MAF-900: Final Assessment Replication

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Introduction

This is group report based on the replication of a paper titled **"Risk Return and Equilibrium: Empirical Tests"** also know as **Fama-MacBeth (1973) regression**. We replicated table 1 to table 4 of the original paper and extended the sample period to December, 2022.

Data and Replication methodology

The data for this replication are monthly return of stocks traded on New York Stock Exchange from January 1926 to December 2022. The data is from CRSP. The risk-free rate is from French's data library.

The basic methodology follows Fama and MacBeth (1973). To replicate the **table 1**, we separate the whole sample period into the subperiod using the same criteria as the original paper. In sum, we totally have 22 subperiods. For each period, we use the same criteria as the original paper to calculate the number of stocks. One thing we do which is not explicitly pointed out in the paper is that we filter all the observations that have missing values in return.

After replicating table 1, we save the permno numbers of stocks that meet data requirements into the next stage.

Before replicating **table 2**, we have to first estimate the betas of each stock and form portfolio in the "Portfolio formation period". We run the time series regression for each stock to estimate the beta, and then ranking the beta to form the 20 portfolios in each period. In the step, when we estimate the beta, we run the market model:

$R_{it} = a_t + \beta^i R_{mt} + \epsilon_{it}$

where the market return in the Fisher's Arithmetic Index, which is the equally weighted average of the returns on all stocks listed on NYSE. After we form the portfolio, we start to estimate the portfolio beta and create table 2. Specifically, we run the market model for each stock over the estimation period, and calculate the portfolio's beta by taking the average.

With the estimated beta, we move the next stage: **creating table 3**.

At first, as the betas have to updated annually, we first rerun the beta estimation for the portfolio. For example, in the first sample period, we run the four regressions with data from 1930 (the starting year in estimation period) to 1935, 1936, and 1937 (one year before the end the testing period) to have annually updated betas. After that, following regression model specified in the paper, we run four models (describe as from Panel A to Panel D in paper 3) to get the time series of gammas. After that, we could create the statistics in table 3 by using those time series. Similar to original paper, we present the results for the whole sample period, 7 longer period with 10 years with one exception of the last period, the 22 testing period specified in the table 1.

For **table 4**, we include the risk-free rate into the dataset to calculate those summary statistics. Also the statistics which are presented in the table 3 are those from the panel A regression. For both Table 3 and Table 4, when we calculate the t-statistics, we follow the adjustment mentioned in the original paper.

Table 1 demonstrates the summary of total securities available for the first month of the testing period and the number of securities that meet the data requirement according to the original paper. Our table 1 replication closely follow the original paper except the first period (1926-29), where we only found 264 securities meet the data requirement. We suspect that this disparity arise due to CRSP database update during that sample. Overall, the number of securities exhibit upward trend over time.

Table 1: Portfolio Formation, Estimation And Testing Periods

Portfolio Formation Period	Initial Formation Period	Testing Period	No. of Securities Available	No. of Securities Data Re quirement
1926-29	1930-34	1935-38	670	264
1927-33	1934-38	1939-42	731	493
1931-37	1938-42	1943-46	753	554
1935-41	1942-46	1947-50	850	640
1939-45	1946-50	1951-54	944	697
1943-49	1950-54	1955-58	983	749
1947-53	1954-58	1959-62	998	779
1951-57	1958-62	1963-66	1265	780
1955-61	1962-66	1967-70	1385	770
1959-65	1966-70	1971-74	1509	750
1963-69	1970-74	1975-78	2042	1040
1967-73	1974-78	1979-82	1994	1131
1971-77	1978-82	1983-86	1920	1577
1975-81	1982-86	1987-90	2060	1417
1979-85	1986-90	1991-94	2178	1290
1983-89	1990-94	1995-98	2915	1420
1987-93	1994-98	1999-2002	3004	1496
1991-97	1998-2002	2003-06	2590	1580
1995-2001	2002-06	2007-10	2618	1674
1999-2005	2006-10	2011-14	2467	1595
2003-09	2010-14	2015-18	2617	1697
2007-13	2014-18	2019-22	2444	1605

To replicate and present table 2, we split the the table into two part for each estimation period. The original paper depicted sample statistic for four estimation periods, which we included. To show the extended sample summary statistic of table two, we choose the four estimation period **(1990-94, 1998-2002, 2006-10 and 2014-18)**, respectively. The replication results are found very close to the original paper.

Table 2: Sample Statistics For Selected Estimation Periods

Portfolios For Estimation 1934-38

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.412	0.565	0.537	0.660	0.723	0.753	0.903	0.967	0.954	1.033
s_beta	0.026	0.029	0.025	0.031	0.025	0.024	0.029	0.033	0.027	0.027
Rsquared	0.815	0.869	0.887	0.887	0.937	0.943	0.944	0.938	0.955	0.962

statistic	1	2	3	4	5	6	7	8	9	10
s_Rp	0.048	0.064	0.060	0.074	0.079	0.082	0.098	0.105	0.103	0.111
s_ep	0.021	0.023	0.020	0.025	0.020	0.020	0.023	0.026	0.022	0.022
sp_ei	0.067	0.078	0.071	0.077	0.084	0.077	0.103	0.113	0.096	0.091
ratio	0.309	0.295	0.284	0.324	0.237	0.253	0.224	0.233	0.228	0.237

statistic	11	12	13	14	15	16	17	18	19	20
beta	1.137	1.122	1.200	1.232	1.212	1.317	1.324	1.380	1.404	1.519
s_beta	0.031	0.034	0.039	0.031	0.037	0.033	0.044	0.046	0.043	0.064
Rsquared	0.960	0.950	0.943	0.964	0.948	0.965	0.940	0.940	0.948	0.906
s_Rp	0.122	0.121	0.130	0.132	0.131	0.141	0.144	0.150	0.152	0.168
s_ep	0.025	0.027	0.031	0.025	0.030	0.026	0.035	0.037	0.035	0.052
sp_ei	0.108	0.123	0.127	0.131	0.122	0.128	0.123	0.137	0.138	0.175
ratio	0.227	0.222	0.244	0.190	0.246	0.206	0.288	0.270	0.250	0.294

Table 2: continue..

Portfolios For Estimation 1942-46

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.457	0.530	0.602	0.604	0.731	0.695	0.794	0.774	0.769	0.858
s_beta	0.045	0.039	0.047	0.037	0.030	0.035	0.041	0.030	0.035	0.036
Rsquared	0.641	0.757	0.740	0.818	0.913	0.875	0.869	0.922	0.894	0.909
s_Rp	0.034	0.037	0.042	0.040	0.046	0.045	0.051	0.048	0.049	0.054
s_ep	0.021	0.018	0.021	0.017	0.014	0.016	0.019	0.014	0.016	0.016
sp_ei	0.054	0.052	0.062	0.055	0.057	0.063	0.063	0.059	0.061	0.066
ratio	0.382	0.349	0.343	0.311	0.240	0.252	0.292	0.228	0.263	0.246

statistic	11	12	13	14	15	16	17	18	19	20
beta	0.929	1.021	1.033	1.086	1.173	1.426	1.412	1.351	1.763	1.593
s_beta	0.033	0.033	0.037	0.041	0.043	0.038	0.055	0.046	0.081	0.088
Rsquared	0.930	0.943	0.930	0.924	0.928	0.961	0.920	0.936	0.891	0.851
s_Rp	0.058	0.063	0.064	0.068	0.073	0.087	0.088	0.084	0.112	0.104
s_ep	0.015	0.015	0.017	0.019	0.020	0.017	0.025	0.021	0.037	0.040
sp_ei	0.069	0.073	0.085	0.080	0.079	0.100	0.093	0.092	0.125	0.115
ratio	0.222	0.206	0.201	0.232	0.248	0.172	0.268	0.230	0.296	0.349

Table 2: continue..

