BENCHMARK ALLOCATION

Risk and Asset Allocation **- Springer – *symmys.com***

Attilio Meucci

www.symmys.com

Formulas and figures in this presentation refer to the book **Risk and Asset Allocation**, Springer.

The notation, say, (5.24) refers to Formula 24 in Chapter 5 of the book

The notation, say, (T4.12) refers to Formula 12 in the Technical Appendices for Chapter 4, which can be downloaded from www.symmys.com

BENCHMARK ALLOCATION

Risk and Asset Allocation **- Springer –** *symmys.com*

total-return allocation

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{H}}\left(\mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\}, \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\}\right) \quad (6.173)$$

BENCHMARK ALLOCATION

***Risk and Asset Allocation* - Springer – `symmys.com`**

total-return allocation

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{H}}\left(\mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\}, \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\}\right) \quad (6.173)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

BENCHMARK ALLOCATION

Risk and Asset Allocation - Springer – `symmys.com`

total-return allocation

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}'\mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{H}}\left(\mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\}, \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\}\right) \quad (6.173)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$\boxed{\widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + \left[e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}\right] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}}} \quad (6.175)$$

$$\boldsymbol{\alpha}_{SR} \overset{(6.177)}{=} \frac{w \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T' \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}$$

$$\boldsymbol{\alpha}_{MV} \overset{(6.176)}{\equiv} \frac{w \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}{\mathbf{p}_T' \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}$$

BENCHMARK ALLOCATION

Risk and Asset Allocation - Springer – `symmys.com`

total-return allocation

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}'\mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{H}}\left(\mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\}, \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\}\right) \quad (6.173)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$\boxed{\widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + \left[e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}\right] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}}} \quad (6.175)$$

$$\boldsymbol{\alpha}_{SR} \overset{(6.177)}{=} \frac{w \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T' \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}$$

$$\boldsymbol{\alpha}_{MV} \overset{(6.176)}{\equiv} \frac{w \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}{\mathbf{p}_T' \, \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}$$

$$\mathrm{EOP}(\boldsymbol{\alpha}) \equiv \mathrm{E}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.178)$$

$$\mathrm{TE}(\boldsymbol{\alpha}) \equiv \mathrm{Sd}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.179)$$

benchmark allocation

$$\boxed{\Phi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}'\mathbf{P}_{T+\tau} - \gamma\widetilde{\boldsymbol{\beta}}'\mathbf{P}_{T+\tau}} \quad (6.170)$$

$$\gamma \equiv \frac{\boldsymbol{\alpha}'\mathbf{p}_T}{\widetilde{\boldsymbol{\beta}}'\mathbf{p}_T} \quad (6.171)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{K}}\left(\mathrm{EOP}(\boldsymbol{\alpha}), \mathrm{TE}^2(\boldsymbol{\alpha})\right) \quad (6.181)$$

BENCHMARK ALLOCATION

Risk and Asset Allocation - Springer – `symmys.com`

total-return allocation

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{H}}\left(\mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\}, \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\}\right) \quad (6.173)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$\boxed{\widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + \left[e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}\right] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}}} \quad (6.175)$$

$$\boldsymbol{\alpha}_{SR} \overset{(6.177)}{=} \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T' \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}$$

$$\boldsymbol{\alpha}_{MV} \overset{(6.176)}{\equiv} \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}{\mathbf{p}_T' \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}$$

---

benchmark allocation

$$\boxed{\Phi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau} - \gamma \widetilde{\boldsymbol{\beta}}' \mathbf{P}_{T+\tau}} \quad (6.170)$$

$$\gamma \equiv \frac{\boldsymbol{\alpha}' \mathbf{p}_T}{\widetilde{\boldsymbol{\beta}}' \mathbf{p}_T} \quad (6.171)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{K}}\left(\mathrm{EOP}(\boldsymbol{\alpha}), \mathrm{TE}^2(\boldsymbol{\alpha})\right) \quad (6.181)$$

$$\mathrm{EOP}(\boldsymbol{\alpha}) \equiv \mathrm{E}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.178)$$

$$\mathrm{TE}(\boldsymbol{\alpha}) \equiv \mathrm{Sd}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.179)$$

$$\widehat{\boldsymbol{\alpha}}(u) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{TE}^2(\boldsymbol{\alpha}) = u}}{\operatorname{argmax}} \mathrm{EOP}(\boldsymbol{\alpha}) \quad (6.182)$$

