APPENDIX B
ESTIMATION OF THE MARKET RISK PREMIUM

Introduction

In this Appendix, I estimate the market risk premium which is generally expressed as the premium of the return on equities over that on long term Canada bonds.[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 the fact that every statistic is 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 is 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.

[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 Estimating the Equity Risk Premium and Expected Equity Rates of Return: The Case of Canada, *Journal of Applied Corporate Finance* Winter 2019.

This gives the common sense solution that if you started and finished with $1,000, then your rate 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 in assessing rates of return.

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 for a regulated utility, 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 utilities are regulated on the basis of annual rates of return.

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 the five year period 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" since 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 to 4.67% for the entire period 1924-2020.* This is partly because the importance of the period prior to the 1960's decreases in relative importance with every passing year.

An alternative procedure is to work backwards, that is, start in the five-year period 2016-2020 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 with its exceptionally high experienced risk premium, this graph always includes the most recent five-year period. As we work back through time we again need to get back to the 1950's before the market risk premium gets above 4.0%. Of importance is that even going back 30 years we only get a market risk premium of barely 1.0%. However, the graph illustrates why 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 during their investing life-time.

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 2020, this is essentially a subset of

2 The graphs use data from the Canadian Institute of Actuaries, "Report on Canadian Economic Statistics" 2020.

the data graphed in Schedule 1. Note for example, that the most recent 20-year period has an earned risk premium of 0.92%, as we go back successively by adding an extra ten years of data each time the earned risk premium increases slightly to 0.94%, before dropping to -0.60% over a 40 year period until eventually it reaches its high of 4.95% for the period 1941-2020.

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 in 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. This was because "modern" monetary policy did not exist in North America until the Federal Reserve's "accord" with the US Treasury in 1951. Subsequently interest rates started to increase with inflation; thereby causing losses to anyone holding long-term bonds. This is because as interest rates go up bond prices and the return from 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 exceptionally low interest rates when the yield on the over 10-year maturity long Canada bond ended 2020 at just 1.12% (Cansim series 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 real 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. As a result, the standard

[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.

deviation of annual bond market returns was only 5.18%. In contrast, from 1957-2020, 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 to 9.73%, that is, bond market risk almost doubled. In contrast, equity market risk, as measured by annual volatility declined from 21.57% to 16.22%.

This changing bond market risk is illustrated in Schedule 4, which graphs the equity market risk divided by the bond market risk. The risk is estimated as the standard deviation or volatility of returns over the prior ten-year period, so the series starts 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 as changing monetary policy made bonds riskier. During this period equities dropped from being six times riskier than long-term Canada bonds to their low point in the early 2000's of similar risk. Since then, the traditionally higher equity market risk has asserted itself again until the period after the 2008/9 financial crisis.

However, what is crucial for the investor is whether this risk is diversifiable, that is, what happens when you hold bonds along with equities in a diversified portfolio. Schedule 5 has the Canadian bond market beta showing that it was very large during the period from the mid-1980s until the early 2000's 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 either earlier or later periods.[4]

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.[5] The regression model explains a large amount of the variation in real Canada yields, and six variables are highly significant.

[4] During this period, the Government of Canada long-term bond had as much market risk as low risk Canadian utilities. Some utilities were allowed a lower return on equity than the prevailing long Canada bond yield.

[5] Before 1991 there was no real return bond.

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 0.24%. That is, the approximate 5% increase in the standard deviation of bond market returns before and after 1956 was associated with over a 1% 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. For 1992, the deficit was 9.0% of GDP, a record peacetime high until the Covid 19 pandemic struck. The sign on this variable indicates that government net borrowing was flooding the markets with government bonds causing interest rates to increase. For 1997, this deficit turned into a surplus, which increased every year until 2000 when the surplus hit almost 3.0% of GDP. The coefficient in the model indicates that for every 1% increase in government borrowing real Canada yields increased by about 26 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 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 four “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. For example, in 1944 the government ran a deficit of over 20% of GDP, which normally would have caused a huge increase in interest rates except for government controls. 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.[6]

Dum3 is for the recent period of unconventional monetary policy and central bank bond-buying since 2010, which indicates that the real yield has recently been about 2.7% below where it would have been without the extreme measures taken in the US, UK, Europe, and Japan. Finally, 2020 is special unto itself, since with a budget deficit of over 10% of GDP, the Bank of Canada has for the first time in recent financial history been financing the government deficit through purchasing 40% of the Treasury bill auction and buying $5 billion of Government of Canada bonds at auction. There is only one indicator variable for 2020, but it indicates that the buying by the Bank decreased the real yield by 3.36%, which was the obvious policy objective of the bond buying program.

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 is the error from a real yield model that excludes the financial crisis and Covid 19 indicator variables (without OLS) estimated using ordinary least squares (OLS) and the second includes them (with OLS). 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 and Dum 4 are added this error largely disappears.

In Schedule 8 is a graph of the real yield produced directly from the real return bond.

[6] These years can be viewed as a tax on western oil consuming countries and the inflation that resulted as the “working out” of who pays the tax.

Unfortunately, this data is not available for earlier periods since these bonds did not exist. However, we can see 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% before collapsing to negative levels during 2020.

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 1926-2020.

Regardless of whether we estimate the AM, GM or OLS average, the historic record is that the US estimate of the market risk premium 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 since 1926 of 1.58% (6.08%-4.50%) is split between a difference in the average equity return of 1.22% and a difference in the average government bond return of 0.35%, that is approximately a 4:1 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], by the historically slightly lower risk of the Canadian market and the

[7] Note, however, that the standard deviation or variability of the S&P500 equity returns was 19.66% or 1.40% 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

"survivor bias" of the success of the US economy.

- The difference in the bond market returns reflects the pivotal role of the US 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 until recently had 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 treasury 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. Typically, long Canada bonds have recently had yields about 0.50% less than equivalent US Treasuries.

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. *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

In assessing the reasonableness of the prior statistical work, we can look at what professionals actually use. On July 17, 2019, BVWire[9] reported the results of a small survey which indicated the following data sources were relied on by professionals:

- 69% said they use Duff and Phelps

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apply to foreign source income, while portfolio restrictions have existed in tax-preferred plans.

[9] Business Valuation Resources, BVWire 202-2, July 17, 2019.

- 45% Professor Aswath Damadoran
- 13% Professor Pablo Fernandes

Duff and Phelps purchased the original data from Ibbotson and Sinquefield which has a long history of being used in regulatory hearings and was originally developed at the University of Chicago.[10] Duff and Phelps base their market risk premium and cost of capital report on this data and market their "Cost of Capital Navigator" product.[11] This is a subscription-based product that provides cost of capital estimates for US and international companies. While this is a subscription-based product they provide their overall market risk premium estimates on their web page. I produce the history of the D&P market risk premium estimates in Schedule 12.

