



JACOBS LEVY EQUITY
MANAGEMENT CENTER
for Quantitative Financial Research

A Global Macroeconomic Risk Model for Value, Momentum, and Other Asset Classes

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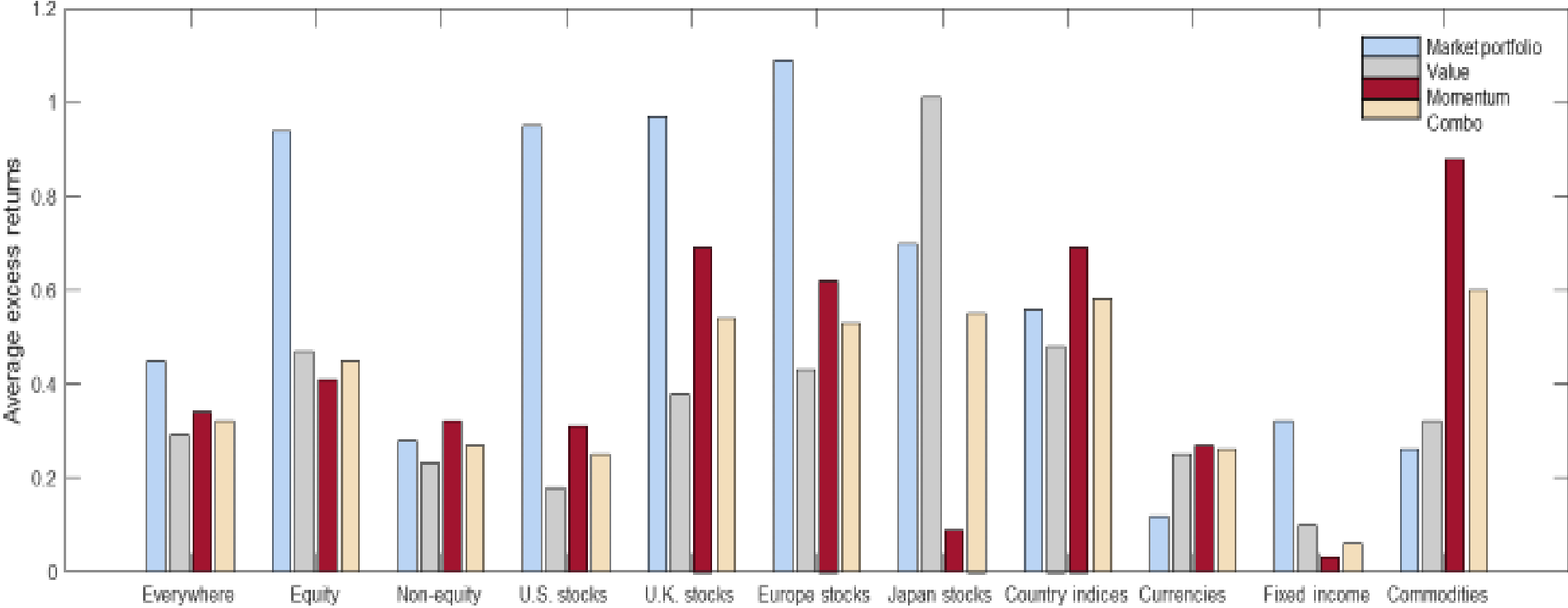
DISCUSSANT

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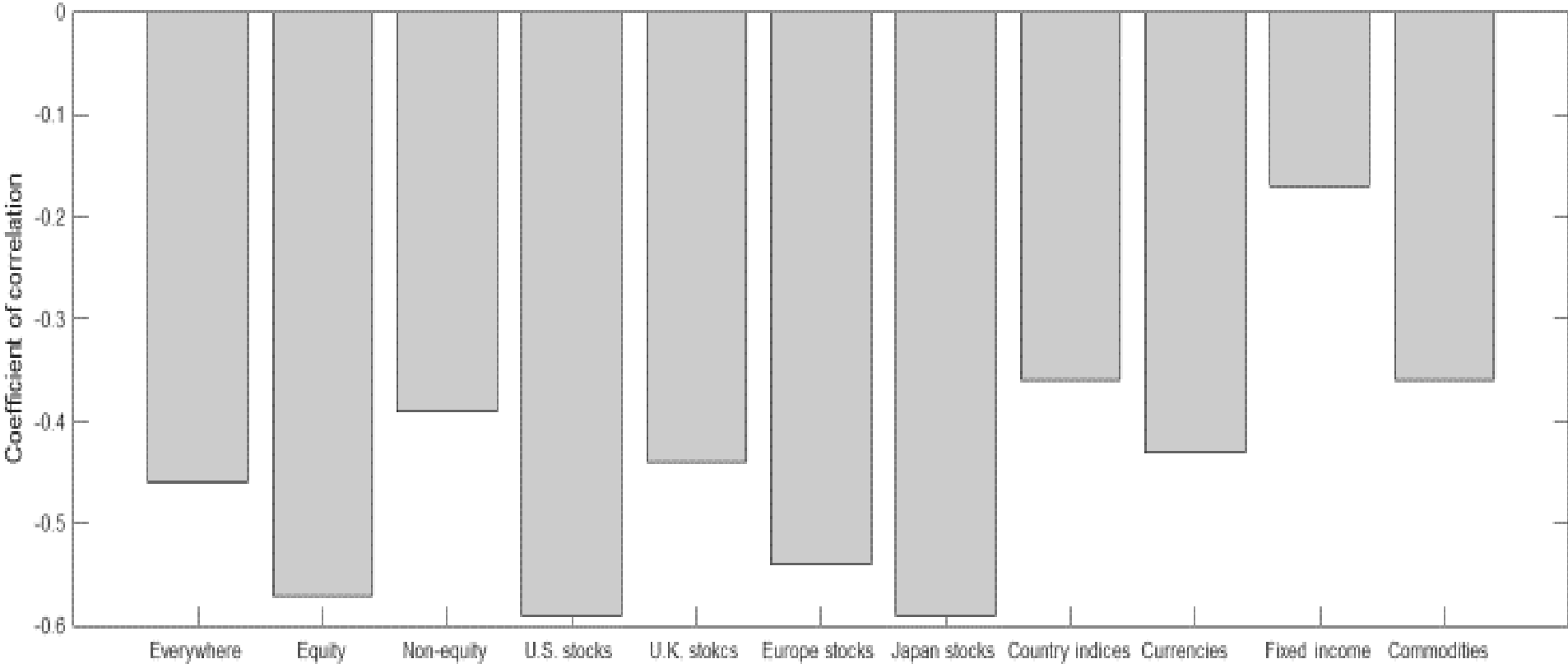
Overview of Talk

1. Facts: value and momentum across markets and across asset classes
2. What we do and why it is interesting
3. Main results
4. Robustness checks

Empirical Facts: performance of value and momentum strategies across markets and across asset classes (Asness, Moskowitz, and Pedersen, 2013)



Empirical Facts: value and momentum premia negatively correlated (Asness, Moskowitz, and Pedersen, 2013)



Main results of Asness, Moskowitz, and Pedersen (2013)

- Various macroeconomic risk factors are not able to explain these return premia.
- Liquidity risk partially explains the value and momentum premia, but not the returns on the combination strategy.
- Propose global characteristic-based factors to explain.

What we do

We propose a version of Ross's (1976) Arbitrage Pricing Theory based on a global representation of the Chen, Roll, and Ross's (1986) macroeconomic risk factors:

$$r_{i,t} = \alpha_i + \beta_{i,MP}MP_t + \beta_{i,UI}UI_t + \beta_{i,DEI}DEI_t + \beta_{i,UTS}UTS_t + \beta_{i,URP}UPR_t + \varepsilon_{i,t}$$

- $r_{i,t}$ - return on asset i (or a long-short value or momentum return premium, or a combination of a value and momentum return premia)
- MP_t - industrial production growth
- UI_t - unexpected inflation
- DEI_t - change in expected inflation
- UTS_t - term spread
- UPR_t - default spread

What We Do

This leads to the following no-arbitrage condition:

$$E(r_{i,t} - r_{f,t}) = \beta_{i,MP}E(r_{MP}) + \beta_{i,UI}E(r_{UI}) + \beta_{i,DEI}E(r_{DEI}) + \beta_{i,UTS}E(r_{UTS}) + \beta_{i,URP}E(r_{URP})$$

where $E(r_{MP})$, $E(r_{UI})$, $E(r_{DEI})$, $E(r_{UTS})$, and $E(r_{URP})$ are the expected returns on the mimicking portfolios for *MP*, *UI*, *DEI*, *UTS*, and *URP*, respectively.

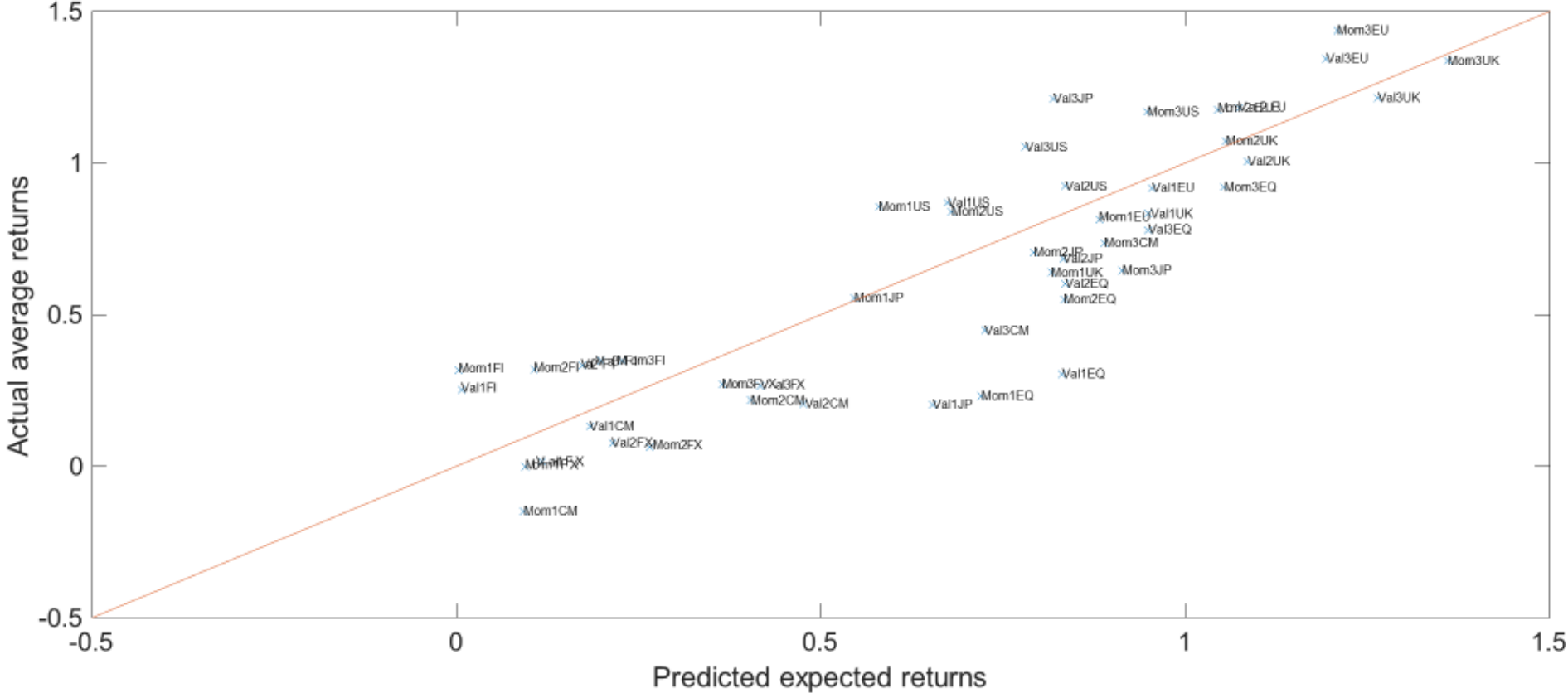
Why It Is Interesting

- Common factor structure across markets and across asset classes
- Economic explanation - global macroeconomic risk - global business cycle
- Differing loadings with respect to the global macroeconomic factors - explain the negative correlation of value and momentum premia
- Asset pricing integration across asset classes and across markets

Tests of Global Integration Across Markets and Across Asset Classes

Model	Global Tangency			Global CRR			Local CRR		
	a	GRS	p(GRS)	a	GRS	p(GRS)	a	GRS	p(GRS)
U.S. stocks	0.20	0.59	0.74	0.20	1.15	0.33	0.19	1.10	0.36
U.K. stocks	0.06	0.32	0.93	0.08	0.40	0.88	0.07	0.45	0.84
Europe stocks	0.14	1.09	0.37	0.12	1.28	0.26	0.13	1.33	0.24
Japan stocks	0.23	2.60	0.02	0.23	3.13	0.01	0.22	2.97	0.01
Country indices	0.31	2.13	0.05	0.31	3.17	0.00			
Currencies	0.11	0.86	0.53	0.13	0.89	0.51			
Fixed income	0.21	2.08	0.05	0.20	2.71	0.01			
Commodities	0.19	0.42	0.86	0.20	0.37	0.90			

