Institutional Stock-Bond Portfolios Rebalancing and Financial Stability

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Research Symposium in Econometrics and Finance, April 2025

Outline

Introduction

Context and Literature

Source : Rattray, Granger, Harvey and Van Hemert (2020)

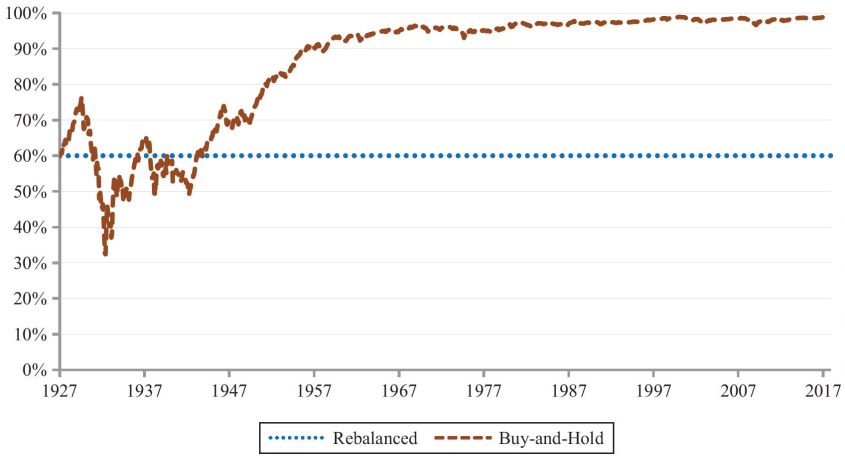


Figure 1 – Allocation to stocks for a monthly rebalanced and buy-and-hold portfolio

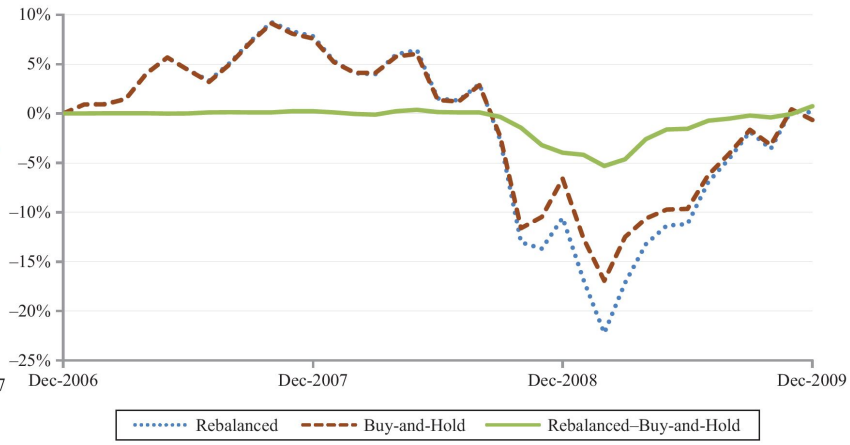


Figure 2 – Performance monthly rebalanced and buy-and-hold portfolio

Introduction

Context and Literature

Rebalancing for long-term investors : periodic, threshold-based or buy-and-hold ?

- Dichtl, Drobetz and Wambach (2016) revisit the literature on rebalancing considering different asset allocations and performance measures (e.g., Sharpe ratio, Sortino ratio and Omega measure). Their findings highlight that rebalancing is preferable iif the allocation to stocks is $\geq 20 - 30\%$;
- Rattray, Granger, Harvey and Van Hemert (2020) include financial crises in their analysis and they also use the drawdown as a performance measure. Their results indicate that mechanical rebalancing should be avoided.

Introduction

Context and Literature

- Among long-term investors, we focus on sovereign wealth funds (SWFs) because :
  - They have no explicit financial liability (Bortolotti and Fotak, 2020) ;
  - They are considered as an attractive model for long-horizon investors ;
  - To our knowledge, no study on SWFs rebalancing strategies ;
  - The rise of their asset, and the role that is expect from them on financial stability.

Introduction

Context and Literature

SWFs and financial stability :

- The view that SWFs play a stabilizing role in the financial system by growing and developing the economy had been widely accepted (i.a., Ciarlone and Miceli, 2016 ; Benedictow and Boug, 2017) ;
- However, the perception of the role of SWFs in the financial system has changed recently (Megginson and Gao, 2020 ; Bahoo et al., 2020) ;
- Bortolotti and Fotak (2020) observed a procyclical behavior in some SWFs, challenging the idea of them being automatically countercyclical.