Portfolios For Estimation 1950-54

Portfolios For Estimation 1950-54

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.430	0.572	0.729	0.734	0.817	0.756	0.929	0.983	0.982	0.987
s_beta	0.041	0.049	0.047	0.042	0.036	0.038	0.050	0.034	0.035	0.031
Rsquared	0.657	0.698	0.807	0.839	0.897	0.870	0.855	0.936	0.932	0.947
s_Rp	0.019	0.025	0.029	0.029	0.031	0.029	0.036	0.037	0.037	0.037
s_ep	0.011	0.014	0.013	0.012	0.010	0.011	0.014	0.009	0.010	0.008
sp_ei	0.039	0.044	0.046	0.051	0.048	0.049	0.053	0.050	0.057	0.053
ratio	0.286	0.314	0.282	0.229	0.209	0.216	0.264	0.188	0.169	0.159

statistic	11	12	13	14	15	16	17	18	19	20
beta	1.086	1.200	1.078	1.205	1.131	1.284	1.228	1.330	1.416	1.531
s_beta	0.034	0.049	0.036	0.052	0.039	0.048	0.045	0.047	0.062	0.086
Rsquared	0.946	0.911	0.940	0.903	0.935	0.926	0.928	0.932	0.899	0.847
s_Rp	0.041	0.046	0.040	0.046	0.042	0.048	0.046	0.050	0.054	0.060
s_ep	0.009	0.014	0.010	0.014	0.011	0.013	0.012	0.013	0.017	0.024
sp_ei	0.058	0.059	0.059	0.065	0.063	0.063	0.062	0.068	0.072	0.089
ratio	0.161	0.231	0.167	0.222	0.173	0.210	0.199	0.191	0.239	0.267

Table 2: continue..

Portfolios For Estimation 1958-62

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.648	0.630	0.696	0.745	0.872	0.857	0.945	0.998	0.960	0.903
s_beta	0.045	0.049	0.041	0.047	0.048	0.032	0.032	0.034	0.038	0.038
Rsquared	0.779	0.738	0.831	0.814	0.849	0.924	0.938	0.936	0.918	0.908
s_Rp	0.031	0.031	0.033	0.035	0.041	0.038	0.042	0.044	0.043	0.041
s_ep	0.015	0.016	0.013	0.015	0.016	0.011	0.010	0.011	0.012	0.012
sp_ei	0.050	0.050	0.052	0.055	0.065	0.060	0.064	0.069	0.069	0.061
ratio	0.297	0.324	0.258	0.278	0.242	0.175	0.162	0.163	0.179	0.201

statistic	11	12	13	14	15	16	17	18	19	20
beta	1.082	0.966	1.042	1.048	0.992	1.141	1.137	1.118	1.229	1.410
s_beta	0.043	0.028	0.035	0.038	0.035	0.045	0.045	0.044	0.050	0.072
Rsquared	0.915	0.952	0.937	0.930	0.933	0.918	0.916	0.918	0.912	0.867
s_Rp	0.048	0.042	0.046	0.047	0.044	0.051	0.051	0.050	0.055	0.065
s_ep	0.014	0.009	0.012	0.012	0.011	0.015	0.015	0.014	0.016	0.024
sp_ei	0.075	0.062	0.064	0.065	0.061	0.072	0.076	0.069	0.067	0.078
ratio	0.187	0.149	0.180	0.188	0.188	0.204	0.195	0.208	0.244	0.302

Table 2: continue..

Portfolios For Estimation 1990-94

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.326	0.389	0.470	0.539	0.764	0.850	0.725	0.909	0.997	0.941
s_beta	0.064	0.056	0.057	0.043	0.051	0.038	0.040	0.042	0.048	0.046
Rsquared	0.312	0.453	0.538	0.734	0.796	0.895	0.847	0.892	0.880	0.877
s_Rp	0.024	0.024	0.026	0.026	0.035	0.037	0.032	0.039	0.043	0.041
s_ep	0.020	0.017	0.018	0.013	0.016	0.012	0.013	0.013	0.015	0.014
sp_ei	0.048	0.057	0.071	0.077	0.090	0.078	0.078	0.077	0.083	0.082
ratio	0.411	0.308	0.252	0.172	0.176	0.151	0.160	0.167	0.182	0.175

statistic	11	12	13	14	15	16	17	18	19	20
beta	1.029	1.013	0.963	1.031	1.214	1.166	1.199	1.356	1.471	1.598
s_beta	0.044	0.050	0.040	0.046	0.045	0.053	0.050	0.059	0.076	0.072
Rsquared	0.902	0.877	0.908	0.895	0.927	0.891	0.909	0.901	0.867	0.894
s_Rp	0.044	0.044	0.041	0.044	0.051	0.050	0.051	0.058	0.064	0.069
s_ep	0.014	0.015	0.012	0.014	0.014	0.017	0.015	0.018	0.024	0.022
sp_ei	0.093	0.084	0.081	0.086	0.099	0.096	0.107	0.110	0.136	0.137
ratio	0.148	0.184	0.155	0.166	0.140	0.174	0.145	0.166	0.173	0.164

Table 2: continue..

Portfolios For Estimation 1998-2002

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.455	0.218	0.328	0.375	0.491	0.590	0.726	0.828	0.950	0.952
s_beta	0.050	0.046	0.050	0.046	0.041	0.038	0.052	0.042	0.044	0.048
Rsquared	0.591	0.281	0.422	0.537	0.710	0.808	0.769	0.870	0.889	0.873
s_Rp	0.028	0.020	0.024	0.025	0.028	0.031	0.040	0.043	0.048	0.049
s_ep	0.018	0.017	0.018	0.017	0.015	0.014	0.019	0.015	0.016	0.017
sp_ei	0.074	0.050	0.061	0.063	0.073	0.075	0.095	0.095	0.091	0.096
ratio	0.246	0.333	0.302	0.264	0.206	0.183	0.201	0.161	0.177	0.180

statistic	11	12	13	14	15	16	17	18	19	20
beta	1.030	1.107	1.114	1.039	1.104	1.178	1.323	1.275	1.455	1.496
s_beta	0.053	0.046	0.040	0.047	0.049	0.041	0.039	0.050	0.050	0.080
Rsquared	0.868	0.908	0.930	0.896	0.897	0.933	0.953	0.917	0.935	0.858
s_Rp	0.053	0.056	0.055	0.053	0.056	0.058	0.065	0.064	0.072	0.077
s_ep	0.019	0.017	0.015	0.017	0.018	0.015	0.014	0.018	0.018	0.029
sp_ei	0.105	0.107	0.104	0.115	0.115	0.118	0.133	0.128	0.138	0.160
ratio	0.183	0.158	0.140	0.148	0.156	0.128	0.106	0.144	0.134	0.182

Table 2: continue..

Portfolios For Estimation 2006-10

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.362	0.291	0.482	0.602	0.817	0.853	0.907	0.930	0.907	0.912
s_beta	0.041	0.051	0.034	0.033	0.036	0.031	0.037	0.030	0.022	0.025
Rsquared	0.579	0.364	0.780	0.849	0.898	0.928	0.911	0.944	0.967	0.958
s_Rp	0.032	0.032	0.036	0.044	0.057	0.059	0.063	0.064	0.061	0.062
s_ep	0.021	0.026	0.017	0.017	0.018	0.016	0.019	0.015	0.011	0.013
sp_ei	0.054	0.047	0.057	0.066	0.079	0.083	0.086	0.093	0.089	0.085
ratio	0.384	0.549	0.298	0.256	0.232	0.191	0.219	0.163	0.125	0.149

statistic	11	12	13	14	15	16	17	18	19	20
beta	1.035	0.984	1.180	1.147	1.345	1.131	1.264	1.297	1.419	1.396
s_beta	0.030	0.032	0.037	0.035	0.040	0.034	0.038	0.033	0.037	0.046
Rsquared	0.954	0.941	0.945	0.948	0.952	0.950	0.951	0.963	0.962	0.941
s_Rp	0.071	0.068	0.081	0.078	0.092	0.077	0.086	0.088	0.096	0.096
s_ep	0.015	0.016	0.019	0.018	0.020	0.017	0.019	0.017	0.019	0.023
sp_ei	0.107	0.094	0.102	0.102	0.109	0.107	0.108	0.113	0.110	0.124
ratio	0.141	0.176	0.185	0.175	0.185	0.161	0.177	0.149	0.170	0.188

Table 2: continue..

