1. Appendix

1.1. Data

1.2. Simulation Study

		Test MAE		
Corr	model	g1	g2	g3
0.01	ELN.MAE	**0.034579**	0.036195	**0.035334**
	RF.MAE	0.035459	**0.03542**	0.03554
	NN2.MAE	0.03596	0.036921	0.036305
	NN1.MAE	0.035894	0.036834	0.036335
	NN3.MAE	0.035816	0.036934	0.036471
1	ELN.MSE	**0.034614**	0.036276	**0.035444**
	RF.MAE	0.035916	**0.035643**	0.036053
	NN5.MAE	0.037009	0.03727	0.037413
	NN4.MSE	0.037382	0.036897	0.037354
	NN3.MAE	0.037285	0.037038	0.037193

		Test MSE		
Corr	model	g1	g2	g3
0.01	ELN.MAE	**0.002565**	0.002688	**0.002621**
	RF.MAE	0.002643	**0.00263**	0.002645
	NN2.MAE	0.002679	0.002747	0.0027
	NN1.MAE	0.002672	0.00274	0.002703
	NN3.MAE	0.00267	0.002749	0.002718
1	ELN.MSE	**0.002568**	0.002698	**0.00263**
	RF.MAE	0.002675	**0.002644**	0.002679
	NN5.MAE	0.002774	0.002783	0.002792
	NN3.MAE	0.002805	0.002751	0.002797
	NN4.MSE	0.002794	0.002765	0.002775

		g1			g2			g3		
model	Corr	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2
LM.MSE	0.01	0.036678	0.002740	0.008273	0.038255	0.002880	-0.111788	0.037310	0.002795	-0.032068
	0.10	0.036965	0.002765	-0.011020	0.038580	0.002914	-0.142944	0.037569	0.002817	-0.054940
	1.00	0.042949	0.003414	-0.438797	0.045376	0.003717	-0.780953	0.043434	0.003469	-0.488779
LM.MAE	0.01	0.036642	0.002737	0.009050	0.038348	0.002886	-0.116369	0.037324	0.002797	-0.035162
	0.10	0.036811	0.002755	0.002919	0.038745	0.002927	-0.152580	0.037489	0.002810	-0.047675
	1.00	0.042340	0.003344	-0.393044	0.045342	0.003685	-0.769955	0.043535	0.003468	-0.544524
ELN.MSE	0.01	0.034588	0.002566	0.140335	0.036223	0.002690	0.036877	0.035353	0.002623	0.099142
	0.10	0.034563	0.002564	0.144238	0.036183	0.002686	0.037258	0.035292	0.002617	0.100241
	1.00	0.034614	0.002568	0.167184	0.036276	0.002698	0.037839	0.035444	0.002630	0.119875
ELN.MAE	0.01	0.034579	0.002565	0.140982	0.036195	0.002688	0.039169	0.035334	0.002621	0.100442
	0.10	0.034558	0.002564	0.144627	0.036173	0.002688	0.038875	0.035285	0.002617	0.100919
	1.00	0.034599	0.002567	0.167771	0.036305	0.002703	0.036583	0.035465	0.002631	0.118022
RF.MSE	0.01	0.035775	0.002671	0.063426	0.035718	0.002657	0.067615	0.035803	0.002661	0.070298
	0.10	0.035769	0.002665	0.066738	0.035684	0.002652	0.069139	0.035867	0.002670	0.062839
	1.00	0.036233	0.002698	0.068774	0.035989	0.002683	0.057103	0.036213	0.002695	0.069887
RF.MAE	0.01	0.035459	0.002643	0.083338	0.035420	0.002630	0.087653	0.035540	0.002645	0.086529
	0.10	0.035515	0.002649	0.081425	0.035489	0.002634	0.083405	0.035569	0.002644	0.081643
	1.00	0.035916	0.002675	0.087081	0.035643	0.002644	0.080965	0.036053	0.002679	0.075357
NN1.MSE	0.01	0.036452	0.002722	0.016344	0.036768	0.002732	-0.003917	0.036687	0.002738	0.009335
	0.10	0.036462	0.002719	0.020422	0.036776	0.002734	-0.007259	0.036733	0.002737	0.002955
	1.00	0.037545	0.002821	-0.014452	0.037049	0.002764	-0.014697	0.037459	0.002798	-0.012469
NN1.MAE	0.01	0.035960	0.002679	0.055814	0.036921	0.002747	-0.015105	0.036305	0.002700	0.039371
	0.10	0.036082	0.002687	0.050698	0.037010	0.002750	-0.020562	0.036322	0.002702	0.032303
	1.00	0.037889	0.002834	-0.043182	0.037979	0.002845	-0.084075	0.037306	0.002793	0.002178
NN2.MSE	0.01	0.037019	0.002785	-0.021787	0.037320	0.002775	-0.043354	0.037089	0.002774	-0.017304
	0.10	0.036977	0.002765	-0.021276	0.037009	0.002748	-0.027538	0.036990	0.002758	-0.020645
	1.00	0.037536	0.002814	-0.013978	0.036903	0.002752	-0.005866	0.037516	0.002809	-0.016934
NN2.MAE	0.01	0.035894	0.002672	0.057743	0.036834	0.002740	-0.007158	0.036335	0.002703	0.036305
	0.10	0.035890	0.002668	0.060310	0.036937	0.002750	-0.017077	0.036270	0.002696	0.037157
	1.00	0.037480	0.002814	-0.009529	0.037715	0.002823	-0.065390	0.037471	0.002804	-0.010118
NN3.MSE	0.01	0.036783	0.002757	-0.006762	0.036840	0.002738	-0.007525	0.037036	0.002764	-0.020078
	0.10	0.036938	0.002761	-0.015399	0.036852	0.002738	-0.015106	0.036874	0.002757	-0.004406
	1.00	0.037424	0.002808	-0.012964	0.036938	0.002754	-0.006353	0.037420	0.002799	-0.010348
NN3.MAE	0.01	0.035816	0.002670	0.065432	0.036934	0.002749	-0.016398	0.036471	0.002718	0.029948
	0.10	0.035893	0.002677	0.062002	0.036859	0.002741	-0.011850	0.036200	0.002693	0.040611
	1.00	0.037009	0.002774	0.021329	0.037270	0.002783	-0.029644	0.037413	0.002792	-0.008307
NN4.MSE	0.01	0.036881	0.002759	-0.020620	0.036856	0.002742	-0.007715	0.037126	0.002775	-0.026563
	0.10	0.036877	0.002761	-0.014579	0.037221	0.002762	-0.048711	0.036872	0.002748	-0.008894
	1.00	0.037382	0.002805	-0.006481	0.036897	0.002751	-0.005369	0.037354	0.002797	-0.007739
NN4.MAE	0.01	0.035935	0.002678	0.057720	0.036897	0.002749	-0.010917	0.036708	0.002738	0.007046
	0.10	0.035828	0.002665	0.065041	0.036933	0.002749	-0.019112	0.036273	0.002695	0.037704
	1.00	0.037095	0.002779	0.019866	0.037323	0.002795	-0.029377	0.037301	0.002787	-0.001888

		g1			g2			g3		
model	Corr	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2
NN5.MSE	0.01	0.037231	0.002785	-0.049970	0.036931	0.002747	-0.017002	0.037114	0.002772	-0.021895
	0.10	0.037026	0.002767	-0.032190	0.037176	0.002762	-0.039436	0.036909	0.002757	-0.011352
	1.00	0.037364	0.002795	-0.010495	0.036928	0.002755	-0.005376	0.037475	0.002807	-0.014974
NN5.MAE	0.01	0.035888	0.002669	0.058579	0.036835	0.002738	-0.008646	0.036685	0.002737	0.004643
	0.10	0.036038	0.002680	0.050976	0.036745	0.002727	-0.004935	0.036484	0.002710	0.018192
	1.00	0.037285	0.002794	0.002541	0.037038	0.002765	-0.012729	0.037193	0.002775	0.002572
LSTM.MSE	0.01	0.037296	0.002798	-0.043289	0.037227	0.002776	-0.044764	0.037591	0.002818	-0.062516
	0.10	0.037237	0.002795	-0.031955	0.037134	0.002767	-0.038255	0.037198	0.002785	-0.030394
	1.00	0.038128	0.002851	-0.082027	0.037382	0.002792	-0.044243	0.037780	0.002830	-0.044330
LSTM.MAE	0.01	0.037431	0.002805	-0.056406	0.037337	0.002780	-0.051854	0.037627	0.002817	-0.067433
	0.10	0.037446	0.002804	-0.062952	0.037118	0.002768	-0.032544	0.037241	0.002793	-0.033320
	1.00	0.038027	0.002846	-0.061483	0.037415	0.002790	-0.045506	0.037743	0.002825	-0.045884
FFORMA.MSE	0.01	0.038277	0.002882	-0.132672	0.038460	0.002889	-0.147390	0.042466	0.003311	-0.486145
	0.10	0.038358	0.002895	-0.140765	0.038479	0.002891	-0.160062	0.042323	0.003291	-0.473991
	1.00	0.038875	0.002965	-0.131239	0.038808	0.002933	-0.165990	0.043013	0.003371	-0.470954
FFORMA.MAE	0.01	0.038755	0.002939	-0.179748	0.038747	0.002918	-0.174094	0.042989	0.003365	-0.527909
	0.10	0.038936	0.002951	-0.192793	0.038796	0.002946	-0.175994	0.043097	0.003406	-0.586375
	1.00	0.039247	0.002972	-0.163656	0.039387	0.002996	-0.211619	0.043709	0.003448	-0.526081
DeepAR	0.01	0.038299	0.002900	-0.128930	0.038489	0.002912	-0.132518	0.039390	0.003016	-0.204980
	0.10	0.038832	0.002935	-0.181663	0.038435	0.002905	-0.131874	0.039177	0.002993	-0.190558
	1.00	0.040535	0.003159	-0.239142	0.038787	0.002952	-0.144029	0.039692	0.003042	-0.182365

