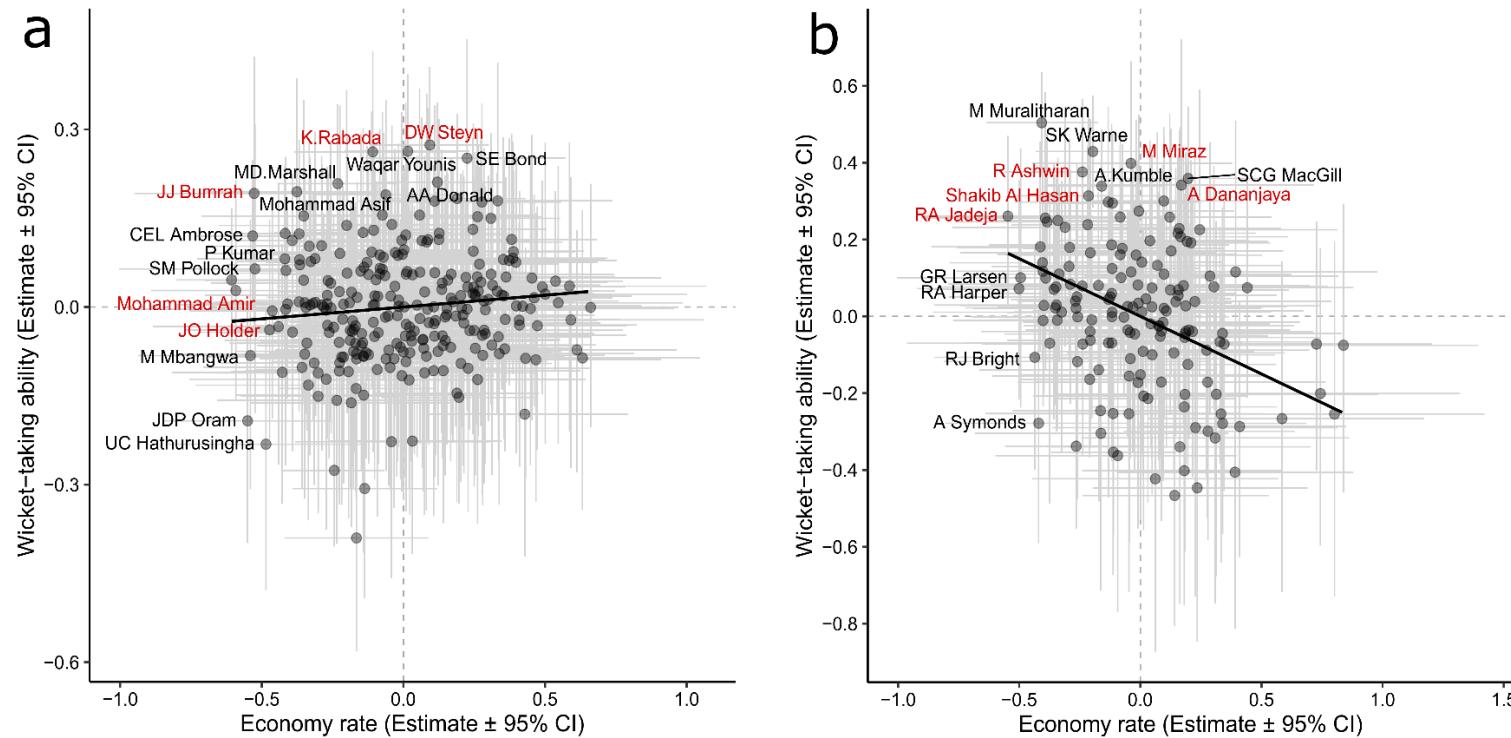


## SUPPORTING INFORMATION

*"Bowled over or over-bowled? Age-related changes in the performance of bowlers in Test match cricket"*

Jack Thorley



**Figure S1. Posterior correlation between economy rate and wicket-taking ability in a) fast and b) slow bowlers, as estimated from multivariate models, including Test cricketers that are still playing, or have only recently stopped playing.** Points denote the player-specific deviations in intercept for each performance metric with 95% CI (grey lines). The posterior among-individual correlation is displayed by the solid line. Estimates are taken from models that controlled for other confounding population-level effects. Individual players with particularly low economy rate or particularly high wicket-taking ability have been highlighted; current players or bowlers that have only recently retired are coloured red.

**Table S1: Best fitting linear mixed effects model for the economy rate of fast bowlers and slow bowlers.** Significance ( $\alpha < 0.05$ ) of fixed effects was assessed by likelihood ratio tests when respective terms were dropped from the main model. We do not present the significance of main effects when present in interactions. Continuous variables were z-score transformed prior to model fitting. 95% confidence intervals for the fixed effects means were calculated by parametric bootstrapping.

#### FAST BOWLERS ECONOMY

Fixed Effect	Estimate	SE	95% CI	t-value	X <sup>2</sup> , df	p- value
Intercept	3.094	0.055	2.984 – 3.201			
Age	-0.105	0.025	-0.155 – -0.057	-4.19		
Innings- 2	0.063	0.032	-0.003 – 0.126	1.96		
3	0.049	0.027	0.001 – 0.103	1.79		
4	0.301	0.036	0.222 – 0.370	8.26		
Home or Away- Home	-0.120	0.028	-0.177 – -0.071	-4.28	18.24, 1	< 0.001
Terminal Effect	0.126	0.036	0.055 – 0.194	3.50	12.11, 1	< 0.001
Last Game Age	-0.080	0.030	-0.135 – 0.021	-2.68	6.69, 1	0.010
Age:Innings2	0.010	0.029	-0.049 – 0.069	0.35	12.46, 3	0.006
Age:Innings3	-0.013	0.027	-0.066 – 0.040	-0.46		
Age:Innings4	-0.094	0.033	-0.158 – -0.026	-2.88		
Random Effect	Variance	Std Dev				
PlayerID (n = 227)	0.104	0.323				
MatchID (n = 2581)	0.196	0.443				
Opposition:Decade (n = 42)	0.050	0.220				
Country:Decade (n = 40)	0.006	0.077				
Residual	1.113	1.055				

#### SLOW BOWLERS ECONOMY

Fixed Effect	Estimate	SE	95% CI	t-value	X <sup>2</sup> , df	p- value
Intercept	3.064	0.078	2.912 – 3.210			
Innings- 2	-0.178	0.050	-0.273 – -0.083	-3.59	31.26, 3	< 0.001
3	-0.067	0.047	-0.162 – 0.021	-1.43		
4	0.108	0.057	-0.011 – 0.220	1.88		
Home or Away- Home	-0.169	0.041	-0.245 – -0.092	-4.12	16.86, 1	< 0.001
Terminal Effect	0.121	0.053	0.010 – 0.216	2.32	5.32, 1	0.021
Last Game Age	-0.155	0.039	-0.231 – -0.077	-3.99	15.44, 1	< 0.001
Random Effect	Variance	Std Dev				
PlayerID (n = 128)	0.142	0.388				
MatchID (n = 2044)	0.151	0.376				
Opposition:Decade (n = 42)	0.082	0.285				
Country:Decade (n = 41)	0.024	0.155				
Residual	1.420	1.191				

**Table S2: Best fitting generalised linear mixed effects model for the wicket-taking ability of fast bowlers and slow bowlers.** Models were fitted to a negative binomial error distribution with a zero-inflation parameter applied across all data points (~1). 95% confidence intervals for the fixed effects means were calculated via the Wald method.

#### FAST BOWLERS WICKETS

Fixed Effect	Estimate	SE	95% CI	z-value	p- value
Intercept	0.531	0.029	0.475 – 0.587		
Age	-0.024	0.017	-0.057 – 0.008	-1.46	0.145
Innings- 2	-0.014	0.020	-0.053 – 0.024	-0.73	0.463
3	-0.041	0.021	-0.082 – 0.000	-1.95	0.051
4	-0.150	0.027	-0.203 – -0.097	-5.56	< 0.001
Home or Away- Home	0.069	0.016	0.038 – 0.100	4.41	< 0.001
Overs	0.324	0.009	0.307 – 0.341	36.95	< 0.001
Terminal Effect	-0.110	0.026	-0.160 – 0.060	-4.32	< 0.001
Last Game Age	0.040	0.017	0.007 – 0.073	2.36	0.018
Age:Innings2	0.039	0.020	0.001 – 0.078	2.02	0.043
Age:Innings3	0.045	0.021	0.005 – 0.086	2.18	0.029
Age:Innings4	0.082	0.025	0.032 – 0.132	3.23	0.001
<b>Zero-inflation Intercept</b>	<b>-4.97</b>	<b>0.843</b>		<b>-5.90</b>	<b>&lt; 0.001</b>
Random Effect	Variance	Std Dev			
PlayerID (n =227)	0.018	0.134			
Opposition:Decade (n = 42)	0.006	0.078			
Country:Decade (n = 40)	0.006	0.075			

#### SLOW BOWLERS WICKETS

Fixed Effect	Estimate	SE	95% CI	z-value	p- value
Intercept	0.284	0.047	0.192 – 0.376		
Innings- 2	0.044	0.033	-0.020 – 0.108	1.34	0.180
3	0.135	0.033	0.071 – 0.199	4.14	< 0.001
4	0.075	0.041	-0.004 – 0.154	1.84	0.066
Home or Away- Home	0.083	0.026	0.033 – 0.133	3.23	0.001
Overs	0.414	0.014	0.387 – 0.441	30.20	< 0.001
Terminal Effect	-0.163	0.036	-0.234 – -0.092	-4.51	< 0.001
Last Game Age	0.036	0.025	-0.014 – 0.086	1.42	0.157
<b>Zero-inflation Intercept</b>	<b>-15.60</b>	<b>1243.6</b>		<b>-0.01</b>	<b>0.99</b>
Random Effect	Variance	Std Dev			
PlayerID (n =128)	0.054	0.233			
Opposition:Decade (n = 41)	0.022	0.148			
Country:Decade (n = 40)	0.006	0.080			

**Table S3: Best fitting generalised linear mixed effects model for the proportion of the overs bowled in the innings.** Models were fitted to a binomial error distribution with the number of overs bowler by the bowler as the numerator, and the total number of overs in the innings set as the denominator. 95% confidence intervals for the fixed effects means were calculated by parametric bootstrapping.

