Interest Rate Forecast Issues

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Purpose and Scope of Report

- Examining the issues with the use of standard interest rate forecasts of Canada 10-year bond yields, which are used to price the "product"

- I have **not** been asked to comment on the specifics of how such forecasts are integrated into Basic pricing in this report, but rather to comment on the historical record of such interest rate forecasts, and the associated interest rate forecasting risk that has resulted for MPI

Report Summary

- Over the last eight years, the standard interest rate forecasts (SIRF) have exceeded actual 10-year Canada yields by a wide margin – 1.7% on average, representing a forecasting error percentage of -93% of the actual yields.

- SIRFs were seldom "below" the actual 10-year rate over this period - cause for concern.

- This presents a real risk whenever such forecasts are relied upon.

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Report Summary (cont'd)

- Naïve forecasts using existing 10-year Canada yields would have improved forecasting accuracy significantly, reducing percentage forecast error by close to 60%.

- This result is consistent with the results of empirical studies which show that economists have fared no better on average than simple naïve forecasts of future interest rate levels.

- As a preliminary step, I suggest **at minimum** that the existing level of 10-year yields be used as a bottom level in terms of estimating future 10-year yields to estimate Basic pricing.

Standard Interest Rate Forecasts versus Actuals

Calendar Quarter		Actual	2009 GRA	2010 GRA	2011 GRA	2012 GRA	2013 GRA	2014 GRA	2015 GRA	2016 GRA	
2008	Q1	3.71%	0.03%								
	Q2	3.53%	-0.02%								
	Q3	3.32%	-0.45%								
	Q4	3.13%	-0.87%								
2009	Q1	3.39%	-0.74%	0.51%							
	Q2	3.38%	-0.84%	0.70%							
	Q3	3.22%	-1.08%	0.50%							
	Q4	3.39%	-1.06%	0.56%							
2010	Q1	3.35%	-1.95%	0.39%	-0.23%						
	Q2	2.76%	-2.56%	-0.29%	-0.94%						
	Q3	3.12%	-2.22%	-0.03%	-0.70%						
	Q4	3.30%	-2.06%	0.01%	-0.69%						
2011	Q1	3.07%	-2.29%	-0.56%	-1.00%	-0.23%					
	Q2	2.49%	-2.86%	-1.40%	-1.62%	-0.99%					
	Q3	2.15%	-3.20%	-1.98%	-2.10%	-1.34%					
	Q4	1.99%	-3.39%	-2.30%	-2.46%	-1.75%					
2012	Q1	1.74%	-3.78%	-2.70%	-2.80%	-2.10%	-0.27%				
	Q2	1.77%	-3.75%	-2.90%	-2.90%	-2.17%	-0.41%				
	Q3	1.70%	-3.82%	-3.03%	-3.01%	-2.39%	-0.63%				
	Q4	1.84%	-3.68%	-2.89%	-2.88%	-2.36%	-0.64%				
2013	Q1	2.06%		-2.66%	-2.65%	-2.71%	-0.52%	0.19%			
	Q2	2.62%		-2.14%	-2.10%	-2.23%	-0.07%	0.70%			
	Q3	2.56%		-2.38%	-2.27%	-2.29%	-0.29%	0.48%			
	Q4	2.43%		-2.98%	-2.80%	-2.42%	-0.53%	0.21%			
2014	Q1	2.25%			-3.34%	-2.61%	-0.73%	-0.18%	-0.37%		
	Q2	2.00%			-3.72%	-2.87%	-1.02%	-0.63%	-0.82%		
	Q3	1.86%			-3.86%	-3.03%	-1.19%	-0.86%	-1.13%		
	Q4	1.30%			-4.42%	-3.82%	-1.89%	-1.53%	-1.84%		
2015	Q1	1.62%				-3.98%	-1.81%	-1.21%	-1.66%	0.16%	
	Q2	1.62%				-4.19%	-1.93%	-1.23%	-1.80%	-0.07%	
	Q3	1.49%				-4.33%	-2.29%	-1.66%	-2.08%	-0.38%	
	Q4	1.57%				-4.25%	-2.44%	-1.80%	-2.14%	-0.47%	
2016	Q1	1.19%					-3.09%	-2.42%	-2.51%	-1.02%	