Main Results - realized returns vs. expected returns



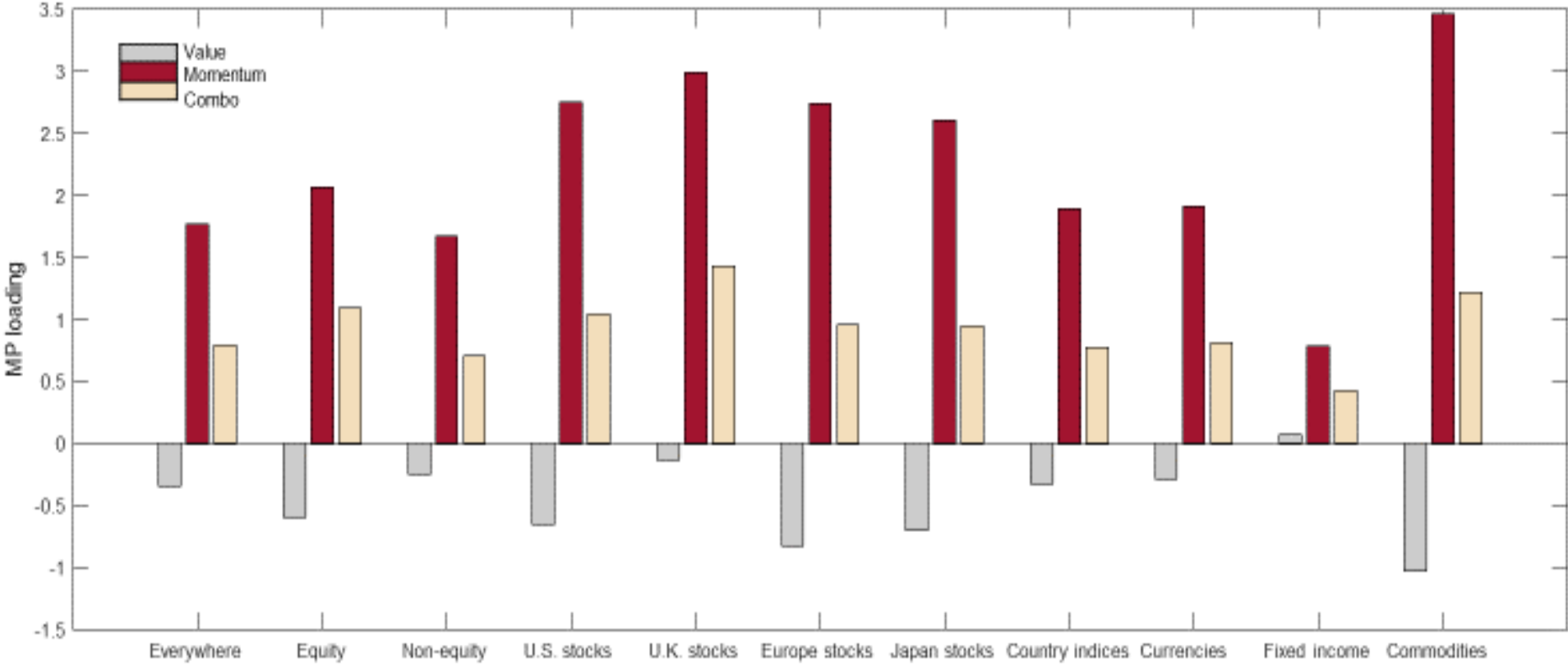
Main Results - Summary statistics of model performance

Model	GRS	p(GRS)	HJ	Diff HJ ²	$A a_i $	$A a_i / A \bar{r}_i $	$A a_i^2 / A \bar{r}_i^2$	$A s^2(a_i) / A a_i^2$	AR^2
Global CAPM	3.99	0.000	0.816	0.1980	0.2453	0.57	0.33	0.50	0.39
AMP	3.99	0.000	0.750	0.0946	0.1848	0.43	0.21	0.85	0.43
Global CRR	2.82	0.000	0.684		0.1824	0.43	0.18	1.06	0.44

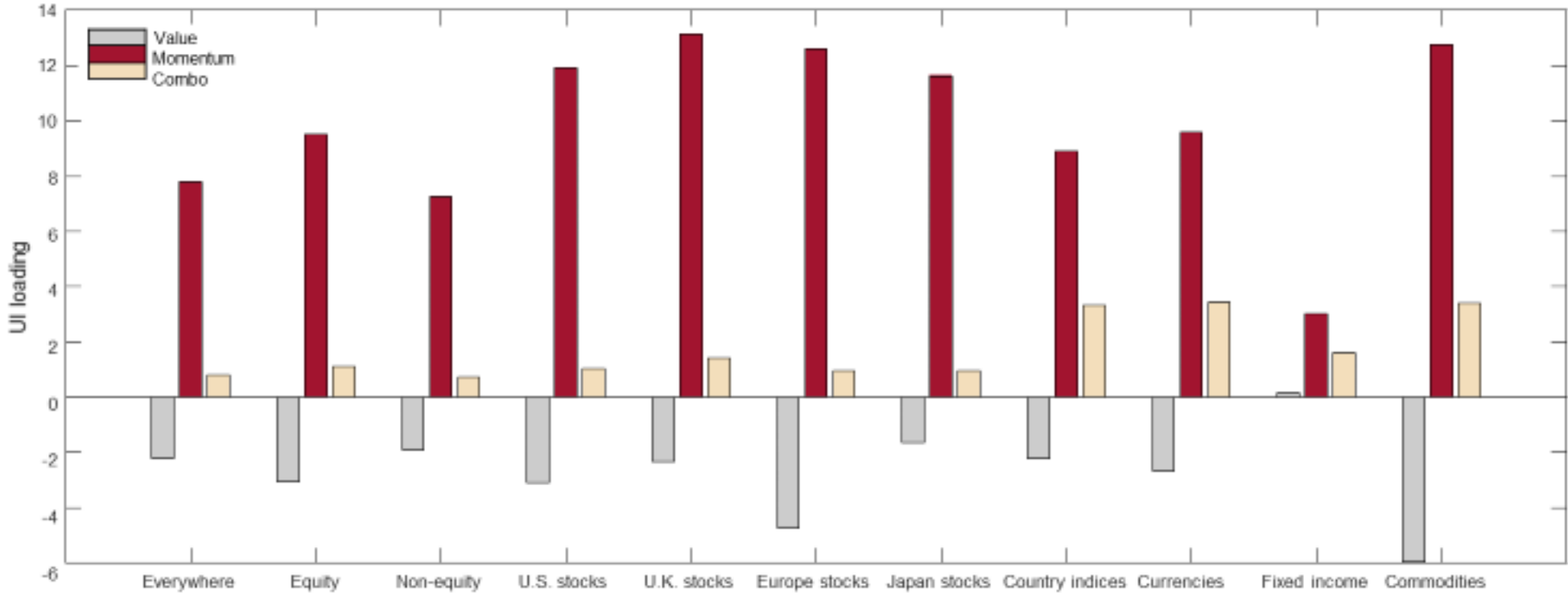
Factor Regressions - Barillas and Shanken (2017)

Factors	MSCI global alphas	Global value and momentum alphas	Global CRR alphas
MSCI global			-0.00 (-0.03)
Global value			0.01 (1.16)
Global momentum			0.01 (0.99)
Global value and momentum			0.01 p(GRS)=0.97 GRS=0.001
MP	-0.06 (-0.62)	0.18 (1.76)	
UI	-0.06 (-1.56)	0.02 (0.52)	
DEI	0.21 (3.33)	-0.13 (-1.77)	
UTS	1.37 (5.09)	-0.09 (-0.40)	
UPR	0.51 (1.18)	0.57 (1.35)	
Global CRR	0.44 p(GRS)=0.00 GRS= 10.81	0.20 p(GRS)=0.00 GRS=1.64	

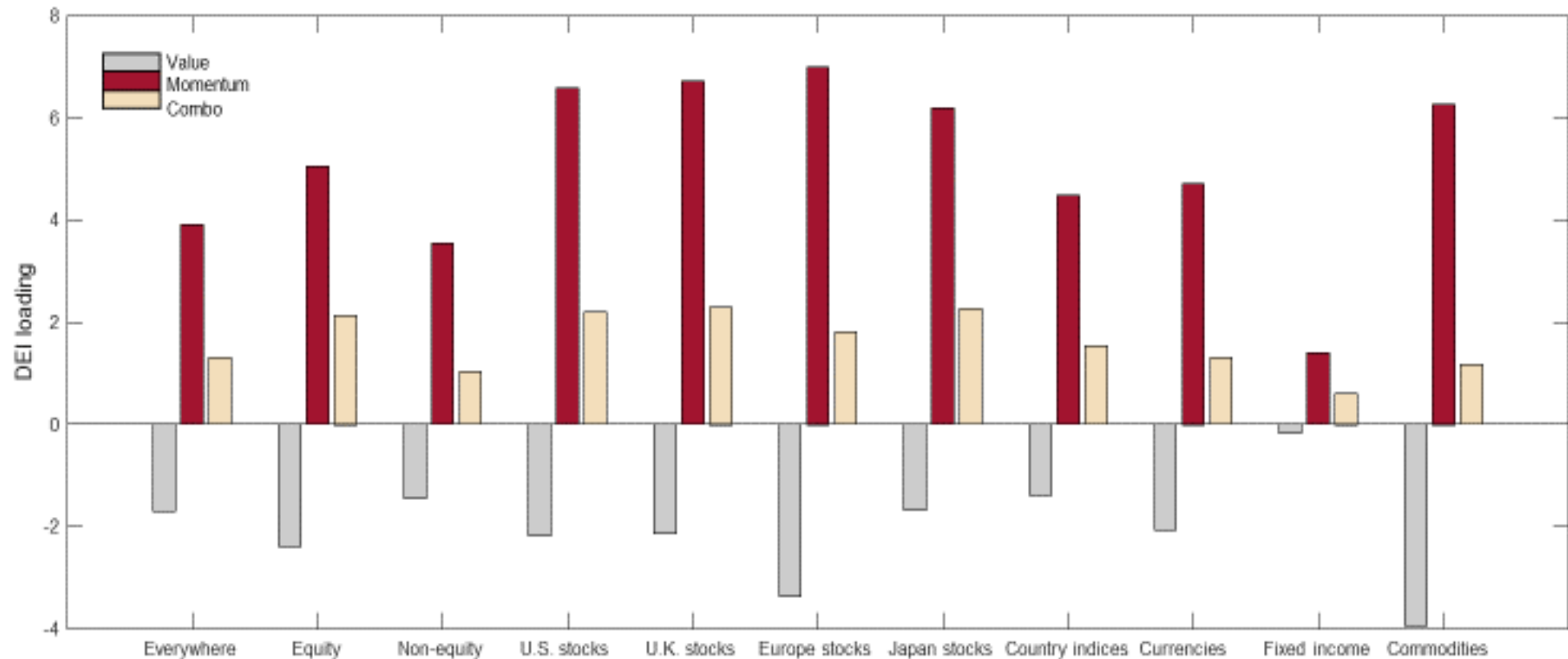
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Industrial production growth (MP)



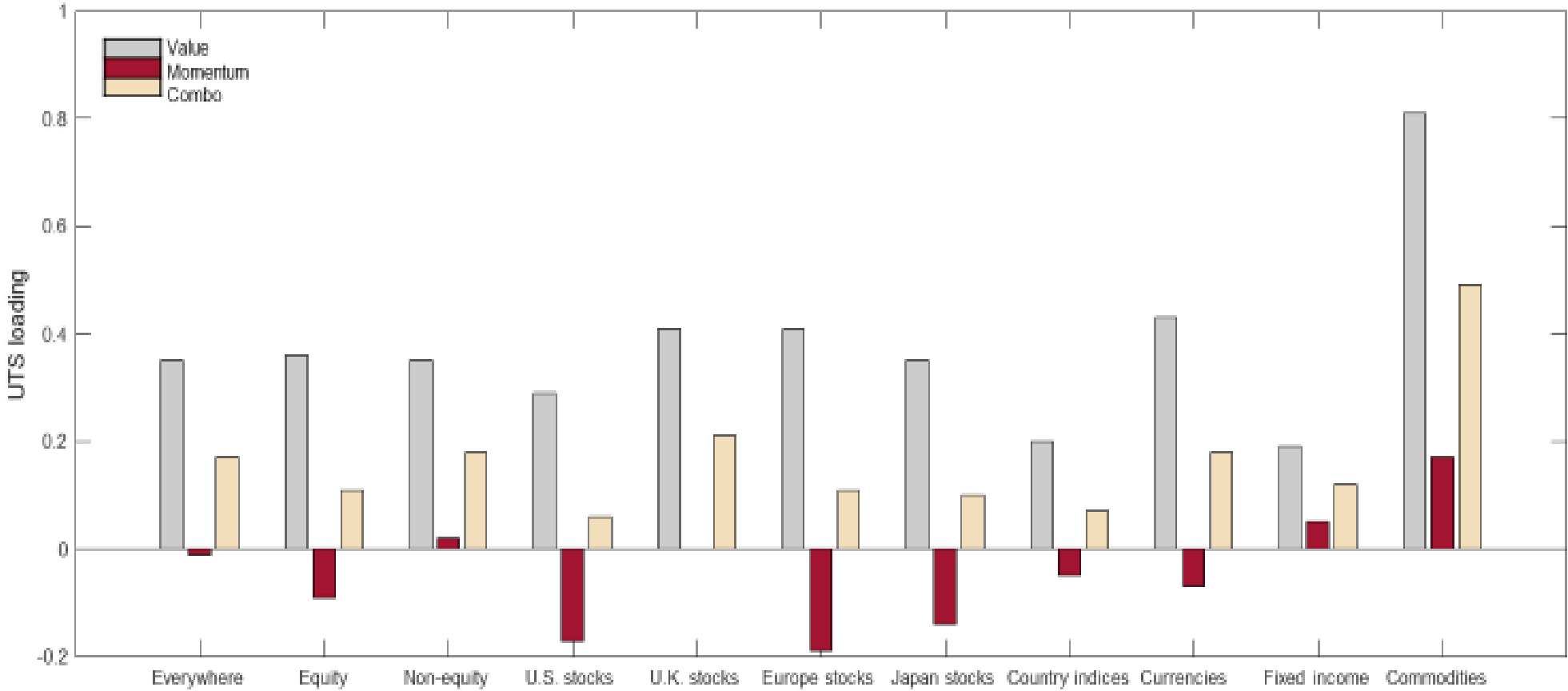
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Unexpected inflation (UI)



