estimate the volatility in the GB markets over a given investment horizon and tenor of the underlying bond. Because no standardized benchmark currently exists that reflects the option-implied fair market value of expected GB volatility, traders, other market participants, and/or money managers currently trade options on GB futures and options to hedge other financial positions, facilitate market-making, and/or take particular investment positions related to market volatility. However, the strategies employed in attempting to hedge risk via the trading of options on GB futures do not necessarily lead to accurate profits and losses due to price dependency, i.e., the tendency to generate profits and losses that are affected by the path of price movements between trade inception and expiry dates rather than the absolute price level prevailing at the time of option expiry.

[0015] As such, some embodiments of the invention provide techniques for calculating an effective volatility index related to the GB market. Additionally, some embodiments of the invention provide techniques for instantiating and/or facilitating trading of derivative products based on such an index.

[0016] In some embodiments, techniques are provided for creating and disseminating one or more volatility indices calculated using data for options on government bond derivatives such as futures and forwards (i.e., an option granting its owner the right but not the obligation to enter into an underlying bond derivative contract), and facilitating the electronic creation and trading of derivative products based on one or more indices relating to volatility.

[0017] Additional features and advantages of the invention will be set forth in the description that follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and advantages of the invention will be realized and attained by the method that is particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0018] According to a first aspect of the present invention, there is provided an electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising memory configured to store at least one program; and at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising: receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards; calculating, using the

data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $Ft(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $Ft(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $Ft(T_D,T_N)$, then  equals $Ft(T_D,T_N)$;

if there does not exist an option struck at $Ft(T_D,T_N)$, then  is the first available strike below $Ft(T_D,T_N)$;

Pt(T) is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at Ki, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i,T,T_D,T_N)$ is a price at time t of a call option, struck at Ki, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; transmitting data regarding the government bond volatility index; receiving an

electronic order for a derivative product based on the government bond volatility index; and executing the electronic order.

[0019] In some embodiments, the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives.

[0020] In one embodiment, the data regarding prices of options on government bond derivatives includes data regarding prices of options on government bond futures or government bond forwards.

[0021] In another embodiment, the data regarding prices of options on government bond derivatives includes data regarding prices of European style options on government bond forwards.

[0022] In some embodiments, the data regarding prices of options on government bond derivatives includes data regarding prices of options that are not European style options on government bond forwards.

[0023] In some embodiments, when the data regarding prices of options on government bond derivatives includes data regarding prices of options that are not European-style options on government bond forwards, converting the data regarding prices of options that are not European-style options on government forwards to data regarding prices of European style options on government bond forwards.

[0024] In some embodiments, calculating the government bond volatility index includes valuing a basket of options on the government bond derivatives required for model-independent pricing of a variance swap contract on the government bond derivatives.

[0025] In some embodiments, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI(t,T,T_D,T_N) \equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1}) \text{ for } i \geq 1, \text{ and } \Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1});$$

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

[0026] ~~In some embodiments~~According to a second aspect of the present invention, there is provided an electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising: memory configured to store at least one program; and at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising: receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards; calculating, using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government volatility index is calculated a time t according to the equation:

$GB-VI^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; transmitting data regarding the government bond volatility index; receiving an electronic order for a derivative product based on the government bond volatility index; and executing the electronic order.

[0027] ~~In some embodiments~~According to a third aspect of the present invention, there is provided an electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising: memory configured to store at least one program; and at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising: receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards; calculating, using the data regarding options on government bond derivatives, the government bond volatility index, wherein, in the absence of accrued coupons at time T, the government bond volatility index is calculated at time t according to the equation

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times\hat{P}^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}(y)\equiv\sum_{i=1}^{N}\frac{C_i}{n}(1+\frac{y}{n})^{-i}+100(1+\frac{y}{n})^{-N};$$

and, wherein, in the presence of accrued coupons at time T with the next coupon due at $t_j$, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times\hat{P}_T^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VT^{bp}(t,T,T_D,T_N)\equiv$$

$$100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$\hat{P}(y)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}^{-1}(y)$ is the functional inverse of $\hat{P}(y)$;

$\hat{P}_T(x)$ is a bond price at time T corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$GB-VI_Y^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; transmitting data regarding the government bond volatility index; receiving an electronic order for a derivative product based on the government bond volatility index; and executing the electronic order

