Listed Real Estate as an Inflation Hedge across Regimes

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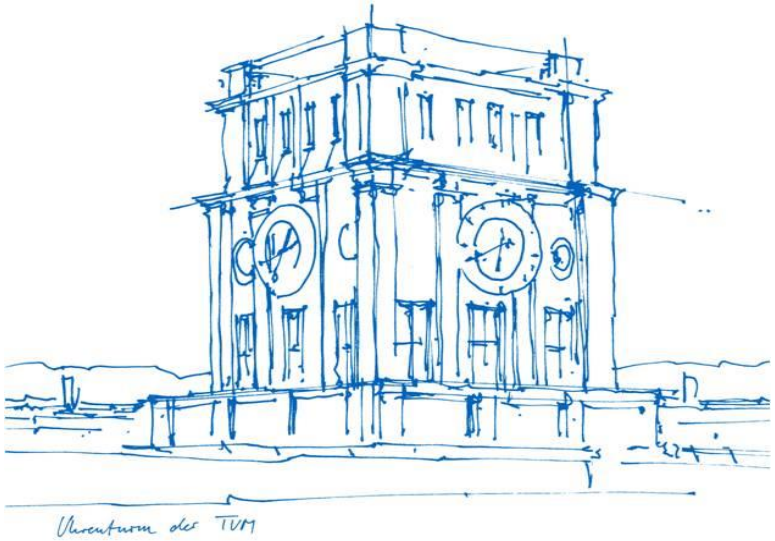
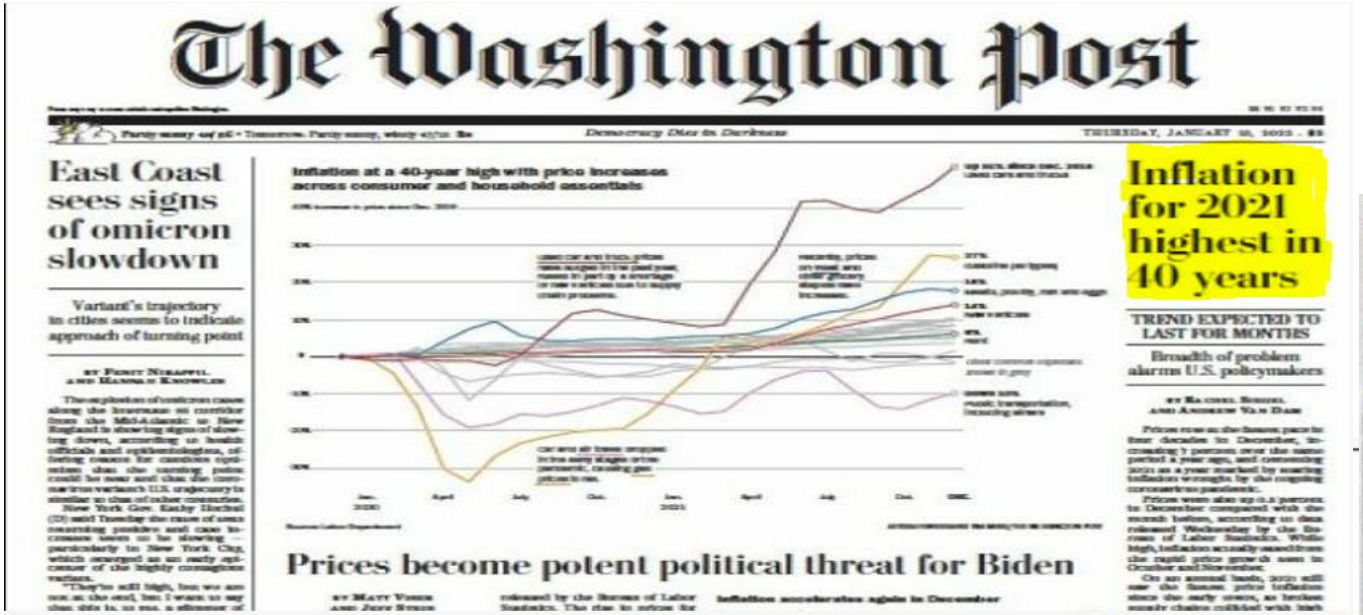
Professorship of Real Estate Development





The Washington Post

Democracy Dies in Darkness

THURSDAY, JANUARY 13, 2022

East Coast sees signs of omicron slowdown

Variant's trajectory in cities seems to indicate approach of turning point

Inflation at a 40-year high with price increases across consumer and household essentials

Inflation for 2021 highest in 40 years

TREND EXPECTED TO LAST FOR MONTHS

Breadth of problem alarms U.S. policymakers

Prices become potent political threat for Biden

THE WALL STREET JOURNAL.

DOW JONES | News Corp

THURSDAY, JULY 28, 2022 - VOL. CCLXXX NO. 23

WSJ.com

★★★★ $5.00

DJIA 32197.59 ▲ 436.05 1.4% NASDAQ 12032.42 ▲ 4.1% STOXX 600 428.12 ▲ 0.5% 10-YR. TREAS. ▲ 15/32, yield 2.731% OIL $97.26 ▲ $2.28 GOLD $1,719.10 ▲ $1.40 EURO $1.0198 YEN 136.60

What's News

Business & Finance

Fed Lifts Rates by 0.75 Point Again

Powell expects further increases even as some indicators show signs of softening

By Nick Timiraos

WASHINGTON—The Federal Reserve continued a sprint to reverse its easy-money policies by approving on Wednesday another unusually large 0.75-percentage-point interest-rate increase and signaling more tightening was likely this year to combat 40-year-high inflation.

