Equity risk factors and the Intertemporal CAPM

Ilan Cooper[1] Paulo Maio[2]

[1]Norwegian Business School (BI)

[2]Hanken School of Economics

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Outline

- New CAPM anomalies in recent years: momentum-, investment- and profitability-based anomalies
- Emergence of new multifactor models containing (different versions of) investment and profitability factors (e.g., Novy-Marx (2013), Fama and French (2014a), and Hou, Xue, and Zhang (2014a)) seeking to explain the extended cross-section of average stock returns
- Although these models perform relatively well in explaining the new patterns in cross-sectional risk premia, there is still some controversy about the theoretical background of such models (e.g., Hou, Xue, and Zhang (2014a) critique on Fama and French (2014a))
- We evaluate whether several equity factor models are consistent with the Merton's Intertemporal CAPM (Merton (1973), ICAPM)

- Three-factor model from Fama and French (1993, 1996, FF3):

$$E(R_{i,t+1} - R_{f,t+1}) = \gamma Cov(R_{i,t+1}, RM_{t+1}) + \gamma_{SMB} Cov(R_{i,t+1}, SMB_{t+1}) + \gamma_{HML} Cov(R_{i,t+1}, HML_{t+1})$$

- Four-factor model from Carhart (1997, C4):

$$E(R_{i,t+1} - R_{f,t+1}) = \gamma Cov(R_{i,t+1}, RM_{t+1}) + \gamma_{SMB} Cov(R_{i,t+1}, SMB_{t+1}) + \gamma_{HML} Cov(R_{i,t+1}, HML_{t+1}) + \gamma_{UMD} Cov(R_{i,t+1}, UMD_{t+1})$$

- Four-factor model employed by Pastor and Stambaugh (2003, PS4):

$$E(R_{i,t+1} - R_{f,t+1}) = \gamma Cov(R_{i,t+1}, RM_{t+1}) + \gamma_{SMB} Cov(R_{i,t+1}, SMB_{t+1}) + \gamma_{HML} Cov(R_{i,t+1}, HML_{t+1}) + \gamma_{LIQ} Cov(R_{i,t+1}, LIQ_{t+1})$$

- Four-factor model from Novy-Marx (2013, NM4):

$$E(R_{i,t+1} - R_{f,t+1}) = \gamma Cov(R_{i,t+1}, RM_{t+1}) + \gamma_{HML^*} Cov(R_{i,t+1}, HML^*_{t+1}$$
$$+\gamma_{UMD^*} Cov(R_{i,t+1}, UMD^*_{t+1}) + \gamma_{PMU^*} Cov(R_{i,t+1}, PMU^*_{t+1})$$

- Four-factor model from Hou, Xue, and Zhang (2014a, 2014b, HXZ4):

$$E(R_{i,t+1} - R_{f,t+1}) = \gamma Cov(R_{i,t+1}, RM_{t+1}) + \gamma_{ME} Cov(R_{i,t+1}, ME_{t+1})$$
$$+\gamma_{IA} Cov(R_{i,t+1}, IA_{t+1}) + \gamma_{ROE} Cov(R_{i,t+1}, ROE_{t+1})$$

- Five-factor model by Fama and French (2014a, 2014b, FF5):

$$E(R_{i,t+1} - R_{f,t+1}) = \gamma Cov(R_{i,t+1}, RM_{t+1}) + \gamma_{SMB} Cov(R_{i,t+1}, SMB_{t+1})$$
$$+\gamma_{HML} Cov(R_{i,t+1}, HML_{t+1}) + \gamma_{RMW} Cov(R_{i,t+1}, RMW_{t+1})$$
$$+\gamma_{CMA} Cov(R_{i,t+1}, CMA_{t+1})$$

