APPENDIX B
ESTIMATION OF THE MARKET RISK PREMIUM

Introduction

In this Appendix, I estimate the market risk premium.[1] If the underlying relationship generating returns has remained reasonably constant then the historic realised difference between equity and bond returns is a useful benchmark for the market risk premium. At the very minimum, it constrains the range of estimates that are reasonable in current market conditions and requires an explanation of why "this time it is different,"

In analysing this historic data, however, we need to be aware of some estimation problems and the impact of changes that have occurred in the markets. This simply reflects that fact that every statistic is actually the result of specific financial and economic phenomena existing at that time.

Different Risk Premium Estimation Procedures

Suppose an investor puts $1,000 into an investment. If the investment doubles, i.e., a 100% return, to $2,000 and then halves, i.e., a -50% return, to $1,000, we can calculate two average or mean rates of return from these two simple rates of return of +100% and -50%. The ***arithmetic*** mean (AM) would be the average of these two rates of return, or 25%. However, it would be difficult to convince an investor, who after two years only has the same $1,000 that they started with, that they have earned 25%. Quite obviously, the investor is no better off at the end of the two periods than they were at the start! To counterbalance this potentially misleading statistic, most mutual funds advertise ***compound*** rates of return, which as the nth root of the terminal value divided by the initial value, minus one. In our case, there are two periods, so that n=2 and the compound rate of return is calculated as $(1/1)^{1/2}$ which is 1, indicating a zero rate of return. This gives the common sense solution that if you started and finished with $1,000, then your rate

[1] This appendix covers similar material to that covered in Laurence Booth "Equities Over Bonds: But By How Much?" *Canadian Investment Review*, Spring 1995 and "Equity Risk Premiums in the US and Canada," *Canadian Investment Review* (Spring 2001). The latter paper is available for download from Professor Booth's web site http://www.rotman.utoronto.ca/~booth

of return is zero.

An alternative way of thinking about the compound rate of return is to calculate the continuous rate of return. This is calculated as the natural logarithm of 1 plus the rate of return. So for the first period when the investment doubled this is Ln(1+100%) or Ln(2) which is 0.693147. Similarly in the second period it is Ln(1-50%) or Ln(0.5) which is -.693147. The average of these two is zero, which is the compound rate of return estimated earlier. We also call this rate of return the geometric mean rate of return (GM).

Both the arithmetic and compound rates of return are normally calculated. If we need the best estimate of *next* period's rate of return, this is the AM return. If we need the best estimate of the return over several periods, the AM return becomes less useful and more emphasis is placed on the GM return. If we want the best estimate of the rate of return earned over a long time this is the GM return. Moreover, if we ignore intervening periods, then the AM return is the same as the GM return, that is, the difference between the AM and GM returns is essentially the definition of the period over which a return is earned.

What causes the AM and GM to differ is the uncertainty in the simple rates of return. If these are constant, then both the AM and GM are identical. However, the more volatile these rates of return, the larger the difference between the AM and GM returns. There is a large amount of uncertainty or a high variance (var) in the rates of return in the example. As a result, the difference between the AM and GM returns is large: 25% vs 0%. Approximately, the relationship is as follows:

$$Compound\ rate\ of\ return = Arithmetic\ return - (var/2)$$

In estimating the market risk premium, I believe that the correct time-period for calculating rates of return is a **one-**year holding period. The reason for this is primarily because most regulated firms are regulated on the basis of annual rates of return where rates are almost always expressed as annual percentages.

In addition to the AM and GM rates of return I also estimate the rate of return by means of an

ordinary least squares regression model. This is a statistical technique that estimates the annual rate of return by minimising the deviations around the estimate. Ordinary least squares (OLS) is the standard technique for estimating economic models and is commonly used for estimating other annual growth rates, such as the growth rate in dividend growth models.

Market Risk Premium Estimates Going Forward and Backwards

In Schedule 1 I graph estimates of the average market risk premium using Canadian data and these three estimation techniques.[2] In the top graph starting in 1924-1928 the average market risk premium is estimated for each of the AM, GM and OLS and is then updated each year with the addition of a new year of data, so the second observation is for the period 1924-1929. In this way the graph captures the "learning" that goes on from 1924. The instability in the 1920s into the 1930's is evident: as the averages all start out very high, due to the strong equity markets in the 1920's, and then in the 1930s they decline precipitously after the great stock market crash of 1929. However, the market risk premium stabilises by the late 1950s, before beginning a long gradual decrease. Note that with over ninety years of data, the impact of any one-year is now very small and the market risk premium is "stuck" around 5.0%. However, it is apparent that the realised market risk premium has been **declining** almost continuously since the mid 1960's as the importance of the prewar period gets smaller and smaller and the impact of the post war period increases.

An alternative to the above procedure is to work backwards, that is, start in the five-year period 2014-2018 and then go back in time, which is the lower graph in Schedule 1. In this way, we capture what current market participants have experienced, rather than what their great grand-parents experienced. Note that whereas the previous graph always includes the period 1924-1928, this graph always includes the most recent five-year period. In this case the last five years includes more favourable equity markets similar to the 1920's. However, as we work back through time we include the impact of the 2008/9 stock market crash and need to get back to the 1950's before the market risk premium gets above 4.0%. However, the graph illustrates why

2 The graphs use data from the Canadian Institute of Actuaries, "Report on Canadian Economic Statistics" May 2018.

current market participants generally assess the risk premium of equities over bonds as much lower than 5.0%, since this is what they have experienced over the last 30 years or so.

In Schedule 2 is the AM risk premium for various holding periods. If we look at the last row we have the AM risk premium for various start dates finishing in 2017, this is essentially a subset of the data graphed in Schedule 1. Note for example, that the most recent 20-year period has an earned risk premium of 1.86%, as we go back successively by adding an extra ten years of data each time the earned risk premium drops to 0.59%, increases to about 2.0% until it finally reaches 3.18% for the last 60 years of market history. It then requires over 70 years of data to get to just below 5.0%. ***For the whole period, 1924-2017, the AM market risk premium is 4.86%.***

The usefulness of the different holding periods in Schedule 2 is simply to note the variability in the AM estimate of the experienced market risk premium that comes from using sub sets of the data. A high estimate can, for example, be estimated by ending the time period in the 1980s or 1990's by using stale data from old textbooks. Equivalently a low market risk premium can be estimated by emphasizing the most recent period since the late 1980's, as most comparable to today. In both cases, the choice is the result of a long cycle on Canadian interest rates.

We can illustrate this problem simply by graphing the behaviour of interest rates, which is the graph in in Schedule 3. Note for example, that there was very little interest rate variability in the 1930's but starting in the 1950's interest rates started to increase with inflation, thereby causing losses to anyone holding long-term bonds, since as interest rates go up the return to holding bonds goes down. This process ended in the period 1981-1989, after which it has gone into reverse until we reach the current period of very low interest rates when over 10 year maturity long Canada bonds ended 2017 at just 2.15% (V122487).

Changes in the Market Risk Premium

The fact that estimates of the market risk premium change over time indicates that some adjustments are in order. In my judgment the riskiness of the equity market is relatively stable. In fact, going back as far as 1871, there is substantial evidence that the average return on US

equities has been quite stable[3] However, there is ***no*** support for the assumption that either bond market risk or average bond market returns have been constant. As Schedule 3 shows, from 1924-1956, there was very little movement in nominal interest rates since monetary policy was subordinate to fiscal policy.4 As a result, the standard deviation of annual bond market returns was only 5.20%. In contrast, from 1956-2018, monetary policy became progressively more important and interest rates more volatile. As a result, the standard deviation of the returns from holding the long Canada bond increased substantially. Effectively bond market risk dramatically increased, while equity market risk was much the same, if not less.

This changing bond market risk is illustrated in Schedule 4, which graphs the equity market risk divided by the bond market risk. For each the risk is estimated as the standard deviation of returns over the prior ten-year period, so the series start with the first observation for the period 1924-1933. We can clearly see the dramatic decrease in equity relative to bond market risk starting in the 1950s, where equities dropped from being six times riskier than long-term Government of Canada (GOC) bonds to their low point, prior to the Internet Bubble, of similar risk. Since then the traditionally higher equity market risk as again asserted itself.