In December 2020 the Duff and Phelp's estimate of the equity market risk premium was 5.50% over a a 2.50% "normalised" 20 year US Treasury yield for an equity market return of 8.00%. As they explain in the footnote, normalised is a proxy for a longer term risk-free rate when the currrent rate is abnormally low, as it is now. Additionally since the inception of the Duff and Phelps service in 2008 their recommended market risk premium estimate has ranged between 5.0% and 6.0%, the most important change has been the risk-free rate over which the market risk premium is measured. Duff and Phelps has variously used the spot or actual risk-free rate or a normalised rate ranging from 2.5% to 4.5%. However, the important point is that Duff and Phelps current market risk poremium is right in the middle of my 5.0-6.0% range.

Aswath Damodaran is a Professor of Finance at New York Univrrsity's Stern School of Business. Damodaran teaches corporate finance and valuation and has a keen interest in equity risk premiums. At Schedule 13 is his graph of the "implied" equity risk premium ftom 1960 to 2019.[12] This estimate is based on "potential" dividends as a proxy for cash flow and a two stage discounted cash flow model. What is striking is that only rarely does his implied equity or market risk premium exceed 6.0% and for the last ten plus years it has also been in the 5.0-6.0% range that I use. Moreover I would regard his estimates as high for three reasonss: 1) his cash

[10] R. G. Ibbotson and R. Singuefield, Stocks, bonds, bills, and inflation: year by year historical returns (1926-1974), *Journal of Business* 49-1, pp 11-47.

[11] See Cost of Capital Navigator | Duff & Phelps (dpcostofcapital.com)

[12] Taken from page 99 of Equity risk premiums (ERP): Determinants, estimation, and implications- the 2020 Edition.

yield includes the impact of share buybacks but not new share issues so is high; 2) he uses analyst growth estiates which even for the overall market may be slightly high, which is why he tapers them with the long run growth rate using the two stage DCF model; and 3) his risk premium is over the ten year US government yield instead of the long term yield as is the practise in regaultory hearings in Canada. His last estimate for the market risk premium in 2020 was 5.2%.

For final sources is the annual survey work of Professor Pablo Fernandes[13] and his co-authors.[14] They survey professionals around the world to find out what they use for the market risk premium. The professionals include analysts in companies, investment banks and professors. A key result from his survey and his table 2 is reproduced below. The table indicates that with 2,156 responses the average US market risk premium was estimated to be 5.6% with the typical (median) value slightly lower at 5.4%. The average market risk premium from the 49 responses in Canada was 5.7% with a median value of 5.5%. Noticeably, the highest value reported by any finance professional in Canada was 8.4%. With a vastly larger number of people responding in the US the range between the minimum and maximum values is higher at from 2.0% to 13.4%.

Table 2. Market Risk Premium (MRP) used for 81 countries in 2020

MRP	Number of Answers	Average	St. Dev.	Median	MAX	min
USA	2156	5,6%	1,4%	5,4%	13,4%	2,0%
Spain 2020	521	6,3%	1,6%	6,4%	13,3%	2,8%
Argentina	31	17,3%	7,9%	15,0%	30,4%	4,8%
Australia	37	7,9%	4,8%	6,2%	20,4%	2,8%
Austria	117	6,2%	1,3%	5,9%	10,4%	3,8%
Belgium	119	6,2%	1,3%	6,0%	10,4%	3,8%
Bolivia	17	8,9%	1,3%	8,9%	11,4%	6,3%
Bosnia	9	11,2%	1,4%	11,5%	13,4%	8,8%
Brazil	51	7,9%	1,4%	7,9%	10,8%	5,7%
Bulgaria	16	7,6%	0,8%	7,7%	9,2%	5,8%
Canada	49	5,7%	0,9%	5,5%	8,4%	4,2%

[13] Market risk Premium and Risk-Free Rate Used for 81 countries in 2020: a survey," IESE Business School, March 25, 2020. Previous survey results were reported in "Market risk premium used in 71 countries in 2016: a survey with 6,932 answers, *Journal of International Business Research and Marketing,* 2(6), pp 23-31.

[14] These include financial analysts, corporate analysts, and finance faculty.

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. The addition of the risk-free rate to the market risk premium provides each country's estimate of its required return on its equity market. (Km). There is a remarkable commonality across most of the developed markets with low and stable inflation. The overall average and median equity market return is 7.4% in both the US and Canada.

Table 4. Km [Required return to equity (market): RF + MRP)] used for 81 countries in 2020

Km	Number of Answers	Average	St. Dev.	Median	MAX	min
USA	2156	7,4%	1,6%	7,4%	15,3%	3,0%
Spain 2020	521	7,6%	1,9%	7,5%	17,0%	3,3%
Argentina	31	29,6%	13,3%	26,1%	55,7%	5,1%
Australia	37	10,3%	5,2%	9,0%	23,3%	4,5%
Austria	117	7,1%	1,5%	7,0%	10,4%	4,5%
Belgium	119	7,2%	1,5%	7,3%	10,4%	4,5%
Bolivia	17	12,0%	1,7%	11,9%	14,6%	8,9%
Bosnia	9	20,3%	1,5%	20,7%	22,3%	18,0%
Brazil	51	12,7%	2,9%	13,1%	19,7%	6,0%
Bulgaria	16	9,9%	2,1%	10,5%	12,8%	6,3%
Canada	49	7,4%	1,3%	7,4%	10,5%	4,9%
Chile	30	10,2%	1,9%	10,2%	16,3%	7,0%

Similar to Duff and Phelps, Credit Suisse now produces an annual "Global Investment Returns Yearbook." The critical equity risk premium data is summarized in their Figure 11 reproduced in my Schedule 13. Between 1900 and 2020, the equity risk premium over Treasury Bills was highest at barely over 6.0% in Japan, but in no country was the equity risk premium over long term bonds materially above 5.0%.

Conclusions

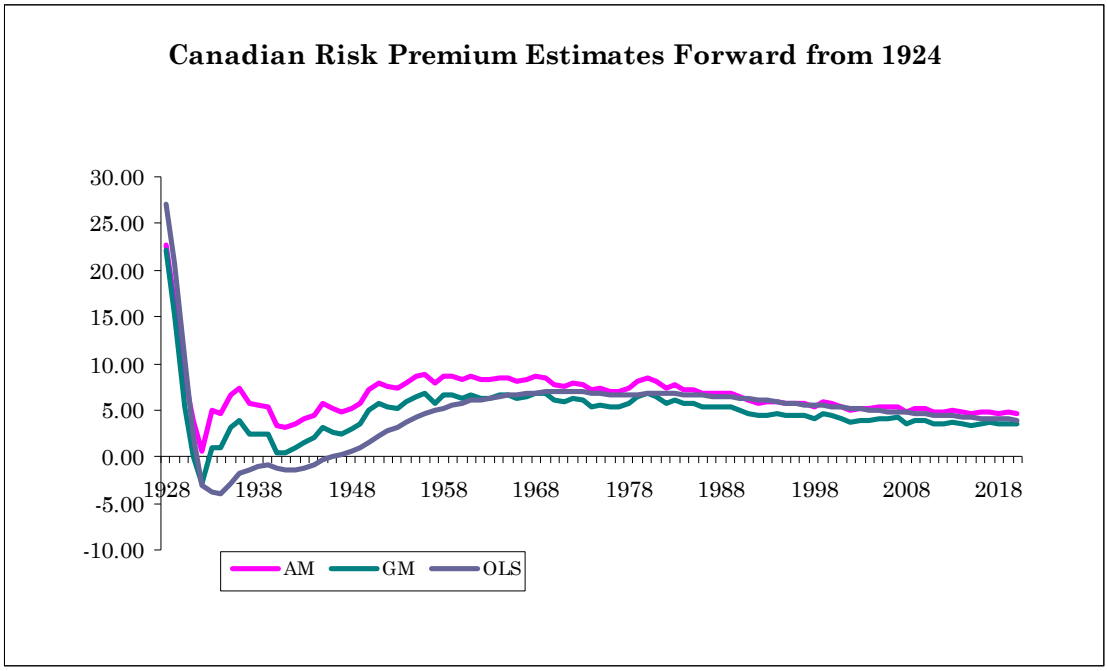
Professor Fernandez's survey work, the academic work of Aswath Damodaran and the professional work by Duff and Phelps and Credit Suisse all support my own empirical work and judgment that the Canadian market risk premium is between 5.0-6.0%. This value is at the *upper* limit of historic equity market performance, but reflects the fact that long Canada bond yields have been significantly lower than historical data for the last 20 years even before the impact of