Correlations of equity factors

	UMD	*LIQ*	*HML**	*UMD**	*PMU**	*ME*	*IA*	*ROE*	*RMW*	*CMA*
RM	−0.14	−0.03	−0.19	−0.19	−0.29	0.25	−0.37	−0.18	−0.23	−0.40
SMB	−0.01	−0.02	−0.03	−0.08	−0.28	0.95	−0.23	−0.39	−0.44	−0.12
HML	−0.15	0.04	0.81	−0.19	−0.08	−0.07	0.69	−0.09	0.15	0.70
UMD	1.00	−0.04	−0.13	0.95	0.25	0.00	0.04	0.50	0.09	0.02
LIQ		1.00	0.07	−0.04	0.00	−0.04	0.03	−0.08	0.02	0.04
HML*			1.00	−0.18	−0.22	0.09	0.55	−0.22	−0.01	0.61
UMD*				1.00	0.28	−0.07	0.02	0.52	0.12	−0.01
PMU*					1.00	−0.26	0.03	0.59	0.68	−0.03
ME						1.00	−0.12	−0.31	−0.38	−0.01
IA							1.00	0.06	0.10	0.90
ROE								1.00	0.67	−0.09
RMW									1.00	−0.03
CMA										1.00

- Testing portfolios: deciles sorted on size, book-to-market, momentum, investment-to-assets, return on equity, operating profitability, and asset growth
- Sample: 1972:01 to 2012:12
- Estimation is by first-stage GMM
- Maio and Santa-Clara (2012):
  - If a state variable forecasts an increase in future aggregate returns, the risk price associated with the corresponding risk factor in the asset pricing equation should be positive
  - If a state variable forecasts an increase in future aggregate stock volatility, the risk price associated with the corresponding factor should be negative

Factor risk premiums for equity risk factors

γ_{SMB}	γ_{HML}	γ_{UMD}	γ_{LIQ}	γ_{HML^*}	γ_{UMD^*}	γ_{PMU^*}	γ_{ME}	γ_{IA}	γ_{ROE}	γ_{RMW}
−1.07	4.03									
(−0.62)	(2.25)									
−0.28	7.93	5.22								
(−0.17)	(**4.15**)	(**3.51**)								
−1.25	4.33		−9.32							
(−0.68)	(2.07)		(−**2.77**)							
				23.27	6.82	16.97				
				(**4.70**)	(**2.67**)	(2.07)				
							5.37	13.25	10.56	
							(2.57)	(**3.71**)	(**3.60**)	
5.46	−7.38									16.57
(**2.75**)	(−2.08)									(**5.18**

- A candidate ICAPM state variable should forecast future investment opportunities
- The state variables correspond to the cumulative sums on the corresponding factors:

$$CIA_t = \sum_{s=t-59}^{t} IA_s$$

- Single long-horizon predictive regressions:

$$r_{t+1,t+q} = a_q + b_q z_t + u_{t+1,t+q}$$

where $r_{t+1,t+q} \equiv r_{t+1} + ... + r_{t+q}$ is the continuously compounded excess return over q periods into the future (from $t+1$ to $t+q$)

- Multivariate regressions:

$$\begin{aligned}
r_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + u_{t+1,t+q}, \\
r_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + d_q CUMD_t + u_{t+1,t+q}, \\
r_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + d_q CLIQ_t + u_{t+1,t+q}, \\
r_{t+1,t+q} &= a_q + b_q CHML_t^* + c_q CUMD_t^* + d_q CPMU_t^* + u_{t+1,t+q}, \\
r_{t+1,t+q} &= a_q + b_q CME_t + c_q CIA_t + d_q CROE_t + u_{t+1,t+q}, \\
r_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + d_q CRMW_t + e_q CCMA_t + u
\end{aligned}$$

Single predictive regressions: equity premium

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
CSMB	−0.00	−0.01	−0.10	0.02	0.01	0.01	−0.04
	(−0.15)	(−0.39)	(−0.16)	(0.25)	(0.06)	(0.07)	(−0.17)
R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHML	0.00	0.01	0.08	0.12	0.12	−0.09	−0.19
	(0.07)	(0.28)	(1.03)	(0.70)	(0.41)	(−0.25)	(−0.54)
R^2	0.00	0.00	0.01	0.02	0.01	0.01	0.02
CUMD	−0.01	−0.03	−0.04	0.01	0.16	0.31	0.25
	(−1.37)	(−1.33)	(−0.47)	(0.06)	(0.76)	(1.38)	(1.21)
R^2	0.00	0.01	0.01	0.00	0.02	0.06	0.03
CLIQ	−0.00	−0.01	−0.03	−0.07	−0.20	−0.33	−0.36
	(−0.59)	(−0.60)	(−0.38)	(−0.58)	(−1.29)	(−1.90)	(−1.90)
R^2	0.00	0.00	0.00	0.01	0.05	0.12	0.13
CHML*	0.01	0.02	0.12	0.21	0.18	−0.16	−0.47
	(0.37)	(0.50)	(0.86)	(0.74)	(0.39)	(−0.25)	(−0.73)
R^2	0.00	0.00	0.01	0.01	0.01	0.00	0.04
CUMD*	−0.02	−0.05	−0.08	−0.01	0.17	0.50	0.51
	(−1.55)	(−1.55)	(−0.58)	(−0.04)	(0.45)	(1.21)	(1.35)
R^2	0.01	0.01	0.01	0.00	0.01	0.05	0.04

