

Climate risk metrics: Convergence, divergence and metrics characteristics

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Contribution

- Climate risks are financial risks
 - assessed, monitored and controlled
 - integrated in financial supervision and monetary policy operations

- (1) Do different climate risk metrics lead to a different risk assessment for the same firm?
- (2) Do the scenario and the methodology underlying a metrics impact on the estimation of transition risk?

Data and variables

- 1543 firms, components of MSCI World Index as of 31 January 2020
- 9 providers of forward-looking climate risk or alignment metrics
- More than 105'000 observations from 69 transition risk metrics
- For each metric, 6 variables describing the underlying scenario and methodology

Convergence analysis

- For each metric, firms are classified in 5 risk categories (1 = lowest risk, 5 = highest risk)
- Two indicators of coherence between metrics:
 - (1) **Absolute distance**: average risk category difference across firms
 - (2) **Agreement rate**: percentage of firms in same risk category
- Coherence within providers

	<i>Specification 1</i>		<i>Specification 2</i>	
	Absolute Distance	Agreement Rate	Absolute Distance	Agreement rate
Intercept	1.45***	0.245***	1.45***	0.245***
Same Provider	-1.07***	0.478***		
Provider 1			-1.35***	0.655***
Provider 2			-0.88***	0.352***
Provider 3			-0.77***	0.305***
Provider 4			-1.34***	0.689***
Provider 5			-1.12***	0.445***
Provider 6			-0.94***	0.354***

* p<0.1; ** p<0.05; *** p<0.01

Convergence across providers

- Scenario and methodology matter for coherence across providers

	Absolute Distance	Agreement Rate
Intercept	1.56***	0.208***
Same Horizon	-0.02*	0.007**
Same Temperature	-0.07***	0.012***
Same Shape	-0.07***	0.018***
Same Output	-0.01	0.015***

*p<0.1; **p<0.05; ***p<0.01

- Higher coherence for firms highly exposed to transition risk

Excess frequency of observed risk assessments pairs vs. independent metrics (in %)

(a) Difference in pairs

0	30
1	6
2	-8
3	-27
4	-20

(b) Per quintile pairs

Highest quintile	1	6				
	2	-6	13			
	3	-2	40	34		
	4	-11	22	3	-8	
	5	-20	-42	-45	-15	105
		1	2	3	4	5
		Lowest quintile				

Metrics characteristics

- Indep. variable: Risk assessments (min-max normalization)
 - (1) Across-metrics panel OLS
 - Dep. variables: Temperature target, time horizon, output type, firm targets, CAPEX, approach
 - Heteroskedasticity- and cluster-robust SE
 - (2) Within-metric OLS
 - Dep. variables: Temperature target, time horizon, transition path
 - Heteroskedasticity-robust SE
- Robust to outliers specification

Across-metrics panel OLS

Dependent variable: Risk assessment

temp_target_b2	-0.129 (0.199)	output_finmetric	0.559* (0.315)
temp_target_2	-0.124 (0.241)	output_gap	0.578*** (0.139)
temp_target_3	-0.149 (0.176)	output_riskscore	0.281*** (0.057)
temp_target_na	0.228 (0.215)	firm_target_1	0.303*** (0.085)
time_horizon_2030	0.042 (0.032)	capex_1	0.565*** (0.089)
time_horizon_2040	0.109* (0.064)	approach_comb	-0.322*** (0.054)
time_horizon_2050	0.119 (0.107)	approach_topdown	0.096 (0.155)
time_horizon_2100	-0.060 (0.109)	Constant	-0.509** (0.222)
time_horizon_na	-0.400*** (0.123)		

* p<0.1; ** p<0.05; *** p<0.01

Across-metrics panel OLS

<i>Dependent variable: Risk assessment</i>		<i>modelling approach</i>	
temp_target_b2	-0.129 (0.199)	output_finmetric	0.559* (0.315)
temp_target_2	-0.124 (0.241)	output_gap	0.578*** (0.139)
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Across-metrics panel OLS

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temp_target_b2	-0.129 (0.199)	output_finmetric	0.559* (0.315)	/
temp_target_2	-0.124 (0.241)	output_gap	0.578*** (0.139)	
temp_target_3	-0.149 (0.176)	output_riskscore	0.281*** (0.057)	
temp_target_na	0.228 (0.215)	firm_target_1	0.303*** (0.085)	forward-looking
time_horizon_2030	0.042 (0.032)	capex_1	0.565*** (0.089)	
time_horizon_2040	0.109* (0.064)	approach_comb	-0.322*** (0.054)	
time_horizon_2050	0.119 (0.107)	approach_topdown	0.096 (0.155)	
time_horizon_2100	-0.060 (0.109)	Constant	-0.509** (0.222)	
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Within-metric analysis

- 5 providers: different assumptions about temperature target, time horizon and transition path
- Robust to outliers, but no panel dimension, no cluster-robust SE and different normalization
- Temperature target, time horizon and transition path matter for the risk assessment

Conclusion

- Metrics based on similar scenario and methodology deliver more similar risk assessments
- Metrics converge more for firms highly exposed to transition risk
- Metrics methodology is associated with changes in the estimation of transition risk
- Scenarios are also associated with changes in the level of risk within tools

Thank you!