Figure 1. Simulation g1 Variable Importance

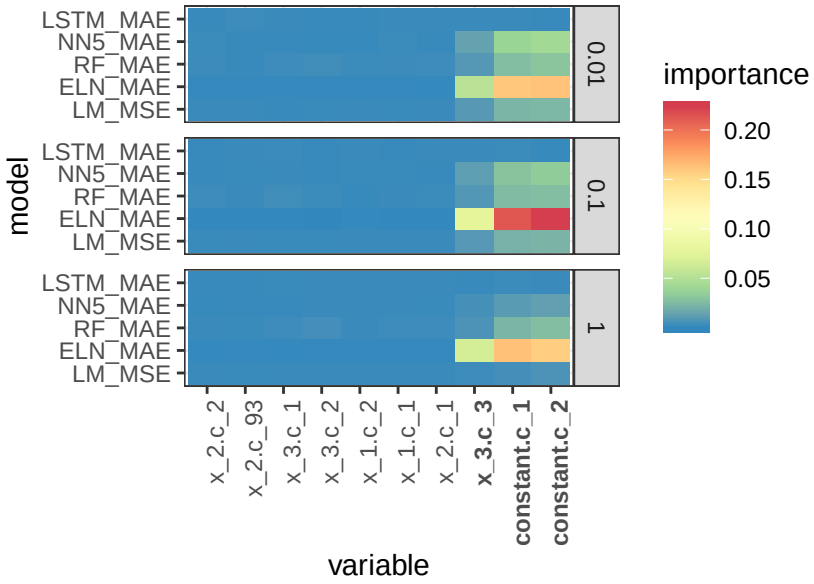
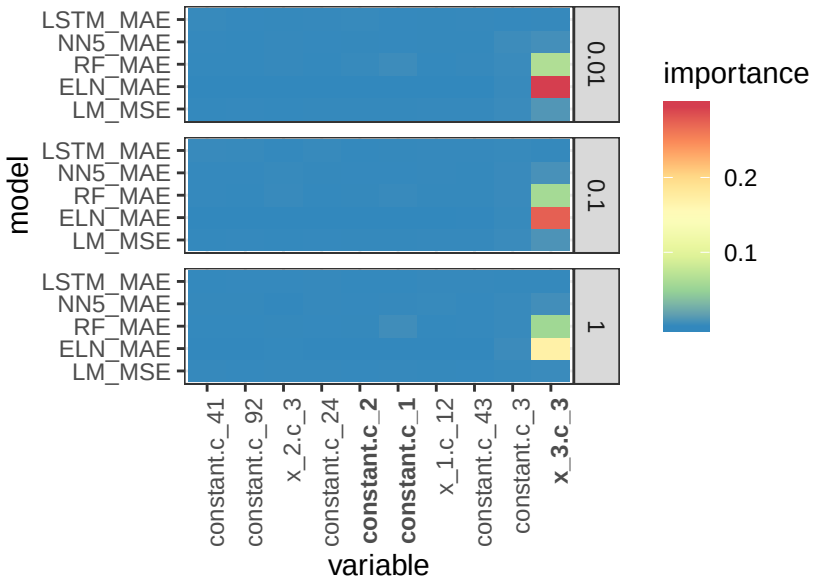