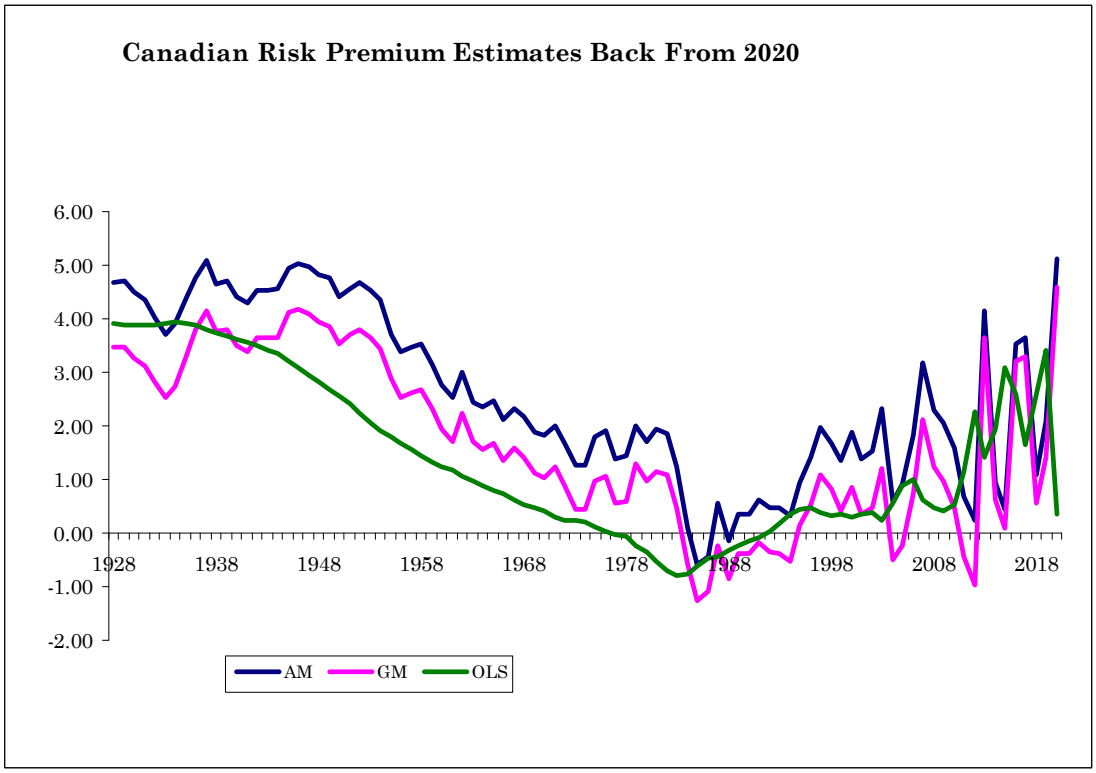
Covid 19. These estimates also support an overall equity market return of 7.4-8.0%, which imply an upper bound for lower risk regulated utilities.

To summarise:

- My own direct estimate of the experienced Canadian equity risk premium since 1926 is 4.50% and for the US 6.06%.
- 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 Fernandes and the opinion of Duff and Phelps but is significantly higher than the widely distributed Credit Suisse report.
- The overall market return from Fernandez and Duff and Phelps is 7.4%- 8.0%, which I regard as slightly low but 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
2018
AM
GM
OLS

