

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

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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<sub>i,t</sub>* return on asset *i* (or a long-short value or momentum return premium, or a combination of a value and momentum return premia)
- *MP<sub>t</sub>* industrial production growth
- *UI*<sub>t</sub> unexpected inflation
- *DEI*<sub>t</sub> change in expected inflation
- UTS<sub>t</sub> term spread
- UPR<sub>t</sub> default spread



#### What We Do

This leads to the following no-arbitrage condition:

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

where  $E(r_{MP})$ ,  $E(r_{UI})$ ,  $E(r_{DEI})$ ,  $E(r_{UTS})$ , and  $E(r_{UTS})$ are the expected returns on the mimicking portfolios for *MP*, *UI*, *DEI*, *UTS*, and *UPR*, 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	Glo	bal Tangency	GlobalCRR	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 Commodities	0.21 0.19	2.08 0.05 0.42 0.86	0.20 2.71 0.01 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 <sup>2</sup>	A   a <sub>i</sub>	$A  a_i /A \overline{r}_i $	$Aa_i^2 / A\overline{r}_i^2$	$As^2(a_i)/Aa_i^2$	AR <sup>2</sup>
Global CAPM	3.99	0.000	0.816	0.1980	0.2453	0.57	0.33	0.50	0.39
АМР	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) crosssectional regressions – 48 value and momentum portfolios

	$\hat{\gamma}$ o	$\hat{\gamma}_{\textit{MP}^+}$	$\hat{\gamma}_{\textit{UI}^+}$	$\hat{\gamma}_{\textit{DEI}}+$	$\hat{\gamma}_{\rm UTS} +$	$\hat{\gamma}_{\textit{UPR}} +$	$\hat{\gamma}_{\rm MP}-$	$\hat{\gamma}_{\textit{UI}-}$	$\hat{\gamma}_{\textit{DEI}}-$	$\hat{\gamma}_{\it U\!I\!I\!S}-$	$\hat{\gamma}_{\textit{UPR}}-$
$\hat{\gamma}$	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 <sup>2</sup>	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 <sup>2</sup>	$A  \alpha_i $	$A \ \alpha_i /\!A \ \overline{r}_i\ $	$A\alpha_i^2/A\overline{r}_i^2$	$As^2(lpha_i)/Alpha_i^2$	AR <sup>2</sup>
currencies	+com	modifie	S+6 FF I	мевм					
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	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	+com	moditie	s+5 Bet	a portfo	lios				
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	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 <sup>2</sup>	$A  \alpha_i $	$A \mid \! \alpha_i \! \mid \! / \! A \mid \! \overline{r}_i \! \mid$	$A\alpha_i^2/A\overline{r}_i^2$	$As^2(lpha_i)/Alpha_i^2$	AR <sup>2</sup>
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	+com	moditie	s+ 18 Eo	quity ind	lex call	and put opt	ions		
CARM	7 00	0.000	0.0000	0.2206	0 2004	0.01	0.00	0.16	0.46
	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	0.2280	0.4370	1.04	0.96	0.17	0.30
GIODAI CRR	5.23	0.000	0.7616		0.3469	0.83	0.57	0.37	0.33
currencies	⊦comi	moditie	s+6 cree	dit sprea	ad				
currences				and option					
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 sove	reign po	ortfolios	;			
CARM	2.07	0.000	0.6412	0.1400	0.2100	1.00	1.12	0.20	0.27
CAPM Clabal 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
GIODAI 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

