Z-Risk Engine™
Unlocking Credit Cycles

ZRE: Coronavirus PIT ECL Impact Analysis – Indirect Effects on a US/UK Hypothetical Credit Portfolio As of March 23, 2020

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ECL Impact Analysis: Trial Portfolio Using ZRE With Updated EDFs to Assess Indirect PIT Coronavirus Loss Effects

- US/UK hypothetical corporate/commercial credit portfolio of about $1.7 bil in limits was developed – detail below
- Trial portfolio has an LGD x EAD-weighted TTC PD of 0.89% and EAD-weighted, TTC LGD of 32%, the one-year TTC loss is **$3.3 million**
- ZRE runs in two modes; simulation of our industry/region credit cycles (Uses a Mean Reversion/Momentum Model) utilizing 'pure' PIT credit measures - which produces an 'unconditional' estimate of ECLs or ZRE runs in scenario mode ('conditional') where 3-4 scenarios on various macro and other factors can be provided
- This analysis presented here is from the **'unconditional' simulation approach** which is fully automated and can therefore be run with **changes in daily one-year EDFs**
- FYI, the automated E2E simulation approach for ECLs can run a portfolio of 400-500k facilities E2E in about 3-4 hours
- **ECLs for this trial portfolio assessed using Ind/Reg cycle-adjusted PIT measures:**
  - **Pre-Substantial Coronavirus: December 31, 2019**
  - **Post-3.5% USA Market Sell-Off: Monday, March 23, 2020**

Overview Cont: ECL Impact Analysis Using ZRE Dynamically

- Estimates from a trial portfolio of US and UK corporate and commercial facilities with a wide range of PDs, EADs, and industry segments
- One-year and lifetime ECLs as of 23 Mar 2020 up relative to values as of 31 Dec 2019 by about 2.4x and about 2.0x, respectively
- ECLs still not as extreme as CCAR 2020 stress values; stock prices as of Mar 23 down about 35% from Dec 31 whereas the severely adverse scenario assumes a fall of over 60%; corporate spreads, while up sharply in Mar, still well below 2008-09 highs
- Stress results based on the CCAR 2020 Severely Adverse scenario indicates that ECLs could rise by an additional 3x for an over 7x rise since Dec 2019

	ZRE Inputs									ZRE Outputs CU (000s)		ZRE Outputs CU (000s)		Ratio 23 Mar		Ratio
	Basel Parameters					Other Facility Attributes		31-Dec-19		31-Dec-19		23-Mar-20		2020/31 Dec 2019		Stress/Dec
FAC #	TTC PD	TTC LGD	TTC EAD	TTC CCF	TTC FCF	Maturity in Years	(Millions CU)	One-Year TTC EL	One-Year Static PIT EL	One-Year ECL	Lifetime ECL	One-Year ECL	Lifetime ECL	One-Year ECL	Lifetime ECL	One Year ECL
All	0.89%	32%	1,178	66%	97%	2.52	1725	3,309	1,858	1,742	4,515	4,216	9,623	2.42	2.13	7.36

Source: ZRE application, Moody's Credit Edge EDFs – 'CU' stands for 'Currency Units'

Trial Portfolio ECL Details – Dec 31, 2019 & March 23th, 2020 (1/2)

Tables Provide Details on TTC PD/LGD/EAD (CCF), Exposures & The Industry/Regions Using Our Credit Cycle Indices for this Hypothetical 'Trial' Portfolio of about $1.7 bil in Limits

Classification Information			ZRE Inputs										Calculations CU (000s)		ZRE Outputs CU (000s)		ZRE Outputs CU (000s)		Ratio 23 Mar	
			Basel Parameters					Other Facility & Borrower Attributes					31-Dec-19		31-Dec-19		23-Mar-20		2020/31 Dec 2019	
FAC #	Portfolio	Product	TTC PD	TTC LGD	TTC EAD	TTC CCF	TTC FCF	Maturity in Years	(Millions CU)	Expected Usage	Primary Region	Primary Industry	EIR	One-Year TTC EL	One-Year Static PIT EL	One-Year ECL	Lifetime ECL	One-Year ECL	Lifetime ECL	One-Year ECL	Lifetime ECL
1	SME	Term	0.72%	25%	5	100%	100%	5.97	5	100%	North America	Media	3.24%	9	5	5	58	16	128	3.34	2.20
2	LC	Backstop	0.12%	35%	49	70%	100%	1.05	70	0%	North America	Business and Consumer Services	2.54%	20	10	11	12	41	44	3.61	3.56
3	SME	Term	0.05%	30%	5	100%	100%	5.54	5	100%	North America	Business and Consumer Services	2.26%	1	0	0	10	2	24	3.68	2.44
4	SME	Term	0.06%	30%	12	100%	100%	0.75	12	100%	North America	Business and Consumer Services	3.29%	2	1	1	1	3	3	3.89	3.89
5.1	LC	Revolving	0.17%	35%	60	70%	100%	1.91	70	50%	North America	Business and Consumer Services	2.48%	34	18	19	51	67	156	3.50	3.06
5.2	LC	Term	0.17%	35%	40	100%	100%	2.00	40	100%	North America	Business and Consumer Services	2.48%	23	12	13	37	44	110	3.44	2.98
6	SME	Term	0.17%	30%	2	100%	100%	5.25	2	100%	North America	Business and Consumer Services	3.08%	1	1	1	8	2	19	3.31	2.38
7	SME	Term	4.04%	25%	5	100%	100%	3.00	5	100%	North America	Construction	4.47%	49	37	37	119	94	246	2.57	2.07
8	SME	Revolving	0.51%	25%	7	20%	100%	0.68	12	50%	North America FI	Finance, Insurance, and Real Estat	2.42%	9	5	3	3	8	8	2.15	2.15
9	LC	Backstop	0.72%	30%	49	70%	100%	0.50	70	0%	North America	Transportation	2.57%	103	68	32	32	111	111	3.42	3.42
10	SME	Term	2.42%	25%	15	100%	100%	1.14	15	100%	North America FI	Finance, Insurance, and Real Estat	4.02%	89	56	59	68	113	130	1.93	1.90
11	LC	Revolving	0.27%	35%	29	20%	100%	6.52	80	20%	UK	Medical	1.73%	26	8	10	218	38	493	3.92	2.26
12	SME	Term	0.51%	25%	12	100%	100%	4.75	12	100%	North America	Hotels and Leisure	2.80%	15	9	9	84	38	237	4.13	2.82
13	LC	Term	0.12%	35%	80	100%	100%	1.75	80	100%	North America	Basic Industries	2.73%	33	19	20	47	71	148	3.57	3.13
14	SME	Term	22.63%	25%	10	100%	100%	1.18	10	100%	North America FI	Finance, Insurance, and Real Estat	7.35%	552	391	393	447	678	757	1.73	1.69
15	SME	Term	0.72%	25%	12	100%	100%	5.71	12	100%	North America	Retail and Wholesale Trade	3.02%	21	14	16	158	47	325	2.98	2.06
16	SME	Revolving	2.42%	25%	1	30%	100%	1.84	2	50%	North America	Construction	2.47%	8	6	6	11	16	28	2.79	2.48
17	SME	Term	11.03%	25%	5	100%	100%	2.08	5	100%	North America	Construction	9.74%	135	108	103	195	231	380	2.25	1.95
18	LC	Backstop	0.72%	30%	35	70%	100%	0.75	50	0%	North America	Oil and Gas	2.58%	74	60	42	42	155	155	3.66	3.66
19	SME	Contingent	6.61%	25%	1	20%	25%	0.99	12	20%	North America	Construction	4.76%	17	13	13	13	33	33	2.49	2.49
20	LC	Backstop	0.27%	35%	36	45%	100%	0.50	80	0%	North America	Consumer Products	2.18%	33	19	9	9	31	31	3.62	3.62
21.1	LC	Revolving	0.72%	30%	22	20%	100%	0.75	80	10%	North America	Retail and Wholesale Trade	2.58%	47	32	25	25	79	79	3.19	3.19
21.2	LC	Term	0.72%	30%	80	100%	100%	0.75	80	100%	North America	Retail and Wholesale Trade	2.58%	171	116	88	88	261	261	2.95	2.95

Source: ZRE application, Moody's Credit Edge EDFs – 'CU' stands for 'Currency Units'

Trial Portfolio ECL Details – Dec 31, 2019 & March 23th, 2020 (2/2)