Figure 2. Simulation g2 Variable Importance



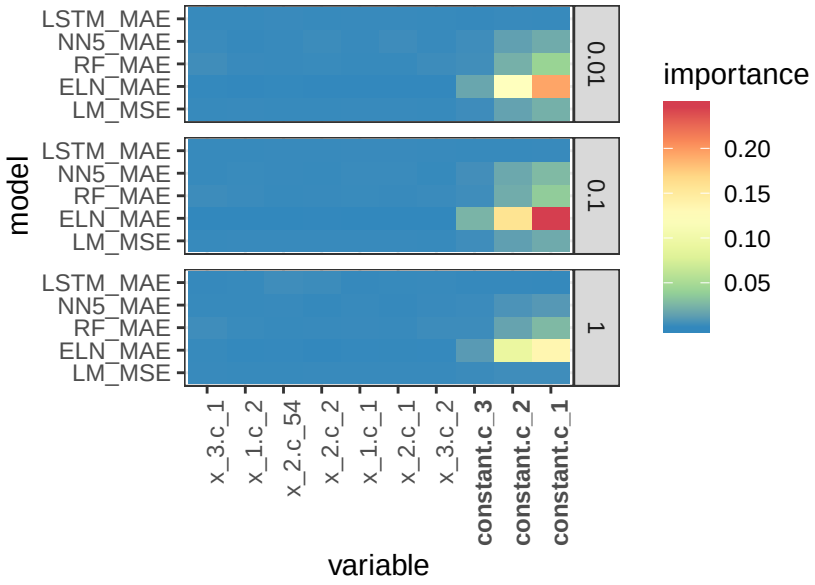


Figure 3. g1 BC VIMP

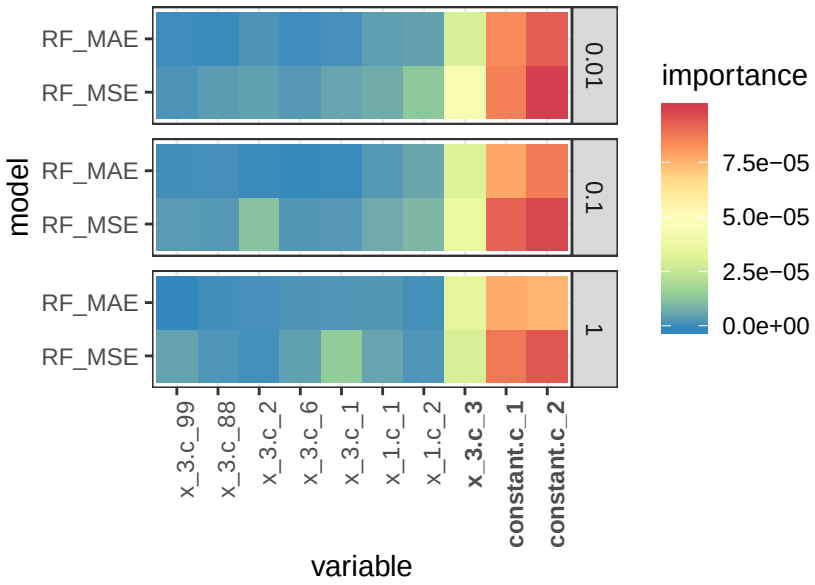


Figure 4. g2 BC VIMP

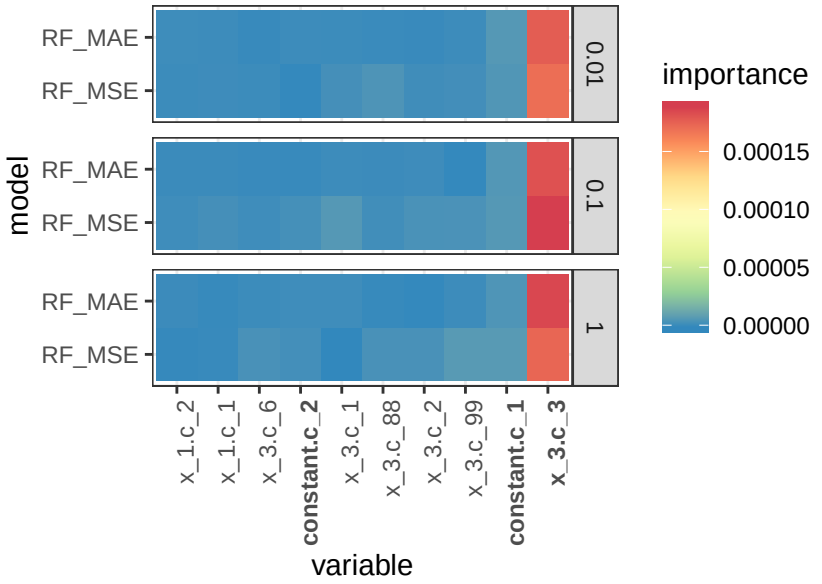


Figure 5. g3 BC VIMP

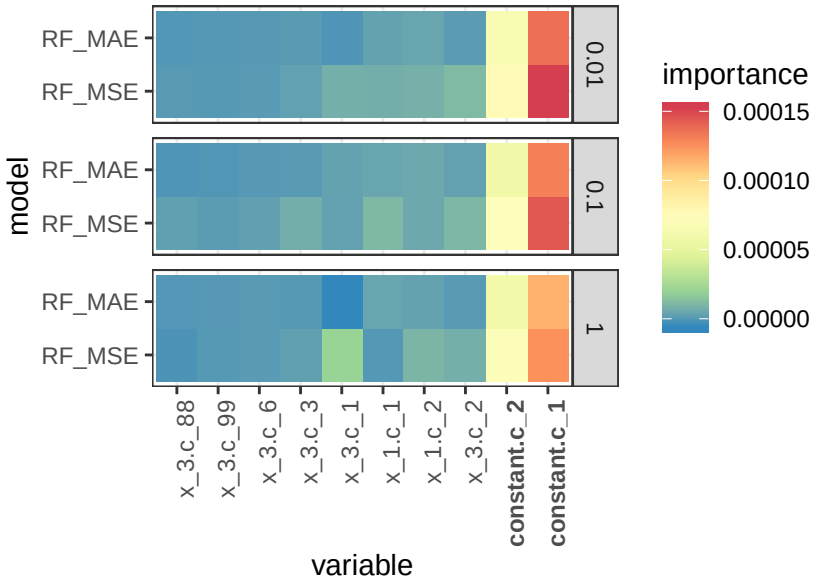


Figure 6. g1 IK VIMP

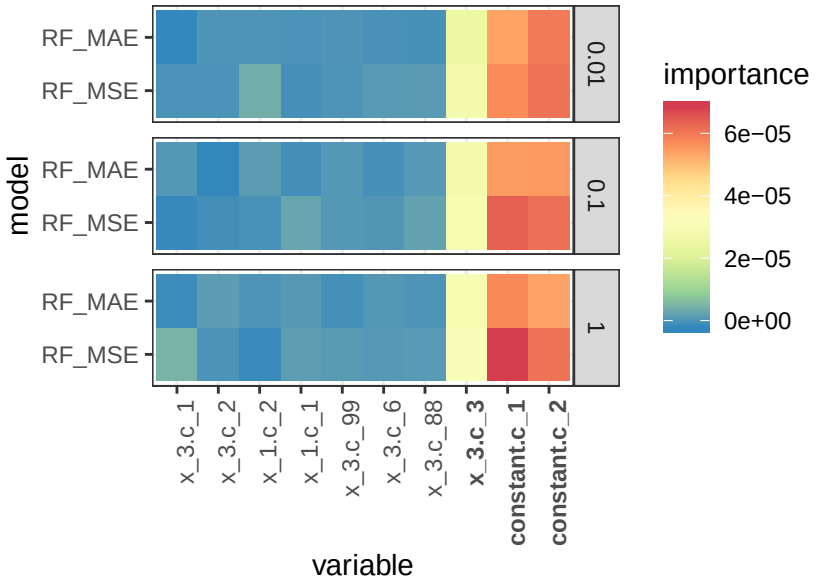


Figure 7. g2 IK VIMP

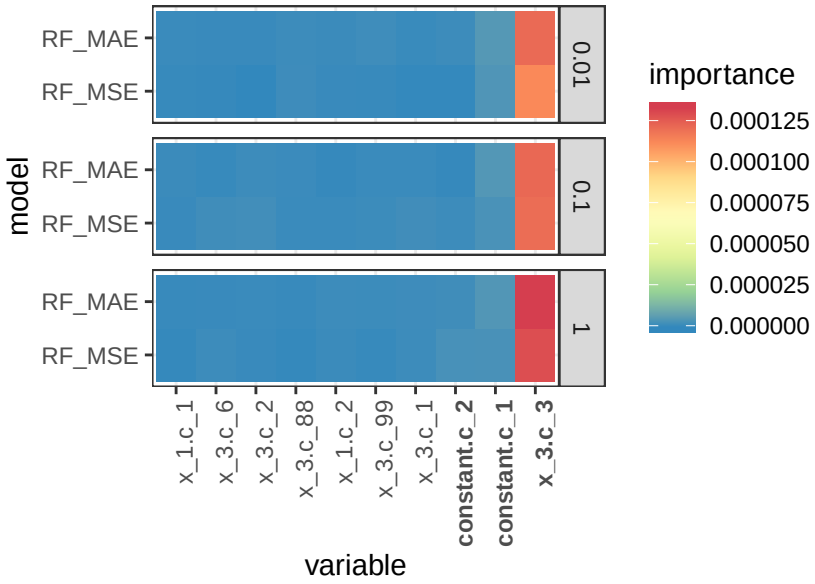
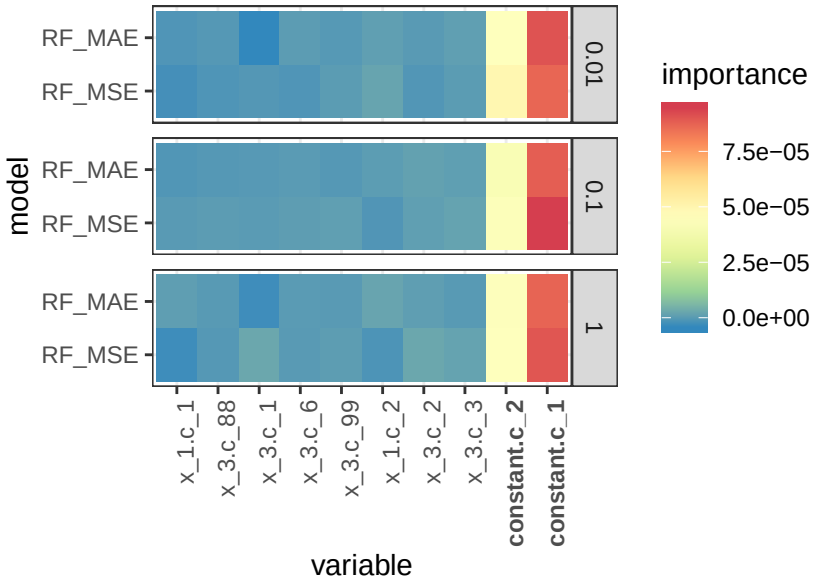


Figure 8. g3 IK VIMP



1.2.1. Empirical Study

	Sample 1			Sample 2			Sample 3		
model	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2
LM.MSE	0.229034	0.116015	-1.808481	0.397573	0.312653	-6.329935	0.566307	0.83804	-17.522476
LM.MAE	0.273452	0.15894	-2.8476	0.555673	0.742223	-16.400898	0.651614	1.225121	-26.077774
ELN.MSE	0.133887	0.039947	0.032956	0.140402	0.04277	-0.002712	**0.14433**	**0.043761**	**0.032789**
ELN.MAE	0.131369	0.040718	0.014306	**0.137092**	**0.041892**	**0.017875**	0.146251	0.045207	0.000835
RF.MSE	0.131411	**0.03645**	**0.117622**	0.194189	0.067855	-0.590814	0.158141	0.051288	-0.133571
RF.MAE	**0.127482**	0.036744	0.110509	0.169321	0.054592	-0.279861	0.147627	0.046516	-0.028109
NN1.MSE	0.169127	0.057044	-0.380909	0.207662	0.074751	-0.752494	0.192125	0.069738	-0.541369
NN1.MAE	0.157324	0.050418	-0.22052	0.191762	0.066746	-0.564818	0.18547	0.063053	-0.393606
NN2.MSE	0.168773	0.059436	-0.43883	0.181808	0.063232	-0.482433	0.180584	0.062745	-0.386797
NN2.MAE	0.162667	0.055447	-0.342256	0.194277	0.069386	-0.626702	0.185173	0.065186	-0.440746
NN3.MSE	0.154784	0.050152	-0.21408	0.180103	0.060193	-0.411175	0.177604	0.060404	-0.335065
NN3.MAE	0.146411	0.044901	-0.086967	0.18499	0.06461	-0.514744	0.184986	0.063861	-0.411475
NN4.MSE	0.153802	0.048641	-0.177503	0.193066	0.067515	-0.582833	0.172707	0.057774	-0.276929
NN4.MAE	0.157301	0.050286	-0.217308	0.168815	0.055711	-0.306102	0.167998	0.055129	-0.218463
NN5.MSE	0.149436	0.047279	-0.14452	0.183584	0.064137	-0.503653	0.170238	0.056992	-0.259652
NN5.MAE	0.140781	0.042832	-0.036882	0.181096	0.06216	-0.4573	0.164896	0.053458	-0.181528