Portfolios For Estimation 2014-18

statistic	1	2	3	4	5	6	7	8	9	10
beta	0.134	0.192	0.444	0.638	0.682	0.740	0.802	0.825	0.775	0.880
s_beta	0.062	0.072	0.055	0.059	0.040	0.037	0.038	0.033	0.037	0.033
Rsquared	0.074	0.108	0.529	0.665	0.835	0.874	0.887	0.914	0.886	0.926
s_Rp	0.018	0.021	0.022	0.028	0.027	0.028	0.030	0.031	0.029	0.033
s_ep	0.017	0.020	0.015	0.016	0.011	0.010	0.010	0.009	0.010	0.009
sp_ei	0.030	0.041	0.050	0.060	0.059	0.063	0.062	0.063	0.060	0.070
ratio	0.558	0.483	0.298	0.268	0.183	0.159	0.165	0.143	0.165	0.127

statistic	11	12	13	14	15	16	17	18	19	20
beta	1.085	1.089	1.128	1.042	1.160	1.330	1.228	1.411	1.419	1.508
s_beta	0.034	0.039	0.036	0.038	0.041	0.050	0.046	0.043	0.057	0.066
Rsquared	0.946	0.929	0.943	0.928	0.932	0.925	0.923	0.949	0.914	0.900
s_Rp	0.040	0.040	0.041	0.039	0.043	0.049	0.046	0.052	0.053	0.057
s_ep	0.009	0.011	0.010	0.010	0.011	0.013	0.013	0.012	0.016	0.018
sp_ei	0.068	0.065	0.071	0.063	0.083	0.085	0.083	0.084	0.092	0.100
ratio	0.135	0.164	0.140	0.164	0.134	0.159	0.152	0.139	0.169	0.180

Table 3 Panel(A): Summary Results For the Regression

Period	$\bar{\hat{\gamma_0}}$	$\bar{\hat{\gamma_1}}$	$\bar{\hat{\gamma_2}}$	$\bar{\hat{\gamma_3}}$	$\gamma_0 \bar{\hat{-}}_{R_f}$	$s(\hat{\gamma_0})$	$s(\hat{\gamma_1})$	$s(\hat{\gamma_2})$	$s(\hat{\gamma_3})$	$\rho_0(\gamma_0 \hat{-} R_f)$
Panel A:										
1935-2022	0.0069	0.0057	...	...	0.0042	0.0341	0.0607	...	...	0.0936
1935-1945	0.0005	0.0187	...	...	0.0003	0.0506	0.1004	...	...	0.0489
1946-1955	0.0090	0.0025	...	...	0.0080	0.0255	0.0411	...	...	0.1047
1956-1965	0.0070	0.0046	...	...	0.0047	0.0290	0.0411	...	...	0.3579
1966-1975	0.0049	0.0018	...	...	0.0003	0.0382	0.0625	...	...	0.1233
1976-1985	0.0092	0.0103	...	...	0.0020	0.0329	0.0580	...	...	0.1369
1986-1995	0.0124	0.0000	...	...	0.0079	0.0358	0.0539	...	...	0.0230
1996-2005	0.0080	0.0054	...	...	0.0050	0.0305	0.0489	...	...	-0.0559
2006-2015	0.0068	0.0014	...	...	0.0059	0.0266	0.0577	...	...	0.0667
2016-2022	0.0047	0.0055	...	...	0.0038	0.0253	0.0537	...	...	-0.0185
1935-1940	-0.0048	0.0170	...	...	-0.0048	0.0619	0.1226	...	...	-0.0097
1941-1945	0.0068	0.0208	...	...	0.0065	0.0314	0.0655	...	...	0.2519
1946-1950	0.0051	0.0030	...	...	0.0045	0.0302	0.0471	...	...	0.1667
1951-1955	0.0128	0.0021	...	...	0.0116	0.0193	0.0344	...	...	-0.0419
1956-1960	0.0152	-0.0061	...	...	0.0130	0.0207	0.0347	...	...	0.1387
1961-1965	-0.0012	0.0152	...	...	-0.0037	0.0337	0.0445	...	...	0.3557
1966-1970	0.0084	-0.0019	...	...	0.0040	0.0390	0.0560	...	...	0.1394
1971-1975	0.0014	0.0055	...	...	-0.0033	0.0375	0.0686	...	...	0.1069
1976-1980	0.0013	0.0207	...	...	-0.0050	0.0309	0.0635	...	...	0.1642
1981-1985	0.0172	-0.0001	...	...	0.0090	0.0331	0.0504	...	...	0.0390
1986-1990	0.0183	-0.0106	...	...	0.0128	0.0365	0.0530	...	...	-0.0972
1991-1995	0.0065	0.0106	...	...	0.0030	0.0344	0.0530	...	...	0.1300
1996-2000	0.0109	0.0021	...	...	0.0067	0.0329	0.0474	...	...	0.0191
2001-2005	0.0052	0.0088	...	...	0.0034	0.0278	0.0505	...	...	-0.0506
2006-2010	0.0036	0.0057	...	...	0.0017	0.0284	0.0652	...	...	0.0425
2011-2015	0.0101	-0.0029	...	...	0.0101	0.0245	0.0492	...	...	0.0318
2016-2022	0.0047	0.0055	...	...	0.0038	0.0253	0.0537	...	...	-0.0185

Table 3 Panel(A):Continue...

Period	$\rho_M(\hat{\gamma_1})$	$\rho_0(\hat{\gamma_2})$	$\rho_0(\hat{\gamma_3})$	$t(\bar{\hat{\gamma_0}})$	$t(\bar{\hat{\gamma_1}})$	$t(\bar{\hat{\gamma_2}})$	$t(\bar{\hat{\gamma_3}})$	$t(\gamma_0 \bar{\hat{-}}_{R_f})$	$\bar{r^2}$	$s(r^2)$
Panel A:										
1935-2022	0.0936	...	...	6.6191	3.0726	...	...	4.0081	0.3365	0.3045
1935-1945	-0.0437	...	...	0.1069	2.1424	...	...	0.0744	0.2739	0.2892
1946-1955	0.0728	...	...	3.8435	0.6754	...	...	3.4414	0.3185	0.3168
1956-1965	0.1978	...	...	2.6377	1.2131	...	...	1.7495	0.2675	0.2857
1966-1975	0.1021	...	...	1.4024	0.3174	...	...	0.0953	0.3082	0.2824
1976-1985	0.2272	...	...	3.0809	1.9369	...	...	0.6783	0.3691	0.3065
1986-1995	0.3032	...	...	3.7910	0.0066	...	...	2.4286	0.2771	0.2656
1996-2005	0.0977	...	...	2.8878	1.2207	...	...	1.8219	0.3749	0.2879
2006-2015	0.1619	...	...	2.8156	0.2697	...	...	2.4211	0.4377	0.3205
2016-2022	-0.0718	...	...	1.6867	0.9390	...	...	1.3945	0.4382	0.3473
1935-1940	-0.0925	...	...	-0.6532	1.1749	...	...	-0.6637	0.2144	0.2840
1941-1945	0.1549	...	...	1.6653	2.4626	...	...	1.6130	0.3454	0.2812
1946-1950	0.0294	...	...	1.3167	0.4918	...	...	1.1465	0.4025	0.3240
1951-1955	0.1043	...	...	5.1291	0.4671	...	...	4.6235	0.2345	0.2883
1956-1960	0.1640	...	...	5.6729	-1.3651	...	...	4.8654	0.2141	0.3037
1961-1965	0.1472	...	...	-0.2714	2.6521	...	...	-0.8481	0.3210	0.2580