**FAST BOWLERS OVERS**

Fixed Effect	Estimate	SE	95% CI	z-value	p- value
Intercept	-1.578	0.017	-1.615 – -1.545		
Age	0.011	0.005	-0.003 – 0.004	1.54	0.124
Age <sup>2</sup>	-0.032	0.003	-0.004 – -0.022	-6.48	< 0.001
Innings- 2	-0.020	0.008	-0.037 – -0.007	-2.35	0.019
3	-0.087	0.007	-0.099 – -0.073	-12.61	< 0.001
4	-0.050	0.011	-0.070 – -0.031	-4.64	< 0.001
Home or Away- Home	-0.027	0.008	-0.037 – -0.007	-2.85	0.004
Terminal Effect	-0.049	0.011	-0.049 – -0.005	2.41	0.016
Last Game Age	0.078	0.014	0.052 – 0.106	5.54	< 0.001
Age: Last Game Age	0.034	0.007	0.019 – 0.048	4.62	< 0.001
Age <sup>2</sup> : Last Game Age	0.003	0.003	-0.002 – 0.008	1.24	0.215
Random Effect	Variance	Std Dev			
MatchID (n = 2568)	0.020	0.144			
PlayerID (n = 219)	0.023	0.152			
Opposition:Decade (n = 42)	0.000	0.018			
Country:Decade (n = 40)	0.004	0.066			

**SLOW BOWLERS OVERS**

Fixed Effect	Estimate	SE	95% CI	z-value	p- value
Intercept	-1.725	0.046	-1.812 – -1.634		
Age	-0.035	0.018	-0.072 – 0.003	-1.92	0.055
Age <sup>2</sup>	-0.038	0.012	-0.006 – -0.015	-3.16	0.002
Innings- 2	0.092	0.016	0.059 – 0.126	5.75	< 0.001
3	0.192	0.012	0.167 – 0.216	15.43	< 0.001
4	0.250	0.020	0.205 – 0.293	12.37	< 0.001
Home or Away- Home	-0.015	0.013	-0.040 – 0.012	-1.10	0.273
Terminal Effect	-0.016	0.021	-0.056 – -0.022	-0.78	0.438
Last Game Age	0.149	0.037	0.080 – 0.226	4.06	< 0.001
Age:Innings2	0.023	0.011	0.002 – 0.049	2.09	0.037
Age:Innings3	0.043	0.010	0.023 – 0.065	4.27	< 0.001
Age:Innings4	0.021	0.015	0.010 – 0.051	1.47	0.141
Age <sup>2</sup> :Innings2	-0.013	0.009	-0.030 – 0.004	-1.49	0.136
Age <sup>2</sup> :Innings3	-0.007	0.008	-0.022 – 0.010	-0.86	0.392
Age <sup>2</sup> :Innings4	-0.016	0.012	-0.041 – 0.008	-1.36	0.173
Age: Last Game Age	0.085	0.017	0.051 – 0.121	4.93	< 0.001
Age <sup>2</sup> : Last Game Age	-0.007	0.006	-0.020 – 0.007	-1.12	0.264
Random Effect	Variance	Std Dev			
MatchID (n = 2044)	0.053	0.230			
PlayerID (n = 128)	0.145	0.381			
Opposition:Decade (n = 42)	0.001	0.035			
Country:Decade (n = 41)	0.018	0.135			

**Table S4: Results from Bayesian multivariate response models investigating the posterior correlation between economy rate and wicket-taking ability in fast bowlers.** Economy rate was fitted to a Gaussian distribution, wicket-taking ability to a negative binomial distribution. Estimates for the group-level and the population-level effects provide the standard deviation and the mean, respectively. Estimates for the wicket-taking ability model are provided on the link (log) scale.

Term	Estimate	Lower 95% CI	Upper 95% CI
<b>Group-level effects</b>			
<b>PlayerID</b>			
Economy rate: Intercept	0.33	0.28	0.38
Wicket-taking ability: Intercept	0.14	0.11	0.16
Cor(Economy-Wicket-taking)	0.06	-0.18	0.29
<b>Match ID</b>			
Economy rate: Intercept	0.44	0.41	0.47
<b>Opposition:decade</b>			
Economy rate: Intercept	0.24	0.17	0.32
Wicket-taking ability: Intercept	0.08	0.06	0.11
<b>Country:decade</b>			
Economy rate: Intercept	0.11	0.03	0.20
Wicket-taking ability: Intercept	0.10	0.05	0.14
<b>Population-level effects</b>			
Economy rate: Intercept	3.12	3.01	3.23
Economy rate: Age	-0.13	-0.17	-0.08
Economy rate: Home or away-Home	-0.12	-0.18	-0.07
Economy rate: Innings2	0.06	0.00	0.13
Economy rate: Innings3	0.05	-0.01	0.10
Economy rate: Innings4	0.30	0.23	0.37
Economy rate: Terminal effect	0.15	0.09	0.22
Economy rate: Age:Innings2	0.01	-0.05	0.06
Economy rate: Age:Innings3	-0.01	-0.07	0.04
Economy rate: Age:Innings4	-0.09	-0.16	-0.03
Wicket-taking ability: Intercept	0.51	0.45	0.57
Wicket-taking ability: Age	-0.01	-0.04	0.02
Wicket-taking ability: Home or away-Home	0.07	0.04	0.10
Wicket-taking ability: Innings2	-0.01	-0.05	0.02
Wicket-taking ability: Innings3	-0.04	-0.08	0.00
Wicket-taking ability: Innings4	-0.15	-0.20	-0.10
Wicket-taking ability: Overs	0.33	0.31	0.34
Wicket-taking ability: Terminal effect	-0.13	-0.18	-0.08
Wicket-taking ability: Age:Innings2	0.04	0.00	0.08
Wicket-taking ability: Age:Innings3	0.05	0.01	0.09
Wicket-taking ability: Age:Innings4	0.08	0.03	0.13
Sigma- Economy rate	1.06	1.04	1.07
Shape parameter – Wicket-taking ability	10.81	8.94	13.20

**Table S5: Results from Bayesian multivariate response models investigating the posterior correlation between economy rate and wicket-taking ability in slow bowlers.** Economy rate was fitted to a Gaussian distribution, wicket-taking ability to a negative binomial distribution. Estimates for the group-level and the population-level effects provide the standard deviation and the mean, respectively. Estimates for the wicket-taking ability model are provided on the link (log) scale.

Term	Estimate	Lower 95% CI	Upper 95% CI
<b>Group-level effects</b>			
<b>PlayerID</b>			
Economy rate: Intercept	0.41	0.33	0.50
Wicket-taking ability: Intercept	0.24	0.19	0.30
Cor(Economy-Wicket-taking)	-0.29	-0.55	0.00
<b>Match ID</b>			
Economy rate: Intercept	0.39	0.32	0.45
<b>Opposition:decade</b>			
Economy rate: Intercept	0.30	0.22	0.40
Wicket-taking ability: Intercept	0.16	0.11	0.22
<b>Country:decade</b>			
Economy rate: Intercept	0.15	0.03	0.28
Wicket-taking ability: Intercept	0.08	0.01	0.15
<b>Population-level effects</b>			
Economy rate: Intercept	3.11	2.96	3.27
Economy rate: Home or away-Home	-0.16	-0.24	-0.09
Economy rate: Innings2	-0.18	-0.28	-0.08
Economy rate: Innings3	-0.07	-0.16	0.03
Economy rate: Innings4	0.11	-0.00	0.22
Economy rate: Terminal effect	0.13	0.03	0.24
Wicket-taking ability: Intercept	0.27	0.17	0.36
Wicket-taking ability: Home or away-Home	0.08	0.03	0.13
Wicket-taking ability: Innings2	0.05	-0.02	0.11
Wicket-taking ability: Innings3	0.14	0.07	0.20
Wicket-taking ability: Innings4	0.08	-0.00	0.15
Wicket-taking ability: Overs	0.41	0.39	0.44
Wicket-taking ability: Terminal effect	-0.17	-0.24	-0.10
Sigma- Economy rate	1.19	1.16	1.22
Shape parameter – Wicket-taking ability	8.73	6.85	11.36

**Table S6: Rankings for the fast bowlers of modern era (post-1973) Test cricket on the basis of their wicket-taking ability.** Estimates represent the player-specific intercepts extracted from the multivariate response models that controlled for various confounding effects- including the number of overs bowled per innings. Players that were still thought to be playing Test cricket on or around June 2019 are not included.

