Testing the Excess Return Hypothesis: The Canadian Case

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Web Appendix

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Appendix 1

Equations

$$R_{t,t+n} = ln\left(\frac{index_{t+n}}{index_t}\right) \quad (1)$$

$$r_{t,t+n} = \left(1 + R_{t,t+n}\right)^{12/n} - 1 \quad (2)$$

$$\pi_{t,t+n} = \left\{1 + ln\left(\frac{CPI_{t+n}}{CPI_t}\right)\right\}^{12/n} - 1 \quad (3)$$

$$r^*_{t,t+n} = r_{t,t+n} - \pi_{t,t+n} \quad (4)$$

$$y^*_{t,t+n} = y_{t,t+n} - \pi_{t,t+n} \quad (5)$$

$$r_{t,t+n} = b_0 + b_1 y_{t,t+n} + u_{t,t+n} \quad (6)$$

$$r^*_{t,t+n} = b^*_0 + b^*_1 y^*_{t,t+n} + u^*_{t,t+n} \quad (7)$$

Variable Definitions

$R_{t,t+n}$ = The *ex-post* nominal monthly log return for holding stock from time t to $t+n$.

$r_{t,t+n}$ = The *ex-post* nominal annualized log return for holding stock from time t to $t+n$.

$y_{t,t+n}$ = The annualized nominal zero-coupon yield for an n-month maturity treasury bond.

$r^*_{t,t+n}$ = The annualized real *ex-post* stock return for the period t to $t+n$.

$y^*_{t,t+n}$= The annualized real zero-coupon bond yield for an n-month maturity treasury bond.

$index_{t+n}$ = The S&P/TSX Monthly Price Index at time $t+n$.

$\pi_{t,t+n}$ = Annualized inflation from time t to time $t+n$.

CPI_{t+n} = The monthly CPI at time $t+n$.

$u_{t,t+n}$ = The stochastic innovation in the nominal stock return.

$u^*_{t,t+n}$ = The stochastic innovation in the real stock return.

$z_t = y_{t-3,t}$ = The lagged real short-term interest used as an instrumental variable.

Table 1:

Data Summary

Obs: Represents number of available observations.

	Stock Return - Canada			Term Structure - Canada			Term Structure - US		
Months	From	To	Obs	From	To	Obs	From	To	Obs
3	1956:04	2008:06	627	1956:04	2008:06	627	1956:04	2008:06	627
12	1957:01	2008:06	618	1986:01	2008:06	270	1956:04	2008:06	627
24	1958:01	2008:06	606	1986:01	2008:06	270	1956:04	2008:06	627
36	1959:01	2008:06	594	1986:01	2008:06	270	1956:04	2008:06	627
60	1961:01	2008:06	570	1986:01	2008:06	270	1956:04	2008:06	627
84	1963:01	2008:06	546	1986:01	2008:06	270	1956:04	2008:06	627

Table 2:

Summary Statistics

Sample means and standard deviations for "Nominal Canadian Stock Return" $r_{t,\,t+n}$ - Can, "Real Canadian Stock Return" $r^{*}_{t,\,t+n}$ - Can, "Nominal Zero Coupon Canadian Bond Yield" $y_{t,\,t+n}$ - Can, "Real Zero Coupon Canadian Bond Yield" $y^{*}_{t,\,t+n}$ - Can, "Canadian Inflation" $\pi_{t,\,t+n}$ - Can, "Nominal Zero Coupon US Bond Yield" $y_{t,\,t+n}$ - US, "Real Zero Coupon US Bond Yield" $y^{*}_{t,\,t+n}$ - US, and "US Inflation" $\pi_{t,\,t+n}$ - US. All variables are measured in annual terms. Number of observations for each of the samples is 270.

