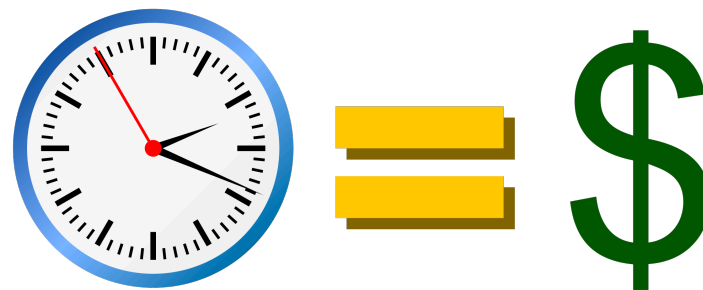


Time is money

The theory of interest rates



Everybody needs money

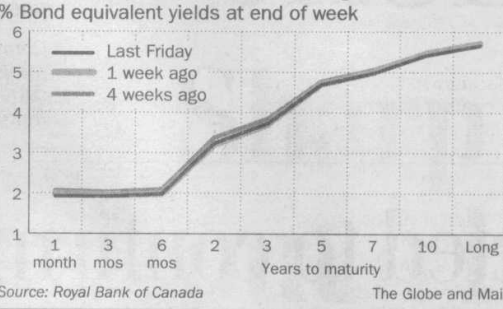
	Good	Bad
Stock	Lots of upside	Lots of downside
Bond	Safety	No upside
Convertible Bond	Lots of upside	Limited downside

CANADIAN BONDS

Provided by RBC Capital Markets
Quotations on the bond issues in the RBC Capital Markets Canadian Bond Market index. Yields are calculated to full maturity. Price is the final bid-side price as of 5 pm, Friday.