However, what is crucial for the investor is whether this risk is diversifiable, that is, is the bond market beta or risk positive? In Schedule 5, I show that the Canadian bond market beta was very large during the period from the mid-1980s until the early 2000's. This was the period when governments had severe financial problems and flooded the market with government debt. This caused both the bond and equity markets to react to a common risk factor: market interest rates. Adding long Canada bonds to an equity portfolio during the 1990's did not reduce risk to the extent that it did in the 1950's and more recently. However since the Canadian government solved its structural budget problems in the 1990's we have seen the bond market beta revert to its more typical negative or insignificant relationship.[5]

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[3] See Laurence Booth, "Estimating the Equity Risk Premium and Equity Costs: New Ways of Looking at Old Data", *Journal of Applied Corporate Finance*, Spring 1999.

4 For part of this period, the world was on the gold standard so interest rates were not as affected by national inflation rates etc., as they are now.

5 During this period, the Government of Canada long-term bond had as much market risk as low risk Canadian utilities.

In Schedule 6 are the results of a regression analysis of the real Canada bond yield against various independent variables. The real Canada bond yield is defined as the nominal yield minus the average CPI rate of inflation, calculated as the average of the current, past and forward year rates of inflation.[6] The regression model explains a large amount of the variation in real Canada yields, and five variables are highly significant.

The two main independent variables capture bond market uncertainty (risk) and the endemic problem of financing government expenditures (deficits). Risk is the standard deviation of the return on the long Canada bond over the preceding ten years. In earlier periods prior to active monetary policy, interest rates barely moved and the returns on long Canada bonds were stable. As a result, the risk of investing in them was very low. The coefficient on the risk variable indicates that for every 1% increase in bond market volatility, real Canada yields increased by about 24 basis points. That is, a 5% increase in the standard deviation of bond market returns before and after 1956 was associated with about a 1.25% increase in real Canada yields between these two periods.

The deficit variable is the total amount of government "lending" (from all levels of government) as a percentage of the gross domestic product. Statistics Canada reports this as lending but usually it is negative, that is, deficits and government borrowing. As governments increasingly ran deficits, this figure became a very large negative number. For 1992, the deficit was about 9.0% of GDP, a record peacetime high, indicating that government net borrowing was flooding the markets with government bonds. For 1997, this deficit turned into a surplus, which increased every year until 2000 when the surplus almost hit 3.0% of GDP. The coefficient in the model indicates that for every 1% increase in government borrowing real Canada yields increased by about 25 basis points. That is, increased government borrowing by competing for funds with other borrowers has driven up real interest rates. At the peak of the government's financing problems in 1992 a 9% deficit was adding well over 2.0% to the real Canada yield relative to what would have happened with a balanced budget.

These two effects can explain the huge increase in real yields in the early 1990s. In 1994, for

[6] Before 1991 there was no real return bond

example, when real yields were over 7%, the deficit added about 1.75% and the bond market uncertainty about another 2.65% or in total close to 4.5 % to the real yield. It is easy to see that with this dramatic increase in real yields there was very little "extra" risk for low risk equities over bonds at this time.

The three “dummy” or indicator variables represent unique periods of intervention in the financial markets. An indicator variable simply inserts a “1” for the years when this special phenomenon was in effect. Dum1 is for the years from 1940-1951, which were the "war" years, when interest rates were effectively controlled to finance the war and recovery. The coefficient indicates that government controls reduced real Canada yields by over 5.0% below where they would otherwise have been. Similarly, Dum2 is for the years 1972-1980, which were the oil crisis years, when huge amounts of "petrodollars" were recycled from the suddenly oil rich OPEC countries back to western capital markets. The sign on Dum2 indicates that, but for this recycling and the oil crisis, real yields would have been about 3.6% higher.

Dum3 is for the recent period of quantitative easing or central bank bond-buying since 2010, which indicates that the real yield has recently been about 2.6% below where it would have been without the recent extreme measures taken in the US, UK, Europe and Japan. These dummy variables are included due to known periods of intervention that have prevented the “normal” application of financial principles in the bond market. Essentially, at these times interest rates were determined largely by political, rather than underlying economic factors.

In Schedule 7 is a graph of the error from two models. The first (M1) is the error from a real yield model that excludes the financial crisis indicator variable. What is clear is that there is a very large model over-prediction (negative error) in the period after the financial crisis. In contrast, once Dum 3 is added (M2) this error disappears. The model indicates that but for the financial crisis the real yield with current Canadian government deficits and bond market uncertainty would be about 3.70%. This would be similar to the situation in the early 2000s.

In Schedule 8 is a graph of the real yield produced directly from the real return bond. Unfortunately, this data is not available for earlier periods, since these bonds did not exist. However, we can see directly the huge decline in the real yield as governments have regained

control over their budgets, uncertainty in the bond market has declined and monetary policy has been loose. For the period 1991-2000 the real yield was 4.0-4.5%, whereas in the after math of the financial crisis it has averaged less than 2.0% and is currently still very low 0.73%.

US Estimates

The prior discussion indicates that much of the dispute over the market risk premium is related to the behaviour of the bond and not the equity market. However, the Canadian data is one time series of equity and bond market returns and may reflect circumstances unique to Canada. Checking on US data allows an assessment as to whether these estimates are reasonable. Schedule 9 provides US estimates of the market risk premium along with the comparable Canadian estimates for the period 1926-2017.

Regardless of whether we estimate the AM, GM or OLS average, the historic record is that the US average estimate is higher than in Canada. Given the "higher" quality of the US data as well as the volatility of the estimates, many put greater faith in the US estimates. This is also frequently justified by the doubt expressed at the "higher risk"[7] Canadian market having a lower market risk premium, as well as the increasing integration between the two capital markets, which "presumably" moves Canada closer to the US experience.

However, the difference between the US and Canadian AM market risk premium estimates of 1.41% (6.08%-4.67%) is split between a difference in the average equity return of 0.98% and a difference in the average government bond return of 0.42%, that is approximately a 2:1 equity-bond market split. In explaining this, note that:

- The difference between the equity market returns can partly be explained by the historic efforts of Canadian governments to segment the Canadian equity market from that in the US[8] as well as by the historically slightly lower risk of the Canadian market.
- The difference in the bond market returns reflects the pivotal role of the US

[7] Note, however, that the standard deviation or variability of the S&P500 equity returns was 19.79% or 1.30% higher than that for the Canadian market. Over the whole period, US equities were marginally ***more*** risky than Canadian equities with most of this coming from the pre-war period.

[8] The dividend tax credit only applies to dividends from Canadian corporations; foreign withholding taxes apply to foreign source income, while portfolio restrictions have existed in tax-preferred plans.

government bond market in the world capital market as the US $ became the world's reserve currency after the second world war.

Further, we have to bear in mind that Canada is in a favourable position as an AAA rated borrower that has solved most of its structural deficit problems. Favourable government finances have resulted in low inflation and interest rates, and the removal of the foreign property restriction on tax preferred investments. We can see this in the graph of long-term interest rates in Canada and the US in Schedule 10. In the mid 1990s the nominal yield on long Canada bonds was routinely higher than that on equivalent US bonds. However, this started to change as the Government of Canada moved into a surplus position and since the mid 2000's long Canada bonds have usually had lower yields than US Treasuries. This is shown more clearly in Schedule 11 which graphs the yield spread that is, the difference between Canadian government bond yields minus those in the US.

All else constant, this swing of over 1.0% in the Canadian bond yield versus that in the US would raise the estimate of the Canadian equity market risk premium simply because it is now over a lower Canadian bond yield. Currently (late December 2018) Canadian long-term bond yields continue to be 0.77% lower than equivalent US Treasuries, consistent with lower required rates of return in Canada. As a result, although my direct estimate of the Canadian market risk premium is well under 5.0% I judge a reasonable range to be 5.0-6.0%, since this reflects the recent behaviour of interest rates in Canada and the removal of regulatory protection in the Canadian equity market.