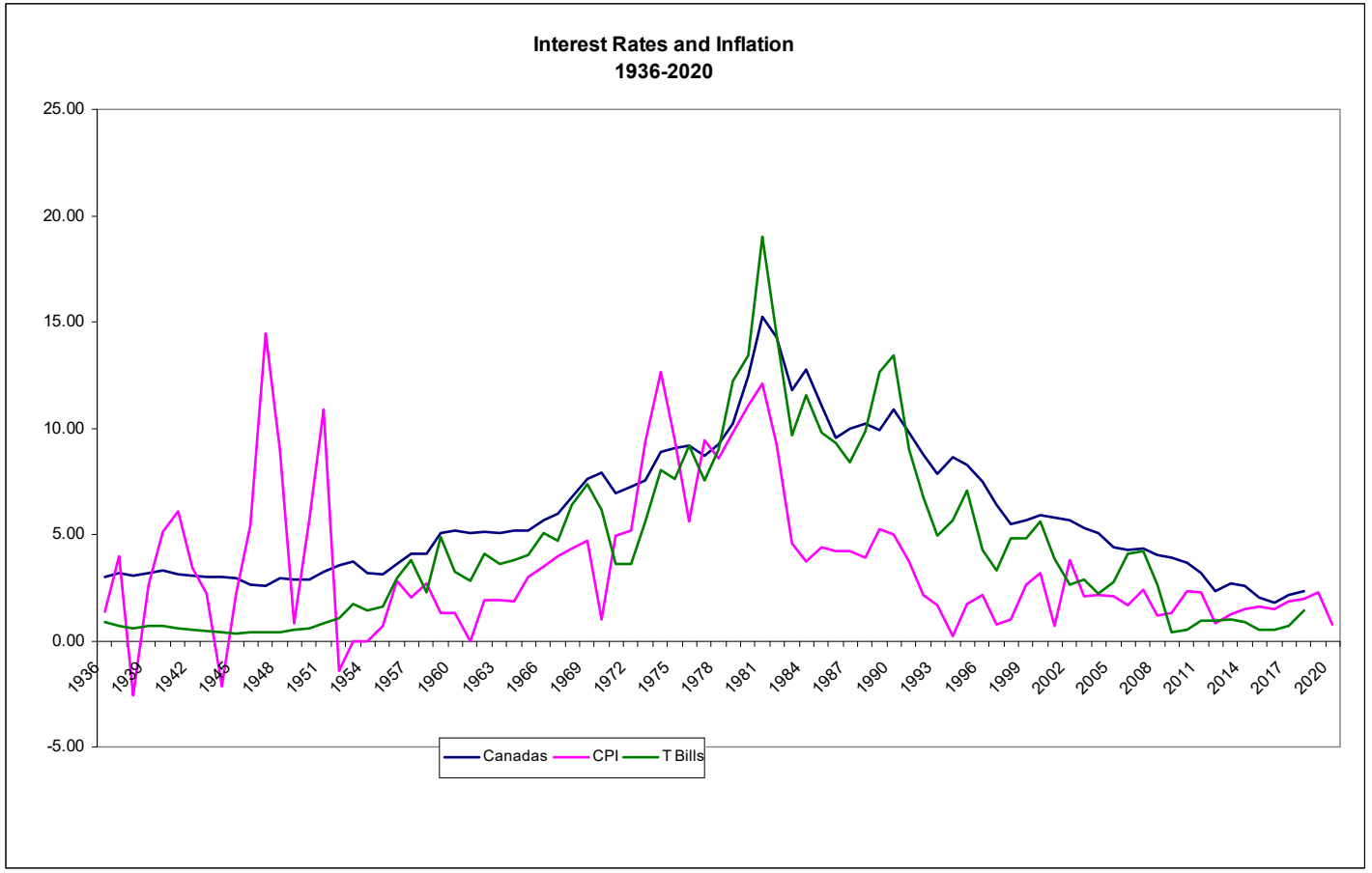

Canadian Risk Premium Estimates Back From 2020
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
1928
1938
1948
1958
1968
1978
1988
1998
2008
2018
AM
GM
OLS

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 3.25% arithmetic risk premium investing from 1961-2000.

	1924	1941	1951	1961	1971	1981	1991	2001	2011
1940	3.42								
1950	7.21	13.65							
1960	8.28	12.40	11.15						
1970	7.77	10.23	8.52	5.89					
1980	8.39	10.51	9.46	8.61	11.34				
1990	6.36	7.36	5.79	4.01	3.07	-5.20			
2000	5.66	6.30	4.83	3.25	2.37	-2.11	0.98		
2010	5.18	5.60	4.26	2.88	2.13	-0.94	1.20	1.41	
2020	4.69	4.95	3.71	2.47	1.79	-0.60	0.94	0.92	0.43

SCHEDULE 3


Interest Rates and Inflation
1936-2020
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
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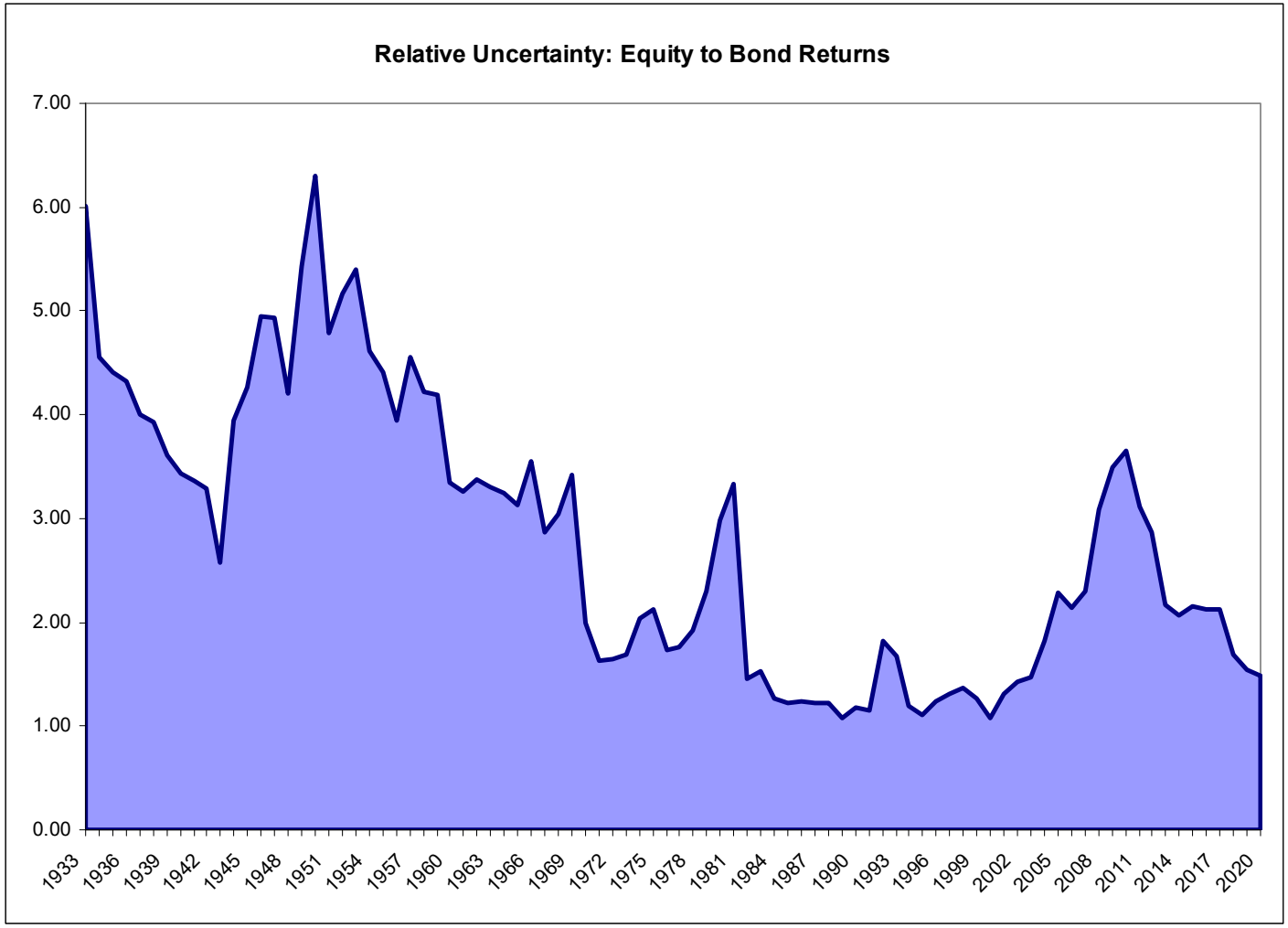
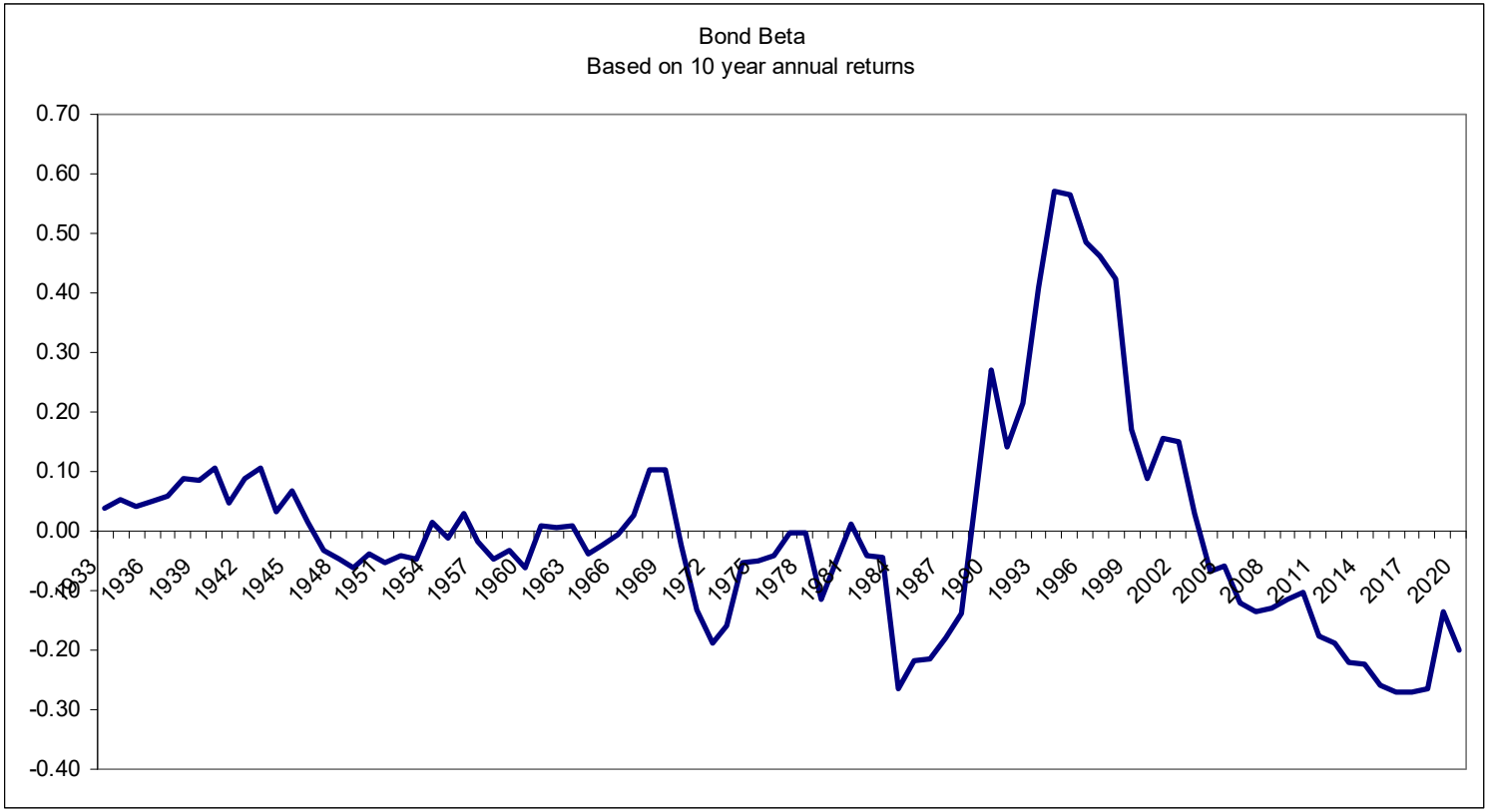
2002
2005
2008
2011
2014
2017
2020
Canadas
CPI
T Bills