Issuer	Coupon	Maturity	Price	Yield
GOVERNMENT OF CANADA				
Broadcast Trs	7.530	May 01/27	105.93	7.02
Canada	11.750	Feb 01/03	109.78	2.39
Canada	7.570	Jun 01/03	104.15	2.70
Canada	7.250	Jun 01/03	106.18	2.70
Canada	5.250	Sep 01/03	103.62	2.97
Canada	9.500	Oct 01/03	110.52	3.19
Canada	5.000	Dec 01/03	103.20	3.24
Canada	7.500	Dec 01/03	107.76	3.24
Canada	10.250	Feb 01/04	113.45	3.44
Canada	6.500	Jun 01/04	106.56	3.61
Canada	13.500	Jun 01/04	122.55	3.59
Canada	3.500	Jun 01/04	99.70	3.63
Canada	5.000	Sep 01/04	102.93	3.82
Canada	10.500	Oct 01/04	116.85	4.78
Canada	9.000	Dec 01/04	113.62	4.32
Canada	12.000	Mar 01/05	122.59	4.24
Canada	6.000	Sep 01/05	105.57	4.33
Canada	12.250	Sep 01/05	126.48	4.31
Canada	8.750	Dec 01/05	115.33	4.42
Canada	12.500	Mar 01/06	129.64	4.56
Canada	5.750	Sep 01/06	104.33	4.70
Canada	14.000	Oct 01/06	138.86	4.72
Canada	7.000	Dec 01/06	109.58	4.78
Canada	13.750	Mar 01/07	140.11	4.84
Canada	7.250	Jun 01/07	110.94	4.92
Canada	4.500	Sep 01/07	97.73	4.97
Canada	13.000	Oct 01/07	139.36	5.01
Canada	12.750	Mar 01/08	139.95	5.09
Canada	10.000	Jun 01/08	126.50	5.09
Canada	6.000	Jun 01/08	104.71	5.13
Canada	11.750	Oct 01/08	136.55	5.23
Canada	11.500	Mar 01/09	136.69	5.27
Canada	11.000	Jun 01/09	135.02	5.23
Canada	5.500	Jun 01/09	101.29	5.29
Canada	10.750	Oct 01/09	133.59	5.38
Canada	9.500	Jun 01/10	127.82	5.34
Canada	5.500	Jun 01/10	100.71	5.39
Canada	8.750	Oct 01/10	122.49	5.47
Canada	9.000	Mar 01/11	125.16	5.46
Canada	6.000	Jun 01/11	104.15	5.43
Canada	8.500	Jun 01/11	122.60	5.40
Canada	5.250	Jun 01/12	98.23	5.48
Canada	10.250	Mar 15/14	141.15	5.55
Canada	11.250	Mar 15/15	153.30	5.55
Canada	10.500	Mar 15/21	153.68	5.82
Canada	9.750	Jun 15/21	146.94	5.77
Canada	9.250	Jun 15/22	140.67	5.82
Canada	8.000	Jun 15/23	126.32	5.83
Canada	9.000	Jun 15/25	140.02	5.84
Canada	8.000	Jun 15/27	129.07	5.80
Canada	5.750	Jun 15/29	100.90	5.68
Canada	5.750	Jun 15/31	102.36	5.59
CMBT	5.527	Jun 15/06	103.01	4.76
CMBT	4.750	Mar 15/07	98.94	4.99
CMHC	5.100	Jun 02/03	103.16	2.78
CMHC	5.300	Dec 01/03	103.06	3.32
CMHC	5.000	Jun 01/04	102.99	3.70
CMHC	5.750	Dec 01/04	104.57	4.06
CMHC	6.250	Dec 01/05	106.04	4.51
CMHC	5.250	Dec 01/06	101.46	4.94
Exp Dev	5.500	Jun 18/04	104.15	3.70
Exp Dev	5.000	May 04/06	101.13	4.71
Exp Dev	5.000	Feb 09/09	97.32	5.46
Exp Dev	6.200	Jun 22/10	103.77	5.63
Exp Dev	5.750	Jun 01/11	100.54	5.67
Farm Credit	5.000	Sep 15/03	103.07	3.11
PROVINCIAL				
Alberta	7.750	May 05/03	106.49	2.71
Alberta	5.100	Dec 01/03	103.22	3.68
Alberta	6.375	Jun 01/04	106.11	3.33
Alberta	5.750	Dec 01/04	104.50	4.08
Alberta	8.450	May 16/05	111.00	4.24
Alberta	7.500	Dec 01/05	110.53	4.32
Alberta	5.000	Dec 16/08	98.42	5.82
Alberta	5.930	Sep 16/10	101.10	5.28
BC	7.750	Jun 16/03	106.85	2.84
BC	5.500	Feb 03/04	105.95	3.49
BC	9.000	Jun 21/04	112.20	3.74
BC	8.000	Aug 23/05	111.63	4.48
BC	5.250	Dec 01/06	101.16	4.98
BC	6.000	Jun 09/08	103.24	5.67
BC	6.250	Dec 01/09	103.67	5.40
BC	6.375	Aug 23/10	104.03	5.77
BC	10.750	Feb 21/11	134.42	5.83
BC	5.750	Jan 09/12	99.15	5.86
BC	9.500	Jan 09/12	127.70	5.81
BC	8.500	Aug 23/13	121.12	5.95
BC	7.500	Jun 09/13	113.09	5.99
BC	10.600	Sep 05/10	147.95	6.22
BC	9.950	May 15/21	141.27	6.24
BC	8.750	Aug 19/22	128.47	6.27
BC	8.000	Sep 08/23	120.01	6.29
BC	5.700	Jun 18/29	92.65	6.26
BC	6.350	Jun 18/31	101.55	6.23
BC Hydro	13.500	Jan 15/11	118.89	3.69
FinanceQue	6.250	Dec 01/03	105.28	3.35
FinanceQue	6.300	Jun 01/06	105.88	4.80
FinanceQue	5.750	Dec 01/08	100.58	5.05
FinanceQue	6.250	Dec 01/15	100.06	6.24
Hydro Quebec	5.750	Feb 15/02	107.94	5.18
Hydro Quebec	5.500	May 15/03	103.65	2.72
Hydro Quebec	7.000	Jun 01/04	107.45	3.71
Hydro Quebec	5.500	Aug 15/05	113.26	4.47
Hydro Quebec	12.500	Feb 06/06	127.62	4.72
Hydro Quebec	7.000	Feb 15/07	108.53	5.08
Hydro Quebec	6.000	Jul 15/09	101.69	5.72
Hydro Quebec	6.500	Feb 15/11	103.98	5.93
Hydro Quebec	10.000	Sep 26/11	129.17	5.99
Hydro Quebec	10.250	Jul 16/12	132.50	6.03
Hydro Quebec	11.000	Aug 15/20	149.68	6.39
Hydro Quebec	10.500	Oct 15/21	145.53	6.40
Hydro Quebec	9.625	Jul 15/22	136.49	6.40
Hydro Quebec	6.000	Aug 15/31	95.04	6.37
Manitoba	1.875	Apr 07/03	106.26	2.71
Manitoba	5.650	Jul 15/04	104.31	3.84
Manitoba	9.375	Nov 15/04	114.28	4.02
Manitoba	6.250	Nov 22/05	106.01	4.35

