Minimum Volatility Portfolio Construction in Barra Portfolio Manager – A Practical Approach

Comparing Minimum Volatility Portfolios with Barra Global Equity Models GEM2 and GEM3

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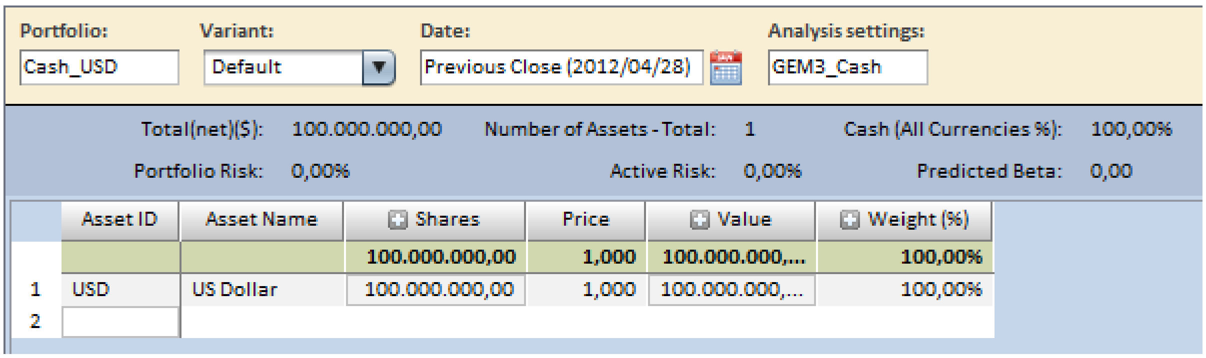
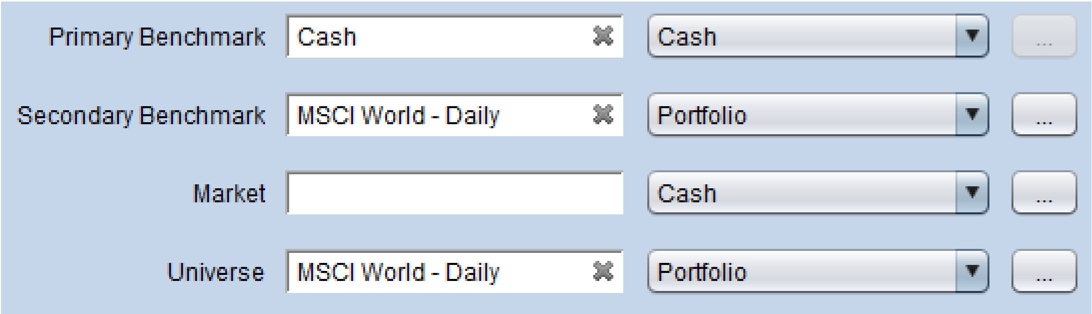
The concept of minimum volatility portfolios and strategies has become increasingly popular among investors and portfolio managers. In this practical note, we will explain how minimum volatility strategies can be designed in Barra Portfolio Manager using the Barra Global Equity Model 2 (GEM2) as well as the new-generation GEM3, which features the new Volatility Regime Adjustment and Optimization Bias Adjustment techniques.

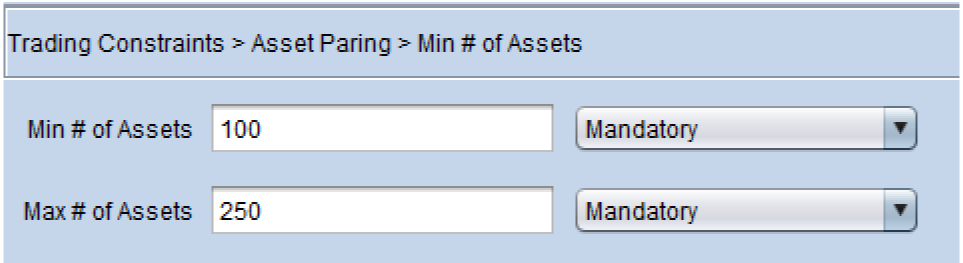
Start with a pure cash portfolio of USD 100,000,000 and an analysis date of April 28th 2012:



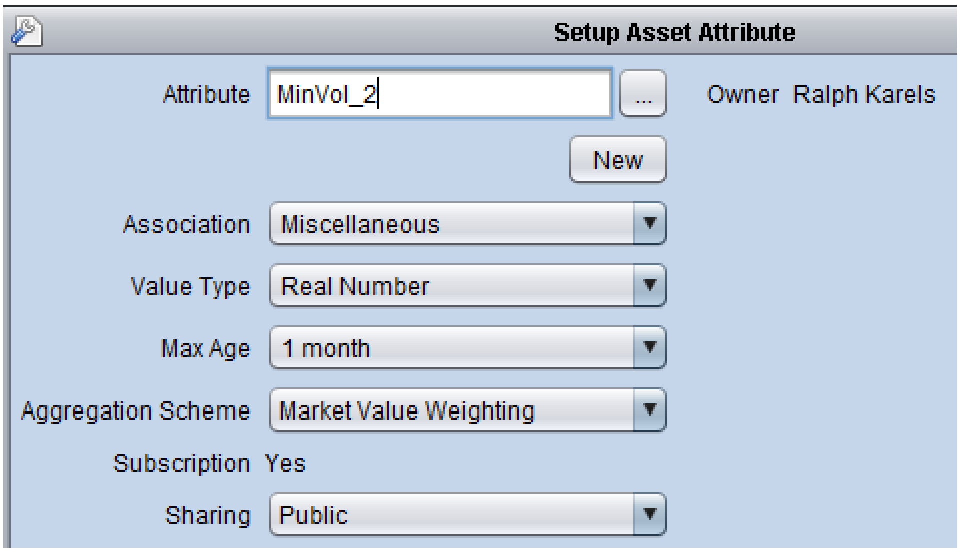
Next, create a new rebalance profile with a *Single Optimization* rebalancing method, *Max Utility* optimization type and *GEM2* as the risk model. Set the benchmark to cash and the investment universe to the *MSCI World - Daily*:



Further constraints can include a minimum number of 100 and a maximum number of 250 stocks to be included in the optimal portfolio:

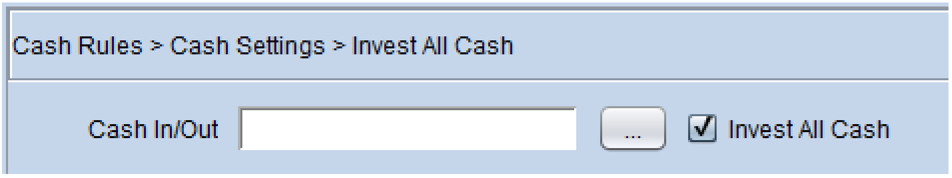


In order to incorporate an asset level bound of MSCI World weight plus 3%, you need define an asset attribute and upload the respective user data into BPM.



	A	B	C
1	<Attribute Name>	MINVOL_2	
2	<Association>	Miscellaneous	
3	<Value Type>	Real Number	
4	<Maximum Age>	1 month	
5	<Aggregation Scheme>	Market Value Weighting	
6	<Sharing>	Public	
7	<asset data>	<idtype>	MINVOL_2
8	<date>		20120428
9	FRAAAA1	BARRAID	3.0786774765965300%
10	FRAAAC1	BARRAID	3.5638217040162800%
11	FRAAAH1	BARRAID	3.0482141091156100%
12	GERAPC1	BARRAID	3.2218393630035600%
13	GERAPA1	BARRAID	3.4809897048684700%
14	UKIFEU1	BARRAID	3.6202948086236700%
15	NORAWZ1	BARRAID	3.1905165167005200%

You can add a factor-level constraint on industries of minimum 0 and maximum 10% weight. Finally, tick the *Invest All Cash* Box in the *Cash Rules* section:

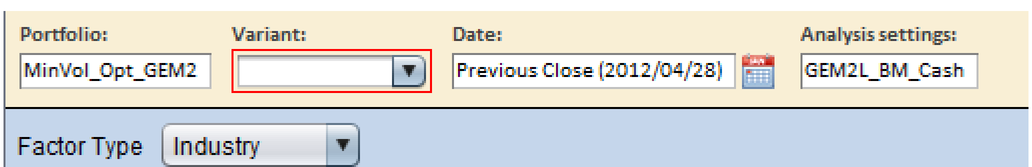


Note that by not defining any expected returns (alphas), the optimizer will effectively minimize risk (given the specified constraints), making the optimized portfolio a minimum volatility one. To run the optimization, save the rebalance profile defined above and start the *Rebalance Tool*:

The optimal portfolio contains 100 assets and an ex-ante annualized total risk of 10.32%. For the same date, the MSCI World has an ex-ante annualized total risk of 18.49% under GEM2 - a risk reduction of 8.17 percent points.