[0028] ~~In some embodiments~~According to a fourth aspect of the present invention, there is provided an electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising: memory configured to store at least one program; and at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising: receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards; calculating, using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_{Yd}^{bp}(t,T,T_D,T_N)\equiv$$

$$\frac{100\times\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)\times GB-VI^{bp}(t,T,T_D,T_N)}{\sum_{i=j}^{N}\frac{C_i}{n}\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_i-T)}{dc(year)}}\left(\frac{dc(t_i-T)}{dc(year)}\right)+100\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_N-T)}{dc(year)}}\left(\frac{dc(t_N-T)}{dc(year)}\right)}$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

x denotes the yield of a government bond;

$\hat{P}_T(x)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$t_j$ is the first coupon payment on or after T;

$GB-VI_{Yd}^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$ transmitting data regarding the government bond volatility index; receiving an electronic order for a derivative product based on the government bond volatility index; and executing the electronic order.

[0029] In some embodiments, the at least one processor is further caused to create a standardized exchange-traded derivative instrument based on the government bond volatility index; and transmit data regarding the standardized exchange-traded derivative.

[0030] In some embodiments, transmitting data regarding the standardized exchange-traded derivative instrument includes transmitting data regarding one or more of a settlement

price, a bid price, an offer price, or a trade price of the standardized exchange-traded derivative instrument.

[0031] According to a ~~second~~ fifth aspect of the present invention, there is provided a non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards; calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the ith highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $Ft(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $Ft(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; $Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and $GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; transmitting, by the electronic trading system, data regarding the government bond volatility index; receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and executing the electronic order.

[0032] In some embodiments of the non-transitory computer readable storage medium, the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives.

[0033] In one embodiment of the non-transitory computer readable storage medium, the data regarding prices of options on government bond derivatives includes data regarding prices of options on government bond futures or government bond forwards.

[0034] In some embodiments of the non-transitory computer readable storage medium, the data regarding prices of options on government bond derivatives includes data regarding prices of European style options on government bond forwards.

[0035] In some embodiments of the non-transitory computer readable storage medium, the data regarding prices of options on government bond derivatives includes data regarding prices of options that are not European style options on government bond forwards.

[0036] In some embodiments of the non-transitory computer readable storage medium, when the data regarding prices of options on government bond derivatives includes data regarding prices of options that are not European-style options on government bond forwards, converting the data regarding prices of options that are not European-style options on government bond forwards to data regarding prices of European style options on government bond forwards.

[0037] In some embodiments of the non-transitory computer readable storage medium, calculating the government bond volatility index includes valuing a basket of options on the government bond derivatives required for model-independent pricing of a variance swap contract on the government bond derivatives.

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

[0039] ~~In some embodiments~~According to a sixth aspect of the present invention, there is provided ~~of the~~ a non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising: receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives including data regarding prices of options on government bond futures or government bond forwards; calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI^{bp}(t, T, T_D, T_N) \equiv$$

$$100^2 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} Put_t(K_i, T, T_D, T_N)\Delta K_i + \sum_{i:K_i \geq K_*} Call_t(K_i, T, T_D, T_N)\Delta K_i\right] - (F_t(T_D, T_N) - K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1}) \text{ for } i \geq 1, \text{ and } \Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1});$$

if the price is observable at time t, then $F_t(T_D, T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D, T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D, T_N)$, then $K_*$ equals $F_t(T_D, T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i,T,T_D,T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; transmitting, by the electronic trading system, data regarding the government bond volatility index; receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and executing the electronic order.

[0040] ~~In some embodiments of the~~According to a seventh aspect of the present invention, there is provided a non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising: receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives including data regarding prices of options on government bond futures or government bond forwards; calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index, wherein, in the absence of accrued coupons at time T, the government bond volatility index is calculated at time t according to the equation

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times\hat{P}^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}(y)\equiv\sum_{i=1}^{N}\frac{C_i}{n}(1+\frac{y}{n})^{-i}+100(1+\frac{y}{n})^{-N};$$

and, in the presence of accrued coupons at time T with the next coupon due at $t_j$, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times\hat{P}_T^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{\frac{dc(t_N-T)}{dc(year)}}$$

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; transmitting, by the electronic trading system, data regarding the government bond volatility index; receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and executing the electronic order.