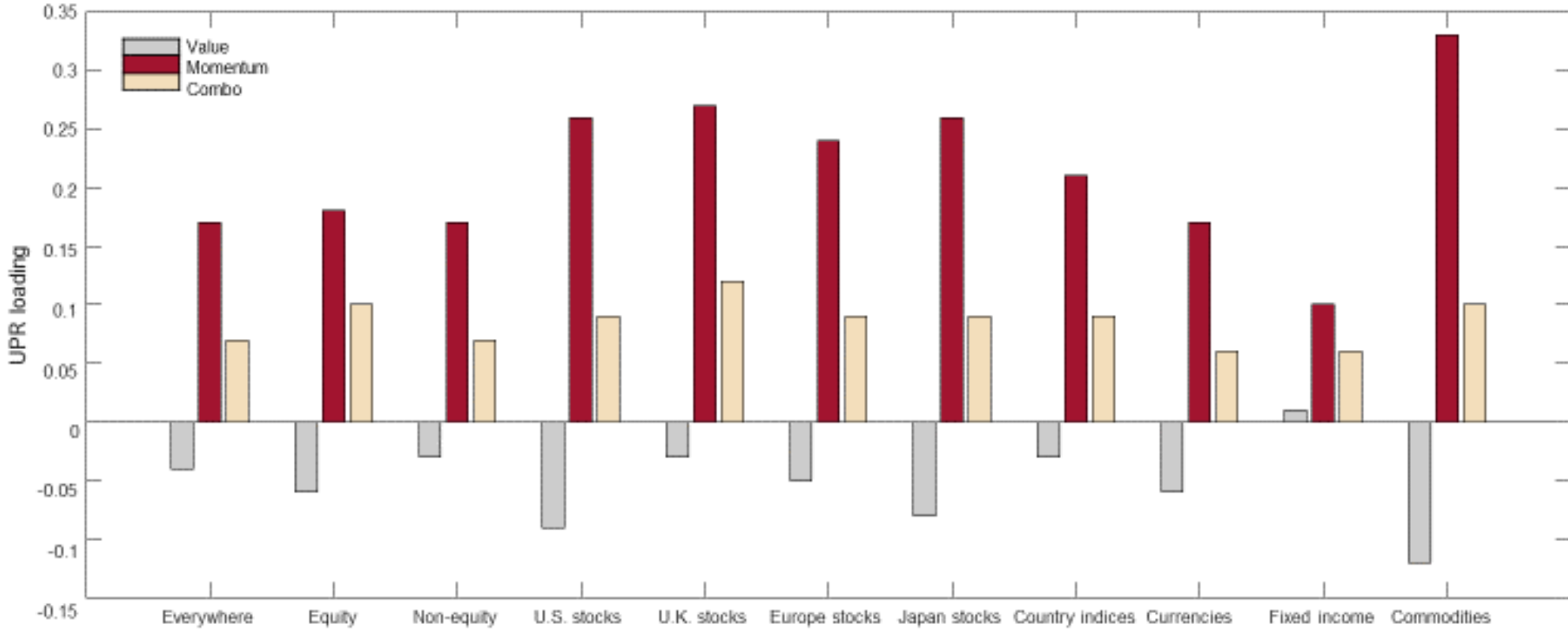
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Change in expected inflation (DEI)



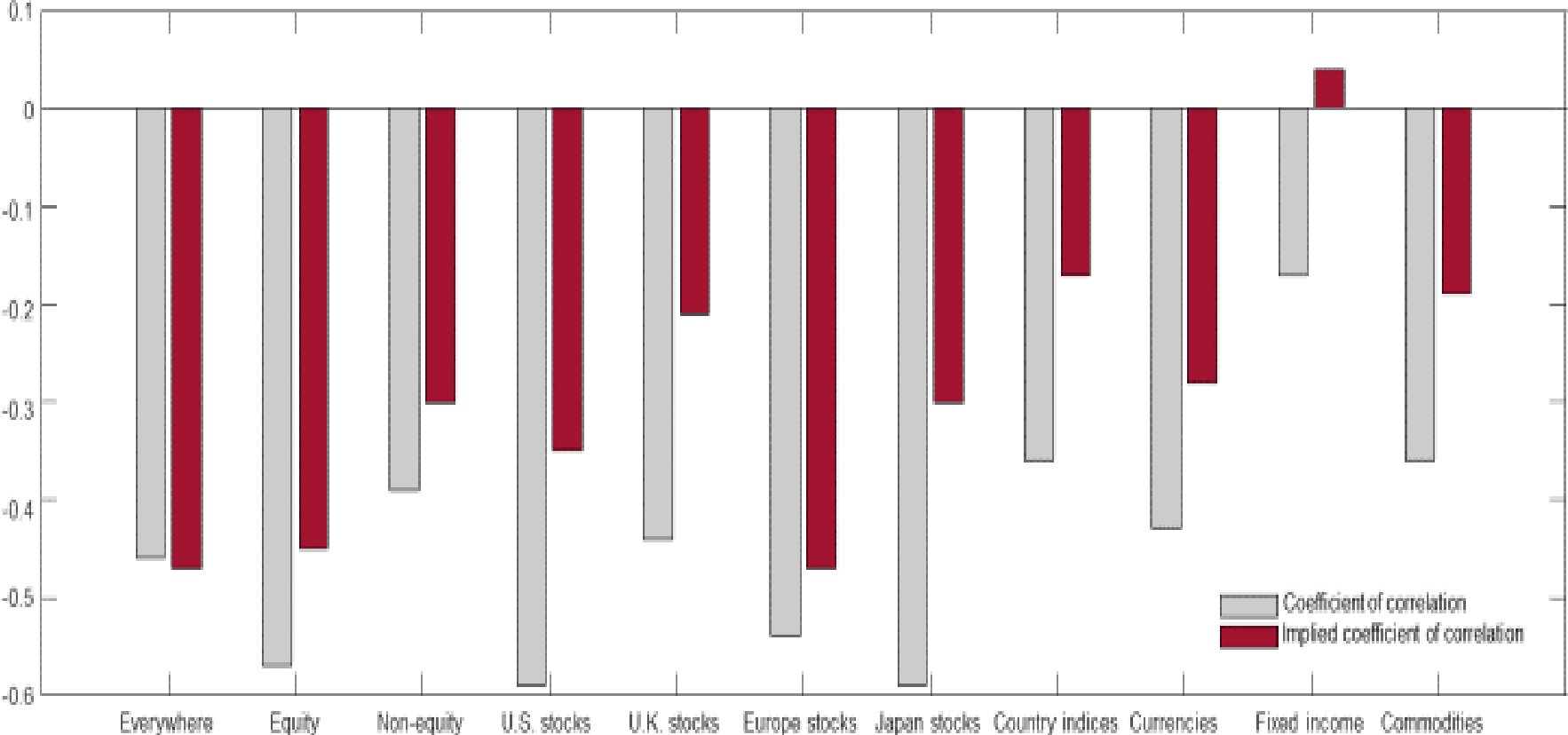
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Term spread (UTS)



Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Default spread (UPR)



Actual Correlation vs. Implied Correlation of Value and Momentum Premia



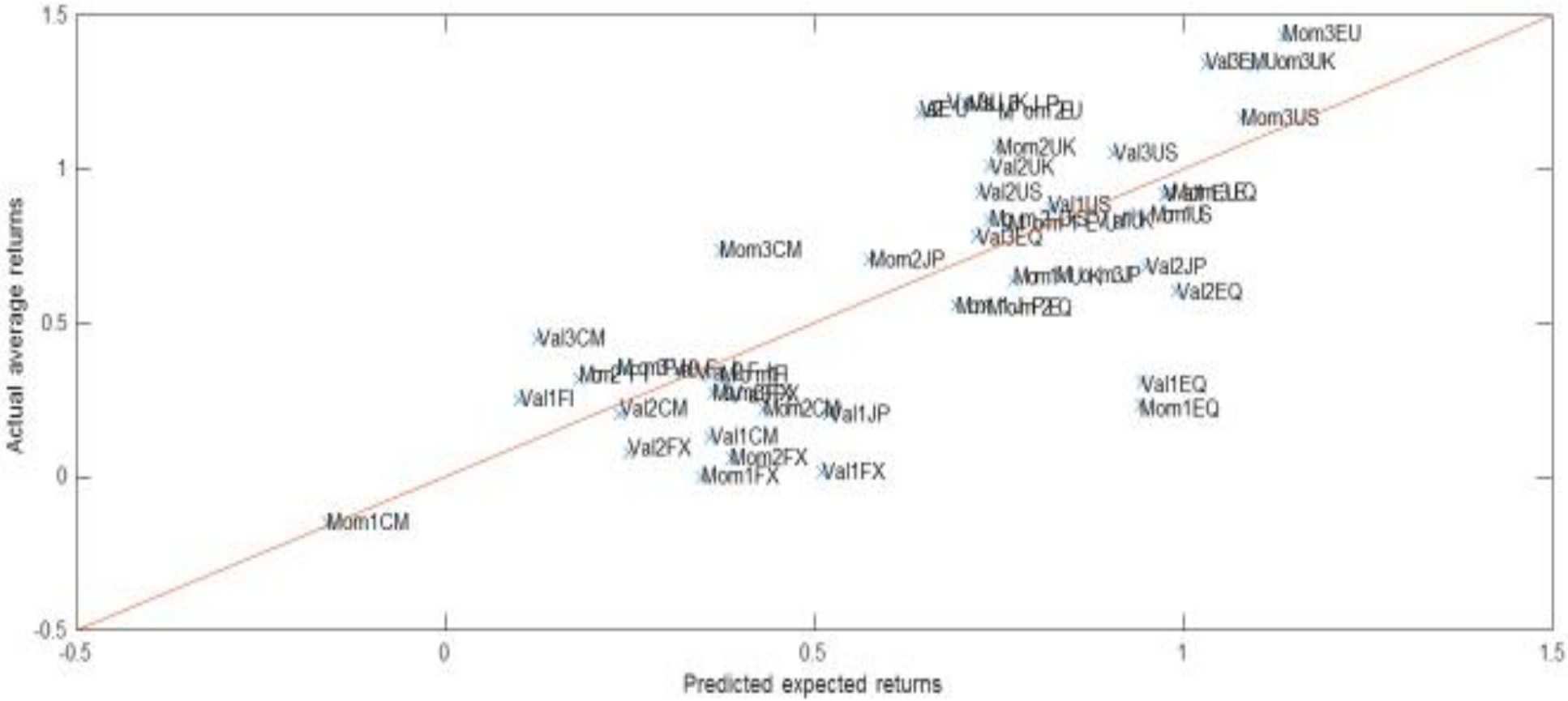
Robustness Checks - Good States and Bad States

Risk premium estimates from two-stage Fama and MacBeth (1973) cross-sectional regressions – 48 value and momentum portfolios