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
2020

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
2020

SCHEDULE 6

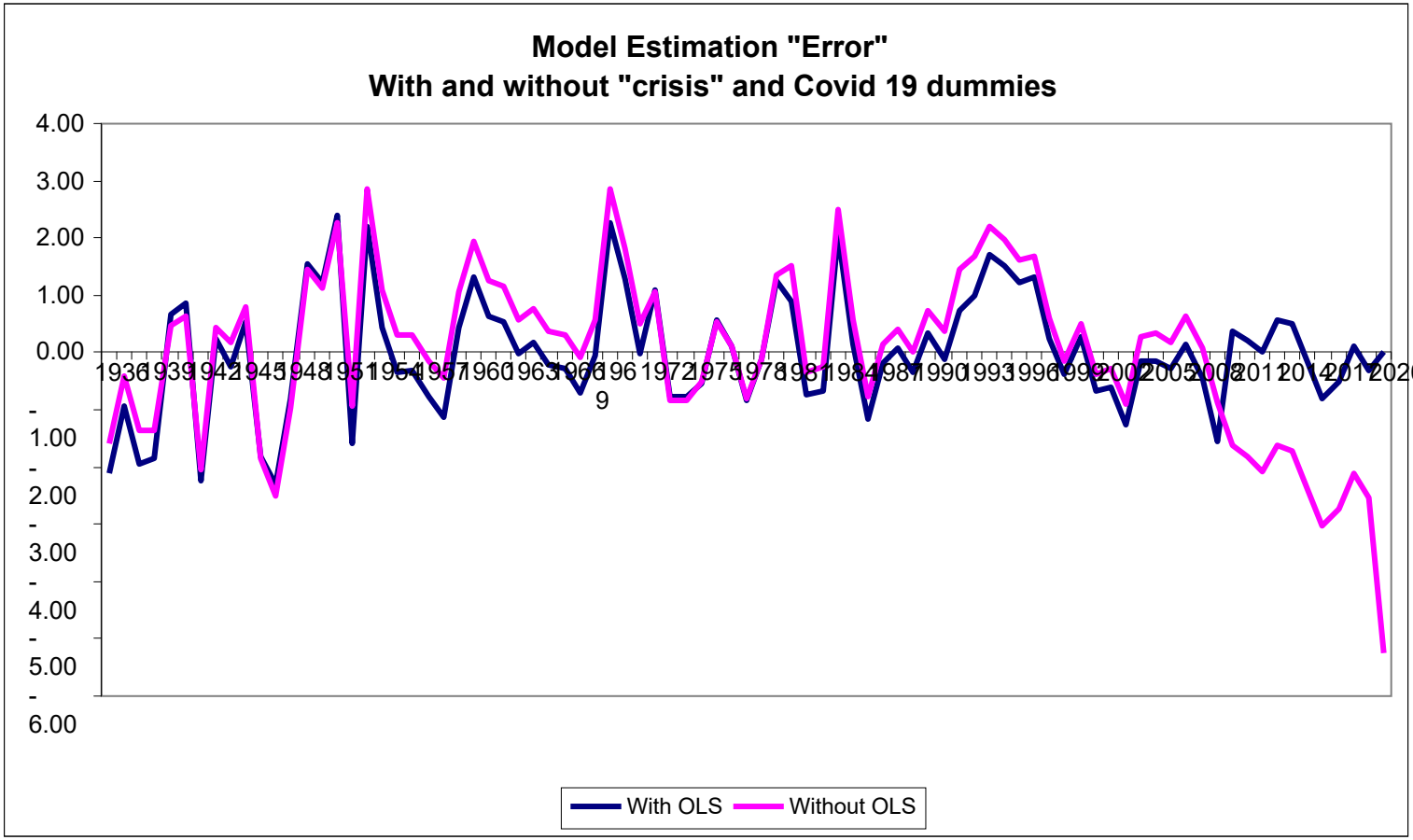
FACTORS INFLUENCING THE REAL CANADA YIELD

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

Independent variables:

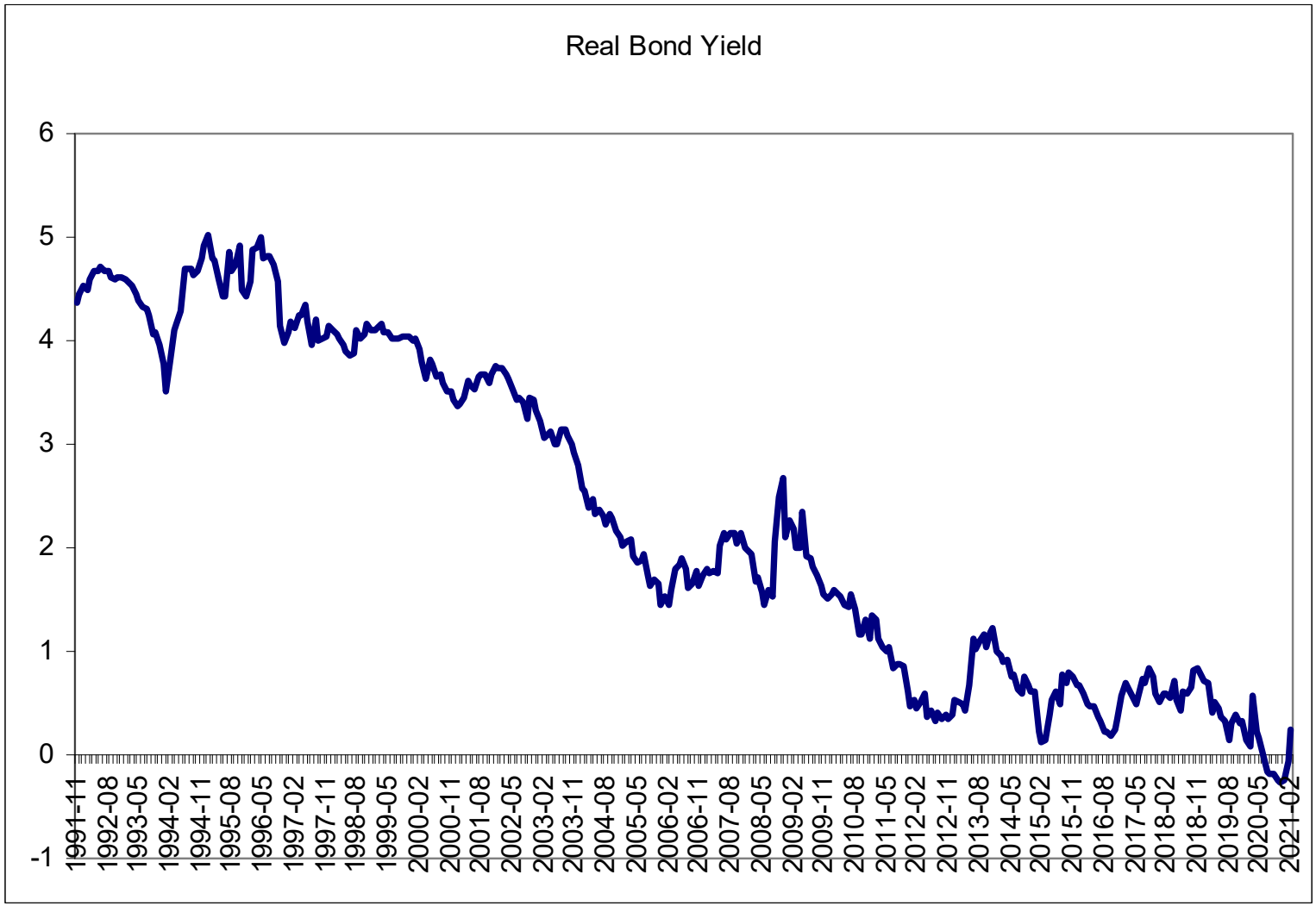
	Coefficient	T-Statistic
Constant:	1.354	3.70
Risk: standard deviation of return on the Long bond index for the prior ten years.	0.236	5.45
Deficit: aggregate government lending (% of GDP).	-0.261	-9.22
Dum1: dummy variable for years 1940-51	-5.334	-13.71
Dum2: dummy variable for years 1972-80	-3.627	- 9.45
Dum3: dummy variable for years 2010-2020	-2.673	- 7.28
Dum 4 Dummy for 2020	-3.361	-2.93

Adjusted R^2 of the regression 86.28%
Data 1936-2020



Without indicates without a crisis and Covid 19 dummies and with includes them. Both are estimated by standard ordinary least squares.

SCHEDULE 8


Real Bond Yield
6
5
4
3
2
1
0
-1
1991-11
1992-08
1993-05
1994-02
1994-11
1995-08
1996-05
1997-02
1997-11
1998-08
1999-05
2000-02
2000-11
2001-08
2002-05
2003-02
2003-11
2004-08
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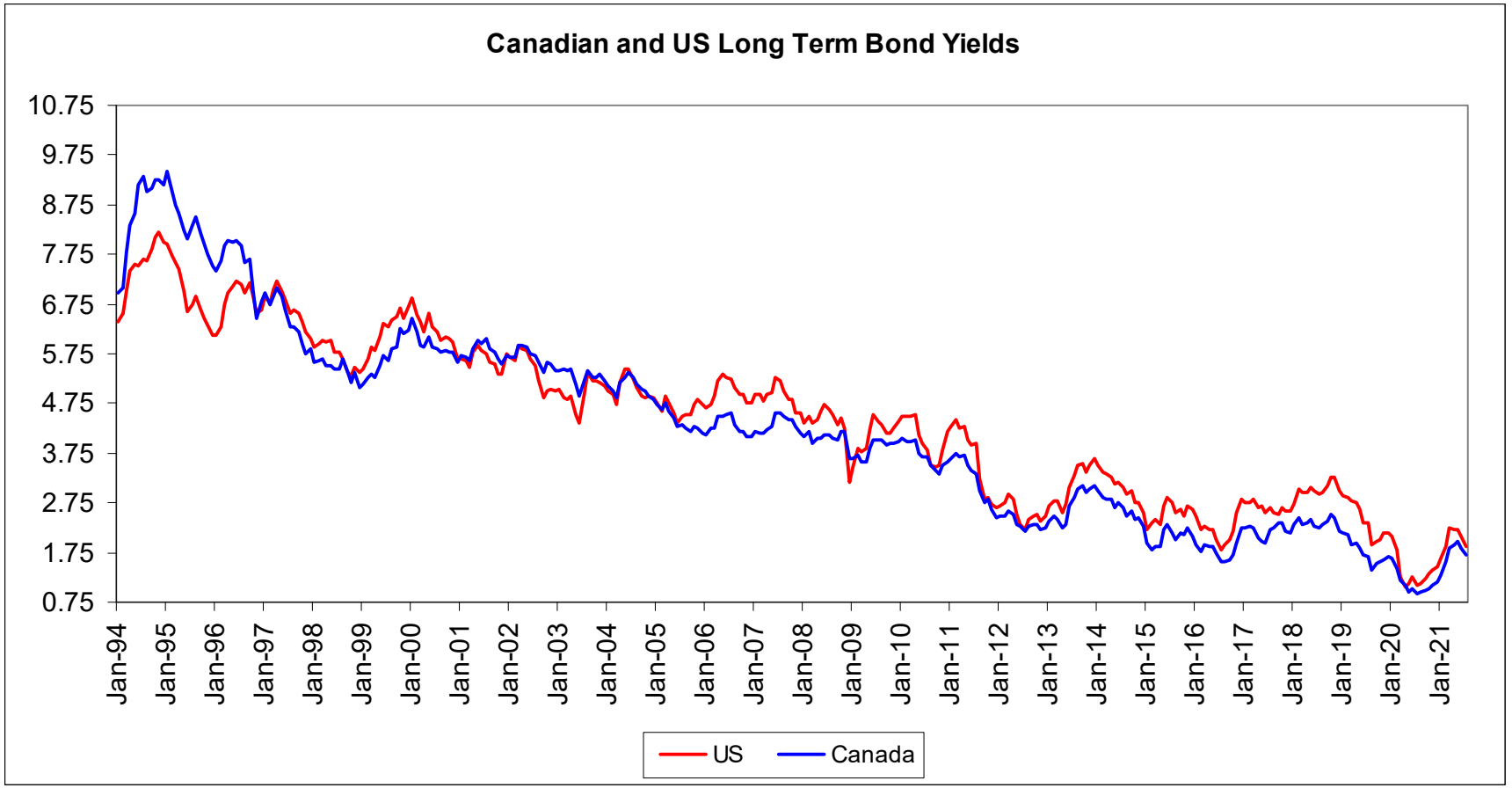
2009-02
2009-11
2010-08
2011-05
2012-02
2012-11
2013-08
2014-05
2015-02
2015-11
2016-08
2017-05
2018-02
2018-11
2019-08
2020-05
2021-02