[0041] ~~In some embodiments of the~~According to an eighth aspect of the present invention, there is provided a non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising: receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives including data regarding prices of options on government bond futures or government bond forwards; calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_{Yd}^{bp}(t,T,T_D,T_N)\equiv \frac{100\times\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)\times GB-VI^{bp}(t,T,T_D,T_N)}{\sum_{i=j}^{N}\frac{C_i}{n}\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_i-T)}{dc(year)}}\left(\frac{dc(t_i-T)}{dc(year)}\right)+100\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_N-T)}{dc(year)}}\left(\frac{dc(t_N-T)}{dc(year)}\right)}$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv 100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv 100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1}) \text{ for } i \geq 1, \text{ and } \Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1});$$

$GB-VI^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; transmitting, by the electronic trading system, data regarding the government bond volatility index; receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and executing the electronic order.

[0042] In some embodiments of the non-transitory computer readable storage medium, the at least one processor is further caused to create a standardized exchange-traded derivative instrument based on the government bond volatility index; and transmit data regarding the standardized exchange-traded derivative.

[0043] In some embodiments of the non-transitory computer readable storage medium, transmitting data regarding the standardized exchange-traded derivative instrument includes transmitting data regarding one or more of a settlement price, a bid price, an offer price, or a trade price of the standardized exchange-traded derivative instrument.

[0044] The foregoing is a non-limiting summary of the invention, some embodiments of which are defined by the attached claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0045] Figure 1 is a diagram of a financial exchange's computerized trading system;

[0046] Figure 2 is a diagram of a financial exchange's back end trading system;

[0047] Figure 3 is a flow diagram of a method of calculating a Basis Point GB price volatility index;

[0048] Figure 4 is a flow diagram of a method of calculating a Percentage GB price volatility index;

[0049] Figure 5 is a diagram of a general purpose computer system that can be modified via computer hardware or software to be customized and specialized so as to be suitable for use in a financial exchanges computerized trading system; and

[0050] Figure 6 is a flow diagram of a method of calculating a Basis Point GB yield volatility index.

[0051] Figure 7 is a flow diagram of a method of calculating a Modified Duration-Based Basis Point GB yield volatility index.

WHAT IS CLAIMED IS:

1. An electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising:

memory configured to store at least one program; and

at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising:

receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards;

calculating, using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i,T,T_D,T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting data regarding the government bond volatility index;

receiving an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

2. An electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising:

memory configured to store at least one program; and

at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising:

receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards;

calculating, using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI^{bp}(t,T,T_D,T_N) \equiv$$

$$100^2 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} Put_t(K_i,T,T_D,T_N)\Delta K_i + \sum_{i:K_i\geq K_*} Call_t(K_i,T,T_D,T_N)\Delta K_i\right] - (F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i = \frac{1}{2}(K_{i+1}-K_{i-1}) \text{ for } i \geq 1, \text{ and } \Delta K_0 = (K_1-K_0), \Delta K_Z = (K_Z-K_{Z-1});$$

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB - VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting data regarding the government bond volatility index;

receiving an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

3. An electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising:

memory configured to store at least one program; and

at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising:

receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards;

calculating, using the data regarding options on government bond derivatives, the government bond volatility index, wherein, in the absence of accrued coupons at time T, the government bond volatility index is calculated at time t according to the equation:

$$GB - VI_Y^{bp}(t, T, T_D, T_N) \equiv 100 \times \hat{P}^{-1}\left[\frac{GB - VI^{bp}(t, T, T_D, T_N)}{GB - VI(t, T, T_D, T_N)}\right] \times GB - VI(t, T, T_D, T_N)$$

where

$$\hat{P}(y) \equiv \sum_{i=1}^{N} \frac{C_i}{n}(1+\frac{y}{n})^{-i} + 100(1+\frac{y}{n})^{-N};$$

and, wherein, in the presence of accrued coupons at time T with the next coupon due at $t_j$, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t,T,T_D,T_N) \equiv 100 \times \hat{P}_T^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}] \times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}_T(x) \equiv \sum_{i=j}^{N} \frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}} + 100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N) \equiv$$

$$100 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} \frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i + \sum_{i:K_i \geq K_*} \frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right] - \left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N) \equiv$$

$$100^2 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} Put_t(K_i,T,T_D,T_N)\Delta K_i + \sum_{i:K_i \geq K_*} Call_t(K_i,T,T_D,T_N)\Delta K_i\right] - (F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$t_j$ is the first coupon payment on or after T;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i = \frac{1}{2}(K_{i+1}-K_{i-1}) \text{ for } i \geq 1, \text{ and } \Delta K_0 = (K_1-K_0), \Delta K_Z = (K_Z-K_{Z-1});$$