Reasonableness of the Estimates

The prior statistical work indicates that the Canadian market risk premium has been well under 5.0% while that for the US has been about 1.4% higher, but the Canadian market risk premium has almost certainly increased. These estimates are consistent with the judgment of professionals in the area of capital markets. Professor Fernandez[9] and his co-authors survey finance professionals around the world to find out what they actually use for the market risk premium. A key result from his 2018 survey is reproduced bas follows:

9 Market risk Premium and Risk-Free Rate Used for 59 countries in 2018: a survey," IESE Business School, 2018.

Table 2. Market Risk Premium (MRP) used for 59 countries in 2018

MRP	Number of Answers	Average	St. Dev.	Median	MAX	min	St.Dev. / Average
USA	1348	5,4%	1,7%	5,2%	17,8%	1,3%	32,1%
Spain	675	6,7%	2,4%	6,2%	20,0%	0,8%	36,2%
Germany	528	5,3%	1,7%	5,2%	15,2%	1,0%	32,5%
Argentina	73	13,9%	4,7%	16,3%	20,2%	1,9%	34,3%
Australia	74	6,6%	1,4%	7,1%	10,2%	3,3%	20,8%
Austria	56	6,2%	0,7%	6,4%	7,2%	4,2%	10,5%
Belgium	53	6,2%	0,8%	6,4%	7,2%	3,3%	12,5%
Bolivia	6	6,6%	2,9%	6,6%	9,4%	3,8%	43,3%
Brazil	100	8,4%	2,3%	8,6%	15,2%	2,3%	26,9%
Bulgaria	8	7,5%	1,3%	7,7%	9,5%	5,0%	16,8%
Canada	77	5,8%	0,7%	6,0%	7,2%	4,1%	12,7%
Chile	72	6,1%	1,1%	6,2%	8,2%	3,1%	17,7%
China	95	6,3%	2,8%	7,0%	13,2%	0,6%	43,4%
Colombia	72	8,7%	3,7%	7,9%	25,2%	3,8%	42,6%
Czech Republic	63	5,9%	0,7%	6,0%	8,2%	4,8%	12,3%
Denmark	53	6,0%	0,8%	6,2%	7,2%	3,8%	12,9%
Ecuador	7	9,0%	3,5%	8,0%	12,8%	5,5%	38,7%
Egypt	9	10,9%	4,5%	12,6%	15,2%	4,8%	41,6%
Estonia	7	5,1%	1,0%	5,2%	6,1%	3,0%	20,4%
Finland	53	5,9%	0,8%	6,0%	7,2%	3,8%	13,0%
France	83	5,9%	1,6%	6,4%	8,8%	1,3%	27,3%

This table indicates that with 1,348 responses the average US market risk premium was estimated to be 5.4% with the typical (median) slightly lower at 5.2%. In contrast, the average market risk premium from the 77 responses in Canada was reported at a slightly higher 5.8% with a median of 6.0%. The median Canadian response of 6.0% was amongst the highest of the developed countries, but across these countries there is an obvious 5.0-6.0% grouping.

A feature of Fernandez's recent surveys is that they also surveyed the use of the risk free rate in estimating the required rate of return. Textbooks normally use a Treasury Bill yield, rather than the long term bond yield used before regulatory boards. However, in the US the average risk free rate was given as 2.8% and in Canada 2.9%. In both cases these look more like long term bond yields than Treasury Bill yields. Further Fernandez remarks that "most respondents use for European counties a R_F (risk free rate) higher than the yield of the 10-year Government bonds."

Finally, with both the market risk premium and the risk-free rate, the survey reports the overall return on the market as shown below where again there is a remarkable commonality: the overall average market return is 8.2% in the US and 8.7% in Canada.

Table 4. Km [Required return to equity (market): RF + MRP)] used for 59 countries in 2018

Km	Number of Answers	Average	St. Dev.	Median	MAX	min	St.Dev. / Average
USA	1348	8,2%	2,0%	8,3%	19,8%	2,4%	23,9%
Spain	675	8,8%	2,5%	8,5%	21,2%	1,9%	27,8%
Germany	528	6,7%	1,9%	6,8%	16,2%	1,0%	28,3%
Argentina	73	23,1%	6,8%	26,2%	43,5%	8,6%	29,4%
Australia	74	9,7%	1,5%	10,0%	14,4%	7,1%	15,2%
Austria	56	8,2%	1,3%	8,2%	12,4%	4,9%	15,6%
Belgium	53	7,8%	1,1%	8,1%	9,2%	4,1%	14,2%
Bolivia	6	9,6%	1,8%	9,6%	11,6%	7,6%	18,7%
Brazil	100	15,7%	3,0%	15,2%	21,4%	10,5%	19,2%
Bulgaria	8	10,3%	1,2%	10,0%	13,0%	9,1%	11,6%
Canada	77	8,7%	1,1%	9,0%	10,4%	6,1%	12,4%
Chile	72	10,2%	1,2%	10,5%	12,4%	7,1%	12,0%
China	95	10,1%	2,7%	10,6%	17,4%	4,3%	27,2%
Colombia	72	15,4%	4,4%	14,6%	35,4%	10,1%	28,7%
Czech Republic	63	8,5%	1,0%	8,5%	11,4%	6,1%	11,9%
Denmark	53	7,6%	1,0%	7,8%	9,0%	4,9%	13,3%
Ecuador	7	12,5%	4,4%	14,0%	17,0%	7,6%	34,7%
Egypt	9	20,9%	3,1%	19,0%	25,4%	18,2%	15,0%
Estonia	7	7,2%	0,8%	7,0%	8,3%	6,1%	10,8%
Finland	53	7,6%	1,0%	7,8%	9,0%	4,5%	12,9%

Estimating the cost of capital has become a business line for some organisations. In the United States Duff and Phelps purchased the Ibbotson and Associates business and now offer a variety of cost of capital services to aid corporate decision making. In Schedule 12 is their summary of their equity market risk premium and their overal equity market return estimate. From January 31, 2016 until November 14, 2016, the Duff and Phelp's estimate of the market risk premium was 5.50% over a 4.0% "normalized" 20 year US Treasury yield for an equity market return of 9.50%. Since then they have dropped their normalized Treasury yield to 3.50% in November 2016 and then their equity market risk premium to 5.0% in September 2017. Currrently, their overall equity market return is 8.50% for the US in between the Fernandez survey result of 8.20% for the US and 8.7% for Canada.

At page 35 of Mr. Troganoski's report he mentions that he uses the Duff and Phelps data to estimate the market risk premium from 1926-2016 at 6.94% which is estimated as the difference between the equity return and government bond income returns. Using Canadian data frrom 1919-2016 he uses a Canadian market risk premioum estimate caclulated in the same way at 5.60%. I have two main problems with these estimates. First, although he uses the Duff and

Phelps data he does not use their actual recommended market risk premium estimate of 5.0%. Second he estimates the equity return over "income" returns. The problem is that there is no such thing as an income return. It is simply impossible to invest in long term bonds and ignore capital gains and losses if you want to estimate an annual rate of return. The equivalent in the equity market would be to estimate the dividend "income" return and ignore all capital gains and losses.

Similar to Duff and Phelps, Credit Suisse now produces an annual "Global Investment Returns Yearbook." This used to be freely available, but now only a summary extract is available. However, the critical equity risk premium data is summarized in their Figure 5 reproduced in my Schedule 13. Between 1900-2017 the equity risk premium over Treasury Bills was highest at barely over 6.0% in Japan, but in not one country was the equity risk premium over long term bonds above 5.50% and only in a few was it even over 5.0%. In the US the equity risk premium over bonds was just over 4.0% and for Canada under 4.0%.