Annual Rate of Return Estimates 1926-2020

	U.S.			**CANADA**		
	S&P Equities	Long US Treasury	Excess Return	TSE Equities	Long Canadas	Excess Return
AM	12.15	6.08	6.07	10.93	6.42	4.50
GM	10.28	5.65	4.63	9.35	6.09	3.26
OLS	10.89	5.62	5.26	10.12	6.24	3.88
Volatility[1]	19.66	9.79		18.26	8.70	

SCHEDULE 10


Canadian and US Long Term Bond Yields
10.75
9.75
8.75
7.75
6.75
5.75
4.75
3.75
2.75
1.75
0.75
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
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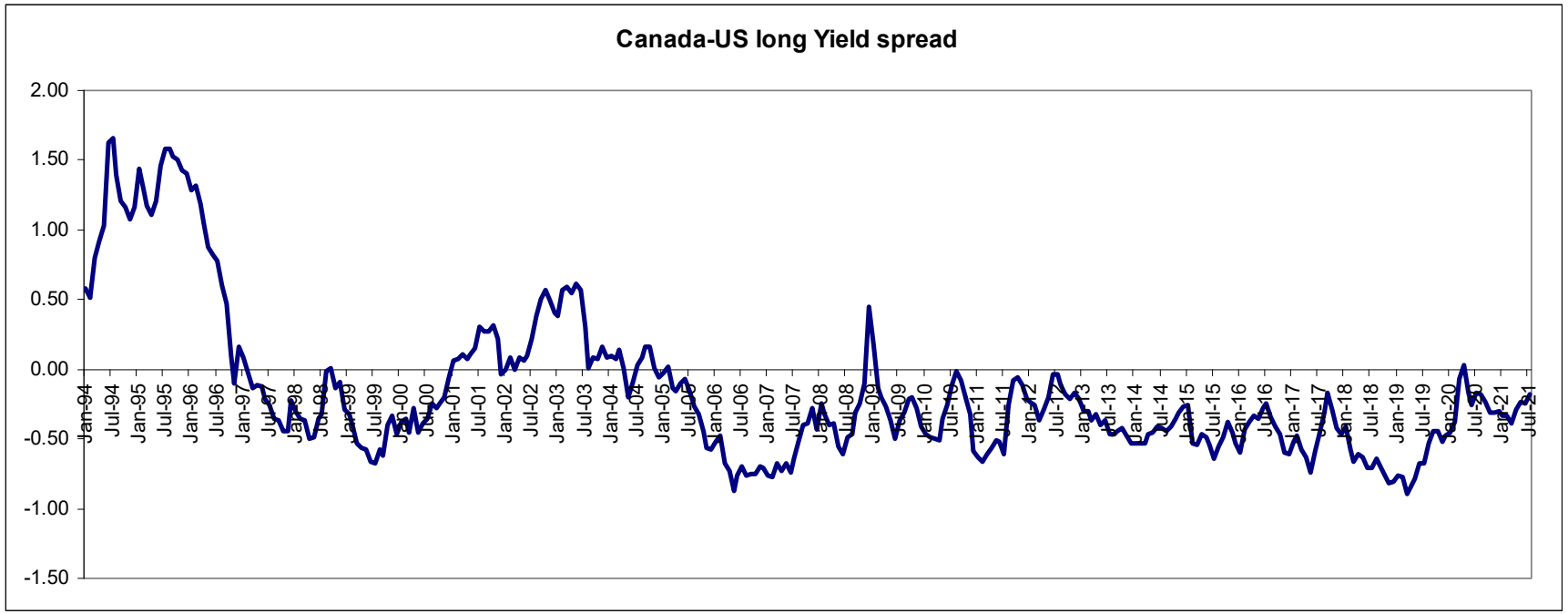
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
US
Canada

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
Jul-94
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
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Jan-21
Jul-21

DUFF&PHELPS

December 9, 2020

Table: Equity Risk Premium & Risk-free Rates

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

For additional information, please visit https://www.duffandphelps.com/insights/publications/cost-of-capital

Date	Risk-free Rate (R_f)	R_f (%)	Duff & Phelps Recommended ERP (%)	What Changed
Current Guidance:				
December 9, 2020 – UNTIL FURTHER NOTICE	Normalized 20-year U.S. Treasury yield	2.50	5.50	ERP
June 30, 2020 – December 8, 2020	Normalized 20-year U.S. Treasury yield	2.50	6.00	Rf
March 25, 2020 – June 29, 2020	Normalized 20-year U.S. Treasury yield	3.00	6.00	ERP
December 19, 2019 – March 24, 2020	Normalized 20-year U.S. Treasury yield	3.00	5.00	ERP
September 30, 2019 – December 18, 2019	Normalized 20-year U.S. Treasury yield	3.00	5.50	R_f
December 31, 2018 – September 29, 2019	Normalized 20-year U.S. Treasury yield	3.50	5.50	ERP
September 5, 2017 – December 30, 2018	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/insights/publications/cost-of-capital.
This and other related resources can also be found in the online Cost of Capital Navigator platform. To learn more about the Cost of Capital Navigator and other Duff & Phelps valuation and industry data products, visit www.DPCostofCapital.com.