Figure 9. Individual Factor Importance

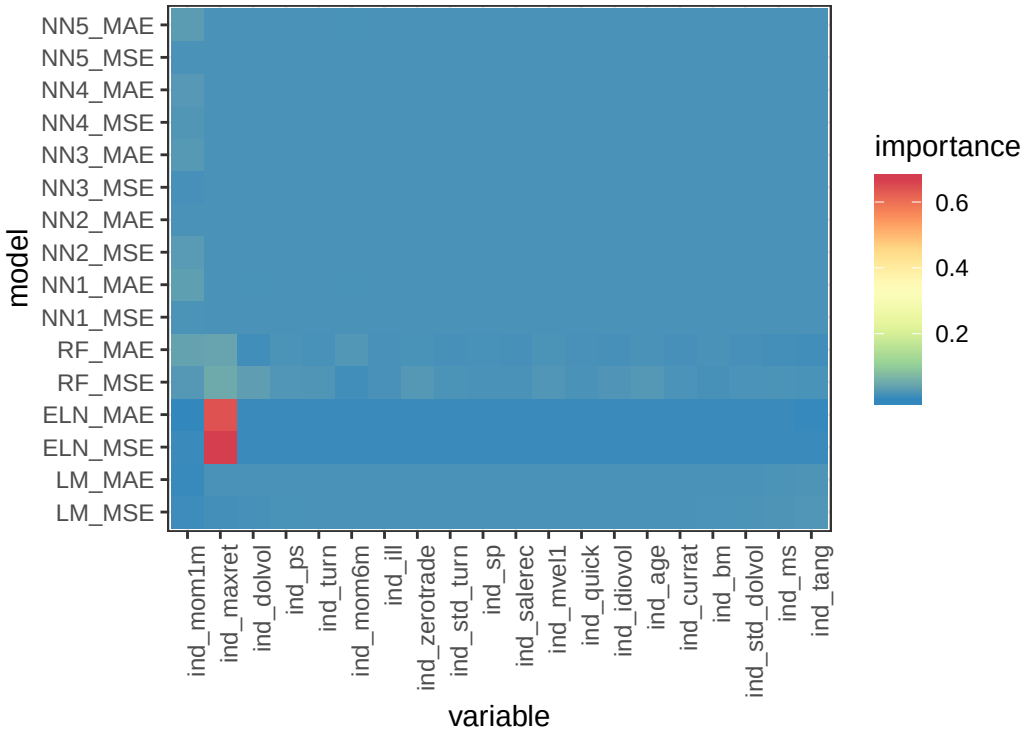


Figure 10. Macroeconomic Factor Importance

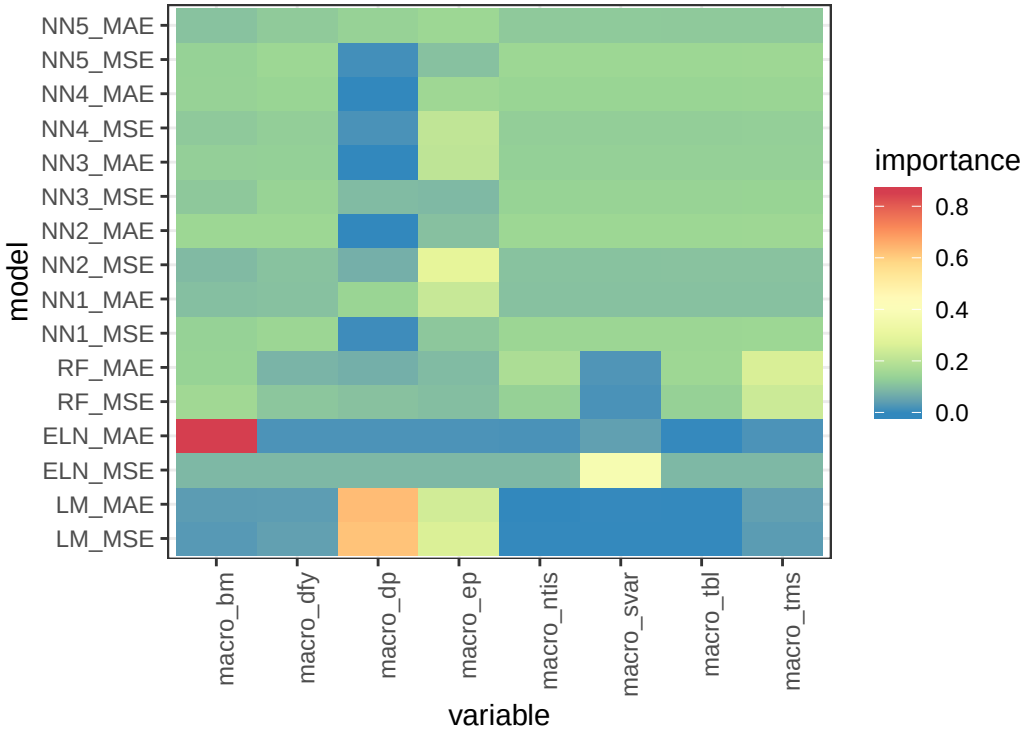
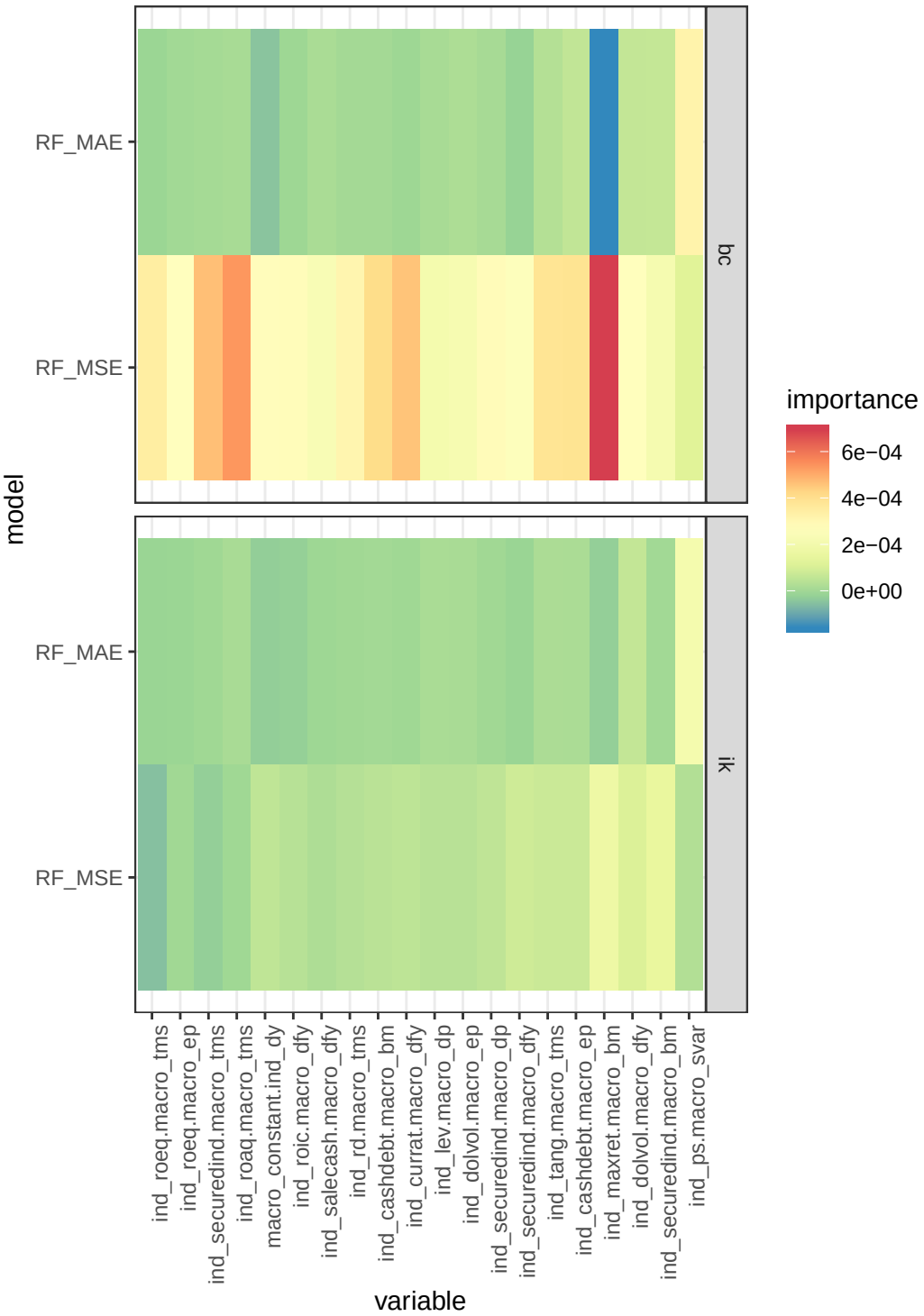


Figure 11. Robustness Check RF VIMP



1.3. Empirical Robustness Checks

1.3.1. Missing Data Threshold Robustness Check

	Sample 1			Sample 2			Sample 3		
model	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2
LM.MSE	0.247457	0.130166	-2.151058	0.541089	0.700574	-15.424468	0.615714	1.188991	-25.279238
LM.MAE	0.214055	0.102848	-1.489727	0.372683	0.259976	-5.094954	0.507397	0.766373	-15.93847
ELN.MSE	0.133887	0.039947	0.032956	0.140402	0.04277	-0.002712	**0.14433**	**0.043761**	**0.032789**
ELN.MAE	0.131338	0.040465	0.020421	**0.137083**	**0.041804**	**0.019938**	0.146589	0.045362	-0.002596
RF.MSE	0.129226	0.035869	0.131692	0.198914	0.072749	-0.705542	0.168068	0.05777	-0.276838
RF.MAE	**0.124319**	**0.035103**	**0.150229**	0.167845	0.053578	-0.256106	0.15463	0.051594	-0.140342
NN1.MSE	0.153785	0.048726	-0.179553	0.221019	0.084867	-0.98964	0.172557	0.058354	-0.289742
NN1.MAE	0.154534	0.048854	-0.18266	0.199647	0.073699	-0.727823	0.176348	0.061359	-0.356155
NN2.MSE	0.158513	0.057061	-0.381324	0.233631	0.095004	-1.227299	0.154083	0.048353	-0.068708
NN2.MAE	0.138489	0.043364	-0.049759	0.215253	0.078792	-0.847234	0.164459	0.055049	-0.216706
NN3.MSE	0.167392	0.058508	-0.416345	0.19754	0.071293	-0.671422	0.156873	0.049602	-0.096299
NN3.MAE	0.144457	0.045293	-0.096445	0.210372	0.077747	-0.822723	0.159841	0.05152	-0.138704
NN4.MSE	0.147989	0.047211	-0.142888	0.184277	0.064247	-0.506225	0.152214	0.048185	-0.064987
NN4.MAE	0.15851	0.052021	-0.259326	0.18643	0.063032	-0.477746	0.177651	0.064046	-0.415562
NN5.MSE	0.153187	0.050053	-0.211683	0.181622	0.060313	-0.413989	0.161028	0.051221	-0.132095
NN5.MAE	0.149496	0.050779	-0.229251	0.165726	0.053988	-0.265712	0.156151	0.049772	-0.100061

