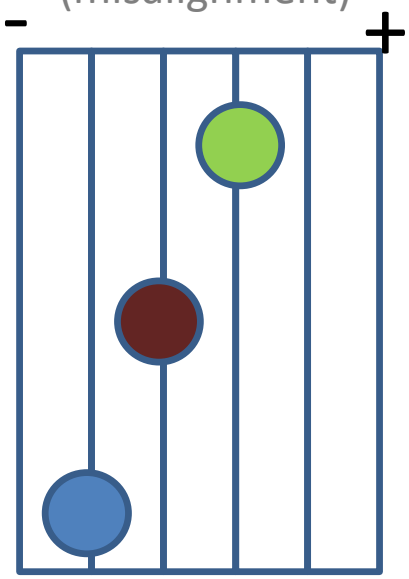
- market share

- Strategic (pipeline new products, technology, cost advantages)
- performance (Profit formula = Ebit margin x Asset Turnover)

Perfect alignment



Turbulence
(misalignment)



Pratical consequences of turbolence

- Shortening of planning horizons
- Reducing details of the financial forecasts
- Reducing planning accuracy

- Single scenario ? Multiple scenarios (best, normal, worst) ? Complex scenarios (Montecarlo) ?

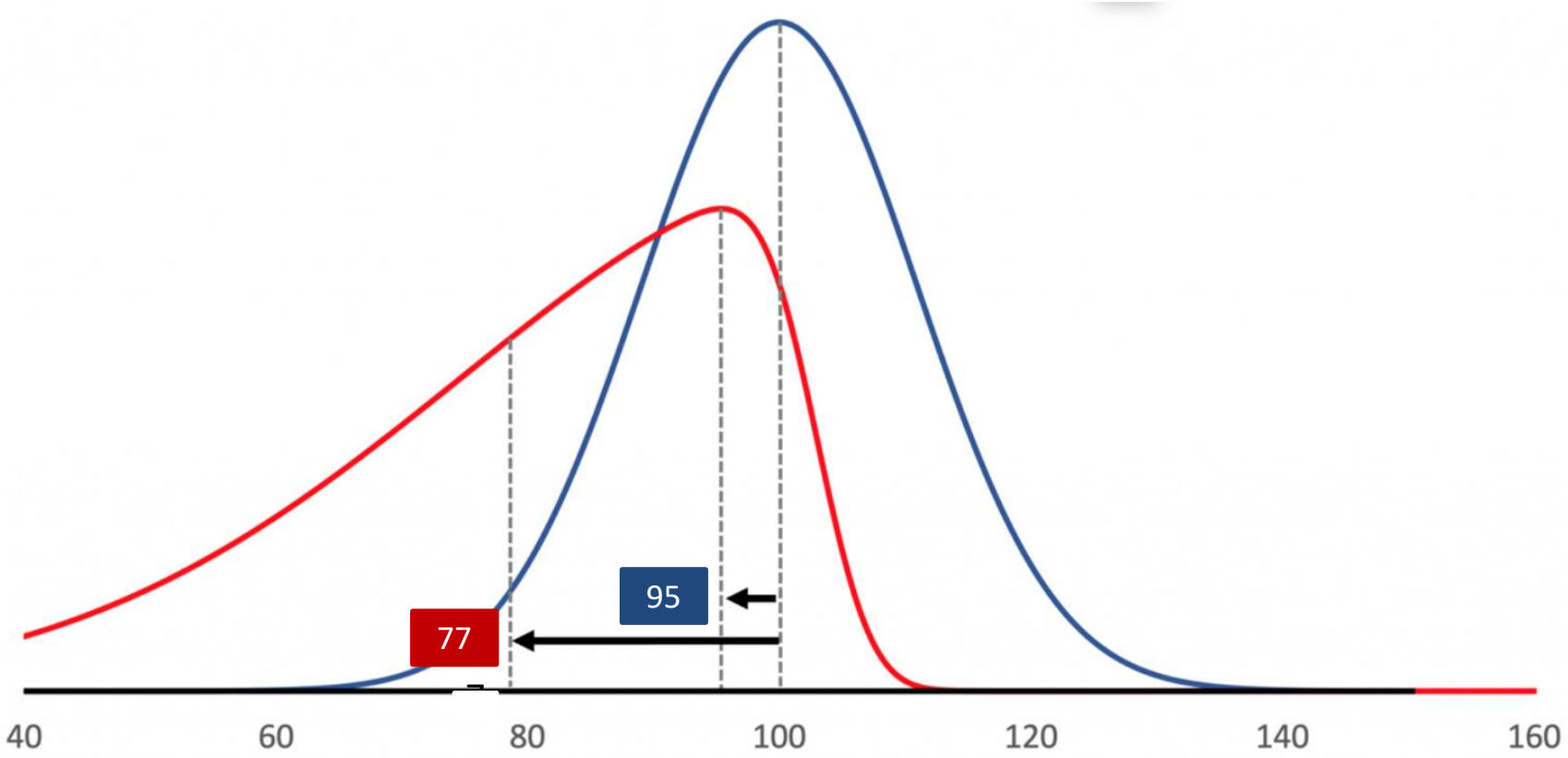
Cash Flows before and after turbulence

Scenarios	Before Turbulence		After Turbulence	
	CF	Pr.	CF	Pr.
Best	120	15%	110	10%
Base	100	70%	95	60%
Worst	80	15%	30	30%
Most Likely	**100**		**95**	
			-5%	
Expected CF	**100**		**77**	
			-23%	
St. deviation	11		31	
Skewness	**0**		**-0,8**	

Symmetrical distribution

Asymmetrical distribution

Don’t confuse mean with mode



Thank you