

Appendix A

A.1. Cointegration Test

A.1.1. The Asia-Pacific region: Sustainability Performance and Major Stock Prices

Johansen test: Major Stocks

Log-likelihood = 36625.4 (including constant term: 32379.9)

Rank	Eigenvalue	Trace test (<i>p</i> -value)	Lmax test (<i>p</i> -value)
0	0.050072	199.42 (0.0000)	76.849 (0.0000)
1	0.038212	122.57 (0.0001)	58.286 (0.0000)
2	0.019208	64.283 (0.1266)	29.015 (0.1740)
3	0.0098990	35.267 (0.4388)	14.883 (0.7571)
4	0.0084091	20.385 (0.4080)	12.633 (0.5004)
5	0.0051664	7.7515 (0.4995)	7.7490 (0.4135)

Corrected for sample size (df = 1446)

Rank	Trace test <i>p</i> -value
0	199.42 (0.0000)
1	122.57 (0.0002)
2	64.283 (0.1288)
3	35.267 (0.4413)
4	20.385 (0.4050)
5	7.7515 (0.5001)

eigenvalue	0.050072	0.038212	0.019208	0.0098990	0.0084091	0.0051664
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A.1.2. The Asia-Pacific region: Sustainability Performance and Top 5% Companies

Johansen test:

Log-likelihood = 32248.3 (including constant term: 28712.3)

Rank	Eigenvalue	Trace test <i>p</i> -value	Lmax test <i>p</i> -value
0	0.039577	152.05 (0.1180)	50.315 (0.0769)
1	0.026453	101.73 (0.5494)	33.405 (0.5783)
2	0.018399	68.328 (0.7749)	23.138 (0.8635)
3	0.015579	45.190 (0.8225)	19.565 (0.7845)
4	0.0093995	25.625 (0.8973)	11.767 (0.9307)
5	0.0076591	13.858 (0.8482)	9.5800 (0.7832)
6	0.0024337	4.2781 (0.8746)	3.0361 (0.9340)
7	0.00099626	1.2420 (0.2651)	1.2420 (0.2651)

Corrected for sample size (df = 1205)

Rank	Trace test <i>p</i> -value					
0	152.05 (0.1242)					
1	101.73 (0.5583)					
2	68.328 (0.7798)					
3	45.190 (0.8254)					
4	25.625 (0.8986)					
5	13.858 (0.8469)					
6	4.2781 (0.8749)					
7	1.2420 (0.2653)					
eigenvalue	0.039577	0.026453	0.018399	0.015579	0.0093995	0.0076591
	0.0024337	0.00099626				

A.1.3. North America: Sustainability Performance and Major Stock Prices

Johansen test:

Log-likelihood = 47944.3 (including constant term: 43698.9)

Rank	Eigenvalue	Trace test <i>p</i> -value	Lmax test <i>p</i> -value
0	0.13755	456.63 (0.0000)	221.37 (0.0000)
1	0.096270	235.26 (0.0000)	151.43 (0.0000)
2	0.042962	83.830 (0.0000)	65.692 (0.0000)
3	0.0088450	18.138 (0.5659)	13.291 (0.4402)
4	0.0031934	4.8466 (0.8223)	4.7849 (0.7675)

Corrected for sample size (df = 1453)

Rank	Trace test <i>p</i> -value					
0	456.63 (0.0000)					
1	235.26 (0.0000)					
2	83.830 (0.0000)					
3	18.138 (0.5631)					
4	4.8466 (0.8226)					
eigenvalue	0.13755	0.096270	0.042962	0.0088450	0.0031934	

A.1.4. North America: Sustainability Performance and Top 5% Companies

Johansen test:

Exogenous regressor(s): DJSI_AP__PR and DJSI_AP__TR

Log-likelihood = 37901.8 (including constant term: 33656.3)