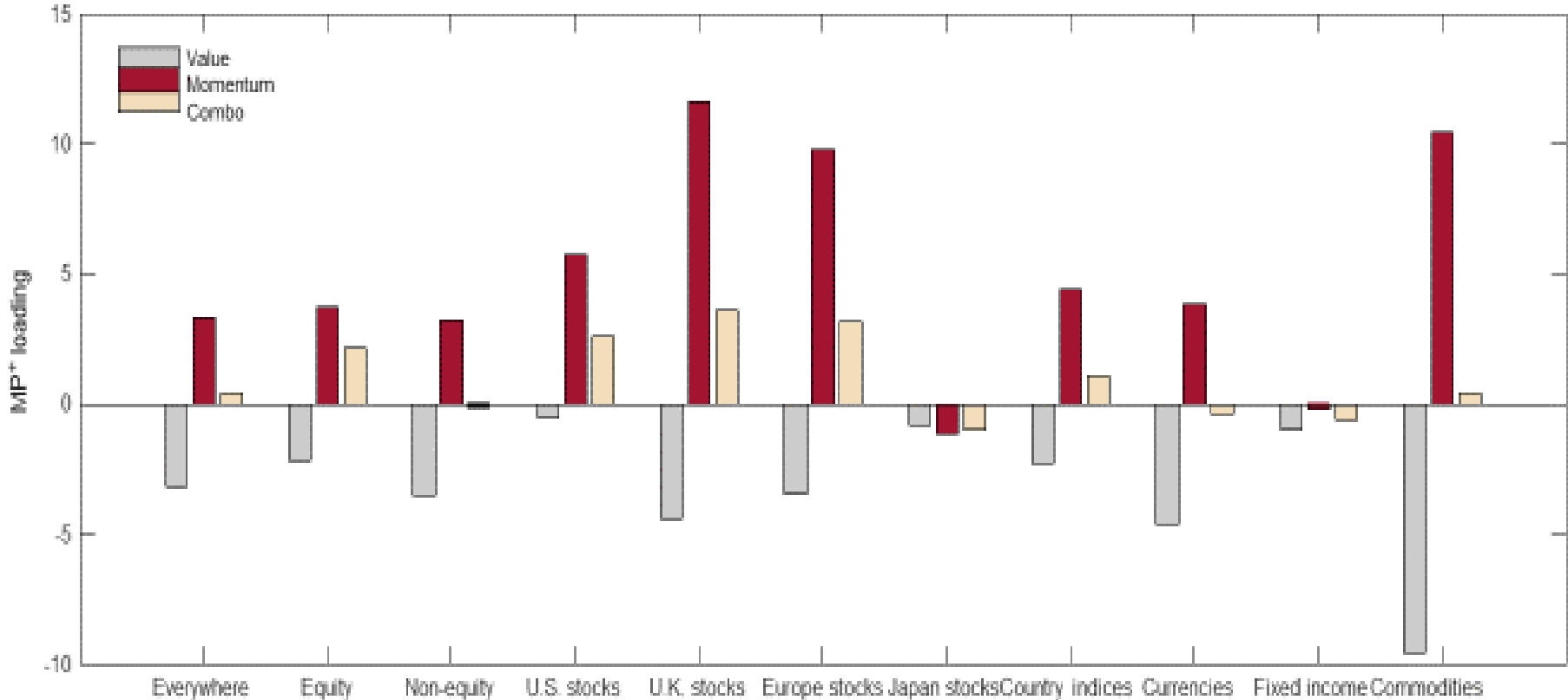
	$\hat{\gamma}_0$	$\hat{\gamma}_{MP+}$	$\hat{\gamma}_{UI+}$	$\hat{\gamma}_{DEI+}$	$\hat{\gamma}_{UTS+}$	$\hat{\gamma}_{UPR+}$	$\hat{\gamma}_{MP-}$	$\hat{\gamma}_{UI-}$	$\hat{\gamma}_{DEI-}$	$\hat{\gamma}_{UTS-}$	$\hat{\gamma}_{UPR-}$
$\hat{\gamma}$	0.21	-0.003	0.005	-0.001	-0.011	-0.10	0.03	0.001	-0.03	0.20	-0.05
	(2.87)	(-0.20)	(2.19)	(-1.16)	(-0.10)	(-3.34)	(1.44)	(0.32)	(-1.1)	(2.37)	(-0.47)
R^2	0.94										
$RMSE$	0.28										

Robustness Checks - Good States and Bad States

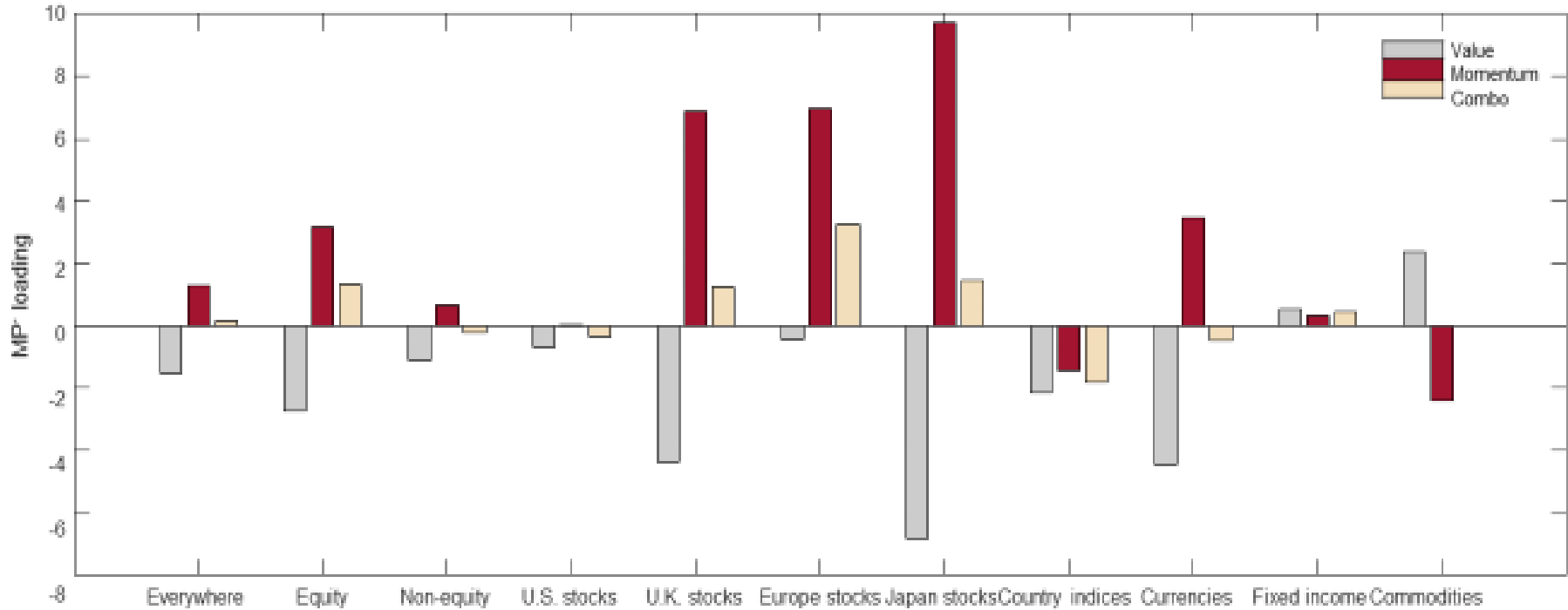
Pricing errors – 48 value and momentum portfolios



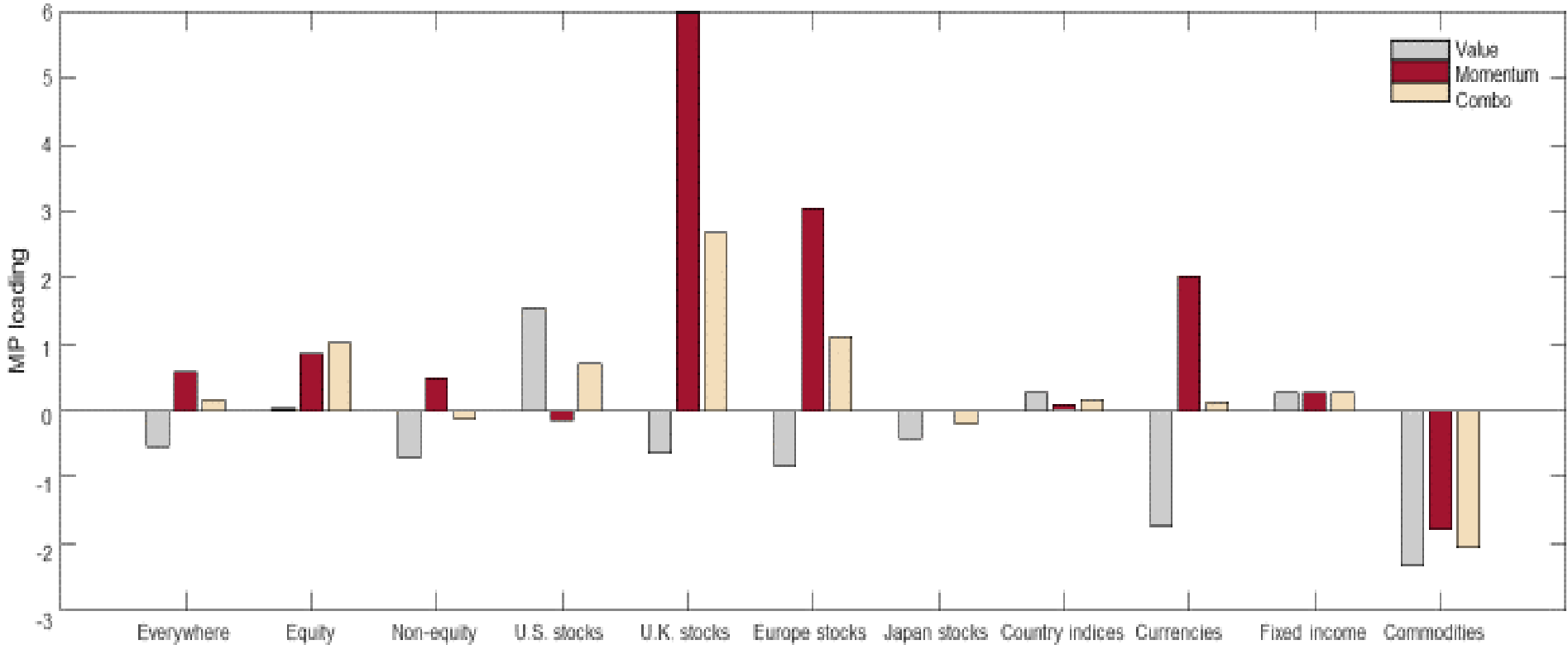
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Industrial production growth (MP) – Good states



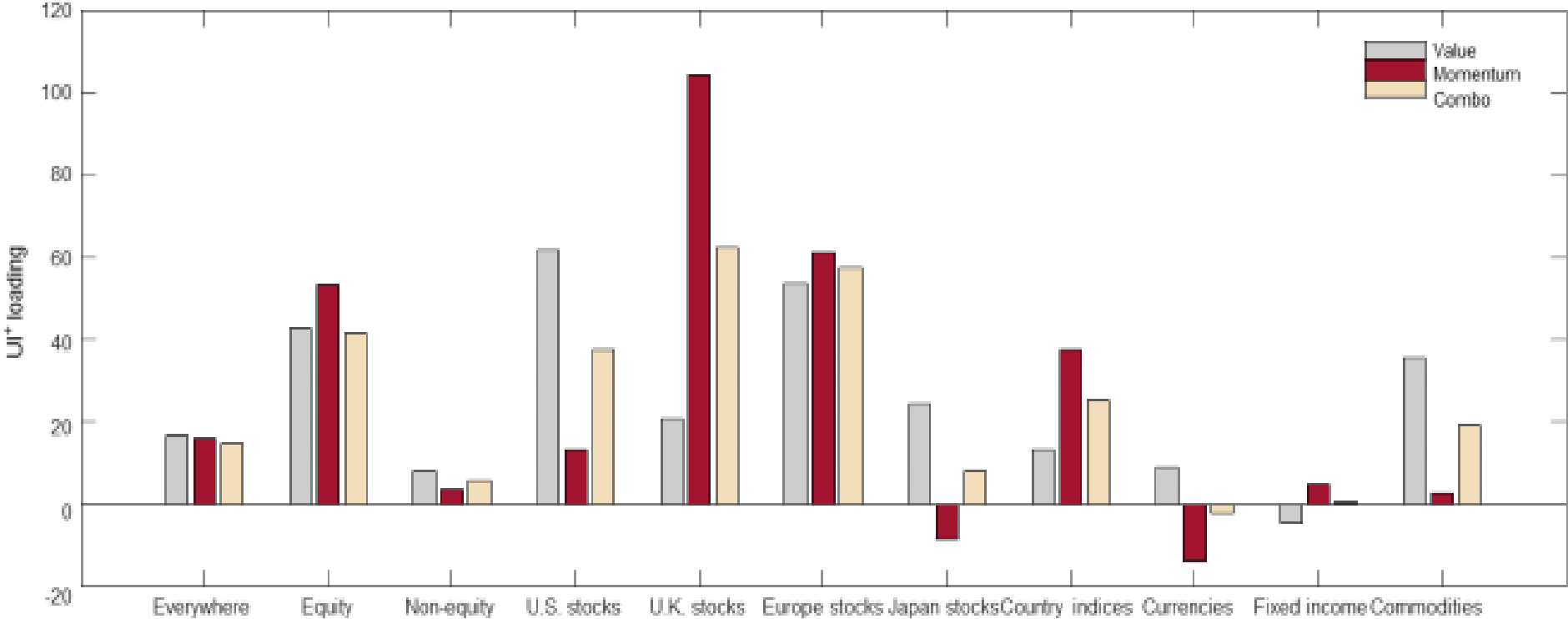
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Industrial production growth (MP) – Bad states