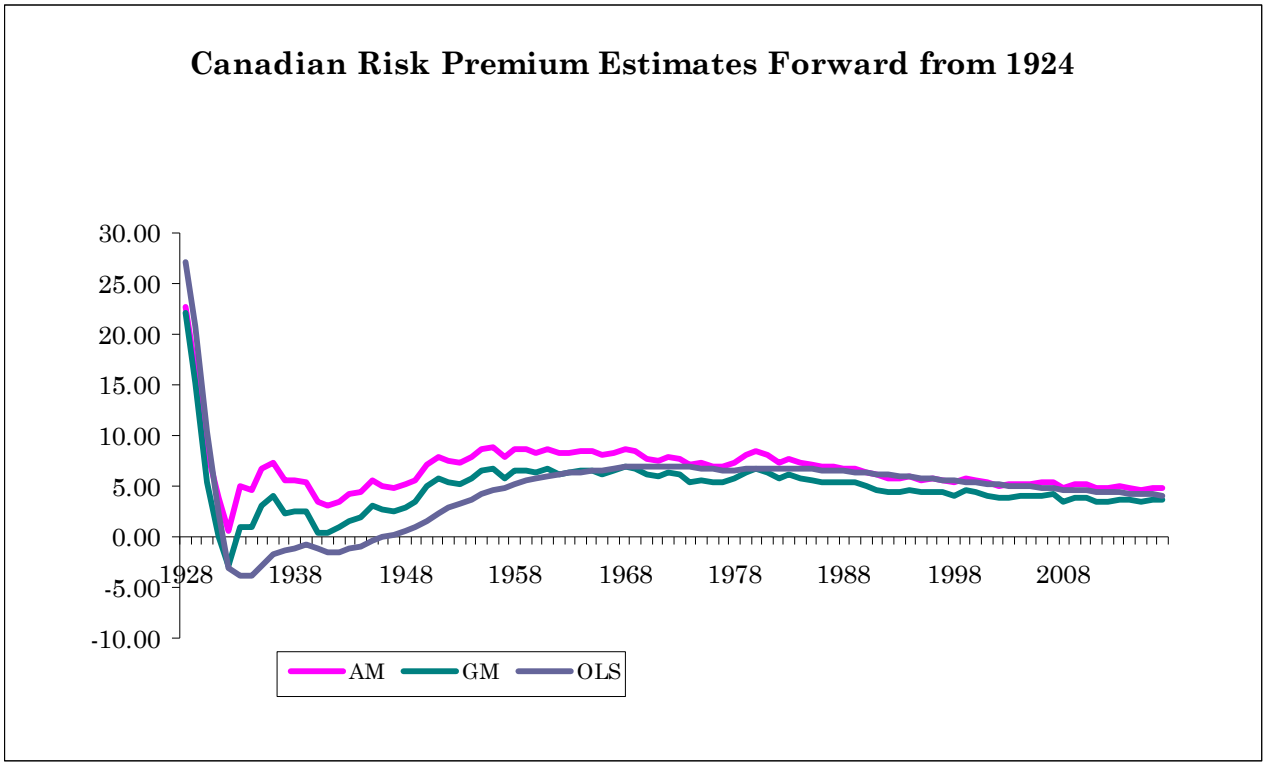
Conclusions

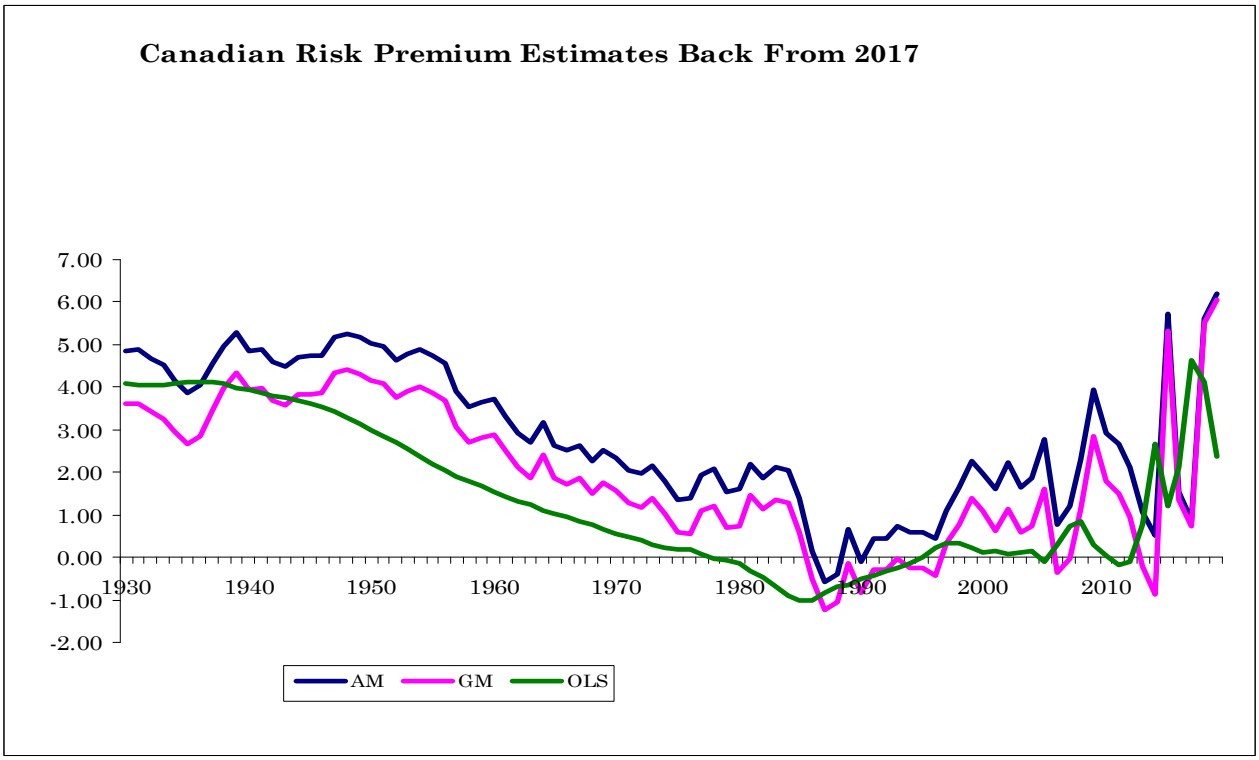
Fernandez's survey work and the professional work by Duff and Phelps and Credit Suisse all support my own empirical work and judgment that the Canadian market risk premium is currently between 5.0-6.0%. This value is at the *upper* limit of historic equity market performance, but reflects the fact that LTC yields have been significantly lower than historical data for the last 20 years. These estimates also support an overall equity market return of 8.2%-8.7%, which imply a lower required return for low risk utilities.

To summarise:

- My own direct estimate of the experienced Canadian equity risk premium since 1926 is 4.67% and for the US 6.08%.
- This historic equity risk premium in Canada is probably low given the removal of barriers to capital flows and the current very low level of Canadian bond yields.
- I would judge the equity risk premium to currently be in a range of 5.00-6.00**%.** This estimate is supported by the survey results of Fernandez and the opinion of Duff and Phelps, but is significantly higher than the widely distributed Credit Suisse report.
- The overall market return from the Fernandez survey and Duff and Phelps is 8.2% - 8.7%, which benchmarks the return for low risk Canadian utilities.

SCHEDULE 1


Canadian Risk Premium Estimates Forward from 1924
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
1928
1938
1948
1958
1968
1978
1988
1998
2008
AM
GM
OLS


Canadian Risk Premium Estimates Back From 2017
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
1930
1940
1950
1960
1970
1980
1990
2000
2010
AM
GM
OLS