Tables Provide Details on TTC PD/LGD/EAD (CCF), Exposures & The Industry/Regions Using Our Credit Cycle Indices for this Hypothetical 'Trial' Portfolio of about $1.7 bil in Limits

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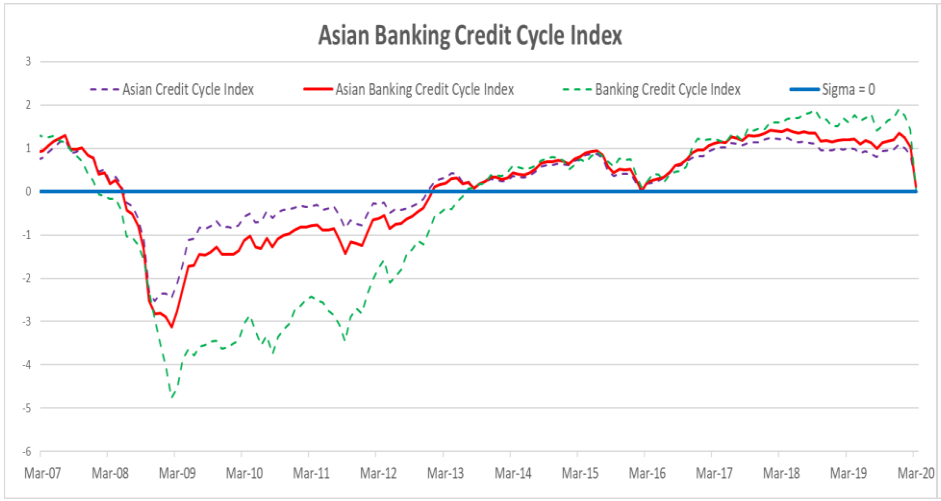
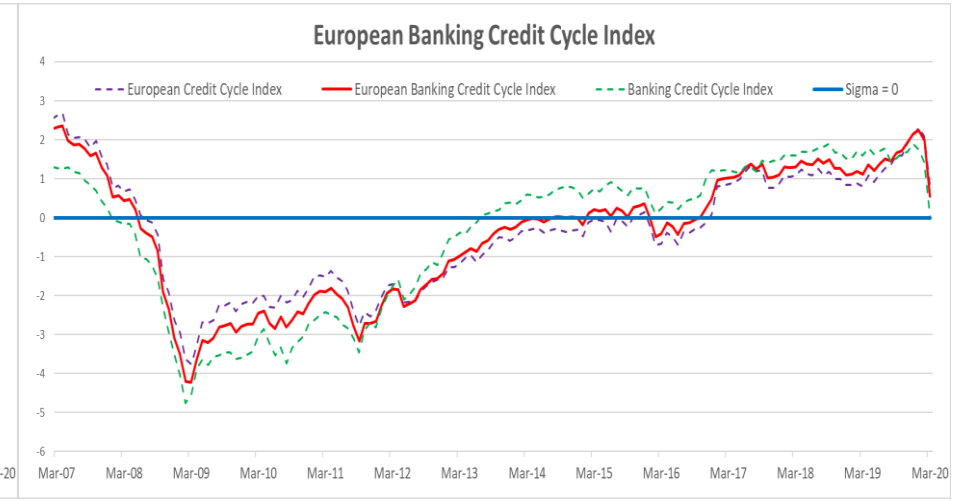
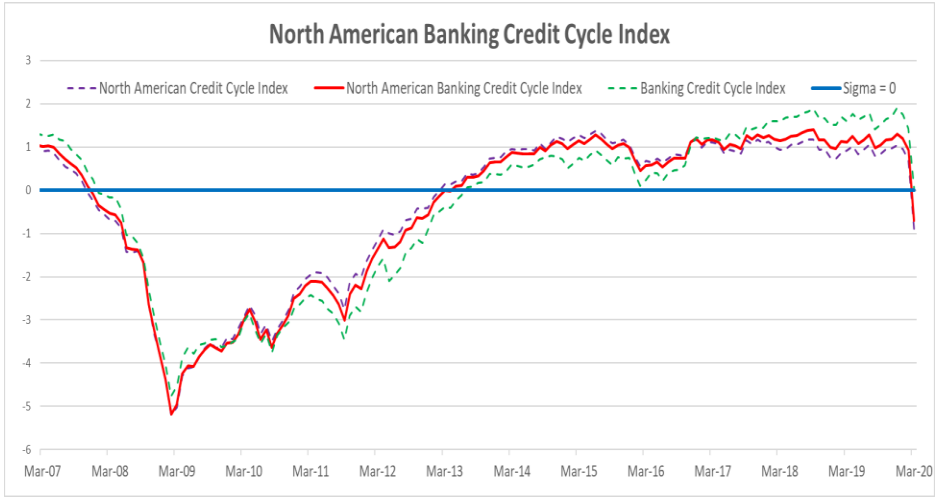
FAC #	Portfolio	Product	TTC PD	TTC LGD	TTC EAD	TTC CCF	TTC FCF	Maturity in Years	(Millions CU)	Expected Usage	Primary Region	Primary Industry	EIR	One-Year TTC EL	One-Year Static PIT EL	One-Year ECL	Lifetime ECL	One-Year ECL	Lifetime ECL	One-Year ECL	Lifetime ECL
22	LC	Revolving	0.51%	30%	45	45%	100%	0.92	50	80%	North America FI	Banking	2.43%	67	40	38	38	77	77	2.02	2.02
23	SME	Term	0.17%	30%	10	100%	100%	3.50	10	100%	North America	Medical	2.63%	5	3	3	21	12	61	3.76	2.94
24	SME	Term	4.04%	25%	10	100%	100%	5.81	10	100%	North America	Basic Industries	4.10%	99	70	68	425	181	766	2.67	1.80
25	SME	Revolving	0.51%	25%	7	30%	100%	4.75	10	50%	North America	Basic Industries	2.84%	8	5	5	46	17	115	3.41	2.48
26	SME	Term	0.17%	30%	10	100%	100%	3.34	10	100%	North America	Hotels and Leisure	2.35%	5	3	3	19	13	61	4.41	3.24
27	LC	Backstop	6.61%	30%	49	70%	100%	1.50	70	0%	UK FI	Banking	6.11%	949	352	357	556	751	1,112	2.10	2.00
28	LC	Term	0.04%	35%	50	100%	100%	0.25	50	100%	UK	Transportation	1.24%	8	2	0	0	2	2	7.55	7.55
29	SME	Term	6.61%	25%	10	100%	100%	6.32	10	100%	North America	Medical	3.99%	161	124	122	640	309	1,105	2.53	1.73
30	LC	Revolving	0.51%	30%	34	20%	100%	3.89	50	60%	UK	Business and Consumer Services	2.12%	51	16	19	156	64	366	3.40	2.35
31	SME	Term	0.06%	30%	5	100%	100%	1.03	5	100%	North America	Machinery and Equipment	2.31%	1	1	1	1	2	2	3.79	3.76
32.1	LC	Revolving	0.17%	35%	14	45%	100%	4.25	30	0%	North America	Machinery and Equipment	2.56%	8	5	5	47	18	125	3.60	2.63
32.2	LC	Term	0.17%	35%	30	100%	100%	4.25	30	100%	North America	Machinery and Equipment	2.56%	17	11	12	106	39	268	3.36	2.53
33.1	LC	Revolving	0.27%	35%	27	35%	100%	1.50	50	30%	North America	Consumer Products	4.30%	25	15	15	27	50	81	3.26	3.04
33.2	LC	Term	0.27%	35%	70	100%	100%	1.36	70	100%	North America	Consumer Products	4.30%	65	38	40	61	125	181	3.10	2.95
34	LC	Revolving	0.12%	35%	42	20%	100%	0.87	70	50%	North America	Media	2.18%	17	8	8	8	28	28	3.76	3.76
35	SME	Contingent	0.12%	30%	1	20%	25%	0.85	5	80%	North America	Retail and Wholesale Trade	2.18%	0	0	0	0	1	1	3.51	3.51
36	LC	Revolving	2.42%	30%	24	30%	100%	2.84	80	0%	UK FI	Banking	2.20%	169	53	55	223	131	425	2.37	1.91
37	SME	Term	0.05%	30%	10	100%	100%	0.65	10	100%	North America	Business and Consumer Services	2.49%	2	1	0	0	2	2	4.05	4.05
38	SME	Revolving	4.04%	25%	9	70%	100%	0.50	12	20%	North America FI	Finance, Insurance, and Real Estat	4.19%	89	56	28	28	58	58	2.07	2.07
39	SME	Revolving	2.42%	25%	6	20%	100%	0.87	10	50%	North America	Oil and Gas	4.60%	35	30	25	25	79	79	3.12	3.12
40	LC	Revolving	0.04%	35%	48	20%	100%	1.50	70	60%	North America FI	Banking	2.03%	7	4	4	9	9	17	2.15	2.00
41	SME	Term	0.17%	30%	2	100%	100%	1.01	2	100%	North America	Mining	3.38%	1	1	1	1	2	2	3.31	3.30
42	SME	Revolving	0.27%	30%	3	30%	100%	1.62	10	0%	North America	Construction	4.19%	2	1	2	3	6	10	3.64	3.26
43	SME	Revolving	0.05%	30%	3	20%	100%	4.00	12	10%	North America	Retail and Wholesale Trade	3.08%	1	0	0	4	1	10	4.07	2.72
44	LC	Revolving	0.06%	35%	51	45%	100%	5.90	70	50%	UK	Media	1.53%	11	2	3	112	13	261	4.21	2.33
45	LC	Revolving	0.27%	35%	8	20%	100%	0.66	30	10%	North America	Media	2.39%	8	4	2	2	9	9	3.77	3.77
46	LC	Revolving	0.27%	35%	29	20%	100%	6.52	80	20%	UK	Medical	1.73%	26	8	10	218	38	493	3.92	2.26
All			0.89%	32%	1,178	66%	97%	2.52	1725					3,309	1,858	1,742	4,515	4,216	9,623	2.42	2.13