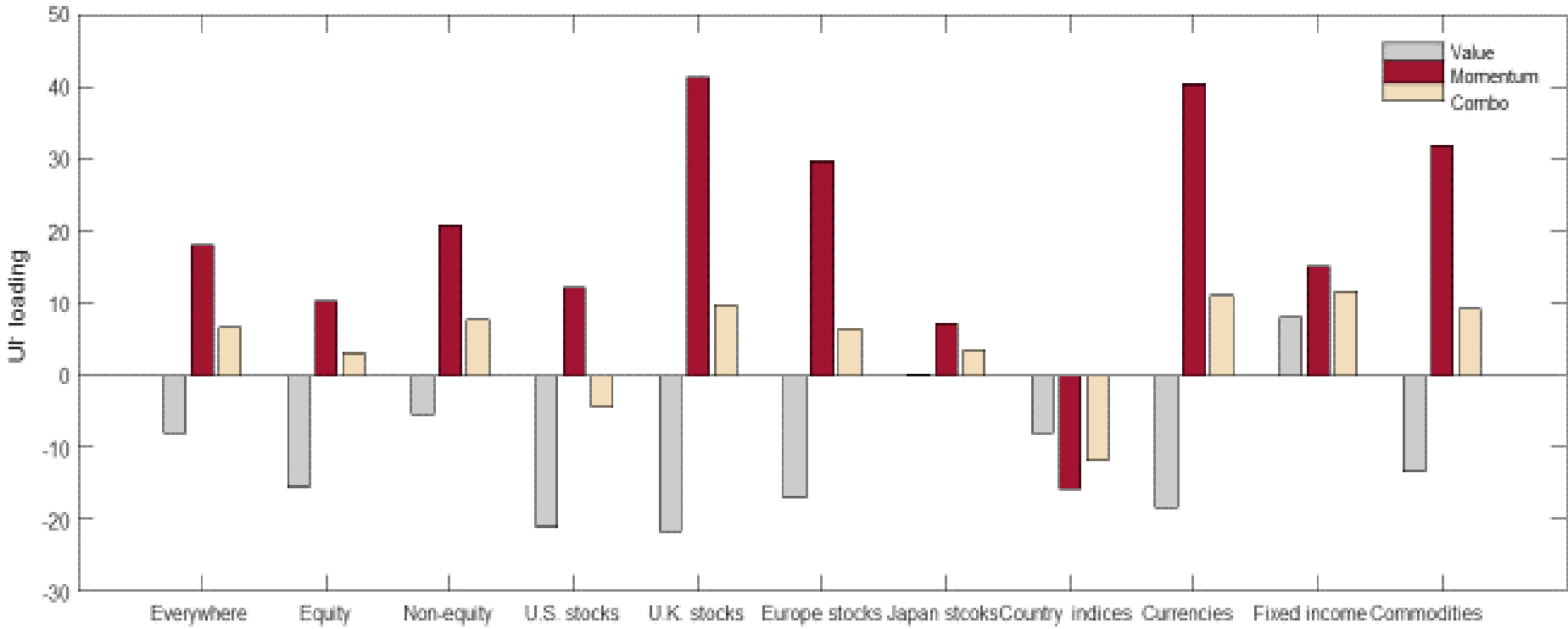
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Industrial production growth (MP) – Full sample



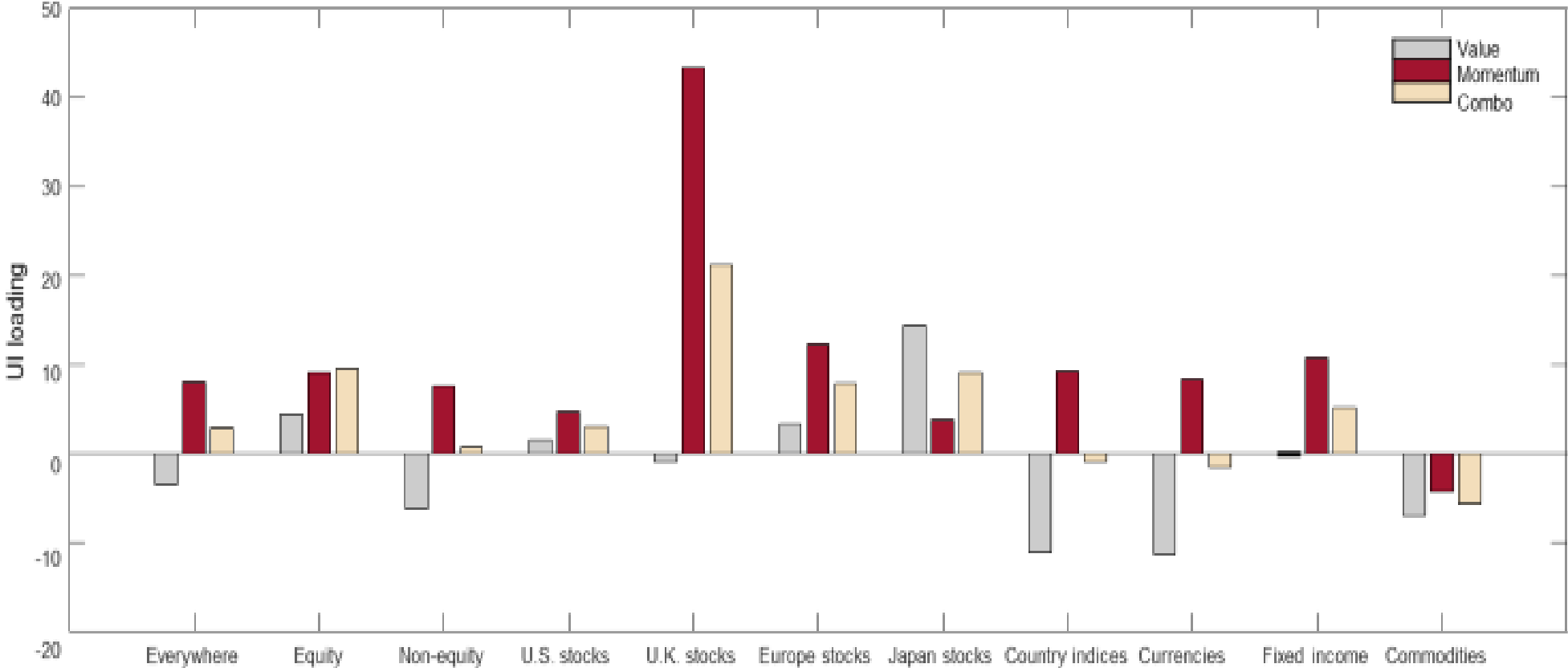
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Unexpected inflation (UI) – Good states



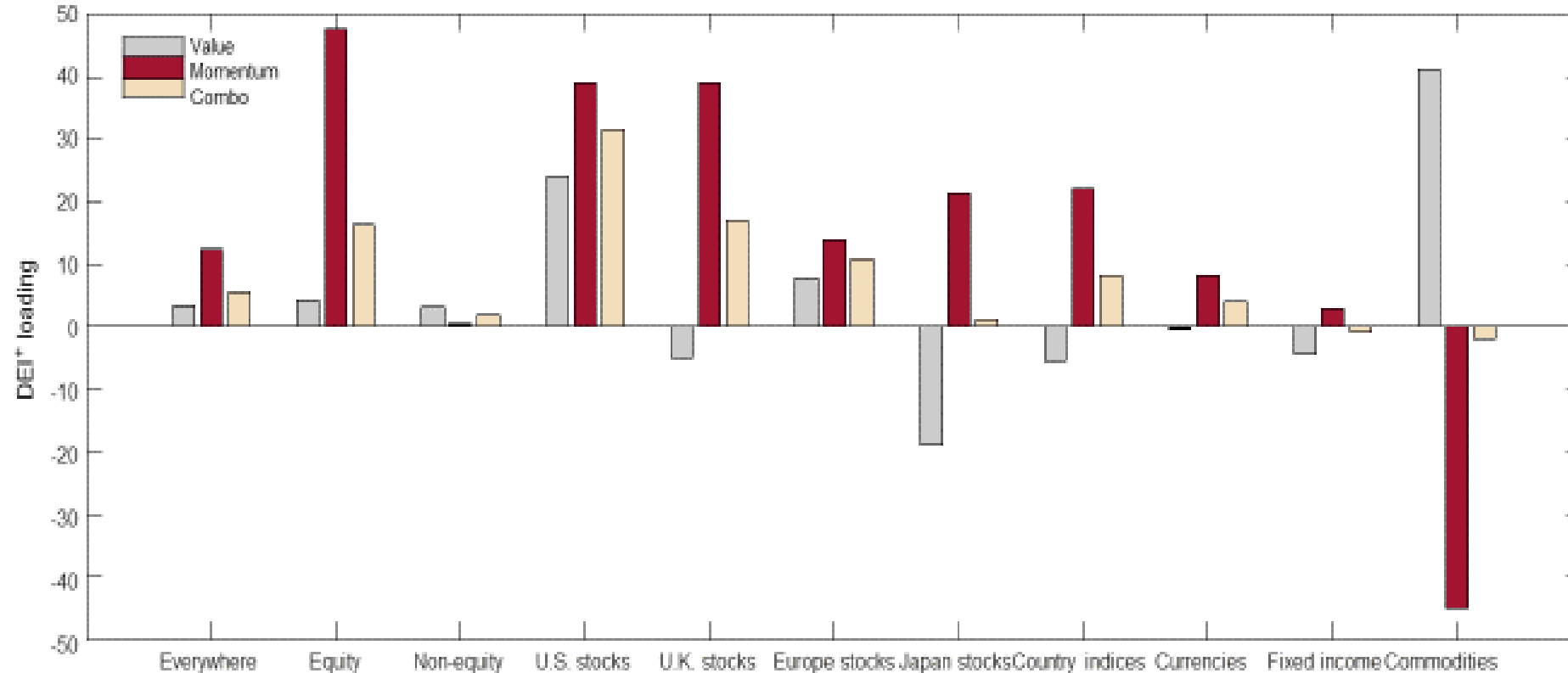
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Unexpected inflation (UI) – Bad states



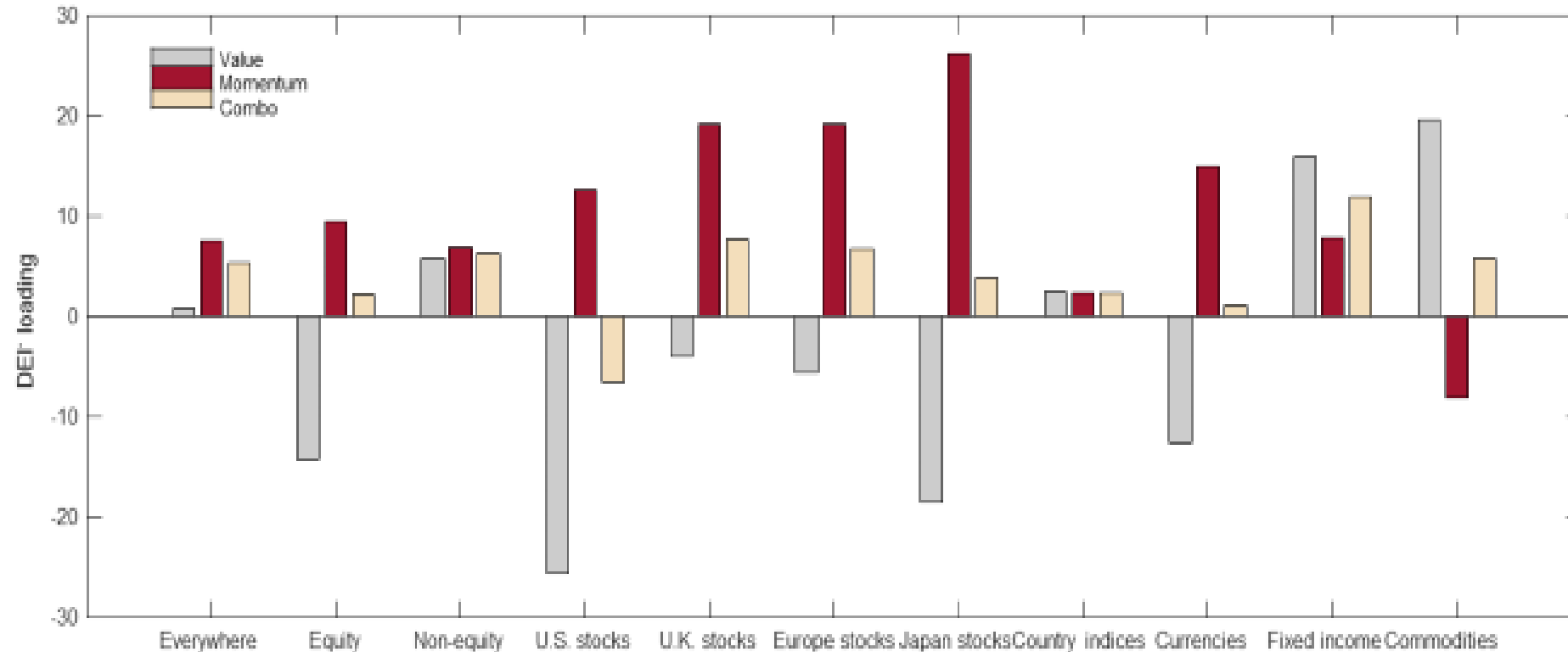
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Unexpected inflation (UI) – Full sample



