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Group

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1 Covariances

Ticker	Company	Industry group
CSCO	Cisco	Technology Hardware and Equipment
FDX	FedEx Corporation	Transportation
GOOG	A	B
JPM	JP Morgan	Banks
KO	The Coca-Cola Company	Food, Beverage and Tobacco
NEM	Newmont Mining Corporation	Materials
PFE	Pfizer	Pharmaceuticals, Biotechnology and Life Sciences
PSX	A	B

Table 1: Choice of stocks

	CSCO	FDX	GOOG	JPM	KO	NEM	PFE	PSX
CSCO	0.0446	0.0226	0.0230	0.0225	0.0097	0.0069	0.0152	0.0201
FDX	0.0226	0.0499	0.0210	0.0251	0.0106	0.0036	0.0153	0.0220
GOOG	0.0230	0.0210	0.0550	0.0205	0.0086	0.0033	0.0147	0.0204
JPM	0.0225	0.0251	0.0205	0.0434	0.0085	-0.0008	0.0169	0.0245
KO	0.0097	0.0106	0.0086	0.0085	0.0187	0.0056	0.0078	0.0085
NEM	0.0069	0.0036	0.0033	-0.0008	0.0056	0.1421	0.0032	0.0117
PFE	0.0152	0.0153	0.0147	0.0169	0.0078	0.0032	0.0305	0.0145
PSX	0.0201	0.0220	0.0204	0.0245	0.0085	0.0117	0.0145	0.0588

Table 2: Covariance

	CSCO	FDX	GOOG	JPM	KO	NEM	PFE	PSX
CSCO	0.0446	0.0221	0.0241	0.0227	0.0101	0.0062	0.0160	0.0219
FDX	0.0221	0.0500	0.0225	0.0255	0.0098	0.0069	0.0158	0.0235
GOOG	0.0241	0.0225	0.0551	0.0205	0.0106	0.0057	0.0174	0.0216
JPM	0.0227	0.0255	0.0205	0.0434	0.0109	0.0083	0.0162	0.0269
KO	0.0101	0.0098	0.0106	0.0109	0.0187	0.0027	0.0073	0.0100
NEM	0.0062	0.0069	0.0057	0.0083	0.0027	0.1425	0.0044	0.0072
PFE	0.0160	0.0158	0.0174	0.0162	0.0073	0.0044	0.0305	0.0157
PSX	0.0219	0.0235	0.0216	0.0269	0.0100	0.0072	0.0157	0.0589

Table 3: Covariance obtained by FF

	CSCO	FDX	GOOG	JPM	KO	NEM	PFE	PSX
CSCO	0.0446	0.0222	0.0231	0.0233	0.0095	0.0064	0.0156	0.0222
FDX	0.0222	0.0499	0.0236	0.0239	0.0097	0.0066	0.0159	0.0228
GOOG	0.0231	0.0236	0.0550	0.0248	0.0101	0.0068	0.0165	0.0236
JPM	0.0233	0.0239	0.0248	0.0434	0.0102	0.0069	0.0167	0.0239
KO	0.0095	0.0097	0.0101	0.0102	0.0187	0.0028	0.0068	0.0097
NEM	0.0064	0.0066	0.0068	0.0069	0.0028	0.1422	0.0046	0.0066
PFE	0.0156	0.0159	0.0165	0.0167	0.0068	0.0046	0.0305	0.0159
PSX	0.0222	0.0228	0.0236	0.0239	0.0097	0.0066	0.0159	0.0589

Table 4: Covariance obtained by CAPM

2 Portfolios

	GMV	TAN	GMVFF	TANFF	GMVCAPM	TANCAPM
CSCO	0.0299	0.5523	0.0448	0.6011	0.0505	0.6000
FDX	0.0086	-0.4388	0.0400	-0.4477	0.0311	-0.4171
GOOG	0.0528	0.1468	0.0102	0.1400	0.0125	0.1485
JPM	0.0684	0.3672	0.0028	0.4060	0.0128	0.2764
KO	0.5364	0.2027	0.5623	0.1529	0.5580	0.2072
NEM	0.0655	0.0805	0.0726	0.0677	0.0703	0.0643
PFE	0.2072	0.2989	0.2390	0.3389	0.2412	0.3533
PSX	0.0312	-0.2096	0.0282	-0.2589	0.0236	-0.2327
Mean	0.0880	0.1968	0.0829	0.2072	0.0848	0.1978
StDev	0.1171	0.1783	0.1173	0.1894	0.1164	0.1813