Rank	PlayerName	Country	Wickets	lower_95CI	upper_95CI
1	Waqar.Younis	Pakistan	0.2628	0.1289	0.3947
2	SE.Bond	New Zealand	0.2380	0.0458	0.4369
3	AA.Donald	South Africa	0.2190	0.0832	0.3528
4	MD.Marshall	West Indies	0.2080	0.0756	0.3439
5	Mohammad.Asif	Pakistan	0.2033	0.0217	0.3931
6	MG.Johnson	Australia	0.1803	0.0523	0.3132
7	Shoaib.Akhtar	Pakistan	0.1758	0.0194	0.3419
8	D.Gough	England	0.1685	0.0240	0.3110
9	M.Morkel	South Africa	0.1557	0.0134	0.3049
10	DW.Headley	England	0.1484	-0.0549	0.3528
11	JL.Pattinson	Australia	0.1483	-0.0543	0.3487
12	DE.Bollinger	Australia	0.1405	-0.0733	0.3622
13	M.Ntini	South Africa	0.1400	0.0153	0.2684
14	GR.Dilley	England	0.1391	-0.0344	0.3161
15	CL.Cairns	New Zealand	0.1372	-0.0021	0.2794
16	CEH.Croft	West Indies	0.1317	-0.0441	0.3108
17	IR.Bishop	West Indies	0.1295	-0.0295	0.2954
18	JJC.Lawson	West Indies	0.1241	-0.0837	0.3356
19	SL.Malinga	SriLanka	0.1159	-0.0684	0.3011
20	B.Lee	Australia	0.1134	-0.0174	0.2503
21	CEL.Ambrose	West Indies	0.1128	-0.0125	0.2395
22	RJ.Harris	Australia	0.1113	-0.0662	0.2868
23	GD.McGrath	Australia	0.1110	0.0004	0.2197
24	Wasim.Akram	Pakistan	0.1075	-0.0155	0.2339
25	LS.Pascoe	Australia	0.1040	-0.0931	0.3032
26	BA.Reid	Australia	0.1025	-0.0760	0.2830
27	KTGD.Prasad	SriLanka	0.1025	-0.0962	0.3028
28	BN.Schultz	South Africa	0.0996	-0.1211	0.3183
29	J.Garner	West Indies	0.0995	-0.0458	0.2494
30	AH.Gray	West Indies	0.0974	-0.1376	0.3381
31	P.Kumar	India	0.0928	-0.1421	0.3323
32	SP.Jones	England	0.0911	-0.1056	0.2988
33	CJ.McDermott	Australia	0.0909	-0.0419	0.2222
34	M.Hayward	South Africa	0.0835	-0.1242	0.2922
35	ALF.de.Mel	SriLanka	0.0814	-0.1338	0.2873
36	ST.Finn	England	0.0798	-0.1060	0.2632
37	CT.Tremlett	England	0.0777	-0.1302	0.2942
38	WW.Daniel	West Indies	0.0769	-0.1416	0.3041
39	Shabbir.Ahmed	Pakistan	0.0764	-0.1346	0.2903
40	PS.de.Villiers	South Africa	0.0749	-0.1171	0.2735

41	SM.Pollock	South Africa	0.0742	-0.0440	0.1941
42	S.Sreesanth	India	0.0713	-0.1172	0.2507
43	AR.Caddick	England	0.0706	-0.0647	0.2073
44	ARC.Fraser	England	0.0689	-0.0849	0.2217
45	CA.Walsh	West Indies	0.0682	-0.0433	0.1788
46	IK.Pathan	India	0.0680	-0.1151	0.2478
47	AM.Blignaut	Zimbabwe	0.0676	-0.1393	0.2696
48	HH.Streak	Zimbabwe	0.0673	-0.0838	0.2189
49	Azeem.Hafeez	Pakistan	0.0659	-0.1322	0.2705
50	DK.Morrison	New Zealand	0.0642	-0.0970	0.2204
51	J.Srinath	India	0.0588	-0.0825	0.1985
52	KJ.Abbott	South Africa	0.0577	-0.1612	0.2821
53	Z.Khan	India	0.0577	-0.0722	0.1885
54	G.Onions	England	0.0577	-0.1660	0.2741
55	DAJ.Bracewell	New Zealand	0.0552	-0.1452	0.2504
56	RJ.Ratnayake	SriLanka	0.0545	-0.1305	0.2479
57	KCG.Benjamin	West Indies	0.0539	-0.1259	0.2322
58	MG.Hughes	Australia	0.0533	-0.0879	0.1968
59	Wahab.Riaz	Pakistan	0.0503	-0.1546	0.2610
60	CEL.Stuart	West Indies	0.0490	-0.1880	0.2862
61	SR.Clark	Australia	0.0486	-0.1317	0.2280
62	FH.Edwards	West Indies	0.0466	-0.1076	0.1995
63	T.Panyangara	Zimbabwe	0.0459	-0.1774	0.2716
64	Mohsin.Kamal	Pakistan	0.0454	-0.1878	0.2818
65	GF.Lawson	Australia	0.0451	-0.1124	0.2019
66	TM.Alderman	Australia	0.0447	-0.1097	0.2025
67	M.Zondeki	South Africa	0.0438	-0.1918	0.2805
68	SB.Doull	New Zealand	0.0438	-0.1339	0.2194
69	MJ.Hoggard	England	0.0427	-0.0969	0.1817
70	IE.O'Brien	New Zealand	0.0422	-0.1504	0.2380
71	NG.Cowans	England	0.0405	-0.1710	0.2518
72	BP.Patterson	West Indies	0.0400	-0.1406	0.2173
73	RM.Ellison	England	0.0400	-0.1815	0.2523
74	JN.Gillespie	Australia	0.0395	-0.0958	0.1789
75	Aamer.Nazir	Pakistan	0.0393	-0.1965	0.2783
76	WPUJC.Vaas	SriLanka	0.0392	-0.0905	0.1713
77	Sohail.Khan	Pakistan	0.0383	-0.2029	0.2645
78	JE.Taylor	West Indies	0.0377	-0.1299	0.1952
79	C.Sharma	India	0.0362	-0.1639	0.2385
80	AJ.Tudor	England	0.0351	-0.1898	0.2604
81	DG.Cork	England	0.0311	-0.1248	0.1854
82	CS.Martin	New Zealand	0.0297	-0.1173	0.1735
83	L.Balaji	India	0.0297	-0.2034	0.2677
84	BW.Hilfenhaus	Australia	0.0291	-0.1594	0.2113
85	RP.Singh	India	0.0285	-0.1821	0.2404
86	DV.Lawrence	England	0.0270	-0.2111	0.2688
87	IG.Butler	New Zealand	0.0269	-0.2062	0.2540

88	CK.Langeveldt	South Africa	0.0268	-0.2097	0.2652
89	ST.Clarke	West Indies	0.0234	-0.1934	0.2419
90	PM.Siddle	Australia	0.0220	-0.1288	0.1692
91	BT.Watambwa	Zimbabwe	0.0219	-0.2232	0.2619
92	DW.Fleming	Australia	0.0218	-0.1672	0.2073
93	T.Thushara	SriLanka	0.0203	-0.2077	0.2336
94	Junaid.Khan	Pakistan	0.0198	-0.1913	0.2310
95	A.Nel	South Africa	0.0194	-0.1441	0.1852
96	SI.Mahmood	England	0.0183	-0.2254	0.2538
97	KR.Pushpakumara	SriLanka	0.0178	-0.1902	0.2210
98	M.Dillon	West Indies	0.0169	-0.1481	0.1781
99	CRD.Fernando	SriLanka	0.0166	-0.1638	0.1884
100	N.Phillip	West Indies	0.0163	-0.2252	0.2500
101	A.Kuruvilla	India	0.0149	-0.2220	0.2406
102	Umar.Gul	Pakistan	0.0142	-0.1475	0.1792
103	DH.Brain	Zimbabwe	0.0135	-0.2091	0.2325
104	SJ.Harmison	England	0.0122	-0.1311	0.1532
105	FA.Rose	West Indies	0.0119	-0.1878	0.2149
106	DR.Tuffey	New Zealand	0.0105	-0.1763	0.1922
107	Talha.Jubair	Bangladesh	0.0091	-0.2437	0.2546
108	Mashrafe.Mortaza	Bangladesh	0.0083	-0.1909	0.1986
109	DT.Hondo	Zimbabwe	0.0082	-0.2376	0.2455
110	GC.Small	England	0.0058	-0.2019	0.2109
111	AIC.Dodemaide	Australia	0.0051	-0.2156	0.2227
112	VR.Aaron	India	0.0037	-0.2349	0.2482
113	JR.Hammond	Australia	0.0033	-0.2375	0.2533
114	DJ.Terbrugge	South Africa	0.0031	-0.2274	0.2300
115	DA.Stirling	New Zealand	0.0021	-0.2456	0.2460
116	Robiul.Islam	Bangladesh	0.0011	-0.2377	0.2328
117	MA.Ealham	England	0.0009	-0.2352	0.2436
118	PAJ.DeFreitas	England	0.0000	-0.1580	0.1575
119	DJ.Nash	New Zealand	0.0000	-0.1826	0.1756
120	CD.Collymore	West Indies	-0.0028	-0.1849	0.1708
121	GF.Labrooy	SriLanka	-0.0030	-0.2323	0.2242
122	NA.Foster	England	-0.0043	-0.1833	0.1724
123	JEC.Franklin	New Zealand	-0.0075	-0.1869	0.1756
124	MB.Owens	New Zealand	-0.0082	-0.2420	0.2215
125	RJ.Sidebottom	England	-0.0083	-0.1943	0.1738
126	N.Kapil.Dev	India	-0.0094	-0.1302	0.1123
127	PDRL.Perera	SriLanka	-0.0109	-0.2509	0.2212
128	RMS.Eranga	SriLanka	-0.0118	-0.2243	0.1952
129	PT.Collins	West Indies	-0.0121	-0.1861	0.1574
130	UWMBCA.Welegedara	SriLanka	-0.0127	-0.2238	0.1959
131	MI.Black	West Indies	-0.0151	-0.2684	0.2300
132	RD.King	West Indies	-0.0174	-0.2246	0.1816
133	R.Rampaul	West Indies	-0.0190	-0.2299	0.1831
134	CR.Miller	Australia	-0.0200	-0.2103	0.1720