Officials agreed unanimously to lift their benchmark federal-funds rate to a range between 2.25% and 2.5%. Markets rallied after the meeting because Fed Chairman Jerome Powell offered fewer specifics about the magnitude of coming rate rises and hinted at an eventual slowdown.

The S&P 500 rose 2.6%, while the Nasdaq Composite had its biggest one-day percentage gain in more than two years, surging 4.1%. Yields on the benchmark 10-year Treasury note fell to 2.731%.

Given Mr. Powell's insistence that the Fed has to cause slower growth and accept rising recession risks to bring down inflation, "it is a bit surprising that all assets reacted in such an exuberant manner," said Michael de Pass, global head of linear rates trading at Citadel Securities.

Mr. Powell said it was too soon to say whether the Fed would dial down the size of its rate increases to a half or even a quarter point at its next meeting, in September. But he said that at some point, it

Please turn to page A6

Federal-funds target rate

Wednesday's increase of 0.75 pct. pt.

- Federal Reserve rate move fuels stock jump..... B1
- Powell's remarks send Treasury yields lower..... B11
- Heard on the Street: How the Fed could lose its nerve... B12

Protesters Storm Iraqi Parliament Over Prime Minister Race

Facebook

- U.S. stocks rallied after the Fed's meeting, extending earlier gains. The S&P 500, Nasdaq and Dow added 2.6%, 4.1% and 1.4%, respectively. Treasury yields fell. B1, B11
- Facebook parent Meta posted its first decline in revenue and issued a muted outlook on weakness

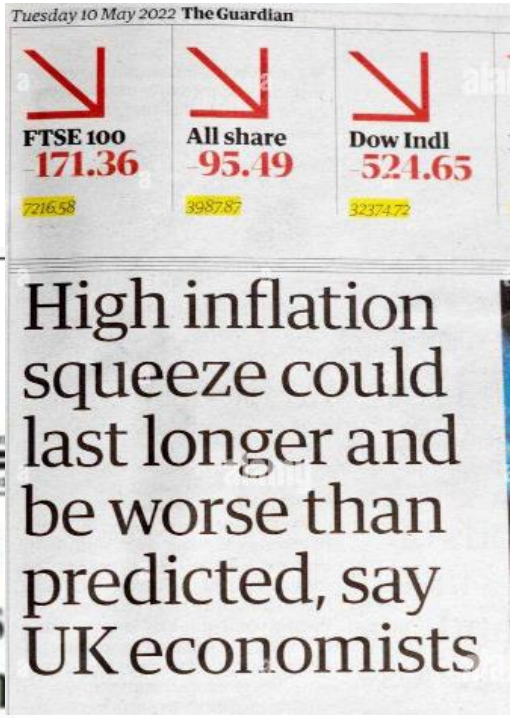
THURSDAY, JULY 28, 2022

Fed raises rates for a 4th time as it fights inflation

A BIG HIKE OF THREE-QUARTERS OF A POINT

Powell says path to avoid recession has narrowed

By Rachel Siegel



Tuesday 10 May 2022 The Guardian

FTSE 100 171.36 7216.58

All share 95.49 3987.87

Dow Indl 524.65 32374.72

High inflation squeeze could last longer and be worse than predicted, say UK economists

BBC

Inflation slows to 4.6% as government says pledge met

Introduction

- Large price swings in energy and commodity markets
- In September 2022, the year-on-year US inflation rose to 8.2%
- Central Banks attempting to curb the massive inflation
- Important to take a fresh look at real estate‘s inflation hedging capability
- Crucial for long-term institutional investors and individual investors

Ideas from literature

- Real estate can deliver an adequate inflation hedge:

Rent or lease payments (tenant leases contain rent escalation clauses and/or pass expense increases through to tenants)

Land values and building costs typically rise with inflation. Empirical evidence for listed real estate is mixed

Ideas from literature / contribution

The project extends the literature in two ways:

- we allow for non-linear inflation hedging characteristics
- the project compares the hedging characteristics across asset classes

Lack of conclusive evidence regarding the inflation hedging capabilities across different asset classes

Ideas from literature / contribution

Previous literature combines Fama and Schwert (1977) framework and the cointegration technique →assume a stable relationship

Most of the research in portfolio optimisation has been done within a mean-variance framework

Mean-variance approach often yields extreme and unrealistic asset allocations to listed real estate

Data and method

Monthly time-series variables:
1975 to 2023 for the US
1990 to 2023 for the UK, Japan, and Australia

LRE Total return indexes
- US (Refinitiv Datastream)
- UK, Japan, and Australia (EPRA)

Stock total return indexes (Refinitiv Datastream)

- S&P 500 index for the US
- FTSE 250 index for the UK
- Nikkei 500 index for Japan
- S&P/ASX 200 index for Australia

Data and method

Price of gold, silver, and oil in US Dollars, along with the total return index of the S&P GSCI Agriculture

- real three-month Treasury Bill rates
- nominal GDP

Portfolio section: Inflation-linked government bonds (Bloomberg Global Inflation-Linked Total Return Indexes)

Inflation decomposition

Decomposition of observed inflation (I_t) into expected inflation (EI_t) and unexpected inflation (UI_t) (Fama and Schwert, 1977)