Government of Canada yield curve



Issuer	Coupon	Maturity	Price	Yield
CU Inc	6.163	Jul 21/06	104.21	5.11
Coca-Cola	5.300	Mar 17/03	102.90	2.79
Coca-Cola	6.700	Jul 24/03	104.91	3.40
Coca-Cola	5.650	Mar 17/04	103.22	4.09
Coca-Cola	5.850	Mar 17/09	96.38	6.49
Cogeco Cable	6.750	Jun 04/09	92.92	8.04
Consumer Gas	7.200	Feb 23/04	106.41	4.01
Consumer Gas	5.850	Sep 25/08	100.13	5.83
Consumer Gas	11.150	Mar 31/09	129.22	6.09
Consumer Gas	11.950	Nov 30/10	138.48	6.24
Consumer Gas	10.800	Apr 15/11	130.54	6.38

Issuer	Coupon	Maturity	Price	Yield
CU Inc	6.800	Aug 13/19	99.68	6.83
CU Inc	11.770	Nov 30/20	152.40	6.80
CU Inc	9.920	Apr 01/22	132.24	6.93
CU Inc	9.400	May 01/23	124.66	7.13
DimrCCFin	6.500	Jun 03/03	103.29	4.15
DimrCCFin	6.470	Aug 28/03	102.95	4.52
DimrCCFin	6.600	Jun 21/04	103.26	5.16
DimrCCFin	7.200	May 03/06	102.89	6.42
DimrCCFin	7.500	Jun 01/05	103.67	6.28
DimrCCFin	7.550	Oct 01/08	99.85	7.58
DimrCCFin	6.100	Dec 18/06	100.08	6.08
Domtar Inc	10.000	Apr 15/11	107.85	8.74
Domtar Inc	10.850	Aug 15/17	115.47	8.98
Edmon, Aprt	7.214	Nov 01/30	101.00	7.13
Enbridge	5.640	Jan 30/04	103.72	3.74
Enbridge	5.600	Nov 24/05	102.30	4.94
Enbridge	5.450	Apr 12/06	101.24	5.12
Enbridge	5.621	Jan 04/07	100.61	5.48
Enbridge	6.850	Oct 26/09	104.67	6.09
Enbridge	6.800	Mar 10/10	102.87	6.34
Enbridge	6.350	Nov 17/23	90.90	7.18
Enbridge	6.050	Feb 12/29	86.92	7.15
Enbridge	7.220	Jul 24/30	96.97	7.48
Enbridge	7.200	Jun 18/32	96.67	7.48
Epcor	6.200	Jun 02/08	100.12	6.18
Epcor	6.350	Jun 28/10	102.10	6.62
Epcor	6.600	Nov 01/11	99.92	6.81
Epcor	6.750	Mar 22/16	97.28	7.05
Epcor	6.800	Jun 28/29	91.38	7.55
ERAC Ltd	7.125	Mar 01/06	102.89	6.32
ExchTower	7.779	Dec 01/05	104.75	6.38
F-M Highway	6.000	Nov 30/27	98.50	6.72
Falconbridge	8.500	Dec 08/08	99.86	8.53
Falconbridge	8.350	Mar 22/04	106.53	5.16
Falconbridge	7.750	Nov 01/04	105.84	5.47
Falconbridge	6.600	Dec 08/06	99.87	6.89
Falconbridge	7.400	Jun 13/08	101.80	4.80
Ford Credit	5.670	Apr 01/03	101.81	4.13
Ford Credit	6.040	Aug 12/03	102.64	4.30
Ford Credit	5.730	Dec 01/03	101.14	5.09
Ford Credit	6.000	Mar 08/04	101.52	5.24
Ford Credit	6.650	Jun 28/08	101.28	6.23
Ford Credit	7.163	Apr 23/07	101.07	6.92
Ford Credit	7.400	Oct 25/10	97.83	7.74
G M Accept	5.550	Mar 12/03	101.75	4.00
G M Accept	5.550	Apr 09/03	101.86	4.00
G M Accept	5.450	Apr 25/03	101.80	4.00
G M Accept	5.350	Aug 30/03	101.41	4.42
G M Accept	6.000	Jan 12/04	102.38	4.75
G M Accept	5.800	Mar 12/04	102.15	4.74
G M Accept	6.500	Jul 19/04	103.01	5.21
G M Accept	5.750	Aug 13/04	100.78	5.42
G M Accept	6.100	Jun 08/05	100.99	5.77
Gaz Metro	10.750	Dec 15/06	121.78	5.63
Gaz Metro	6.050	Nov 10/08	100.13	6.03
Gaz Metro	6.950	Nov 02/09	104.66	6.19
Gaz Metro	10.450	Oct 31/16	134.81	6.70
Gaz Metro	9.000	May 16/25	121.76	7.08
Gaz Metro	7.200	Nov 19/27	101.78	7.05
Gaz Metro	7.050	Oct 30/30	100.01	7.05
Genesis Trus	6.688	Jan 15/03	103.95	2.72
Genesis Trus	6.428	Nov 15/03	105.15	3.52
Genesis Trus	6.869	Feb 15/05	107.22	4.35
Genesis Trus	6.462	Nov 15/05	105.08	4.77
GloucesterCred	6.222	Nov 15/03	104.66	3.59
GloucesterCred	8.171	Nov 15/03	104.64	5.49