Single predictive regressions: equity premium (contd)

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
*CPMU**	0.03	0.08	0.33	0.43	0.31	0.07	−0.01
	(1.44)	(1.89)	(2.11*)	(2.19*)	(1.23)	(0.19)	(−0.03)
R^2	0.00	0.01	0.06	0.06	0.02	0.00	0.00
CME	−0.00	−0.01	−0.02	0.01	0.00	−0.03	−0.11
	(−0.42)	(−0.72)	(−0.36)	(0.17)	(0.01)	(−0.17)	(−0.48)
R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.01
CIA	0.01	0.05	0.21	0.31	0.30	0.16	−0.08
	(0.81)	(1.00)	(1.23)	(1.16)	(0.93)	(0.38)	(−0.14)
R^2	0.00	0.01	0.04	0.04	0.03	0.01	0.00
CROE	0.00	0.02	0.21	0.47	0.64	0.67	0.88
	(0.22)	(0.61)	(1.47)	(1.91)	(2.45*)	(2.39*)	(2.96**)
R^2	0.00	0.00	0.04	0.11	0.13	0.12	0.18
CRMW	0.01	0.05	0.28	0.38	0.23	0.01	0.05
	(1.09)	(1.81)	(2.18*)	(2.06*)	(1.31)	(0.03)	(0.25)
R^2	0.00	0.01	0.08	0.09	0.02	0.00	0.00
CCMA	0.01	0.02	0.08	0.14	0.12	−0.10	−0.34
	(0.40)	(0.53)	(0.71)	(0.85)	(0.49)	(−0.26)	(−0.79)
R^2	0.00	0.00	0.01	0.01	0.01	0.00	0.04

- Single regressions:

$$svar_{t+1,t+q} = a_q + b_q z_t + u_{t+1,t+q}$$

where $svar_{t+1,t+q} \equiv svar_{t+1} + ... + svar_{t+q}$ and
$svar_{t+1} \equiv \ln(SVAR_{t+1})$ is the log of the realized market volatility

- Multiple regressions:

$$\begin{aligned}
svar_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + u_{t+1,t+q}, \\
svar_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + d_q CUMD_t + u_{t+1,t+q}, \\
svar_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + d_q CLIQ_t + u_{t+1,t+q}, \\
svar_{t+1,t+q} &= a_q + b_q CHML_t^* + c_q CUMD_t^* + d_q CPMU_t^* + u_{t+1,t+q}, \\
svar_{t+1,t+q} &= a_q + b_q CME_t + c_q CIA_t + d_q CROE_t + u_{t+1,t+q}, \\
svar_{t+1,t+q} &= a_q + b_q CSMB_t + c_q CHML_t + d_q CRMW_t + e_q CCMA_t
\end{aligned}$$