We can define inflation based on the prior anticipated inflation rate, adjusted for differences between actual inflation and the prior expectation for each period

This leads to a univariate time series approach using Box-Jenkins / ARIMA (1,0,1) procedures to inflation

Markov-Switching Vector Error Correction Model (MS-VECM)

Following Beckman and Czudaj (2013), a MS-VECM is used to examine the relationship between the price of assets and expected and unexpected inflation

The parameters of this model are designed to take a constant value in each regime and to shift discretely from one regime to the other with different switching probabilities

Empirical Results – Long-term Hedging

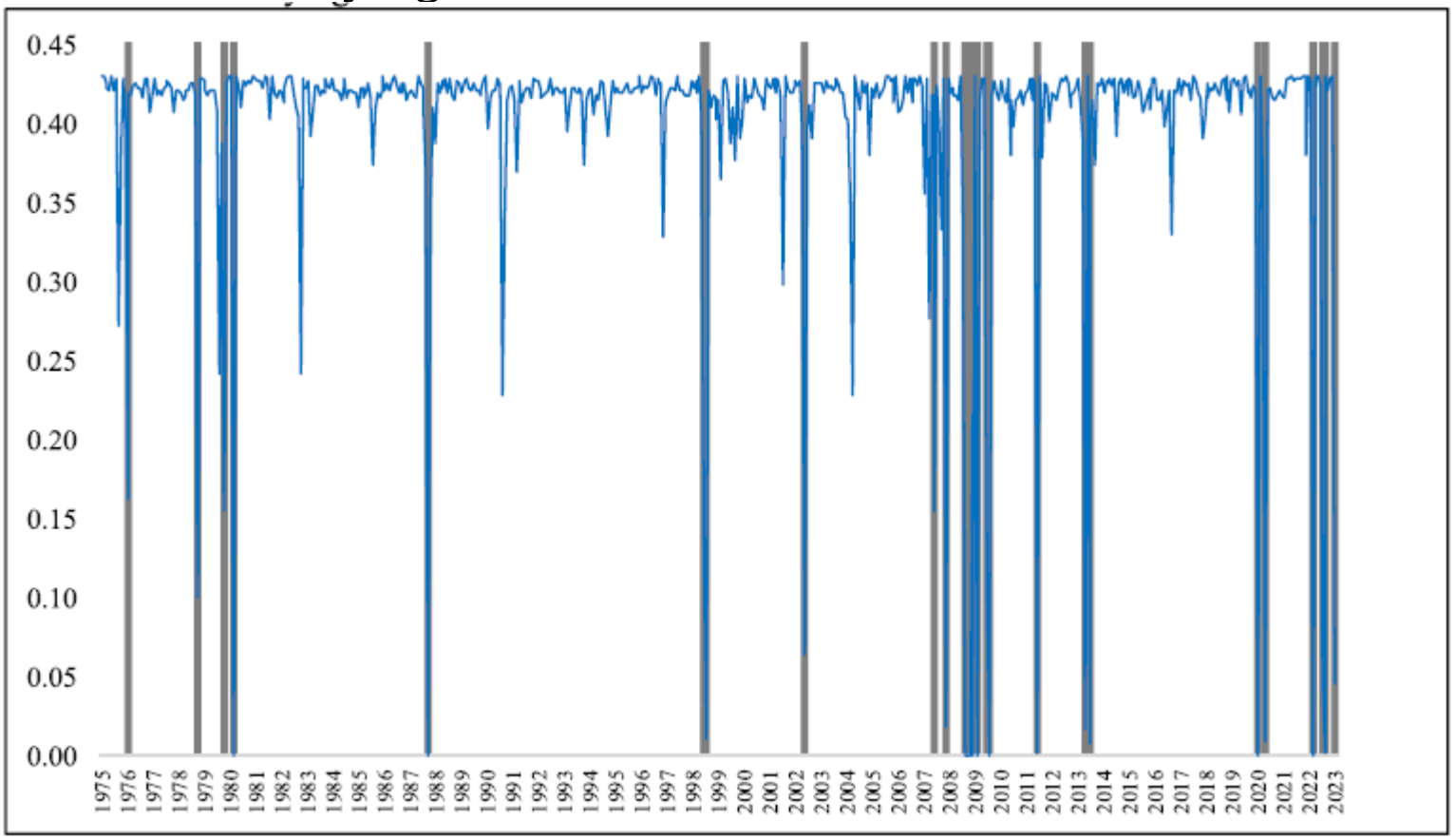
Country	Rank	$r_{LRE,t-1}$	$r_{stock,t-1}$	$r_{oil,t-1}$	$r_{gold,t-1}$	$r_{silver,t-1}$	$r_{agri,t-1}$	GDP_{t-1}	ir_{t-1}	EI_{t-1}	UI_{t-1}
US	3	1.000	0.000	0.000	-0.227	-0.509	0.580	-0.021***	-0.236***	1.754**	-1.026
		(0.000)	(0.000)	(0.000)	(0.892)	(0.695)	(0.915)	(0.010)	(0.076)	(1.038)	(5.568)
		0.000	1.000	0.000	0.446	-2.032	4.781**	0.031	1.017***	-3.891*	-13.145
		(0.000)	(0.000)	(0.000)	(2.016)	(1.569)	(2.067)	(0.022)	(0.175)	(2.345)	(12.576)
		0.000	0.000	1.000	0.204	0.887	-4.272***	-0.028***	-0.550***	1.807	-7.354
		(0.000)	(0.000)	(0.000)	(0.906)	(0.705)	(0.929)	(0.010)	(0.077)	(1.054)	(5.652)
UK	2	1.000	0.000	0.350*	-0.556	-0.209	-0.304	-0.052***	-0.161***	1.711**	-11.070
		(0.000)	(0.000)	(0.203)	(0.353)	(0.299)	(0.490)	(0.011)	(0.032)	(0.868)	(12.499)
		0.000	1.000	-0.127	-0.112	-0.370**	0.886***	-0.030***	-0.065***	-1.571***	-25.827***
		(0.000)	(0.000)	(0.122)	(0.211)	(0.179)	(0.294)	(0.007)	(0.019)	(0.520)	(7.482)
JPN	3	1.000	0.000	0.000	-0.556*	-0.282	-0.217	-0.132***	-0.228***	11.182***	6.190
		(0.000)	(0.000)	(0.000)	(0.337)	(0.279)	(0.418)	(0.018)	(0.058)	(4.136)	(5.908)
		0.000	1.000	0.000	-1.109***	0.485	-0.193	-0.068***	-0.396***	1.192	-24.117***
		(0.000)	(0.000)	(0.000)	(0.473)	(0.391)	(0.586)	(0.025)	(0.082)	(5.805)	(8.291)
		0.000	0.000	1.000	-1.618	0.464	0.350	0.028	-0.396***	4.673	-7.153
		(0.000)	(0.000)	(0.000)	(1.168)	(0.964)	(1.446)	(0.061)	(0.047)	(14.315)	(20.445)