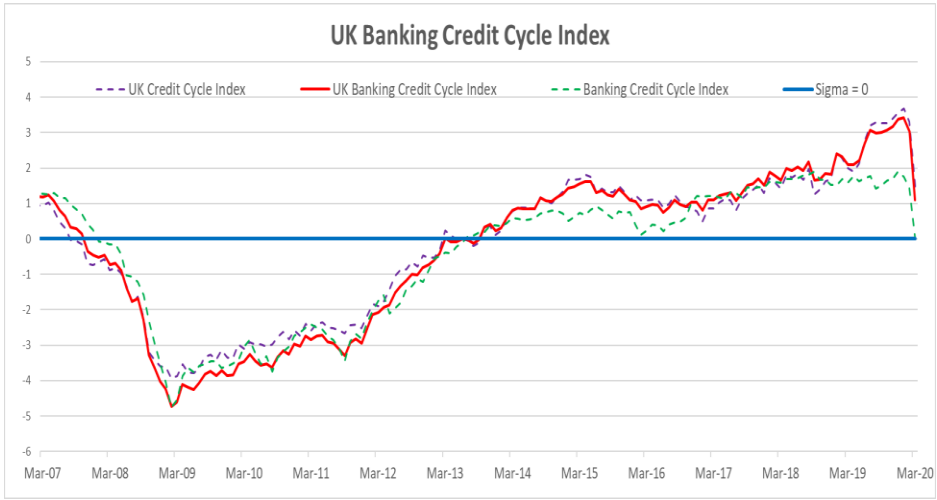
Source: ZRE application, Moody's Credit Edge EDFs – 'CU' stands for 'Currency Units'