Single predictive regressions: stock market volatility

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
CSMB	−0.43	−1.17	−4.02	−5.48	−3.37	1.94	11.50
	(−3.10**)	(−2.37*)	(−1.37)	(−0.70)	(−0.25)	(0.10)	(0.49)
R^2	0.02	0.02	0.02	0.01	0.00	0.00	0.02
CHML	−0.88	−2.55	−8.33	−10.35	−4.76	8.18	16.04
	(−5.19**)	(−4.36**)	(−2.41*)	(−0.97)	(−0.25)	(0.31)	(0.58)
R^2	0.06	0.07	0.06	0.03	0.00	0.01	0.02
CUMD	0.09	0.18	−1.68	−7.33	−15.19	−21.85	−15.29
	(0.50)	(0.27)	(−0.46)	(−0.78)	(−1.03)	(−1.10)	(−0.63)
R^2	0.00	0.00	0.00	0.02	0.04	0.05	0.02
CLIQ	0.61	1.83	7.37	14.20	21.32	27.51	28.98
	(3.26**)	(2.47*)	(1.60)	(1.37)	(1.42)	(1.47)	(1.46)
R^2	0.04	0.05	0.08	0.09	0.12	0.14	0.13
CHML*	−1.33	−3.97	−15.38	−24.78	−22.28	−4.44	15.88
	(−3.76**)	(−3.14**)	(−2.42*)	(−1.41)	(−0.74)	(−0.11)	(0.36)
R^2	0.05	0.06	0.07	0.05	0.02	0.00	0.01
CUMD*	0.22	0.51	−2.53	−13.57	−32.68	−58.05	−57.68
	(0.77)	(0.48)	(−0.44)	(−0.86)	(−1.23)	(−1.70)	(−1.86)
R^2	0.00	0.00	0.00	0.03	0.06	0.11	0.09

Single predictive regressions: stock market volatility (contd)

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
$CPMU^*$	0.44	0.76	−4.64	−15.41	−18.62	−11.30	7.31
	(1.06)	(0.47)	(−0.47)	(−0.74)	(−0.71)	(−0.40)	(0.27)
R^2	0.00	0.00	0.01	0.02	0.02	0.00	0.00
CME	−0.41	−1.14	−3.89	−5.58	−4.04	1.48	10.96
	(−3.23**)	(−2.49*)	(−1.42)	(−0.76)	(−0.32)	(0.08)	(0.51)
R^2	0.02	0.02	0.03	0.02	0.01	0.00	0.02
CIA	−1.67	−5.18	−21.23	−42.02	−56.01	−58.21	−40.13
	(−4.41**)	(−3.71**)	(−3.23**)	(−3.52**)	(−3.54**)	(−2.43*)	(−1.30)
R^2	0.09	0.12	0.18	0.22	0.21	0.13	0.04
$CROE$	0.14	0.10	−4.23	−14.43	−25.79	−31.62	−32.28
	(0.44)	(0.09)	(−0.60)	(−0.78)	(−0.90)	(−0.93)	(−0.88)
R^2	0.00	0.00	0.01	0.03	0.04	0.04	0.04
$CRMW$	0.45	0.89	−2.90	−12.17	−16.76	−14.43	−10.09
	(1.46)	(0.77)	(−0.42)	(−0.79)	(−0.92)	(−0.76)	(−0.49)
R^2	0.01	0.00	0.00	0.02	0.02	0.01	0.01
$CCMA$	−0.97	−3.07	−13.28	−27.53	−37.05	−34.94	−20.07
	(−3.12**)	(−2.63**)	(−2.25*)	(−2.56*)	(−2.56*)	(−1.66)	(−0.77)
R^2	0.04	0.06	0.10	0.14	0.14	0.08	0.02

Consistency of factors with the ICAPM: single regressions

CSMB	*CHML*	*CUMD*	*CLIQ*	*CHML**	*CUMD**	*CPMU**	*CME*	*CIA*	*CROE*	*CRMW*	*CCM*
Panel A (*r*)											
✓	×										
✓	×	×									
✓	×		×								
				×	×	✓					
							×	×	✓		
×	×									✓	×
Panel B (*svar*)											
×	✓										
×	✓	×									
×	✓		✓								
				✓	×	×					
							✓	✓	×		
✓	×									×	✓

Consistency of factors with the ICAPM: multiple regressions

CSMB	*CHML*	*CUMD*	*CLIQ*	*CHML**	*CUMD**	*CPMU**	*CME*	*CIA*	*CROE*	*CRMW*	*CCM*
Panel A (*r*)											
✓	×										
✓	×	×									
✓	×		×								
				×	× ×	✓					
							×	×	✓		
×	×									✓	×
Panel B (*svar*)											
✓	✓										
✓	✓	×									
×	✓		✓								
				✓	✓	×					
							×	✓	×		
×	✓									×	✓