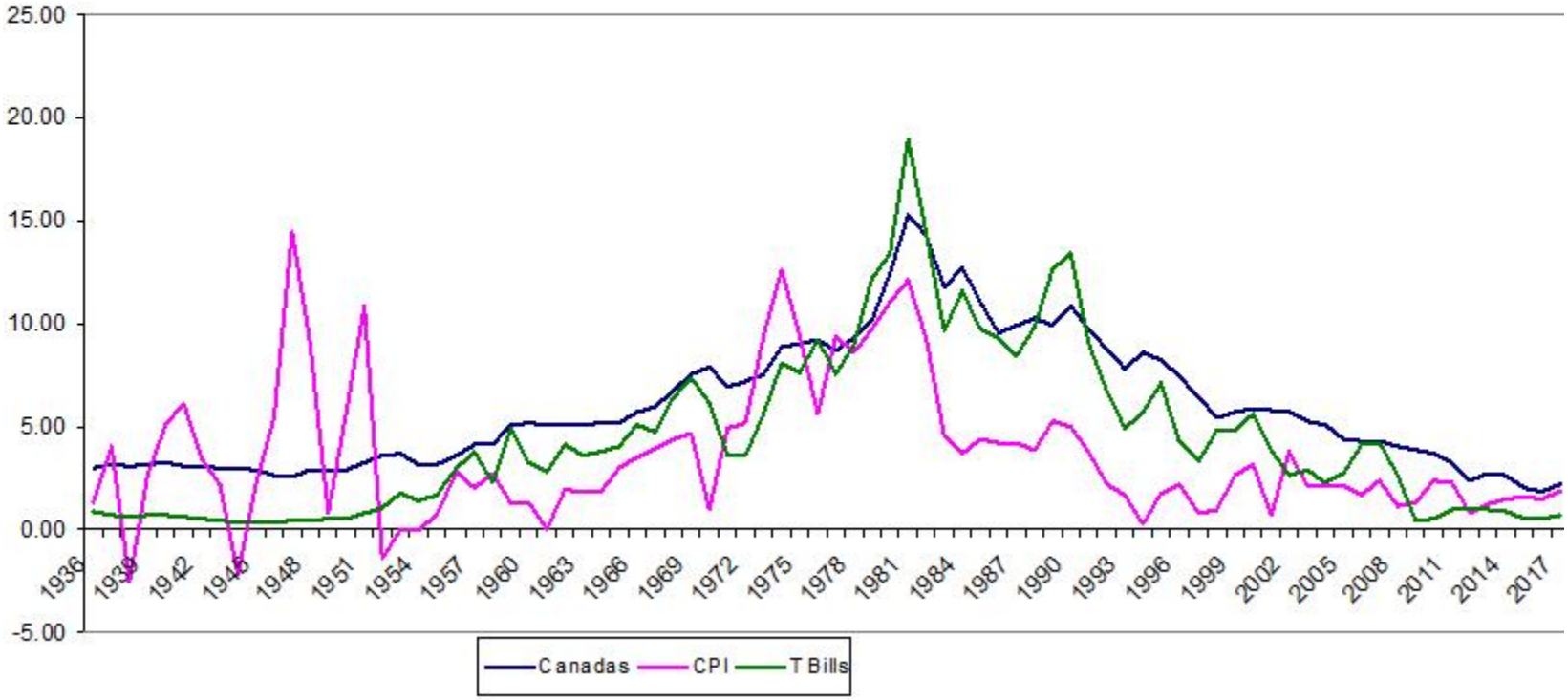
SCHEDULE 2

Arithmetic Earned Risk Premiums for Different Holding Periods

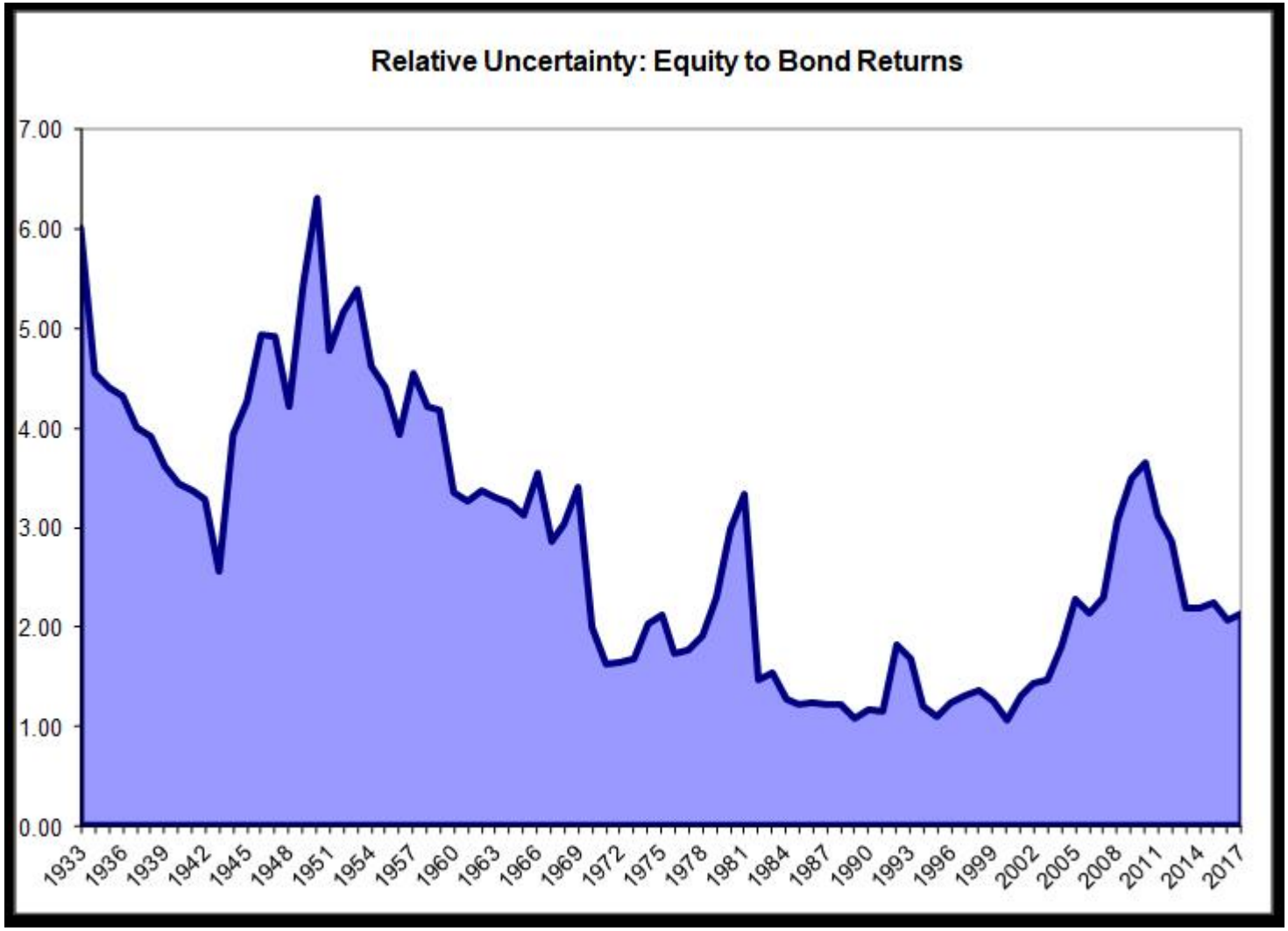
Start dates on the horizontal and ending dates on the vertical. For example, an investor would have earned a 5.78% arithmetic risk premium investing from 1958-1987.

	1924	1938	1948	1958	1968	1978	1988	1998	2008
1937	5.67								
1947	4.74	3.45							
1957	7.81	9.31	15.17						
1967	8.32	9.56	12.62	10.07					
1977	6.94	7.38	8.36	5.45	0.84				
1987	6.86	7.19	8.12	5.78	3.63	6.43			
1997	5.67	5.66	6.11	3.84	1.77	2.24	-1.96		
2007	4.74	5.32	5.63	2.84	2.13	2.56	0.63	3.22	
2017	4.86	4.71	4.90	3.18	1.81	2.05	0.59	1.86	0.51

