

Appendix A

Slack variable based on input/output-orientated BCC model

No.	Variables	DMU input-orientation	DMU output-orientation
1	Terminal-HIT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
2	Terminal-COSCO	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
3	Terminal-MTL	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
4	Terminal-DPI	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000

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No.	Variables	DMU input-orientation	DMU output-orientation
	Water depth	0.000	0.000
5	Terminal-ACT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Berth length	-43.581	0.000
	Water depth	-0.218	-73.45
6	Terminal-Yantian	Summary of input slacks	-0.64
	Yard area per berth	0.000	0.000
	Quay crane per berth	-0.642	-0.615
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	-0.261	-0.716
	Berth length	-30.827	-93.57
	Water depth	0.000	-1.653
7	Terminal-Chiwan	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	-0.056
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	-43.113	-61.624
	Water depth	0.000	-0.007
8	Terminal-Shekou	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
9	Terminal-Nansha	Summary of input slacks	Summary of input slacks
	Yard area per berth	-153,749.613	-220,503.392
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	-1.395	-0.367
	Berth length	-18.344	-45.008
	Water depth	-0.033	-1.771
10	Terminal-NBCT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000

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No.	Variables	DMU input-orientation	DMU output-orientation
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
11	Terminal-NBSCT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	-0.334	0.000
	Terminal crane per berth	-1.633	-0.789
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	-0.443
	12	Terminal-CS-4	Summary of input slacks
Yard area per berth		0.000	0.000
Quay crane per berth		0.000	0.000
Terminal crane per berth		0.000	0.000
Yard tractor per berth		0.000	0.000
Berth length		0.000	0.000
Water depth		0.000	0.000
13		Terminal-WQ-2	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
	14	Terminal-YS-1&2	Summary of input slacks
Yard area per berth		-32,780.732	-63,421.106
Quay crane per berth		0.000	0.000
Terminal crane per berth		-0.23	-0.793
Yard tractor per berth		0.000	0.000
Berth length		0.000	0.000
Water depth		-0.14	-0.266
15		Terminal-KBCT	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
	16	Terminal-HBCT	Summary of input slacks
Yard area per berth		0.000	0.000

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No.	Variables	DMU input-orientation	DMU output-orientation
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
17	Terminal-INTERGIS	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
18	Terminal-Hanjin	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
19	Terminal-HGCT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	-0.398	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	-16.317	-25.069
	Water depth	0.000	0.000
20	Terminal-DPCT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	-3.254	-3.327
	Yard tractor per berth	0.000	0.000
	Berth length	-38.832	-41.516
	Water depth	-2.071	-2.263
21	Terminal-UTC	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000

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No.	Variables	DMU input-orientation	DMU output-orientation
22	Terminal-BICT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
23	Terminal-KIT2-2	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
24	Terminal-KX3-1	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
25	Terminal-HKTL	Summary of input slacks	Summary of input slacks
	Yard area per berth	-42,455.284	-46,709.697
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	-0.564	-0.308
	Yard tractor per berth	-7.044	-6.923
	Berth length	-90.717	-109.385
	Water depth	-2.55	-3.462
26	Terminal-GICT1	Summary of input slacks	Summary of input slacks
	Yard area per berth	-27,990.003	-11,525.056
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	-1.539	-0.844
	Yard tractor per berth	-2.084	0.000
	Berth length	-32.447	-84.545
	Water depth	0.000	-1.597
27	Terminal-DBE2-1	Summary of input slacks	Summary of input slacks
	Yard area per berth	-69,496.982	-72,400.803
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	-7.473	-7.500

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No.	Variables	DMU input-orientation	DMU output-orientation
	Berth length	-109.262	-112.442
	Water depth	-3.982	-4.183
28	Terminal-ICT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
29	Terminal-SGCT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
30	Terminal-JUCT	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000
31	Terminal-PCTC	Summary of input slacks	Summary of input slacks
	Yard area per berth	0.000	0.000
	Quay crane per berth	0.000	0.000
	Terminal crane per berth	0.000	0.000
	Yard tractor per berth	0.000	0.000
	Berth length	0.000	0.000
	Water depth	0.000	0.000