- Economic activity as a proxy for investment opportunities (Roll's critique)
- Two measures of economic activity: log growth in the industrial production index (*IPG*) and the Chicago FED National Activity Index (*CFED*)
- Single regressions:

$$y_{t+1,t+q} = a_q + b_q z_t + u_{t+1,t+q}$$

where $y \equiv IPG, CFED$ and $y_{t+1,t+q} \equiv y_{t+1} + ... + y_{t+q}$ denotes the forward cumulative sum in either *IPG* or *CFED*

Single predictive regressions: industrial production growth

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
CSMB	−0.00	−0.00	−0.02	−0.03	−0.04	−0.06	−0.08
	(−0.33)	(−0.48)	(−0.88)	(−0.99)	(−0.95)	(−1.12)	(−1.17)
R^2	0.00	0.00	0.01	0.02	0.03	0.05	0.08
CHML	0.00	0.00	0.01	0.02	−0.05	−0.13	−0.18
	(0.70)	(0.72)	(0.75)	(0.44)	(−0.81)	(−1.43)	(−1.94)
R^2	0.00	0.00	0.01	0.00	0.02	0.11	0.21
CUMD	−0.00	−0.00	0.01	0.05	0.11	0.18	0.16
	(−1.24)	(−1.10)	(0.30)	(0.82)	(1.67)	(2.50*)	(2.25*)
R^2	0.00	0.00	0.00	0.04	0.11	0.22	0.14
CLIQ	−0.00	−0.01	−0.02	−0.05	−0.09	−0.15	−0.18
	(−1.50)	(−1.50)	(−1.21)	(−1.06)	(−1.49)	(−2.33*)	(−2.74**)
R^2	0.01	0.01	0.03	0.04	0.11	0.27	0.33
CHML*	0.00	0.01	0.03	0.05	−0.05	−0.19	−0.35
	(1.39)	(1.36)	(1.04)	(0.81)	(−0.56)	(−1.36)	(−2.03*)
R^2	0.00	0.01	0.01	0.01	0.01	0.07	0.21
CUMD*	−0.00	−0.01	−0.00	0.06	0.17	0.34	0.31
	(−2.02*)	(−1.93)	(−0.02)	(0.66)	(1.42)	(2.26*)	(2.11*)
R^2	0.01	0.01	0.00	0.02	0.10	0.23	0.16

Single predictive regressions: industrial production growth (contd)

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
*CPMU**	0.00	0.00	0.07	0.15	0.17	0.12	0.08
	(0.14)	(0.37)	(1.33)	(1.76)	(1.87)	(0.82)	(0.42)
R^2	0.00	0.00	0.04	0.08	0.07	0.03	0.01
CME	−0.00	−0.00	−0.02	−0.03	−0.05	−0.07	−0.10
	(−0.46)	(−0.60)	(−0.98)	(−1.04)	(−1.12)	(−1.44)	(−1.59)
R^2	0.00	0.00	0.01	0.02	0.04	0.08	0.13
CIA	0.01	0.02	0.08	0.11	0.07	0.00	−0.17
	(2.16*)	(1.96*)	(1.59)	(1.50)	(1.14)	(0.01)	(−1.17)
R^2	0.02	0.05	0.08	0.07	0.02	0.00	0.05
CROE	−0.00	−0.00	0.05	0.18	0.31	0.37	0.42
	(−0.36)	(−0.08)	(1.20)	(2.04*)	(3.73**)	(4.83**)	(5.11**)
R^2	0.00	0.00	0.04	0.19	0.35	0.38	0.42
CRMW	−0.00	−0.00	0.04	0.11	0.11	0.05	0.04
	(−0.46)	(−0.19)	(1.08)	(1.55)	(1.82)	(0.49)	(0.31)
R^2	0.00	0.00	0.03	0.08	0.06	0.01	0.00
CCMA	0.00	0.01	0.04	0.04	−0.01	−0.10	−0.24
	(1.59)	(1.47)	(1.17)	(0.81)	(−0.25)	(−1.22)	(−2.30*)
R^2	0.01	0.02	0.03	0.01	0.00	0.04	0.20