Period	$\rho_M(\hat{\gamma}_1)$	$\rho_0(\hat{\gamma}_2)$	$\rho_0(\hat{\gamma}_3)$	$t(\bar{\hat{\gamma}}_0)$	$t(\bar{\hat{\gamma}}_1)$	$t(\bar{\hat{\gamma}}_2)$	$t(\bar{\hat{\gamma}}_3)$	$t(\gamma_0 \bar{\hat{-}}_{R_f})$	$\bar{r^2}$	$s(r^2)$
1966-1970	0.1430	...	...	1.6725	-0.2595	...	...	0.7937	0.3107	0.2805
1971-1975	0.0609	...	...	0.2850	0.6204	...	...	-0.6814	0.3056	0.2868
1976-1980	0.1910	...	...	0.3292	2.5178	...	...	-1.2664	0.3675	0.2954
1981-1985	0.2233	...	...	4.0150	-0.0204	...	...	2.0819	0.3708	0.3197
1986-1990	0.3122	...	...	3.8865	-1.5448	...	...	2.7228	0.2762	0.2817
1991-1995	0.2411	...	...	1.4587	1.5554	...	...	0.6716	0.2781	0.2508
1996-2000	0.1079	...	...	2.5619	0.3441	...	...	1.5796	0.3495	0.2667
2001-2005	0.0713	...	...	1.4425	1.3485	...	...	0.9477	0.4004	0.3078
2006-2010	0.2567	...	...	0.9790	0.6783	...	...	0.4762	0.4523	0.3028
2011-2015	-0.0210	...	...	3.1891	-0.4512	...	...	3.1829	0.4230	0.3391
2016-2022	-0.0718	...	...	1.6867	0.9390	...	...	1.3945	0.4382	0.3473

Table 3 Panel(B):Summary Results for the Regression

Period	$\bar{\hat{\gamma}}_0$	$\bar{\hat{\gamma}}_1$	$\bar{\hat{\gamma}}_2$	$\bar{\hat{\gamma}}_3$	$\gamma_0 \bar{\hat{-}}_{R_f}$	$s(\hat{\gamma}_0)$	$s(\hat{\gamma}_1)$	$s(\hat{\gamma}_2)$	$s(\hat{\gamma}_3)$	$\rho_0(\gamma_0 \hat{-} R_f)$
Panel B:										
1935-2022	0.0057	0.0093	-0.0071	...	0.0057	0.0352	0.0925	0.0354	...	0.0592
1935-1945	0.0020	0.0155	0.0016	...	0.0018	0.1160	0.2484	0.1280	...	-0.0219
1946-1955	-0.0007	0.0229	-0.0098	...	-0.0017	0.0339	0.0949	0.0376	...	0.0180
1956-1965	0.0052	0.0084	-0.0019	...	0.0028	0.0591	0.1181	0.0592	...	0.3042
1966-1975	0.0030	0.0060	-0.0022	...	-0.0016	0.0881	0.1819	0.0927	...	0.0114
1976-1985	0.0061	0.0166	-0.0029	...	-0.0012	0.0797	0.1857	0.0743	...	0.2078
1986-1995	0.0123	-0.0014	0.0015	...	0.0078	0.0558	0.1402	0.0760	...	0.0661
1996-2005	0.0116	-0.0042	0.0056	...	0.0087	0.0405	0.1020	0.0550	...	0.0152
2006-2015	0.0058	0.0047	-0.0021	...	0.0049	0.0461	0.1315	0.0521	...	0.1148
2016-2022	0.0013	0.0146	-0.0049	...	0.0005	0.0277	0.0615	0.0233	...	0.0637
1935-1940	-0.0093	0.0278	-0.0055	...	-0.0094	0.1429	0.3188	0.1578	...	-0.0429
1941-1945	0.0155	0.0009	0.0100	...	0.0152	0.0705	0.1195	0.0794	...	0.0284
1946-1950	-0.0011	0.0160	-0.0061	...	-0.0018	0.0356	0.0998	0.0369	...	0.1244
1951-1955	-0.0004	0.0298	-0.0136	...	-0.0016	0.0324	0.0899	0.0381	...	-0.1310
1956-1960	0.0113	0.0022	-0.0041	...	0.0092	0.0381	0.0898	0.0435	...	0.2182
1961-1965	-0.0010	0.0146	0.0004	...	-0.0035	0.0743	0.1414	0.0719	...	0.3092
1966-1970	0.0016	0.0133	-0.0079	...	-0.0029	0.0764	0.1671	0.0696	...	0.0254
1971-1975	0.0044	-0.0014	0.0035	...	-0.0002	0.0990	0.1967	0.1114	...	0.0060
1976-1980	-0.0017	0.0263	-0.0025	...	-0.0079	0.0905	0.2170	0.0891	...	0.2358
1981-1985	0.0138	0.0068	-0.0033	...	0.0056	0.0672	0.1494	0.0565	...	0.1516
1986-1990	0.0089	0.0106	-0.0111	...	0.0034	0.0635	0.1592	0.0694	...	-0.0502
1991-1995	0.0156	-0.0134	0.0141	...	0.0121	0.0471	0.1184	0.0806	...	0.2538
1996-2000	0.0143	-0.0070	0.0054	...	0.0101	0.0429	0.1121	0.0589	...	0.0884
2001-2005	0.0090	-0.0015	0.0059	...	0.0073	0.0382	0.0917	0.0513	...	-0.0766
2006-2010	0.0060	0.0001	0.0029	...	0.0041	0.0552	0.1622	0.0646	...	0.1176
2011-2015	0.0057	0.0093	-0.0071	...	0.0057	0.0352	0.0925	0.0354	...	0.0592
2016-2022	0.0013	0.0146	-0.0049	...	0.0005	0.0277	0.0615	0.0233	...	0.0637

Period	$\bar{\hat{\gamma}}_0$	$\bar{\hat{\gamma}}_1$	$\bar{\hat{\gamma}}_2$	$\bar{\hat{\gamma}}_3$	$\gamma_0 \bar{\hat{-}}_{R_f}$	$s(\hat{\gamma}_0)$	$s(\hat{\gamma}_1)$	$s(\hat{\gamma}_2)$	$s(\hat{\gamma}_3)$	$\rho_0(\gamma_0 \hat{-} R_f)$

Table 3 Panel(B):Continue...

$\rho_M(\hat{\gamma}_1)$	$\rho_0(\hat{\gamma}_2)$	$\rho_0(\hat{\gamma}_3)$	$t(\bar{\hat{\gamma}}_0)$	$t(\bar{\hat{\gamma}}_1)$	$t(\bar{\hat{\gamma}}_2)$	$t(\bar{\hat{\gamma}}_3)$	$t(\gamma_0 \bar{\hat{-}}_{R_f})$	$\bar{r^2}$	$s(r^2)$
Panel B:									
1935-2022	-0.0265	0.0857	...	1.2579	0.7782	-1.5536	...	1.2540	0.4885
1935-1945	-0.0624	-0.0675	...	0.1937	0.7193	0.1394	...	0.1795	0.2838
1946-1955	0.0140	-0.0476	...	-0.2419	2.6472	-2.8640	...	-0.5469	0.3464
1956-1965	0.2402	0.1610	...	0.9569	0.7798	-0.3440	...	0.5258	0.3123
1966-1975	-0.0260	-0.1131	...	0.3743	0.3589	-0.2562	...	-0.1930	0.3437
1976-1985	0.2305	0.1666	...	0.8330	0.9770	-0.4254	...	-0.1616	0.4277
1986-1995	0.0393	0.0043	...	2.4103	-0.1093	0.2171	...	1.5260	0.3362
1996-2005	0.0113	-0.0734	...	3.1455	-0.4527	1.1252	...	2.3441	0.4412
2006-2015	0.0874	0.1319	...	1.3891	0.3914	-0.4415	...	1.1660	0.5077
2016-2022	-0.1019	-0.1276	...	0.4418	2.1700	-1.9491	...	0.1732	0.4759
1935-1940	-0.0625	-0.0950	...	-0.5527	0.7391	-0.2966	...	-0.5572	0.2118
1941-1945	-0.0696	0.0584	...	1.6988	0.0575	0.9785	...	1.6757	0.3701
1946-1950	0.1028	0.0373	...	-0.2390	1.2441	-1.2751	...	-0.3834	0.4259
1951-1955	-0.1391	-0.1339	...	-0.0953	2.5678	-2.7544	...	-0.3878	0.2669
1956-1960	0.0950	0.1649	...	2.3008	0.1877	-0.7293	...	1.8688	0.2652
1961-1965	0.2958	0.1578	...	-0.1028	0.8019	0.0405	...	-0.3656	0.3595
1966-1970	0.0512	-0.0585	...	0.1593	0.6180	-0.8757	...	-0.2901	0.3282
1971-1975	-0.0603	-0.1108	...	0.3480	-0.0557	0.2456	...	-0.0192	0.3591
1976-1980	0.2253	0.1579	...	-0.1421	0.9406	-0.2134	...	-0.6815	0.4496
1981-1985	0.2443	0.1976	...	1.5899	0.3518	-0.4542	...	0.6464	0.4058
1986-1990	0.0195	-0.1500	...	1.0874	0.5176	-1.2420	...	0.4148	0.3332
1991-1995	0.0513	0.0814	...	2.5708	-0.8787	1.3583	...	2.0004	0.3392
1996-2000	0.1350	0.0815	...	2.5770	-0.4822	0.7114	...	1.8188	0.4089
2001-2005	-0.1242	-0.1684	...	1.8263	-0.1229	0.8892	...	1.4698	0.4735
2006-2010	0.1103	0.1200	...	0.8385	0.0052	0.3474	...	0.5785	0.5269
2011-2015	-0.0265	0.0857	...	1.2579	0.7782	-1.5536	...	1.2540	0.4885
2016-2022	-0.1019	-0.1276	...	0.4418	2.1700	-1.9491	...	0.1732	0.4759