BENCHMARK ALLOCATION

Risk and Asset Allocation **- Springer –** `symmys.com`

total-return allocation

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}'\mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{H}}\left(\mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\}, \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\}\right) \quad (6.173)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$\boxed{\widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + \left[e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}\right] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}}} \quad (6.175)$$

$$\boldsymbol{\alpha}_{SR} \overset{(6.177)}{=} \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T' \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}$$

$$\boldsymbol{\alpha}_{MV} \overset{(6.176)}{\equiv} \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}{\mathbf{p}_T' \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}$$

---

benchmark allocation

$$\boxed{\Phi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}'\mathbf{P}_{T+\tau} - \gamma\widetilde{\boldsymbol{\beta}}'\mathbf{P}_{T+\tau}} \quad (6.170)$$

$$\gamma \equiv \frac{\boldsymbol{\alpha}'\mathbf{p}_T}{\widetilde{\boldsymbol{\beta}}'\mathbf{p}_T} \quad (6.171)$$

$$\mathcal{S}(\boldsymbol{\alpha}) \approx \widetilde{\mathcal{K}}\left(\mathrm{EOP}(\boldsymbol{\alpha}), \mathrm{TE}^2(\boldsymbol{\alpha})\right) \quad (6.181)$$

$$\mathrm{EOP}(\boldsymbol{\alpha}) \equiv \mathrm{E}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.178)$$

$$\mathrm{TE}(\boldsymbol{\alpha}) \equiv \mathrm{Sd}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.179)$$

$$\widehat{\boldsymbol{\alpha}}(u) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{TE}^2(\boldsymbol{\alpha}) = u}}{\operatorname{argmax}} \mathrm{EOP}(\boldsymbol{\alpha}) \quad (6.182)$$

$$\boxed{\widehat{\boldsymbol{\alpha}} = \boldsymbol{\beta} + \left[e - \mathrm{E}\{\Psi_{\boldsymbol{\beta}}\}\right] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}}} \quad (6.190)$$

BENCHMARK ALLOCATION

Risk and Asset Allocation - Springer – `symmys.com`

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\boxed{\Phi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau} - \gamma \widetilde{\boldsymbol{\beta}}' \mathbf{P}_{T+\tau}} \quad (6.170)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}' \mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$\boxed{\widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}}} \quad (6.175)$$

$$\boldsymbol{\alpha}_{SR} \overset{(6.177)}{=} \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T' \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}$$

$$\boldsymbol{\alpha}_{MV} \overset{(6.176)}{\equiv} \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}{\mathbf{p}_T' \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}$$