			2009 GRA	2010 GRA	2011 GRA	2012 GRA Actual-Forecast	2013 GRA	2014 GRA	2015 GRA	2016 GRA	WT Av
		Average	-2.14%	-1.28%	-2.32%	-2.60%	-1.16%	-0.76%	-1.60%	-0.36%	-1.72%
		Median	-2.22%	-1.69%	-2.56%	-2.41%	-0.73%	-0.86%	-1.80%	-0.38%	
		Max	-0.02%	0.70%	-0.23%	-0.23%	-0.07%	0.70%	-0.37%	0.16%	
		Min	-3.82%	-3.03%	-4.42%	-4.33%	-3.09%	-2.42%	-2.51%	-1.02%	
		StdDev	1.27%	1.45%	1.16%	1.11%	0.90%	0.98%	0.69%	0.45%	

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Percentage Forecasting Error Using SIRFs

Calendar Quarter		2009 GRA	2010 GRA	2011 GRA	2012 GRA	2013 GRA	2014 GRA	2015 GRA	2016 GRA	
				Percent Error = Error/Actual (%)						
2008	Q1	0.88%								
	Q2	-0.45%								
	Q3	-13.57%								
	Q4	-27.75%								
2009	Q1	-21.71%	15.07%							
	Q2	-24.89%	20.74%							
	Q3	-33.42%	15.45%							
	Q4	-31.23%	16.40%							
2010	Q1	-58.22%	11.71%	-6.81%						
	Q2	-92.96%	-10.59%	-34.16%						
	Q3	-71.25%	-0.90%	-22.52%						
	Q4	-62.37%	0.41%	-20.91%						
2011	Q1	-74.65%	-18.08%	-32.38%	-7.51%					
	Q2	-114.84%	-56.27%	-64.95%	-39.56%					
	Q3	-148.82%	-92.16%	-97.58%	-62.48%					
	Q4	-170.79%	-115.97%	-123.96%	-87.97%					
2012	Q1	-217.27%	-155.30%	-160.77%	-120.68%	-15.52%				
	Q2	-211.89%	-163.76%	-163.93%	-122.59%	-22.88%				
	Q3	-224.73%	-178.01%	-177.32%	-140.58%	-37.06%				
	Q4	-200.51%	-157.26%	-156.64%	-128.63%	-34.73%				
2013	Q1		-128.95%	-128.41%	-131.07%	-25.24%	9.40%			
	Q2		-81.64%	-80.23%	-85.42%	-2.64%	26.61%			
	Q3		-93.02%	-88.84%	-89.72%	-11.50%	18.82%			
	Q4		-122.73%	-115.39%	-99.96%	-21.65%	8.45%			
2014	Q1			-148.90%	-116.34%	-32.68%	-7.97%	-16.53%		
	Q2			-186.55%	-144.06%	-50.88%	-31.33%	-41.12%		
	Q3			-207.86%	-163.13%	-64.16%	-46.39%	-61.05%		
	Q4			-340.00%	-294.10%	-145.38%	-117.31%	-141.35%		
2015	Q1				-245.37%	-111.21%	-74.26%	-101.99%	9.59%	
	Q2				-258.09%	-118.60%	-75.49%	-110.84%	-4.37%	
	Q3				-290.68%	-153.69%	-111.41%	-139.72%	-25.17%	
	Q4				-270.77%	-155.41%	-114.65%	-136.48%	-30.15%	
2016	Q1					-259.66%	-203.36%	-211.23%	-85.99%	
				Error/Actual (%)							
		2009 GRA	2010 GRA	2011 GRA	2012 GRA	2013 GRA	2014 GRA	2015 GRA	2016 GRA	WT Av
		-94.81%	-64.74%	-117.90%	-144.94%	-74.29%	-55.30%	-106.70%	-27.22%	-92.95%
		-71.25%	-68.96%	-119.67%	-125.61%	-37.06%	-46.39%	-110.84%	-25.17%	
		-0.45%	20.74%	-6.81%	-7.51%	-2.64%	26.61%	-16.53%	9.59%	
		-224.73%	-178.01%	-340.00%	-294.10%	-259.66%	-203.36%	-211.23%	-85.99%	
		77.19%	71.59%	80.42%	83.85%	71.29%	68.65%	59.85%	36.55%	