135	Harbhajan.Singh	India	-0.0201	-0.1413	0.1040
136	JR.Ratnayake	SriLanka	-0.0230	-0.2281	0.1878
137	AtaNAurNARehman	Pakistan	-0.0237	-0.2426	0.1934
138	A.Sanford	West Indies	-0.0245	-0.2428	0.1998
139	CG.Rackemann	Australia	-0.0268	-0.2443	0.1884
140	WW.Davis	West Indies	-0.0269	-0.2375	0.1834
141	Shahadat.Hossain	Bangladesh	-0.0279	-0.2353	0.1737
142	LE.Plunkett	England	-0.0279	-0.2412	0.1747
143	HK.Olonga	Zimbabwe	-0.0284	-0.2239	0.1664
144	CJ.Jordan	England	-0.0285	-0.2691	0.1988
145	TJ.Friend	Zimbabwe	-0.0286	-0.2685	0.2035
146	WKM.Benjamin	West Indies	-0.0298	-0.2189	0.1619
147	MR.Whitney	Australia	-0.0310	-0.2465	0.1746
148	TCB.Fernando	SriLanka	-0.0311	-0.2648	0.2053
149	DNT.Zoysa	SriLanka	-0.0314	-0.2222	0.1557
150	CE.Cuffy	West Indies	-0.0315	-0.2560	0.1868
151	Saleem.Jaffar	Pakistan	-0.0318	-0.2475	0.1718
152	BKV.Prasad	India	-0.0323	-0.2106	0.1441
153	NAM.McLean	West Indies	-0.0333	-0.2411	0.1675
154	CEW.Silverwood	England	-0.0337	-0.2824	0.2080
155	DE.Malcolm	England	-0.0347	-0.1931	0.1283
156	SB.O'Connor	New Zealand	-0.0349	-0.2301	0.1646
157	VRV.Singh	India	-0.0349	-0.2902	0.2131
158	VC.Drakes	West Indies	-0.0359	-0.2492	0.1697
159	TT.Bresnan	England	-0.0414	-0.2396	0.1569
160	DK.Liyanage	SriLanka	-0.0445	-0.2862	0.1967
161	CPH.Ramanayake	SriLanka	-0.0449	-0.2560	0.1544
162	AJ.Bichel	Australia	-0.0482	-0.2495	0.1464
163	KD.Mills	New Zealand	-0.0484	-0.2506	0.1462
164	JDS.Neesham	New Zealand	-0.0487	-0.2954	0.1847
165	Shahid.Nazir	Pakistan	-0.0494	-0.2578	0.1561
166	PR.Reiffel	Australia	-0.0496	-0.2205	0.1206
167	A.Nehra	India	-0.0517	-0.2633	0.1543
168	PW.Jarvis	England	-0.0559	-0.2836	0.1684
169	BP.Julian	Australia	-0.0585	-0.2978	0.1769
170	RMH.Binny	India	-0.0587	-0.2622	0.1415
171	Tapash.Baisya	Bangladesh	-0.0606	-0.2854	0.1566
172	ML.Su'a	New Zealand	-0.0616	-0.2773	0.1452
173	KSC.de.Silva	SriLanka	-0.0630	-0.3200	0.1753
174	MS.Kasprowicz	Australia	-0.0631	-0.2313	0.1022
175	PJW.Allott	England	-0.0646	-0.2866	0.1502
176	MM.Patel	India	-0.0646	-0.2813	0.1365
177	Tahir.Naqqash	Pakistan	-0.0650	-0.2855	0.1465
178	BS.Sandhu	India	-0.0661	-0.3180	0.1711
179	DJ.Bravo	West Indies	-0.0666	-0.2490	0.1067
180	M.Mbangwa	Zimbabwe	-0.0673	-0.2829	0.1415
181	AJ.Hall	South Africa	-0.0704	-0.2754	0.1271

182	DR.Gilbert	Australia	-0.0705	-0.3146	0.1571
183	A.Flintoff	England	-0.0717	-0.2166	0.0655
184	Mohammad.Sharif	Bangladesh	-0.0721	-0.3232	0.1659
185	CC.Lewis	England	-0.0721	-0.2457	0.0988
186	TL.Best	West Indies	-0.0724	-0.2713	0.1185
187	NW.Bracken	Australia	-0.0734	-0.3212	0.1658
188	EA.Brandes	Zimbabwe	-0.0738	-0.2986	0.1444
189	CJ.Anderson	New Zealand	-0.0739	-0.3132	0.1592
190	Mushfiqur.Rahman	Bangladesh	-0.0756	-0.3167	0.1553
191	NavedNAulNAHasan	Pakistan	-0.0759	-0.3118	0.1531
192	KMDN.Kulasekara	SriLanka	-0.0767	-0.2799	0.1167
193	AINAAmin.Hossain	Bangladesh	-0.0774	-0.3384	0.1679
194	PJ.Martin	England	-0.0782	-0.3149	0.1532
195	MC.Snedden	New Zealand	-0.0801	-0.2815	0.1197
196	CR.Matthews	South Africa	-0.0835	-0.2858	0.1196
197	DR.Pringle	England	-0.0914	-0.2803	0.0980
198	GI.Allott	New Zealand	-0.0921	-0.3292	0.1313
199	BJ.Arnel	New Zealand	-0.0925	-0.3309	0.1421
200	C.White	England	-0.0925	-0.2918	0.0927
201	GP.Wickramasinghe	SriLanka	-0.0950	-0.2829	0.0870
202	AD.Mullally	England	-0.0995	-0.2930	0.0855
203	Mohammad.Akram	Pakistan	-0.0995	-0.3381	0.1260
204	Aaqib.Javed	Pakistan	-0.1003	-0.3024	0.0973
205	Manjural.Islam	Bangladesh	-0.1003	-0.3235	0.1144
206	E.Chigumbura	Zimbabwe	-0.1009	-0.3388	0.1192
207	Khaled.Mahmud	Bangladesh	-0.1023	-0.3443	0.1278
208	SP.O'Donnell	Australia	-0.1041	-0.3602	0.1320
209	AB.Agarkar	India	-0.1088	-0.3072	0.0825
210	DJ.Capel	England	-0.1105	-0.3441	0.1102
211	W.Watson	New Zealand	-0.1129	-0.3275	0.0949
212	DJG.Sammy	West Indies	-0.1212	-0.3033	0.0536
213	C.Pringle	New Zealand	-0.1230	-0.3569	0.0917
214	M.Prabhakar	India	-0.1262	-0.3019	0.0467
215	Mohammad.Sami	Pakistan	-0.1349	-0.3105	0.0396
216	Abdul.Razzaq	Pakistan	-0.1362	-0.3162	0.0432
217	ML.Nkala	Zimbabwe	-0.1408	-0.3879	0.0851
218	DBL.Powell	West Indies	-0.1421	-0.3150	0.0285
219	EAE.Baptiste	West Indies	-0.1462	-0.3842	0.0702
220	Azhar.Mahmood	Pakistan	-0.1464	-0.3584	0.0560
221	JDP.Oram	New Zealand	-0.1909	-0.3925	0.0021
222	BM.McMillan	South Africa	-0.2107	-0.3946	-0.0384
223	MF.Maharoof	SriLanka	-0.2114	-0.4241	-0.0082
224	JH.Kallis	South Africa	-0.2213	-0.3482	-0.0952
225	UC.Hathurusingha	SriLanka	-0.2257	-0.4702	-0.0037
226	L.Klusener	South Africa	-0.2761	-0.4594	-0.1057
227	SR.Watson	Australia	-0.3459	-0.5383	-0.1706

**Table S7: Rankings for the fast bowlers of modern era (post-1973) Test cricket on the basis of their economy rate.** Estimates represent the player-specific intercepts extracted from the multivariate response models that controlled for various confounding effects. Players that were still thought to be playing Test cricket on or around June 2019 are not included.

Rank	Player Name	Country	Economy	Econ_lower95CI	Econ_upper95CI
1	SM.Pollock	South Africa	-0.6161	-0.8110	-0.4098
2	CEL.Ambrose	West Indies	-0.5460	-0.7460	-0.3444
3	JDP.Oram	New Zealand	-0.5439	-0.8472	-0.2584
4	M.Mbangwa	Zimbabwe	-0.5265	-0.9210	-0.1337
5	P.Kumar	India	-0.5103	-0.9855	-0.0350
6	UC.Hathurusingha	Sri Lanka	-0.4762	-0.8448	-0.1234
7	CD.Collymore	West Indies	-0.4698	-0.7607	-0.1764
8	Wasim.Akram	Pakistan	-0.4299	-0.6317	-0.2291
9	W.Watson	New Zealand	-0.4257	-0.8127	-0.0508
10	JR.Hammond	Australia	-0.4239	-0.9611	0.0787
11	GD.McGrath	Australia	-0.4231	-0.6074	-0.2313
12	HH.Streak	Zimbabwe	-0.4103	-0.6601	-0.1611
13	WPUJC.Vaas	Sri Lanka	-0.4015	-0.6138	-0.2018
14	WKM.Benjamin	West Indies	-0.3938	-0.7319	-0.0483
15	CA.Walsh	West Indies	-0.3885	-0.5696	-0.1964
16	CR.Matthews	South Africa	-0.3852	-0.7522	-0.0243
17	BW.Hilfenhaus	Australia	-0.3780	-0.6924	-0.0620
18	Mohammad.Asif	Pakistan	-0.3693	-0.7128	-0.0282
19	DJ.Nash	New Zealand	-0.3634	-0.6648	-0.0567
20	IR.Bishop	West Indies	-0.3613	-0.6267	-0.1021
21	C.Pringle	New Zealand	-0.3348	-0.7276	0.0792
22	PJ.Martin	England	-0.3336	-0.7990	0.1193
23	BA.Reid	Australia	-0.3317	-0.6621	-0.0105
24	J.Garner	West Indies	-0.3248	-0.5802	-0.0702
25	KJ.Abbott	South Africa	-0.3217	-0.7461	0.1061
26	NA.Foster	England	-0.3215	-0.6450	-0.0031
27	ARC.Fraser	England	-0.3167	-0.5803	-0.0598
28	T.Panyangara	Zimbabwe	-0.3122	-0.7532	0.1305
29	Shabbir.Ahmed	Pakistan	-0.3072	-0.7212	0.0971
30	AD.Mullally	England	-0.3029	-0.6524	0.0380
31	MA.Ealham	England	-0.3008	-0.7841	0.1571
32	SR.Clark	Australia	-0.2991	-0.6084	0.0221
33	N.Kapil.Dev	India	-0.2833	-0.4839	-0.0854
34	Harbhajan.Singh	India	-0.2807	-0.4782	-0.0835
35	DT.Hondo	Zimbabwe	-0.2799	-0.7353	0.1619
36	ST.Clarke	West Indies	-0.2793	-0.7124	0.1289
37	AIC.Dodemaide	Australia	-0.2768	-0.7062	0.1468
38	Abdul.Razzaq	Pakistan	-0.2756	-0.5585	-0.0129
39	PAJ.DeFreitas	England	-0.2746	-0.5327	-0.0131
40	CE.Cuffy	West Indies	-0.2677	-0.6760	0.1000
41	A.Flintoff	England	-0.2655	-0.4908	-0.0485