Table 5: Portfolios

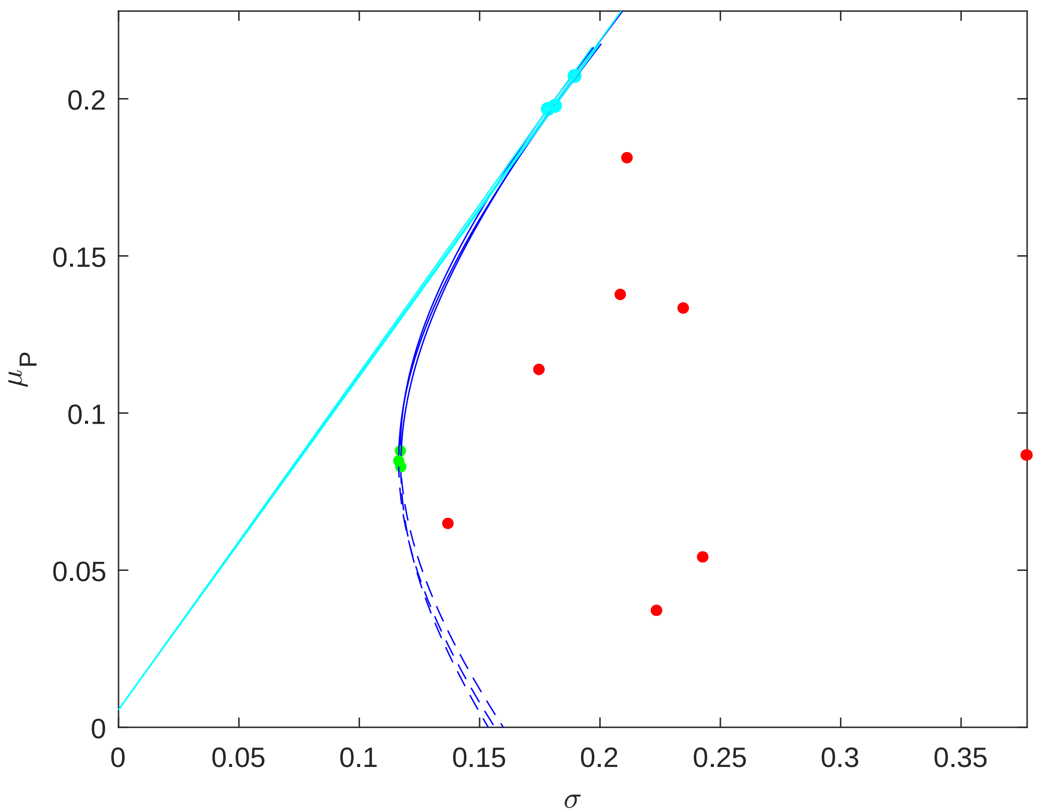

Figure 1: Efficient frontier with restrictions

3 CAPM test

Ticker	β
CSCO	1.0887
FDX	1.1160
GOOG	1.1567
JPM	1.1696
KO	0.4752
NEM	0.3227
PFE	0.7805
PSX	1.1156

Table 6: Betas

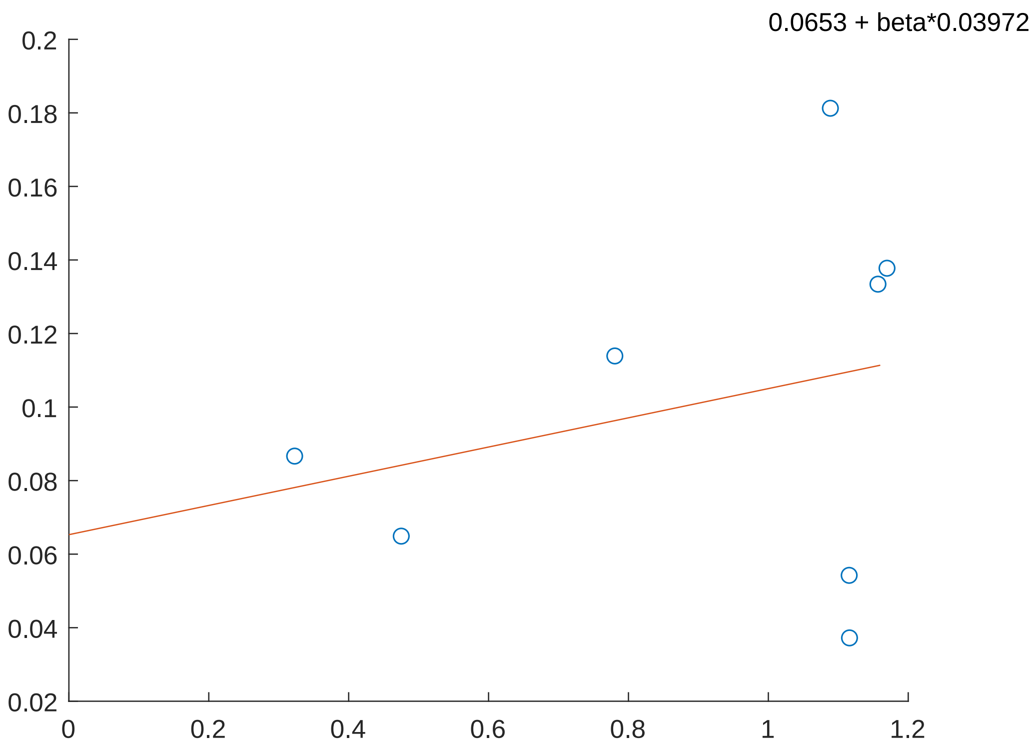

Figure 2: CAPM test

4 Fama French interpretation

Ticker	β	SMB	HML
CSCO	1.1015	-0.2499	-0.1484
FDX	1.1321	0.0079	0.2454
GOOG	1.1373	-0.3325	-0.7304
JPM	1.2443	-0.0839	0.9782
KO	0.5144	-0.4199	0.0091
NEM	0.3313	0.0747	0.2253
PFE	0.7921	-0.2199	-0.1253
PSX	1.1474	-0.0043	0.4596

Table 7: FF loadings

Variable	σ^2	σ	$\sigma^2_{\epsilon,P}$	$\sigma_{\epsilon,P}$	$\beta^2\sigma^2_M$	$\beta\sigma_M$	$\bar{\sigma}_\epsilon$
	0.0198	0.1406	0.0048	0.0695	0.0149	0.1222	0.1966