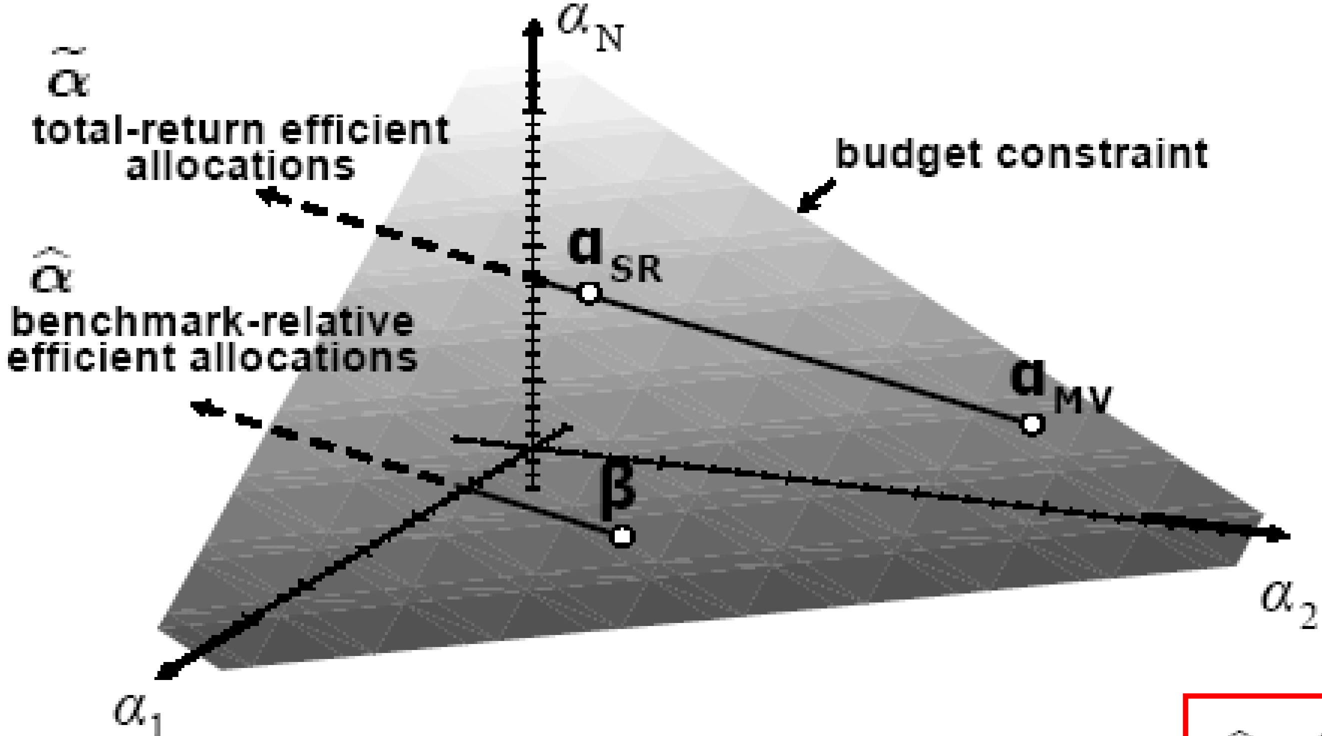

Fig. 6.19

$$\mathrm{EOP}(\boldsymbol{\alpha}) \equiv \mathrm{E}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.178)$$

$$\mathrm{TE}(\boldsymbol{\alpha}) \equiv \mathrm{Sd}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.179)$$

$$\widehat{\boldsymbol{\alpha}}(u) = \underset{\substack{\boldsymbol{\alpha}' \mathbf{p}_T = w \\ \mathrm{TE}^2(\boldsymbol{\alpha}) = u}}{\operatorname{argmax}} \mathrm{EOP}(\boldsymbol{\alpha}) \quad (6.182)$$

$$\boxed{\widehat{\boldsymbol{\alpha}} = \boldsymbol{\beta} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\beta}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}}} \quad (6.190)$$

BENCHMARK ALLOCATION

Risk and Asset Allocation - Springer – `symmys.com`

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}'\mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\boxed{\Phi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}'\mathbf{P}_{T+\tau} - \gamma\widetilde{\boldsymbol{\beta}}'\mathbf{P}_{T+\tau}} \quad (6.170)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$(6.193) \quad \boxed{\widetilde{\boldsymbol{\alpha}}: \quad v = \frac{A}{D}e^2 - \frac{2wB}{D}e + \frac{w^2C}{D}} \Longleftarrow \widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}} \quad (6.175)$$