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Standard Interest Rate Forecasts – Terrible Performance

- SIRF forecasts too "high" by an average of **-1.72%** in absolute interest rate terms

- Average percentage forecast error of **-92.9%** - i.e., **almost double** the actual yields (i.e., which would correspond to a -100% percentage forecast error). Clearly, these forecasts were not very informative at all. In fact, it would have been much better to use the prevailing rates (i.e., "naïve" forecasting approach)
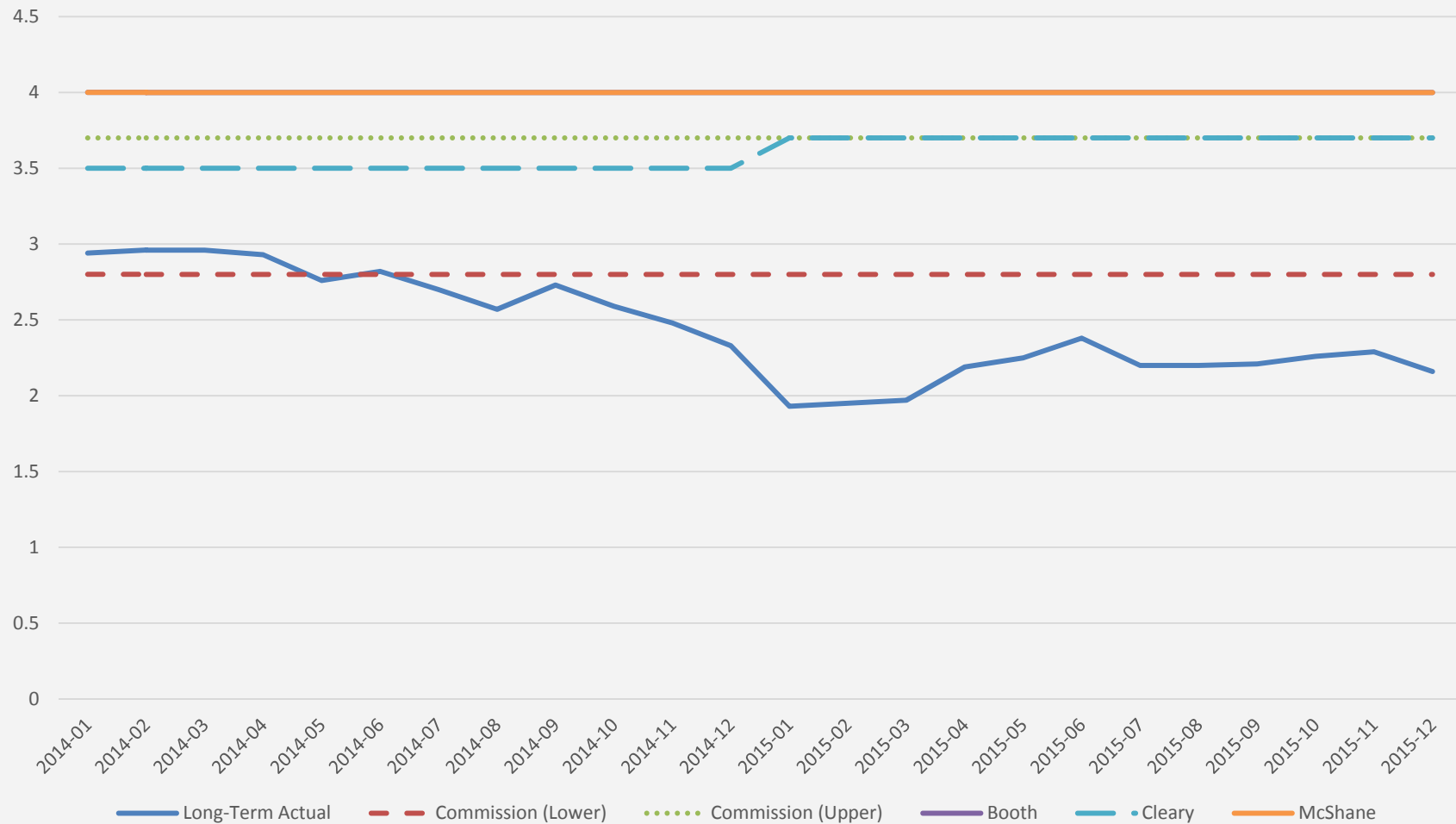
Forecasting Performance – Specific to SIRF?