42	SP.O'Donnell	Australia	-0.2642	-0.7406	0.2198
43	GC.Small	England	-0.2624	-0.6146	0.1008
44	JH.Kallis	South Africa	-0.2576	-0.4382	-0.0729
45	MD.Marshall	West Indies	-0.2550	-0.4748	-0.0299
46	PR.Reiffel	Australia	-0.2542	-0.5288	0.0323
47	EAE.Baptiste	West Indies	-0.2492	-0.6513	0.1574
48	JN.Gillespie	Australia	-0.2374	-0.4601	-0.0094
49	SR.Watson	Australia	-0.2273	-0.4811	0.0298
50	RJ.Sidebottom	England	-0.2231	-0.5763	0.1185
51	AH.Gray	West Indies	-0.2205	-0.7070	0.2554
52	DNT.Zoysa	Sri Lanka	-0.2180	-0.5292	0.0918
53	NW.Bracken	Australia	-0.2155	-0.7025	0.2746
54	Aaqib.Javed	Pakistan	-0.2143	-0.5580	0.1259
55	TT.Bresnan	England	-0.2102	-0.5580	0.1277
56	DR.Tuffey	New Zealand	-0.2095	-0.5322	0.1127
57	R.Rampaul	West Indies	-0.2087	-0.5610	0.1644
58	CJ.Anderson	New Zealand	-0.2007	-0.6366	0.2248
59	PJW.Allott	England	-0.1975	-0.6003	0.2089
60	CG.Rackemann	Australia	-0.1935	-0.6049	0.2067
61	JR.Ratnayake	Sri Lanka	-0.1927	-0.5803	0.1742
62	Manjural.Islam	Bangladesh	-0.1834	-0.5830	0.2117
63	CJ.Jordan	England	-0.1807	-0.6377	0.2672
64	Azhar.Mahmood	Pakistan	-0.1760	-0.5124	0.1693
65	A.Nel	South Africa	-0.1725	-0.4574	0.1097
66	SB.O'Connor	New Zealand	-0.1670	-0.5237	0.1830
67	PS.de.Villiers	South Africa	-0.1661	-0.5307	0.1940
68	CEH.Croft	West Indies	-0.1650	-0.4741	0.1450
69	L.Klusener	South Africa	-0.1633	-0.4195	0.1109
70	MM.Patel	India	-0.1613	-0.5412	0.2182
71	DJG.Sammy	West Indies	-0.1601	-0.4433	0.1285
72	KMDN.Kulasekara	Sri Lanka	-0.1567	-0.4869	0.1816
73	AtaNAurNARehman	Pakistan	-0.1555	-0.5631	0.2357
74	A.Nehra	India	-0.1538	-0.5199	0.2058
75	CT.Tremlett	England	-0.1494	-0.5500	0.2544
76	GP.Wickramasinghe	Sri Lanka	-0.1488	-0.4424	0.1408
77	WW.Daniel	West Indies	-0.1434	-0.5750	0.2748
78	BKV.Prasad	India	-0.1325	-0.4297	0.1711
79	SB.Doull	New Zealand	-0.1322	-0.4345	0.1646
80	MC.Snedden	New Zealand	-0.1310	-0.4832	0.2189
81	ML.Nkala	Zimbabwe	-0.1270	-0.5689	0.3242
82	DJ.Bravo	West Indies	-0.1242	-0.4103	0.1565
83	BN.Schultz	South Africa	-0.1185	-0.5478	0.3316
84	CC.Lewis	England	-0.1169	-0.4105	0.1789
85	Mashrafe.Mortaza	Bangladesh	-0.1150	-0.4474	0.2075
86	A.Kuruvilla	India	-0.1143	-0.5453	0.3102
87	VC.Drakes	West Indies	-0.1087	-0.5113	0.2864
88	GF.Lawson	Australia	-0.1086	-0.3785	0.1650

89	DW.Fleming	Australia	-0.1064	-0.4330	0.2297
90	SJ.Harmison	England	-0.1040	-0.3337	0.1395
91	J.Srinath	India	-0.1025	-0.3310	0.1320
92	CR.Miller	Australia	-0.1009	-0.4547	0.2458
93	RJ.Harris	Australia	-0.0999	-0.4135	0.2042
94	PM.Siddle	Australia	-0.0961	-0.3337	0.1467
95	Khaled.Mahmud	Bangladesh	-0.0950	-0.5111	0.3175
96	M.Morkel	South Africa	-0.0908	-0.3155	0.1491
97	GR.Dilley	England	-0.0828	-0.3773	0.2164
98	DR.Pringle	England	-0.0757	-0.3791	0.2194
99	IK.Pathan	India	-0.0592	-0.3646	0.2448
100	RJ.Ratnayake	Sri Lanka	-0.0573	-0.4168	0.2940
101	Tahir.Naqqash	Pakistan	-0.0478	-0.4551	0.3478
102	M.Dillon	West Indies	-0.0450	-0.3280	0.2401
103	RM.Ellison	England	-0.0423	-0.4759	0.3928
104	DR.Gilbert	Australia	-0.0385	-0.5098	0.4223
105	CJ.McDermott	Australia	-0.0347	-0.2525	0.1953
106	DE.Bollinger	Australia	-0.0269	-0.4365	0.3818
107	DJ.Terbrugge	South Africa	-0.0246	-0.4859	0.4420
108	AJ.Hall	South Africa	-0.0206	-0.3673	0.3062
109	BM.McMillan	South Africa	-0.0164	-0.3194	0.2750
110	AB.Agarkar	India	-0.0158	-0.3332	0.3008
111	TM.Alderman	Australia	-0.0155	-0.2894	0.2581
112	BT.Watambwa	Zimbabwe	-0.0138	-0.4869	0.4691
113	Saleem.Jaffar	Pakistan	-0.0138	-0.4148	0.3826
114	SP.Jones	England	-0.0124	-0.3599	0.3353
115	BP.Julian	Australia	-0.0084	-0.4594	0.4468
116	ML.Su'a	New Zealand	-0.0045	-0.4099	0.3826
117	FA.Rose	West Indies	-0.0037	-0.3670	0.3442
118	M.Prabhakar	India	-0.0025	-0.2793	0.2796
119	Azeem.Hafeez	Pakistan	0.0008	-0.3855	0.3989
120	MG.Hughes	Australia	0.0061	-0.2333	0.2550
121	WW.Davis	West Indies	0.0086	-0.3585	0.3672
122	GF.Labrooy	Sri Lanka	0.0110	-0.4367	0.4437
123	MF.Maharoof	Sri Lanka	0.0119	-0.3392	0.3509
124	M.Ntini	South Africa	0.0128	-0.1868	0.2199
125	MR.Whitney	Australia	0.0131	-0.3885	0.3996
126	AR.Caddick	England	0.0192	-0.2137	0.2463
127	Waqar.Younis	Pakistan	0.0195	-0.1950	0.2315
128	JJC.Lawson	West Indies	0.0226	-0.3462	0.3951
129	DK.Liyanage	Sri Lanka	0.0229	-0.4197	0.4578
130	NAM.McLean	West Indies	0.0272	-0.3094	0.3856
131	PW.Jarvis	England	0.0347	-0.3832	0.4621
132	LS.Pascoe	Australia	0.0445	-0.3411	0.4279
133	CK.Langeveldt	South Africa	0.0493	-0.4413	0.5266
134	E.Chigumbura	Zimbabwe	0.0633	-0.3388	0.4696
135	KD.Mills	New Zealand	0.0648	-0.2987	0.4278