Figure 12. Missing Data Threshold Robustness Check Individual Factor Importance

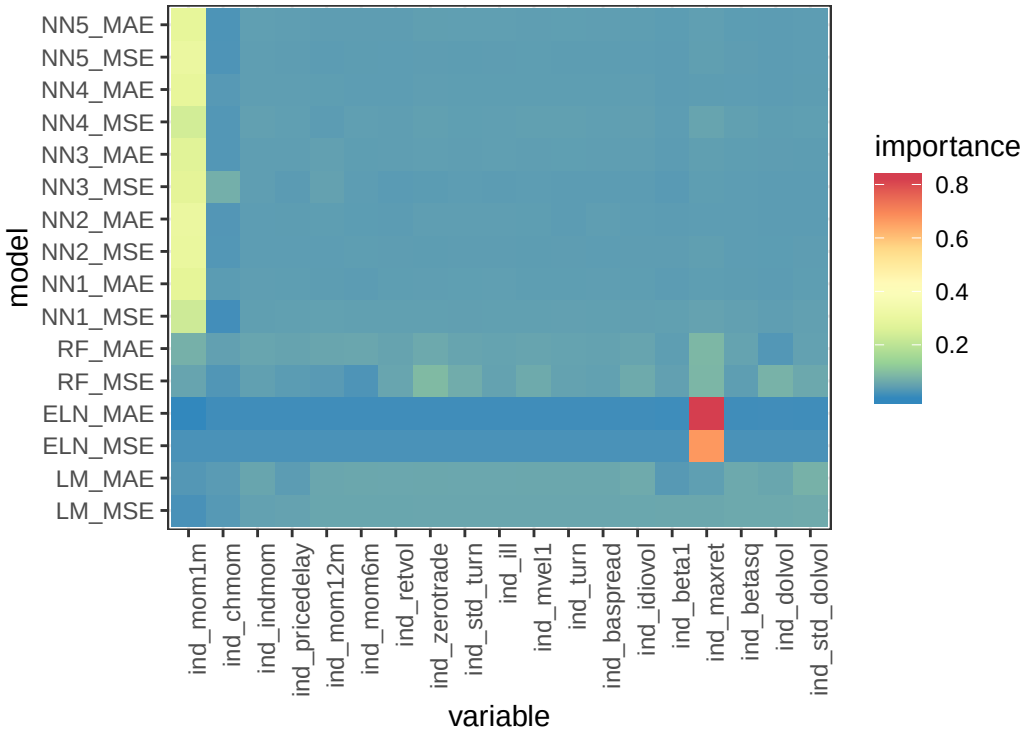


Figure 13. Missing Data Threshold Robustness Check Macroeconomic Factor Importance

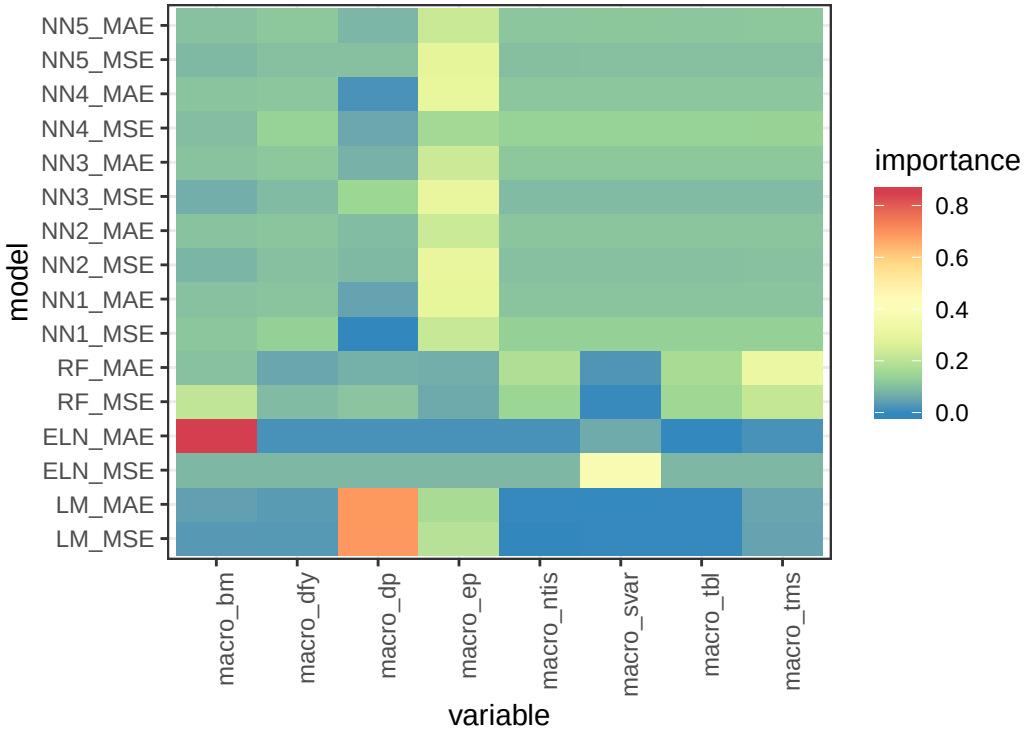
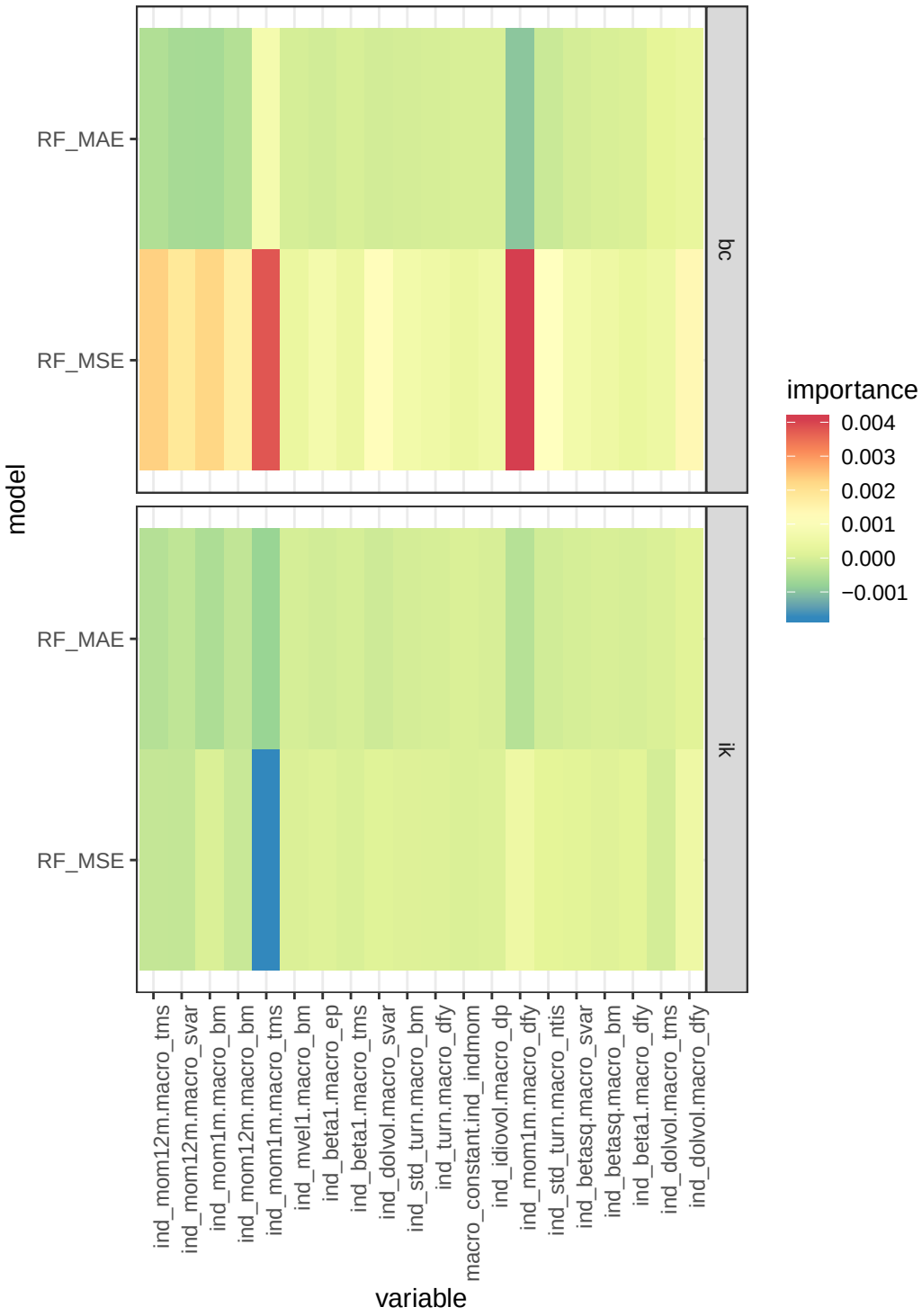


Figure 14. Missing Data Threshold Robustness Check RF VIMP



1.3.2. Train:Validation = 1:1 Robustness Check

	Sample 1			Sample 2			Sample 3		
model	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2
LM.MSE	0.915703	2.495094	-59.401029	0.717	1.553454	-35.419641	0.451206	0.375505	-7.299459
LM.MAE	0.751551	1.583265	-37.32754	0.469831	0.524686	-11.300895	0.675112	1.105759	-23.43964
ELN.MSE	0.134609	**0.040072**	**0.029933**	0.141434	0.043169	-0.012055	**0.144375**	**0.043705**	**0.034019**
ELN.MAE	**0.131668**	0.040748	0.013583	**0.137494**	**0.042135**	**0.012178**	0.146776	0.045753	-0.01123
RF.MSE	0.155282	0.046655	-0.129427	0.210936	0.078006	-0.828784	0.229147	0.092622	-1.047155
RF.MAE	0.13882	0.04016	0.027805	0.185338	0.063217	-0.482087	0.182753	0.063873	-0.411736
NN1.MSE	0.218129	0.087699	-1.123002	0.238606	0.110201	-1.583582	0.260721	0.120908	-1.672321
NN1.MAE	0.202259	0.072844	-0.763409	0.205092	0.073567	-0.724721	0.239051	0.096477	-1.132346
NN2.MSE	0.239446	0.101312	-1.452556	0.206109	0.078412	-0.838305	0.228591	0.095126	-1.102488
NN2.MAE	0.19141	0.068261	-0.652455	0.184095	0.062366	-0.462125	0.220087	0.086888	-0.920403
NN3.MSE	0.193117	0.069206	-0.675336	0.193859	0.070747	-0.658609	0.205093	0.076497	-0.690745
NN3.MAE	0.191596	0.066926	-0.620138	0.176555	0.060022	-0.407183	0.234768	0.091003	-1.011359
NN4.MSE	0.191361	0.07068	-0.71101	0.175311	0.059253	-0.389136	0.18148	0.061718	-0.364096
NN4.MAE	0.139659	0.041096	0.005158	0.179318	0.05976	-0.401027	0.188921	0.066144	-0.461932
NN5.MSE	0.17209	0.056982	-0.379418	0.164756	0.054398	-0.275325	0.202012	0.074051	-0.636691
NN5.MAE	0.170945	0.056029	-0.356356	0.180669	0.059697	-0.399552	0.189149	0.065921	-0.456988