Appendix B

Projection analysis based on input-orientated BCC model

Terminal	Input and output variables	DMU input-orientation			
		Original value	Projection	Difference	%
1					
HIT	Yard area per berth	92,500.0	92,500.0	0.00	0.00
	Quay crane per berth	4.1	4.1	0.00	0.00
	TC per berth	11.8	11.8	0.00	0.00
	Yard tractor per berth	23.3	23.3	0.00	0.00
	Berth length	307.0	307.0	0.00	0.00
	Water depth	14.9	14.9	0.00	0.00
	Throughput per berth	692,083.0	692,083.0	0.00	0.00
2					
COSCO	Yard area per berth	150,000.0	150,000.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	16.0	16.0	0.00	0.00
	Yard tractor per berth	37.5	37.5	0.00	0.00
	Berth length	320.0	320.0	0.00	0.00
	Water depth	14.5	14.5	0.00	0.00
	Throughput per berth	877,000.0	877,000.0	0.00	0.00
3					
MTL	Yard area per berth	132,300.0	132,300.0	0.00	0.00
	Quay crane per berth	4.3	4.3	0.00	0.00
	TC per berth	15.1	15.1	0.00	0.00
	Yard tractor per berth	27.7	27.7	0.00	0.00
	Berth length	347.0	347.0	0.00	0.00
	Water depth	15.5	15.5	0.00	0.00
	Throughput per berth	817,143.0	817,143.0	0.00	0.00

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Terminal	Input and output variables	DMU input-orientation			
		Original value	Projection	Difference	%
4					
DPI	Yard area per berth	167,000.0	167,000.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	8.0	8.0	0.00	0.00
	Yard tractor per berth	50.0	50.0	0.00	0.00
	Berth length	305.0	305.0	0.00	0.00
	Water depth	14.0	14.0	0.00	0.00
	Throughput per berth	589,000.0	589,000.0	0.00	0.00
5					
ACT	Yard area per berth	142,700.0	130,600.0	-12,100.0	-8.48
	Quay crane per berth	4.0	3.6	-0.41	-10.33
	TC per berth	10.0	9.2	-0.85	-8.48
	Yard tractor per berth	30.0	27.5	-2.54	-8.48
	Berth length	370.0	285.4	-84.56	-22.85
	Water depth	15.5	14.0	-1.53	-9.86
	Throughput per berth	588,000.0	588,000.0	0.00	0.00
6					
Yantian	Yard area per berth	168,000.0	134,389.4	-33,610.6	-20.01
	Quay crane per berth	4.9	3.1	-1.77	-36.11
	TC per berth	14.0	11.2	-2.80	-20.01
	Yard tractor per berth	30.7	24.0	-6.68	-21.76
	Berth length	406.0	281.9	-124.08	-30.56
	Water depth	16.0	12.8	-3.20	-20.01
	Throughput per berth	640,000.0	640,000.0	0.00	0.00
7					
Chiwan	Yard area per berth	138,400.0	125,636.6	-12,763.4	-9.22
	Quay crane per berth	4.1	3.7	-0.41	-10.01
	TC per berth	12.0	10.9	-1.11	-9.22
	Yard tractor per berth	23.3	21.2	-2.15	-9.22
	Berth length	380.0	294.0	-85.99	-22.63
	Water depth	15.3	13.8	-1.41	-9.22
	Throughput per berth	655,556.0	655,556.0	0.00	0.00
8					
Shekou	Yard area per berth	173,300.0	173,300.0	0.00	0.00
	Quay crane per berth	4.1	4.1	0.00	0.00
	TC per berth	10.5	10.5	0.00	0.00
	Yard tractor per berth	23.3	23.3	0.00	0.00
	Berth length	281.0	281.0	0.00	0.00
	Water depth	16.0	16.0	0.00	0.00
	Throughput per berth	700,000.0	700,000.0	0.00	0.00