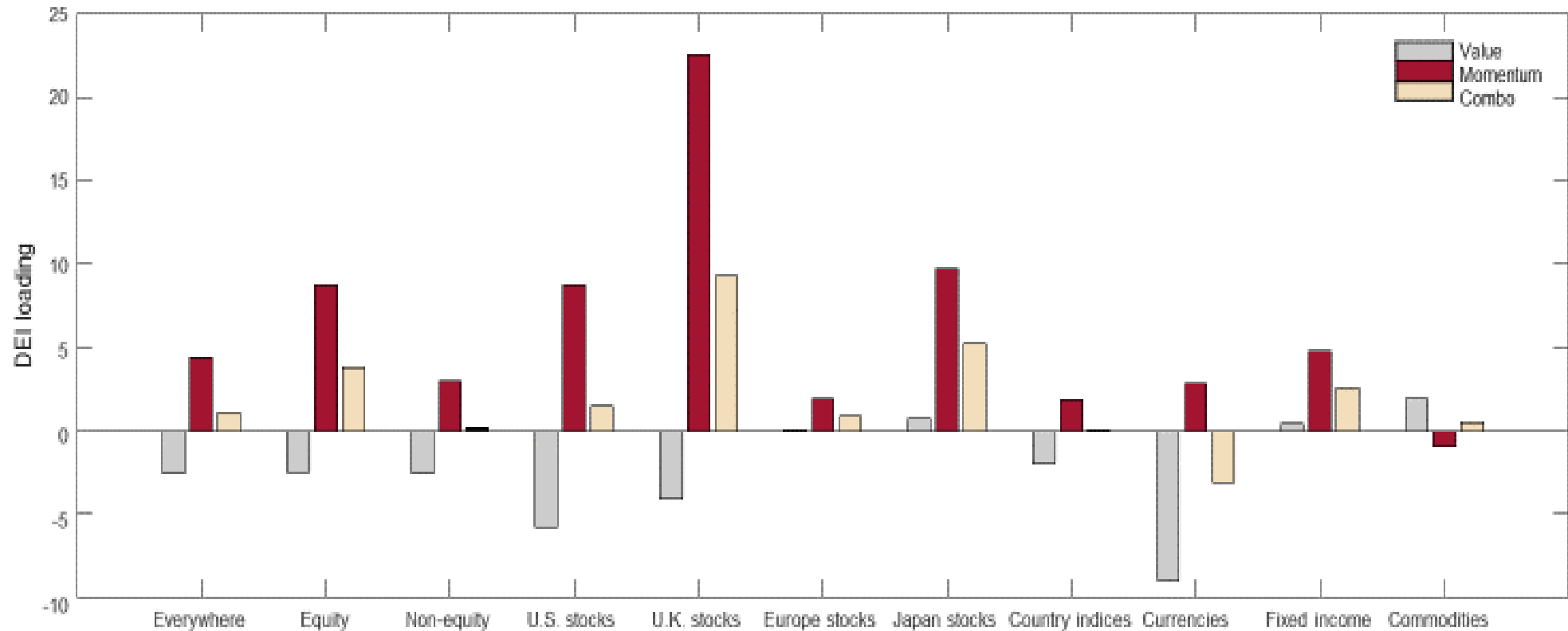
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Change in expected inflation (DEI) – Good states



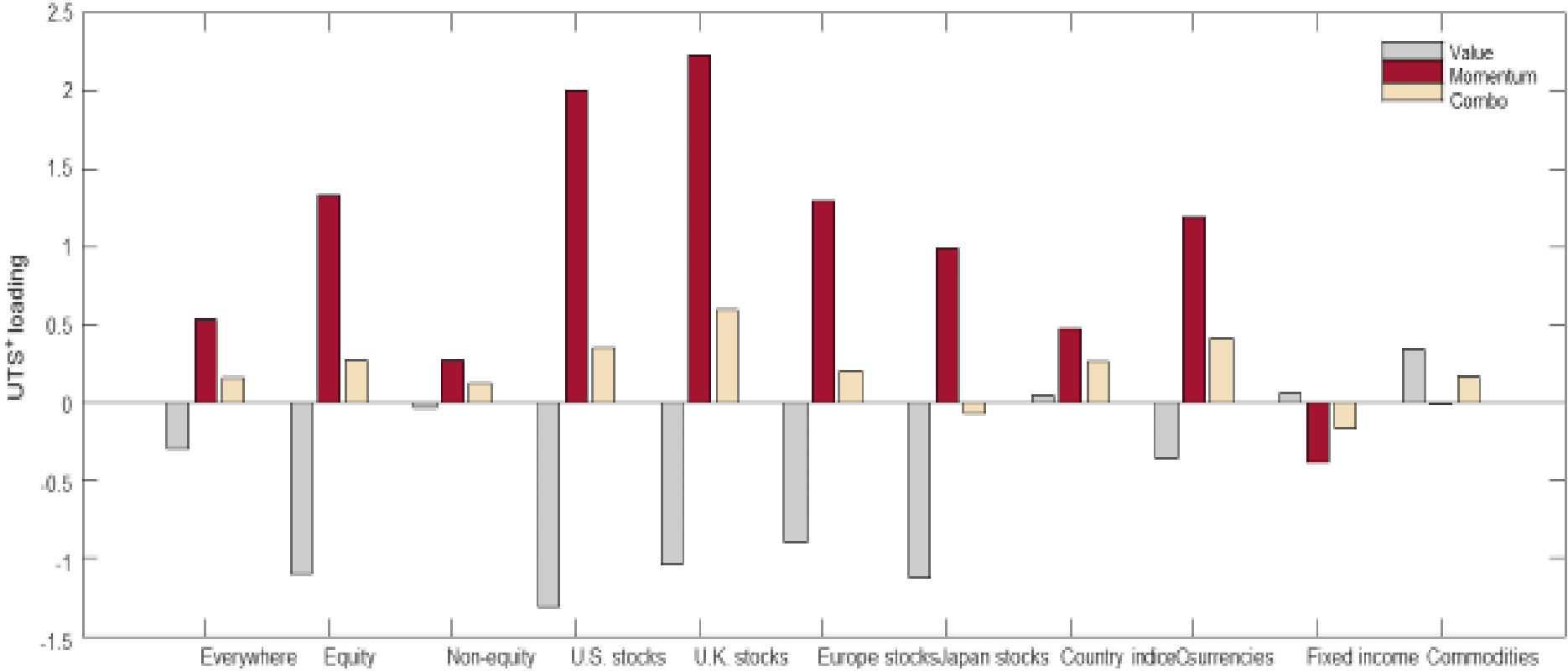
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Change in expected inflation (DEI) – Bad states



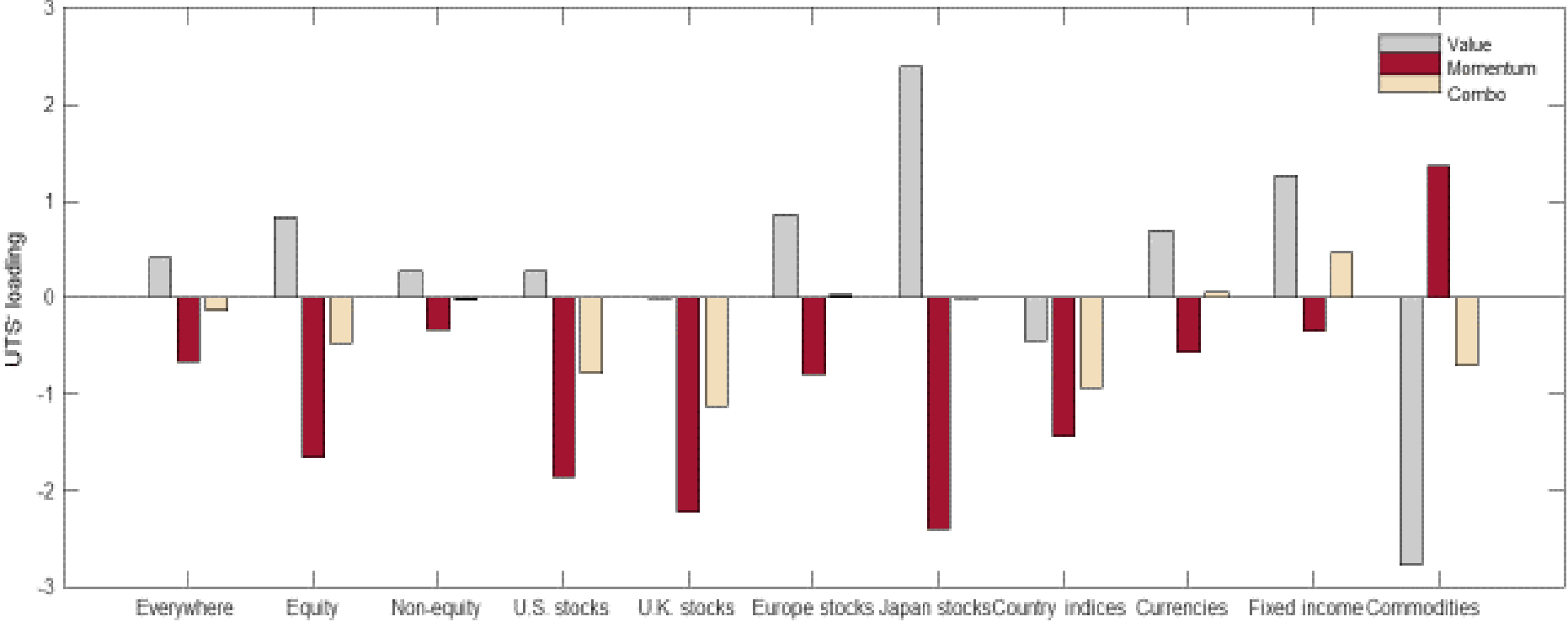
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Change in expected inflation (DEI) – Full sample



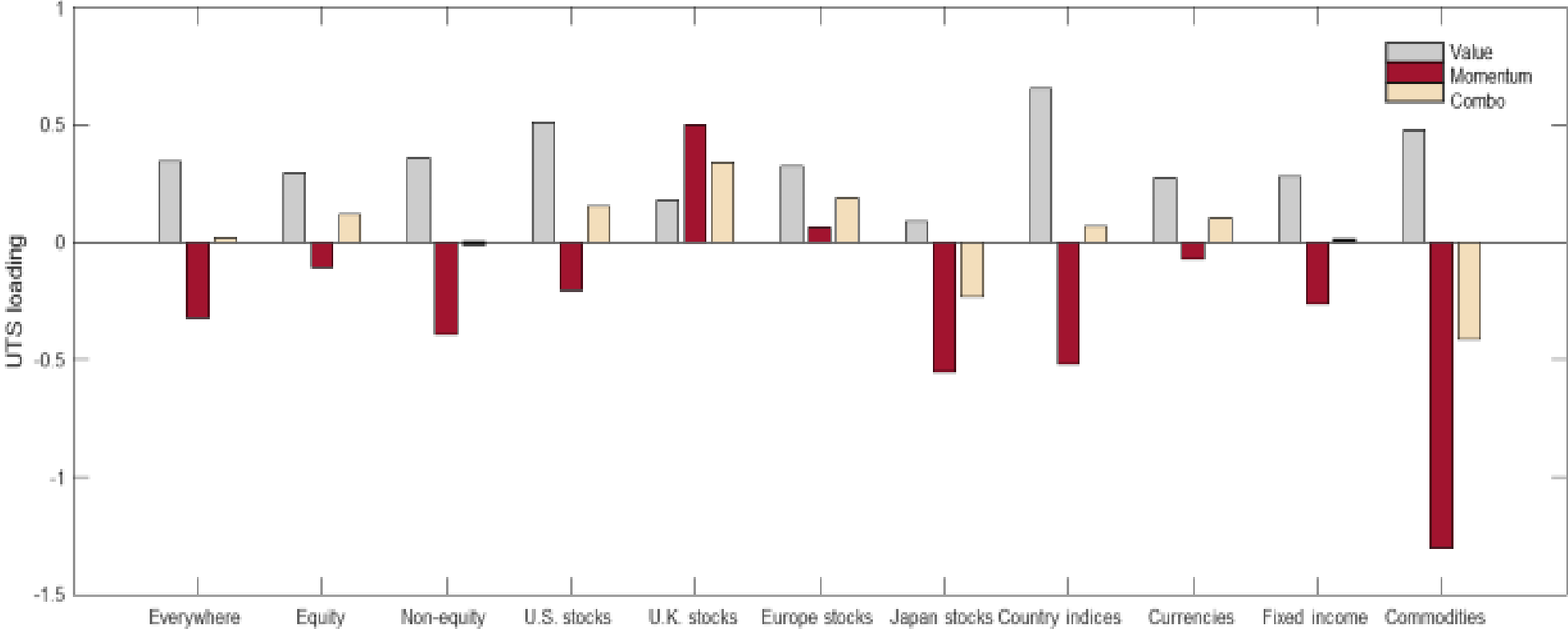
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Term spread (UTS) – Good states