Cointegration tests, ignoring exogenous variables

Rank	Eigenvalue	Trace test <i>p</i> -value	Lmax test <i>p</i> -value
0	0.038790	155.17 (0.0002)	59.185 (0.0005)
1	0.021245	95.983 (0.0463)	32.125 (0.3075)
2	0.01608	63.858 (0.1354)	24.261 (0.4497)
3	0.011977	39.597 (0.2397)	18.025 (0.5048)
4	0.0070393	21.571 (0.3330)	10.568 (0.6962)
5	0.0060669	11.003 (0.2147)	9.1038 (0.2841)
6	0.0012690	1.8996 (0.1681)	1.8996 (0.1681)

Corrected for sample size (df = 1444)

Rank Trace test *p*-value

Rank	Trace test <i>p</i> -value					
0	155.17 (0.0002)					
1	95.983 (0.0478)					
2	63.858 (0.1376)					
3	39.597 (0.2418)					
4	21.571 (0.3302)					
5	11.003 (0.2152)					
6	1.8996 (0.1681)					
eigenvalue	0.038790	0.021245	0.016086	0.011977	0.0070393	0.0060669
	0.0012690					

A.1.5. The Asia-Pacific region: GDP Per Capita, and Sustainability Performance

Johansen test:

Log-likelihood = 386.628 (including constant term: 182.301)

Rank	Eigenvalue	Trace test	<i>p</i> -value	Lmax test	<i>p</i> -value
0	0.27892	30.767 (0.0382)		23.544 (0.0202)	
1	0.070398	7.2221 (0.5585)		5.2559 (0.7113)	
2	0.026938	1.9661 (0.1609)		1.9661 (0.1609)	

Corrected for sample size (df = 41)

Rank	Trace test <i>p</i> -value			
0	30.767 (0.0535)			
1	7.2221 (0.5805)			
2	1.9661 (0.1747)			
eigenvalue	0.27892	0.070398	0.026938	

A.1.6. The Asia-Pacific region: GNI Per Capita, and Sustainability Performance

Johansen test:

Log-likelihood = 52.6431 (including constant term: 7.23707)

Rank	Eigenvalue	Trace test	<i>p</i> -value	Lmax test	<i>p</i> -value
0	0.46962	16.290 (0.6983)		10.147 (0.7344)	
1	0.26172	6.1430 (0.6823)		4.8548 (0.7594)	
2	0.077354	1.2882 (0.2564)		1.2882 (0.2564)	

Corrected for sample size (df = 12)

Rank	Trace test <i>p</i> -value			
0	16.290 (0.8501)			
1	6.1430 (0.7491)			
2	1.2882 (0.3114)			
eigenvalue	0.46962	0.26172	0.077354	

A.1.7. North America: GDP, GNI per Capita, and Sustainability Performance (Dummy Variables: Great Recession, Population)

Johansen test:

Log-likelihood = 995.443 (including constant term: 799.63)

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.35476	77.317 (0.0099)		30.231 (0.1289)	
1	0.27113	47.086 (0.0574)		21.822 (0.2370)	
2	0.22630	25.264 (0.1568)		17.703 (0.1456)	
3	0.10288	7.5603 (0.5205)		7.4913 (0.4416)	
4	0.00099986	0.069025 (0.7928)		0.069025 (0.7928)	

Corrected for sample size (df = 38)

Rank	Trace test p-value				
0	77.317 (0.0377)				
1	47.086 (0.1062)				
2	25.264 (0.1986)				
3	7.5603 (0.5451)				
4	0.069025 (0.7999)				
eigenvalue	0.35476	0.27113	0.22630	0.10288	0.00099986

Appendix B

B.1. Hypothesis 1 Results

B.1.1. Hypothesis 1-1 : Sustainability and Asia Major Stocks in The Asia-Pacific region (Tables B1 and B2)