Single predictive regressions: Chicago FED Index

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
CSMB	0.08	0.11	−0.70	−1.50	−1.59	−3.74	−6.47
	(0.36)	(0.13)	(−0.17)	(−0.20)	(−0.16)	(−0.30)	(−0.41)
R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.01
CHML	0.83	2.48	9.35	12.85	1.92	−16.87	−33.12
	(4.64**)	(3.98**)	(2.81**)	(2.06*)	(0.18)	(−0.99)	(−1.79)
R^2	0.04	0.06	0.07	0.05	0.00	0.04	0.16
CUMD	0.02	0.10	3.37	13.80	31.72	51.13	50.34
	(0.12)	(0.19)	(0.88)	(1.30)	(2.35*)	(3.10**)	(3.03**)
R^2	0.00	0.00	0.01	0.08	0.21	0.37	0.33
CLIQ	−0.21	−0.67	−2.91	−5.52	−12.71	−24.56	−31.90
	(−1.12)	(−0.97)	(−0.71)	(−0.58)	(−0.92)	(−1.53)	(−2.05*)
R^2	0.00	0.01	0.01	0.01	0.05	0.15	0.23
CHML*	1.59	4.81	18.54	28.69	12.92	−23.12	−67.91
	(4.53**)	(3.67**)	(2.75**)	(2.39*)	(0.70)	(−0.85)	(−2.11*)
R^2	0.06	0.08	0.09	0.07	0.01	0.02	0.19
CUMD*	−0.09	−0.23	3.15	18.58	48.85	86.35	83.47
	(−0.49)	(−0.36)	(0.60)	(1.14)	(2.01*)	(2.64**)	(2.66**)
R^2	0.00	0.00	0.00	0.05	0.17	0.32	0.28

Single predictive regressions: Chicago FED Index (contd)

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
CPMU*	−0.44	−0.86	5.75	19.10	22.99	9.98	−8.85
	(−0.83)	(−0.43)	(0.49)	(0.91)	(1.15)	(0.42)	(−0.27)
R^2	0.00	0.00	0.01	0.03	0.03	0.00	0.00
CME	0.08	0.14	−0.43	−1.08	−2.16	−6.02	−10.48
	(0.43)	(0.20)	(−0.12)	(−0.16)	(−0.25)	(−0.57)	(−0.75)
R^2	0.00	0.00	0.00	0.00	0.00	0.01	0.03
CIA	2.24	6.92	27.59	45.80	46.72	31.84	−13.33
	(5.29**)	(4.25**)	(3.30**)	(3.34**)	(3.49**)	(1.32)	(−0.50)
R^2	0.13	0.19	0.26	0.27	0.17	0.05	0.01
CROE	0.10	0.54	9.55	35.21	65.72	80.59	90.10
	(0.37)	(0.54)	(1.26)	(1.93)	(3.05**)	(3.65**)	(4.23**)
R^2	0.00	0.00	0.03	0.16	0.34	0.38	0.45
CRMW	−0.41	−0.92	3.89	15.96	17.91	4.87	−6.38
	(−1.18)	(−0.70)	(0.46)	(0.95)	(1.15)	(0.30)	(−0.31)
R^2	0.01	0.00	0.01	0.04	0.03	0.00	0.00
CCMA	1.40	4.29	16.43	24.29	18.82	−0.95	−36.33
	(4.31**)	(3.45**)	(2.56*)	(2.45*)	(1.67)	(−0.06)	(−2.02*)
R^2	0.07	0.10	0.13	0.11	0.04	0.00	0.11

Consistency of factors with the ICAPM: economic activity

CSMB	*CHML*	*CUMD*	*CLIQ*	*CHML**	*CUMD**	*CPMU**	*CME*	*CIA*	*CROE*	*CRMW*	*CCM*
Panel A (*IPG*)											
✓	×										
✓	×	✓									
✓	×		✓								
				××	?	×					
							×	✓	✓		
×	×									×	××
Panel B (*CFED*)											
✓	✓										
✓	✓	✓									
✓	✓		✓								
				?	✓	×					
							×	✓	✓		
×	×									×	?