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Terminal	Input and output variables	DMU input-orientation			
		Original value	Projection	Difference	%
9					
Nansha	Yard area per berth	371,700.0	97,744.6	-273,955	-73.70
	Quay crane per berth	3.0	2.0	-1.03	-34.44
	TC per berth	8.0	5.8	-2.17	-27.08
	Yard tractor per berth	15.0	9.6	-5.40	-35.99
	Berth length	350.0	237.6	-112.42	-32.12
	Water depth	15.5	11.0	-4.50	-29.03
	Throughput per berth	333,333.0	333,333.0	0.00	0.00
10					
NBCT	Yard area per berth	252,300.0	252,300.0	0.00	0.00
	Quay crane per berth	3.3	3.3	0.00	0.00
	TC per berth	10.7	10.7	0.00	0.00
	Yard tractor per berth	16.7	16.7	0.00	0.00
	Berth length	300.0	300.0	0.00	0.00
	Water depth	14.5	14.5	0.00	0.00
	Throughput per berth	600,000.0	600,000.0	0.00	0.00
11					
NBSCT	Yard area per berth	175,000.0	150,577.9	-24,422.1	-13.96
	Quay crane per berth	4.0	3.1	-0.95	-23.73
	TC per berth	14.5	9.9	-4.60	-31.72
	Yard tractor per berth	27.5	20.3	-7.22	-26.27
	Berth length	315.0	271.0	-43.96	-13.96
	Water depth	14.5	12.5	-2.02	-13.96
	Throughput per berth	600,000.0	600,000.0	0.00	0.00
12					
CS-4	Yard area per berth	200,000.0	200,000.0		0.00
	Quay crane per berth	3.6	3.6	0.00	0.00
	TC per berth	11.2	11.2	0.00	0.00
	Yard tractor per berth	20.4	20.4	0.00	0.00
	Berth length	350.0	350.0	0.00	0.00
	Water depth	17.0	17.0	0.00	0.00
	Throughput per berth	700,000.0	700,000.0	0.00	0.00
13					
WQ-2	Yard area per berth	334,000.0	334,000.0	0.00	0.00
	Quay crane per berth	5.0	5.0	0.00	0.00
	TC per berth	15.6	15.6	0.00	0.00
	Yard tractor per berth	33.0	33.0	0.00	0.00
	Berth length	313.0	313.0	0.00	0.00
	Water depth	13.2	13.2	0.00	0.00
	Throughput per berth	1,058,000	1,058,000	0.00	0.00

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Terminal	Input and output variables	DMU input-orientation			
		Original value	Projection	Difference	%
14					
YS-1&2	Yard area per berth	278,900.0	175,932.8	-102,967	-36.92
	Quay crane per berth	3.8	3.2	-0.64	-16.86
	TC per berth	13.3	10.1	-3.18	-23.89
	Yard tractor per berth	24.4	20.3	-4.11	-16.86
	Berth length	333.0	271.8	-61.19	-18.38
	Water depth	16.0	12.1	-3.92	-24.48
	Throughput per berth	633,333.0	633,333.0	0.00	0.00
15					
KBCT	Yard area per berth	228,918.0	130,911.0	-98,007	-42.81
	Quay crane per berth	2.8	2.5	-0.25	-9.11
	TC per berth	9.2	8.4	-0.84	-9.11
	Yard tractor per berth	14.6	13.3	-1.33	-9.11
	Berth length	300.0	272.7	-27.32	-9.11
	Water depth	15.0	12.5	-2.49	-16.60
		Throughput per berth	468,353.0	468,353.0	0.00
16					
HBCT	Yard area per berth	129,400.0	129,400.0	0.00	0.00
	Quay crane per berth	2.8	2.8	0.00	0.00
	TC per berth	6.8	6.8	0.00	0.00
	Yard tractor per berth	12.6	12.6	0.00	0.00
	Berth length	289.4	289.4	0.00	0.00
	Water depth	12.5	12.5	0.00	0.00
	Throughput per berth	420,594.0	420,594.0	0.00	0.00
17					
Intergis	Yard area per berth	162,750.0	162,750.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	19.0	19.0	0.00	0.00
	Yard tractor per berth	24.0	24.0	0.00	0.00
	Berth length	350.0	350.0	0.00	0.00
	Water depth	15.0	15.0	0.00	0.00
		Throughput per berth	768,459.0	768,459.0	0.00
18					
Hanjin	Yard area per berth	74,000.0	74,000.0	0.00	0.00
	Quay crane per berth	2.5	2.5	0.00	0.00
	TC per berth	6.5	6.5	0.00	0.00
	Yard tractor per berth	11.5	11.5	0.00	0.00
	Berth length	300.0	300.0	0.00	0.00
	Water depth	13.4	13.4	0.00	0.00
		Throughput per berth	279,569.0	279,569.0	0.00

