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HIGHLIGHTS

- This report uses four estimation techniques to determine where the U.S. 10-year yield should eventually settle in a decade's time.
- The models use a mix of historical data, forward curve analysis, central bank expectations and economic projections to generate forecasts ranging from 3.92% to 5.00%.
- But special considerations – such as changing investment preferences, a shortage of safe assets and the potential for subtle interest rate repression (offset against the spectre of a higher debt load) – should subtract up to 50 basis points from these figures.
- In the end, we project an average U.S. 10-year yield just shy of 4.00%.

ESTIMATING A “NORMAL” YIELD

Bond yields are now well off their lows and should continue to rise over the next few years – a subject we tackled in a recent *Economic Compass* entitled *Yields Regain Buoyancy*. But we left a related question unanswered: where will yields ultimately end up once this process of economic and financial market normalization is complete (Exhibit 1)?

This follow-up report provides perspective on what constitutes a “normal” bond yield, based on the work of our Long-Term Expected Returns Committee (Textbox A) and with the help of four estimation techniques (Exhibit 2). The first approach simply determines the historical average yield. The second starts with central bankers’ definition of a neutral policy rate and then extrapolates out the yield curve. The third capitalizes on a connection between economic growth and the level of bond yields. The fourth uncovers the bond market’s own thinking about this subject.

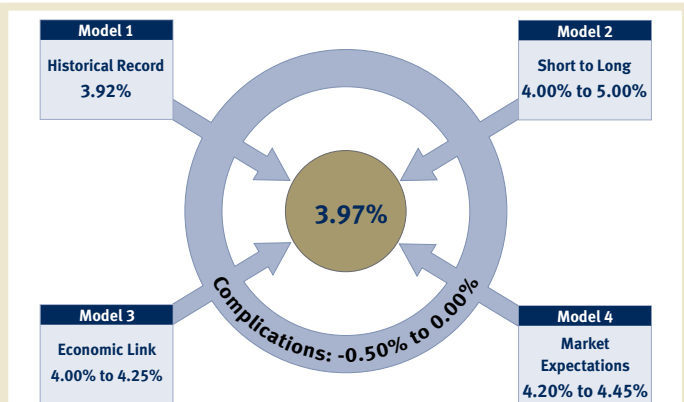
Before proceeding further, a few details need to be fleshed out. We seek to define the “normal” U.S. 10-year Treasury yield, as it will exist in one decade’s time. The U.S. 10-year bond is the appropriate benchmark for this exercise because it is precisely that: the benchmark against which all other bonds – both in the U.S. and around the world – are measured. We squint our eyes to look out a full 10 years into the future because we assume that economies and financial markets will be safely removed from the gravitational pull of the financial crisis by then. Economic slack should be mostly taken up, public deficits should be tamer and central bank balance sheets should be less bloated. Equally important, investors’ terrifying memories of the financial crisis should have faded. This, in turn, is an

Exhibit 1: Bond yields start normalizing



Source: Federal Reserve Board, Haver Analytics, RBC GAM

Exhibit 2: Models estimate normal yield



Source: RBC GAM

TEXTBOX A: LONG-TERM EXPECTED RETURNS COMMITTEE

The RBC GAM Long-Term Expected Returns Committee brings together expertise from a variety of disciplines:

- Dan Chornous, Chief Investment Officer
- Stephen Burke, Head of Quantitative Research Group
- Jim Cole, Vice President, Fixed Income Portfolio Manager
- Eric Lascelles, Chief Economist
- Andrew MacNeil, Vice President, Fixed Income Portfolio Manager
- Peter Quan, Quantitative Analyst
- Bill Tilford, Head of Quantitative Investments
- Milos Vukovic, Head of Investment Policy

The group's purpose is to advance the state of long-term return forecasting within the firm. Trustworthy long-term forecasts are a key weapon in the battle against myopic inclinations, and they crucially inform our asset allocation decisions. It is our hope that these forecasts are also of use to our clients, whether as a tool for setting return expectations, evaluating liability-driven investment (LDI) strategies or simply providing a better understanding of the world we live in.