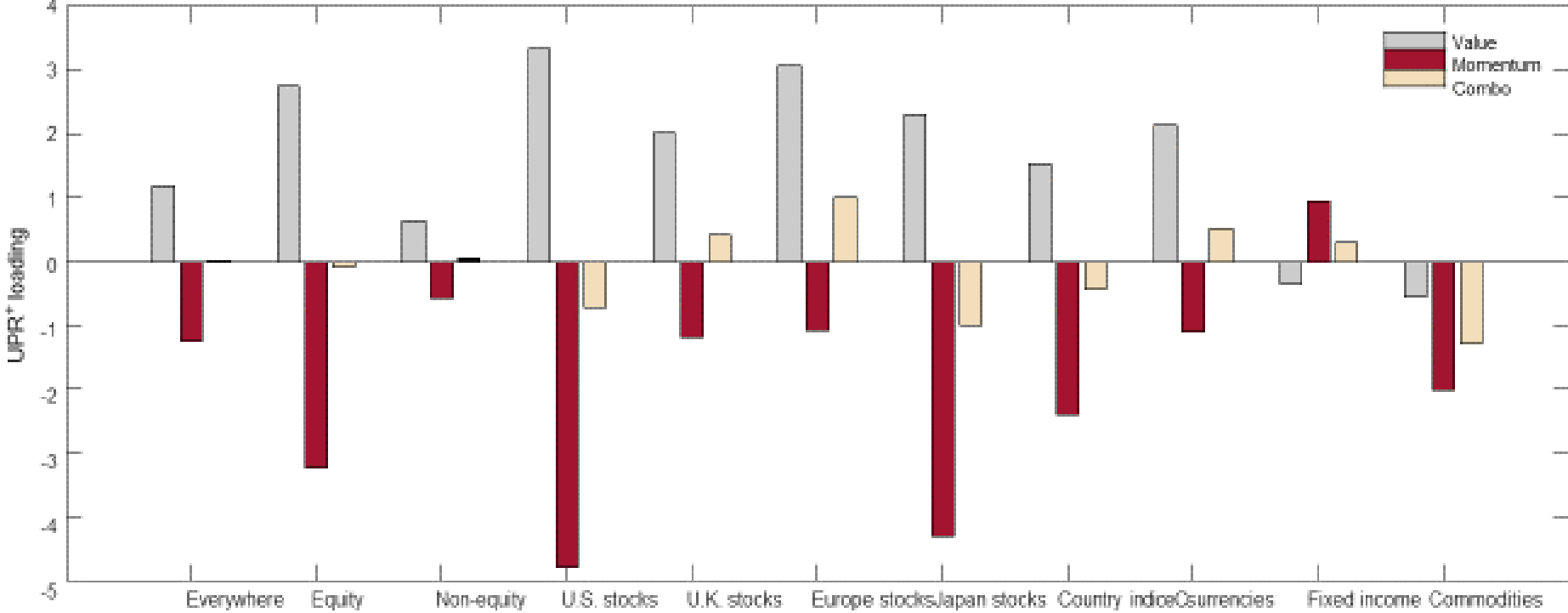
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Term spread (UTS) – Bad states



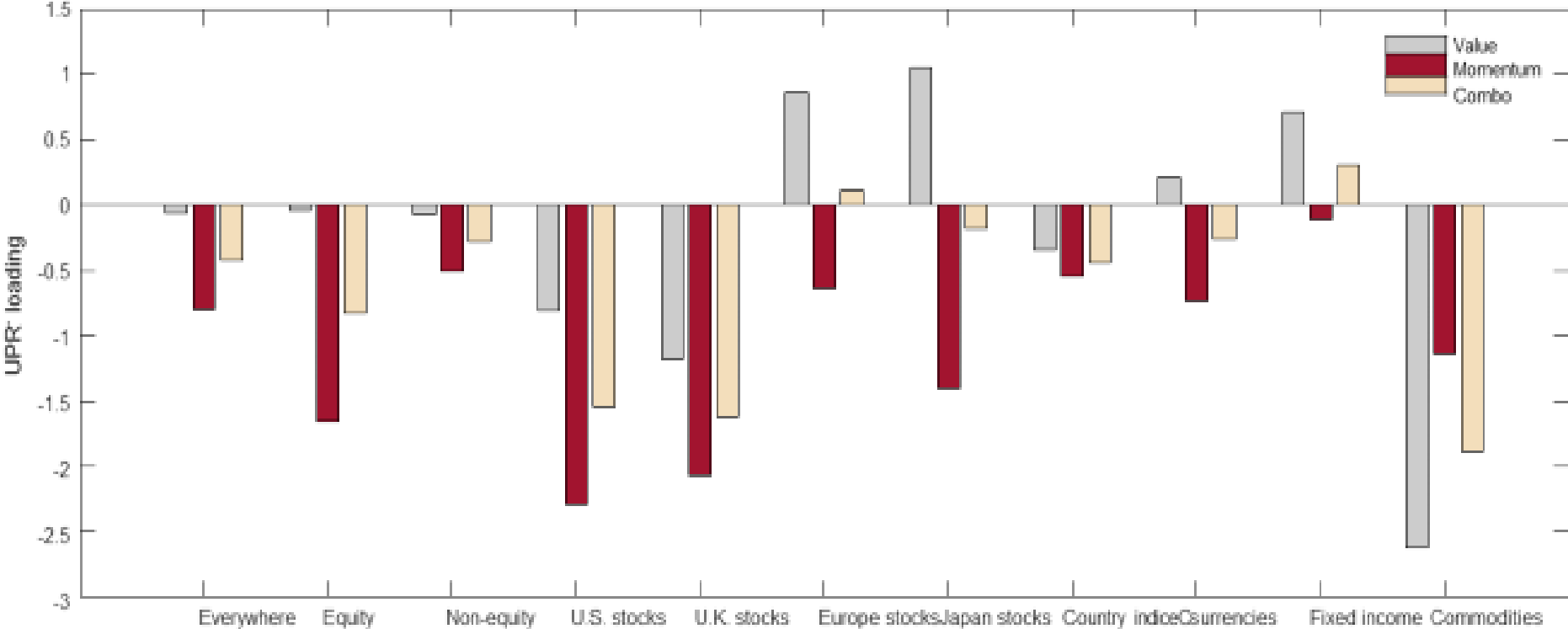
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Term spread (UTS) – Full sample



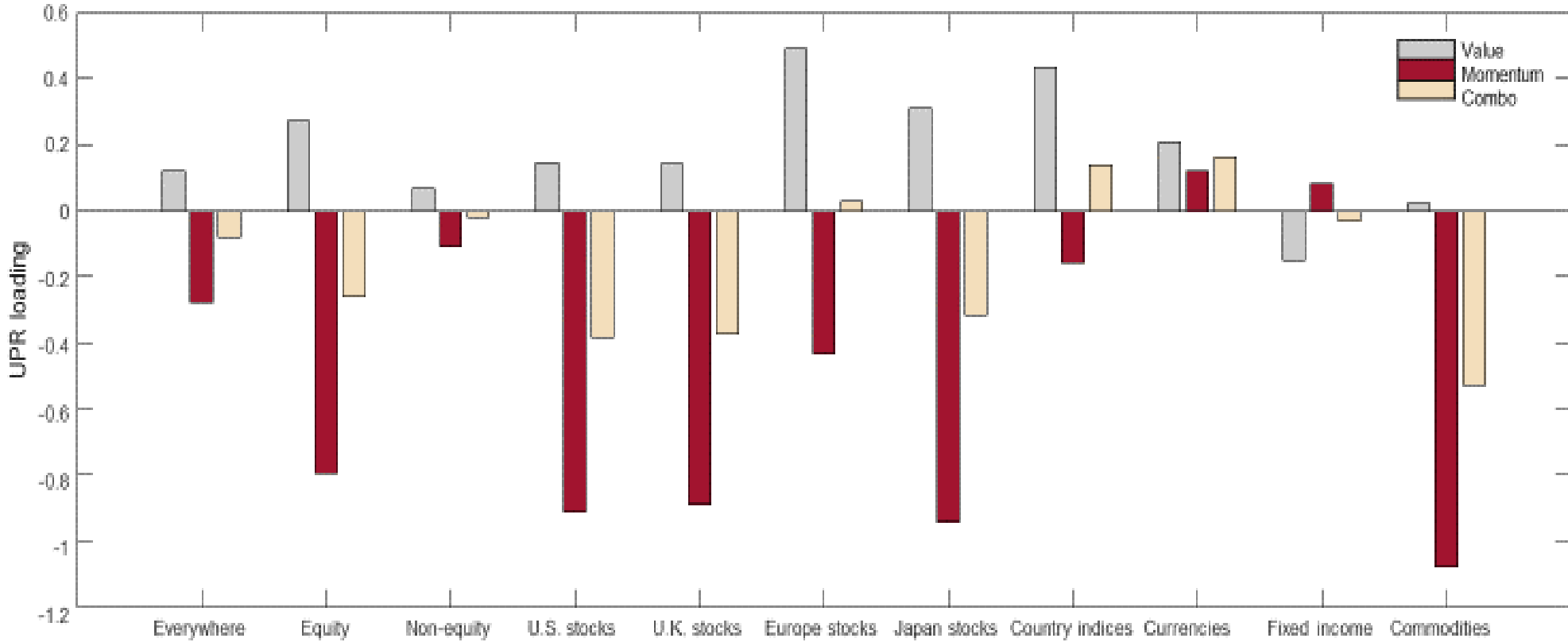
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Default spread (UPR) – Good states



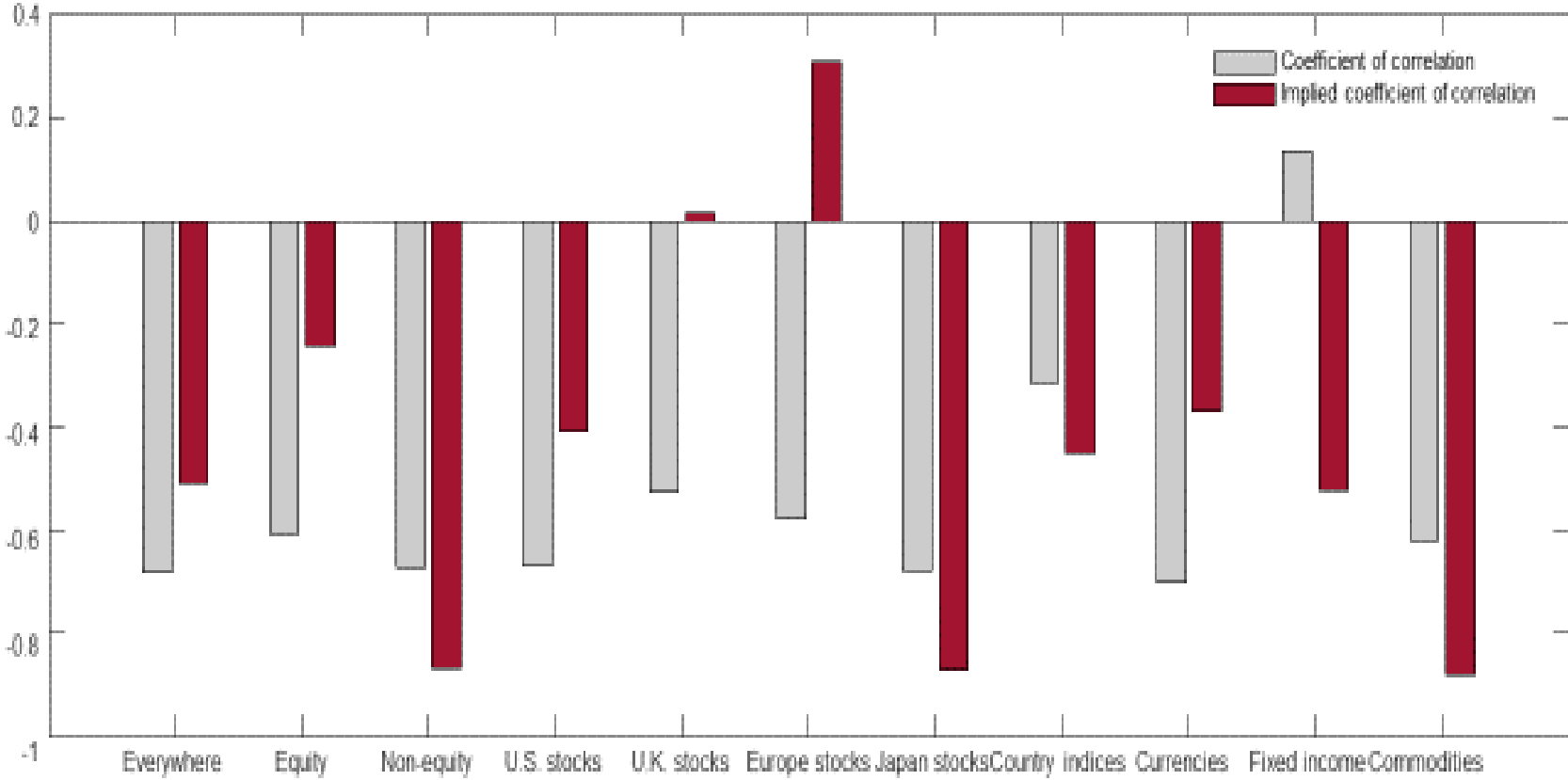
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Default spread (UPR) – Bad states