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i,T,T_D,T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

y denotes the yield of a government bond;

x denotes the yield of a government bond;

$\hat{P}(y)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}^{-1}(y)$ is the functional inverse of $\hat{P}(y)$;

$\hat{P}_T(x)$ is a bond price at time T corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$is the number of days between t and T based on a day count convention used for the government bond;

$GB-VI_Y^{bp}(t,T,T_D,T_N)$is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t,T,T_D,T_N)$is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting data regarding the government bond volatility index;

receiving an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

4. An electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising:

memory configured to store at least one program; and

at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising:

receiving data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives and includes data regarding prices of options on government bond futures or government bond forwards;

calculating, using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_{Yd}^{bp}(t,T,T_D,T_N)\equiv$$

$$\frac{100\times\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)\times GB-VI^{bp}(t,T,T_D,T_N)}{\sum_{i=j}^{N}\frac{C_i}{n}\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_i-T)}{dc(year)}}\left(\frac{dc(t_i-T)}{dc(year)}\right)+100\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_N-T)}{dc(year)}}\left(\frac{dc(t_N-T)}{dc(year)}\right)}$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv$$

$$100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i,T,T_D,T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

x denotes the yield of a government bond;

$\hat{P}_T(x)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$t_j$ is the first coupon payment on or after T;

$GB-VI_{Yd}^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting data regarding the government bond volatility index;

receiving an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

5. The electronic trading system of claim 1, wherein the at least one processor is further configured to:

create a standardized exchange-traded derivative instrument based on the government bond volatility index; and

transmit data regarding the standardized exchange-traded derivative.

6. The electronic trading system of claim 5, wherein to transmit data regarding the standardized exchange-traded derivative instrument the at least one processor is further configured to transmit data regarding one or more of a settlement price, a bid price, an offer price, or a trade price of the standardized exchange-traded derivative instrument.

7. A non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising:

receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives including data regarding prices of options on government bond futures or government bond forwards;

calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1}) \text{ for } i\geq 1, \text{ and } \Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1});$$

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting, by the electronic trading system, data regarding the government bond volatility index;

receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

8. A non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising:

receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives including data regarding prices of options on government bond futures or government bond forwards;

calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI^{bp}(t, T, T_D, T_N) \equiv$$

$$100^2 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} Put_t(K_i, T, T_D, T_N)\Delta K_i + \sum_{i:K_i \geq K_*} Call_t(K_i, T, T_D, T_N)\Delta K_i\right] - (F_t(T_D, T_N) - K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1}) \text{ for } i \geq 1, \text{ and } \Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1});$$

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB - VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting, by the electronic trading system, data regarding the government bond volatility index;

receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

9. A non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising:

receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives including data regarding prices of options on government bond futures or government bond forwards;

calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index,

wherein, in the absence of accrued coupons at time T, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times \hat{P}^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}(y)\equiv \sum_{i=1}^{N}\frac{C_i}{n}(1+\frac{y}{n})^{-i}+100(1+\frac{y}{n})^{-N};$$

and, wherein, in the presence of accrued coupons at time T with the next coupon due at $t_j$, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times \hat{P}_T^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}_T(x)\equiv \sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv$$

$$100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$t_j$ is the first coupon payment on or after T;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

y denotes the yield of a government bond;

x denotes the yield of a government bond;

$\hat{P}(y)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}^{-1}(y)$ is the functional inverse of $\hat{P}(y)$;

$\hat{P}_T(x)$ is a bond price at time T corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$GB-VI_Y^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting, by the electronic trading system, data regarding the government bond volatility index;

receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

10. A non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising:

receiving, by the electronic trading system, data regarding options on government bond derivatives, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives including data regarding prices of options on government bond futures or government bond forwards;

calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_{Yd}^{bp}(t,T,T_D,T_N) \equiv \frac{100\times\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)\times GB-VI^{bp}(t,T,T_D,T_N)}{\sum_{i=j}^{N}\frac{C_i}{n}\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_i-T)}{dc(year)}}\left(\frac{dc(t_i-T)}{dc(year)}\right)+100\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_N-T)}{dc(year)}}\left(\frac{dc(t_N-T)}{dc(year)}\right)}$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv$$

$$100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1}) \text{ for } i\geq 1, \text{ and } \Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1});$$