Banking/Regional Credit Cycles as of March 23, 2020



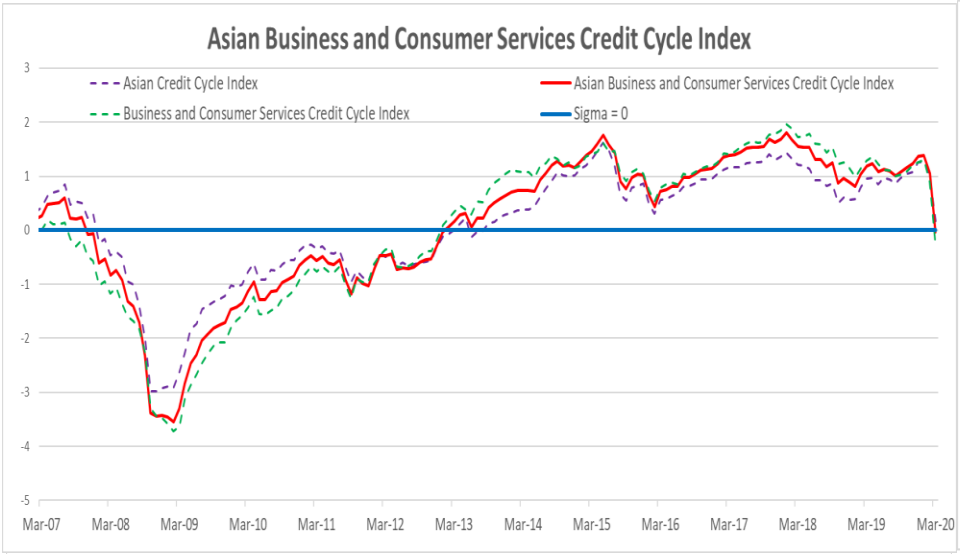


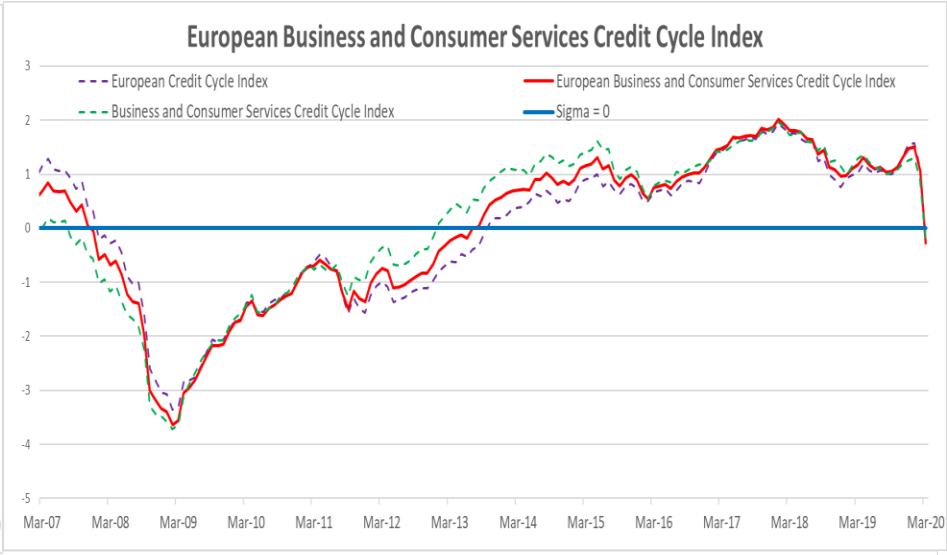


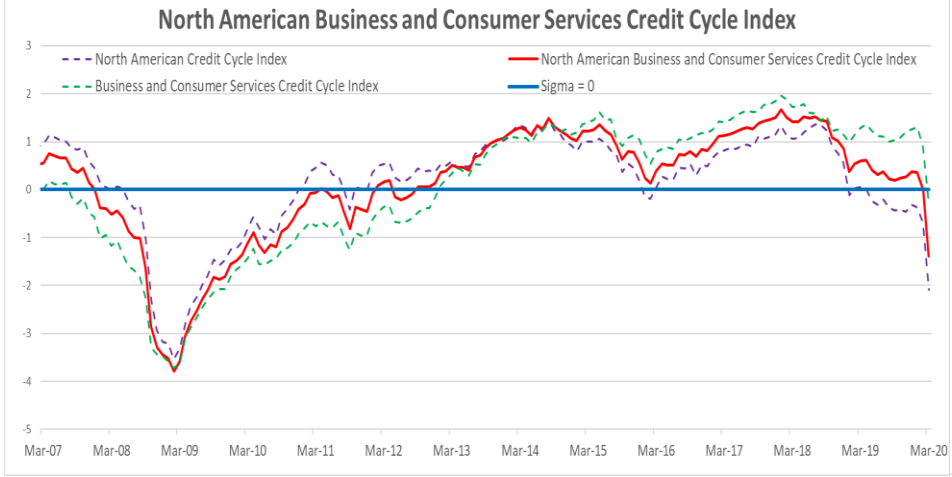


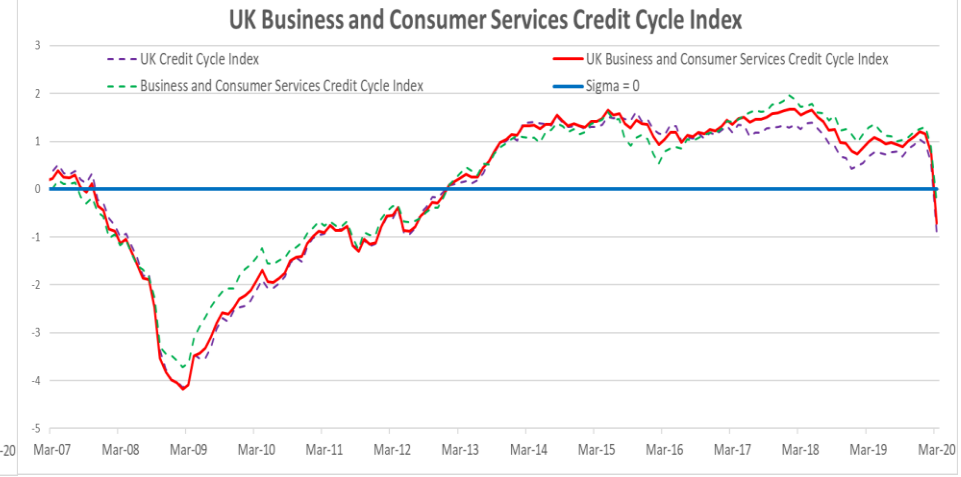
Source: ZRE application, Moody's CreditEdge EDFs - 0 = TTC Credit Conditions – Cycles Shown in Sigma Units – Cycle Below 0 Implies PIT Risk > TTC Risk

Business & Consumer Services/Regional Credit Cycles as of March 23, 2020



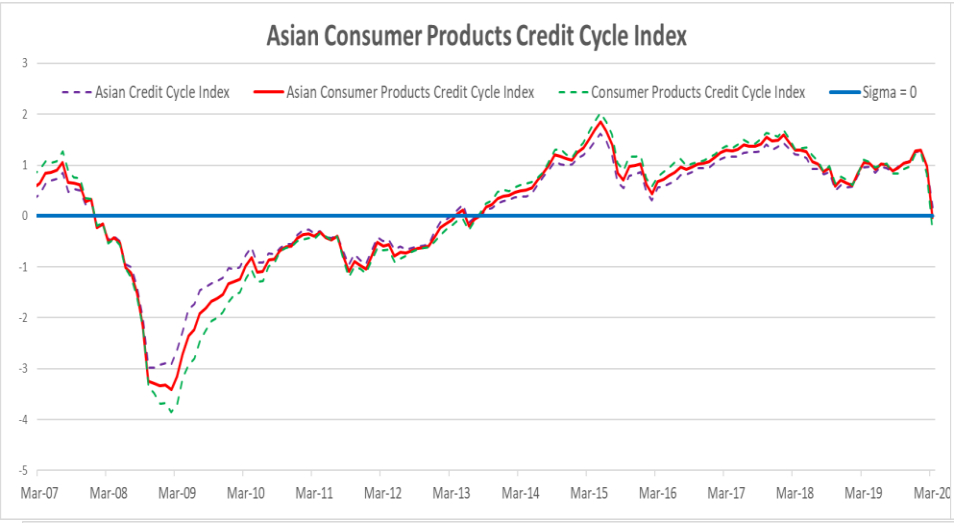


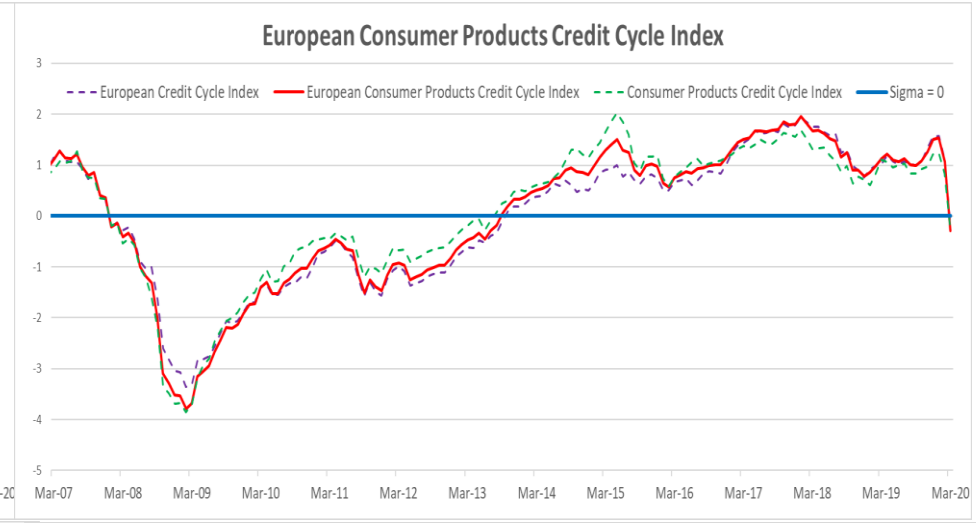


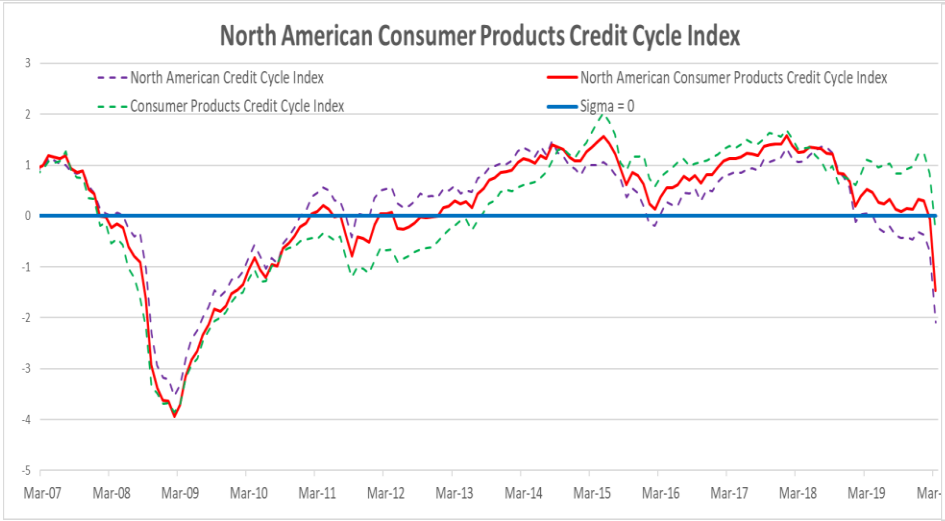


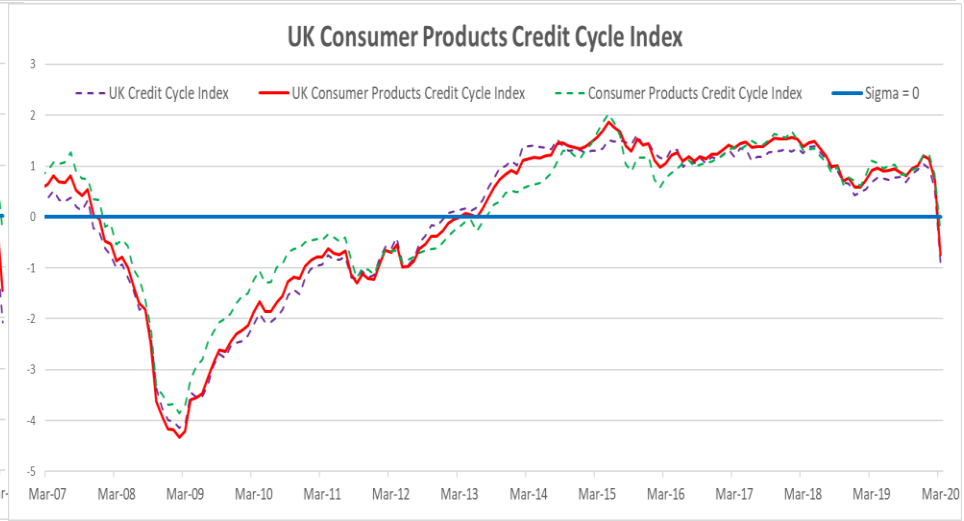
Source: ZRE application, Moody's CreditEdge EDFs - 0 = TTC Credit Conditions – Cycles Shown in Sigma Units – Cycle Below 0 Implies PIT Risk > TTC Risk