Issuer	Coupon	Maturity	Price	Yield
Oxford	6.930	Sep 11/03	104.67	4.00
Oxford	6.860	Jul 21/04	103.86	5.21
Oxford	7.250	Jun 28/08	100.12	7.23
Pancdn Pete	5.500	Mar 17/03	102.53	3.30
Pancdn Pete	7.000	Mar 23/04	100.00	6.99
Pancdn Pete	8.400	Dec 15/04	110.38	4.57
Pancdn Pete	8.750	Nov 09/05	111.01	5.52
Pancdn Pete	7.500	Aug 25/06	106.27	5.93
Pancdn Pete	5.800	Jun 02/08	97.27	6.33
Poco Petrol	6.400	Dec 03/03	103.71	4.34
Proviso	6.600	Sep 11/07	99.68	6.67
Proviso	7.650	Jan 05/06	109.59	4.97
Precision Dr	6.850	Jun 26/07	100.83	6.67
Precision Dr	7.650	Oct 27/10	101.63	7.39
PrideTrst	6.424	Sep 01/04	103.83	4.93
Proviso	6.350	Dec 01/04	104.81	4.55
Proviso	8.700	May 23/06	114.11	5.06
Quebec Tel	7.100	Feb 01/07	99.66	7.18
Renaissance	5.750	Feb 03/03	102.86	3.01
Renaissance	6.300	Jun 01/04	103.70	4.64
Renaissance	6.850	Feb 06/07	102.44	6.28
Renaissance	6.950	Jul 14/09	99.22	7.09
Riocan Reit	6.350	Oct 31/02	102.38	3.61
Riocan Reit	6.800	Aug 01/07	96.13	7.67
Royal Bank	5.400	Apr 07/03	103.02	2.90
Royal Bank	6.370	Jul		