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Appendix

Data providers

Table: Data provider

Provider	Type	Tool name	Metric name	Output type
2 Degrees Investing Initiative & Asset Resolution	Think tank	PACTA		alignment gap
ClimateWise from CISL	Academia	Transition Risk Framework	Transition Risk Exposure Matrix	risk score
Entelligent	Financial services			risk score
ESG+	Financial services			risk score
ISS-ESG	Financial services	Portfolio Climate Impact	Carbon Risk Rating Climate VaR Climate Margin	risk score financial metric financial metric
Moody's / Vigeo Eiris	Financial services			financial metric
MSCI / CarbonDelta	Financial services		Climate VaR Warming potential	financial metric alignment gap
PWC / The CO-Firm	Financial Services	Climate Excellence	EBITDA change	balance sheet effect
right. based on science	Think tank	XDC model		alignment gap
S&P Global Market Intelligence	Financial Services	S&P Global Corporate Sustainability Assessment (CSA)	Climate Strategy Metric	risk score
Sustainaccount	Financial Services	ESG Enterprise Suite		balance sheet effect
University of Augsburg	Academia	Carima	Carbon Beta	risk score
Planetrics	Think tank	Climate Risk Metric Toolkit	Profit impairment	financial metric alignment gap
Zero-carbon 2030	Think tank			risk score

Explanatory variables

Table: Descriptive overview explanatory variables

Explanatory variable	Categories	Shares
Temperature target	1.5° C	0.12
	below 2° C	0.42
	2° C	0.2
	3° C	0.23
	na	0.29
Time horizon	2025	0.22
	2030	0.22
	2040	0.23
	2050	0.26
	2100	0.01
	na	0.01
Output type	balance sheet effect	0.52
	financial metric	0.35
	gap	0.03
	risk score	0.1
Firm targets	included	0.58
	not included	0.42
CAPEX plans	included	0.58
	not included	0.42
Approach	bottom-up	0.93
	combined	0.04
	top-down	0.03

Double LASSO - Risk assessments I

- Prediction: LASSO + robust OLS on reduced model
- 16 dummified variables, only 1 dropped (bottom-up approach)
- Same direction of impacts but different significance
 - Non significance of the type of output
 - Non significance of including of firm targets

Double LASSO - Risk assessments II

Dependent variable: Risk assessment

temp_target_b2	-0.143 (0.150)	output_finmetric	0.356* (0.202)
temp_target_2	-0.124 (0.163)	output_gap	0.193 (0.148)
temp_target_3	-0.115 (0.150)	output_riskscore	0.082 (0.088)
temp_target_na	0.198 (0.181)	firm_target_1	0.203 (0.137)
time_horizon_2030	0.042** (0.018)	capex_1	0.447*** (0.109)
time_horizon_2040	0.094** (0.039)	approach_topdown	0.217*** (0.076)
time_horizon_2050	0.087 (0.055)	Constant	-0.352* (0.202)
time_horizon_2100	-0.133 (0.146)		
time_horizon_na	-0.223 (0.169)		

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Within-metric OLS

Dependent variable: risk assessment

	Metrics 5-6	Metrics 7-30	Metrics 31-46	Metrics 53-64	Metrics 66-73
temp_target_b2	0.006*** (0.002)	0.004*** (0.0003)		-0.021*** (0.001)	
temp_target_2			-0.001*** (0.0003)	-0.026*** (0.001)	
temp_target_3		-0.002*** (0.0003)	-0.003*** (0.0005)		
time_horizon_2030		-0.001* (0.0003)	0.0003 (0.0003)	0.006*** (0.001)	0.003*** (0.001)
time_horizon_2040		-0.0003 (0.0003)	0.002*** (0.0003)	0.008*** (0.001)	0.007*** (0.001)
time_horizon_2050		-0.0001 (0.0004)	0.003*** (0.0003)	0.011*** (0.001)	0.009*** (0.001)
ass_mainstream		-0.011*** (0.0002)			
ass_immediate			0.00004 (0.0003)		-0.002*** (0.0004)
Constant	-0.355*** (0.001)	0.296*** (0.0003)	0.289*** (0.0004)	-0.467*** (0.001)	-0.525*** (0.0004)