Consumer Products/Regional Credit Cycles as of March 23, 2020









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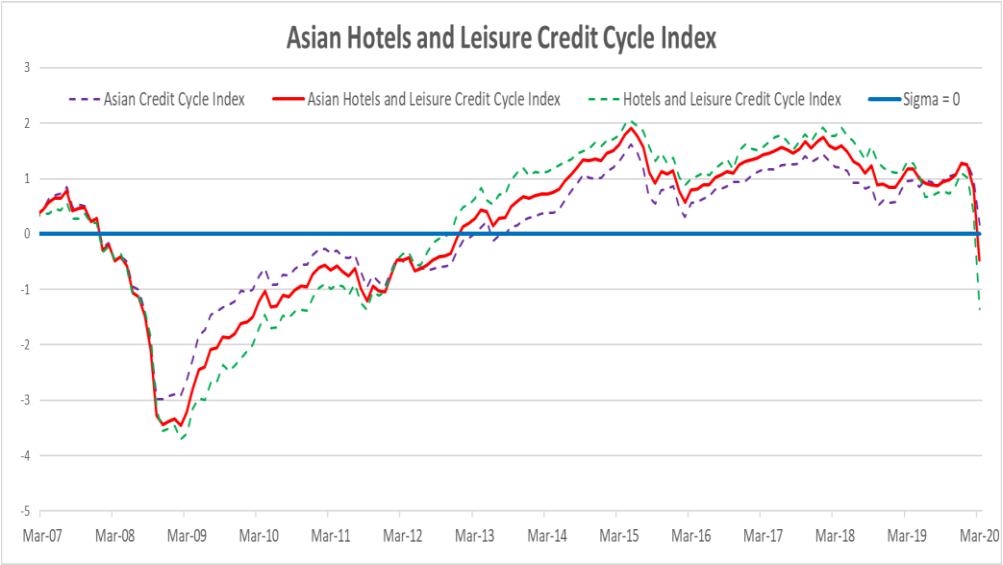
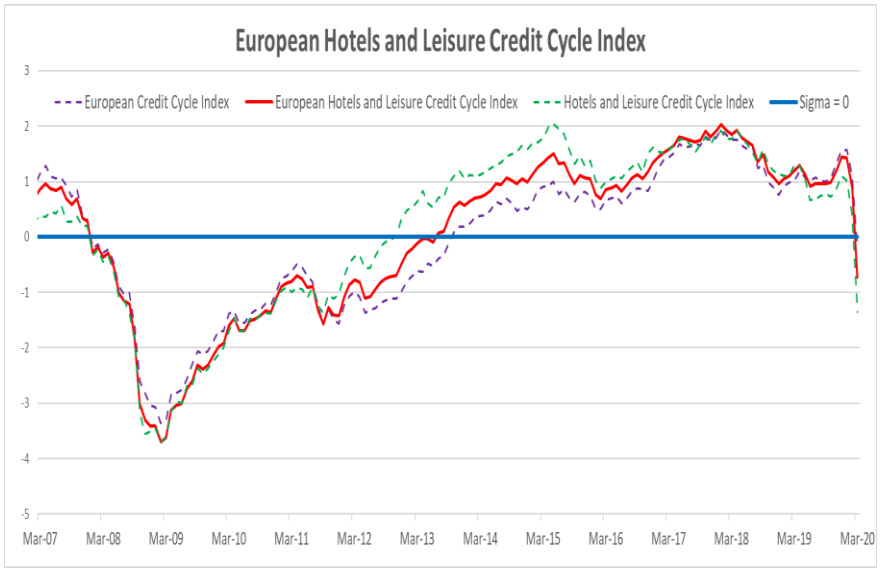
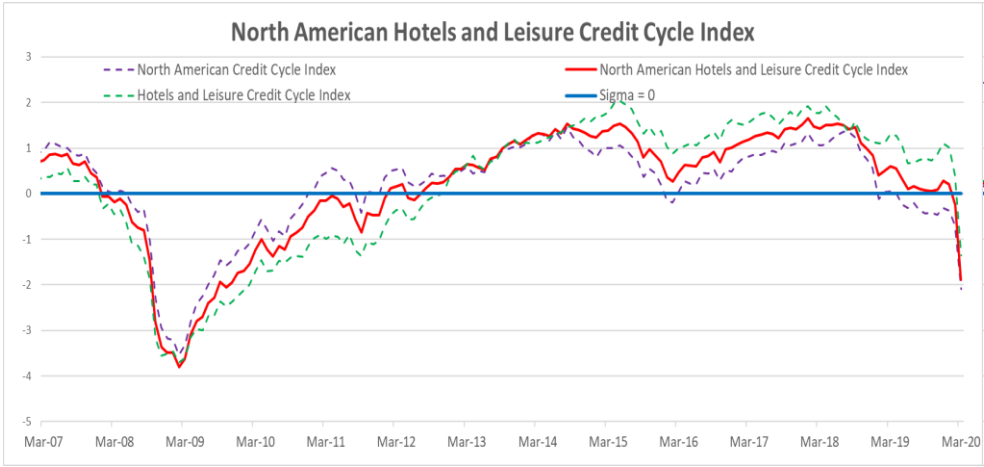
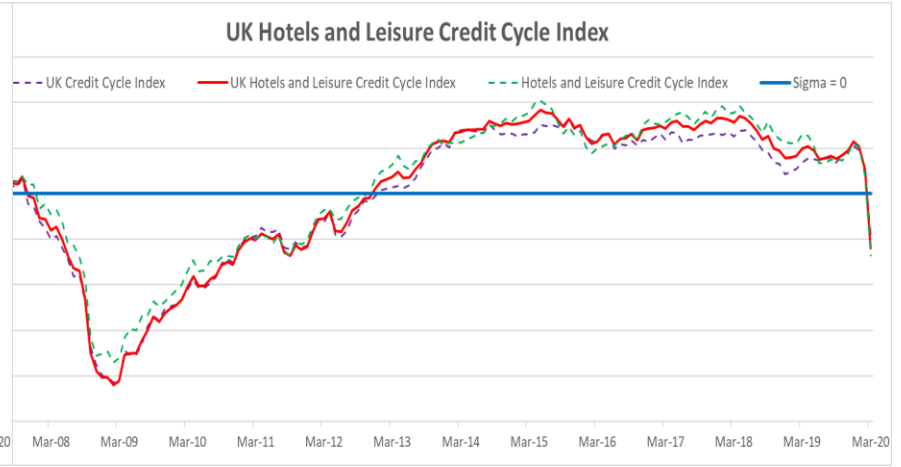
Hotels & Leisure/Regional Credit Cycles as of March 23, 2020