Introduction

Context and Literature

- Among SWFs, the Norwegian SWF is the most interesting because of its size, its investor profile (long term investor), as well as its investment universe (stock/bonds investor) (Chambers, Dimson and Ilmanen, 2021).

Introduction

Context and Literature

Source : Based on our reading of the periodic reports of the Norwegian sovereign wealth fund

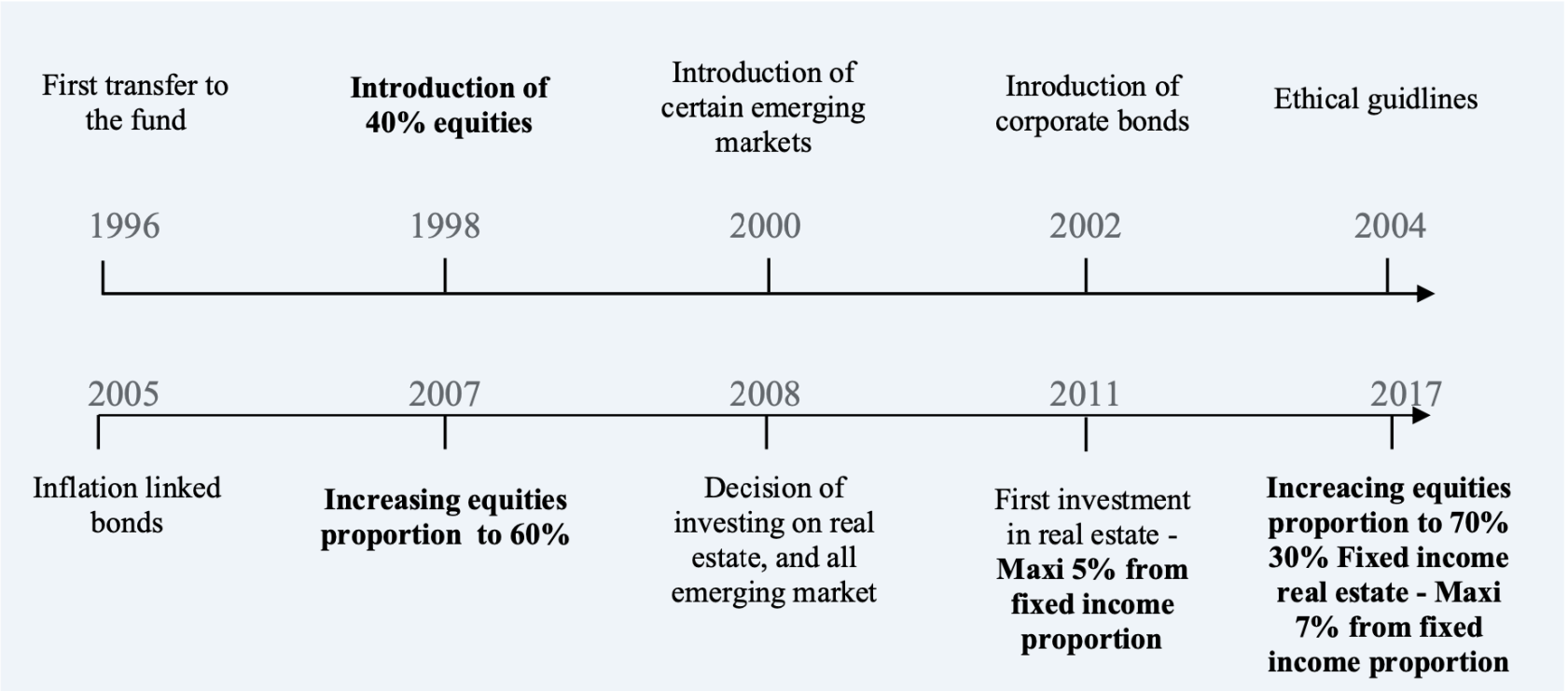


Figure 3 – Main changes in the Norwegian fund's investment strategy

Introduction

Motivation

Our motivation is twofold, as we aim at :

- Examine the rebalancing strategies for SWFs, by considering the business cycle (economic and markets turmoil) and using an innovative empirical framework ;
- Revisit the assumption of the positive role in financial stability played by SWFs during financial turmoil.