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

x denotes the yield of a government bond;

$\hat{P}_T(x)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$t_j$ is the first coupon payment on or after T;

$GB-VI_{Yd}^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

transmitting, by the electronic trading system, data regarding the government bond volatility index;

receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

11. The non-transitory computer readable storage medium of claim 7, wherein the computer-executable instructions further comprise instructions that, when executed by the at least one computer, configure the at least one computer to perform operations comprising:

creating a standardized exchange-traded derivative instrument based on the government bond volatility index; and

transmitting data regarding the standardized exchange-traded derivative instrument.

12. The non-transitory computer readable storage medium of claim 11, wherein the computer-executable instructions for transmitting data regarding the standardized exchange-traded derivative instrument include instructions for transmitting data regarding one or more of a settlement price, a bid price, an offer price, or a trade price of the standardized exchange-traded derivative instrument.

WHAT IS CLAIMED IS:

1. An electronic trading system for trading derivative products based on a government bond volatility index, the electronic trading system comprising:

memory configured to store at least one program; and

at least one processor communicatively coupled to the memory, in which the at least one program, when executed by the at least one processor, causes the at least one processor to perform operations comprising:

receiving data regarding options on government bond derivatives;

calculating, using the data regarding options on government bond derivatives, the government bond volatility index;

transmitting data regarding the government bond volatility index;

receiving an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

2. The electronic trading system of claim 1, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives.

3. The electronic trading system of claim 2, wherein the data regarding prices of options on government bond derivatives includes data regarding prices of options on government bond futures or government bond forwards.

4. The electronic trading system of claim 3, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI(t,T,T_D,T_N) \equiv$$

$$100 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i + \sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right] - \left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1})$ for $i \geq 1$, and $\Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i,T,T_D,T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

5. The electronic trading system of claim 3, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI^{bp}(t,T,T_D,T_N) \equiv$$

$$100^2 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} Put_t(K_i,T,T_D,T_N)\Delta K_i + \sum_{i:K_i \geq K_*} Call_t(K_i,T,T_D,T_N)\Delta K_i\right] - (F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1})$ for $i \geq 1$, and $\Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB - VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

6. The electronic trading system of claim 3,

wherein, in the absence of accrued coupons at time T, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times \hat{P}^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}(y)\equiv\sum_{i=1}^{N}\frac{C_i}{n}(1+\frac{y}{n})^{-i}+100(1+\frac{y}{n})^{-N};$$

and, wherein, in the presence of accrued coupons at time T with the next coupon due at $t_j$, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t,T,T_D,T_N)\equiv 100\times \hat{P}_T^{-1}[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}]\times GB-VI(t,T,T_D,T_N)$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv$$

$$100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$t_j$ is the first coupon payment on or after T;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1})$ for $i \geq 1$, and $\Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

y denotes the yield of a government bond;

x denotes the yield of a government bond;

$\hat{P}(y)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}^{-1}(y)$ is the functional inverse of $\hat{P}(y)$;

$\hat{P}_T(x)$ is a bond price at time T corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$GB-VI_Y^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

7. The electronic trading system of claim 3, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_{Yd}^{bp}(t,T,T_D,T_N) \equiv$$

$$\frac{100\times\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)\times GB-VI^{bp}(t,T,T_D,T_N)}{\sum_{i=j}^{N}\frac{C_i}{n}\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{-\frac{dc(t_i-T)}{dc(year)}}\left(\frac{dc(t_i-T)}{dc(year)}\right)+100\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{-\frac{dc(t_N-T)}{dc(year)}}\left(\frac{dc(t_N-T)}{dc(year)}\right)}$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv$$

$$100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

x denotes the yield of a government bond;

$\hat{P}_T(x)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$t_j$ is the first coupon payment on or after T;

$GB-VI_{Yd}^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

8. The electronic trading system of claim 1, wherein the at least one processor is further caused to:

create a standardized exchange-traded derivative instrument based on the government bond volatility index; and

transmit data regarding the standardized exchange-traded derivative.

9. The computer system of claim 8, wherein transmitting data regarding the standardized exchange-traded derivative instrument includes transmitting data regarding one or more of a settlement price, a bid price, an offer price, or a trade price of the standardized exchange-traded derivative instrument.