136	VRV.Singh	India	0.0676	-0.4136	0.5489
137	DW.Headley	England	0.0716	-0.3093	0.4663
138	BS.Sandhu	India	0.0749	-0.4157	0.5688
139	AINAAmin.Hossain	Bangladesh	0.0753	-0.4326	0.5779
140	AA.Donald	South Africa	0.0757	-0.1606	0.3170
141	Shahid.Nazir	Pakistan	0.0784	-0.2917	0.4500
142	RD.King	West Indies	0.0885	-0.2556	0.4312
143	BJ.Arnel	New Zealand	0.0998	-0.3696	0.5829
144	EA.Brandes	Zimbabwe	0.1055	-0.3173	0.5338
145	AJ.Tudor	England	0.1075	-0.3034	0.5241
146	Mohammad.Akram	Pakistan	0.1144	-0.3270	0.5708
147	Junaid.Khan	Pakistan	0.1170	-0.2907	0.4989
148	Shoaib.Akhtar	Pakistan	0.1189	-0.1470	0.3829
149	M.Hayward	South Africa	0.1199	-0.2360	0.4701
150	N.Phillip	West Indies	0.1265	-0.3147	0.5790
151	RMS.Eranga	Sri Lanka	0.1293	-0.2520	0.5058
152	IE.O'Brien	New Zealand	0.1314	-0.1924	0.4827
153	JL.Pattinson	Australia	0.1317	-0.2370	0.5069
154	TCB.Fernando	Sri Lanka	0.1341	-0.3076	0.5816
155	CPH.Ramanayake	Sri Lanka	0.1350	-0.2265	0.5073
156	TJ.Friend	Zimbabwe	0.1365	-0.2702	0.5446
157	MJ.Hoggard	England	0.1374	-0.0913	0.3616
158	Aamer.Nazir	Pakistan	0.1393	-0.3086	0.6104
159	S.Sreesanth	India	0.1414	-0.1572	0.4404
160	KSC.de.Silva	Sri Lanka	0.1418	-0.3023	0.5925
161	PT.Collins	West Indies	0.1456	-0.1531	0.4287
162	PDRL.Perera	Sri Lanka	0.1606	-0.2910	0.6160
163	IG.Butler	New Zealand	0.1699	-0.2739	0.6336
164	L.Balaji	India	0.1718	-0.2664	0.6089
165	DBL.Powell	West Indies	0.1760	-0.0966	0.4639
166	KCG.Benjamin	West Indies	0.1762	-0.1270	0.4846
167	Z.Khan	India	0.1900	-0.0192	0.3974
168	JEC.Franklin	New Zealand	0.1982	-0.1108	0.4976
169	MI.Black	West Indies	0.2030	-0.2855	0.6913
170	MB.Owens	New Zealand	0.2036	-0.2318	0.6600
171	ST.Finn	England	0.2083	-0.1041	0.5242
172	Mohammad.Sami	Pakistan	0.2106	-0.0840	0.4954
173	DAJ.Bracewell	New Zealand	0.2117	-0.1132	0.5442
174	SE.Bond	New Zealand	0.2133	-0.1461	0.5852
175	GI.Allott	New Zealand	0.2178	-0.2084	0.6676
176	CS.Martin	New Zealand	0.2180	-0.0072	0.4475
177	D.Gough	England	0.2190	-0.0196	0.4604
178	KR.Pushpakumara	Sri Lanka	0.2218	-0.1127	0.5581
179	MG.Johnson	Australia	0.2254	-0.0011	0.4476
180	RMH.Binny	India	0.2296	-0.1207	0.5741
181	Umar.Gul	Pakistan	0.2298	-0.0448	0.5050
182	C.White	England	0.2305	-0.0751	0.5410

183	DV.Lawrence	England	0.2392	-0.2342	0.7399
184	Mohsin.Kamal	Pakistan	0.2480	-0.2053	0.7136
185	DJ.Capel	England	0.2568	-0.1313	0.6361
186	RP.Singh	India	0.2587	-0.1233	0.6417
187	T.Thushara	Sri Lanka	0.2669	-0.1683	0.6974
188	DK.Morrison	New Zealand	0.2706	0.0033	0.5327
189	DG.Cork	England	0.2729	-0.0029	0.5467
190	M.Zondeki	South Africa	0.2933	-0.1857	0.7785
191	CEW.Silverwood	England	0.2951	-0.2042	0.7822
192	Mushfiqur.Rahman	Bangladesh	0.2972	-0.1550	0.7541
193	LE.Plunkett	England	0.2977	-0.0700	0.6858
194	Wahab.Riaz	Pakistan	0.2999	-0.0751	0.6758
195	CL.Cairns	New Zealand	0.3010	0.0719	0.5362
196	Talha.Jubair	Bangladesh	0.3074	-0.1848	0.8164
197	NG.Cowans	England	0.3108	-0.0467	0.6835
198	G.Onions	England	0.3138	-0.1164	0.7640
199	Robiul.Islam	Bangladesh	0.3274	-0.1343	0.7835
200	UWMBCA.Welegedara	Sri Lanka	0.3299	-0.0390	0.7026
201	MS.Kasprowicz	Australia	0.3329	0.0616	0.6082
202	Sohail.Khan	Pakistan	0.3434	-0.1231	0.8230
203	C.Sharma	India	0.3488	-0.0117	0.6891
204	JE.Taylor	West Indies	0.3520	0.0786	0.6115
205	Tapash.Baisya	Bangladesh	0.3530	-0.0355	0.7341
206	AM.Blignaut	Zimbabwe	0.3570	-0.0209	0.7278
207	B.Lee	Australia	0.3687	0.1502	0.5852
208	Mohammad.Sharif	Bangladesh	0.3733	-0.0951	0.8564
209	ALF.de.Mel	Sri Lanka	0.3839	-0.0192	0.7704
210	A.Sanford	West Indies	0.4011	-0.0088	0.8158
211	DE.Malcolm	England	0.4063	0.1399	0.6712
212	SI.Mahmood	England	0.4141	-0.0308	0.8718
213	SL.Malinga	Sri Lanka	0.4200	0.1130	0.7312
214	KTGD.Prasad	Sri Lanka	0.4401	0.0929	0.7949
215	TL.Best	West Indies	0.4438	0.1159	0.7637
216	DA.Stirling	New Zealand	0.4552	-0.0318	0.9728
217	NavedNAulNAHasan	Pakistan	0.4631	0.0392	0.8964
218	BP.Patterson	West Indies	0.4717	0.1786	0.7791
219	HK.Olonga	Zimbabwe	0.4816	0.1565	0.8053
220	CRD.Fernando	Sri Lanka	0.4924	0.1949	0.7743
221	DH.Brain	Zimbabwe	0.5223	0.0992	0.9539
222	FH.Edwards	West Indies	0.5381	0.3063	0.7814
223	VR.Aaron	India	0.5463	0.1010	1.0131
224	AJ.Bichel	Australia	0.5731	0.2214	0.9248
225	JDS.Neesham	New Zealand	0.5779	0.1260	1.0288
226	CEL.Stuart	West Indies	0.5809	0.1228	1.0495
227	Shahadat.Hossain	Bangladesh	0.7362	0.4133	1.0519

**Table S8: Rankings for the slow bowlers of modern era (post-1973) Test cricket on the basis of their wicket-taking ability.** Estimates represent the player-specific intercepts extracted from the multivariate response models that controlled for various confounding effects, including the number of overs bowled per innings. Players that were still thought to be playing Test cricket on or around June 2019 are not included.

Rank	PlayerName	Country	Style	Wickets	Wickets_lower95CI	Wickets_Upper95CI
1	M.Muralitharan	Sri Lanka	Spin	0.4779	0.3351	0.6138
2	SK.Warne	Australia	Spin	0.4390	0.2917	0.5736
3	SCG.MacGill	Australia	Spin	0.3591	0.1698	0.5418
4	A.Kumble	India	Spin	0.3464	0.2080	0.4908
5	GP.Swann	England	Spin	0.3319	0.1413	0.5265
6	Danish.Kaneria	Pakistan	Spin	0.3004	0.1182	0.4834
7	Saeed.Ajmal	Pakistan	Spin	0.2911	0.0625	0.5225
8	D.Ramnarine	West Indies	Spin	0.2566	-0.0454	0.5504
9	ND.Hirwani	India	Spin	0.2552	-0.0068	0.5090
10	Saqlain.Mushtaq	Pakistan	Spin	0.2408	0.0530	0.4245
11	Mushtaq.Ahmed	Pakistan	Spin	0.2250	0.0210	0.4198
12	PP.Ojha	India	Spin	0.2247	-0.0128	0.4586
13	Abdur.Rehman	Pakistan	Spin	0.2178	-0.0551	0.4857
14	PR.Adams	South Africa	Spin	0.2072	0.0020	0.4137
15	S.Shillingford	West Indies	Spin	0.2061	-0.0572	0.4734
16	NM.Hauritz	Australia	Spin	0.2052	-0.0508	0.4690
17	A.Mishra	India	Spin	0.1956	-0.0493	0.4467
18	NGB.Cook	England	Spin	0.1797	-0.1059	0.4777
19	DL.Piedt	South Africa	Spin	0.1739	-0.1682	0.5289
20	KPJ.Warnaweera	Sri Lanka	Spin	0.1738	-0.1501	0.4903
21	DS.de.Silva	Sri Lanka	Spin	0.1724	-0.1393	0.4829
22	KJ.Silva	Sri Lanka	Spin	0.1642	-0.1803	0.5116
23	AJ.Traicos	South Africa	Spin	0.1582	-0.1684	0.4801
24	JG.Bracewell	New Zealand	Spin	0.1394	-0.0875	0.3720
25	MS.Panesar	England	Spin	0.1369	-0.0591	0.3389
26	Mohammad.Rafique	Bangladesh	Spin	0.1331	-0.0972	0.3740
27	BAW.Mendis	Sri Lanka	Spin	0.1304	-0.1245	0.3809
28	AG.Huckle	Zimbabwe	Spin	0.1273	-0.2084	0.4616
29	SJ.Benn	West Indies	Spin	0.1251	-0.1043	0.3593
30	Jubair.Hossain	Bangladesh	Spin	0.1244	-0.2625	0.5285
31	DR.Doshi	India	Spin	0.1234	-0.1025	0.3403
32	S.Randiv	Sri Lanka	Spin	0.1164	-0.1936	0.4158
33	SLV.Raju	India	Spin	0.1102	-0.1186	0.3346
34	GR.Larsen	New Zealand	SlowMedium	0.1094	-0.2259	0.4318
35	Sohag.Gazi	Bangladesh	Spin	0.1044	-0.2107	0.4321
36	RG.Holland	Australia	Spin	0.1008	-0.2150	0.4138
37	MD.Craig	New Zealand	Spin	0.0998	-0.2129	0.4067
38	PHT.Kaushal	Sri Lanka	Spin	0.0997	-0.2345	0.4365
39	TBA.May	Australia	Spin	0.0963	-0.1364	0.3290
40	Arshad.Ayub	India	Spin	0.0949	-0.2028	0.3792