Introduction

Innovations

We revisit the recent literature on stock-bond portfolio rebalancing :

- Using a new performance measure, the modified Sharpe ratio (mSR) as in Candelon, Hasse and Fuerst (2021).
  - The consideration for periods of crisis and non normality of returns confirm this choice ;
- Testing the significance of the difference between two performance measures (mSR), instead of a visual comparison.
  - We do this by using the modified Sharpe ratios equality test of Ardia and Boudt (2015) ;
- Considering the phases of economic and financial cycles separately.

Methodology

Approach overview

- Using the values of stock and bonds return of the Norwegian SWF. We simulate 9 portfolios with different asset allocations (i.e.,from 10% to 90% stocks)
- For each of them we apply 6 different investment strategies : buy-and-hold, periodic rebalancing (monthly, quarterly and semiannual) and threshold-based rebalancing (2% and 4%)..
- For each of the 54 simulated portfolios we compute 5 different performance measure.
- We compare and determine which strategy outperforms the other, by using the Sharpe ratios equality test .
- Finally, We make different Robustness Check, alternative performance measure, different investment horizon, include transaction costs, time sampling...

Methodology

Performance measure : Modified Sharpe ratio

- In the recent literature, Sharpe Ratios (SR) are widely used to compare rebalancing strategies (Dichtl, Drobetz and Wambach, 2016 ; Rattray, Granger, Harvey, Van Hemert, 2020) ;
- Our investigations include left-tailed events such as financial crises, so the traditional Sharpe ratio is not the best indicator designed for such periods ;
- Alternatively, several modified Sharpe Ratios (mSR) coexist in the literature, i.e., Favre and Galeano (2002), Gregoriou and Gueyie (2003) and Bali, Brown and Demirtas (2013).

Methodology

Performance measure : Modified Sharpe ratio

We choose the measure put forth by Gregoriou and Gueyie (2003), as suggested in Candelon, Hasse and Fuerst (2021), which is defined as follows :

$$mS_i = \frac{\mu_i - r_f}{mVaR_i^{\alpha\%}}, \tag{1}$$

where μ_i and $mVaR_i^{\alpha\%}$ are the mean return and the $1-\alpha$ % Cornish-Fisher's approximation of the value-at-risk of the portfolio i, respectively, and r_f is the risk-free rate.

Methodology

Testing equality of modified Sharpe ratios

In the recent literature, authors often compare the values of Sharpe ratios or modified Sharpe ratios across strategies. However, our approach goes a step further by using a statistical test to assess the significance of the difference in performance between two strategies, A and B.

- Under normal returns, Ledoit and Wolf (2008) introduce the following test for equality of Sharpe ratios :

$$H_0 : \Delta \equiv SR_A - SR_B = 0 \tag{2}$$

- However, under nonnormal returns, Ardia and Boudt (2015) argue that testing for equality of modified Sharpe ratios boils down to the following :

$$H_0 : \Delta_m \equiv mSR_A - mSR_B = 0. \tag{3}$$

Methodology

Resampling procedure - Bootstrap method

Econometric methods. To make statistical inference, we use a resampling procedure. Bootstrap method :
(ii) It allows us to compute robust confidence intervals, and (iii) it also makes it possible to explore different investment horizons.

- (i) Since performance is highly path-dependent (Sharpe, 2010), bootstrapping historical returns helps avoid data snooping issues ,
- (ii) It allows us to compute robust confidence intervals,
- and (iii) it also enables to examine different investment horizons .