Bond prices

Issuer	Coupon	Maturity	Price	Yield
GOVERNMENT OF CANADA				
Broadcast Trs	7.530	May 01/27	105.93	7.02
Canada	11.750	Feb 01/03	109.78	2.39
Canada	5.750	Jun 01/03	104.15	2.70
Canada	7.250	Jun 01/03	106.18	2.70
Canada	7.250	Jun 01/03	103.62	2.97
Canada	7.250	Jun 01/03	110.52	3.19
Canada	7.250	Jun 01/03	103.20	3.24
Canada	7.250	Jun 01/03	107.76	3.24
Canada	7.250	Jun 01/04	113.45	3.44
Canada	7.250	Jun 01/04	106.56	3.61
Canada	7.250	Jun 01/04	122.55	3.59
Canada	7.250	Jun 01/04	99.70	3.63
Canada	5.000	Sep 01/04	102.93	3.82
Canada	10.500	Oct 01/04	116.85	3.92
Canada	9.000	Dec 01/04	113.62	3.97
Canada	12.000	Mar 01/05	122.59	4.24
Canada	6.000	Sep 01/05	105.57	4.33
Canada	12.250	Sep 01/05	126.48	4.31
Canada	8.750	Dec 01/05	115.33	4.42
Canada	12.500	Mar 01/06	129.64	4.56
Canada	5.750	Sep 01/06	104.33	4.70
Canada	14.000	Oct 01/06	138.86	4.72
Canada	7.000	Dec 01/06	109.58	4.78
Canada	13.750	Mar 01/07	140.11	4.84
Canada	7.250	Jun 01/07	110.04	4.82

Unlike stocks
bond prices do not trade in an exchange
prices are determine by independent brokers

Clean vs. dirty prices

Issuer	Coupon	Maturity	Price	Yield
GOVERNMENT OF CANADA				
Broadcast Trs	7.530	May 01/27	105.93	7.02
Canada	11.750	Feb 01/03	109.78	2.39
Canada	5.750	Jun 01/03	104.15	2.70
Canada	7.250	Jun 01/03	106.18	2.70
Canada	5.250	Sep 01/03	103.62	2.97
Canada	9.500	Oct 01/03	110.52	3.19
Canada	5.000	Dec 01/03	103.20	3.24
Canada	7.500	Dec 01/03	107.76	3.24
Canada	10.250	Feb 01/04	113.45	3.44
Canada	6.500	Jun 01/04	106.56	3.61
Canada	13.500	Jun 01/04	122.55	3.59
Canada	3.500	Jun 01/04	99.70	3.63
Canada	5.000	Sep 01/04	102.93	3.82
Canada	10.500	Oct 01/04	116.85	3.92
Canada	9.000	Dec 01/04	113.62	3.97
Canada	12.000	Mar 01/05	122.59	4.24
Canada	6.000	Sep 01/05	105.57	4.33
Canada	12.250	Sep 01/05	126.48	4.31
Canada	8.750	Dec 01/05	115.33	4.42
Canada	12.500	Mar 01/06	129.64	4.56
Canada	5.750	Sep 01/06	104.33	4.70
Canada	14.000	Oct 01/06	138.86	4.72
Canada	7.000	Dec 01/06	109.58	4.78
Canada	13.750	Mar 01/07	140.11	4.84
Canada	7.250	Jun 01/07	110.94	4.92

With annual compounding

$$\text{Dirty price} = \sum_i p_i (1 + r)^{-t_i}$$

$$= \text{Accrued interest} + \text{Clean price}$$

Number of days
since the last
coupon payment

$$\text{Accrued interest} = \frac{n}{365} \times \text{Annual Coupon Rate}$$

Canadian Bonds

CanadianFixedIncome.ca

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CanadianFixedIncome.ca provides investors with the information they need to invest knowledgeably in the Canadian fixed income market. We provide access to the best offer prices and yields available through CBID - Perimeter Markets' electronic fixed income marketplace.

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Today's Market

CBID Fixed Income

Closing Markets		28Sep17 04:45PM EDT	
Wholesale Pricing			
Cda T-Bills	Price	Yield	
1 Month 02Nov	99.92	.88	
2 Month 30Nov	99.84	.92	
3 Month 28Dec	99.76	.98	
6 Month 22Mar	99.46	1.13	
1 Year 20Sep	98.66	1.39	

Featured Quotations

	Coupon	Eff. Maturity	Price	Yield
28-SEP-17				
CIBC Cap Tr	10.250	2108Jun30	129.78	7.46
CIBC Cap Tr	10.250	2039Jun30	129.78	7.46
TD Cap Tr	10.000	2108Jun30	127.89	7.40
TD Cap Tr	10.000	2039Jun30	127.89	7.40
TransAlta Ut	0.000	2029Oct22	44.81	6.77
TransAlta Ut	0.000	2029Oct22	44.81	6.77

MARKET SUBSCRIBERS

CBID's market subscribers are able to shop the bond inventories of multiple investment dealers in a single location in real time, searching for the best products and prices for their clients. Over 50 investment firms have recognized the significant value of price competition in the fixed income market and have given more than 2,500 advisors direct access to the CBID marketplace.

