RBC Commodity Index

Contract Month Selection Algorithm

MAY 9, 2017

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This document contains description about the RBC Commodity Index Contract Month Selection Algorithm, which is referred to as the “Algorithm”. The Algorithm generates the Lead Contract Months and Next Contract Months for use in the calculation of a specific instance of the RBC Commodity Excess Return Index or RBC Commodity Total Return Index.

RBC Capital Markets

Disclaimer

This section can be used to insert a disclaimer and any other assumptions used in the document.

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Description of the Algorithm

At a high level, a future is said to be backwardated (contango) if its longer-dated Contract Months are lower in price (higher in price) than its shorter-dated Contract Months. The Roll Yield is the return generated from the convergence of long-dated Contract Month prices towards spot prices. In the following, we define methods for calculating the Roll Yield between futures contract and how Roll Yield is used to generate Next Contract Months for use in the specific version of the Index.

Section 1. Terms and Notations

Term/Notation	Definition
$P^i(t,T)$	Denotes the **Settlement Price** of the i^{th} Index Commodity with Contract Month T on Index Business day t. If there is a Market Disruption Event for the i^{th} Index Commodity, the most recently available Settlement Price will be used.
$t_0(k)$	Denotes the **Contract Selection Day** for the Reference Month k. The Contract Selection Day is the Index Business Day on which the Next Contract Months of all Index Commodities are updated by the algorithm discussed in Section 2. Please refer to Section 5 of "Index Information" for the Contract Selection Day of a specific index.
$ECM^i(k)$ and Anchor Month	Denotes the **Eligible Contract Months** for the i^{th} Index Commodity in the Reference Month k. If the set is empty, there will be NO rolling for the Index Commodity in the Reference Month k. Assume that the set is non-empty. Then we require the set to have at least two Contract Months. Let $ECM^i(k) = \{T_0, T_1, T_2, \dots, T_n\}$ with $T_0 < T_1 < \cdots < T_n$. The contract month T_0 is called the **Anchor Month**. Other Contract Months $T_1, T_2, \dots, T_n$ are candidates for the Contract Month Selection Algorithm. That is, one of these Contract Months will be selected as the Next Contract Month of the i^{th} Index Commodity. Please refer to Section 5 of "Index Information" for the eligible contract months of all included Index Commodities of a specific index.
Base Month	**Base Month** is the Next Contract Month used in the last Reference Month, which is the same as the Lead Contract Month of the current Reference Month. Base Month on the First Calculation Day of the Index is defined in Section 5 of "Index Information".
Reference Month Method	There are three methods used obtain the Reference Month for the Roll Yield calculation of the contract month T_j, where $1 \le j \le n$: 1. **Base Month Method**: the Base Month is used; 2. **Anchor Month Method**: The earliest Contract Month in $ECM^i(k)$, i.e. T_0; 3. **Adjacent Month Method**: The Contract Month which is just earlier than T_j, i.e. T_{j-1}. Please refer to Section 5 of "Index Information" for the Reference Month Method selected for a specific index.
Time Count Method	Given two Contract Months T_j and T_k, there are two methods to count the time between them: 1. **Calendar Month Method**: $Month(T_j, T_k)$ is the number of the calendar months between T_j and T_k; 2. **Calendar Day Method**: $Day(T_j, T_k)$ is the number of the calendar days between T_j and T_k. Please refer to Section 5 of "Index Information" for the Time Count Method selected for a specific index.