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Terminal	Input and output variables	DMU input-orientation			
		Original value	Projection	Difference	%
19					
HGCT	Yard area per berth	149,000.0	134,181.2	-14,818.8	-9.95
	Quay crane per berth	4.0	3.6	-0.40	-9.95
	TC per berth	13.0	11.0	-2.00	-15.37
	Yard tractor per berth	23.0	20.7	-2.29	-9.95
	Berth length	350.0	291.8	-58.21	-16.63
	Water depth	15.0	13.5	-1.49	-9.95
	Throughput per berth	650,570.0	650,570.0	0.00	0.00
20					
DPCT	Yard area per berth	123,200.0	100,951.3	-22,248.7	-18.06
	Quay crane per berth	2.8	2.3	-0.51	-18.06
	TC per berth	10.8	7.3	-3.47	-32.09
	Yard tractor per berth	14.4	11.8	-2.60	-18.06
	Berth length	330.4	255.1	-75.31	-22.79
	Water depth	15.0	11.6	-3.36	-22.40
	Throughput per berth	409,165.0	409,165.0	0.00	0.00
21					
UTC	Yard area per berth	123,333.0	101,476.3	-21,856.7	-17.72
	Quay crane per berth	3.3	1.9	-1.40	-42.55
	TC per berth	10.0	5.5	-4.52	-45.21
	Yard tractor per berth	16.0	8.7	-7.25	-45.32
	Berth length	333.3	232.4	-100.91	-30.28
	Water depth	11.0	11.0	0.00	0.00
	Throughput per berth	284,868.0	284,868.0	0.00	0.00
22					
BICT	Yard area per berth	148,768.0	148,768.0	0.00	0.00
	Quay crane per berth	3.5	3.5	0.00	0.00
	TC per berth	16.0	16.0	0.00	0.00
	Yard tractor per berth	17.0	17.0	0.00	0.00
	Berth length	350.0	350.0	0.00	0.00
	Water depth	15.0	15.0	0.00	0.00
	Throughput per berth	632,997.0	632,997.0	0.00	0.00
23					
KIT2-2	Yard area per berth	175,600.0	175,600.0	0.00	0.00
	Quay crane per berth	2.0	2.0	0.00	0.00
	TC per berth	3.8	3.8	0.00	0.00
	Yard tractor per berth	4.0	4.0	0.00	0.00
	Berth length	390.0	390.0	0.00	0.00
	Water depth	15.5	15.5	0.00	0.00
	Throughput per berth	51,638.0	51,638.0	0.00	0.00

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Terminal	Input and output variables	DMU input-orientation			
		Original value	Projection	Difference	%
24					
KX3-1	Yard area per berth	210,000.0	111,219.8	-98,780.2	-47.04
	Quay crane per berth	3.0	2.3	-0.74	-24.78
	TC per berth	8.0	7.5	-0.51	-6.39
	Yard tractor per berth	12.0	11.2	-0.77	-6.39
	Berth length	350.0	256.8	-93.16	-26.62
	Water depth	15.0	11.7	-3.31	-22.09
	Throughput per berth	403,603.0	403,603.0	0.00	0.00
25					
HKTL	Yard area per berth	210,000.0	113,817.3	-96,182.7	-45.80
	Quay crane per berth	2.0	1.7	-0.34	-16.95
	TC per berth	6.0	4.3	-1.70	-28.26
	Yard tractor per berth	15.0	5.9	-9.07	-60.46
	Berth length	350.0	215.2	-134.75	-38.50
	Water depth	16.0	11.0	-5.00	-31.25
	Throughput per berth	124,590.0	124,590.0	0.00	0.00
26					
GICT1	Yard area per berth	210,000.0	117,549.4	-92,450.6	-44.02
	Quay crane per berth	2.5	1.6	-0.91	-36.40
	TC per berth	8.5	3.9	-4.55	-53.54
	Yard tractor per berth	11.5	5.1	-6.42	-55.84
	Berth length	350.0	210.1	-139.94	-39.98
	Water depth	15.0	11.0	-4.00	-26.67
	Throughput per berth	76,120.0	76,120.0	0.00	0.00
27					
DBE2-1	Yard area per berth	206,984.0	110,600.3	-96,383.7	-46.57
	Quay crane per berth	2.0	1.7	-0.28	-13.89
	TC per berth	5.0	4.6	-0.39	-7.79
	Yard tractor per berth	15.0	6.7	-8.33	-55.56
	Berth length	350.0	219.7	-130.28	-37.22
	Water depth	16.0	11.0	-5.00	-31.25
	Throughput per berth	166,371.0	166,371.0	0.00	0.00
28					
ICT	Yard area per berth	68,886.0	68,886.0	0.00	0.00
	Quay crane per berth	3.0	3.0	0.00	0.00
	TC per berth	6.5	6.5	0.00	0.00
	Yard tractor per berth	7.0	7.0	0.00	0.00
	Berth length	300.0	300.0	0.00	0.00
	Water depth	14.0	14.0	0.00	0.00
	Throughput per berth	172,448.0	172,448.0	0.00	0.00

