GIC Redemption Option Sensitivity Calculation

There are four types of GIC: Non-Redeemable, Redeemable, Prime, and Flexible.

Non-Redeemable is a closed GIC, which periodically pays a fixed coupon and pays the principal at maturity.

Redeemable GIC is a GIC where one month after inception till maturity (up to 7 years), the holder has an option to redeem the principal and accrued interest less a penalty based on the "call" rate specified by the exercise schedule; the schedule may include up to six contiguous windows with individual call rates.

Prime GIC has a three year maturity. Over two respective 30 day windows, which start on inception anniversary dates, the holder has an option to redeem the principal and accrued interest less penalty interest based on the call rates assigned to the respective windows.

Flexible is a one year maturity GIC whose holder has an option to redeem the principal and accrued interest without any penalty from one month after inception till maturity. If the holder chooses to redeem the GIC within the first 30 days after inception, a zero call rate is applied.

when the interest rate curve is shifted by a small amount, Δr , the option price is expected to be approximately

$$P_0 + \delta \Delta r \,, \qquad (1)$$

where P_0 is the option price for the non-shifted yield curve, and δ is the option's Delta.

Here we test how the price given by eq. (1) with P_0 and δ computed by the Treasury spreadsheet matches the price calculated by the benchmark for the shifted interest rate curve.

Closed GIC sensitivities.

Treasury calculates the following closed GIC price sensitivities:

a) DV01 $$DV01 = \frac{1}{10000} \frac{\partial\, price\left(R_1 + h, \ldots, R_n + h\right)}{\partial h}\Big|_{h=0} ;$$

b) Convexity the second derivative of the price with respect to a constant shift, expressed in basis points, of all input basis yield curve key rates, $$10^{-8} \frac{\partial^2\, price\left(R_1 + h, \ldots, R_n + h\right)}{\partial h^2}\Big|_{h=0} ;$$

c) Key Rate DV01 the first derivative of the price with respect to a downward shift, measured in basis points, of an individual basis yield curve key rate; Treasury calculates the respective Key Rate DV01 for each input basis yield curve key rate, $\frac{1}{10000} \frac{\partial\, price}{\partial R_i}$;

d) Key Rate Convexity — the second derivative of the price with respect to a shift, in basis points, of an individual basis yield curve key rate; Treasury calculates the respective Key Rate Convexity for each input basis yield curve key rate, $10^{-8} \frac{\partial^2 \, price}{\partial R_i^2}$;

e) Theta — the negative first derivative of the price with respect to time, expressed in days, remaining to maturity; Treasury calculates Theta as the difference between the price of a GIC, which is identical to the actual one but whose payment dates occur one business day earlier, and the actual GIC price.

Option sensitivities.

a) Delta — the same as DV01 with respect to the option price;

b) Gamma — the same as Convexity with respect to the option price;

c) Key Rate Delta — the same as Key Rate DV01 with respect to the option price; Treasury calculates the respective Key Rate Delta for each input basis yield curve key rate;

d) Key Rate Gamma — the same as Key Rate Convexity with respect to the option price; Treasury calculates the respective Key Rate Gamma for each input

	basis yield curve key rate (ref https://finpricing.com/lib/IrInflationCurve.html);
e) Theta	the same as the closed GIC Theta with respect to the option price;
f) Vega	the first derivative of the option price with respect to a shift in the implied Black's volatility, expressed as percentage, to which the input Hull-White volatility is calibrated.