Figure 15. Train:Validation = 1:1 Robustness Check Individual Factor Importance

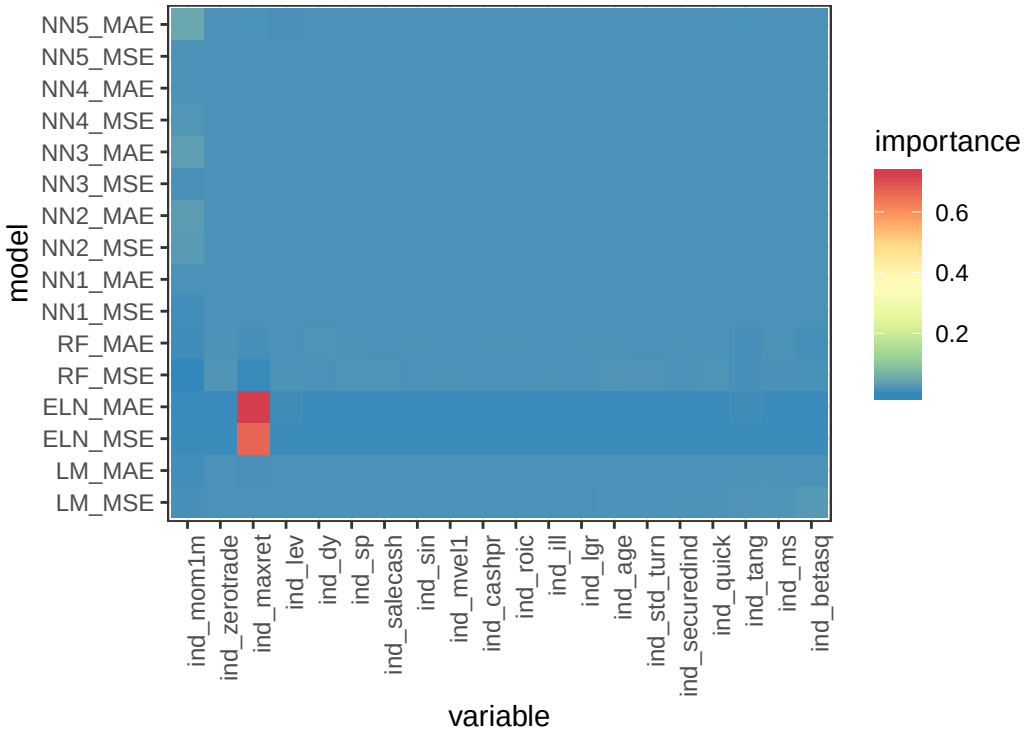


Figure 16. Train:Validation = 1:1 Robustness Check Macroeconomic Factor Importance

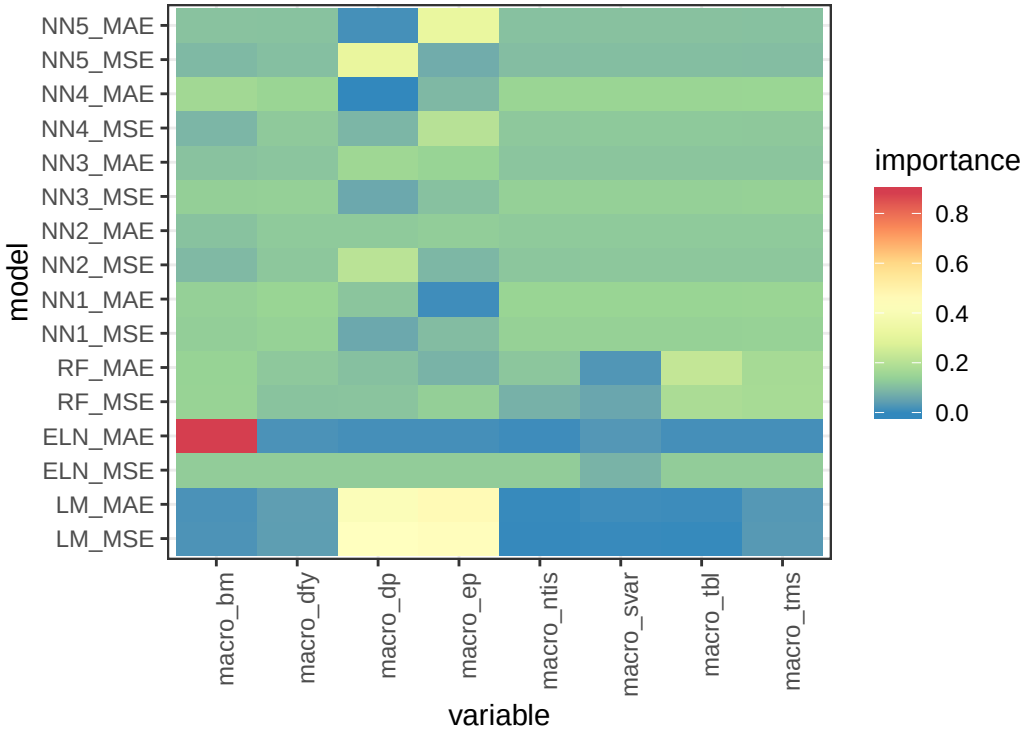
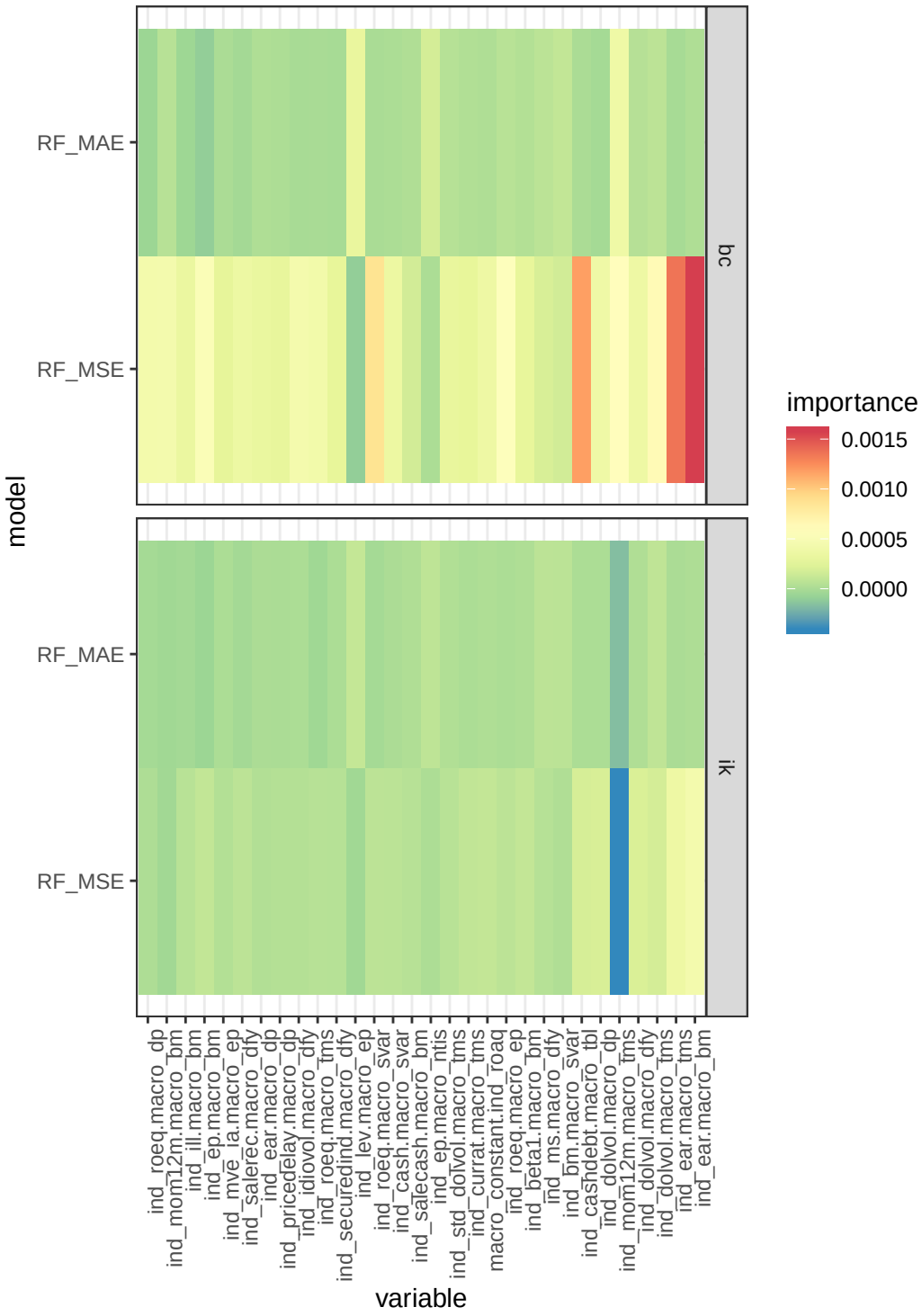