Table 3 Panel(C):Summary Results for the Regression

Period	$\bar{\hat{\gamma}}_0$	$\bar{\hat{\gamma}}_1$	$\bar{\hat{\gamma}}_2$	$\bar{\hat{\gamma}}_3$	$\gamma_0 \bar{\hat{-}}_{R_f}$	$s(\hat{\gamma}_0)$	$s(\hat{\gamma}_1)$	$s(\hat{\gamma}_2)$	$s(\hat{\gamma}_3)$	$\rho_0(\gamma_0 \hat{-} R_f)$
Panel C:										
1935-2022	0.0064	0.0042	...	0.0191	0.0037	0.0434	0.0791	...	0.9465	0.0988
1935-1945	-0.0011	0.0171	...	0.0427	-0.0012	0.0540	0.1302	...	0.8927	0.0745
1946-1955	0.0108	0.0066	...	-0.0861	0.0099	0.0380	0.0582	...	0.8586	-0.0164
1956-1965	0.0075	0.0058	...	-0.0253	0.0052	0.0370	0.0538	...	1.0046	0.3004
1966-1975	0.0051	0.0018	...	-0.0099	0.0006	0.0484	0.0758	...	1.1315	0.0564
1976-1985	0.0051	0.0001	...	0.1569	-0.0021	0.0496	0.0845	...	1.3616	0.3109
1986-1995	0.0139	0.0006	...	-0.0262	0.0094	0.0441	0.0695	...	0.8287	-0.0196
1996-2005	0.0050	-0.0015	...	0.1110	0.0020	0.0407	0.0663	...	0.7964	-0.0609

Period	$\bar{\hat{\gamma_0}}$	$\bar{\hat{\gamma_1}}$	$\bar{\hat{\gamma_2}}$	$\bar{\hat{\gamma_3}}$	$\gamma_0 \bar{\hat{-}}_{R_f}$	$s(\hat{\gamma_0})$	$s(\hat{\gamma_1})$	$s(\hat{\gamma_2})$	$s(\hat{\gamma_3})$	$\rho_0(\gamma_0 \hat{-} R_f)$
2006-2015	0.0060	0.0001	...	0.0311	0.0050	0.0381	0.0750	...	0.7594	0.0313
2016-2022	0.0060	0.0069	...	-0.0438	0.0052	0.0306	0.0607	...	0.5871	-0.0621
1935-1940	-0.0040	0.0232	...	-0.0524	-0.0041	0.0607	0.1694	...	0.8718	-0.0141
1941-1945	0.0025	0.0098	...	0.1568	0.0023	0.0449	0.0548	...	0.9113	0.2555
1946-1950	0.0070	0.0077	...	-0.0836	0.0063	0.0454	0.0713	...	0.9687	0.0291
1951-1955	0.0146	0.0055	...	-0.0886	0.0134	0.0285	0.0419	...	0.7405	-0.0714
1956-1960	0.0119	-0.0092	...	0.1064	0.0098	0.0359	0.0482	...	1.0719	0.2685
1961-1965	0.0032	0.0209	...	-0.1570	0.0007	0.0379	0.0552	...	0.9227	0.3037
1966-1970	0.0113	0.0021	...	-0.0987	0.0069	0.0445	0.0689	...	0.9965	0.0058
1971-1975	-0.0011	0.0015	...	0.0788	-0.0058	0.0517	0.0827	...	1.2543	0.1161
1976-1980	-0.0112	-0.0087	...	0.4651	-0.0175	0.0526	0.0740	...	1.4394	0.3518
1981-1985	0.0215	0.0089	...	-0.1513	0.0133	0.0406	0.0936	...	1.2141	0.0643
1986-1990	0.0223	-0.0015	...	-0.1551	0.0167	0.0474	0.0879	...	0.9847	-0.1471
1991-1995	0.0055	0.0026	...	0.1027	0.0020	0.0391	0.0447	...	0.6178	0.1122
1996-2000	0.0076	-0.0058	...	0.1327	0.0033	0.0473	0.0674	...	0.9159	0.0011
2001-2005	0.0024	0.0028	...	0.0893	0.0006	0.0330	0.0655	...	0.6627	-0.0033
2006-2010	0.0013	0.0018	...	0.0809	-0.0005	0.0402	0.0917	...	0.8749	-0.0697
2011-2015	0.0106	-0.0016	...	-0.0187	0.0106	0.0356	0.0540	...	0.6267	0.1096
2016-2022	0.0060	0.0069	...	-0.0438	0.0052	0.0306	0.0607	...	0.5871	-0.0621

Table 3 Panel(C):Continue...

Period	$\rho_M(\hat{\gamma_1})$	$\rho_0(\hat{\gamma_2})$	$\rho_0(\hat{\gamma_3})$	$t(\bar{\hat{\gamma_0}})$	$t(\bar{\hat{\gamma_1}})$	$t(\bar{\hat{\gamma_2}})$	$t(\bar{\hat{\gamma_3}})$	$t(\gamma_0 \bar{\hat{-}}_{R_f})$	$\bar{r^2}$	$s(r^2)$
Panel C:										
1935-2022	0.0238	...	0.0348	4.8080	1.7386	...	0.6542	2.7508	0.3620	0.3045
1935-1945	-0.0846	...	-0.0116	-0.2272	1.5126	...	0.5492	-0.2577	0.2991	0.2927
1946-1955	-0.0431	...	-0.1494	3.1169	1.2467	...	-1.0985	2.8460	0.3545	0.3180
1956-1965	0.1735	...	0.1745	2.2299	1.1882	...	-0.2755	1.5359	0.2951	0.2887
1966-1975	0.0655	...	-0.0018	1.1618	0.2655	...	-0.0963	0.1301	0.3309	0.2935
1976-1985	0.1506	...	0.1396	1.1355	0.0129	...	1.2623	-0.4681	0.3736	0.3129
1986-1995	0.0785	...	-0.0381	3.4506	0.0911	...	-0.3464	2.3403	0.3146	0.2697
1996-2005	0.0743	...	-0.0692	1.3354	-0.2502	...	1.5265	0.5325	0.4271	0.2735
2006-2015	0.0383	...	-0.0385	1.7181	0.0156	...	0.4484	1.4442	0.4525	0.3119
2016-2022	-0.1161	...	-0.1334	1.8003	1.0445	...	-0.6843	1.5609	0.4408	0.3494
1935-1940	-0.0858	...	-0.1780	-0.5639	1.1643	...	-0.5102	-0.5747	0.2387	0.2811
1941-1945	-0.1073	...	0.1398	0.4305	1.3878	...	1.3326	0.3923	0.3716	0.2922
1946-1950	-0.0219	...	-0.0900	1.1893	0.8414	...	-0.6684	1.0760	0.4311	0.3181
1951-1955	-0.1525	...	-0.2042	3.9748	1.0193	...	-0.9268	3.6406	0.2779	0.3014
1956-1960	0.2052	...	0.2824	2.5632	-1.4789	...	0.7692	2.1038	0.2506	0.3066
1961-1965	0.0802	...	0.0430	0.6538	2.9285	...	-1.3178	0.1362	0.3395	0.2648
1966-1970	0.0005	...	-0.0951	1.9729	0.2392	...	-0.7670	1.2069	0.3365	0.2795
1971-1975	0.1084	...	0.0679	-0.1603	0.1448	...	0.4864	-0.8637	0.3253	0.3091
1976-1980	0.1512	...	0.1617	-1.6530	-0.9142	...	2.5029	-2.6093	0.3633	0.3089
1981-1985	0.1346	...	-0.0157	4.0958	0.7396	...	-0.9654	2.5206	0.3839	0.3192
1986-1990	0.0685	...	-0.1204	3.6428	-0.1311	...	-1.2199	2.7402	0.3031	0.2816
1991-1995	0.0979	...	0.0984	1.0868	0.4577	...	1.2873	0.3929	0.3260	0.2592
1996-2000	0.0277	...	-0.0799	1.2371	-0.6685	...	1.1222	0.5488	0.4133	0.2524
2001-2005	0.0936	...	0.0136	0.5555	0.3299	...	1.0432	0.1423	0.4408	0.2946
2006-2010	0.0886	...	-0.0953	0.2560	0.1512	...	0.7160	-0.0987	0.4793	0.2784