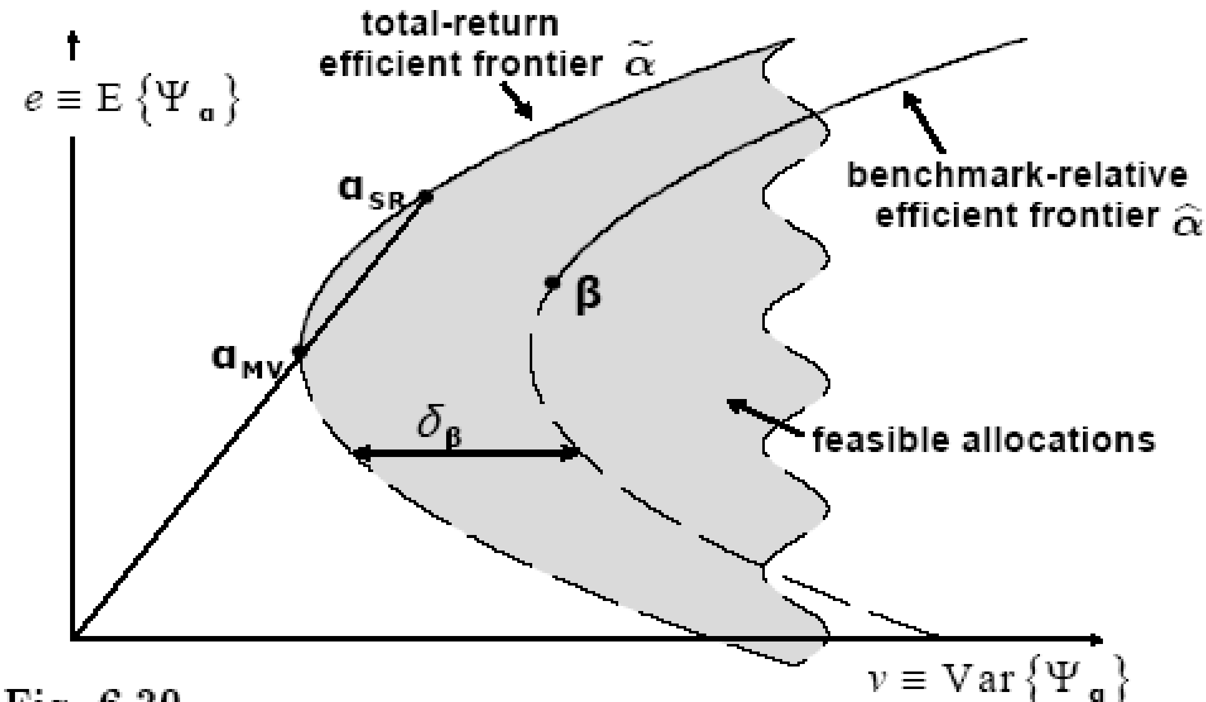

Fig. 6.20.

$$(6.177) \quad \boldsymbol{\alpha}_{SR} = \frac{w\,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1}\mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T'\,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1}\mathrm{E}\{\mathbf{P}_{T+\tau}\}}$$

$$(6.176) \quad \boldsymbol{\alpha}_{MV} \equiv \frac{w\,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1}\mathbf{p}_T}{\mathbf{p}_T'\,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1}\mathbf{p}_T}$$

$$\mathrm{EOP}(\boldsymbol{\alpha}) \equiv \mathrm{E}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.178)$$

$$\mathrm{TE}(\boldsymbol{\alpha}) \equiv \mathrm{Sd}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.179)$$

$$\widehat{\boldsymbol{\alpha}}(u) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{TE}^2(\boldsymbol{\alpha}) = u}}{\operatorname{argmax}} \mathrm{EOP}(\boldsymbol{\alpha}) \quad (6.182)$$

$$(6.195) \quad \boxed{\widehat{\boldsymbol{\alpha}}: \quad v = \frac{A}{D}e^2 - \frac{2wB}{D}e + \frac{w^2C}{D} + \delta_{\beta}} \Longleftarrow \widehat{\boldsymbol{\alpha}} = \boldsymbol{\beta} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\beta}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}} \quad (6.190)$$

BENCHMARK ALLOCATION

***Risk and Asset Allocation* - Springer – `symmys.com`**

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\boxed{\Phi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau} - \gamma \widetilde{\boldsymbol{\beta}}' \mathbf{P}_{T+\tau}} \quad (6.170)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}' \mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$\boxed{\widetilde{\boldsymbol{\alpha}} : \quad u = \frac{A}{D} p^2 + \delta_{\beta}} \quad (6.200) \quad \Longleftarrow \quad \widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}} \quad (6.175)$$