Table B1. Sustainability and Major Stock Indices in Asia Pacific

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
const	-0.25828	0.0501213	-5.1531	<0.00001	***
DJSI AP TR 1	-0.376414	0.0878289	-4.2858	0.00002	***
DJSI AP TR 2	-0.279773	0.10485	-2.6683	0.00771	***
AUS200	0.0425609	0.00946702	4.4957	<0.00001	***
Hongkong Hangsen	-0.00243169	0.00564701	-0.4306	0.66681	
Nikkei 225	6.69217e-05	0.00252908	0.0265	0.97889	
Shanghai Shenzhen	-0.00166616	0.000929865	-1.7918	0.07336	*
Kospi	0.0173326	0.00646122	2.6826	0.00739	***

* $p < 10\%$; ** $p < 5\%$; and *** $p < 1\%$.

Table B2. Descriptive Statistics in B.1.1.

Mean Dependent var	0.000119	S.D. Dependent var	0.010974
Sum squared resid	0.170889	S.E. of regression	0.010735
R-squared	0.052169	Adjusted R-squared	0.043221
rho	-0.002731	Durbin-Watson	2.004587

B.1.2. Hypothesis 1-2: Sustainability Performance and Top 5% Companies in Asia-Pacific region (Table B3 and B4)

Table B3. Sustainability and Top 5% Companies in Asia Pacific

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
const	0.0276998	0.0343111	0.8073	0.41964	
DJSI AP TR 1	-0.250126	0.0302913	-8.2574	<0.00001	***
DJSI AP TR 2	-0.132501	0.0305765	-4.3334	0.00002	***
DJSI AP TR 3	-0.0682469	0.0297634	-2.2930	0.02202	**
Samsung Electronics	-0.00121541	0.00260241	-0.4670	0.64056	
Toyota Motor	0.000247451	0.0031117	0.0795	0.93663	
NTT Docomo	-0.00590851	0.00271244	-2.1783	0.02957	**
Astellas Phama	0.00485957	0.00272154	1.7856	0.07441	*
Seven and Holdings	-0.00150992	0.00397724	-0.3796	0.70428	
West Banking GR	-0.00364771	0.00490616	-0.7435	0.45732	
EC1	-0.0208552	0.00873587	-2.3873	0.01712	**

* $p < 10\%$; ** $p < 5\%$; and *** $p < 1\%$.

Table B4. Descriptive Statistics in B.1.2.

Mean Dependent var	0.000166	S.D. Dependent var	0.011146
Sum squared resid	0.116320	S.E. of regression	0.009725
R-squared	0.247944	Adjusted R-squared	0.238773
rho	-0.004115	Durbin-Watson	2.004091

B.1.3. Hypothesis 1-1.: Sustainability Performance and Major Stocks in North America

Table B5. Sustainability and Major Stock Indices in North America

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
const	0.102927	0.0309391	3.3267	0.00090	***
NASDAQ 1	-0.00147645	0.0891948	-0.0166	0.98680	

NASDAQ 2	-0.000152853	0.0891785	-0.0017	0.99863	
NASDAQ 3	-0.19826	0.089072	-2.2258	0.02618	**
DJSI NA PR	-0.0790962	0.0294078	-2.6896	0.00723	***
DJSI NA TR	0.091003	0.0286718	3.1740	0.00153	***
EC1	-0.0259547	0.00911177	-2.8485	0.00445	***

* $p < 10\%$; ** $p < 5\%$; and *** $p < 1\%$.

Table B6. Descriptive Statistics in B.1.3.

Mean Dependent var	0.000511	S.D. Dependent var	0.011189
Sum squared resid	0.182365	S.E. of regression	0.011123
R-squared	0.024288	Adjusted R-squared	0.011711
rho	0.001068	Durbin-Watson	1.996174

Table B7. Sustainability and S&P 500 in North America

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
const	-0.128415	0.0171057	-7.5071	<0.00001	***
DJSI North America TR 1	-0.231994	0.0716583	-3.2375	0.00123	***
DJSI North America TR 2	-0.200256	0.0860118	-2.3282	0.02003	**
DJSI North America TR 3	-0.200014	0.0858076	-2.3310	0.01989	**
DJSI North America TR 4	-0.119864	0.0719811	-1.6652	0.09608	*
S&P 500 Net TR	0.0471296	0.0122462	3.8485	0.00012	***
NASDAQ	0.0112437	0.0105518	1.0656	0.28679	
EC1	0.00226497	0.00027094	8.3597	<0.00001	***

* $p < 10\%$; ** $p < 5\%$; and *** $p < 1\%$.