Period	$\rho_M(\hat{\gamma_1})$	$\rho_0(\hat{\gamma_2})$	$\rho_0(\hat{\gamma_3})$	$t(\bar{\hat{\gamma_0}})$	$t(\bar{\hat{\gamma_1}})$	$t(\bar{\hat{\gamma_2}})$	$t(\bar{\hat{\gamma_3}})$	$t(\gamma_0 \bar{\hat{-}}_{R_f})$	$\bar{r^2}$	$s(r^2)$
2011-2015	-0.1180	...	0.0550	2.3098	-0.2260	...	-0.2311	2.3055	0.4258	0.3424
2016-2022	-0.1161	...	-0.1334	1.8003	1.0445	...	-0.6843	1.5609	0.4408	0.3494

Table 3 Panel(D):Summary Results for the Regression

Period	$\bar{\hat{\gamma_0}}$	$\bar{\hat{\gamma_1}}$	$\bar{\hat{\gamma_2}}$	$\bar{\hat{\gamma_3}}$	$\gamma_0 \bar{\hat{-}}_{R_f}$	$s(\hat{\gamma_0})$	$s(\hat{\gamma_1})$	$s(\hat{\gamma_2})$	$s(\hat{\gamma_3})$	$\rho_0(\gamma_0 \hat{-} R_f)$
Panel D:										
1935-2022	0.0024	0.0102	-0.0037	0.0488	-0.0004	0.0765	0.1565	0.0744	0.9076	0.0242
1935-1945	-0.0042	0.0209	-0.0031	0.0683	-0.0044	0.1202	0.2513	0.1298	0.8726	-0.1615
1946-1955	-0.0009	0.0221	-0.0095	0.0107	-0.0018	0.0491	0.0948	0.0372	0.8351	0.0554
1956-1965	0.0035	0.0132	-0.0041	-0.0062	0.0011	0.0633	0.1232	0.0587	0.9824	0.2750
1966-1975	-0.0015	0.0100	-0.0056	0.0577	-0.0061	0.1104	0.1925	0.1017	1.1981	0.0106
1976-1985	0.0032	0.0051	-0.0019	0.1464	-0.0040	0.0863	0.1880	0.0725	1.2442	0.2624
1986-1995	0.0099	0.0053	-0.0030	0.0037	0.0054	0.0619	0.1370	0.0658	0.7332	0.0473
1996-2005	0.0063	-0.0036	0.0016	0.1025	0.0033	0.0469	0.1013	0.0499	0.7146	0.0448
2006-2015	0.0047	0.0054	-0.0030	0.0201	0.0037	0.0535	0.1368	0.0526	0.6878	0.0741
2016-2022	0.0005	0.0131	-0.0050	0.0277	-0.0003	0.0349	0.0643	0.0238	0.6294	0.0759
1935-1940	-0.0105	0.0314	-0.0064	-0.0023	-0.0106	0.1501	0.3262	0.1669	0.9325	-0.1698
1941-1945	0.0033	0.0083	0.0008	0.1531	0.0031	0.0699	0.1089	0.0623	0.7941	-0.1102
1946-1950	-0.0024	0.0153	-0.0064	0.0424	-0.0031	0.0564	0.1011	0.0371	0.9193	0.1213
1951-1955	0.0007	0.0288	-0.0127	-0.0211	-0.0006	0.0410	0.0885	0.0373	0.7481	-0.0536
1956-1960	0.0059	-0.0004	-0.0055	0.1599	0.0038	0.0488	0.0905	0.0426	1.0542	0.0680
1961-1965	0.0010	0.0267	-0.0026	-0.1723	-0.0015	0.0755	0.1485	0.0717	0.8827	0.3558
1966-1970	0.0001	0.0173	-0.0096	0.0024	-0.0044	0.1091	0.1821	0.0878	1.2603	-0.0303
1971-1975	-0.0030	0.0026	-0.0017	0.1131	-0.0077	0.1126	0.2035	0.1145	1.1403	0.0466
1976-1980	-0.0108	-0.0043	-0.0003	0.4157	-0.0171	0.0990	0.2019	0.0860	1.2314	0.2908
1981-1985	0.0172	0.0145	-0.0035	-0.1229	0.0090	0.0693	0.1743	0.0566	1.2076	0.1539

Period	$\bar{\hat{\gamma_0}}$	$\bar{\hat{\gamma_1}}$	$\bar{\hat{\gamma_2}}$	$\bar{\hat{\gamma_3}}$	$\gamma_0 \bar{\hat{-}}_{R_f}$	$s(\hat{\gamma_0})$	$s(\hat{\gamma_1})$	$s(\hat{\gamma_2})$	$s(\hat{\gamma_3})$	$\rho_0(\gamma_0 \hat{-} R_f)$
1986-1990	0.0106	0.0147	-0.0118	-0.0611	0.0051	0.0683	0.1633	0.0656	0.8689	-0.0274
1991-1995	0.0092	-0.0040	0.0058	0.0684	0.0057	0.0554	0.1048	0.0654	0.5664	0.1226
1996-2000	0.0069	-0.0054	-0.0004	0.1414	0.0027	0.0540	0.1086	0.0497	0.8478	0.0697
2001-2005	0.0056	-0.0019	0.0037	0.0637	0.0039	0.0389	0.0944	0.0504	0.5551	-0.0025
2006-2010	0.0023	-0.0018	0.0015	0.0914	0.0005	0.0625	0.1657	0.0651	0.7265	0.0363
2011-2015	0.0070	0.0125	-0.0074	-0.0513	0.0070	0.0430	0.1009	0.0361	0.6449	0.1278
2016-2022	0.0005	0.0131	-0.0050	0.0277	-0.0003	0.0349	0.0643	0.0238	0.6294	0.0759

Table 3 Panel(D):Continue...