41	PM.Such	England	Spin	0.0936	-0.2179	0.3965
42	M.Kartik	India	Spin	0.0867	-0.2717	0.4210
43	RA.Harper	West Indies	Spin	0.0814	-0.2121	0.3628
44	TV.Hohns	Australia	Spin	0.0800	-0.2905	0.4256
45	TAM.Siriwardana	Sri Lanka	Spin	0.0790	-0.3203	0.4678
46	Imran.Tahir	South Africa	Spin	0.0718	-0.2098	0.3563
47	Enamul.Haque.jnr	Bangladesh	Spin	0.0699	-0.2097	0.3635
48	NS.Yadav	India	Spin	0.0609	-0.1600	0.2825
49	MRCN.Bandaratilleke	Sri Lanka	Spin	0.0585	-0.2765	0.3981
50	RJ.Peterson	South Africa	Spin	0.0534	-0.2419	0.3346
51	D.Mohammed	West Indies	Spin	0.0491	-0.3376	0.4299
52	TG.Hogan	Australia	Spin	0.0470	-0.3112	0.4017
53	EE.Hemmings	England	Spin	0.0438	-0.2357	0.3239
54	DL.Vettori	New Zealand	Spin	0.0420	-0.1100	0.1909
55	DR.Parry	West Indies	Spin	0.0407	-0.3119	0.3814
56	Shahid.Afridi	Pakistan	Spin	0.0372	-0.2409	0.3105
57	RK.Illingworth	England	Spin	0.0343	-0.3180	0.3744
58	PL.Harris	South Africa	Spin	0.0319	-0.1964	0.2540
59	RW.Price	Zimbabwe	Spin	0.0314	-0.2180	0.2758
60	Arshad.Khan	Pakistan	Spin	0.0309	-0.2987	0.3555
61	PA.Strang	Zimbabwe	Spin	0.0309	-0.2259	0.2744
62	Mohammad.Nazir	Pakistan	Spin	0.0283	-0.3031	0.3604
63	V.Permaul	West Indies	Spin	0.0254	-0.3409	0.3872
64	Maninder.Singh	India	Spin	0.0242	-0.2213	0.2573
65	SB.Joshi	India	Spin	0.0215	-0.2603	0.2944
66	RR.Jumadeen	West Indies	Spin	0.0171	-0.3169	0.3392
67	AF.Giles	England	Spin	0.0030	-0.2015	0.2074
68	Tauseef.Ahmed	Pakistan	Spin	0.0017	-0.2415	0.2304
69	VJ.Marks	England	Spin	-0.0054	-0.3991	0.3861
70	PCR.Tufnell	England	Spin	-0.0067	-0.2245	0.2080
71	PI.Pocock	England	Spin	-0.0104	-0.3073	0.2790
72	SD.Anurasiri	Sri Lanka	Spin	-0.0131	-0.3056	0.2712
73	SP.Narine	West Indies	Spin	-0.0135	-0.3612	0.3335
74	L.Sivaramakrishnan	India	Spin	-0.0192	-0.3540	0.3178
75	OAC.Banks	West Indies	Spin	-0.0196	-0.3392	0.3032
76	JS.Patel	New Zealand	Spin	-0.0212	-0.2759	0.2239
77	RDB.Croft	England	Spin	-0.0222	-0.2907	0.2290
78	PL.Taylor	Australia	Spin	-0.0231	-0.3395	0.2818
79	MN.Hart	New Zealand	Spin	-0.0308	-0.3568	0.2807
80	N.Boje	South Africa	Spin	-0.0315	-0.2568	0.1972
81	DN.Patel	New Zealand	Spin	-0.0337	-0.2822	0.2026
82	HMCB.Bandara	Sri Lanka	Spin	-0.0361	-0.4082	0.3092
83	CW.Henderson	South Africa	Spin	-0.0408	-0.3877	0.2815
84	RKJ.Dawson	England	Spin	-0.0426	-0.4249	0.3349
85	PL.Symcox	South Africa	Spin	-0.0503	-0.3536	0.2366
86	CG.Butts	West Indies	Spin	-0.0517	-0.4382	0.3214
87	GB.Hogg	Australia	Spin	-0.0559	-0.4220	0.3005

88	RK.Chauhan	India	Spin	-0.0594	-0.3335	0.2060
89	ET.Willett	West Indies	Spin	-0.0603	-0.4562	0.2962
90	HDPK.Dharmasena	Sri Lanka	Spin	-0.0646	-0.2986	0.1696
91	UDU.Chandana	Sri Lanka	Spin	-0.0687	-0.3701	0.2205
92	NB.Mahwire	Zimbabwe	SlowMedium	-0.0760	-0.4525	0.2815
93	RJ.Bright	Australia	Spin	-0.0789	-0.3647	0.1947
94	N.Deonarine	West Indies	Spin	-0.0801	-0.4078	0.2403
95	Enamul.Haque	Bangladesh	Spin	-0.0868	-0.4346	0.2637
96	EJ.Gray	New Zealand	Spin	-0.0896	-0.4398	0.2608
97	BC.Strang	Zimbabwe	SlowMedium	-0.0968	-0.3559	0.1636
98	PJ.Wiseman	New Zealand	Spin	-0.1176	-0.3642	0.1260
99	SR.Patel	England	Spin	-0.1205	-0.5329	0.2752
100	Akram.Raza	Pakistan	Spin	-0.1232	-0.4771	0.2286
101	BA.Murphy	Zimbabwe	Spin	-0.1345	-0.4798	0.1839
102	RJ.Shastri	India	Spin	-0.1575	-0.3515	0.0390
103	RS.Kalpage	Sri Lanka	Spin	-0.1650	-0.5333	0.1835
104	GJ.Batty	England	Spin	-0.1671	-0.5298	0.1846
105	Naimur.Rahman	Bangladesh	Spin	-0.1674	-0.5614	0.2102
106	SA.Thomson	New Zealand	Spin	-0.1792	-0.5203	0.1458
107	MM.Patel	England	Spin	-0.1897	-0.6536	0.2602
108	GRJ.Matthews	Australia	Spin	-0.1949	-0.4514	0.0550
109	Mohammad.Hafeez	Pakistan	Spin	-0.2077	-0.4904	0.0675
110	S.Shivnarine	West Indies	Spin	-0.2164	-0.6484	0.1937
111	Mehrab.Hossain.jnr	Bangladesh	Spin	-0.2192	-0.6603	0.1960
112	RO.Hinds	West Indies	Spin	-0.2262	-0.5959	0.1215
113	MLC.Foster	West Indies	Spin	-0.2298	-0.6292	0.1301
114	Shuvagata.Hom	Bangladesh	Spin	-0.2308	-0.6269	0.1465
115	CS.Cowdrey	England	SlowMedium	-0.2309	-0.6827	0.1986
116	A.Symonds	Australia	SlowMedium	-0.2456	-0.5616	0.0508
117	ED.Solkar	India	Spin	-0.2509	-0.6966	0.1373
118	IDK.Salisbury	England	Spin	-0.2641	-0.6123	0.0611
119	CE.Eksteen	South Africa	Spin	-0.2819	-0.6762	0.0742
120	KBJ.Azad	India	Spin	-0.2853	-0.6962	0.1090
121	CL.Hooper	West Indies	Spin	-0.3145	-0.5328	-0.1076
122	AR.Whittall	Zimbabwe	Spin	-0.3213	-0.7178	0.0376
123	EAR.de.Silva	Sri Lanka	Spin	-0.3379	-0.7304	0.0196
124	ST.Jayasuriya	Sri Lanka	Spin	-0.3578	-0.5769	-0.1569
125	Alok.Kapali	Bangladesh	Spin	-0.3669	-0.7812	-0.0031
126	CZ.Harris	New Zealand	SlowMedium	-0.3789	-0.7283	-0.0627
127	Naeem.Islam	Bangladesh	Spin	-0.3887	-0.8161	-0.0057
128	Mohammad.Ashraful	Bangladesh	Spin	-0.6483	-1.0037	-0.3214

**Table S9: Rankings for the slow bowlers of modern era (post-1973) Test cricket on the basis of their economy rate.** Estimates represent the player-specific intercepts extracted from the multivariate response models that controlled for various confounding effects. Players that were still thought to be playing Test cricket on or around June 2019 are not included.