n (Months) →		**3**	**12**	**24**	**36**	**60**	**84**
$r_{t,\,t+n}$ **- Can**	**Mean**	0.1113	0.0727	0.0677	0.0638	0.0593	0.0555
	SD	0.3083	0.1510	0.0920	0.0675	0.0411	0.0216
$r^{*}_{t,\,t+n}$ **- Can**	**Mean**	0.0848	0.0468	0.0419	0.0379	0.0326	0.0273
	SD	0.3091	0.1536	0.0959	0.0721	0.0450	0.0261
$y_{t,\,t+n}$ **- Can**	**Mean**	0.0581	0.0592	0.0612	0.0627	0.0652	0.0671
	SD	0.0297	0.0272	0.0250	0.0238	0.0225	0.0217
$y^{*}_{t,\,t+n}$ **- Can**	**Mean**	0.0316	0.0334	0.0354	0.0368	0.0386	0.0388
	SD	0.0312	0.0209	0.0191	0.0183	0.0160	0.0139
$\pi_{t,\,t+n}$ **- Can**	**Mean**	0.0265	0.0258	0.0258	0.0259	0.0267	0.0283
	SD	0.0265	0.0144	0.0122	0.0113	0.0111	0.0128
$y_{t,\,t+n}$ **- US**	**Mean**	0.0461	0.0495	0.0529	0.0549	0.0581	0.0604
	SD	0.0194	0.0196	0.0191	0.0184	0.0172	0.0165
$y^{*}_{t,\,t+n}$ **- US**	**Mean**	0.0150	0.0195	0.0234	0.0256	0.0293	0.0308
	SD	0.0278	0.0170	0.0162	0.0162	0.0143	0.0124
$\pi_{t,\,t+n}$ **- US**	**Mean**	0.0311	0.0301	0.0296	0.0294	0.0289	0.0297
	SD	0.0239	0.0106	0.0083	0.0072	0.0059	0.0073

Table 3:

Comparative Summary Statistics - 3 Month Time Horizon

Sample means and standard deviations for "Nominal Canadian Stock Return" $r_{t,\,t+n}$ - Can, "Real Canadian Stock Return" $r^{*}_{t,\,t+n}$ - Can, "Nominal Zero Coupon Canadian Bond Yield" $y_{t,\,t+n}$ - Can, "Real Zero Coupon Canadian Bond Yield" $y^{*}_{t,\,t+n}$ - Can, "Canadian Inflation" $\pi_{t,\,t+n}$ - Can, "Nominal Zero Coupon US Bond Yield" $y_{t,\,t+n}$ - US, "Real Zero Coupon US Bond Yield" $y^{*}_{t,\,t+n}$ - US, and "US Inflation" $\pi_{t,\,t+n}$ - US. Large sample includes 627 observations during the period 1956:04 - 2008:06, whereas small sample includes 270 observations during the period 1986:01 - 2008:06. All variables are measured in annual terms.

		Large Sample	**Small Sample**
$r_{t,\,t+n}$ **- Can**	**Mean**	0.1022	0.1113
	SD	0.3230	0.3083
$r^{*}_{t,\,t+n}$ **- Can**	**Mean**	0.0610	0.0848
	SD	0.3278	0.3091
$y_{t,\,t+n}$ **- Can**	**Mean**	0.0636	0.0581
	SD	0.0351	0.0297
$y^{*}_{t,\,t+n}$ **- Can**	**Mean**	0.0225	0.0316
	SD	0.0346	0.0312
$\pi_{t,\,t+n}$ **- Can**	**Mean**	0.0412	0.0265
	SD	0.0383	0.0265
$y_{t,\,t+n}$ **- US**	**Mean**	0.0540	0.0461
	SD	0.0279	0.0194

$y^*_{t,\,t+n}$ - US	Mean	0.0130	0.0150
	SD	0.0290	0.0278
$\pi_{t,\,t+n}$ - US	Mean	0.0410	0.0311
	SD	0.0339	0.0239

Table 4:

Instrumental Variable: Correlation with Stock Returns

$z_t = y_{t-3,t}$ is used as Instrumental Variable.

n (months)	3	12	24	36	60	84
Corr (z_t, $y_{t,t+n}$)	0.4826	0.8167	0.8711	0.8894	0.8912	0.8452

Table 5:

Canadian Stock Returns vs Canadian Interest Rates - Nominal

Results of OLS regression of n-period realized Canadian nominal stock returns on matching maturity Canadian nominal interest rates using equation (6). Given the presence of unit roots for return and interest rate time series data, we use first differenced data. Sample includes 269 observations for the period 1986:01 to 2008:06. Standard errors are reported in parentheses and adjusted for autocorrelation and hetroscedasticity using the Newey-West approach. Note: * statistically significant at 10%.