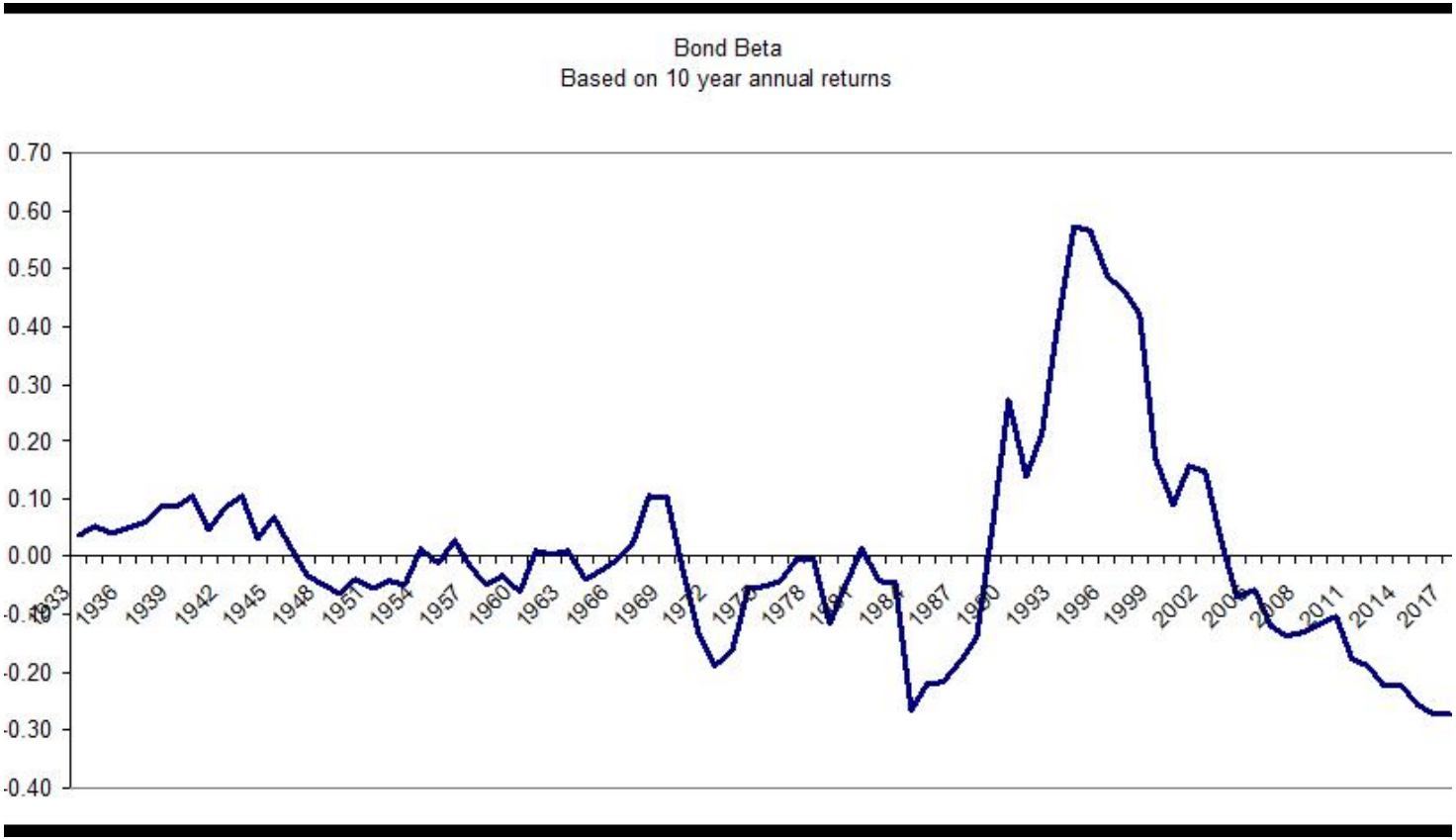
Interest Rates and Inflation
1936-2017



SCHEDULE 4


Relative Uncertainty: Equity to Bond Returns
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017

SCHEDULE 5


Bond Beta
Based on 10 year annual returns
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017

SCHEDULE 6

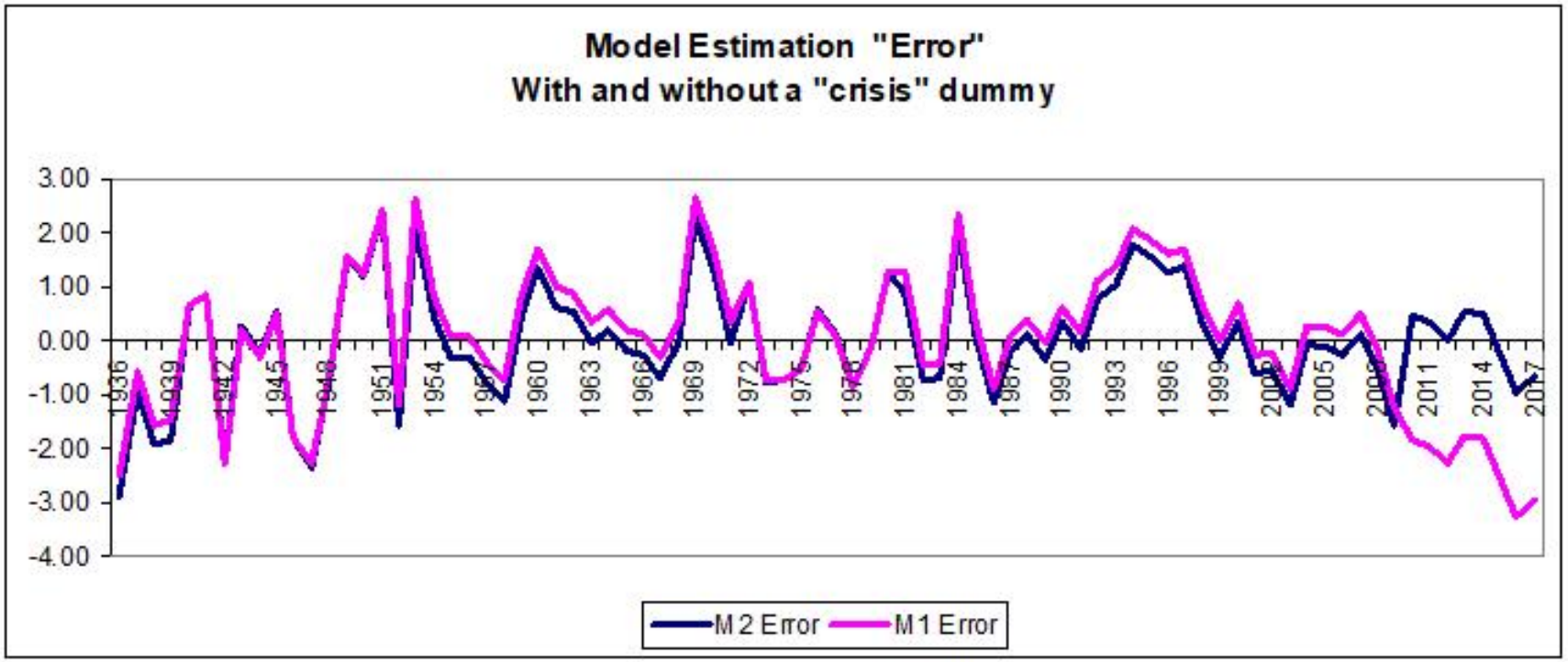
FACTORS INFLUENCING THE REAL CANADA YIELD

Dependent variable: Long Canada (over 10) yield minus the average CPI inflation rate for the past, current and forward year.

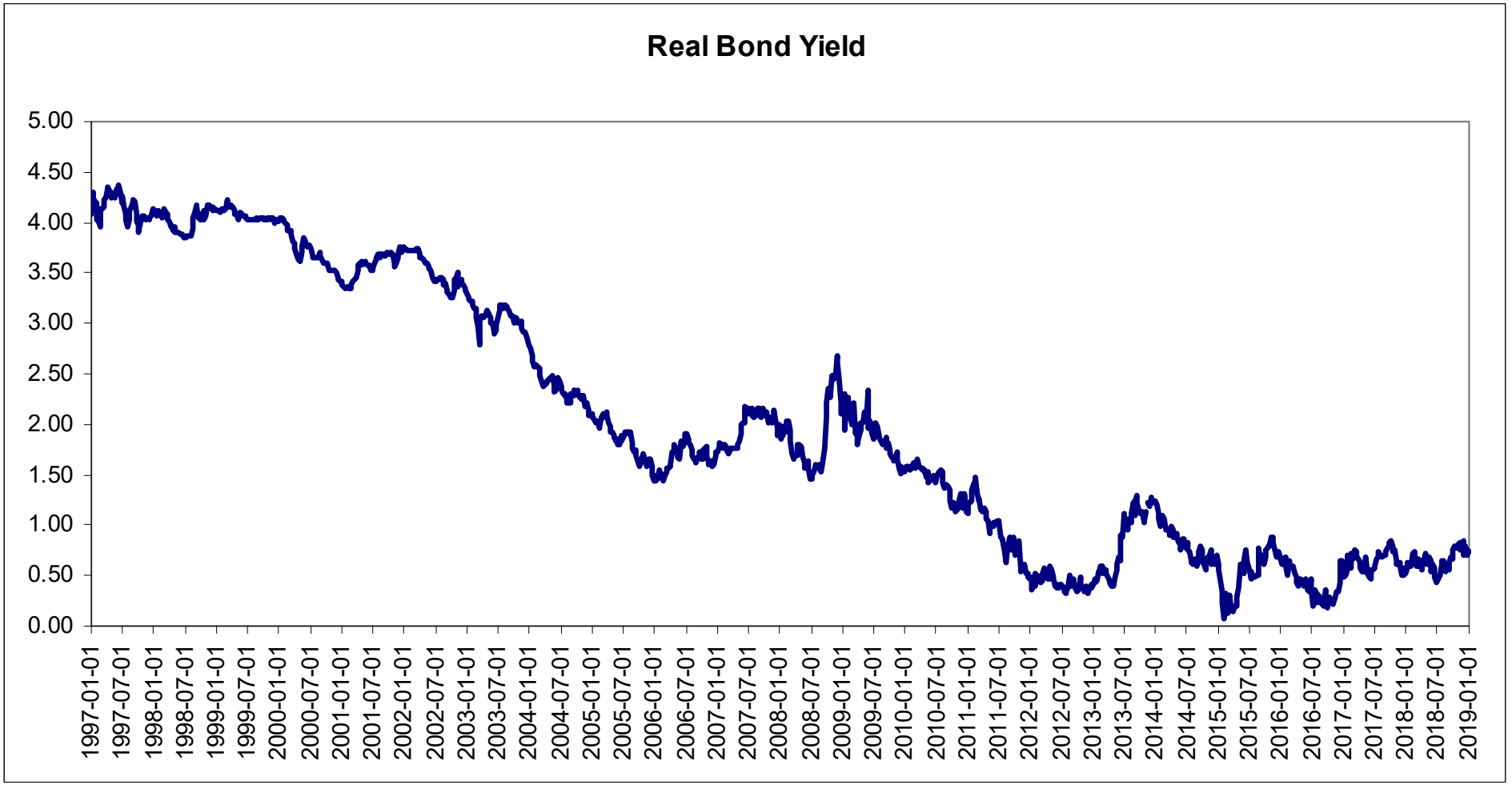
Independent variables:

	Coefficient	T-Statistic
Constant:	1.351	3.560
Risk: standard deviation of return on long bond index for prior ten years.	0.235	5.212
Deficit: aggregate government lending as a % of GDP.	-0.260	-8.853
Dum1: dummy variable for years 1940-51	-5.319	-13.151
Dum2: dummy variable for years 1972-80	-3.628	- 9.093
Dum3: dummy variable for years 2010-2017	-2.647	- 6.315

Adjusted R^2 of the regression 85.34%
Data 1936-2017


Model Estimation "Error"
With and without a "crisis" dummy
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2005
2011
2014
2017
M2 Error
M1 Error

SCHEDULE 8


Real Bond Yield
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1997-01-01
1997-07-01
1998-01-01
1998-07-01
1999-01-01
1999-07-01
2000-01-01
2000-07-01
2001-01-01
2001-07-01
2002-01-01
2002-07-01
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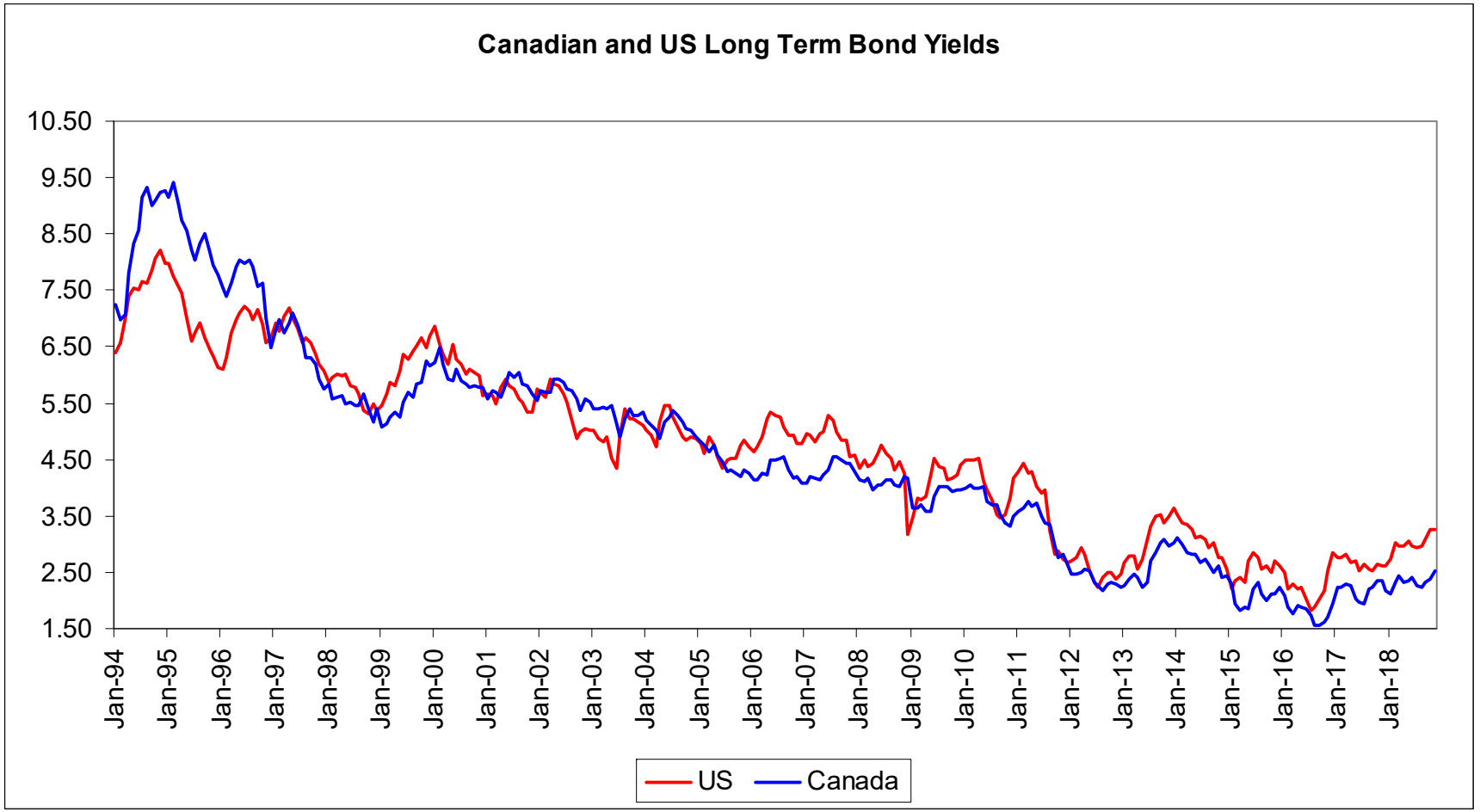
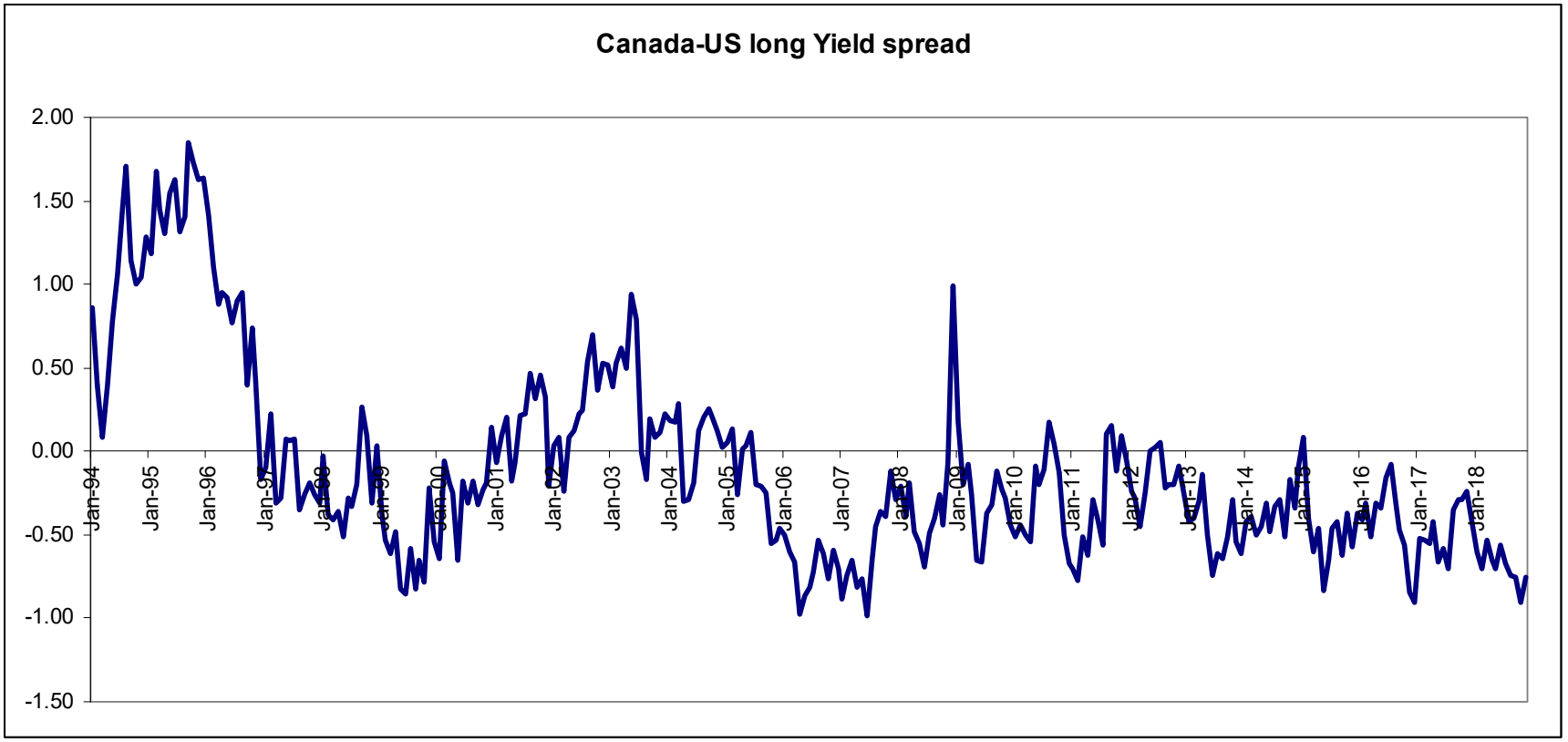
2015-01-01
2015-07-01
2016-01-01
2016-07-01
2017-01-01
2017-07-01
2018-01-01
2018-07-01
2019-01-01