Methodology

Resampling procedure - Bootstrap method

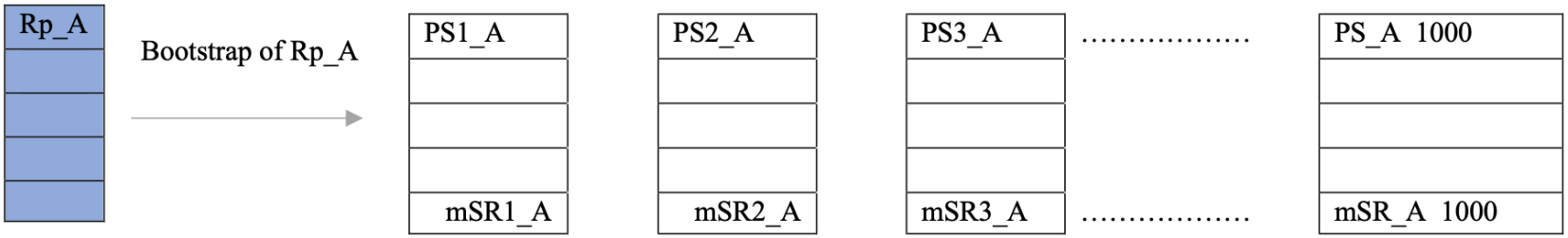
- Recent works are based on bootstrap resampling *à la* Kunsch (1989) and Politis and Romano (1991 ; 1994) ;
- We use different block sizes as advocated by Cogneau and Zakamouline (2013), whereas Dichtl, Drobetz and Wambach (2016) use blocks of random size as an alternative ;
- In the main results, the block size is determined following the rule put forth by Hall, Horowitz and Jing (1995) (i.e., $l \in \{n^{1/3}, n^{1/4}, n^{1/5}\}$, with l being the block size and n being the number of observations).

Methodology

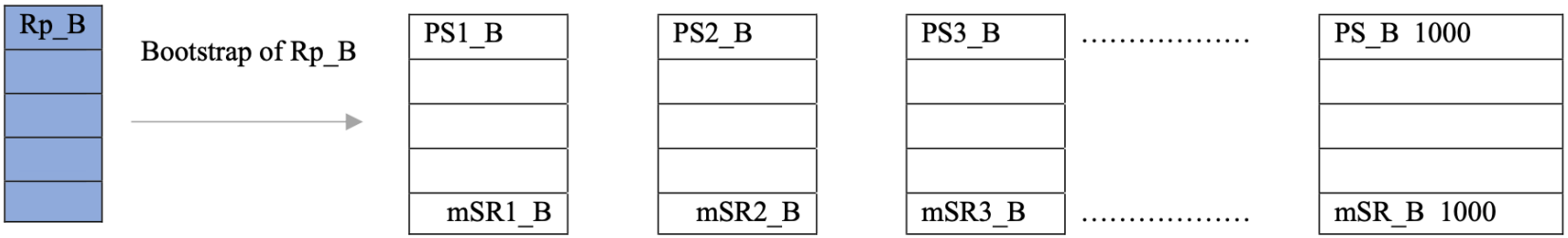
Resampling procedure - Bootstrap method

Construction of confidence intervals

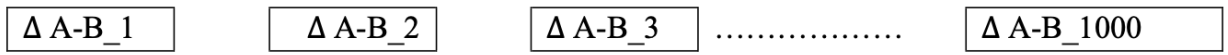
1. Block Bootstrap of the return of the portfolio "P" for the strategy A



2. Block Bootstrap of the return of the portfolio "P" for the strategy B



3. Computing the difference between the mSR of both strategies



Methodology

Resampling procedure

Construction of confidence intervals

We construct a two-sided bootstrap confidence interval with nominal level $1-\alpha$ for Δ (resp. Δ_m), defined as follows :

$$\hat{\Delta}^*_{A-B[1]} \cdots \leq \hat{\Delta}^*_{A-B[50]} \leq \cdots \leq \hat{\Delta}^*_{A-B[950]} \cdots \leq \hat{\Delta}^*_{A-B[1000]} \tag{4}$$

$$CI = [\hat{\Delta}^*_{A-B[\alpha/2\times 1000]}, \hat{\Delta}^*_{A-B[(1-\alpha)/2\times 1000]}]. \tag{5}$$

For $\alpha = 10\%$

$$CI = [\hat{\Delta}^*_{A-B[50]}, \hat{\Delta}^*_{A-B[(950]}]. \tag{6}$$

If this interval does not contain zero, then $H0$ is rejected at nominal level α. This mean that the difference between the SR / mSR of the strategy A and B is significant.