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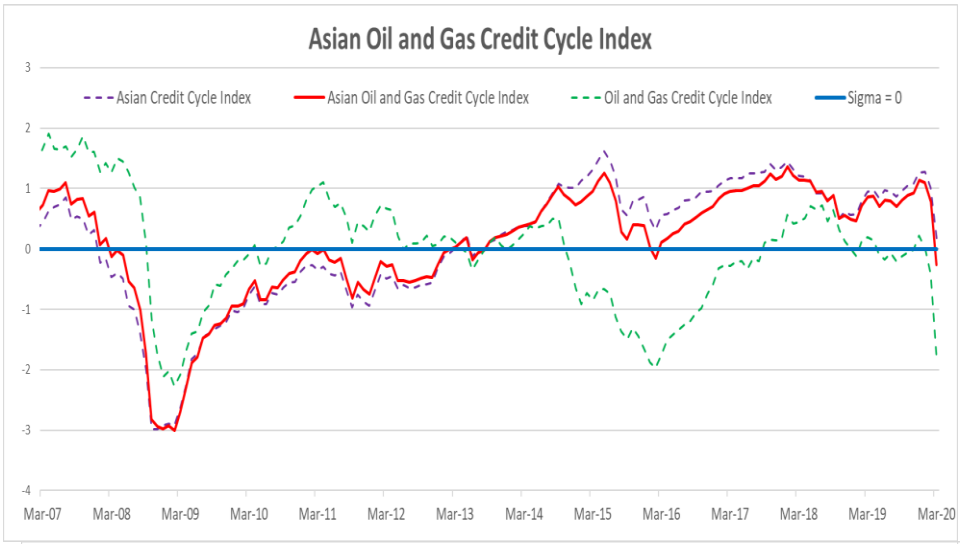
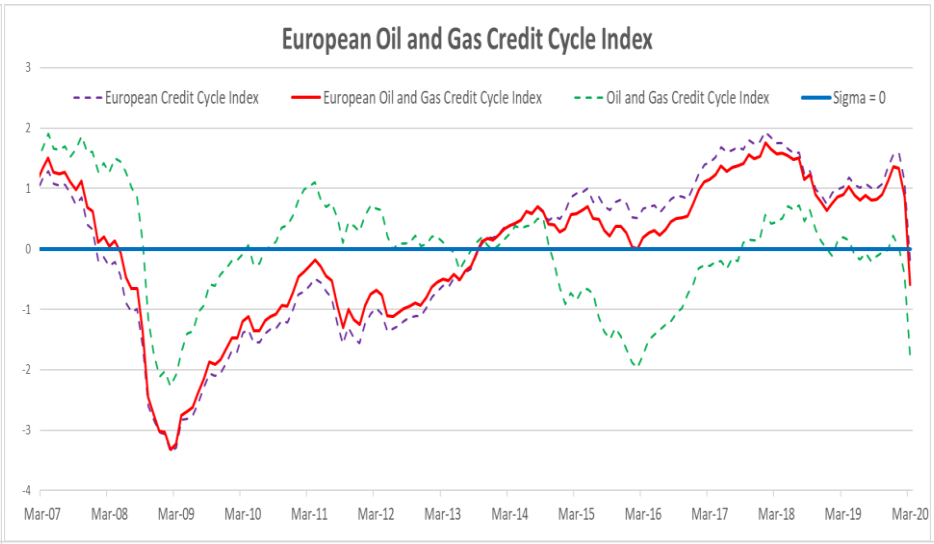
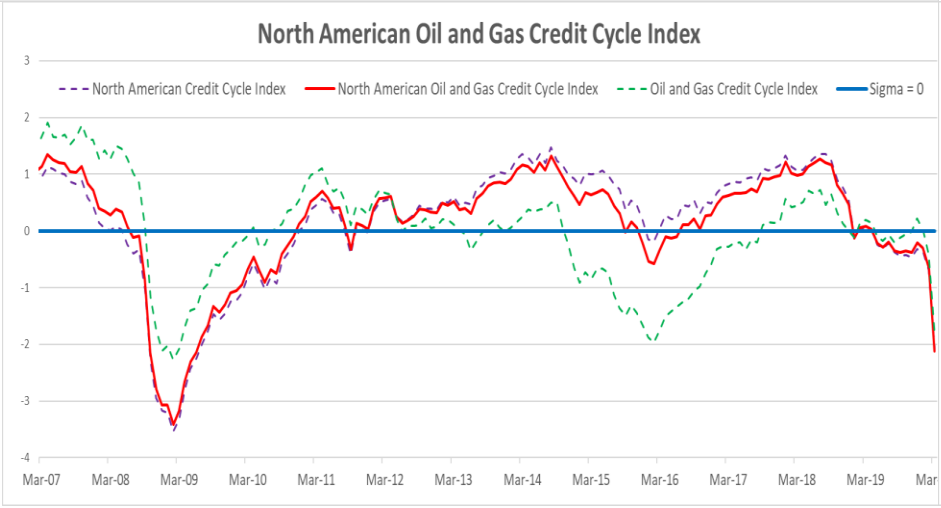
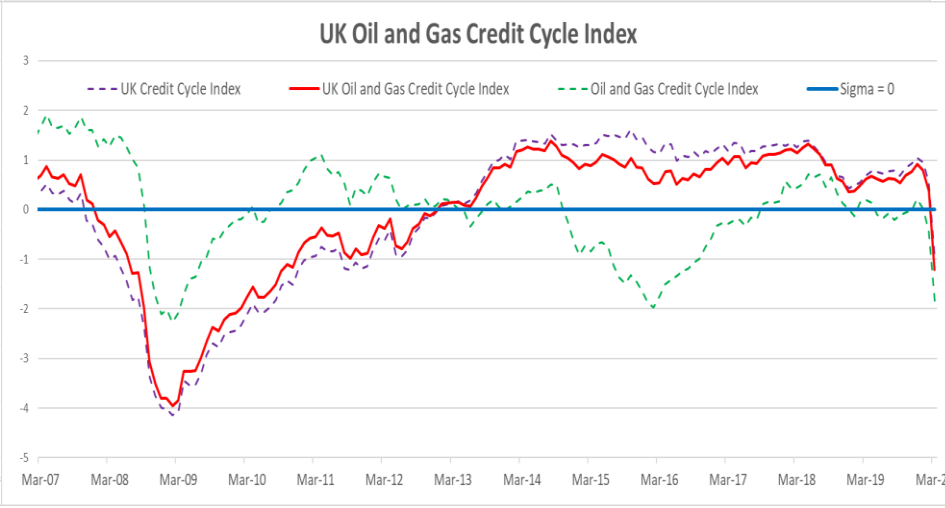
Oil & Gas/Regional Credit Cycles as of March 23, 2020