Rank	PlayerName	Country	Style	Economy	Econ_lower95CI	Econ_upper95CI
1	GR.Larsen	New Zealand	SlowMedium	-0.5364	-1.0993	-0.0163
2	RA.Harper	West Indies	Spin	-0.5280	-0.9756	-0.1099
3	RJ.Bright	Australia	Spin	-0.4722	-0.8989	-0.0622
4	DR.Doshi	India	Spin	-0.4202	-0.7842	-0.0500
5	CG.Butts	West Indies	Spin	-0.4191	-1.0114	0.1447
6	Mohammad.Rafique	Bangladesh	Spin	-0.4153	-0.8475	0.0054
7	A.Symonds	Australia	SlowMedium	-0.4126	-0.8074	-0.0320
8	PL.Harris	South Africa	Spin	-0.3988	-0.7602	-0.0532
9	PCR.Tufnell	England	Spin	-0.3905	-0.7499	-0.0588
10	Arshad.Ayub	India	Spin	-0.3832	-0.8701	0.0899
11	M.Kartik	India	Spin	-0.3817	-0.9042	0.1332
12	PP.Ojha	India	Spin	-0.3782	-0.7880	0.0365
13	Abdur.Rehman	Pakistan	Spin	-0.3760	-0.8299	0.0918
14	Arshad.Khan	Pakistan	Spin	-0.3607	-0.8905	0.1468
15	Mohammad.Nazir	Pakistan	Spin	-0.3571	-0.9143	0.1647
16	Maninder.Singh	India	Spin	-0.3563	-0.7408	0.0322
17	M.Muralitharan	Sri Lanka	Spin	-0.3562	-0.5990	-0.1008
18	Saeed.Ajmal	Pakistan	Spin	-0.3515	-0.7557	0.0390
19	SD.Anurasiri	Sri Lanka	Spin	-0.3465	-0.7848	0.0777
20	SLV.Raju	India	Spin	-0.3364	-0.7074	0.0310
21	D.Ramnarine	West Indies	Spin	-0.3344	-0.8204	0.1414
22	TV.Hohns	Australia	Spin	-0.3261	-0.8883	0.2112
23	NGB.Cook	England	Spin	-0.3138	-0.7857	0.1422
24	PM.Such	England	Spin	-0.3134	-0.8165	0.1621
25	EE.Hemmings	England	Spin	-0.2954	-0.7256	0.1418
26	Enamul.Haque	Bangladesh	Spin	-0.2928	-0.8452	0.2676
27	RK.Chauhan	India	Spin	-0.2585	-0.6791	0.1518
28	CL.Hooper	West Indies	Spin	-0.2514	-0.5408	0.0200
29	MS.Panesar	England	Spin	-0.2313	-0.5417	0.1004
30	KJ.Silva	Sri Lanka	Spin	-0.2283	-0.8023	0.3098
31	PI.Pocock	England	Spin	-0.2229	-0.6922	0.2338
32	DL.Vettori	New Zealand	Spin	-0.2197	-0.4649	0.0362
33	RJ.Shastri	India	Spin	-0.2139	-0.4970	0.0877
34	Tauseef.Ahmed	Pakistan	Spin	-0.2095	-0.5798	0.1884
35	SJ.Benn	West Indies	Spin	-0.2048	-0.5877	0.1968
36	Saqlain.Mushtaq	Pakistan	Spin	-0.1988	-0.5142	0.1221
37	CE.Eksteen	South Africa	Spin	-0.1884	-0.7200	0.3390
38	HDPK.Dharmasena	Sri Lanka	Spin	-0.1873	-0.5392	0.1537
39	TBA.May	Australia	Spin	-0.1806	-0.5508	0.2033
40	SK.Warne	Australia	Spin	-0.1649	-0.4059	0.0800
41	ET.Willett	West Indies	Spin	-0.1647	-0.7496	0.4151

42	MLC.Foster	West Indies	Spin	-0.1458	-0.7052	0.4002
43	RR.Jumadeen	West Indies	Spin	-0.1387	-0.6524	0.3658
44	A.Kumble	India	Spin	-0.1329	-0.3822	0.1340
45	Enamul.Haque.jnr	Bangladesh	Spin	-0.1304	-0.6116	0.3579
46	SB.Joshi	India	Spin	-0.1233	-0.5746	0.3306
47	PL.Symcox	South Africa	Spin	-0.1192	-0.5448	0.3217
48	BAW.Mendis	Sri Lanka	Spin	-0.1186	-0.5509	0.2893
49	KPJ.Warnaweera	Sri Lanka	Spin	-0.1184	-0.6343	0.4128
50	EAR.de.Silva	Sri Lanka	Spin	-0.1142	-0.6413	0.4121
51	Mohammad.Hafeez	Pakistan	Spin	-0.1130	-0.4917	0.2598
52	MRCN.Bandaratilleke	Sri Lanka	Spin	-0.1125	-0.6488	0.3915
53	BA.Murphy	Zimbabwe	Spin	-0.1086	-0.6106	0.3903
54	JG.Bracewell	New Zealand	Spin	-0.1018	-0.4777	0.2644
55	S.Shivnarine	West Indies	Spin	-0.1016	-0.6950	0.5113
56	DS.de.Silva	Sri Lanka	Spin	-0.1009	-0.5881	0.4206
57	ST.Jayasuriya	Sri Lanka	Spin	-0.0644	-0.3312	0.2053
58	TG.Hogan	Australia	Spin	-0.0515	-0.6494	0.5373
59	RDB.Croft	England	Spin	-0.0480	-0.4586	0.3597
60	SR.Patel	England	Spin	-0.0436	-0.6504	0.5772
61	A.Mishra	India	Spin	-0.0427	-0.4503	0.3720
62	CW.Henderson	South Africa	Spin	-0.0409	-0.6038	0.5220
63	N.Boje	South Africa	Spin	-0.0347	-0.3776	0.3011
64	GP.Swann	England	Spin	-0.0219	-0.3385	0.2975
65	Akram.Raza	Pakistan	Spin	-0.0214	-0.5385	0.4979
66	PA.Strang	Zimbabwe	Spin	-0.0146	-0.4117	0.3876
67	RK.Illingworth	England	Spin	-0.0117	-0.5700	0.5477
68	AF.Giles	England	Spin	-0.0088	-0.3493	0.3115
69	RW.Price	Zimbabwe	Spin	-0.0059	-0.4259	0.4051
70	BC.Strang	Zimbabwe	SlowMedium	-0.0001	-0.3904	0.3804
71	RS.Kalpage	Sri Lanka	Spin	0.0008	-0.5080	0.4978
72	S.Shillingford	West Indies	Spin	0.0040	-0.4377	0.4653
73	SA.Thomson	New Zealand	Spin	0.0060	-0.4351	0.4569
74	NS.Yadav	India	Spin	0.0109	-0.3541	0.3761
75	GRJ.Mathewss	Australia	Spin	0.0242	-0.3397	0.3938
76	DL.Piedt	South Africa	Spin	0.0299	-0.5251	0.5995
77	VJ.Marks	England	Spin	0.0551	-0.5233	0.6500
78	S.Randiv	Sri Lanka	Spin	0.0600	-0.4233	0.5766
79	AJ.Traicos	South Africa	Spin	0.0621	-0.4822	0.6030
80	EJ.Gray	New Zealand	Spin	0.0634	-0.4484	0.5896
81	OAC.Banks	West Indies	Spin	0.0685	-0.3994	0.5607
82	MN.Hart	New Zealand	Spin	0.0866	-0.3821	0.5475
83	PL.Taylor	Australia	Spin	0.0937	-0.3651	0.5715
84	NM.Hauritz	Australia	Spin	0.0950	-0.3136	0.5016
85	RG.Holland	Australia	Spin	0.1048	-0.3754	0.6024
86	Shahid.Afridi	Pakistan	Spin	0.1126	-0.2721	0.4996
87	GJ.Batty	England	Spin	0.1129	-0.4113	0.6579
88	Naeem.Islam	Bangladesh	Spin	0.1222	-0.4337	0.6517

89	Sohag.Gazi	Bangladesh	Spin	0.1278	-0.3689	0.6233
90	Danish.Kaneria	Pakistan	Spin	0.1312	-0.1717	0.4567
91	ND.Hirwani	India	Spin	0.1436	-0.2720	0.5674
92	V.Permaul	West Indies	Spin	0.1441	-0.4117	0.6912
93	SP.Narine	West Indies	Spin	0.1561	-0.4187	0.7279
94	DR.Parry	West Indies	Spin	0.1598	-0.3513	0.6826
95	Mushtaq.Ahmed	Pakistan	Spin	0.1853	-0.1293	0.4939
96	AR.Whittall	Zimbabwe	Spin	0.1913	-0.3657	0.7346
97	PR.Adams	South Africa	Spin	0.1967	-0.1374	0.5202
98	DN.Patel	New Zealand	Spin	0.1983	-0.1685	0.5468
99	RKJ.Dawson	England	Spin	0.2090	-0.3994	0.8269
100	CZ.Harris	New Zealand	SlowMedium	0.2123	-0.2096	0.6455
101	PHT.Kaushal	Sri Lanka	Spin	0.2246	-0.3150	0.7901
102	ED.Solkar	India	Spin	0.2261	-0.3433	0.8098
103	TAM.Siriwardana	Sri Lanka	Spin	0.2265	-0.3826	0.8386
104	PJ.Wiseman	New Zealand	Spin	0.2279	-0.1497	0.5841
105	SCG.MacGill	Australia	Spin	0.2378	-0.0828	0.5480
106	HMCMBandara	Sri Lanka	Spin	0.2394	-0.2939	0.7840
107	RJ.Peterson	South Africa	Spin	0.2427	-0.2046	0.7012
108	JS.Patel	New Zealand	Spin	0.2449	-0.1259	0.6426
109	D.Mohammed	West Indies	Spin	0.2536	-0.3324	0.8689
110	Imran.Tahir	South Africa	Spin	0.2908	-0.1647	0.7370
111	KBJ.Azad	India	Spin	0.3077	-0.2539	0.8782
112	AG.Huckle	Zimbabwe	Spin	0.3083	-0.2322	0.8529
113	Shuvagata.Hom	Bangladesh	Spin	0.3182	-0.2540	0.9041
114	L.Sivaramakrishnan	India	Spin	0.3306	-0.1643	0.8448
115	MM.Patel	England	Spin	0.3585	-0.2976	1.0663
116	UDU.Chandana	Sri Lanka	Spin	0.3694	-0.0701	0.8001
117	RO.Hinds	West Indies	Spin	0.3696	-0.1084	0.8564
118	GB.Hogg	Australia	Spin	0.3742	-0.1514	0.9243
119	N.Deonarine	West Indies	Spin	0.3889	-0.0556	0.8395
120	Alok.Kapali	Bangladesh	Spin	0.4130	-0.1024	0.9212
121	MD.Craig	New Zealand	Spin	0.4183	-0.0569	0.9072
122	IDK.Salisbury	England	Spin	0.4379	-0.0089	0.9166
123	Jubair.Hossain	Bangladesh	Spin	0.4465	-0.1488	1.0940
124	Mehrab.Hossain.jnr	Bangladesh	Spin	0.5464	-0.0260	1.1628
125	Naimur.Rahman	Bangladesh	Spin	0.7970	0.1873	1.4100
126	CS.Cowdrey	England	SlowMedium	0.8885	0.2716	1.5432
127	NB.Mahwire	Zimbabwe	SlowMedium	1.0255	0.4719	1.6234
128	Mohammad.Ashraful	Bangladesh	Spin	1.7366	1.3063	2.1417