(Figure 1 - 2013 AUC Hearings)
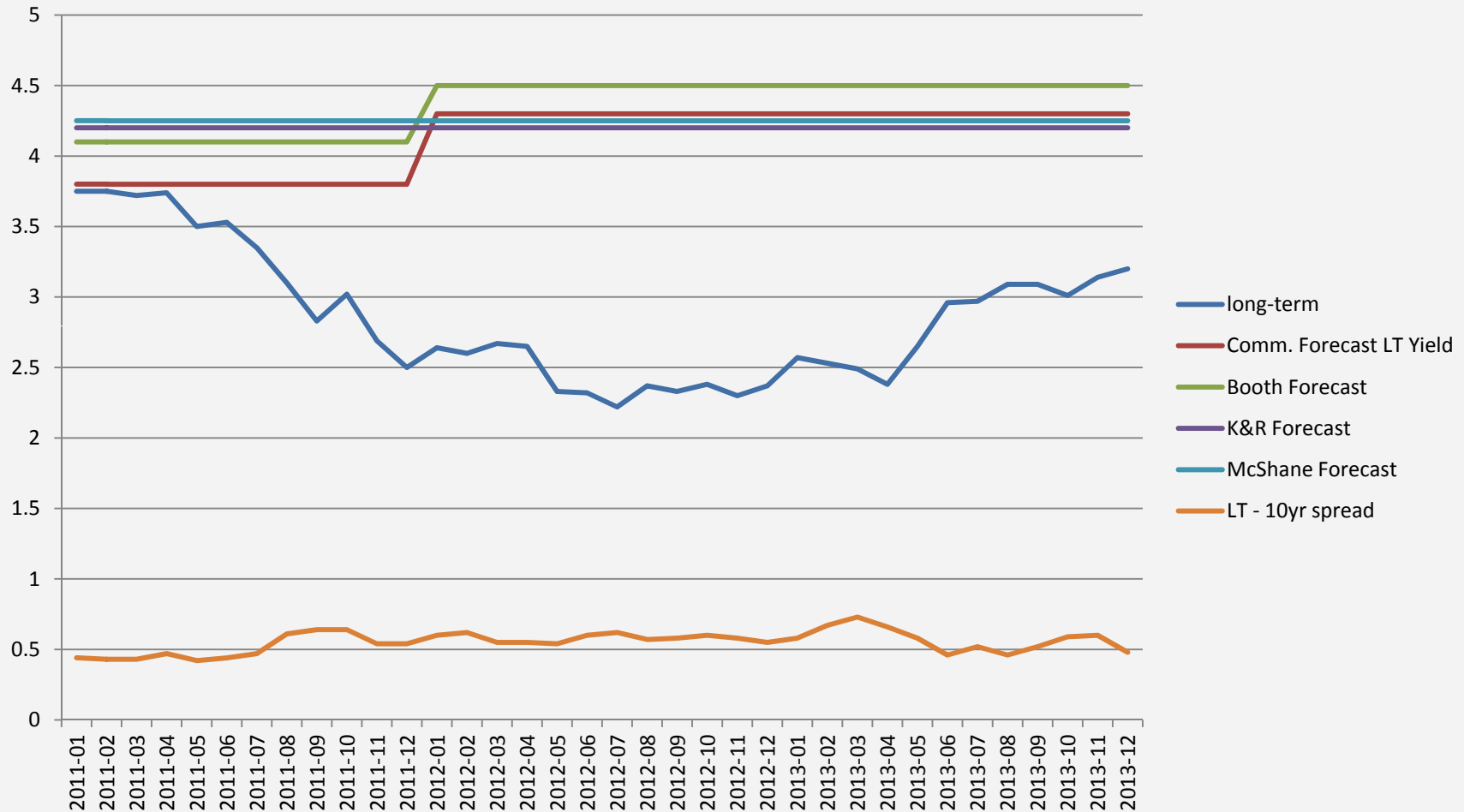
Forecasting Performance – Specific to SIRF?