Table B8. Descriptive Statistics in Table B7.

Mean Dependent var	0.000402	S.D. Dependent var	0.009909
Sum squared resid	0.137147	S.E. of regression	0.009607
R-squared	0.067005	Adjusted R-squared	0.060099
rho	-0.007581	Durbin-Watson	2.014257

B.1.4. Hypothesis 1-2: Sustainability Performance and Top 5% companies in North America

Table B9. Sustainability and Top 5% Companies in North America

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
const	0.0472015	0.0228456	2.0661	0.03899	**
DJSI NA PR 1	-0.464005	0.0751827	-6.1717	<0.00001	***
DJSI NA PR 2	-0.194565	0.0931189	-2.0894	0.03684	**
DJSI NA PR 3	-0.182082	0.0971522	-1.8742	0.06110	*
DJSI NA TR1	0.432012	0.075579	5.7160	<0.00001	***
DJSI NA TR2	0.247207	0.0935961	2.6412	0.00835	***
Exxon Mobile	0.0139425	0.00488384	2.8548	0.00437	***
Pepsi Co. Inc.	0.0155388	0.00838486	1.8532	0.06405	*
Verizon Inc.	-0.00602455	0.0052432	-1.1490	0.25073	
EC1	-0.108264	0.0187302	-5.7802	<0.00001	***

* $p < 10\%$; ** $p < 5\%$; and *** $p < 1\%$.

Table B10. Descriptive Statistics in B.1.4.

Mean dependent var	0.000305	S.D. Dependent var	0.010185
Sum squared resid	0.143277	S.E. of regression	0.009839

R-squared	0.076687	Adjusted R-squared	0.066705
rho	0.001011	Durbin-Watson	1.996198

B.1.5. Hypothesis 1-3: Sustainability Performance and ROI, ROIC, and ROA of Top 5~6% companies in North America and The Asia-Pacific region (See the P-value)

Table B11. ROI of Top 6% Company and Sustainability in North America.

Mean Dependent var	4.934266	S.D. Dependent var	0.305873
Sum squared resid	0.198641	S.E. of regression	0.157576
R-squared	0.858455	Adjusted R-squared	0.734602
F(7, 8)	6.931285	P-value (F)	0.006982
rho	-0.291912	Durbin-Watson	2.583113

F-tests of zero restrictions: All lags of North America Sustainability LoF(1, 8) = 0.39677 (0.5463).

Table B12. ROIC of Top 6% Company and Sustainability in North America.

Mean Dependent var	4.934266	S.D. Dependent var	0.305873
Sum squared resid	0.255915	S.E. of regression	0.178856
R-squared	0.817643	Adjusted R-squared	0.658081
F(7, 8)	5.124295	P-value (F)	0.017531
rho	-0.207474	Durbin-Watson	2.367653

F-tests of zero restrictions: All lags of North America Sustainability LoF(1, 8) = 0.7962 (0.3983).

Table B13. ROA of Top 6% Company and Sustainability in North America.

Mean Dependent var	4.934266	S.D. Dependent var	0.305873
Sum squared resid	0.206214	S.E. of regression	0.160551
R-squared	0.853059	Adjusted R-squared	0.724485
F(7, 8)	6.634786	P-value (F)	0.008012
rho	-0.263801	Durbin-Watson	2.521545

F-tests of zero restrictions: All lags of North America Sustainability LoF(1, 8) = 0.37232 (0.5587).

Table B14. ROI of Top 5% Company and Sustainability in Asia-Pacific region.