10. A non-transitory computer readable storage medium having computer-executable instructions recorded thereon that, when executed by at least one computer, configure the at least one computer to perform operations for trading derivative products in an electronic trading system based on a government bond volatility index, the operations comprising:

receiving, by the electronic trading system, data regarding options on government bond derivatives;

calculating, by the electronic trading system and using the data regarding options on government bond derivatives, the government bond volatility index;

transmitting, by the electronic trading system, data regarding the government bond volatility index;

receiving, by the electronic trading system, an electronic order for a derivative product based on the government bond volatility index; and

executing the electronic order.

11. The non-transitory computer readable storage medium of claim 10, wherein the data regarding options on government bond derivatives includes data regarding prices of options on government bond derivatives.

12. The non-transitory computer readable storage medium of claim 11, wherein the data regarding prices of options on government bond derivatives includes data regarding prices of options on government bond futures or government bond forwards.

13. The non-transitory computer readable storage medium of claim 12, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI(t,T,T_D,T_N)\equiv$$

$$100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i,T,T_D,T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t,T,T_D,T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

14. The non-transitory computer readable storage medium of claim 12, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI^{bp}(t,T,T_D,T_N) \equiv$$

$$100^2 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} Put_t(K_i,T,T_D,T_N)\Delta K_i + \sum_{i:K_i\geq K_*} Call_t(K_i,T,T_D,T_N)\Delta K_i\right] - (F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i = \frac{1}{2}(K_{i+1}-K_{i-1})$ for $i \geq 1$, and $\Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

15. The non-transitory computer readable storage medium of claim 12,

wherein, in the absence of accrued coupons at time T, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t, T, T_D, T_N) \equiv 100 \times \hat{P}^{-1}\left[\frac{GB-VI^{bp}(t, T, T_D, T_N)}{GB-VI(t, T, T_D, T_N)}\right] \times GB-VI(t, T, T_D, T_N)$$

where

$$\hat{P}(y) \equiv \sum_{i=1}^{N} \frac{C_i}{n}\left(1+\frac{y}{n}\right)^{-i} + 100\left(1+\frac{y}{n}\right)^{-N};$$

and, wherein, in the presence of accrued coupons at time T with the next coupon due at $t_j$, the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_Y^{bp}(t, T, T_D, T_N) \equiv 100 \times \hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t, T, T_D, T_N)}{GB-VI(t, T, T_D, T_N)}\right] \times GB-VI(t, T, T_D, T_N)$$

where

$$\hat{P}_T(x) \equiv \sum_{i=j}^{N} \frac{C_i}{n}(1+x)^{\frac{dc(t_i-T)}{dc(year)}} + 100(1+x)^{\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t, T, T_D, T_N) \equiv$$

$$100 \times \sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*} \frac{Put_t(K_i, T, T_D, T_N)}{K_i^2}\Delta K_i + \sum_{i:K_i \geq K_*} \frac{Call_t(K_i, T, T_D, T_N)}{K_i^2}\Delta K_i\right] - \left(\frac{F_t(T_D, T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv$$

$$100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$t_j$ is the first coupon payment on or after T;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i=\frac{1}{2}(K_{i+1}-K_{i-1})$ for $i\geq 1$, and $\Delta K_0=(K_1-K_0), \Delta K_Z=(K_Z-K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i,T,T_D,T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

y denotes the yield of a government bond;

x denotes the yield of a government bond;

$\hat{P}(y)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}^{-1}(y)$ is the functional inverse of $\hat{P}(y)$;

$\hat{P}_T(x)$ is a bond price at time T corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$GB-VI_Y^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB-VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB-VI(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

16. The non-transitory computer readable storage medium of claim 12, wherein the government bond volatility index is calculated at time t according to the equation:

$$GB-VI_{Yd}^{bp}(t,T,T_D,T_N)\equiv \frac{100\times\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)\times GB-VI^{bp}(t,T,T_D,T_N)}{\sum_{i=j}^{N}\frac{C_i}{n}\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_i-T)}{dc(year)}}\left(\frac{dc(t_i-T)}{dc(year)}\right)+100\left(1+\hat{P}_T^{-1}\left[\frac{GB-VI^{bp}(t,T,T_D,T_N)}{GB-VI(t,T,T_D,T_N)}\right]\right)^{\frac{dc(t_N-T)}{dc(year)}}\left(\frac{dc(t_N-T)}{dc(year)}\right)}$$