(Figure 2 - 2016 AUC Hearings)

Legend: Long-Term Actual — Commission (Lower) — Commission (Upper) — Booth — Cleary — McShane

Forecasting Performance – Specific to SIRF?
(Figure 2 - 2016 AUC Hearings)

- The AUC implemented the use of "actual" prevailing yields as lower bound on yield forecasts in its 2013 Decision.

- The AUC Noted:

  - *"forecast appears to have mostly overestimated the yields on long-term government bonds in the 2010 to 2014 period"*

  - *"in all likelihood, the adopted upper bound estimate may be optimistic, given that, based on recent history, the return to the long-term interest rate levels may not occur as quickly as the Consensus Forecasts predicted in April 2014*."

- I introduced the use of this lower bound in my 2016 evidence to reflect the importance of *existing yields*

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Forecasting Performance – Specific to Canada since 2008?

- Spiwoks, Bedke and Hein (2008)
  - evaluated 10-year US government bond yield and three-month US Treasury bill rate forecasts Oct 1989-Dec 2004.
  - "the information content of most of the forecast time series is **lower than that of naïve forecasts**."
- Mitchell and Pearce (2005):
  - economists' six-month ahead forecasts (1982-2002)
  - "the forecast accuracy of most of the economists is indistinguishable from that of the random walk model when forecasting the Treasury bill rate but that the **forecast accuracy is significantly worse for many of the forecasters for predictions of the Treasury bond rate** and the exchange rate."

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Forecasting Performance – Specific to Canada since 2008? (cont'd)

- 2010 "MoneyWatch" article:

  – "A year ago, *The Wall Street Journal* asked 50 economic forecasters for their prediction of where the yield on the 10-year Treasury note would be in one year. Forty-three expected the 10-year U.S. Treasury note yield to move higher over the year ahead, with an **average estimate of 4.13** percent. Seven expected a rate of 5 percent or higher, while only two predicted rates to fall below 3 percent. The result? The **10-year Treasury yield slumped to 2.95 percent** on June 30, 2010."

  – "While the forecasts clearly turned out to be wrong, it doesn't mean the experts were incompetent. The point is that even the most talented analysts are **unlikely to make reliable predictions**."

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Naïve Forecasts versus Actuals