Empirical Results – Short-term Hedging

Country		ΔEI	ΔUI	ECT1	ECT2	ECT3		Regime 1	Regime 2
U.S.	Regime 1	0.430* (0.230)	-1.410* (0.720)	-0.004 (0.009)	-0.001 (0.008)	0.004 (0.010)	Regime 1	0.941	0.206
	Regime 2	-0.900 (1.430)	-30.430*** (7.020)	-0.081* (0.048)	-0.036 (0.057)	-0.010 (0.094)	Regime 2	0.059	0.794
UK	Regime 1	4.630* (2.660)	-3.630*** (1.240)	0.022 (0.014)	0.014 (0.026)		Regime 1	0.773	0.410
	Regime 2	-3.880 (5.340)	-5.580 (5.530)	-0.054 (0.039)	0.058 (0.061)		Regime 2	0.227	0.590
JPN	Regime 1	60.010** (26.020)	4.640 (3.050)	-0.282*** (0.048)	0.230*** (0.050)	-0.062*** (0.018)	Regime 1	0.954	0.041
	Regime 2	-17.680*** (3.540)	-1.570 (1.120)	0.001 (0.013)	-0.040*** (0.006)	0.023*** (0.002)	Regime 2	0.046	0.959
AUS	Regime 1	1.320* (0.750)	1.830 (1.680)				Regime 1	0.984	0.209
	Regime 2	-10.290 (8.170)	2.920 (24.660)				Regime 2	0.016	0.791

Empirical Results – Short-term Hedging

U.S. Time-Varying Coefficient of EI



Robustness Tests

- Alternative Inflation Disaggregation

- Income and Capital Returns

- Housing Rent Modified Inflation Index

- Lower Frequency Test

Inflation Hedging Portfolios

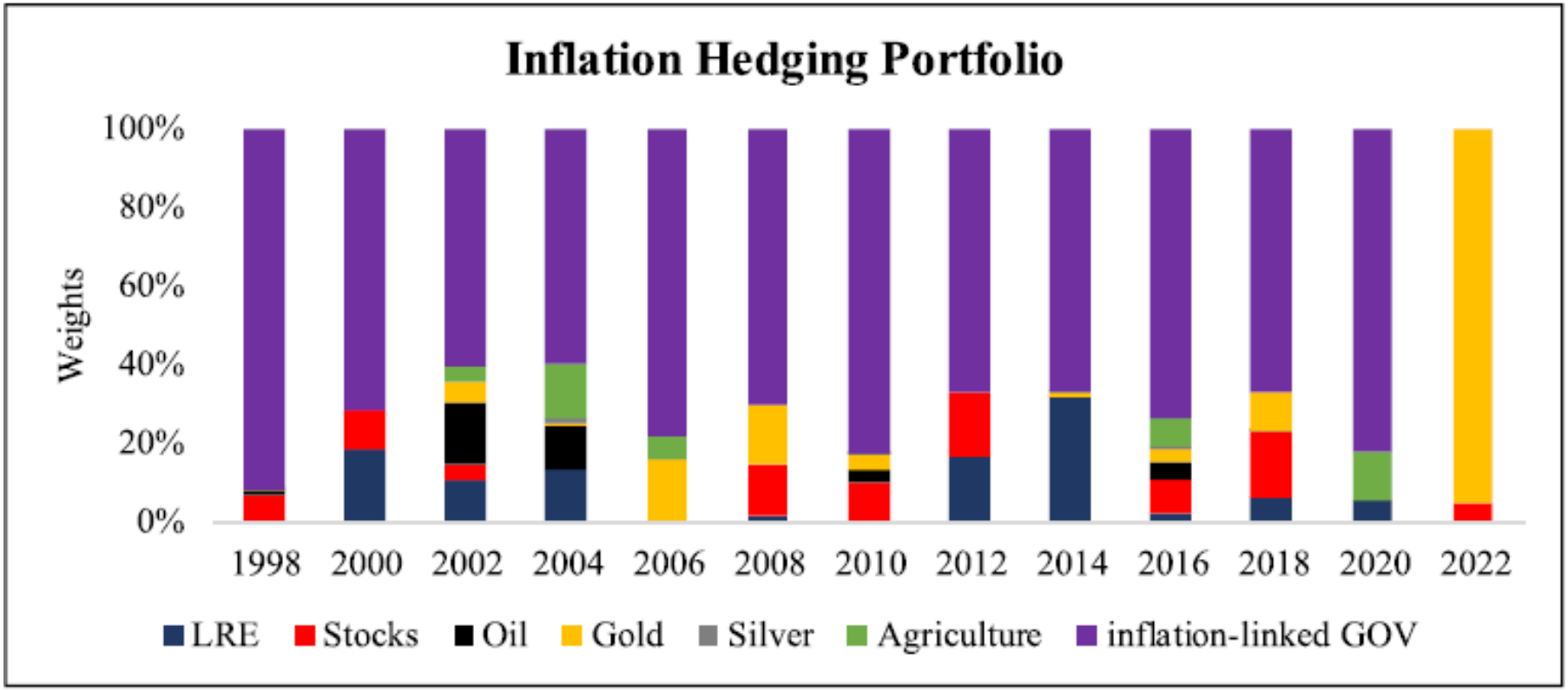
We present optimal portfolios using the shortfall probability approach for the US, UK, Japan, and Australia for a minimum target return of 3% and an investment horizon of T (T = 2 years, rebalancing every two years)