Schedule 13

Damodaran Implied equity (market) risk premiums

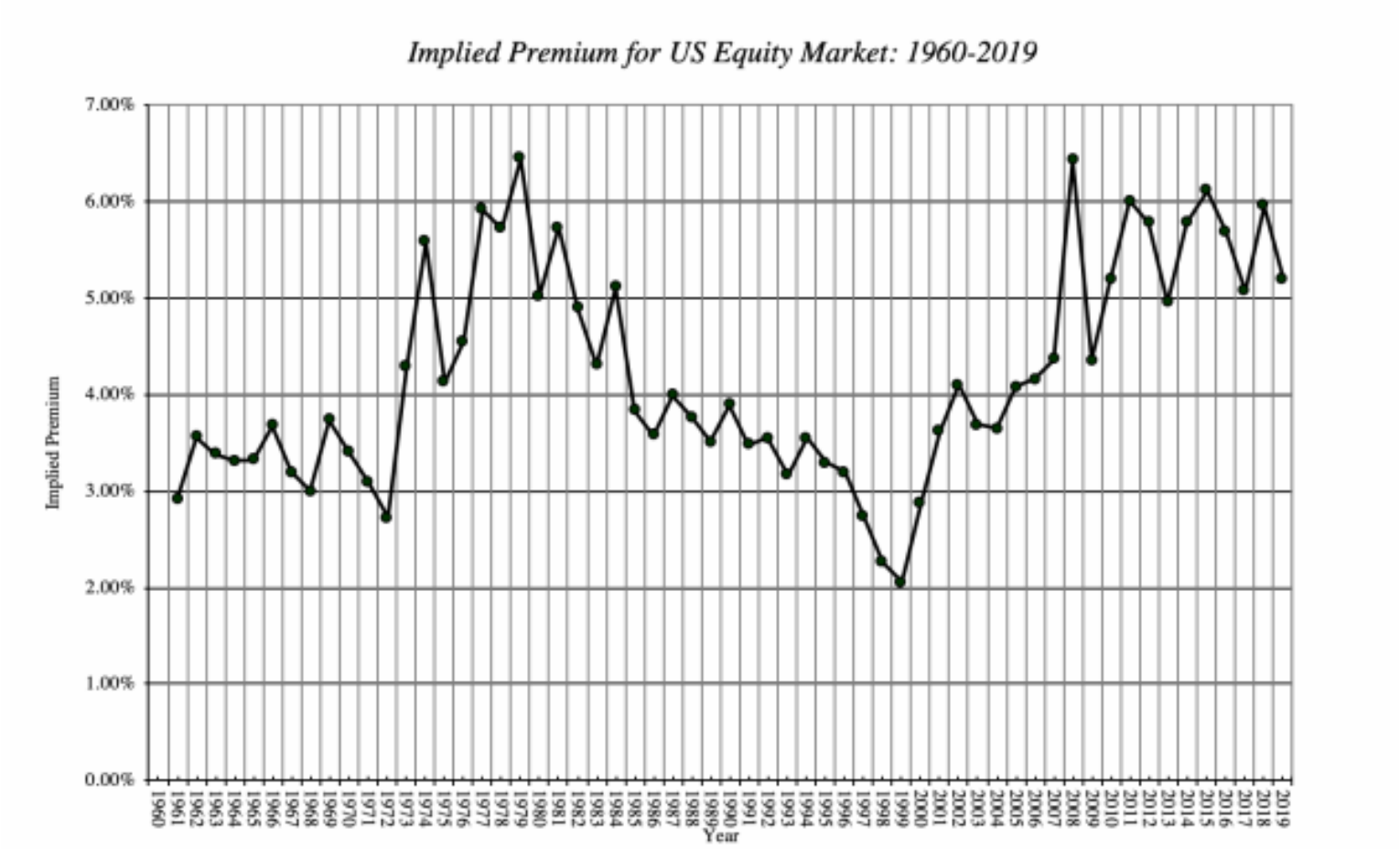
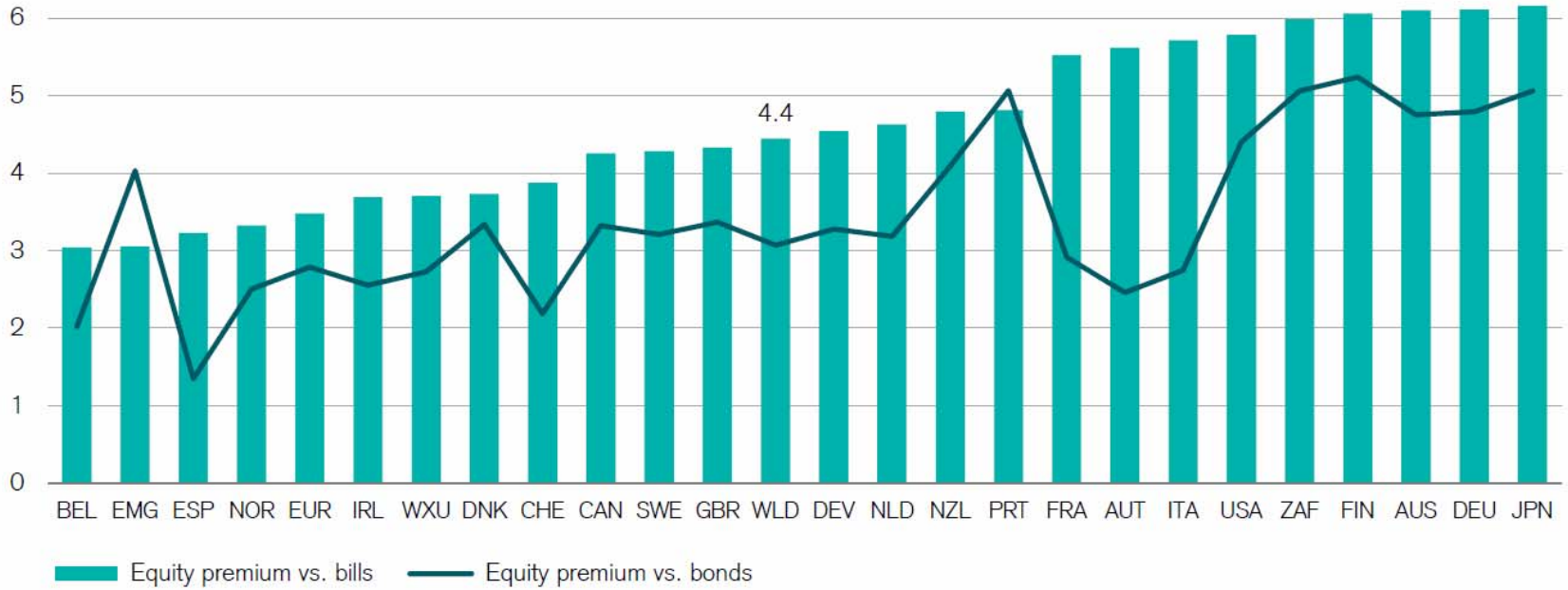


Figure 11: Worldwide annualized equity risk premium (%) relative to bills and bonds, 1900–2020



Sources: Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of the Optimists, Princeton University Press, 2002, and Global Investment Returns Yearbook, Credit Suisse, 2021. Not to be reproduced without express written permission from the authors.