Calendar Quarter		Actual	2009 NV	2010 NV	2011 NV	2012 NV	2013 NV	2014 NV	2015 NV	2016 NV
2008	Q1	3.71%	-0.36%							
	Q2	3.53%	-0.54%							
	Q3	3.32%	-0.75%							
	Q4	3.13%	-0.94%							
2009	Q1	3.39%	-0.69%	0.25%						
	Q2	3.38%	-0.70%	0.24%						
	Q3	3.22%	-0.85%	0.09%						
	Q4	3.39%	-0.68%	0.26%						
2010	Q1	3.35%	-0.72%	0.22%	-0.04%					
	Q2	2.76%	-1.31%	-0.37%	-0.63%					
	Q3	3.12%	-0.95%	-0.01%	-0.27%					
	Q4	3.30%	-0.77%	0.17%	-0.09%					
2011	Q1	3.07%	-1.00%	-0.06%	-0.32%	-0.23%				
	Q2	2.49%	-1.58%	-0.64%	-0.90%	-0.81%				
	Q3	2.15%	-1.92%	-0.98%	-1.24%	-1.15%				
	Q4	1.99%	-2.08%	-1.14%	-1.40%	-1.31%				
2012	Q1	1.74%	-2.33%	-1.39%	-1.65%	-1.56%	-0.25%			
	Q2	1.77%	-2.30%	-1.36%	-1.62%	-1.53%	-0.22%			
	Q3	1.70%	-2.37%	-1.43%	-1.69%	-1.60%	-0.29%			
	Q4	1.84%	-2.23%	-1.29%	-1.55%	-1.46%	-0.15%			
2013	Q1	2.06%		-1.07%	-1.33%	-1.24%	0.08%	0.23%		
	Q2	2.62%		-0.52%	-0.78%	-0.68%	0.63%	0.78%		
	Q3	2.56%		-0.58%	-0.84%	-0.74%	0.57%	0.72%		
	Q4	2.43%		-0.71%	-0.97%	-0.87%	0.44%	0.59%		
2014	Q1	2.25%			-1.15%	-1.05%	0.26%	0.41%	-0.18%	
	Q2	2.00%			-1.40%	-1.30%	0.01%	0.16%	-0.43%	
	Q3	1.86%			-1.53%	-1.44%	-0.13%	0.02%	-0.57%	
	Q4	1.30%			-2.09%	-2.00%	-0.69%	-0.54%	-1.13%	
2015	Q1	1.62%				-1.68%	-0.36%	-0.21%	-0.80%	0.32%
	Q2	1.62%				-1.68%	-0.36%	-0.21%	-0.80%	0.32%
	Q3	1.49%				-1.81%	-0.50%	-0.35%	-0.94%	0.19%
	Q4	1.57%				-1.73%	-0.42%	-0.27%	-0.86%	0.27%
2016	Q1	1.19%					-0.80%	-0.65%	-1.24%	-0.11%

		2009 GRA	2010 GRA	2011 GRA	2012 GRA	2013 GRA	2014 GRA	2015 GRA	2016 GRA	WT Av
	Average	-1.30%	-0.52%	-1.07%	-1.29%	-0.13%	0.05%	-0.77%	0.20%	-0.73%
	Median	-0.95%	-0.55%	-1.19%	-1.38%	-0.22%	0.02%	-0.80%	0.27%	
	Max	-0.54%	0.26%	-0.04%	-0.23%	0.63%	0.78%	-0.18%	0.32%	
	Min	-2.37%	-1.43%	-2.09%	-2.00%	-0.80%	-0.65%	-1.24%	-0.11%	
	StdDev	0.68%	0.63%	0.58%	0.45%	0.41%	0.47%	0.33%	0.18%	

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Percentage Forecasting Error Using Naïve Forecasts

Calendar Quarter		2009 NV (Naïve)	2010 NV (Naïve)	2011 NV (Forecast Error = Error/Actual (%))	2012 NV	2013 NV	2014 NV	2015 NV	2016 NV
2008	Q1	-9.67%							
	Q2	-15.17%							
	Q3	-22.44%							
	Q4	-29.99%							
2009	Q1	-20.24%	7.50%						
	Q2	-20.59%	7.23%						
	Q3	-26.28%	2.85%						
	Q4	-20.02%	7.67%						
2010	Q1	-21.60%	6.45%	-1.31%					
	Q2	-47.57%	-13.52%	-22.95%					
	Q3	-30.37%	-0.29%	-8.62%					
	Q4	-23.37%	5.09%	-2.79%					
2011	Q1	-32.40%	-1.85%	-10.31%	-7.32%				
	Q2	-63.45%	-25.74%	-36.18%	-32.49%				
	Q3	-89.21%	-45.56%	-57.65%	-53.37%				
	Q4	-104.83%	-57.57%	-70.66%	-66.03%				
2012	Q1	-133.91%	-79.94%	-94.89%	-89.60%	-14.20%			
	Q2	-129.94%	-76.89%	-91.58%	-86.38%	-12.26%			
	Q3	-139.41%	-84.18%	-99.47%	-94.06%	-16.88%			
	Q4	-121.56%	-70.44%	-84.59%	-79.59%	-8.17%			
2013	Q1		-51.70%	-64.29%	-59.84%	3.73%	11.00%		
	Q2		-19.69%	-29.63%	-26.11%	24.04%	29.78%		
	Q3		-22.50%	-32.67%	-29.07%	22.26%	28.13%		
	Q4		-29.11%	-39.84%	-36.04%	18.06%	24.25%		
2014	Q1			-50.98%	-46.88%	11.53%	18.21%	-7.97%	
	Q2			-69.97%	-65.36%	0.40%	7.92%	-21.55%	
	Q3			-82.51%	-77.56%	-6.94%	1.13%	-30.52%	
	Q4			-160.85%	-153.77%	-52.85%	-41.31%	-86.54%	
2015	Q1				-103.14%	-22.35%	-13.12%	-49.32%	19.95%
	Q2				-103.14%	-22.35%	-13.12%	-49.32%	19.95%
	Q3				-121.41%	-33.36%	-23.29%	-62.75%	12.75%
	Q4				-110.13%	-26.56%	-17.01%	-54.46%	17.20%
2016	Q1					-66.97%	-54.37%	-103.78%	-9.24%