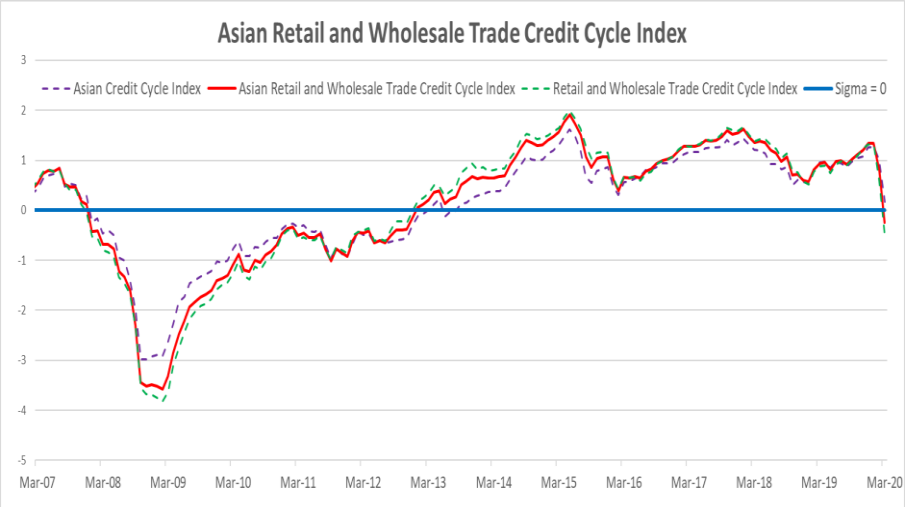


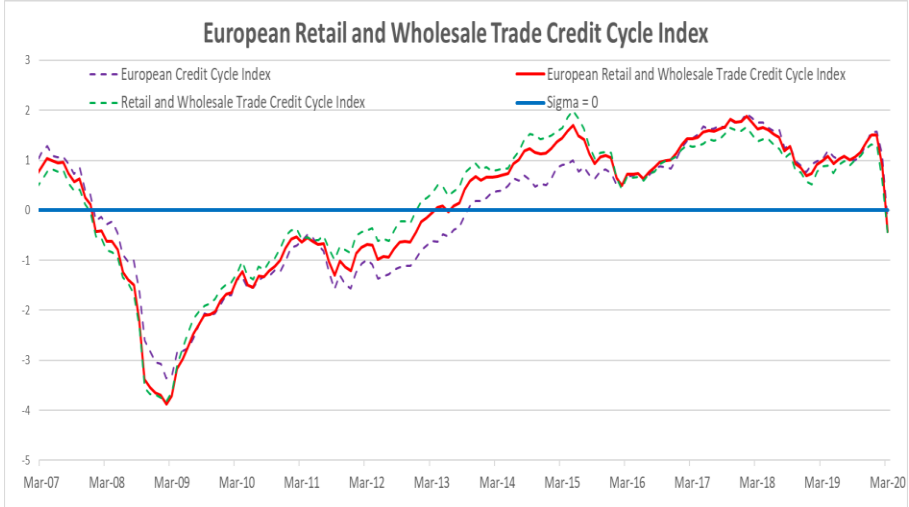


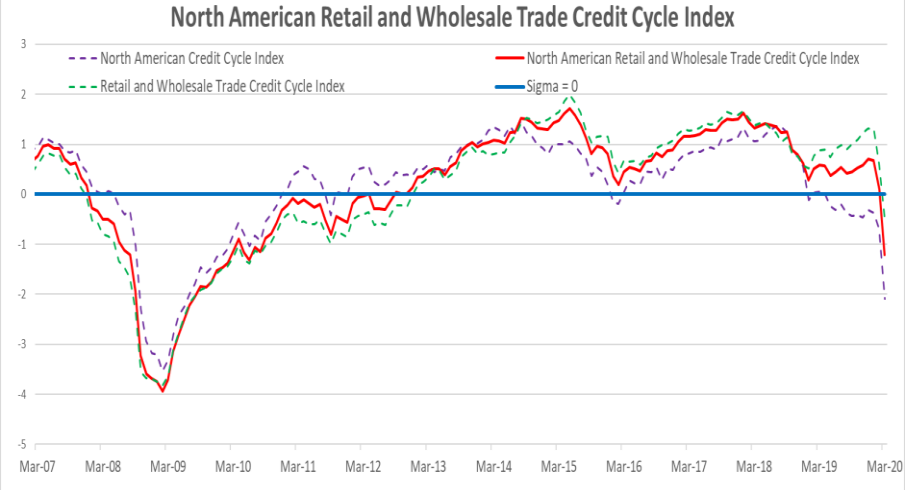


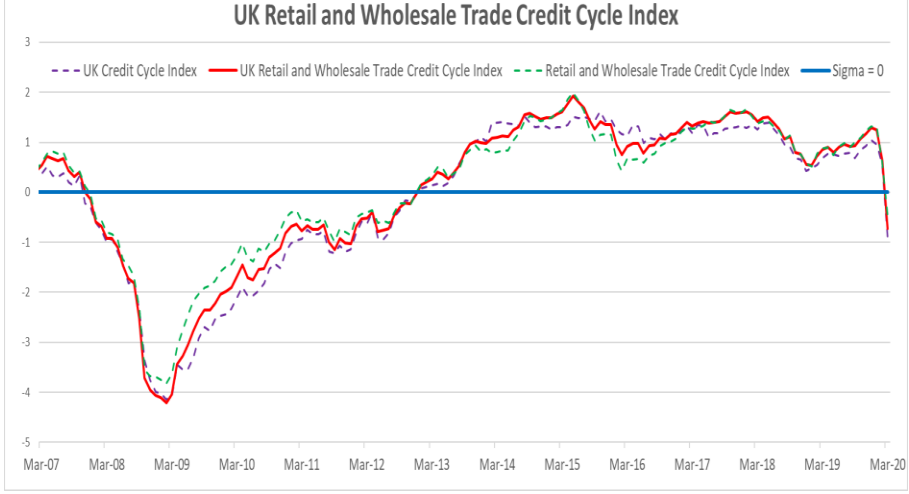
Source: ZRE application, Moody's CreditEdge EDFs - 0 = TTC Credit Conditions – Cycles Shown in Sigma Units – Cycle Below 0 Implies PIT Risk > TTC Risk