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Terminal	Input and output variables	DMU input-orientation			
		Original value	Projection	Difference	%
29					
SGCT	Yard area per berth	122,273.0	122,273.0	0.00	0.00
	Quay crane per berth	1.5	1.5	0.00	0.00
	TC per berth	3.5	3.5	0.00	0.00
	Yard tractor per berth	4.0	4.0	0.00	0.00
	Berth length	203.5	203.5	0.00	0.00
	Water depth	11.0	11.0	0.00	0.00
	Throughput per berth	14,772.0	14,772.0	0.00	0.00
30					
JUCT	Yard area per berth	84,275.0	84,275.0	0.00	0.00
	Quay crane per berth	3.0	3.0	0.00	0.00
	TC per berth	7.0	7.0	0.00	0.00
	Yard tractor per berth	7.0	7.0	0.00	0.00
	Berth length	220.0	220.0	0.00	0.00
	Water depth	13.0	13.0	0.00	0.00
	Throughput per berth	169,952.0	169,952.0	0.00	0.00
31					
PCTC	Yard area per berth	96,000.0	96,000.0	0.00	0.00
	Quay crane per berth	2.0	2.0	0.00	0.00
	TC per berth	6.0	6.0	0.00	0.00
	Yard tractor per berth	10.0	10.0	0.00	0.00
	Berth length	240.0	240.0	0.00	0.00
	Water depth	11.0	11.0	0.00	0.00
	Throughput per berth	355,991.0	355,991.0	0.00	0.00

Appendix C

Projection analysis based on output-orientated BCC model

Terminal	Input and output variables	DMU output-orientation			
		Original value	Projection	Difference	%
1					
HIT	Yard area per berth	92,500.0	92,500.0	0.00	0.00
	Quay crane per berth	4.1	4.1	0.00	0.00
	TC per berth	11.8	11.8	0.00	0.00
	Yard tractor per berth	23.3	23.3	0.00	0.00
	Berth length	307.0	307.0	0.00	0.00
	Water depth	14.9	14.9	0.00	0.00
	Throughput per berth	692,083.0	692,083.0	0.00	0.00
2					
COSCO	Yard area per berth	150,000.0	150,000.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	16.0	16.0	0.00	0.00
	Yard tractor per berth	37.5	37.5	0.00	0.00
	Berth length	320.0	320.0	0.00	0.00
	Water depth	14.5	14.5	0.00	0.00
	Throughput per berth	877,000.0	877,000.0	0.00	0.00
3					
MTL	Yard area per berth	132,300.0	132,300.0	0.00	0.00
	Quay crane per berth	4.3	4.3	0.00	0.00
	TC per berth	15.1	15.1	0.00	0.00
	Yard tractor per berth	27.7	27.7	0.00	0.00
	Berth length	347.0	347.0	0.00	0.00
	Water depth	15.5	15.5	0.00	0.00
	Throughput per berth	817,143.0	817,143.0	0.00	0.00