Period	$\rho_M(\hat{\gamma_1})$	$\rho_0(\hat{\gamma_2})$	$\rho_0(\hat{\gamma_3})$	$t(\bar{\hat{\gamma_0}})$	$t(\bar{\hat{\gamma_1}})$	$t(\bar{\hat{\gamma_2}})$	$t(\bar{\hat{\gamma_3}})$	$t(\gamma_0 \bar{\hat{-}}_{R_f})$	$\bar{r^2}$	$s(r^2)$
Panel D:										
1935-2022	0.0265	-0.0689	0.0062	1.0057	2.1113	-1.6047	1.7471	-0.1636	0.3966	0.3100
1935-1945	-0.0778	-0.2061	-0.0780	-0.4049	0.9538	-0.2750	0.8997	-0.4186	0.3057	0.3110
1946-1955	0.0127	0.0171	-0.0927	-0.1949	2.5506	-2.8067	0.1398	-0.4054	0.3641	0.3225
1956-1965	0.1906	0.1128	0.1666	0.5968	1.1712	-0.7571	-0.0689	0.1953	0.3256	0.3001
1966-1975	-0.0086	-0.0921	-0.0083	-0.1487	0.5672	-0.6051	0.5278	-0.6019	0.3715	0.2949
1976-1985	0.1803	0.1626	0.0742	0.4060	0.2957	-0.2812	1.2886	-0.5158	0.4313	0.3161
1986-1995	0.0653	0.0159	-0.0076	1.7528	0.4277	-0.5018	0.0548	0.9556	0.3468	0.2725
1996-2005	0.0227	-0.0648	-0.1000	1.4639	-0.3940	0.3590	1.5717	0.7669	0.4626	0.2721
2006-2015	0.0539	0.1241	-0.0715	0.9560	0.4299	-0.6177	0.3194	0.7628	0.5173	0.3048
2016-2022	-0.1862	-0.1005	-0.0998	0.1413	1.8712	-1.9203	0.4040	-0.0724	0.4775	0.3386
1935-1940	-0.0726	-0.2049	-0.1833	-0.5961	0.8155	-0.3245	-0.0210	-0.6005	0.2349	0.3014
1941-1945	-0.1333	-0.1768	0.0758	0.3692	0.5883	0.1024	1.4933	0.3448	0.3906	0.3033
1946-1950	0.0891	0.1336	0.0092	-0.3325	1.1733	-1.3289	0.3571	-0.4232	0.4297	0.3324
1951-1955	-0.1282	-0.1224	-0.1883	0.1271	2.5254	-2.6353	-0.2181	-0.1043	0.2986	0.3009

Period	$\rho_M(\hat{\gamma}_1)$	$\rho_0(\hat{\gamma}_2)$	$\rho_0(\hat{\gamma}_3)$	$t(\bar{\hat{\gamma}_0})$	$t(\bar{\hat{\gamma}_1})$	$t(\bar{\hat{\gamma}_2})$	$t(\bar{\hat{\gamma}_3})$	$t(\bar{\gamma_0 - R_f})$	$\bar{r^2}$	$s(r^2)$
1956-1960	0.0365	-0.0141	0.2682	0.9311	-0.0314	-1.0055	1.1753	0.5962	0.2750	0.3135
1961-1965	0.2361	0.1565	0.0140	0.1061	1.3935	-0.2800	-1.5119	-0.1532	0.3762	0.2795
1966-1970	0.0467	-0.0491	-0.0591	0.0036	0.7363	-0.8438	0.0145	-0.3116	0.3709	0.2766
1971-1975	-0.0370	-0.1021	0.0544	-0.2097	0.0996	-0.1130	0.7682	-0.5325	0.3720	0.3144
1976-1980	0.1120	0.1285	0.0200	-0.8470	-0.1660	-0.0238	2.6147	-1.3434	0.4442	0.3126
1981-1985	0.2819	0.2474	0.0321	1.9253	0.6435	-0.4734	-0.7886	1.0127	0.4183	0.3218
1986-1990	0.0493	-0.0345	-0.0629	1.2054	0.6953	-1.3920	-0.5445	0.5803	0.3398	0.2901
1991-1995	0.0536	0.0033	0.0881	1.2846	-0.2928	0.6815	0.9356	0.7944	0.3537	0.2560
1996-2000	0.1484	0.1181	-0.1657	0.9866	-0.3857	-0.0616	1.2917	0.3837	0.4389	0.2612
2001-2005	-0.0968	-0.1695	0.0549	1.1248	-0.1545	0.5628	0.8886	0.7717	0.4864	0.2828
2006-2010	0.0952	0.1202	-0.1900	0.2864	-0.0837	0.1726	0.9741	0.0581	0.5363	0.2834
2011-2015	-0.1147	0.0647	0.0417	1.2660	0.9611	-1.5849	-0.6157	1.2628	0.4982	0.3261
2016-2022	-0.1862	-0.1005	-0.0998	0.1413	1.8712	-1.9203	0.4040	-0.0724	0.4775	0.3386

Analysis of replication result of Table 3

The above table 3 presents the replication results of the Table 3 in the original paper. The results are presented into the subgroups. The first row is the result about the whole sample period. The following 9 rows are longer periods with 10 years (except the last one from 2016 to 2022). The following 22 rows are five-year periods (except the last one also from 2016 to 2022). Since each regression results related to 32 periods in total, we present the panel results in separate tables.

When comparing the statistics with the original paper covering the same period, we could see that the results are quite similar, which is evidence of the validity of our replication.

If the CAPM model is valid, then we have the following three empirical implication, according to the Fama and MacBeth (1973).

C1: the relationship between expected return of the stock is linear relationship with market portfolio return, i.e., γ_2=0

C2: the only risk measure is from beta. No other risk measures, i.e., γ_3=0

C3: higher risk is related to higher return.

For C1, in general, the results in panel B and panel D do not reject C1. In Panel B, there are only two periods that have $t(\bar{\hat{\gamma}_2})$ larger than 2. One covers 1951 – 1955, same as the paper. The other is 2016 – 2022. In general, the linear relationship between the expected returns and β holds for the sample period.

For C2, the results in panel C and panel D also could not reject C2. All $t(\bar{\hat{\gamma}_3})$ expected period between 1976 and 1980 are less than 2. This suggests that the CAPM model works fine in our sample period: there are no other risk measures, except β, that would systematically affect the expected returns. The time period of

1976 to 1980 cover the crude oil crisis in US history, and that may be the reason why the idiosyncratic risks also significant in the regression.

For C3, the results in four panels provide some insights about the model. If the CAPM is true, then the price of the beta should be significant and positive. However, in the results table, the number of significance is roughly half. The good news is that all values are positive. More importantly, for the whole sample period, $t(\bar{\hat{\gamma}_1})$ are all significant.

To test of the market efficiency theory, we resort to the time behavior of the γ_1, γ_2, and γ_3. Specifically, we focus on the $\rho_M(\hat{\gamma_1})$, $\rho_0(\hat{\gamma_2})$, and $\rho_0(\hat{\gamma_3})$. What we find is that, in most periods, the magnitudes of the autocorrelation is quite small. Specifically, for the years between 1976 and 1986 and years between 2006 and 2010 are much higher (between 0.25 to 0.32).

In summary, the CAPM model generally holds for all those years. However, the Market Efficiency Hypothesis is not always holds.