Table 8: Risk components

5 Running beta

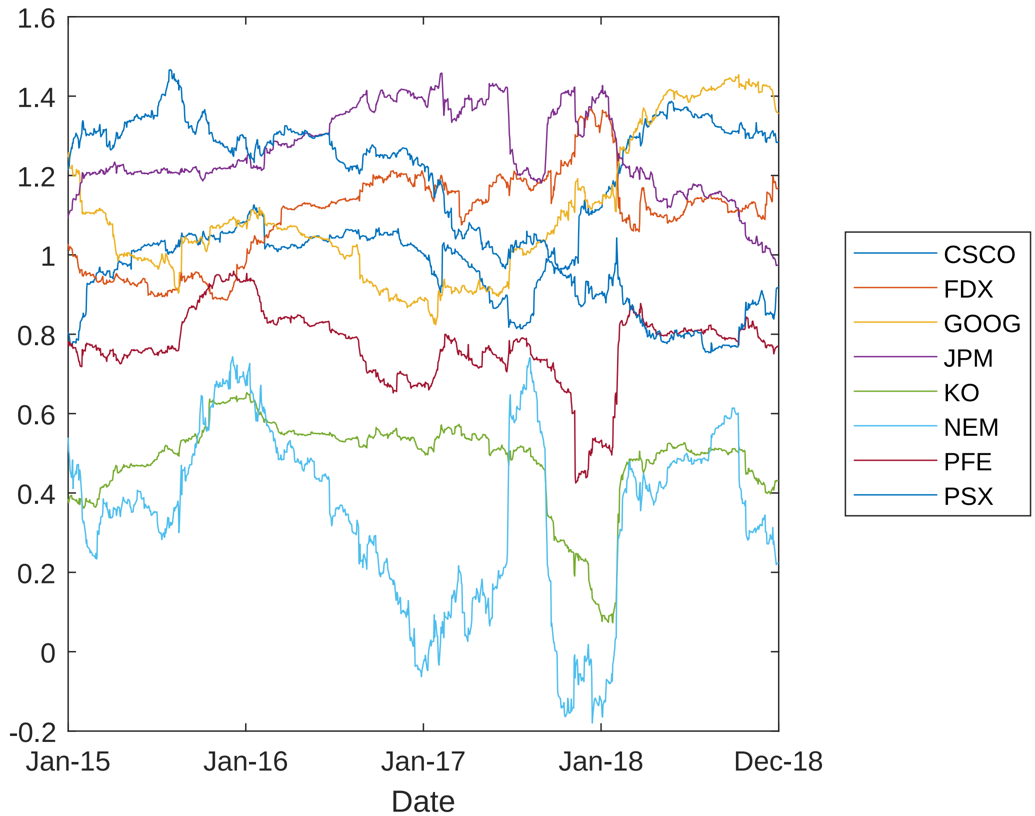

Figure 3: Running beta

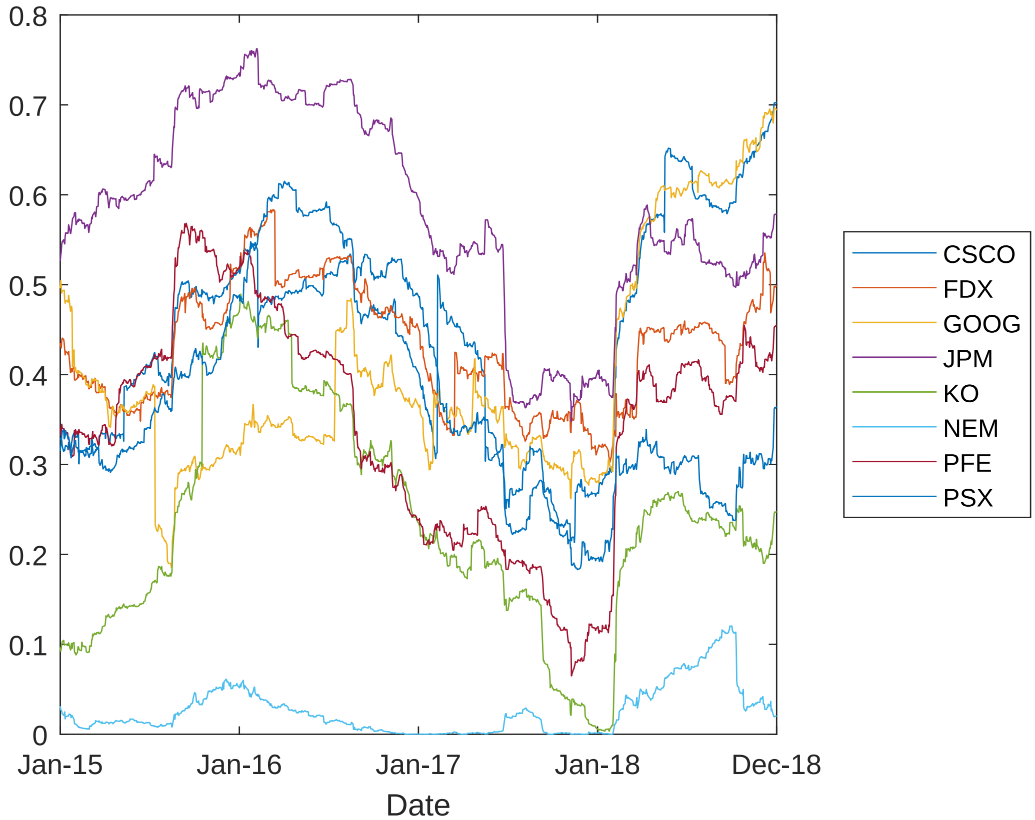
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-15
Jan-16
Jan-17
Jan-18
Dec-18
Date
CSCO
FDX
GOOG
JPM
KO
NEM
PFE
PSX

Figure 4: R^2