Table 1: G7 equity markets: Benchmark weights, volatilities and correlations, risk aversion, and equilibrium expected returns

	Benchmark weights, h_B (in per cent)	*Annualized volatilities (in per cent)*	*Correlation matrix*							*Equilibrium expected returns, $\Pi=\delta\Sigma h_B$ (in per cent)*
			Australia	*Canada*	*France*	*Germany*	*Japan*	*UK*	*USA*	
Australia	1.6	16.0	1							3.94
Canada	2.2	20.3	0.488	1						6.92
France	5.2	24.8	0.478	0.664	1					8.36
Germany	5.5	27.1	0.515	0.655	0.861	1				9.03
Japan	11.6	21.0	0.439	0.310	0.355	0.354	1			4.30
United Kingdom	12.4	20.0	0.512	0.608	0.783	0.777	0.405	1		6.77
United States of America	61.5	18.7	0.491	0.779	0.668	0.653	0.306	0.652	1	7.56

Risk aversion parameter, δ=2.5.

3. Scale the strategy portfolios by the risk budgeting weights and add them together to produce a vector of asset-level active holdings.
4. Add the active holdings to the weights of a benchmark.
5. Use reverse optimization to calculate Black–Litterman expected returns.

Viewing Black–Litterman from a risk budgeting perspective helps clarify the mechanics of the model. In particular, the active component of Black–Litterman expected returns takes on a clear interpretation: just as equilibrium expected returns are derived from benchmark weights, Black–Litterman alphas can be derived from active portfolio holdings using reverse optimization. The Black–Litterman alphas are designed to produce the same active holdings when used in unconstrained MVO as those generated from risk budgeting MVO at the strategy level, where the strategy alphas have been Bayesian-adjusted for levels of confidence.[12]

EXAMPLE: HE AND LITTERMAN

This example replicates the two market views case in He and Litterman (1999) using the risk budgeting framework. The universe of assets is the G7 equity markets, and the benchmark weights are proportional to the market capitalization of each country. Given the benchmark weights, expected volatilities and correlations for each stock market, and a risk aversion parameter, the equilibrium annual expected returns can be found using reverse optimization. These values are shown in Table 1.

There are two active strategies: relative positioning in European markets and relative positioning in North American markets. For European equities, the view is that Germany will outperform the rest of Europe by 5 per cent per year, whereas for North America the view is that the Canadian equity market will

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