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Terminal	Input and output variables	DMU output-orientation			
		Original value	Projection	Difference	%
4					
DPI	Yard area per berth	167,000.0	167,000.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	8.0	8.0	0.00	0.00
	Yard tractor per berth	50.0	50.0	0.00	0.00
	Berth length	305.0	305.0	0.00	0.00
	Water depth	14.0	14.0	0.00	0.00
	Throughput per berth	589,000.0	589,000.0	0.00	0.00
5					
ACT	Yard area per berth	142,700.0	142,700.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.03	-0.72
	TC per berth	10.0	10.0	0.00	0.00
	Yard tractor per berth	30.0	30.0	0.00	0.00
	Berth length	370.0	293.7	76.29	-20.62
	Water depth	15.5	14.9	0.65	-4.19
	Throughput per berth	588,000.0	650,422.5	62,422.55	10.62
6					
Yantian	Yard area per berth	168,000.0	168,000.0	0.00	0.00
	Quay crane per berth	4.9	4.3	0.62	-12.55
	TC per berth	14.0	14.0	0.00	0.00
	Yard tractor per berth	30.7	30.0	0.72	-2.33
	Berth length	406.0	312.4	93.57	-23.05
	Water depth	16.0	14.3	1.65	-10.33
	Throughput per berth	640,000.0	836,513.1	196,513.1	30.71
7					
Chiwan	Yard area per berth	138,400.0	138,400.0	0.00	0.00
	Quay crane per berth	4.1	4.0	0.06	-1.37
	TC per berth	12.0	12.0	0.00	0.00
	Yard tractor per berth	23.3	23.3	0.00	0.00
	Berth length	380.0	318.4	61.62	-16.22
	Water depth	15.3	15.2	0.01	-0.05
	Throughput per berth	655,556.0	722,460.4	66,904.44	10.21
8					
Shekou	Yard area per berth	173,300.0	173,300.0	0.00	0.00
	Quay crane per berth	4.1	4.1	0.00	0.00
	TC per berth	10.5	10.5	0.00	0.00
	Yard tractor per berth	23.3	23.3	0.00	0.00
	Berth length	281.0	281.0	0.00	0.00
	Water depth	16.0	16.0	0.00	0.00
	Throughput per berth	700,000.0	700,000.0	0.00	0.00

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Terminal	Input and output variables	DMU output-orientation			
		Original value	Projection	Difference	%
9					
Nansha	Yard area per berth	371,700.0	149,719.5	221,980.5	-59.72
	Quay crane per berth	3.0	2.8	0.21	-6.91
	TC per berth	8.0	8.0	0.00	0.00
	Yard tractor per berth	15.0	15.0	0.00	0.00
	Berth length	350.0	268.4	81.59	-23.31
	Water depth	15.5	11.9	3.64	-23.49
	Throughput per berth	333,333.0	504,103.3	170,770.3	51.23
10					
NBCT	Yard area per berth	252,300.0	252,300.0	0.00	0.00
	Quay crane per berth	3.3	3.3	0.00	0.00
	TC per berth	10.7	10.7	0.00	0.00
	Yard tractor per berth	16.7	16.7	0.00	0.00
	Berth length	300.0	300.0	0.00	0.00
	Water depth	14.5	14.5	0.00	0.00
	Throughput per berth	600,000.0	600,000.0	0.00	0.00
11					
NBSCT	Yard area per berth	175,000.0	175,000.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	14.5	13.7	0.77	-5.30
	Yard tractor per berth	27.5	27.5	0.00	0.00
	Berth length	315.0	315.0	0.00	0.00
	Water depth	14.5	14.0	0.51	-3.51
	Throughput per berth	600,000.0	800,509.9	200,510	33.42
12					
CS-4	Yard area per berth	200,000.0	200,000.0	0.00	0.00
	Quay crane per berth	3.6	3.6	0.00	0.00
	TC per berth	11.2	11.2	0.00	0.00
	Yard tractor per berth	20.4	20.4	0.00	0.00
	Berth length	350.0	350.0	0.00	0.00
	Water depth	17.0	17.0	0.00	0.00
	Throughput per berth	700,000.0	700,000.0	0.00	0.00
13					
WQ-2	Yard area per berth	334,000.0	334,000.0	0.00	0.00
	Quay crane per berth	5.0	5.0	0.00	0.00
	TC per berth	15.6	15.6	0.00	0.00
	Yard tractor per berth	33.0	33.0	0.00	0.00
	Berth length	313.0	313.0	0.00	0.00
	Water depth	13.2	13.2	0.00	0.00
	Throughput per berth	1,058,000	1,058,000	0.00	0.00