$RY\left[t_0(k), T_j\right]$	Denotes the **Roll Yield** of Contract Month T_j on Contract Selection Day $t_0(k)$
Roll Yield Calculation Method	Given a Contract Month T_j, let T_j^{ref} be the Reference Month of T_j using any of the Reference Month Methods mentioned previously and let ΔT_j be $Month\left(T_j, T_j^{ref}\right)$ or $Day\left(T_j, T_j^{ref}\right)$. On a Contract Selection Day $t_0(k)$, if $T_j^{ref} = T_j$, then ΔT_j is equal to zero and the Roll Yield, denoted by $RY\left[t_0(k), T_j\right]$, is defined to be zero. Otherwise, the Roll Yield is defined from one of the following methods: 1. **Simple Method**: $$RY\left[\mathrm{t}_0(k), T_j\right] = \frac{1}{\Delta T_j}\left[\frac{P^i\left(t_0(k), T_j^{ref}\right) - P^i\left(t_0(k), T_j\right)}{P^i\left(t_0(k), T_j\right)}\right]$$ 2. **Compound Method**: $$RY\left[\mathrm{t}_0(k), T_j\right] = \left[\frac{P^i\left(t_0(k), T_j^{ref}\right)}{P^i\left(t_0(k), T_j\right)}\right]^{\frac{1}{\Delta T_j}} - 1$$ 3. **Continuous Method**: $$RY\left[\mathrm{t}_0(k), T_j\right] = \frac{1}{\Delta T_j} log\left[\frac{P^i\left(t_0(k), T_j^{ref}\right)}{P^i\left(t_0(k), T_j\right)}\right]$$ Please refer to Section 5 of "Index Information" for the Calculation Formula Method selected for a specific index.
Ranking Operator "$\succ$"	Define the symbol "$\succ$" for the Contract Months $T_1, T_2, \ldots, T_n$ as follows: $T_i \succ T_j$ if $RY[t_0(k), T_i] \geq RY\left[t_0(k), T_j\right]$ and T_i is earlier (smaller) than T_j. "$\succ$" is referred to as the Roll Yield Ranking Operator and is used to rank/order futures contracts in terms of their respective Roll Yields. It can be qualitatively interpreted as "is preferred to". Note that the second condition in the definition of "$\succ$" is a tie-breaker since we prefer contracts with earlier maturities in general.
Order of Optimal Basket	The **Order of the Optimal Basket** is an integer which is greater than or equal to one and less than or equal to the number of eligible futures contracts. Please refer to Section 5 of "Index Information" for the Order of Optimal Basket of all included Index Commodities of a specific index.

Section 2. Optimal Basket Algorithm

At a high level, the algorithm ranks the eligible futures contracts by Roll Yield and subsequently selects the futures contract with the highest ranking, except in cases where the Order of the Optimal Basket is greater than one. In such cases, the Base Month contract may be selected in place of the highest ranking contract if its ranking is less than or equal to the Order of the Optimal Basket. A precise mathematical description of the algorithm follows, and is applied to each Index Commodity.

Step 1: Rank eligible futures contracts

Let n^i be the number of eligible futures contracts for the i^{th} Index Commodity.

The futures contracts $T_1, T_2, \dots, T_{n^i}$ are reordered as $\widehat{T_1}, \widehat{T_2}, \dots, \widehat{T_{n^i}}$ so that $\widehat{T_1} \succ \widehat{T_2} \succ \cdots \succ \widehat{T_{n^i}}$, ie. the contracts are ranked in terms of Roll Yield giving preference to earlier maturities.

Step 2: Compute the Optimal Basket

Let m^i be the Order of the Optimal Basket for the i^{th} Index Commodity, as specified in Section 5 of "Index Information". The Optimal Basket of Order m^i is an ordered list given by:

$$OB_{m^i}\left(ECM^i(k)\right) = \{\widehat{T_1}, \widehat{T_2}, \dots, \widehat{T_{m^i}}\} \qquad \text{where } m^i \leq n^i$$

The contracts in the Optimal Basket are the m^i contracts with the highest Roll Yields (with preference given to earlier maturities).

Step 3: Select a contract from the Optimal Basket

In Reference Month k, if the Base Month is in $OB_{m^i}\left(ECM^i(k)\right)$, it will be used as the Next Contract Month, otherwise, $\widehat{T_1}$ will be used as the Next Contract Month.

Step 4 (Optional): No Roll Back

This step is an optional feature that ensures the Next Contract Month selected does not mature earlier than the Lead Contract Month.

If the Next Contract Month selected from Step 3 has a shorter maturity than the Lead Contract Month, then the Lead Contract Month will be used as the Next Contract Month, i.e. there is NO rolling for the upcoming rolling period.

Please refer to Section 5 of "Index Information" to see whether this optional feature is enabled for a specific index.

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