Mean dependent var	4.932797	S.D. Dependent var	0.236012
Sum squared resid	0.045000	S.E. of regression	0.080178
R-squared	0.946142	Adjusted R-squared	0.884590
F(8, 7)	15.37147	P-value (F)	0.000855
rho	-0.141623	Durbin-Watson	2.254296

F-tests of zero restrictions: All lags of The Asia-Pacific region Sustainability LogF(1, 7) = 47.395 (0.0002).

Table B15. ROIC of Top 5% Company and Sustainability in Asia-Pacific region.

Mean Dependent var	4.932797	S.D. Dependent var	0.236012
Sum squared resid	0.092135	S.E. of regression	0.114727
R-squared	0.889728	Adjusted R-squared	0.763702
F(8, 7)	7.059894	P-value (F)	0.009136
rho	-0.015106	Durbin-Watson	2.009564

F-tests of zero restrictions: All lags of The Asia-Pacific region Sustainability LogF(1, 7) = 1.3504 (0.2833).

Table B16. ROA of Top 5% Company and Sustainability in Asia-Pacific region.

Mean Dependent var	4.932797	S.D. Dependent var	0.236012
Sum squared resid	0.063539	S.E. of regression	0.095273
R-squared	0.923954	Adjusted R-squared	0.837044

F(8, 7)	10.63116	P-value (F)	0.002710
rho	0.030502	Durbin-Watson	1.936730

F-tests of zero restrictions: All lags of The Asia-Pacific region Sustainability LogF(1, 7) = 23.657 (0.0018).

B.2. Hypothesis 2 Results

B.2.1. Hypothesis 2-1: Sustainability Performance and GDP Per Capita in Asia-Pacific region

Table B17. Sustainability and GDP in the Asia Pacific

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
const	0.106917	0.133464	0.8011	0.42680	
Population log1	0.054724	0.0266501	2.0534	0.04518	**
Population log2	0.0501459	0.0266954	1.8784	0.06604	*
Asia Pacific Sustainability 7	-0.226886	0.132538	-1.7119	0.09300	*
Asia Pacific GDP log	0.034562	0.017906	1.9302	0.05915	*
EC1	-0.0334078	0.0264163	-1.2647	0.21174	

* $p < 10\%$; ** $p < 5\%$; and *** $p < 1\%$.

Table B18. Descriptive Statistics in B.2.1.

Mean Dependent var	0.003749	S.D. Dependent var	0.042871
Sum squared resid	0.097840	S.E. of regression	0.043800
R-squared	0.250211	Adjusted R-squared	-0.043824
rho	0.013043	Durbin-Watson	1.946557

B.2.2. Hypothesis 2-1: Sustainability Performance and GNI Per Capita in The Asia-Pacific region

Table B19. Sustainability and GNI in Asia Pacific by ARIMA

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
Const	18.5077	5.19202	3.5646	0.00036	***
Phi 1	-0.11305	0.251165	-0.4501	0.65264	
Theta 1	1	0.309313	3.2330	0.00123	***
The Asia-Pacific region Sustainability Log	2.29636	1.07819	2.1298	0.03319	**

Table B20. Descriptive Statistics in Table B.2.2.

Mean Dependent var	29.95311	S.D. Dependent var	1.043681
Mean of innovations	-0.019966	S.D. of innovations	0.501897
Log-likelihood	-13.74151	Akaike criterion	39.48303
Schwarz criterion	44.48231	Hannan-Quinn	39.97997

B.2.3. Hypothesis 2-1: Sustainability Performance, GNI and GDP Per Capita in North America

Table B21. Sustainability and GNI and GDP in North America

Variable	Coefficient	Std. Error	T-Ratio	P-Value	
Const	0.00708408	0.00173884	4.0740	0.00015	***
GDP log	-0.219931	0.153838	-1.4296	0.15848	
GNI log	0.379953	0.139819	2.7175	0.00878	***
Sustainability log	0.0275953	0.0078443	3.5179	0.00088	***
Population	-0.0024001	0.00136396	-1.7597	0.08403	*
Great Recession	-0.00782993	0.00291081	-2.6900	0.00944	***

Table B22. Descriptive Statistics in B.2.3.