Weights for LRE vary over time → inflation-linked government bonds always play a noticeable role in the portfolio

Average percentages of the portfolios for the US, UK, Japan, and Australia over the entire period are 8.32%, 10.87%, 8.55%, and 32.15%, respectively

➥ Highlighting benefits of holding LRE for investors

Inflation Hedging Portfolios



Main Findings

- LRE is a good hedge against inflation, but mainly against expected inflation and in the long term → Long-term hedging ability comes from value appreciation
- Short-term heging ability moves towards being negative during crisis periods
- Inflation hedging ability of LRE also varies across countries
- LRE is adequately hedge against core, food, and housing inflation in Japan; In Australia, we observe positive hedging characterisitcs concerning the energy inflation

Main Findings

- In the long-run the hedging quality comes from value appreciation and not from income returns
- In the short run, we find hedging capabilities for price returns against expected inflation, for income returns against unexpected inflation
- Rent-adjusted inflation index reveal a superior hedging ability for LRE compared to when an unadjusted inflation index is used
- Inflation-hedging portfolios provide more realistic and less extreme allocations to listed real estate than when the standard mean-variance approach is used

Thank you for listening!

Jan Muckenhaupt

E-CREDA 2023 Annual Conference

Paris, 24th November 2023

Appendix: Decomposition, Stationarity and Cointegration

$$EI_t = \alpha + \rho I_{t-1} + \varepsilon_t$$
$$\varepsilon_t = \theta \varepsilon_{t-1} + e_t$$

Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test for stationarity

All series are I(1), indicating stationarity in first differences

Using trace test to test for cointegration

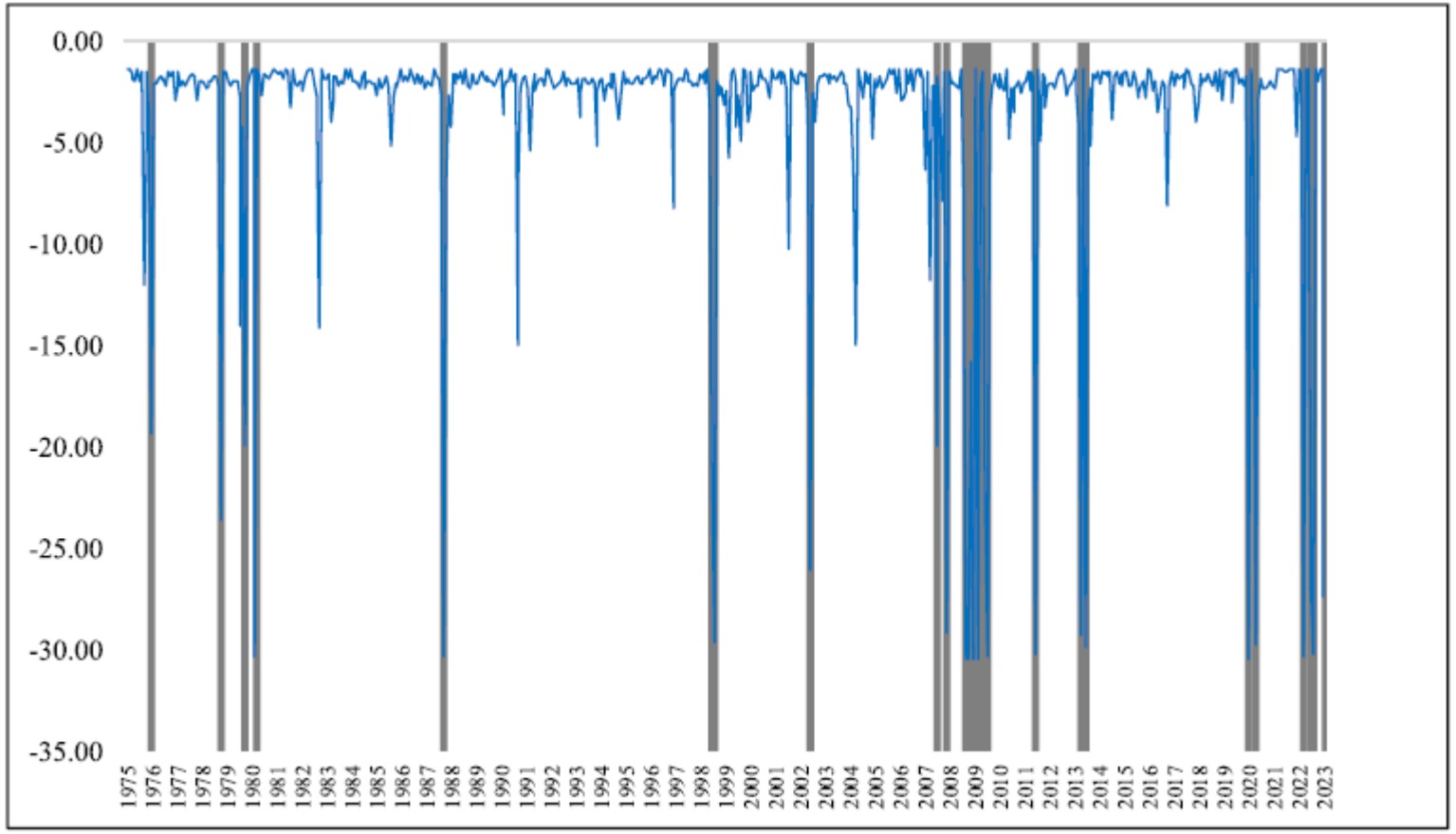
Appendix– Short-term Hedging

Short-term coefficients for Regime 1 and 2															Transition probability matrix P		
Country		$\Delta r_{LRE,t-1}$	$\Delta r_{stock,t-1}$	$\Delta r_{oil,t-1}$	$\Delta r_{gold,t-1}$	$\Delta r_{silver,t-1}$	$\Delta r_{agri,t-1}$	ΔGDP_{t-1}	Δir_{t-1}	ΔEI	ΔUI	ECT1	ECT2	ECT3		Regime 1	Regime 2
U.S	Regime 1	-0.119*** (0.033)	0.112*** (0.043)	-0.028 (0.023)	0.053 (0.041)	-0.072*** (0.024)	0.022 (0.029)	0.0001 (0.000)	-0.009** (0.003)	0.430* (0.230)	-1.410* (0.720)	-0.004 (0.009)	-0.001 (0.008)	0.004 (0.010)	Regime 1	0.941	0.206
	Regime 2	0.044 (0.106)	0.775*** (0.417)	0.417*** (0.111)	-1.596*** (0.322)	0.734** (0.323)	0.805*** (0.1181)	0.001 (0.002)	0.003 (0.056)	-0.900 (1.430)	-30.430*** (7.020)	-0.081* (0.048)	-0.036 (0.057)	-0.010 (0.094)	Regime 2	0.059	0.794
UK	Regime 1	-0.153** (0.075)	0.015 (0.083)	0.029 (0.028)	-0.078 (0.053)	0.008 (0.044)	0.089 (0.063)	0.003* (0.001)	-0.063*** (0.012)	4.630* (2.660)	-3.630*** (1.240)	0.022 (0.014)	0.014 (0.026)		Regime 1	0.773	0.410
	Regime 2	0.029 (0.147)	0.377* (0.216)	0.094 (0.085)	-0.231 (0.201)	-0.155 (0.135)	-0.083 (0.228)	0.007 (0.008)	0.047 (0.078)	-3.880 (5.340)	-5.580 (5.530)	-0.054 (0.039)	0.058 (0.061)		Regime 2	0.227	0.590
JPN	Regime 1	-0.116* (0.070)	0.452*** (0.119)	-0.058 (0.058)	0.158 (0.144)	-0.127 (0.099)	-0.127 (0.172)	-0.009 (0.009)	-0.065 (0.064)	60.010** (26.020)	4.640 (3.050)	-0.282*** (0.048)	0.230*** (0.050)	-0.062*** (0.018)	Regime 1	0.954	0.041
	Regime 2	-0.186*** (0.049)	0.702*** (0.064)	0.102*** (0.033)	-0.368*** (0.088)	0.090** (0.042)	0.110 (0.076)	0.001 (0.003)	-0.056* (0.031)	-17.680*** (3.540)	-1.570 (1.120)	0.001 (0.013)	-0.040*** (0.006)	0.023*** (0.002)	Regime 2	0.046	0.959
AUS	Regime 1	-0.117* (0.061)	0.024 (0.063)	-0.051** (0.020)	-0.069 (0.049)	-0.026 (0.030)	0.029 (0.036)	-0.001** (0.001)	-0.023 (0.014)	1.320* (0.750)	1.830 (1.680)				Regime 1	0.984	0.209
	Regime 2	-0.489** (0.236)	0.642 (0.510)	0.396** (0.172)	-0.467 (0.350)	-0.173 (0.251)	-0.722** (0.337)	0.002 (0.004)	0.425*** (0.138)	-10.290 (8.170)	2.920 (24.660)				Regime 2	0.016	0.791