Error/Actual (%)

2009 GRA	2010 GRA	2011 GRA	2012 GRA	2013 GRA	2014 GRA	2015 GRA	2016 GRA	WT Av
-57.49%	-27.11%	-55.59%	-72.06%	-11.93%	-3.21%	-51.80%	12.12%	-39.48%
-30.37%	-21.09%	-54.31%	-71.79%	-12.26%	1.13%	-49.32%	17.20%	
-15.17%	7.67%	-1.31%	-7.32%	24.04%	29.78%	-7.97%	19.95%	
-139.41%	-84.18%	-160.85%	-153.77%	-66.97%	-54.37%	-103.78%	-9.24%	
45.95%	32.89%	40.28%	36.85%	24.97%	26.59%	30.28%	12.30%	

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Naïve Interest Rate Forecasts

- Naïve forecasts too "high" by an average of **-0.73%** in absolute interest rate terms – approx. 60% better than the -1.72% average error of using GRA forecasts

- Average percentage forecast error of **-39.5%** - versus -93% using GRA forecasts

- NOTE: A 50/50 strategy (using 50% GRA + 50% Naïve) would fall "in-between":

  – With – 1.22% absolute error and -66.2% percentage forecasting error

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But Surely Interest Rates have to Go Up?

- True, but…

- Monetary authorities currently holding over $6 trillion US in bonds (US > $3.5 trillion plus ECB, Japan and UK)

- Long-term yield spread over inflation around 1.85% implies 3.85% "normal" 10-year yield.

- This is a long way to go from existing 1%, and things are far from "normal" and with $6.5 trillion US "overhang"

  – i.e., don't expect a quick transition….

- Be skeptical of forecasts over 3% over the next 1-3 years – this is unlikely….

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Why a 50/50 Approach as a "Best Estimate"?

- Recall:
  - SIRF: avg. error **-1.72%** / avg. % error **-92.9%**
  - Naïve: avg. error **-0.73%** / avg. % error **-39.5%**
  - 50/50: avg. error **– 1.22%** / avg. % error **-66.2%**

- So why not Naïve?
  - Rates are likely to increase at some point in the future – it is the magnitude and timing that is difficult to predict; although a decline can never be ruled out (just look at the recent evidence)
  - 50/50 weight minimizes the chance of being "way off" in terms of what future rates turn out to be – essentially establishing forecasts as one limit (upper limit today) and existing rates as other limit (bottom limit today) – and then choosing the mid-point of this range as the most likely.

- Given the issues with both SIRF or Naïve in predicting the future, a 50/50 approach should minimize forecasting error

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Conclusions

- Over the last eight years, the standard interest rate forecasts (SIRF) have exceeded actual 10-year Canada yields by a wide margin – 1.7% on average, representing a forecasting error percentage of -93% of the actual yields – **almost double the actuals.**

- This presents a **real risk** whenever such forecasts are relied upon.

- While not fully addressing forecasting risk, **naïve forecasts** using existing 10-year Canada yields would have improved forecasting accuracy significantly, reducing percentage forecast error by close to 60%.

- I recommend that the existing level of 10-year yields be used as one limit and the SIRF be used as the other limit, and that a 50/50 approach be used to obtain the "best estimate."

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