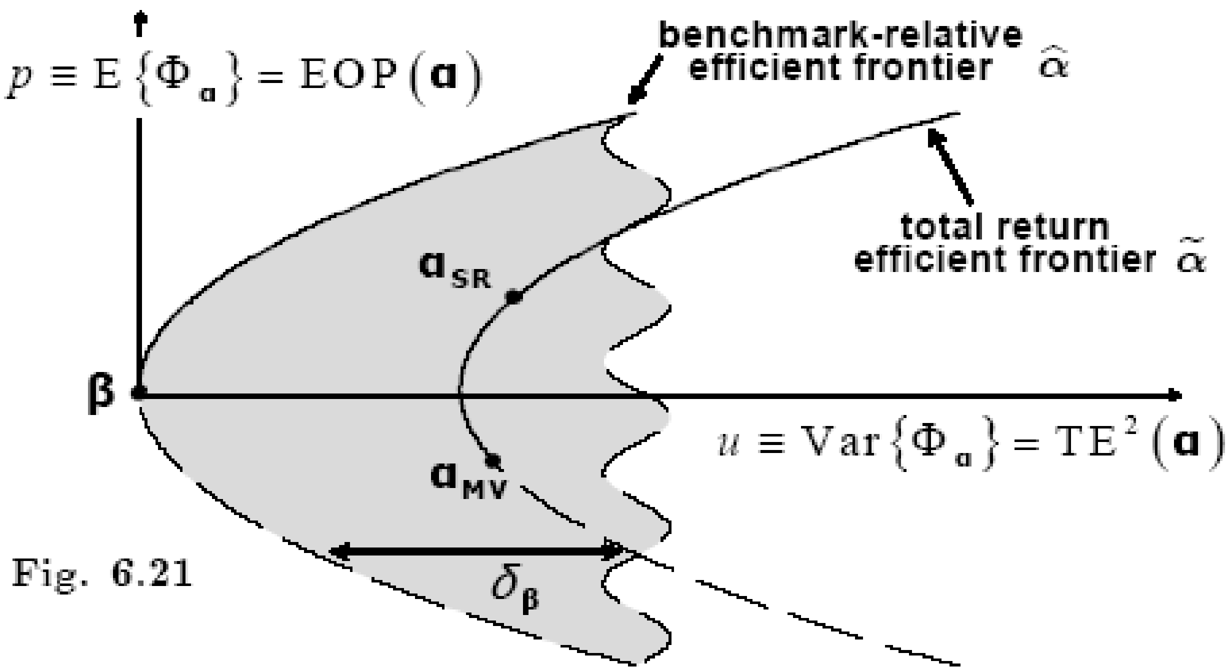

Fig. 6.21

$$\boldsymbol{\alpha}_{SR} = \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T' \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}} \quad (6.177)$$

$$\boldsymbol{\alpha}_{MV} \equiv \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}{\mathbf{p}_T' \mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T} \quad (6.176)$$

$$\mathrm{EOP}(\boldsymbol{\alpha}) \equiv \mathrm{E}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.178)$$

$$\mathrm{TE}(\boldsymbol{\alpha}) \equiv \mathrm{Sd}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.179)$$

$$\widehat{\boldsymbol{\alpha}}(u) = \underset{\substack{\boldsymbol{\alpha}' \mathbf{p}_T = w \\ \mathrm{TE}^2(\boldsymbol{\alpha}) = u}}{\operatorname{argmax}} \mathrm{EOP}(\boldsymbol{\alpha}) \quad (6.182)$$

$$\boxed{\widehat{\boldsymbol{\alpha}} : \quad u = \frac{A}{D} p^2} \quad (6.199) \quad \Longleftarrow \quad \widehat{\boldsymbol{\alpha}} = \boldsymbol{\beta} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\beta}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}} \quad (6.190)$$

BENCHMARK ALLOCATION

***Risk and Asset Allocation* - Springer – `symmys.com`**

$$\boxed{\Psi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau}} \quad (6.169)$$

$$\boxed{\Phi_{\boldsymbol{\alpha}} \equiv \boldsymbol{\alpha}' \mathbf{P}_{T+\tau} - \gamma \widetilde{\boldsymbol{\beta}}' \mathbf{P}_{T+\tau}} \quad (6.170)$$

$$\widetilde{\boldsymbol{\alpha}}(v) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{Var}\{\Psi_{\boldsymbol{\alpha}}\} = v}}{\operatorname{argmax}} \mathrm{E}\{\Psi_{\boldsymbol{\alpha}}\} \quad (6.174)$$

$$(6.200) \quad \widetilde{\boldsymbol{\alpha}}: \quad u = \frac{A}{D} p^2 + \delta_{\boldsymbol{\beta}}. \quad \Longleftarrow \quad \widetilde{\boldsymbol{\alpha}} = \boldsymbol{\alpha}_{MV} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}} \quad (6.175)$$