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Terminal	Input and output variables	DMU output-orientation			
		Original value	Projection	Difference	%
14					
YS-1&2	Yard area per berth	278,900.0	233,638.4	45,261.64	-16.23
	Quay crane per berth	3.8	3.8	0.00	0.00
	TC per berth	13.3	11.9	1.36	-10.24
	Yard tractor per berth	24.4	24.4	0.00	0.00
	Berth length	333.0	285.3	47.65	-14.31
	Water depth	16.0	12.4	3.58	-22.37
	Throughput per berth	633,333.0	779,810.2	146,477.3	23.13
15					
KBCT	Yard area per berth	228,918.0	156,886.8	72,031.21	-31.47
	Quay crane per berth	2.8	2.8	0.00	0.00
	TC per berth	9.2	9.2	0.00	0.00
	Yard tractor per berth	14.6	14.6	0.00	0.00
	Berth length	300.0	290.2	9.78	-3.26
	Water depth	15.0	13.6	1.42	-9.45
	Throughput per berth	468,353.0	516,851.0	48,498.04	10.36
16					
HBCT	Yard area per berth	129,400.0	129,400.0	0.00	0.00
	Quay crane per berth	2.8	2.8	0.00	0.00
	TC per berth	6.8	6.8	0.00	0.00
	Yard tractor per berth	12.6	12.6	0.00	0.00
	Berth length	289.4	289.4	0.00	0.00
	Water depth	12.5	12.5	0.00	0.00
	Throughput per berth	420,594.0	420,594.0	0.00	0.00
17					
Intergis	Yard area per berth	162,750.0	162,750.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	19.0	19.0	0.00	0.00
	Yard tractor per berth	24.0	24.0	0.00	0.00
	Berth length	350.0	350.0	0.00	0.00
	Water depth	15.0	15.0	0.00	0.00
	Throughput per berth	768,459.0	768,459.0	0.00	0.00
18					
Hanjin	Yard area per berth	74,000.0	74,000.0	0.00	0.00
	Quay crane per berth	2.5	2.5	0.00	0.00
	TC per berth	6.5	6.5	0.00	0.00
	Yard tractor per berth	11.5	11.5	0.00	0.00
	Berth length	300.0	300.0	0.00	0.00
	Water depth	13.4	13.4	0.00	0.00
	Throughput per berth	279,569.0	279,569.0	0.00	0.00

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(continued)

Terminal	Input and output variables	DMU output-orientation			
		Original value	Projection	Difference	%
19					
HGCT	Yard area per berth	149,000.0	149,000.0	0.00	0.00
	Quay crane per berth	4.0	4.0	0.00	0.00
	TC per berth	13.0	13.0	0.00	0.00
	Yard tractor per berth	23.0	23.0	0.00	0.00
	Berth length	350.0	323.5	26.48	-7.57
	Water depth	15.0	15.0	0.00	0.00
	Throughput per berth	650,570.0	728,487.2	77,917.18	11.98
20					
DPCT	Yard area per berth	123,200.0	123,200.0	0.00	0.00
	Quay crane per berth	2.8	2.8	0.00	0.00
	TC per berth	10.8	10.8	0.00	0.00
	Yard tractor per berth	14.4	14.4	0.00	0.00
	Berth length	330.4	293.6	36.82	-11.14
	Water depth	15.0	13.0	1.95	-13.01
	Throughput per berth	409,165.0	509,104.8	99,939.82	24.43
21					
UTC	Yard area per berth	123,333.0	96,000.0	27,333.00	-22.16
	Quay crane per berth	3.3	2.0	1.30	-39.39
	TC per berth	10.0	6.0	4.00	-40.00
	Yard tractor per berth	16.0	10.0	6.00	-37.50
	Berth length	333.3	240.0	93.30	-27.99
	Water depth	11.0	11.0	0.00	0.00
	Throughput per berth	284,868.0	355,991.0	71,123.00	24.97
22					
BICT	Yard area per berth	148,768.0	148,768.0	0.00	0.00
	Quay crane per berth	3.5	3.5	0.00	0.00
	TC per berth	16.0	16.0	0.00	0.00
	Yard tractor per berth	17.0	17.0	0.00	0.00
	Berth length	350.0	350.0	0.00	0.00
	Water depth	15.0	15.0	0.00	0.00
	Throughput per berth	632,997.0	632,997.0	0.00	0.00
23					
KIT2-2	Yard area per berth	175,600.0	175,600.0	0.00	0.00
	Quay crane per berth	2.0	2.0	0.00	0.00
	TC per berth	3.8	3.8	0.00	0.00
	Yard tractor per berth	4.0	4.0	0.00	0.00
	Berth length	390.0	390.0	0.00	0.00
	Water depth	15.5	15.5	0.00	0.00
	Throughput per berth	51,638.0	51,638.0	0.00	0.00