Figure 17. Train:Validation = 1:1 Robustness Check RF VIMP



1.3.3. Train:Validation = 2:1 Robustness Check

	Sample 1			Sample 2			Sample 3		
model	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2
LM.MSE	0.277087	0.164599	-2.98459	0.383421	0.31299	-6.337839	0.523418	0.740288	-15.361936
LM.MAE	0.246936	0.147979	-2.582262	0.277044	0.161215	-2.779579	0.487285	0.631575	-12.95915
ELN.MSE	0.133715	0.039919	0.033647	0.139723	0.042525	0.003028	**0.145034**	**0.044306**	**0.020752**
ELN.MAE	0.131237	0.040361	0.022952	**0.137205**	**0.041858**	**0.018674**	0.174408	0.064513	-0.425873
RF.MSE	0.130808	0.036982	0.104754	0.162762	0.051118	-0.198417	0.155264	0.048661	-0.075516
RF.MAE	**0.127013**	**0.036722**	**0.111033**	0.146758	0.043961	-0.030633	0.168905	0.055983	-0.237348
NN1.MSE	0.155088	0.050284	-0.217281	0.165871	0.053459	-0.253309	0.181984	0.064621	-0.428262
NN1.MAE	0.159797	0.050566	-0.224107	0.163397	0.052329	-0.226828	0.181636	0.062407	-0.379326
NN2.MSE	0.155815	0.050954	-0.233492	0.168576	0.055738	-0.306745	0.170991	0.057453	-0.269824
NN2.MAE	0.148149	0.047617	-0.152709	0.166334	0.054058	-0.26734	0.163141	0.052639	-0.163436
NN3.MSE	0.154141	0.04976	-0.204586	0.166218	0.053402	-0.251967	0.169539	0.05661	-0.251204
NN3.MAE	0.142464	0.043771	-0.059594	0.154233	0.048682	-0.141321	0.184217	0.064175	-0.418401
NN4.MSE	0.166547	0.056184	-0.360092	0.150748	0.047566	-0.115162	0.168447	0.056575	-0.250437
NN4.MAE	0.150167	0.046919	-0.135802	0.16197	0.05226	-0.225199	0.171676	0.057352	-0.267598
NN5.MSE	0.155784	0.052258	-0.265047	0.139699	0.043082	-0.010018	0.166166	0.055027	-0.216219
NN5.MAE	0.161161	0.053216	-0.28825	0.149207	0.046344	-0.086511	0.149424	0.047544	-0.050824

Figure 18. Train:Validation = 2:1 Robustness Check Individual Factor Importance

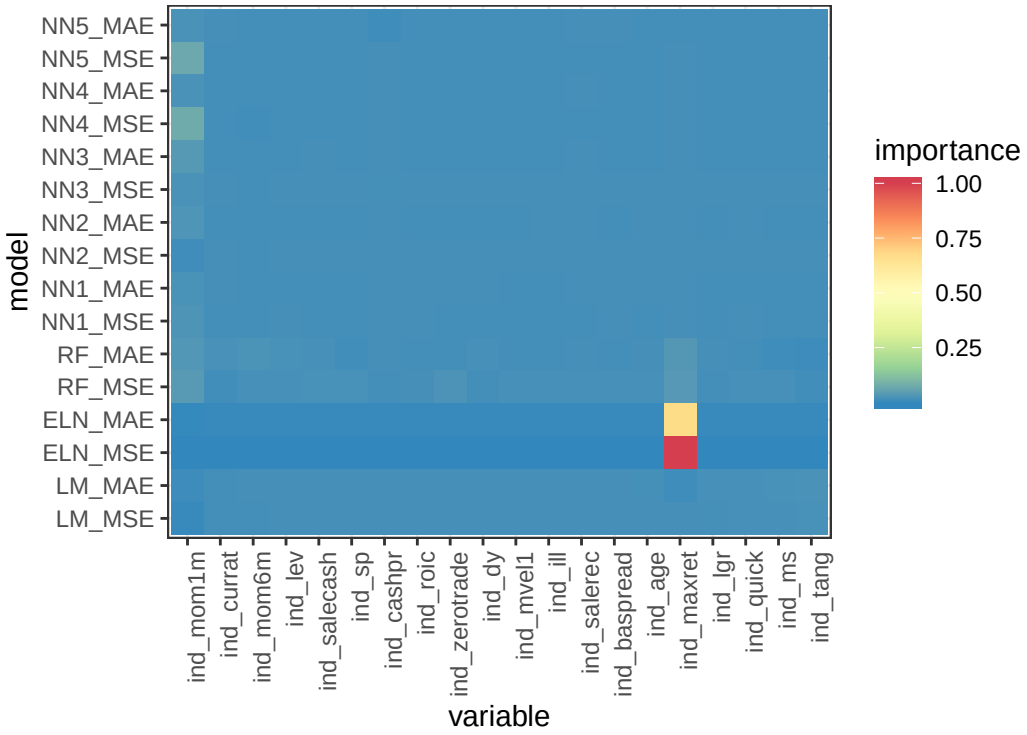


Figure 19. Train:Validation = 2:1 Robustness Check Macroeconomic Factor Importance

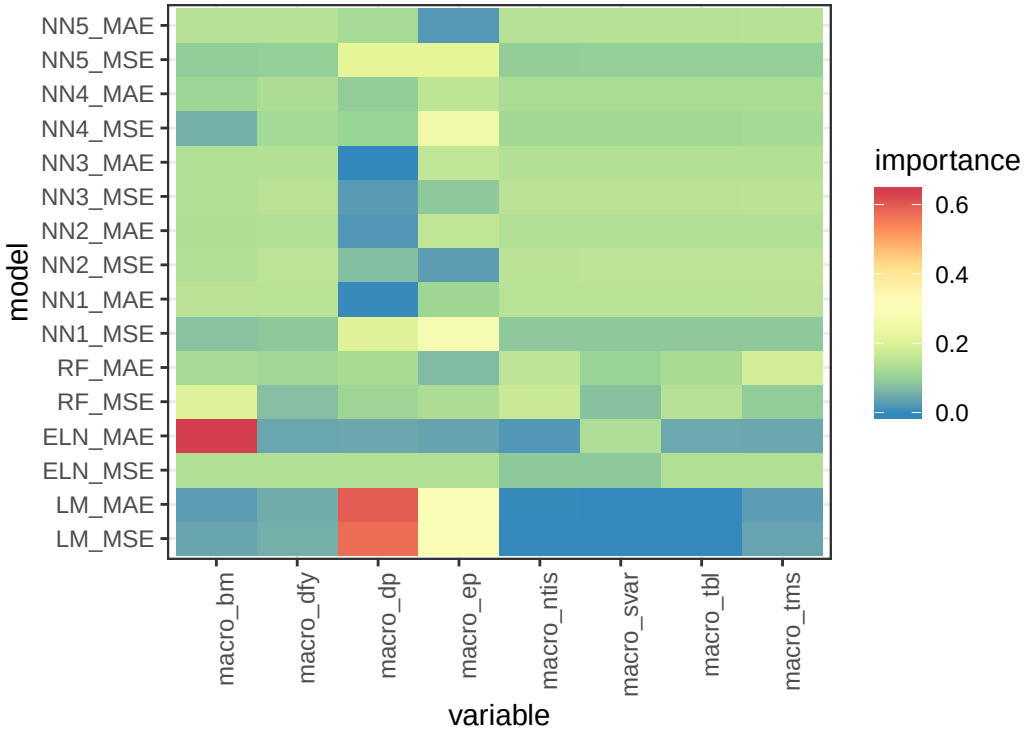
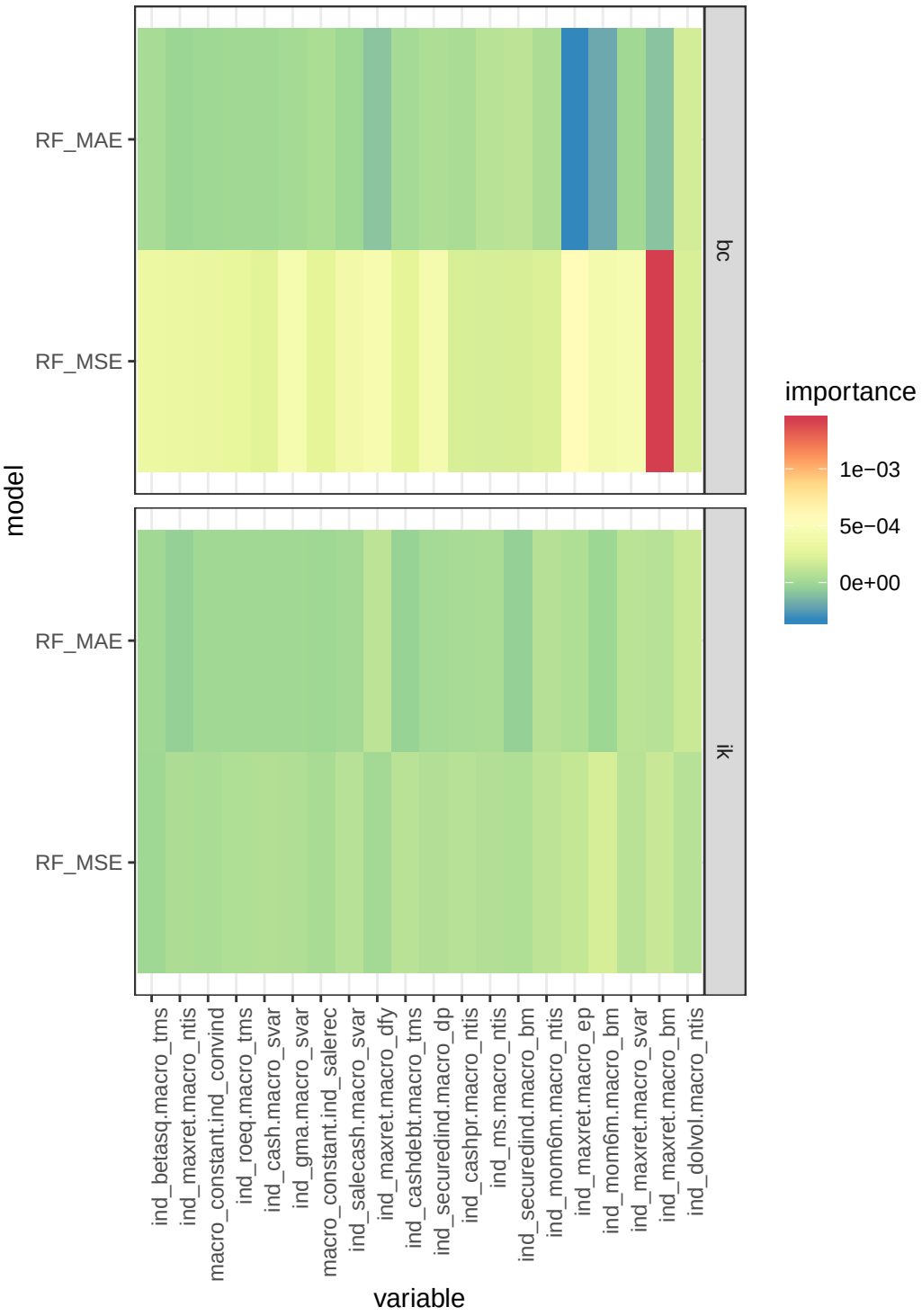