where

$$\hat{P}_T(x)\equiv\sum_{i=j}^{N}\frac{C_i}{n}(1+x)^{-\frac{dc(t_i-T)}{dc(year)}}+100(1+x)^{-\frac{dc(t_N-T)}{dc(year)}}$$

and

$$GB-VI(t,T,T_D,T_N)\equiv 100\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}\frac{Put_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i+\sum_{i:K_i\geq K_*}\frac{Call_t(K_i,T,T_D,T_N)}{K_i^2}\Delta K_i\right]-\left(\frac{F_t(T_D,T_N)-K_*}{K_*}\right)^2\right]}$$

and

$$GB-VI^{bp}(t,T,T_D,T_N)\equiv 100^2\times\sqrt{\frac{1}{(T-t)}\left[\frac{2}{P_t(T)}\left[\sum_{i:K_i<K_*}Put_t(K_i,T,T_D,T_N)\Delta K_i+\sum_{i:K_i\geq K_*}Call_t(K_i,T,T_D,T_N)\Delta K_i\right]-(F_t(T_D,T_N)-K_*)^2\right]}$$

wherein:

t denotes a time at which the government bond volatility index is calculated;

T denotes a time of expiry of options on government bond derivatives;

$T_D$ denotes a time of maturity of government bond derivatives underlying the options where $T_D \geq T$;

$T_N$ denotes a time of expiry of government bonds;

Z+1 denotes a total number of options used in the index calculation;

$K_0$ denotes the lowest strike of the Z+1 options;

$K_i$ denotes the $i^{th}$ highest strike of the Z+1 options;

$K_Z$ denotes the highest strike of the Z+1 options;

$\Delta K_i = \frac{1}{2}(K_{i+1} - K_{i-1})$ for $i \geq 1$, and $\Delta K_0 = (K_1 - K_0), \Delta K_Z = (K_Z - K_{Z-1})$;

if the price is observable at time t, then $F_t(T_D,T_N)$ is a price at time t of a government bond derivative contract underlying the put and call options, expiring at $T_D$ with an underlying government bond maturing at $T_N$;

if the price is not observable at time t, then $F_t(T_D,T_N)$ is the strike at which the difference between the put and call prices is smallest;

if there exists an option struck at $F_t(T_D,T_N)$, then $K_*$ equals $F_t(T_D,T_N)$;

if there does not exist an option struck at $F_t(T_D,T_N)$, then $K_*$ is the first available strike below $F_t(T_D,T_N)$;

$P_t(T)$ is a price at time t of a zero-coupon non-defaultable bond maturing at T;

$Put_t(K_i, T, T_D, T_N)$ is a price at time t of a put option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

$Call_t(K_i, T, T_D, T_N)$ is a price at time t of a call option, struck at $K_i$, expiring at T, and having an underlying government bond derivative expiring at $T_D$ with an underlying bond maturing at $T_N$;

N denotes the total number of coupon payments of a government bond;

$C_i$ denotes the amount of the $i^{th}$ coupon out of N coupons of a government bond;

n denotes the frequency of coupon payments per annum of a government bond;

x denotes the yield of a government bond;

$\hat{P}_T(x)$ is a bond price corresponding to a bond yield of a coupon-bearing government bond;

$\hat{P}_T^{-1}(x)$ is the functional inverse of $\hat{P}_T(x)$;

$dc(year)$ is the number of days in a year based on a day count convention used for the government bond;

$dc(T-t)$ is the number of days between t and T based on a day count convention used for the government bond;

$t_j$ is the first coupon payment on or after T;

$GB - VI_{Yd}^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point yield volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$;

$GB - VI^{bp}(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of basis point price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$; and

$GB - VI(t, T, T_D, T_N)$ is the value of the government bond volatility index in terms of percentage price volatility at time t calculated based on options expiring at T on government bond derivatives expiring at $T_D$ with an underlying bond maturing at $T_N$.

17. The non-transitory computer readable storage medium of claim 10, wherein the computer-executable instructions further comprise instructions that, when executed by the at least one computer, configure the at least one computer to perform operations comprising::

creating a standardized exchange-traded derivative instrument based on the government bond volatility index; and

transmitting data regarding the standardized exchange-traded derivative instrument.

18. The non-transitory computer readable storage medium of claim 17, wherein transmitting data regarding the standardized exchange-traded derivative instrument includes transmitting data regarding one or more of a settlement price, a bid price, an offer price, or a trade price of the standardized exchange-traded derivative instrument.