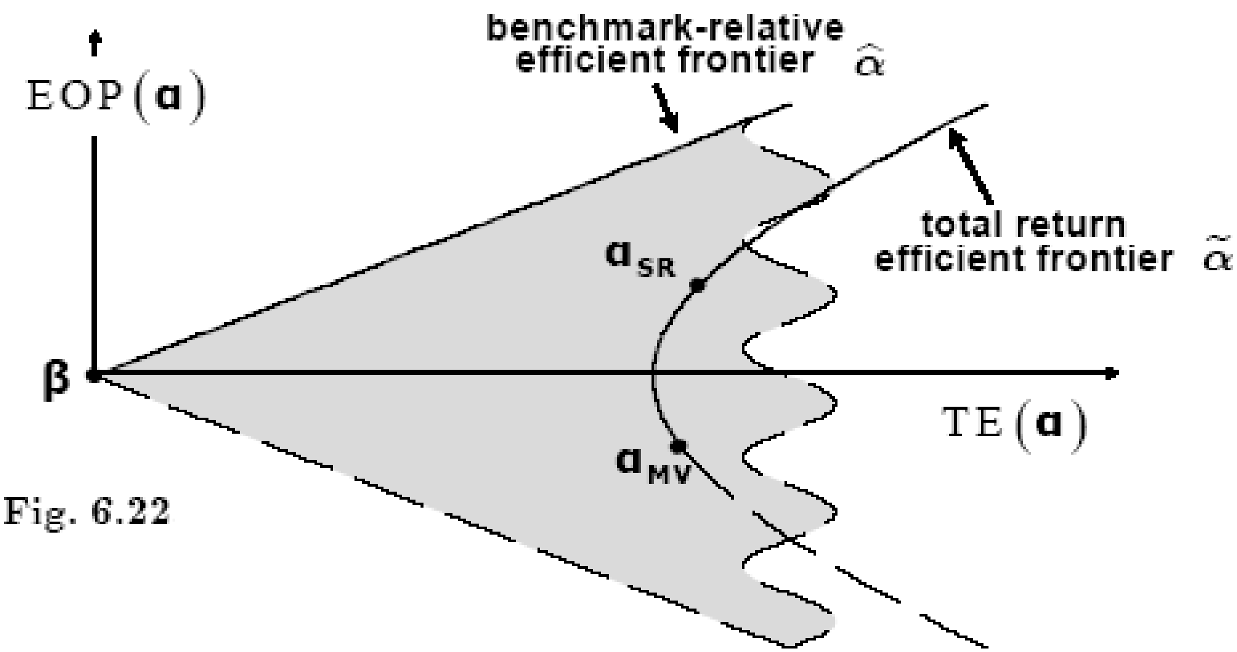

Fig. 6.22

$$(6.177) \quad \boldsymbol{\alpha}_{SR} = \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}{\mathbf{p}_T' \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathrm{E}\{\mathbf{P}_{T+\tau}\}}$$

$$(6.176) \quad \boldsymbol{\alpha}_{MV} \equiv \frac{w \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}{\mathbf{p}_T' \,\mathrm{Cov}\{\mathbf{P}_{T+\tau}\}^{-1} \mathbf{p}_T}$$

$$\mathrm{EOP}(\boldsymbol{\alpha}) \equiv \mathrm{E}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.178)$$

$$\mathrm{TE}(\boldsymbol{\alpha}) \equiv \mathrm{Sd}\{\Phi_{\boldsymbol{\alpha}}\} \quad (6.179)$$

$$\widehat{\boldsymbol{\alpha}}(u) = \underset{\substack{\boldsymbol{\alpha}'\mathbf{p}_T = w \\ \mathrm{TE}^2(\boldsymbol{\alpha}) = u}}{\operatorname{argmax}} \mathrm{EOP}(\boldsymbol{\alpha}) \quad (6.182)$$

$$(6.201) \quad \boxed{\mathrm{EOP}(\widehat{\boldsymbol{\alpha}}) = \sqrt{\frac{D}{A}} \mathrm{TE}(\widehat{\boldsymbol{\alpha}})} \quad \Longleftrightarrow \quad (6.199) \quad \widehat{\boldsymbol{\alpha}}: \quad u = \frac{A}{D} p^2, \quad \Longleftarrow \quad \widehat{\boldsymbol{\alpha}} = \boldsymbol{\beta} + [e - \mathrm{E}\{\Psi_{\boldsymbol{\beta}}\}] \frac{\boldsymbol{\alpha}_{SR} - \boldsymbol{\alpha}_{MV}}{\mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{SR}}\} - \mathrm{E}\{\Psi_{\boldsymbol{\alpha}_{MV}}\}} \quad (6.190)$$