Empirical study

Data

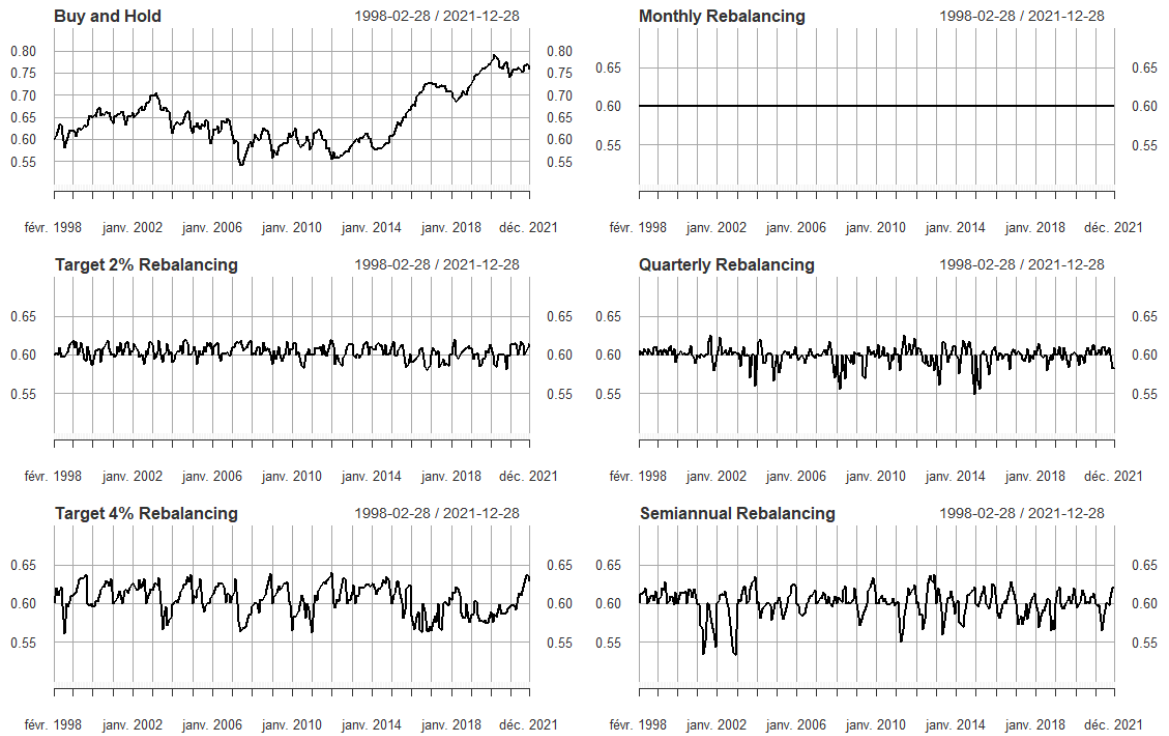
Table 1 – Description of the dataset

Variable	Description	Code	Source
Stocks returns	Investment equities	Rs	NBIM
Bonds returns	Investment fixed income	Rb	NBIM
Risk free rate		Rf	Kenneth French's website
Financial cycles	Dummy for stock market crises	CRI	IMF
Business cycles	Dummy for recessions	REC	OECD

Empirical study

Main results - 60/40 stock-bond portfolios

Figure 5 – Allocation to Stocks for several Investment Strategies, GPFG, 1998-2021



Empirical study

Main results - 60/40 stock-bond portfolios

Table 2 – Comparing performances - Optimal rebalancing

	No rebalancing	Threshold rebalancing		Periodic rebalancing		
	Buy & Hold	2%	4%	Monthly	Quarterly	Semiannual
			Global			
SR	0.148***	0.162***	**0.164*** **	0.163**	0.163***	**0.164*** **
mSR	0.082***	0.090***	**0.091*** **	0.090**	0.090***	0.090***
			Recession periods			
SR	**0.048*** **	-0.013	-0.009	-0.015	-0.013	-0.011
mSR	**0.028*** **	-0.008	-0.006	-0.009	-0.008	-0.006
			Expansion periods			
SR	0.336***	0.357***	0.356***	**0.358*** **	0.358***	0.357***
mSR	0.170***	**0.179*** **	0.178***	**0.179*** **	0.178***	0.178***
			Crisis periods			
SR	**-0.103*** **	-0.375***	-0.375***	-0.375***	-0.375***	-0.374***
mSR	**-0.067*** **	-0.295***	-0.295***	-0.296***	-0.296***	-0.294***
			Noncrisis periods			
SR	0.341***	0.376***	0.376***	**0.378*** **	**0.378*** **	0.377***
mSR	0.172***	0.186***	0.186***	**0.187*** **	**0.187*** **	**0.187*** **