Figure 20. Train:Validation = 2:1 Robustness Check RF VIMP



1.3.4. Fama French Factors Robustness Check

	Sample 1			Sample 2			Sample 3		
model	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2	Test MAE	Test MSE	Test R^2
LM.MSE	0.288636	0.182966	-3.42923	0.367636	0.264918	-5.210825	1.101604	5.012469	-109.78624
LM.MAE	0.280535	0.179777	-3.352038	0.376163	0.279476	-5.552114	1.25341	7.06036	-155.048996
ELN.MSE	0.13383	0.039956	0.032746	0.14022	0.0427	-0.00107	**0.144472**	**0.043852**	**0.030769**
ELN.MAE	**0.128936**	**0.039665**	**0.039798**	**0.13716**	0.042144	0.011965	0.172148	0.063154	-0.395841
RF.MSE	0.146318	0.042607	-0.031434	0.151137	0.047091	-0.104011	0.177125	0.064664	-0.429221
RF.MAE	0.138597	0.040075	0.029879	0.138147	**0.041666**	**0.023169**	0.151722	0.047505	-0.049957
NN1.MSE	0.168063	0.055354	-0.340017	0.192143	0.068904	-0.61541	0.275195	0.138165	-2.053731
NN1.MAE	0.161596	0.051507	-0.246873	0.199416	0.068181	-0.598444	0.23054	0.093434	-1.065082
NN2.MSE	0.169842	0.056899	-0.377415	0.179733	0.058966	-0.382416	0.252929	0.117102	-1.588199
NN2.MAE	0.155816	0.046809	-0.133147	0.185008	0.060854	-0.426679	0.219342	0.085115	-0.881213
NN3.MSE	0.1621	0.053165	-0.287008	0.182996	0.059643	-0.398278	0.232226	0.099353	-1.195903
NN3.MAE	0.161255	0.050737	-0.228237	0.191625	0.064676	-0.516291	0.218355	0.085297	-0.885238
NN4.MSE	0.166036	0.055575	-0.345349	0.191589	0.066207	-0.552182	0.23417	0.097348	-1.151607
NN4.MAE	0.148375	0.045227	-0.094843	0.168623	0.054176	-0.270114	0.20837	0.077667	-0.7166
NN5.MSE	0.147379	0.044503	-0.077315	0.166006	0.054935	-0.287914	0.20667	0.077866	-0.721013
NN5.MAE	0.150541	0.045723	-0.106868	0.172466	0.055402	-0.298865	0.218796	0.084938	-0.877301

References

Figure 21. Fama French Factors Robustness Check Individual Factor Importance

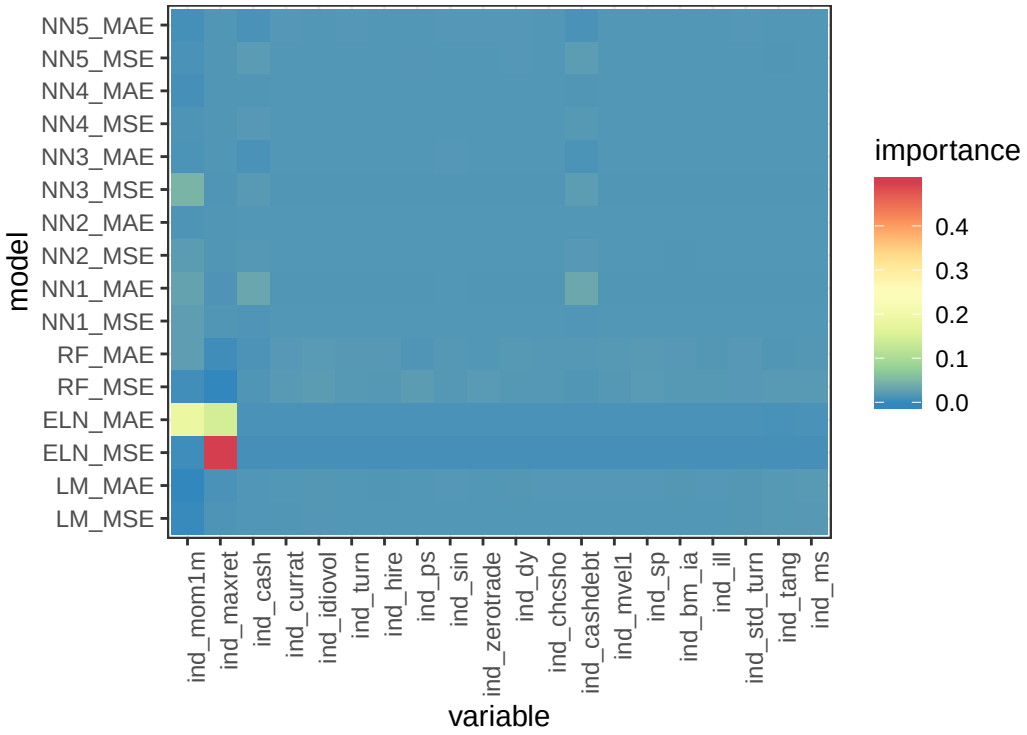


Figure 22. Fama French Factors Robustness Check Macroeconomic Factor Importance

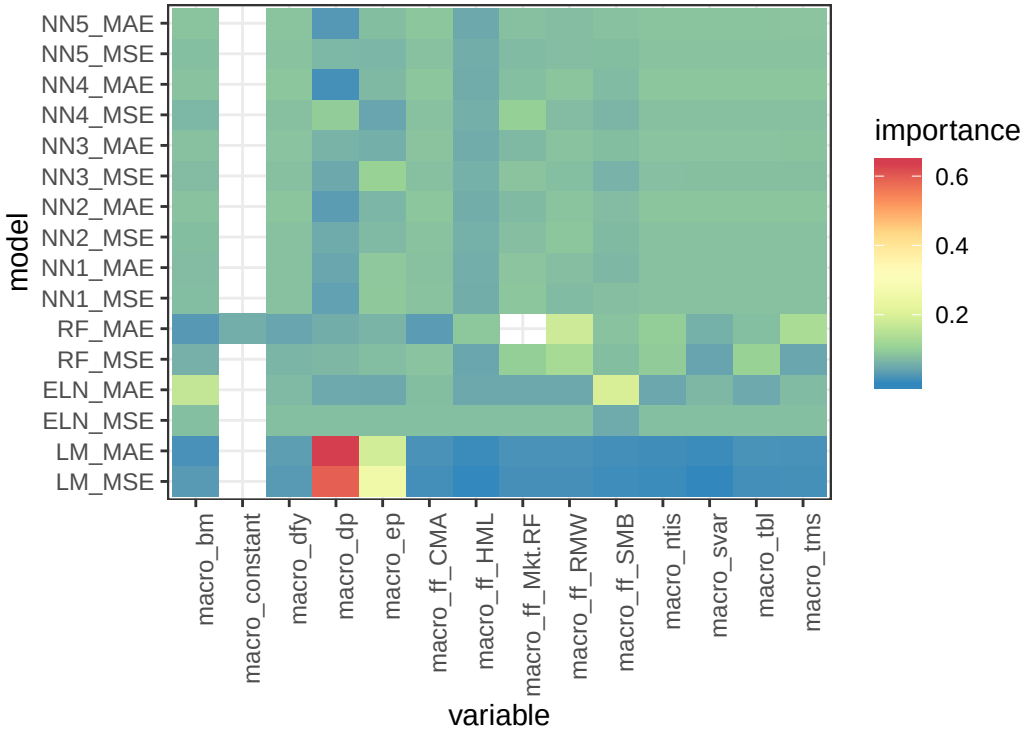


Figure 23. Fama French Factors Robustness Check RF VIMP