Annual Rate of Return Estimates 1926-2017

	U.S.			CANADA		
	S&P Equities	Long US Treasury	Excess Return	TSE Equities	Long Canadas	Excess Return
AM	12.05	5.98	6.08	11.07	6.40	4.67
GM	10.27	5.60	4.67	9.58	6.13	3.45
OLS	10.91	5.52	5.39	10.21	6.16	4.05
Volatility[1]	19.79	9.86		18.49	8.86	


Canadian and US Long Term Bond Yields
10.50
9.50
8.50
7.50
6.50
5.50
4.50
3.50
2.50
1.50
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
US
Canada

SCHEDULE 11


Canada-US long Yield spread
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18

DUFF&PHELPS

Table: Equity Risk Premium & Risk-free Rates

September 5, 2017

For additional information, please visit
www.duffandphelps.com/CostofCapital

Duff & Phelps Recommended U.S. Equity Risk Premium (ERP) and Corresponding Risk-free Rates (R_f): January 2008–Present

Date	Risk-free Rate (R_f)	R_f (%)	Duff & Phelps Recommended ERP (%)	What Changed
Current Guidance: September 5, 2017 – UNTIL FURTHER NOTICE	**Normalized 20-year U.S. Treasury yield**	**3.50**	**5.00**	**ERP**
November 15, 2016 – September 4, 2017	Normalized 20-year U.S. Treasury yield	3.50	5.50	R_f
January 31, 2016 – November 14, 2016	Normalized 20-year U.S. Treasury yield	4.00	5.50	ERP
December 31, 2015	Normalized 20-year U.S. Treasury yield	4.00	5.00	
December 31, 2014	Normalized 20-year U.S. Treasury yield	4.00	5.00	
December 31, 2013	Normalized 20-year U.S. Treasury yield	4.00	5.00	
February 28, 2013 – January 30, 2016	Normalized 20-year U.S. Treasury yield	4.00	5.00	ERP
December 31, 2012	Normalized 20-year U.S. Treasury yield	4.00	5.50	
January 15, 2012 – February 27, 2013	Normalized 20-year U.S. Treasury yield	4.00	5.50	ERP
December 31, 2011	Normalized 20-year U.S. Treasury yield	4.00	6.00	
September 30, 2011 – January 14, 2012	Normalized 20-year U.S. Treasury yield	4.00	6.00	ERP
July 1 2011 – September 29, 2011	Normalized 20-year U.S. Treasury yield	4.00	5.50	R_f
June 1, 2011 – June 30, 2011	Spot 20-year U.S. Treasury yield	Spot	5.50	R_f
May 1, 2011 – May 31, 2011	Normalized 20-year U.S. Treasury yield	4.00	5.50	R_f
December 31, 2010	Spot 20-year U.S. Treasury yield	Spot	5.50	
December 1, 2010 – April 30, 2011	Spot 20-year U.S. Treasury yield	Spot	5.50	R_f
June 1, 2010 – November 30, 2010	Normalized 20-year U.S. Treasury yield	4.00	5.50	R_f
December 31, 2009	Spot 20-year U.S. Treasury yield	Spot	5.50	
December 1, 2009 – May 31, 2010	Spot 20-year U.S. Treasury yield	Spot	5.50	ERP
June 1, 2009 – November 30, 2009	Spot 20-year U.S. Treasury yield	Spot	6.00	R_f
December 31, 2008	Normalized 20-year U.S. Treasury yield	4.50	6.00	
November 1, 2008 – May 31, 2009	Normalized 20-year U.S. Treasury yield	4.50	6.00	R_f
October 27, 2008 – October 31, 2008	Spot 20-year U.S. Treasury yield	Spot	6.00	ERP
January 1, 2008 – October 26, 2008	Spot 20-year U.S. Treasury yield	Spot	5.00	Initialized

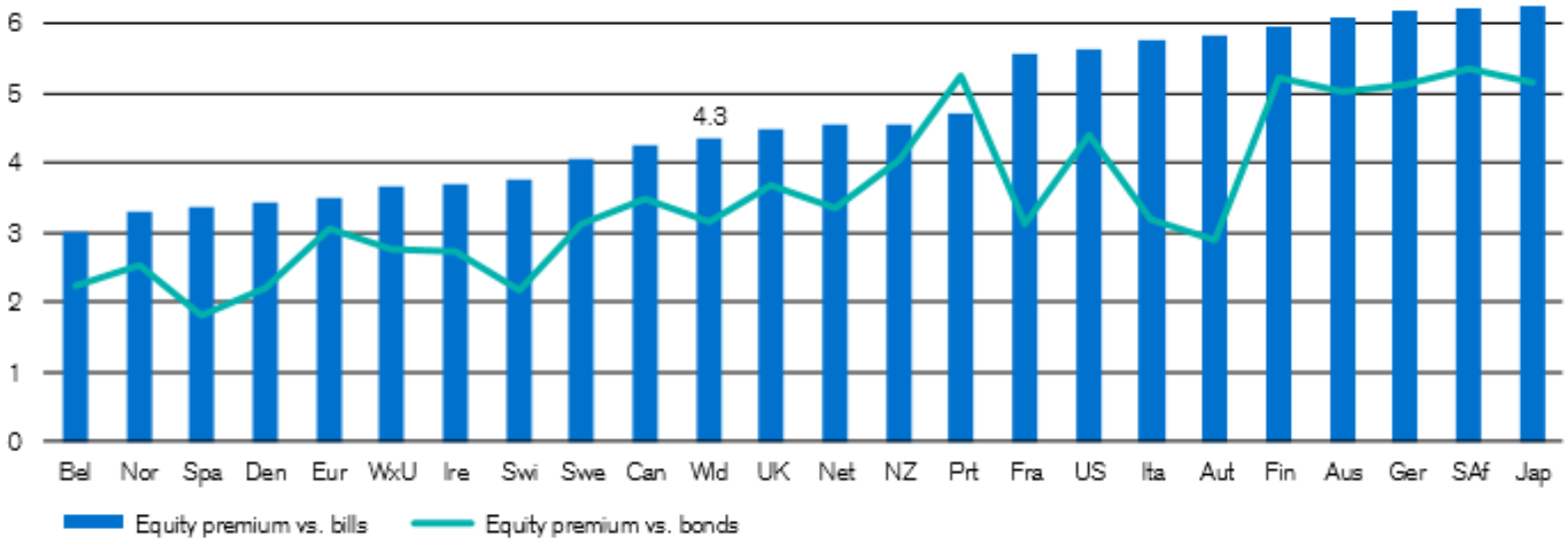
"Normalized" in this context means that in months where the risk-free rate is deemed to be abnormally low, a proxy for a longer-term sustainable risk-free rate is used.

To learn more about cost of capital issues, and to ensure that you are using the most recent Duff & Phelps Recommended ERP, visit www.duffandphelps.com/CostofCapital.

To learn more about/purchase Duff & Phelps valuation data resources published by John Wiley & Sons, visit: www.wiley.com/go/ValuationHandbooks.

Figure 8

Worldwide annualized equity risk premium (%) relative to bills and bonds, 1900–2017



Source: Elroy Dimson, Paul Marsh, and Mike Staunton, Triumph of the Optimists, Princeton University Press, 2002, and subsequent research. Premiums for Austria and Germany are based on 116 years, excluding 1921–22 for Austria and 1922–23 for Germany.