Empirical study

Main results - 60/40 stock-bond portfolios

Table 3 – Testing difference of modified Sharpe ratios - Optimal rebalancing

	No rebalancing	Threshold rebalancing		Periodic rebalancing		
	Buy & Hold	2%	4%	Monthly	Quarterly	Semiannual
			Global			
Buy & Hold		-0.009	-0.008	-0.008	**-0.014****	-0.011
2%			0.001	0.002	**-0.005*****	-0.001
4%				0.000	**-0.006***	-0.003
Monthly					**-0.006*****	-0.003
Quarterly						0.003
Semiannual						
			Recession periods			
Buy & Hold		0.013	0.012	0.014	0.013	0.016
2%			0.000	0.000	0.000	0.003
4%				0.001	0.000	**0.004****
Monthly					0.000	0.002
Quarterly						0.003
Semiannual						
			Expansion periods			
Buy & Hold		-0.023	-0.018	-0.027	-0.025	-0.028
2%			0.005	-0.004	-0.002	-0.005
4%				**-0.009*****	-0.007	**-0.010****
Monthly					0.002	0.000
Quarterly						-0.003
Semiannual						
			Crisis periods			
Buy & Hold		**0.017***	**0.017***	**0.017***	**0.018***	**0.018****
2%			0.000	0.000	0.001	0.002
4%				0.000	0.001	0.002
Monthly					0.000	0.000
Quarterly						0.000
Semiannual						
			Noncrisis periods			
Buy & Hold		**-0.096*****	**-0.096*****	**-0.096*****	**-0.100*****	**-0.097*****
2%			0.000	0.000	-0.004	-0.001
4%				0.000	-0.005	-0.001
Monthly					-0.004	-0.001
Quarterly						0.003
Semiannual						

Robustness checks

Alternative performance measures

Table 4 – Comparing performances - Optimal rebalancing - Alternative performance measures

	No rebalancing	Threshold rebalancing		Periodic rebalancing		
	Buy & Hold	2%	4%	Monthly	Quarterly	Semiannual
			Global			
SR	0.157	0.163	0.164	0.165	**0.166**	0.161
mSR	0.087	0.090	0.090	0.091	**0.092**	0.089
Sortino	0.255	0.266	0.267	0.271	**0.271**	0.263
Omega	0.943	0.946	0.944	0.950	**0.954**	0.943
MDD	**3.069**	3.109	3.160	3.100	3.100	3.100
			Recession periods			
SR	**-0.001**	-0.010	-0.009	-0.014	-0.010	-0.011
mSR	**-0.001**	-0.006	-0.006	-0.009	-0.006	-0.006
Sortino	**0.046**	0.029	0.030	0.024	0.029	0.027
Omega	**0.745**	0.740	0.742	0.733	0.741	0.738
MDD	**3.074**	3.109	3.094	3.135	3.135	3.100
			Expansion periods			
SR	0.334	0.345	0.344	**0.347**	0.345	0.344
mSR	0.169	0.173	0.173	**0.174**	0.173	0.173
Sortino	0.666	0.718	0.711	**0.723**	0.720	0.717
Omega	1.197	1.338	1.330	**1.343**	1.340	1.340
MDD	2.171	1.962	1.990	1.905	**1.899**	1.970
			Crisis periods			
SR	**-0.376**	-0.397	-0.396	-0.402	-0.400	-0.398
mSR	**-0.296**	-0.318	-0.318	-0.324	-0.322	-0.319
Sortino	**-0.412**	-0.433	-0.435	-0.438	-0.435	-0.435
Omega	**0.693**	0.663	0.670	0.655	0.657	0.661
MDD	**3.469**	3.836	3.836	3.940	4.051	3.836
			Noncrisis periods			
SR	0.343	0.377	0.375	0.378	**0.379**	0.377
mSR	0.172	0.187	0.186	0.187	**0.188**	0.187
Sortino	0.564	0.649	0.636	0.650	**0.651**	0.648
Omega	1.041	1.226	1.220	1.230	**1.235**	1.230
MDD	3.069	2.972	3.069	**2.970**	**2.970**	**2.968**