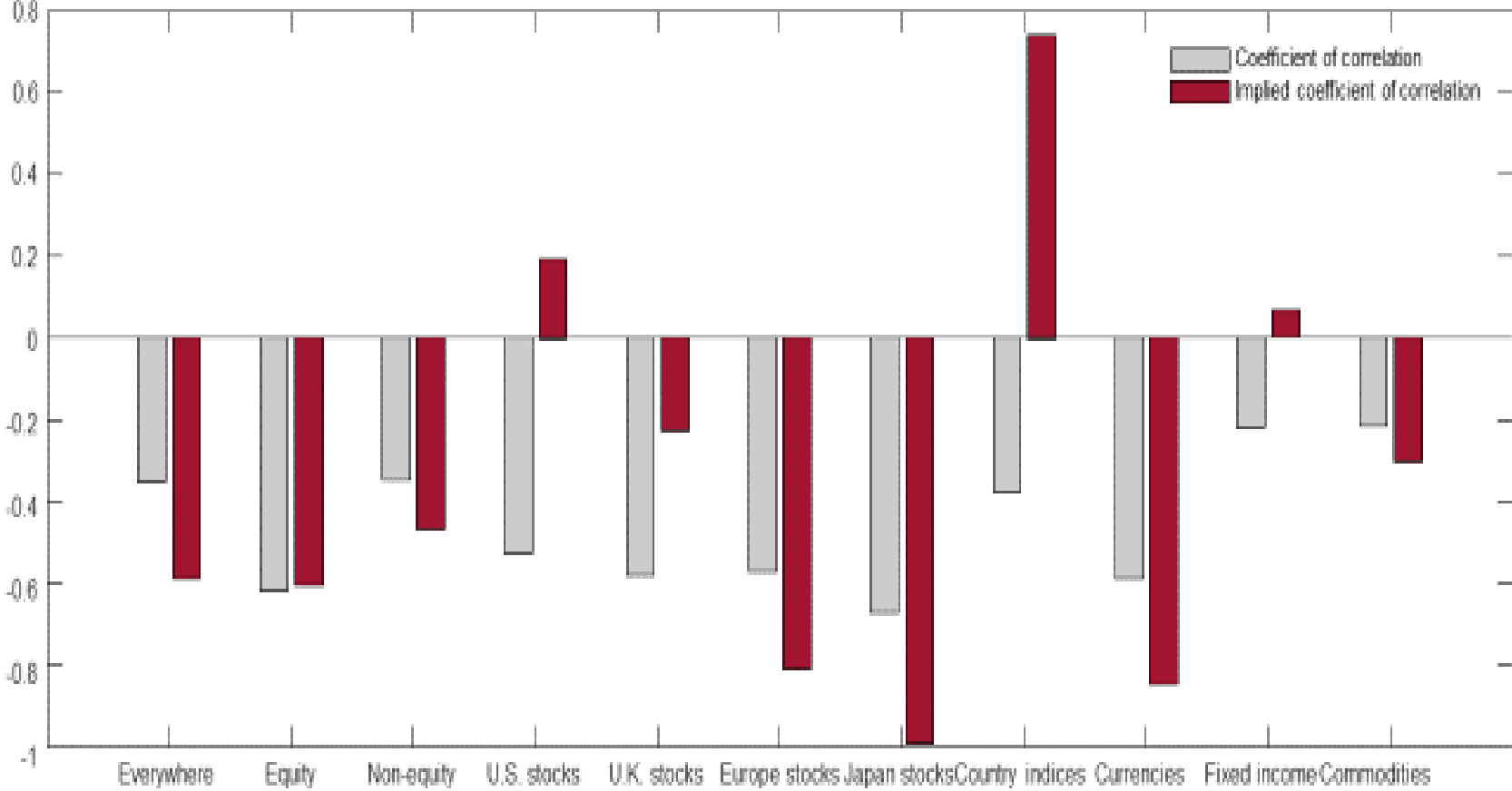
Differing Factor Loadings – value and momentum long-short premia and the combination of the two – Default spread (UPR) – Full sample



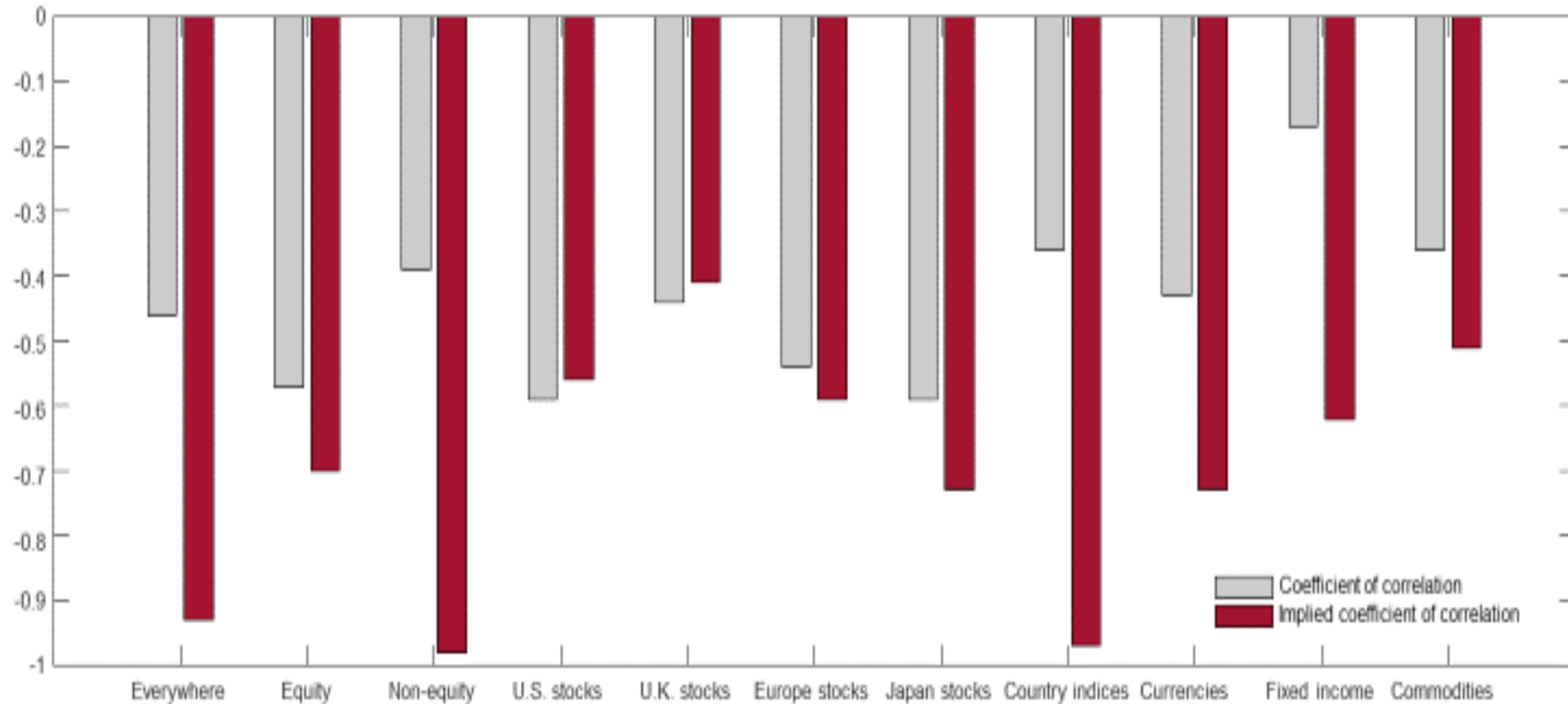
Actual Correlation vs. Implied Correlation of Value and Momentum Premia – Good states



Actual Correlation vs. Implied Correlation of Value and Momentum Premia – Bad states

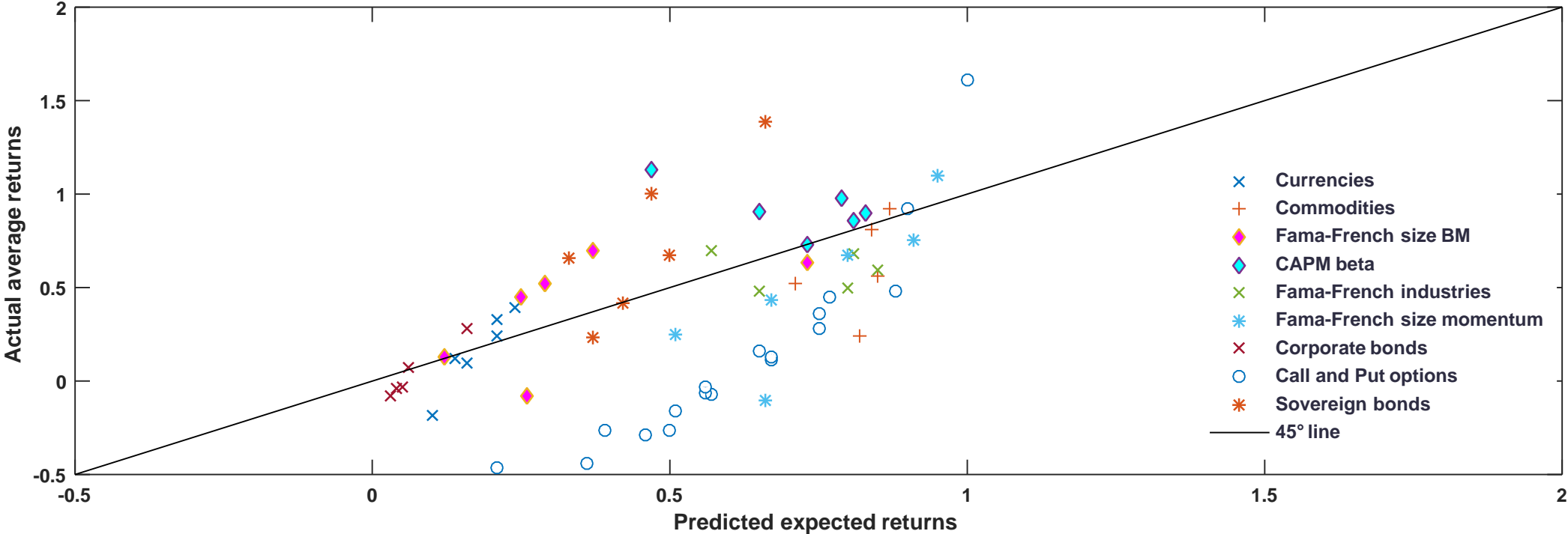


Actual Correlation vs. Implied Correlation of Value and Momentum Premia – Full sample



Robustness Checks – Additional test assets

- Describe the average returns on a different set of assets (Lettau, Maggiori, and Weber, 2014)



Additional test assets: Summary statistics of model performance

Model	GRS	p(GRS)	HJ	Diff HJ ²	$A \alpha_j $	$A \alpha_j /A \bar{r}_j $	$A\alpha_j^2 / A\bar{r}_j^2$	$AS^2(\alpha_j)/A\alpha_j^2$	AR^2
currencies+commodities+6 FF ME BM									
CAPM	6.84	0.000	0.5836	0.1833	0.2687	1.04	0.99	0.36	0.28
Global CAPM	6.43	0.000	0.5846	0.1845	0.2263	0.88	0.90	0.55	0.22
Global CRR	4.63	0.000	0.3966		0.1658	0.64	0.47	1.33	0.26
currencies+commodities+BAB factor									
CAPM	5.85	0.000	0.4277	0.1555	0.3493	1.11	1.47	0.22	0.01
Global CAPM	5.23	0.000	0.4367	0.1633	0.2925	0.93	1.31	0.28	0.07
Global CRR	2.87	0.000	0.1656		0.2031	0.64	0.55	0.65	0.16
currencies+commodities+5 Beta portfolios									
CAPM	4.23	0.000	0.4040	0.1046	0.3061	0.97	0.99	0.35	0.22
Global CAPM	3.29	0.000	0.4085	0.1083	0.2221	0.70	0.59	0.78	0.17
Global CRR	1.89	0.021	0.2421		0.1667	0.53	0.30	1.92	0.23
currencies+commodities+5 FF industry									
CAPM	3.58	0.000	0.3844	0.0658	0.2428	1.06	0.95	0.44	0.24
Global CAPM	2.84	0.000	0.3828	0.0645	0.2062	1.06	0.80	0.65	0.21
Global CRR	1.90	0.020	0.2864		0.1565	0.68	0.39	1.63	0.25

Additional test assets: Summary statistics of model performance

Model	GRS	p(GRS)	HJ	Diff HJ ²	$A \alpha_j $	$A \alpha_j /A \bar{r}_j $	$A\alpha_j^2/A\bar{r}_j^2$	$As^2(\alpha_j)/A\alpha_j^2$	AR^2
currencies+commodities+6 FF ME Momentum									
CAPM	5.61	0.000	0.5523	0.1307	0.2964	0.99	0.97	0.29	0.28
Global CAPM	5.42	0.000	0.5511	0.1294	0.2673	0.88	1.09	0.36	0.22
Global CRR	3.97	0.000	0.4175		0.1789	0.60	0.45	1.11	0.27
currencies+commodities+ 18 Equity index call and put options									
CAPM	7.00	0.000	0.8992	0.2286	0.3804	0.91	0.80	0.16	0.46
Global CAPM	6.92	0.000	0.8992	0.2286	0.4370	1.04	0.96	0.17	0.36
Global CRR	5.23	0.000	0.7616		0.3469	0.83	0.57	0.37	0.33
currencies+commodities+6 credit spread									
CAPM	2.94	0.000	0.2963	0.0626	0.2130	0.63	0.49	0.45	0.02
Global CAPM	2.38	0.002	0.3000	0.0648	0.1654	0.49	0.35	0.71	0.06
Global CRR	1.66	0.053	0.1588		0.1308	0.39	0.18	1.41	0.13
currencies+6 FF ME BM+6 sovereign portfolios									
CAPM	3.97	0.000	0.6412	0.1498	0.3106	1.02	1.13	0.30	0.37
Global CAPM	3.86	0.000	0.6375	0.1451	0.2697	0.94	1.13	0.41	0.35
Global CRR	3.04	0.000	0.5112		0.2329	0.77	0.67	0.74	0.40

Additional Robustness Checks

- Simulation evidence
- Mean-variance analysis

Conclusions

- Global macroeconomic risk – good description of expected returns across markets and across asset classes
- Unified risk view across markets and across asset classes – asset pricing integration