n (Months) →	3	12	24	36	60	84
b_0	-0.00185	-0.00054	-0.00054	0.000049	0.000049	-0.00010
	(0.0151)	(0.0118)	(0.0039)	(0.0041)	(0.0018)	(0.0018)
b_1	-7.336*	-1.379	-0.354	-0.596*	-0.226	-0.312*
	(3.8808)	(1.2900)	(0.5117)	(0.3442)	(0.2543)	(0.1697)
R^2	0.0176	0.0083	0.0025	0.0150	0.0058	0.0232

Table 6:

Canadian Stock Returns vs Canadian Interest Rates - Real

Results of OLS regression of n-period realized real Canadian stock returns on real Canadian matching maturity interest rates using equation (7). Given the presence of unit roots for return and interest rate time series data, we use first differenced data. Sample includes 269 observations for the period 1986:01 - 2008:06. Standard errors are reported in parentheses and adjusted for autocorrelation and hetroscedasticity using the Newey-West approach with a maximum lag of 4. Note: * statistically significant at 10%.

n (Months) →	3	12	24	36	60	84
b_0	0.00038	-0.00036	-0.00036	0.00015	0.00015	0.00002
	(0.0152)	(0.0122)	(0.0039)	(0.0042)	(0.0018)	(0.0018)
b_1	0.445	-0.999	-0.165	-0.478	-0.133	-0.279*
	(0.7544)	(0.7820)	(0.4605)	(0.3168)	(0.2405)	(0.1605)
R^2	0.0012	0.0084	0.0006	0.0102	0.0021	0.0189

Table 7:

Canadian Stock Returns vs US Interest Rates - Nominal

Results of OLS regression of n-period realized Canadian nominal stock returns on US matching maturity nominal interest rates using equation (6). Given the presence of unit roots for return and interest rate time series data, we use first differenced data. Sample includes 269 observations for the period 1986:01 - 2008:06. Standard errors are reported in parentheses and adjusted for autocorrelation and hetroscedasticity using the Newey-West approach with a maximum lag of 4.

n (Months) →	3	12	24	36	60	84
b_0	0.00104	-0.00029	-0.00029	0.00024	0.00024	-0.00006
	(0.0152)	(0.0122)	(0.0039)	(0.0041)	(0.0018)	(0.0017)
b_1	3.527	-0.523	0.552	-0.563	0.249	-0.0833
	(8.7123)	(1.9511)	(0.7748)	(0.4193)	(0.2985)	(0.1573)

R^2	0.0012	0.0005	0.0032	0.0081	0.0047	0.0012

Table 8:

Canadian Stock Returns vs US Interest Rates - Real

Results of OLS regression of n-period realized Canadian real stock returns on matching maturity US real interest rates using equation (7). Given the presence of unit roots for return and interest rate time series data, we use first differenced data. Sample includes 269 observations for the period 1986:01 - 2008:06. Standard errors are reported in parentheses and adjusted for autocorrelation and hetroscedasticity using the Newey-West approach with a maximum lag of 4.
Note: *** statistically significant at the 1%.

n (Months) →	3	12	24	36	60	84
b_0	0.00134	-0.000161	-0.000161	0.000276	0.000276	0.0000111
	(0.0150)	(0.0120)	(0.0039)	(0.0042)	(0.0018)	(0.0018)
b_1	2.618***	-0.060	0.494	-0.490	0.282	-0.075
	(0.8099)	(1.0663)	(0.6731)	(0.4028)	(0.2999)	(0.1539)
R^2	0.0328	0.0000	0.0030	0.0065	0.0059	0.0009

Table 9:

Canadian Stock Returns vs Canadian Interest Rates with IV - Real

Results of 2SLS regression of n-period realized Canadian real stock returns on matching maturity Canadian real interest rates. Sample included 267 observations for the period 1986:01 - 2008:06. $z_t = y_{t-3,t}$ is used as the instrumental variable. Standard errors are reported in parentheses.
Note: ***, **, * statistically significant at the 1%, 5% and 10%, respectively.