Retail/Wholesale Trade/Regional Credit Cycles as of March 23, 2020



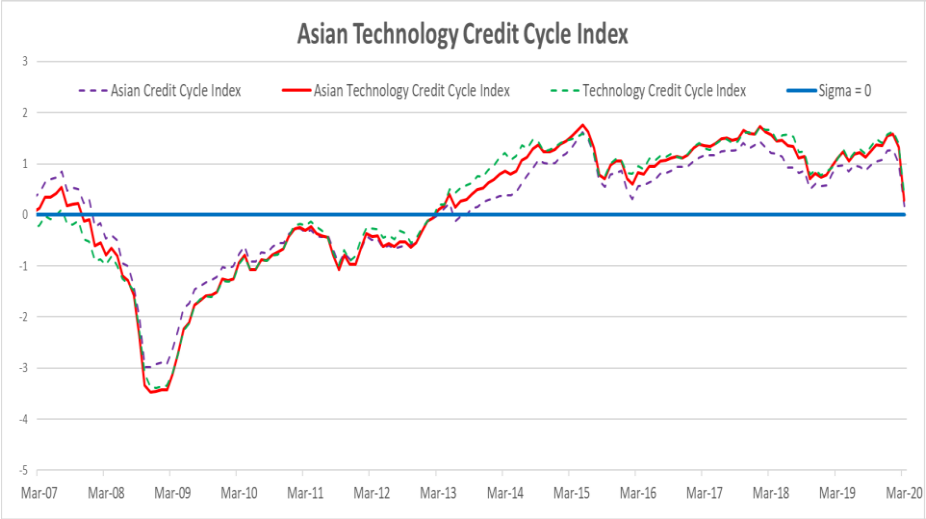


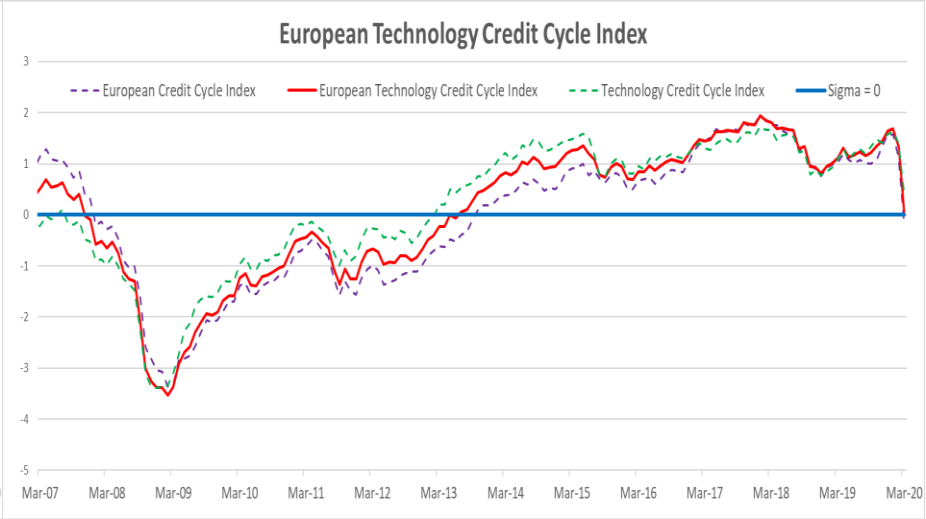


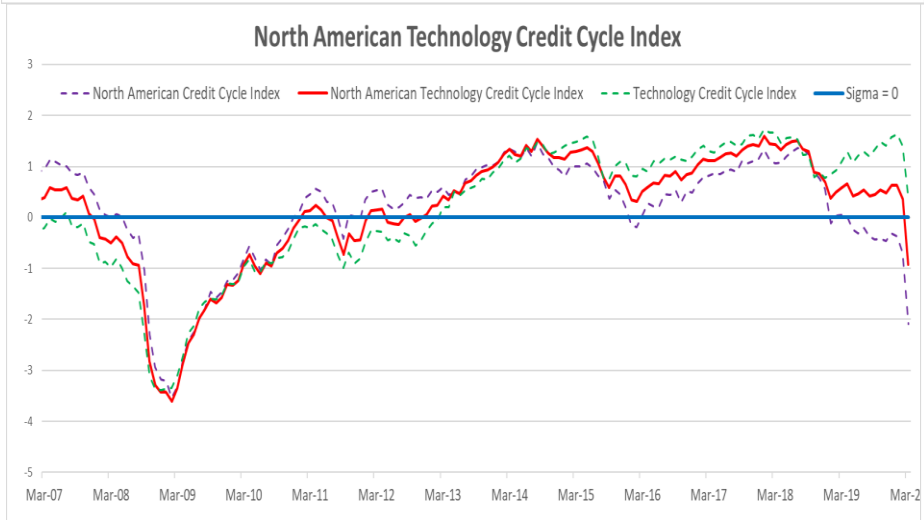


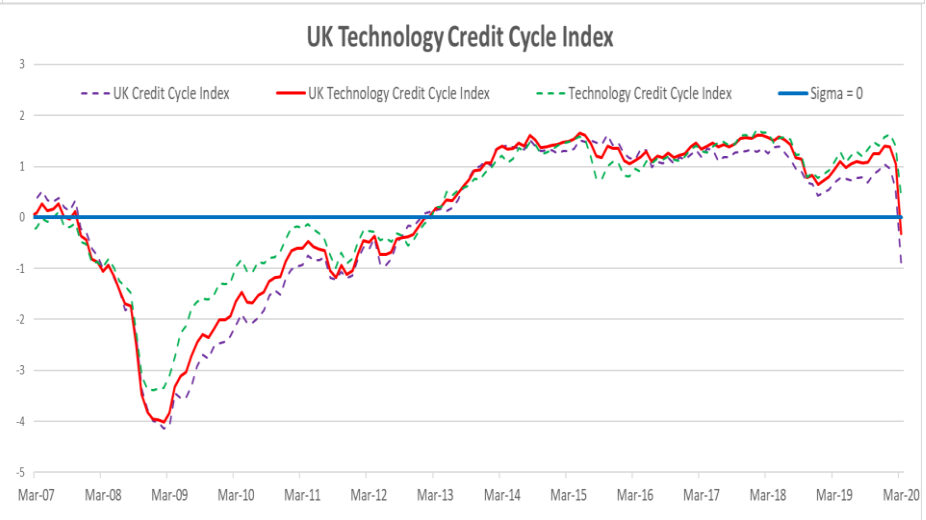
Source: ZRE application, Moody's CreditEdge EDFs - 0 = TTC Credit Conditions – Cycles Shown in Sigma Units – Cycle Below 0 Implies PIT Risk > TTC Risk

Technology/Regional Credit Cycles as of March 23, 2020



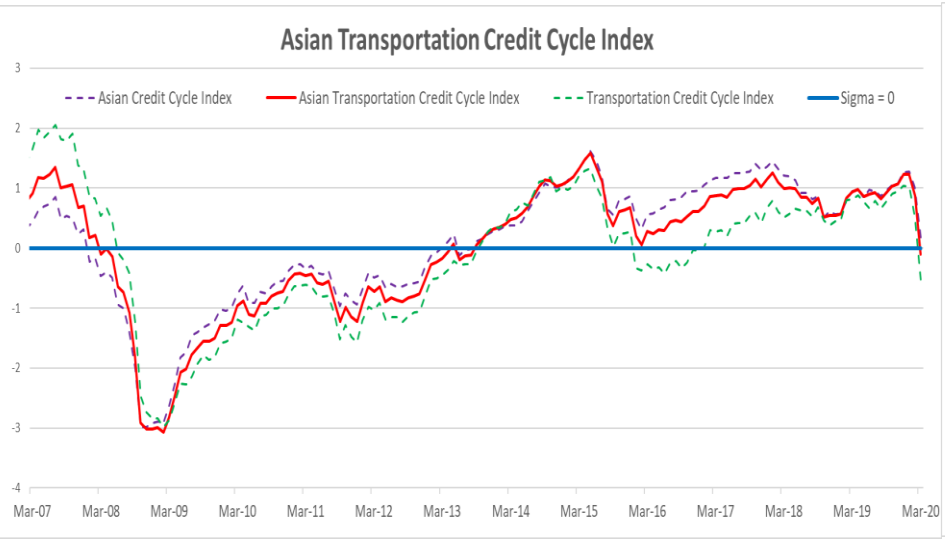


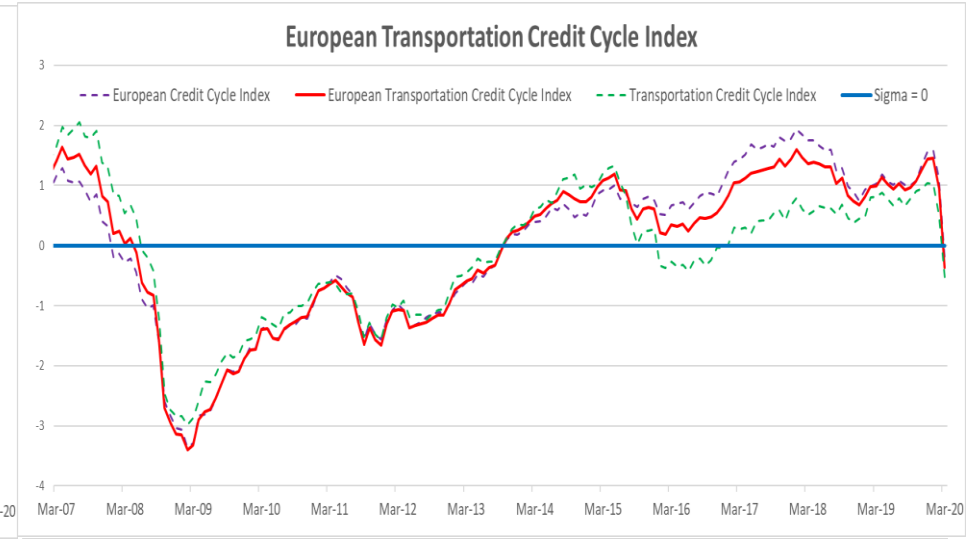


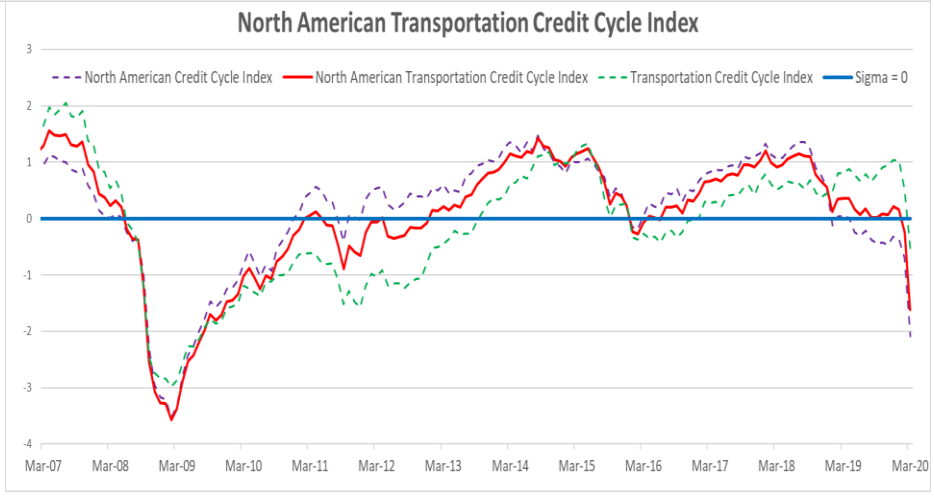


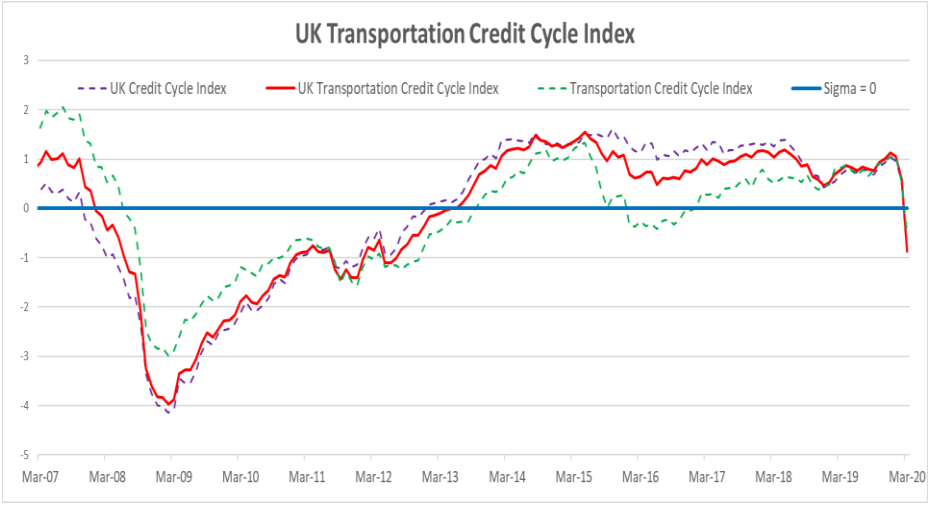
Source: ZRE application, Moody's CreditEdge EDFs - 0 = TTC Credit Conditions – Cycles Shown in Sigma Units – Cycle Below 0 Implies PIT Risk > TTC Risk

Transportation/Regional Credit Cycles as of March 23, 2020









Source: ZRE application, Moody's CreditEdge EDFs - 0 = TTC Credit Conditions – Cycles Shown in Sigma Units – Cycle Below 0 Implies PIT Risk > TTC Risk