	Status	Iteration	Primary Benchmark	Number Of Assets	Active Risk	Turnover
1	Success	Iteration 2	Cash	100	10,32%	100,00%

The largest holding in the optimized portfolio is Kimberley Clark Corp (1.92%), and the smallest is Motorola Mobility (0.30%). Industry exposures are concentrated in Banks, Telecomms, Pharma, Utilities and Food & Beverages:



	Factor	Portfolio Net Exposure	Portfolio Long Exposure
1	Industry	1,00	1,00
2	Banks	0,10	0,10
3	Telecommunication Services	0,10	0,10
4	Pharmaceuticals and Life Sciences	0,10	0,10
5	Utilities	0,10	0,10
6	Food Beverage and Tobacco	0,10	0,10
7	Household and Personal Products	0,09	0,09
8	Food and Staples Retailing	0,08	0,08
9	Retailing	0,07	0,07
10	IT Services and Software	0,06	0,06

A risk decomposition using the Correlation Risk Attribution methodology shows that the majority of the optimized portfolio's total risk of 10.32% stems from common factor risk (9.32%), with minor contributions from specific risk (0.23%) and currency (0.77%):

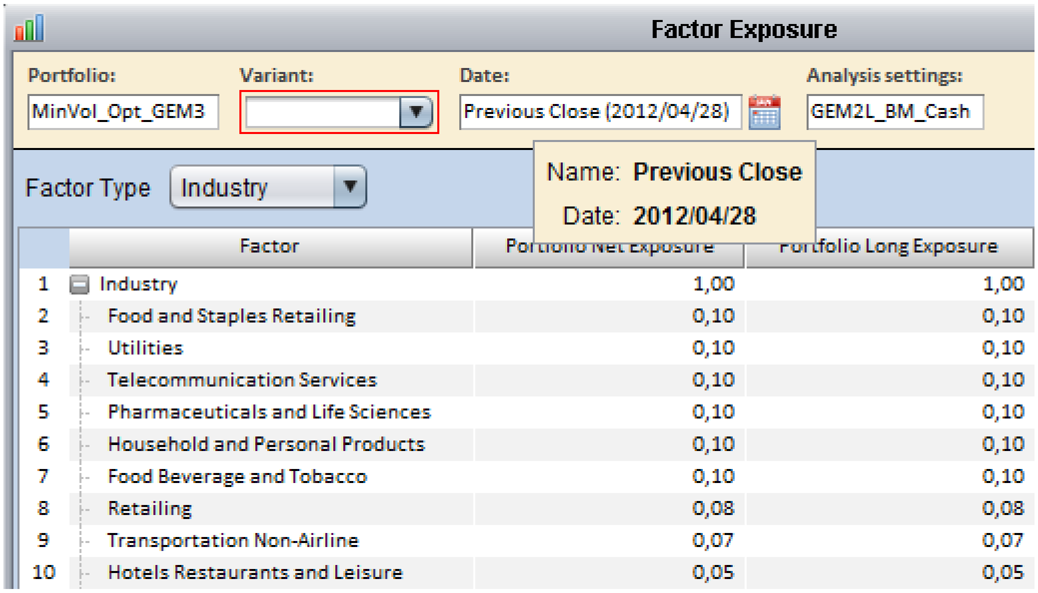
	Risk Source	[Net] Active Risk	[Net] Active Correlation	[Net] Active Risk Contribution
1	Total	10,32%	1,00	10,32%
2	Local Excess	10,21%	0,94	9,55%
3	Market Timing	0,00%	0,00	0,00%
4	Residual	10,21%	0,94	9,55%
5	Common Factor	10,09%	0,92	9,32%
6	Industry	2,17%	-0,31	-0,67%
7	Risk Indices	9,28%	-0,57	-5,28%
8	Country	3,68%	0,10	0,35%
9	World	18,65%	0,80	14,92%
10	Factor Interaction	N/A	N/A	N/A
11	Specific	1,54%	0,15	0,23%
12	Currency	3,69%	0,21	0,77%
13	Currency/Market Interaction	N/A	N/A	N/A

To replicate the analysis using GEM3 as the risk model, create a new rebalance profile with the same constrains as the ones defined above, but using the GEM3 model:

The GEM3 optimal portfolio contains 100 assets and an ex-ante annualized total risk of 8.37%. For the same date, the MSCI World has an ex-ante annualized total risk of 16.55% under GEM3. A risk reduction of 8.18 percent points was achieved - very similar to the GEM2 Case (8.17 percent points of risk reduction) but with lower total risk levels:

	Status	Iteration	Primary Benchmark	Number Of Assets	Active Risk	Turnover
1	Success	Iteration 1	Cash	100	8,37%	100,00%

The largest holding in the optimal portfolio is Kimberly Clark Corp (2.66%), and the smallest is Coca Cola (0.02%). Industry exposures are similar to the ones obtained when optimizing with GEM2 – with the notable exception of Banks:



Factor Exposure

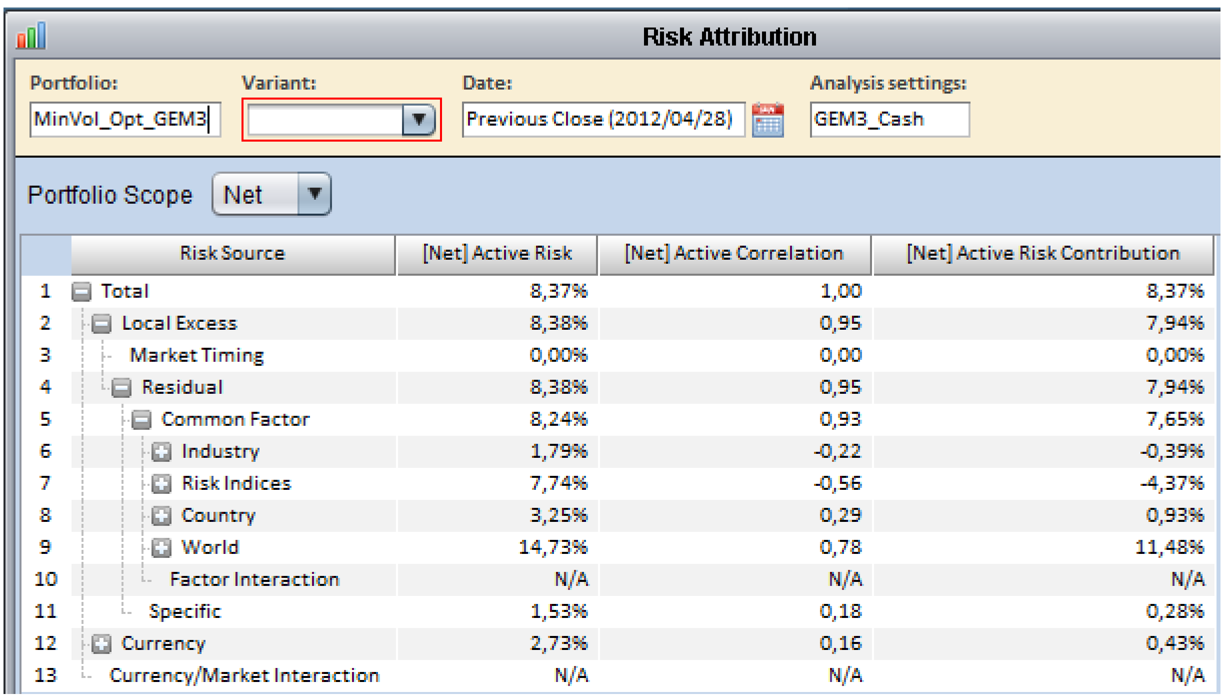
Portfolio: MinVol_Opt_GEM3 Variant: Date: Previous Close (2012/04/28) Analysis settings: GEM2L_BM_Cash

Factor Type Industry

Name: Previous Close
Date: 2012/04/28

	Factor	Portfolio Net Exposure	Portfolio Long Exposure
1	Industry	1,00	1,00
2	Food and Staples Retailing	0,10	0,10
3	Utilities	0,10	0,10
4	Telecommunication Services	0,10	0,10
5	Pharmaceuticals and Life Sciences	0,10	0,10
6	Household and Personal Products	0,10	0,10
7	Food Beverage and Tobacco	0,10	0,10
8	Retailing	0,08	0,08
9	Transportation Non-Airline	0,07	0,07
10	Hotels Restaurants and Leisure	0,05	0,05

A risk decomposition using the Correlation Risk Attribution methodology shows a similar picture compared with GEM2: The majority of the portfolio's total risk of 8.37% stems from common factor risk (7.65%) and minor contributions from specific risk (0.28%) and currency (0.43%):



Risk Attribution

Portfolio: MinVol_Opt_GEM3 Variant: Date: Previous Close (2012/04/28) Analysis settings: GEM3_Cash

Portfolio Scope Net

	Risk Source	[Net] Active Risk	[Net] Active Correlation	[Net] Active Risk Contribution
1	Total	8,37%	1,00	8,37%
2	Local Excess	8,38%	0,95	7,94%
3	Market Timing	0,00%	0,00	0,00%
4	Residual	8,38%	0,95	7,94%
5	Common Factor	8,24%	0,93	7,65%
6	Industry	1,79%	-0,22	-0,39%
7	Risk Indices	7,74%	-0,56	-4,37%
8	Country	3,25%	0,29	0,93%
9	World	14,73%	0,78	11,48%
10	Factor Interaction	N/A	N/A	N/A
11	Specific	1,53%	0,18	0,28%
12	Currency	2,73%	0,16	0,43%
13	Currency/Market Interaction	N/A	N/A	N/A

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