Table 4: The Behaviour of the Market

STATISTIC*										
Period	$\bar{R_m}$	$\bar{R_m - R_f}$	$\bar{\hat{\gamma}_1}$	$\bar{\hat{\gamma}_0}$	$\bar{R_f}$	$\frac{\bar{R_m - R_f}}{s(R_m)}$	$\frac{\bar{\hat{\gamma}_1}}{s(R_m)}$	$s(_{R_m})$	$s(\gamma_1)$	$s(\gamma_0)$
1935-2022	0.0127	0.0100	0.0057	0.0069	0.0027	0.1440	0.0826	0.0695	0.061	0.034
1935-1945	0.0196	0.0194	0.0170	-0.0048	0.0001	0.2207	0.1926	0.0881	0.1	0.051
1946-1955	0.0114	0.0105	0.0208	0.0068	0.0009	0.2422	0.4807	0.0433	0.041	0.026
1956-1965	0.0114	0.0091	0.0030	0.0051	0.0023	0.2403	0.0794	0.0377	0.041	0.029
1966-1975	0.0068	0.0023	0.0021	0.0128	0.0046	0.0349	0.0318	0.0651	0.062	0.038
1976-1985	0.0207	0.0135	-0.0061	0.0152	0.0072	0.2593	-0.1175	0.0521	0.058	0.033
1986-1995	0.0127	0.0081	0.0152	-0.0012	0.0045	0.1774	0.3320	0.0459	0.054	0.036
1996-2005	0.0128	0.0098	-0.0019	0.0084	0.0030	0.2388	-0.0456	0.0411	0.049	0.03
2006-2015	0.0078	0.0068	0.0055	0.0014	0.0009	0.1257	0.1011	0.0544	0.058	0.027
2016-2022	0.0088	0.0080	0.0207	0.0013	0.0008	0.1365	0.3529	0.0585	0.054	0.025
1935-1940	0.0134	0.0133	0.0170	-0.0048	0.0001	0.1240	0.1585	0.1071	0.123	0.062
1941-1945	0.0271	0.0269	0.0208	0.0068	0.0002	0.4651	0.3605	0.0577	0.065	0.031
1946-1950	0.0079	0.0072	0.0030	0.0051	0.0007	0.1392	0.0576	0.0519	0.047	0.03
1951-1955	0.0150	0.0137	0.0021	0.0128	0.0012	0.4218	0.0636	0.0326	0.034	0.019
1956-1960	0.0092	0.0071	-0.0061	0.0152	0.0021	0.2089	-0.1803	0.0339	0.035	0.021
1961-1965	0.0135	0.0110	0.0152	-0.0012	0.0025	0.2671	0.3691	0.0412	0.044	0.034
1966-1970	0.0091	0.0046	-0.0019	0.0084	0.0044	0.0784	-0.0316	0.0593	0.056	0.039
1971-1975	0.0046	-0.0001	0.0055	0.0014	0.0047	-0.0014	0.0776	0.0708	0.069	0.038
1976-1980	0.0240	0.0177	0.0207	0.0013	0.0063	0.3084	0.3590	0.0575	0.064	0.031
1981-1985	0.0175	0.0093	-0.0001	0.0172	0.0082	0.2004	-0.0029	0.0462	0.05	0.033
1986-1990	0.0081	0.0026	-0.0106	0.0183	0.0055	0.0463	-0.1886	0.0561	0.053	0.036

STATISTIC*										
1991-1995	0.0172	0.0137	0.0106	0.0065	0.0035	0.4212	0.3277	0.0325	0.053	0.034
1996-2000	0.0114	0.0072	0.0021	0.0109	0.0042	0.1762	0.0514	0.0410	0.047	0.033
2001-2005	0.0142	0.0124	0.0088	0.0052	0.0018	0.2986	0.2113	0.0416	0.05	0.028
2006-2010	0.0095	0.0077	0.0057	0.0036	0.0018	0.1156	0.0856	0.0666	0.065	0.028
2011-2015	0.0060	0.0060	-0.0029	0.0101	0.0000	0.1532	-0.0735	0.0390	0.049	0.024
2016-2022	0.0088	0.0080	0.0055	0.0047	0.0008	0.1365	0.0940	0.0585	0.054	0.025

Table 4: Continue...

Period	$s(R_f)$	$t(\bar{R_m})$	$t(\bar{R_m - R_f})$	$t(\bar{\hat{\gamma_1}})$	$t(\bar{\hat{\gamma_0}})$	$\rho_m(R_m)$	$\rho_m(R_m - R_f)$	$\rho_m(\hat{\gamma_1})$	$\rho_m(\hat{\gamma_0})$	$\rho_m(R_f)$
1935-2022	0.0025	6.19	4.88	3.07	6.62	0.19	0.19	0.09	0.09	0.97
1935-1945	0.0002	2.55	2.54	2.14	0.11	-0.06	-0.06	-0.04	0.05	0.63
1946-1955	0.0004	2.89	2.65	0.68	3.84	0.08	0.08	0.07	0.1	0.87
1956-1965	0.0007	3.31	2.63	1.21	2.64	0.12	0.13	0.2	0.36	0.74
1966-1975	0.0012	1.15	0.38	0.32	1.4	0.17	0.18	0.1	0.12	0.83
1976-1985	0.0025	4.36	2.81	1.94	3.08	0.11	0.13	0.23	0.14	0.9
1986-1995	0.0014	3.02	1.94	0.01	3.79	0.22	0.22	0.3	0.02	0.92
1996-2005	0.0015	3.41	2.61	1.22	2.89	0.18	0.19	0.1	-0.06	0.96
2006-2015	0.0015	1.56	1.38	0.27	2.82	0.21	0.21	0.16	0.07	0.98
2016-2022	0.0008	1.38	1.25	0.94	1.69	-0.06	-0.06	-0.07	-0.02	0.89
1935-1940	0.0002	1.06	1.05	1.17	-0.65	-0.12	-0.12	-0.09	-0.01	0.43
1941-1945	0.0001	3.63	3.61	2.46	1.67	0.15	0.15	0.15	0.25	0.67
1946-1950	0.0003	1.18	1.08	0.49	1.32	0.08	0.08	0.03	0.17	0.88
1951-1955	0.0004	3.56	3.25	0.47	5.13	-0.02	-0.02	0.1	-0.04	0.74
1956-1960	0.0007	2.1	1.61	-1.37	5.67	0.11	0.13	0.16	0.14	0.66
1961-1965	0.0006	2.54	2.07	2.65	-0.27	0.11	0.11	0.15	0.36	0.81
1966-1970	0.0009	1.19	0.6	-0.26	1.67	0.21	0.22	0.14	0.14	0.84
1971-1975	0.0014	0.5	-0.01	0.62	0.28	0.12	0.12	0.06	0.11	0.83
1976-1980	0.0024	3.23	2.38	2.52	0.33	0.04	0.04	0.19	0.16	0.83

Period	$s(R_f)$	$t(\bar{R_m})$	$t(\bar{R_m - R_f})$	$t(\bar{\hat{\gamma_1}})$	$t(\bar{\hat{\gamma_0}})$	$\rho_m(R_m)$	$\rho_m(R_m - R_f)$	$\rho_m(\hat{\gamma_1})$	$\rho_m(\hat{\gamma_0})$	$\rho_m(R_f)$
1981-1985	0.0022	2.93	1.53	-0.02	4.02	0.21	0.24	0.22	0.04	0.88
1986-1990	0.0011	1.12	0.36	-1.54	3.89	0.21	0.21	0.31	-0.1	0.79
1991-1995	0.001	4.1	3.28	1.56	1.46	0.22	0.22	0.24	0.13	0.87
1996-2000	0.0005	2.16	1.36	0.34	2.56	0.13	0.14	0.11	0.02	0.49
2001-2005	0.0011	2.64	2.31	1.35	1.44	0.18	0.19	0.07	-0.05	0.84
2006-2010	0.0018	1.11	0.89	0.68	0.98	0.31	0.32	0.26	0.04	0.97
2011-2015	0	1.19	1.19	-0.45	3.19	-0.1	-0.1	-0.02	0.03	0.48
2016-2022	0.0008	1.38	1.25	0.94	1.69	-0.06	-0.06	-0.07	-0.02	0.89

Analysis of replication result of Table 4

The Table 4 in the original paper is about the analysis of the behavior of the market. Comparing the replication results with the original paper when the periods are the same, most of the statistics are quite similar. This suggests that the replication is quite successful.

If CAPM is valid, then $E(\gamma_0) = E(R_0)$, where $E(R_0)$ is the expected return of zero-beta portfolio. Besides, the excess return of the market portfolio is equal to the expectation of γ_1. Specifically, the zero-beta portfolio is a risk-free asset when applicable. However, in the table 4, we could see that in the majority of time periods, γ_0 is larger than risk-free rate. The only exception is in the period of 1970s, during which America economy experienced an economy with high inflation and high unemployment rate.

The risk premium of the market portfolio is 1% for the whole sample period. The periods during which the risk premium is substantially larger than the average level are related to the bubble periods. For example, the period 1941 to 1945 corresponds to the World War II. Between 1976 and 1985 is just before the Black Monday in 1987.

Another pattern which is also observed in the Table 4 is that both the values of $\bar{R_m - R_f}$ and $\bar{\hat{\gamma_1}}$ decline from the pre-crisis period to post-crisis. On the other hand, the Sharpe ratio of the market portfolio becomes relatively stable occasionally. It would climb to a relatively high level before bubble or crisis (such as 0.465 in years 1941 to 1945 and 0.422 for years between 1951 to 1955). For other time, the value is roughly around 0.14.

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