Mean Dependent var	0.004859	S.D. Dependent var	0.006336
Sum squared resid	0.001267	S.E. of regression	0.004799
R-squared	0.535942	Adjusted R-squared	0.426256
F(13, 55)	4.886135	P-value(F)	0.000014
Rho	-0.132906	Durbin-Watson	2.241414

Appendix C

C.1. Impulse Response Function

C.1.1. Hypothesis 2-2; The Response of Sustainability to a Shock in GDP in The Asia-Pacific region (Figure C1)

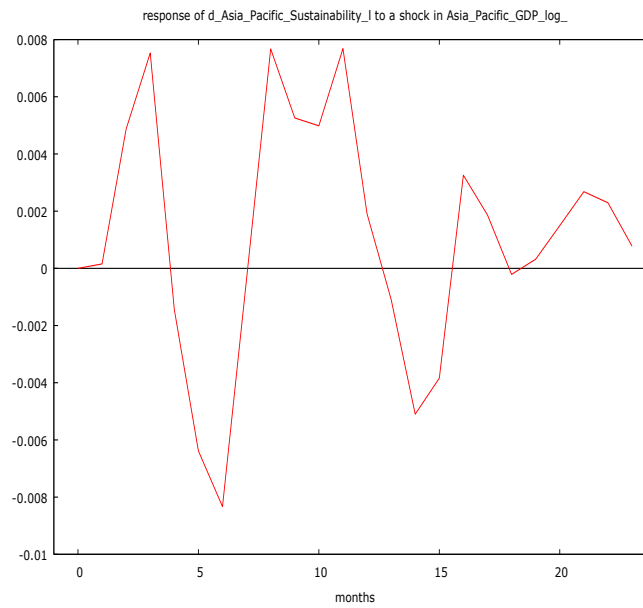
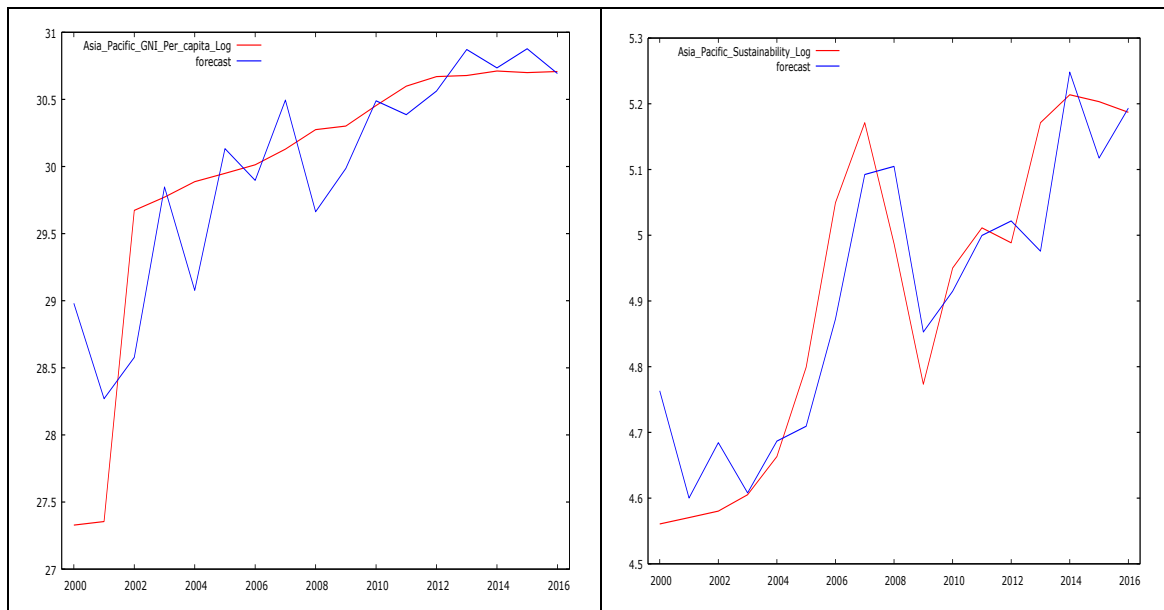