- Multiple forecasting regressions for the equity premium:

$$r_{t+1,t+q} = a_q + b_q z_t + c_q TERM_t + d_q DEF_t + e_q dp_t + f_q TB_t + g_q vs_t + h_q pe_t + u$$

- Multiple forecasting regressions for market volatility:

$$svar_{t+1,t+q} = a_q + b_q z_t + c_q TERM_t + d_q DEF_t + e_q dp_t + f_q TB_t + g_q vs_t + h_q pe_t$$

Predictive regressions for equity premium: controls

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
CSMB	0.00	−0.01	0.03	0.16	0.18	0.22	0.12
	(0.16)	(−0.30)	(0.36)	(1.46)	(1.20)	(1.24)	(0.60)
R^2	−0.00	0.02	0.15	0.30	0.44	0.51	0.56
CHML	−0.01	−0.03	−0.04	0.06	0.17	−0.12	−0.10
	(−0.62)	(−0.78)	(−0.48)	(0.39)	(0.82)	(−0.43)	(−0.70)
R^2	−0.00	0.02	0.15	0.28	0.42	0.49	0.55
CUMD	−0.01	−0.01	0.02	0.10	0.31	0.39	0.25
	(−0.74)	(−0.59)	(0.23)	(0.75)	(2.21*)	(2.39*)	(1.55)
R^2	−0.00	0.02	0.15	0.29	0.47	0.54	0.57
CLIQ	−0.00	−0.01	−0.04	0.02	−0.20	−0.09	0.29
	(−0.11)	(−0.21)	(−0.32)	(0.11)	(−1.18)	(−0.79)	(1.56)
R^2	−0.00	0.02	0.15	0.28	0.43	0.49	0.57
CHML*	0.01	0.02	0.04	0.25	0.50	0.23	0.05
	(0.38)	(0.36)	(0.26)	(0.86)	(1.39)	(0.52)	(0.16)
R^2	−0.00	0.02	0.15	0.29	0.44	0.49	0.55
CUMD*	−0.01	−0.03	−0.01	0.09	0.32	0.60	0.68
	(−0.98)	(−0.89)	(−0.07)	(0.43)	(1.57)	(2.68**)	(2.25*)
R^2	0.00	0.02	0.15	0.28	0.44	0.52	0.59

Predictive regressions for equity premium: controls (contd)

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
$CPMU^*$	0.07	0.23	0.84	1.18	1.06	0.84	1.15
	(2.83**)	(3.70**)	(3.15**)	(5.74**)	(3.54**)	(2.01*)	(3.26**)
R^2	0.01	0.07	0.31	0.47	0.53	0.55	0.64
CME	−0.00	−0.02	0.01	0.16	0.21	0.18	0.06
	(−0.33)	(−0.79)	(0.18)	(1.58)	(1.46)	(1.07)	(0.39)
R^2	−0.00	0.00	0.15	0.30	0.45	0.50	0.55
CIA	0.02	0.08	0.23	0.27	0.23	−0.06	−0.29
	(1.10)	(1.39)	(1.00)	(1.07)	(1.27)	(−0.36)	(−0.96)
R^2	0.00	0.03	0.17	0.30	0.43	0.49	0.56
$CROE$	0.01	0.06	0.35	0.63	0.61	0.27	0.44
	(0.62)	(1.32)	(1.76)	(2.61**)	(2.80**)	(0.99)	(1.42)
R^2	−0.00	0.03	0.20	0.38	0.49	0.50	0.58
$CRMW$	0.02	0.09	0.40	0.56	0.35	0.15	0.36
	(1.63)	(2.67**)	(2.47*)	(3.24**)	(2.21*)	(0.68)	(1.86)
R^2	0.00	0.04	0.26	0.40	0.46	0.49	0.58
$CCMA$	0.01	0.03	0.07	0.14	0.22	−0.05	−0.21
	(0.48)	(0.62)	(0.44)	(0.74)	(1.24)	(−0.22)	(−0.74)
R^2	−0.00	0.02	0.15	0.28	0.43	0.49	0.56