n (Months) →	3	12	24	36	60	84
b_0	0.12580*	0.11290***	0.04824***	0.03545**	0.03595***	0.04426***
	[0.06432]	[0.02622]	[0.01819]	[0.01459]	[0.01002]	[0.00619]
b_1	-0.718	-1.128***	-0.106	0.035	-0.045	-0.253***
	[1.06956]	[0.41722]	[0.28298]	[0.22278]	[0.14832]	[0.08989]

Table 10:

Canadian Stock Returns vs US Interest Rates with IV - Real

Results of 2SLS regression of n-period realized Canadian real stock returns on matching maturity US real interest rates. Sample included 267 observations for the period 1986:01 - 2008:06. $z_t = y_{t-3,t}$ is used as instrumental variable. Standard errors are reported in parentheses.
Note: ***, * statistically significant at 1% and 10% level, respectively.

n (Months) →	3	12	24	36	60	84
b_0	0.12591	0.01739	-0.02016	-0.02980*	-0.00047	0.02615***
	[0.09564]	[0.03077]	[0.01959]	[0.01564]	[0.01109]	[0.00720]
b_1	-0.902	0.592	1.176***	1.233***	0.579***	0.0200
	[2.04295]	[0.59404]	[0.35461]	[0.27393]	[0.18535]	[0.11655]

Table 11:

3-Month Canadian Stock Returns vs Interest Rates - Large Sample

Results of OLS regression of 3-month realized Canadian nominal stock returns on 3-month interest rates. Sample includes 627 observations for the period 1956:01 - 2008:06. Standard errors are reported in parentheses and adjusted for autocorrelation and hetroscedasticity using the Newey-West approach with maximum lag of 4. 1 = Nominal Canadian Stock Return vs Nominal Canadian Interest Rates, 2= Real Canadian Stock Return vs Real Canadian Interest Rates, 3 = Nominal Canadian Stock Return vs Nominal US Interest Rates, 4= Real Canadian Stock Return vs Real US Interest Rates.

n (Months) →	1	2	3	4
b_0	0.15057	0.04963	0.12030	0.04755
	[0.03407]	[0.01950]	[0.03780]	[0.01819]
b_1	-0.760	0.507	-0.336	1.038
	[0.52962]	[0.47253]	[0.71807]	[0.67342]
R^2	0.0052	0.0013	0.0008	0.0069

Table 12:

Test for Structural Change for 3-Month Asset Returns

Results of OLS regression of 3-month Canadian stock returns on 3-month interest rates. Sample includes 627 observations for the period 1956:01 - 2008:06. Standard errors are reported in parenthesis and adjusted for autocorrelation and hetroscedasticity using the Newey-West approach with maximum lag of 4. 1 = Nominal Canadian Stock Return vs Nominal Canadian Interest Rates, 2 = Real Canadian Stock Return vs Real Canadian Interest Rates, 3 = Nominal Canadian Stock Return vs Nominal US Interest Rates, 4 = Real Canadian Stock Return vs Real US Interest Rates. b_1 = Coefficient on Interest Rate, b_2 = Coefficient on "Monthly Dummy", b_3 = Coefficient on "Interaction Variable" (Monthly Dummy x Interest Rate). Reported P-value is for post estimation test for H_0: Coefficients on b_2 and b_3 are equal to 0.

n (Months) →	**1**	**2**	**3**	**4**
$\mathbf{b_0}$	0.12348	0.02421	0.11166	0.03340
	[0.05585]	[0.03075]	[0.06145]	[0.03029]
$\mathbf{b_1}$	-0.41490	1.20840	-0.27263	0.84596
	[0.87281]	[0.84268]	[1.08970]	[1.38647]
$\mathbf{b_2}$	0.07253	0.09257	0.01443	0.03291
	[0.08032]	[0.05108]	[0.09184]	[0.04374]
$\mathbf{b_3}$	-1.04510	-2.22194	-0.48877	0.38263
	[1.19693]	[1.17616]	[1.76160]	[1.54288]
P-value	0.6548	0.1039	0.9555	0.6735