Figure C1. Impulse response between sustainability and GDP in Asia Pacific

C.1.2. Hypothesis 2-2; Forecast of GNI in The Asia-Pacific region (Figure C2)



(a)	(b)
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Figure C2. The prediction of GNI and Sustainability in Asia Pacific: **(a)** Prediction of GNI in Asia Pacific; **(b)** Prediction of sustainability in Asia Pacific

C.1.3. Hypothesis 2-2; The Response of Sustainability to a Shock in GDP in North America (Figure C3)

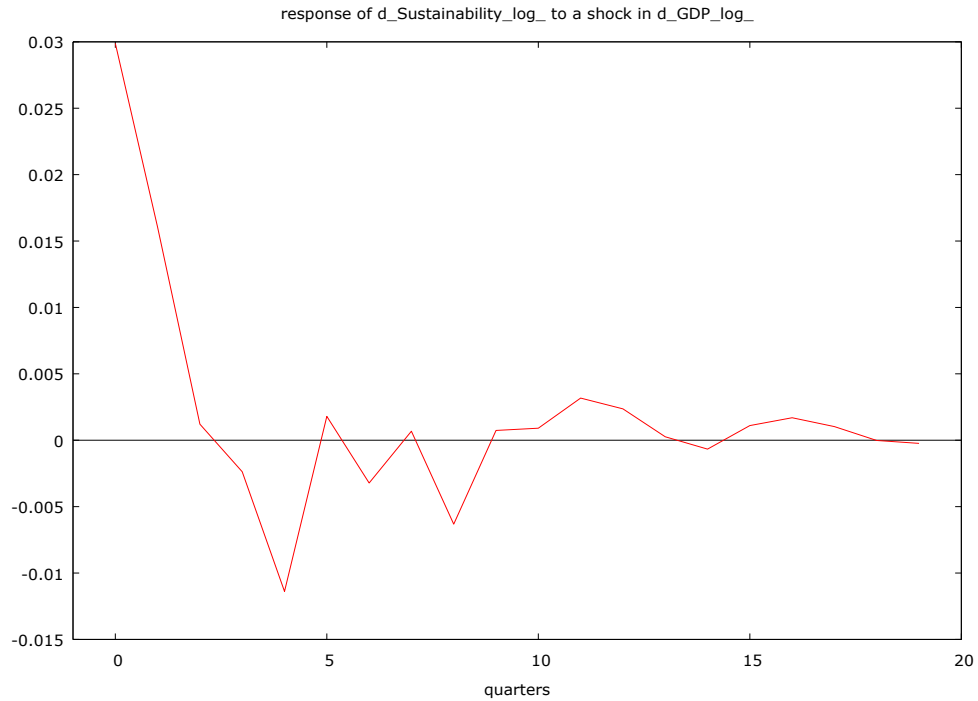


Figure C3. Impulse response between sustainability and GDP in North America

C.1.4. Hypothesis 2-2; The Response of Sustainability to Shock in GNI in North America