(continued)

(continued)

Terminal	Input and output variables	DMU output-orientation			
		Original value	Projection	Difference	%
24					
KX3-1	Yard area per berth	210,000.0	129,691.3	80,308.74	-38.24
	Quay crane per berth	3.0	2.4	0.60	-19.84
	TC per berth	8.0	8.0	0.00	0.00
	Yard tractor per berth	12.0	12.0	0.00	0.00
	Berth length	350.0	263.5	86.54	-24.73
	Water depth	15.0	12.1	2.91	-19.43
	Throughput per berth	403,603.0	431,418.5	27,815.51	6.89
25					
HKTL	Yard area per berth	210,000.0	96,000.0	114,000.0	-54.29
	Quay crane per berth	2.0	2.0	0.00	0.00
	TC per berth	6.0	6.0	0.00	0.00
	Yard tractor per berth	15.0	10.0	5.00	-33.33
	Berth length	350.0	240.0	110.00	-31.43
	Water depth	16.0	11.0	5.00	-31.25
	Throughput per berth	124,590.0	355,991.0	231,401.0	185.73
26					
GICT1	Yard area per berth	210,000.0	107,307.4	102,692.6	-48.90
	Quay crane per berth	2.5	2.3	0.18	-7.14
	TC per berth	8.5	8.1	0.36	-4.20
	Yard tractor per berth	11.5	11.5	0.00	0.00
	Berth length	350.0	263.6	86.43	-24.69
	Water depth	15.0	11.9	3.14	-20.95
	Throughput per berth	76,120.0	415,349.4	339,229.4	445.65
27					
DBE2-1	Yard area per berth	206,984.0	106,509.2	100,474.8	-48.54
	Quay crane per berth	2.0	1.8	0.20	-10.00
	TC per berth	5.0	5.0	0.00	0.00
	Yard tractor per berth	15.0	7.6	7.40	-49.33
	Berth length	350.0	225.4	124.60	-35.60
	Water depth	16.0	11.0	5.00	-31.25
	Throughput per berth	166,371.0	219,503.4	53,132.40	31.94
28					
ICT	Yard area per berth	68,886.0	68,886.0	0.00	0.00
	Quay crane per berth	3.0	3.0	0.00	0.00
	TC per berth	6.5	6.5	0.00	0.00
	Yard tractor per berth	7.0	7.0	0.00	0.00
	Berth length	300.0	300.0	0.00	0.00
	Water depth	14.0	14.0	0.00	0.00
	Throughput per berth	172,448.0	172,448.0	0.00	0.00

(continued)

(continued)

Terminal	Input and output variables	DMU output-orientation			
		Original value	Projection	Difference	%
29					
SGCT	Yard area per berth	122,273.0	122,273.0	0.00	0.00
	Quay crane per berth	1.5	1.5	0.00	0.00
	TC per berth	3.5	3.5	0.00	0.00
	Yard tractor per berth	4.0	4.0	0.00	0.00
	Berth length	203.5	203.5	0.00	0.00
	Water depth	11.0	11.0	0.00	0.00
	Throughput per berth	14,772.0	14,772.0	0.00	0.00
30					
JUCT	Yard area per berth	84,275.0	84,275.0	0.00	0.00
	Quay crane per berth	3.0	3.0	0.00	0.00
	TC per berth	7.0	7.0	0.00	0.00
	Yard tractor per berth	7.0	7.0	0.00	0.00
	Berth length	220.0	220.0	0.00	0.00
	Water depth	13.0	13.0	0.00	0.00
	Throughput per berth	169,952.0	169,952.0	0.00	0.00
31					
PCTC	Yard area per berth	96,000.0	96,000.0	0.00	0.00
	Quay crane per berth	2.0	2.0	0.00	0.00
	TC per berth	6.0	6.0	0.00	0.00
	Yard tractor per berth	10.0	10.0	0.00	0.00
	Berth length	240.0	240.0	0.00	0.00
	Water depth	11.0	11.0	0.00	0.00
	Throughput per berth	355,991.0	355,991.0	0.00	0.00

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