* p<0.1; ** p<0.05; *** p<0.01

Within-metric double LASSO

Dependent variable: Risk assessment

	Metrics 5-6	Metrics 6-30	Metrics 31-46	Metrics 53-64	Metrics 66-73
time_horizon_2030				0.010*** (0.001)	
temp_target_2			-0.002** (0.001)	-0.056*** (0.001)	
temp_target_3		-0.005*** (0.001)	-0.004*** (0.001)		
temp_target_b2	0.007*** (0.003)	0.005*** (0.0005)		-0.049*** (0.001)	
time_horizon_2040		-0.002*** (0.0005)	0.002*** (0.0005)	0.013*** (0.001)	0.008*** (0.001)
time_horizon_2050		-0.004*** (0.001)	0.005*** (0.001)	0.019*** (0.001)	0.016*** (0.001)
ass_mainstream		-0.019*** (0.0004)			
ass_immediate			-0.0001 (0.001)		-0.007*** (0.001)
Constant	-0.343*** (0.002)	0.271*** (0.0004)	0.288*** (0.001)	-0.440*** (0.001)	-0.522*** (0.001)

* p<0.1; ** p<0.05; *** p<0.01

Moments of the distribution

- Mean, standard deviation, skewness and kurtosis
- Higher temperature target associated with lower kurtosis
- Financial/gap/risk scores metrics associated with higher mean, lower skewness, mixed standard deviation
- CAPEX/firm targets associated with larger mean and lower skewness
- Combined/top-down approach associated with lower standard deviation

Moments of the distributions OLS

Dependent variable: Distribution of risk assessment

	Mean	Standard deviation	Skewness	Kurtosis
temp_target_b2	-0.094 (0.292)	0.007 (0.006)	1.425 (6.108)	-4.777*** (1.111)
temp_target_2	-0.085 (0.307)	0.003 (0.006)	1.275 (5.990)	-2.647 (2.426)
temp_target_3	-0.135 (0.354)	-0.006 (0.005)	1.989 (6.404)	-4.659* (2.387)
temp_target_na	0.269 (0.275)	-0.122*** (0.011)	-3.246 (6.204)	6.019 (7.451)
time_horizon_2030	0.036 (0.074)	0.003 (0.006)	-0.695 (1.750)	-6.263 (3.993)
time_horizon_2040	0.103 (0.138)	0.005 (0.010)	-1.144 (2.256)	-6.761** (2.864)
time_horizon_2050	0.116 (0.144)	0.004 (0.015)	-0.880 (2.195)	-4.213 (6.832)
time_horizon_2100	-0.007 (0.155)	0.037*** (0.012)	-3.253 (2.274)	13.204 (9.653)
time_horizon_na	-0.403*** (0.098)	0.056* (0.033)	5.500** (2.613)	-28.462 (19.133)
output_finmetric	0.596* (0.339)	-0.125*** (0.020)	-6.618 (4.364)	46.254*** (11.599)
output_gap	0.587*** (0.086)	0.082** (0.035)	-8.110*** (1.990)	23.243 (20.924)
output_riskscore	0.269*** (0.030)	0.262*** (0.015)	-2.721*** (0.627)	-2.500 (7.897)
firm_target_1	0.322*** (0.054)	-0.029 (0.018)	-4.885*** (1.146)	14.183 (10.251)
capex_1	0.562*** (0.097)	-0.102*** (0.014)	-6.166*** (1.308)	20.486** (9.688)
approach_comb	-0.333*** (0.046)	-0.196*** (0.011)	4.313*** (0.808)	5.653 (6.442)
approach_topdown	0.109 (0.137)	-0.258*** (0.014)	-0.261 (1.601)	0.598 (7.830)
Constant	-0.091 (0.203)	0.185*** (0.015)	6.763 (4.942)	2.446 (9.722)

* p<0.1; ** p<0.05; *** p<0.01

Moments of the distributions double LASSO

Dependent variable: Distribution of risk assessment

	Mean	Standard deviation	Skewness	Kurtosis
temp_target_2		-0.017 (0.013)		
temp_target_3		-0.041 (0.025)		-17.049 (18.737)
output_finmetric		-0.073*** (0.020)		
output_riskscore		0.128*** (0.046)		-31.986*** (9.578)
firm_target_1			-2.001 (2.735)	
capex_1	0.241* (0.130)	-0.063*** (0.020)	-2.689* (1.593)	
approach_comb		-0.108*** (0.038)		
Constant	0.354*** (0.130)	0.163*** (0.008)	2.084 (2.052)	45.475*** (14.808)

* p<0.1; ** p<0.05; *** p<0.01