Robustness checks

Transaction costs

Table 5 – Comparing performances - Optimal rebalancing - Transaction costs

	No rebalancing	Threshold rebalancing		Periodic rebalancing		
	Buy & Hold	2%	4%	Monthly	Quarterly	Semiannual
			Global			
SR	0.157	0.162	0.163	**0.165**	0.166	0.161
mSR	0.087	0.090	0.090	**0.091**	0.092	0.089
			Recession periods			
SR	**-0.001**	-0.011	-0.009	-0.015	-0,011	-0,011
mSR	**-0.001**	-0.006	-0.006	-0.009	-0.007	-0.007
			Expansion periods			
SR	0.334	0.345	0.343	**0.346**	0.344	0.344
mSR	0.169	0.173	0.172	**0.174**	0.173	0.173
			Crisis periods			
SR	**-0.376**	-0.397	-0.397	-0.402	-0.400	-0.398
mSR	**-0.296**	-0.318	-0.317	-0.324	-0.332	-0.319
			Noncrisis periods			
SR	0.343	0.377	0.375	0.378	**0.379**	0.377
mSR	0.172	0.186	0.186	**0.187**	**0.187**	**0.187**

Robustness checks

Alternative investment horizons

Table 6 – Comparing performances - Optimal rebalancing - Alternative investment horizon

	No rebalancing	Threshold rebalancing		Periodic rebalancing		
	Buy & Hold	2%	4%	Monthly	Quarterly	Semiannual
			Global			
SR	0.152	0.166	**0.169**	0.164	0.164	**0.169**
mSR	0.085	0.092	**0.093**	0.091	0.090	**0.093**
			Recession periods			
SR	**0.000**	-0.013	-0.013	-0.014	-0.012	-0.012
mSR	**0.000**	-0.008	-0.008	-0.009	-0.008	-0.007
			Expansion periods			
SR	0.346	0.359	0.357	**0.361**	0.360	0.358
mSR	0.174	0.179	0.178	**0.180**	**0.180**	0.179
			Crisis periods			
SR	**-0.254**	-0.374	-0.375	-0.376	-0.376	-0.373
mSR	**-0.182**	-0.294	-0.296	-0.297	-0.296	-0.293
			Noncrisis periods			
SR	0.357	0.378	0.378	0.378	**0.380**	0.379
mSR	0.178	0.187	0.187	0.187	**0.188**	0.187

Robustness checks

Time sampling

Table 7 – Comparing performances - Optimal rebalancing - Subsampling

	No rebalancing	Threshold rebalancing		Periodic rebalancing		
	Buy & Hold	2%	4%	Monthly	Quarterly	Semiannual
			Global			
SR	0.157	0.163	0.164	0.165	**0.166**	0.161
mSR	0.087	0.090	0.090	0.091	**0.092**	0.089
			Subsample 1998 - 2009			
SR	0.056	0.066	0.068	0.067	**0.069**	0.064
mSR	0.033	0.039	0.040	0.039	**0.040**	0.037
			Subsample 2009 - 2021			
SR	0.265	0.278	0.278	**0.279**	0.277	0.277
mSR	0.139	0.145	0.145	**0.145**	0.144	0.144
			Subsample 1998 - 2014			
SR	0.120	0.129	0.131	0.127	**0.132**	0.131
mSR	0.068	0.073	0.074	0.072	**0.074**	**0.074**
			Subsample 2014 - 2021			
SR	0.246	**0.256**	0.250	0.253	0.255	0.255
mSR	0.130	**0.135**	0.132	0.133	0.134	0.134

Conclusion

Policy Implications

Our empirical results have several implications.

- First, we have shown that an investment policy that does not take into account economic and financial cycles is suboptimal, even for a long-term investor without financial liabilities. Therefore, an adaptative rebalancing policy should be preferred over a calendar- or threshold-based rule rebalancing policy.
- Second, the hypothesis of the countercyclical behavior of SWFs contrasts with our findings. Hence, we advocate for the consideration of macroprudential rules to improve the Santiago Principles and a specific monitoring framework targeted at SWFs.