Predictive regressions for stock market volatility: controls

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
CSMB	−1.13	−3.07	−11.83	−20.55	−17.56	−3.81	19.26
	(−5.85**)	(−4.85**)	(−3.61**)	(−3.00**)	(−1.80)	(−0.33)	(1.56)
R^2	0.35	0.41	0.49	0.58	0.61	0.63	0.62
CHML	−0.20	−0.47	−3.02	−4.30	7.67	22.16	17.72
	(−0.66)	(−0.42)	(−0.66)	(−0.31)	(0.42)	(1.46)	(1.15)
R^2	0.28	0.35	0.40	0.49	0.57	0.64	0.60
CUMD	0.07	−0.11	−4.56	−13.27	−18.69	−7.82	11.39
	(0.36)	(−0.17)	(−1.98*)	(−3.17**)	(−3.08**)	(−0.69)	(0.75)
R^2	0.28	0.35	0.42	0.54	0.61	0.63	0.60
CLIQ	0.10	0.33	2.25	6.89	18.22	15.91	1.18
	(0.36)	(0.34)	(0.46)	(0.74)	(1.61)	(1.14)	(0.08)
R^2	0.28	0.35	0.40	0.50	0.59	0.64	0.59
*CHML**	−0.09	−0.55	−8.58	−26.03	−35.21	−38.90	−45.34
	(−0.19)	(−0.34)	(−1.19)	(−1.13)	(−1.05)	(−1.33)	(−1.54)
R^2	0.28	0.35	0.41	0.51	0.59	0.64	0.61
*CUMD**	0.31	0.34	−6.93	−23.45	−41.04	−50.23	−38.19
	(1.06)	(0.33)	(−1.76)	(−3.01**)	(−6.89**)	(−3.95**)	(−2.30*)
R^2	0.29	0.35	0.41	0.55	0.64	0.66	0.61

Predictive regressions for stock market volatility: controls (contd)

	$q = 1$	$q = 3$	$q = 12$	$q = 24$	$q = 36$	$q = 48$	$q = 60$
$CPMU^*$	-1.08	-4.86	-32.91	-66.57	-80.92	-77.57	-56.04
	(-2.08^*)	(-2.62^{**})	(-2.95^{**})	(-3.02^{**})	(-3.62^{**})	(-3.69^{**})	(-2.15^*)
R^2	0.29	0.38	0.52	0.65	0.70	0.71	0.63
CME	-0.94	-2.53	-10.64	-20.52	-20.32	-7.39	13.92
	(-5.19^{**})	(-4.22^{**})	(-3.74^{**})	(-3.22^{**})	(-2.12^*)	(-0.66)	(1.21)
R^2	0.33	0.40	0.48	0.59	0.62	0.63	0.61
CIA	-0.38	-1.89	-13.75	-37.69	-59.53	-67.68	-69.84
	(-0.91)	(-1.25)	(-1.70)	(-2.55^*)	(-4.05^{**})	(-4.45^{**})	(-2.63^{**})
R^2	0.29	0.36	0.44	0.59	0.68	0.71	0.64
$CROE$	0.91	1.65	-1.98	-9.22	-9.25	6.71	20.11
	(2.37^*)	(1.26)	(-0.26)	(-0.61)	(-0.52)	(0.39)	(0.97)
R^2	0.30	0.35	0.40	0.50	0.57	0.63	0.60
$CRMW$	-0.19	-1.28	-11.78	-26.69	-34.44	-35.99	-36.52
	(-0.66)	(-1.33)	(-1.94)	(-2.06^*)	(-2.92^{**})	(-4.62^{**})	(-3.11^{**})
R^2	0.28	0.35	0.44	0.57	0.64	0.68	0.64
$CCMA$	-0.22	-1.17	-10.71	-32.44	-58.63	-78.02	-88.05
	(-0.66)	(-0.99)	(-1.76)	(-2.73^{**})	(-4.70^{**})	(-7.67^{**})	(-5.11^{**})
R^2	0.28	0.35	0.43	0.59	0.72	0.77	0.73

- The state variables associated with (alternative) profitability factors help to forecast the equity premium in a way consistent with the ICAPM
- Several state variables (those associated with investment factors) forecast a significant decline in stock volatility, being consistent with the ICAPM
- There is strong evidence of predictability for future economic activity, especially from investment and profitability factors
- The new factors are generally consistent with the ICAPM
- The four-factor model of Hou, Xue, and Zhang (2014a) presents the best convergence with the ICAPM
- The predictive ability of most equity state variables does not seem to be subsumed by traditional ICAPM state variables