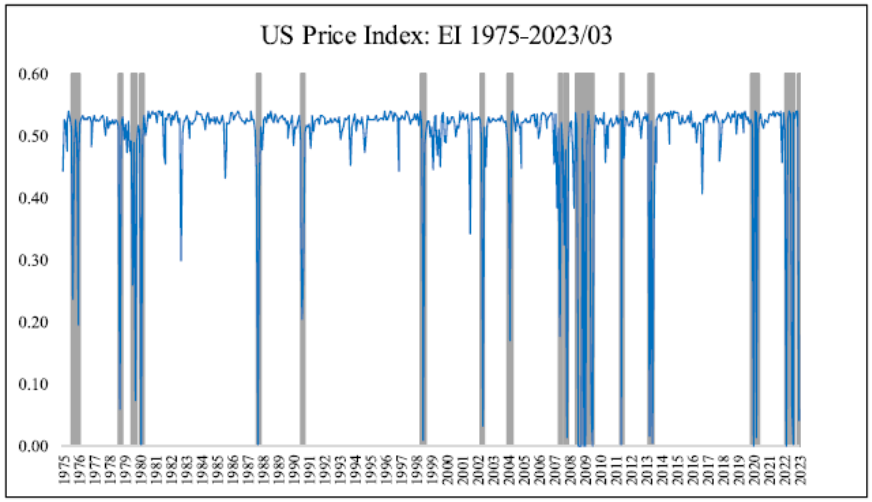
Notes: US stands for United States of America, UK for United Kingdom, JPN for Japan, and AU for Australia. We only report the equation for LRE returns. $r_{LRE,t-1}$ denotes the FTSE/EPRA/NAREIT real estate stock total return index. $r_{stock,t-1}$ denotes for each country the corresponding total return of the stock market index. $r_{oil,t-1}$ denotes the oil price in US Dollars. $r_{gold,t-1}$ denotes the gold price in US Dollars. $r_{silver,t-1}$ denotes the silver price in US Dollars. $r_{agri,t-1}$ denotes the total return index of S&P GSCI Agriculture. GDP_{t-1} stands for GDP of each country. ir_{t-1} are the 3-month treasury bill rates. EI_{t-1} and UI_{t-1} stand for expected and unexpected inflation, respectively. ECT1, ECT2, and ECT3 are the coefficients of error correction terms. Regime 1 and 2 are reported. The transition matrix P reports the transition probabilities of the stochastic process