LIQUIDITY PROVIDERS

CBID is proud to provide access to the best price markets from leading Canadian investment dealers who compete in our live market.

Closing Markets as of: 4:00 PM EST 28-Sep-17

Government of Canada Benchmarks

	Coupon	Eff. Maturity	Price	Yield
2 Year	0.750	2019-Aug-01	98.60	1.53
5 Year	1.000	2022-Sep-01	96.35	1.78
10 Year	1.000	2027-Jun-01	90.42	2.10
20 Year	5.000	2037-Jun-01	139.65	2.45
30 Year	2.750	2048-Dec-01	105.43	2.50

Active Corporates

	Coupon	Eff. Maturity	Price	Yield
CIBC Cap Tr	10.250	2108-Jun-30	129.78	7.46
BNS	2.290	2024-Jun-28	97.00	2.78
LaurentianBk	3.278	2018-Oct-15	101.17	2.13
Bell CDA	2.900	2026-Aug-12	95.82	3.45
TD Cap Tr	10.000	2108-Jun-30	127.89	7.40

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<http://www.pfin.ca/canadianfixedincome/Default.aspx>

Compounding

- The definition of interest rates is dependent on the compounding convention.
- For annual compounding, a series of cashflows is discounted

$$P_1 = \sum_i p_i (1 + r)^{-t_i}.$$

- If the compounding is n times a year,

$$P_n = \sum_i p_i \left(1 + \frac{r}{n}\right)^{-t_i n}.$$

- In the limit, instantaneous compounding, yields

$$P_\infty = \sum_i p_i e^{-r t_i}.$$

- Instantaneous compounding has many analytical advantages, and from now on, we will use it most of the time.

Zero coupon bonds

Imagine a market where all bonds pay no coupons

- Bonds will contain a single cash flow: a single payment of at the time of maturity
- A bond will be characterized by three variables:
 - The notional, i.e. the payment to occur at maturity.
 - The price of the bond
 - The time to maturity
- With these concepts in mind, we define the yield

The diagram illustrates the components of the yield formula for a zero-coupon bond. It features a central equation $r(T) = -\frac{\log(P/N)}{T}$. Four blue boxes with white text are connected to the equation by arrows: 'Bond price' points to 'P' in the numerator, 'Notional' points to 'N' in the numerator, 'Time to maturity' points to 'T' in the denominator, and 'yield' points to the entire equation.

$$\text{yield} \rightarrow r(T) = -\frac{\log(P/N)}{T}$$

Bond price

Notional

Time to maturity

Cashflow valuation formula

The yield curve can then be used to calculate the price of any series of future cashflows:

$$P = \sum_i p_i e^{-r(t_i) t_i}.$$

Bootstrapping

If we return to a world where bonds have coupon payments, we can still recover the yield curve from those, avoiding the zero coupon bonds, as follows:

- For maturities less than 6 months, all coupons are zero-coupon bonds, therefore

$$r(T) = -\frac{\log(P/N)}{T} \quad \leftarrow \text{Valid for } 0 < T < 1$$

- For maturities between six months and one year, bonds have a coupon payment within six months, and another payment between six months and a year.

Known number,
using the previous step

Unknown, can be solved
as a one-variable equation

$$P = p_1 e^{-r(t_1) \cdot t_1} + p_2 e^{-r(t_2) \cdot t_2}, \quad 0 < t_1 < \frac{1}{2} < t_2 < 1.$$

From the market
(Dirty price)

- The process can be extended to infinity, therefore allowing us to calculate the yield curve for all maturities, assuming coupon bearing bonds for all maturities.