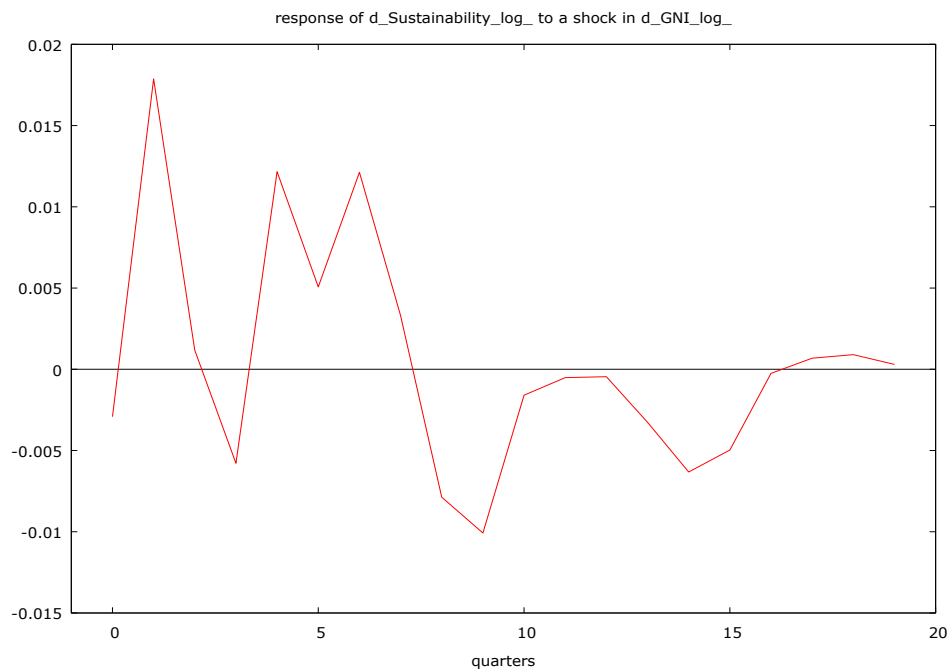


Figure C4. Impulse response between sustainability and GNI in North America

C.2. Forecast Error Variance Decomposition

C.2.1. Hypothesis 2-2: Decomposition of Variance for Sustainability in Asia-Pacific region

period	std. error	Population	Asia Pacific GDP log	Asia Pacific Sustainability log
1	0.031344	4.4980	0.0181	95.4839
2	0.0408924	5.0785	0.0162	94.9053
3	0.0482745	3.9116	0.8387	95.2497
4	0.0561424	2.9478	5.1939	91.8583
5	0.0610802	3.9986	7.2307	88.7707
6	0.0665939	5.4413	6.3676	88.1910
7	0.072398	6.8692	6.0194	87.1115
8	0.0761064	9.3982	6.0303	84.5715
9	0.0793286	11.1161	5.5827	83.3012
10	0.0836756	14.4344	5.4888	80.0768
11	0.0895513	16.7985	5.9387	77.2628
12	0.096616	18.7281	7.7999	73.4720
13	0.104097	21.3809	9.3266	69.2924
14	0.111016	23.3920	10.1504	66.4576
15	0.116867	24.5528	9.8586	65.5887

C.2.2. Hypothesis 2-2: Decomposition of Variance for Sustainability log in North America

Period	std. error	GDP log	Sustainability log	GR	Population
1	0.0653108	27.7679	72.2321	0.0000	0.0000
2	0.0676831	30.5592	68.8086	0.4747	0.1575
3	0.0700152	28.5584	64.5224	6.3748	0.5443
4	0.0763279	24.1659	54.7630	20.2524	0.8188
5	0.0780887	24.2839	54.1782	19.3546	2.1832
6	0.0788093	24.7153	53.3903	19.7451	2.1492
7	0.079447	24.3450	53.5594	19.9796	2.1160
8	0.0801673	24.0698	52.6189	20.9777	2.3335
9	0.0808326	25.0554	51.9043	20.6416	2.3988
10	0.0810394	25.1232	51.7520	20.5603	2.5645
11	0.081348	25.0899	51.5956	20.7695	2.5450
12	0.0818684	24.8019	51.2687	21.4096	2.5198
13	0.0820088	24.7435	51.1407	21.5927	2.5231
14	0.0821009	24.6881	51.0304	21.7291	2.5525
15	0.0821133	24.6841	51.0329	21.7225	2.5605