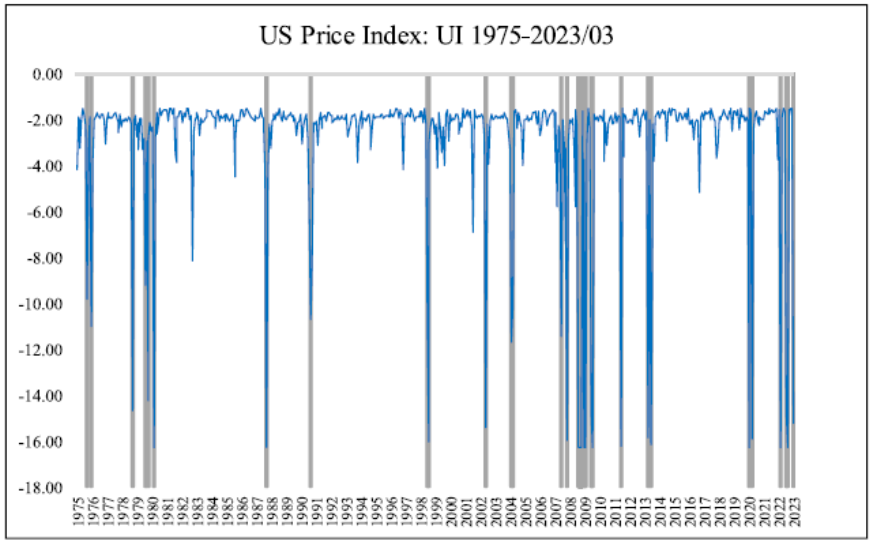
Appendix– Short-term Hedging

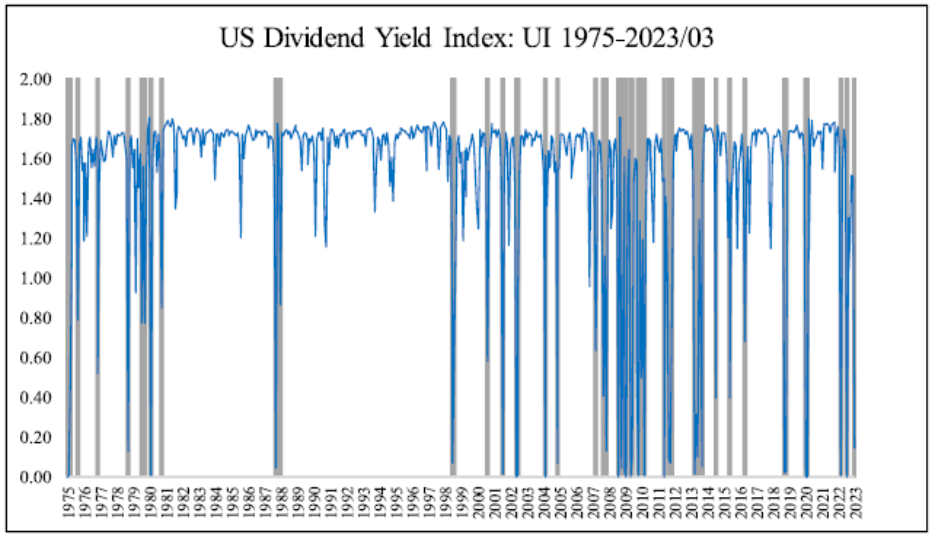
U.S. Time-Varying Coefficient of UI



Appendix - Income and Capital Returns



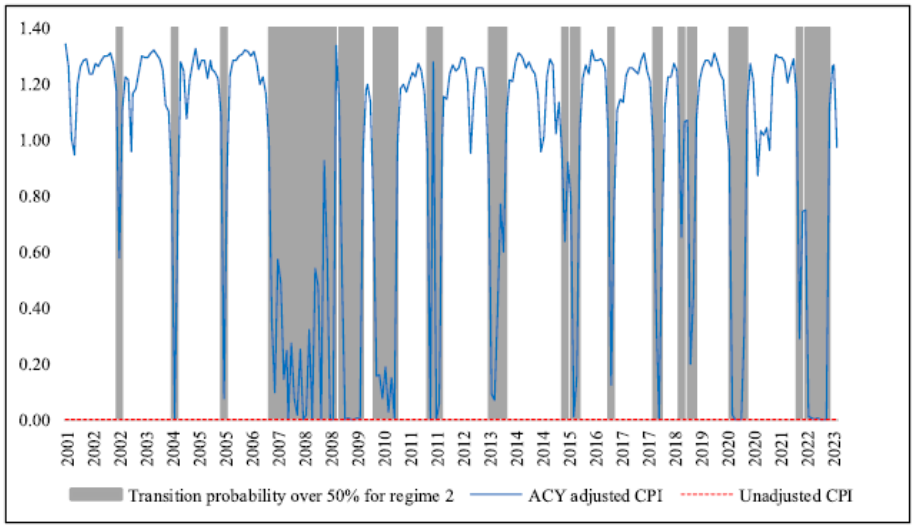


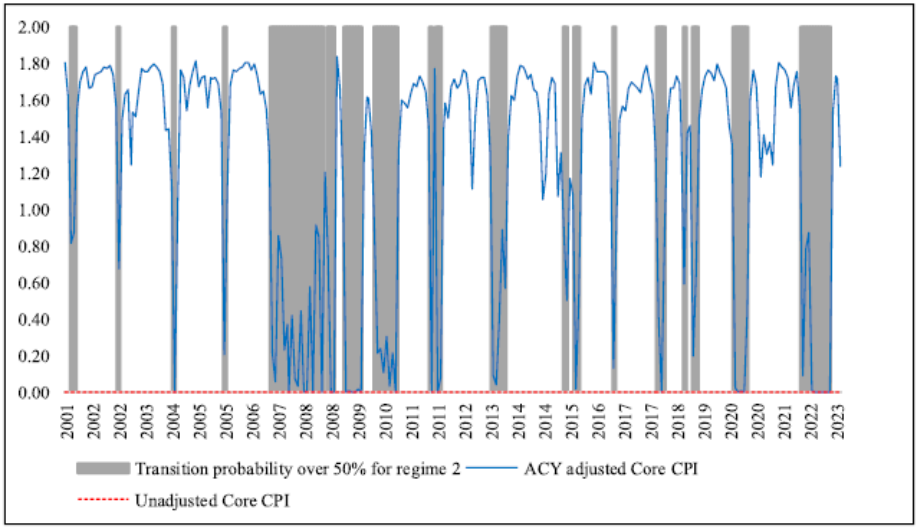


Country	Index	Rank	EI_{t-1}	UI_{t-1}
US	Price	3	1.072***	1.430
			(0.525)	(2.817)
	Dividend	4	-2.004	-15.001
			(1.330)	(9.281)

Appendix: Modified Inflation Index (Long-term)

Country	Rank	$ACYmod.CPI_{t-1}$	Rank	CPI_{t-1}	Rank	$ACYmod.CPICore_{t-1}$	Rank	$CPICore_{t-1}$
US	1	19.063*** (2.484)	1	11.073*** (1.169)	1	24.333*** (3.227)	1	11.382*** (1.177)





Appendix: Inflation Hedging Portfolios

Minimum Target Return	Weights of LRE	Shortfall Probability	Mean	SD	Sharpe Ratio
Rebalanced every 2 years					
r=0%	6.88%	1.57%	6.36%	16.60%	37.95%
r=1%	7.43%	1.61%	6.43%	16.81%	38.29%
r=2%	6.50%	1.70%	6.88%	17.93%	38.37%
r=3%	8.32%	1.74%	6.98%	17.62%	39.65%
Rebalanced every 5 years					
r=3%	3.67%	2.33%	6.38%	21.86%	29.19%
Rebalanced every 10 years					
r=3%	2.67%	2.82%	4.85%	21.43%	22.63%
Rebalanced every 30 years					
r=3%	6.11%	6.14%	4.50%	17.24%	26.10%

Note: The weights of LRE, the shortfall probability, the mean of portfolio returns, the standard deviation of portfolio returns (SD), and the Sharpe ratios of portfolios are the average values over the entire sample period.