In generating long-term return forecasts, we seek to maximize the robustness of the answers by triangulating between multiple models and perspectives. This mosaic of outcomes dampens the effect of the idiosyncrasies and assumptions that bias each individual model. Moreover, it is heartening that the various model findings so often agree with one another.

It is our intention to continue innovating in this sphere, and to publish regular reports on our findings. Some of this research will cover entirely new subject areas, others will refine prior forecasts based on new information or techniques.

environment theoretically supportive of normal bond market valuations.¹

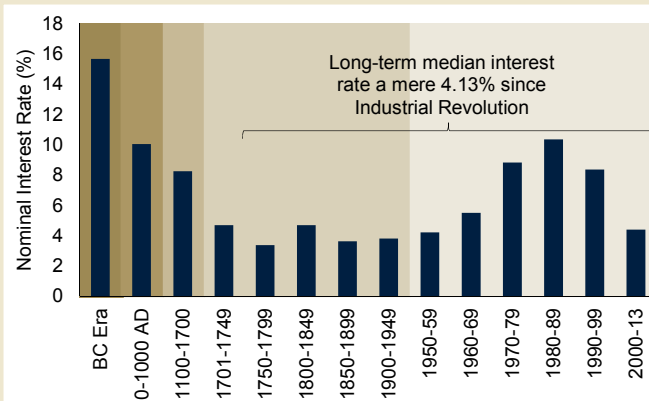
1) Historical record: 3.92%

What can history tell us about normal bond yields? The answer depends on just how far back we are willing to time travel. At an extreme, we can venture back a head-spinning 5,000 years, observing the (rather usurious) rates that Babylonians and Sumerians paid on their debts (Exhibit 3).

Fascinating as this is, the world was indisputably a very different place back then, lacking in sustained economic growth, and with much flimsier financial and legal systems. Conditions become more familiar in the 18th century as the Enlightenment replaced centuries of traditional thinking with reason and science,

¹ Admittedly, it is impossible to say where precisely in the business cycle the economy will be in 2023. As such, it is quite possible that yields will be temporarily (and perhaps significantly) higher or lower than our "normal" estimate. Why, then, have we bothered to specify a 10-year outlook rather than simply to speak vaguely of the "long term"? Because one of our models requires demographic assumptions that must be anchored to a specific year. And another of our models must be pinned to a specific point on the forward curve. Still, it is not unreasonable to view these estimates as an approximation of the long-term normal outlook over the next few decades.

Exhibit 3: An ultra-long history of interest rates



Note: Posted rates are a blend of long-term nominal interest rates for the world's major powers of each era. Source: Homer & Sylla, "A History of Interest Rates", Haver Analytics, RBC GAM

enabling the Industrial Revolution to kick-start economic growth and deepen financial markets. Starting from this period (1750), the median long-term interest rate for advanced nations is a tame 4.13%.

We can drill even deeper into the subject by sacrificing a bit of history in exchange for better data² that focuses specifically on the U.S. 10-year yield. Even including the distortions of the 1970s and 1980s, the median U.S. 10-year yield over the past 143 years is just 3.92% (Exhibit 4).

2) Short to long: 4.00% to 5.00%

A completely different bond yield forecasting technique starts with a neutral short-term rate, then projects out the yield curve via a term premium. The U.S. Federal Reserve helpfully informs us that they believe the neutral fed funds rate is just shy of 4.00% (Exhibit 5).

Term premiums reflect the extra return that investors are supposed to earn as compensation for taking on the additional uncertainty of a longer-dated bond. Since 1990, the U.S. term premium has averaged about 100 basis points (Exhibit 6). However, we are inclined to shave a little off of this figure. Even setting aside its extreme behaviour in recent years, the term premium has been on a multi-decade decline.³

Combining these two inputs, the short-to-long approach represents a vote for a neutral U.S. 10-year yield in the range of 4.50% to 5.00%. However, a definitional problem remains. We seek “normal” yields, not “neutral” yields. What’s the difference? Central banks tend to behave asymmetrically, spending more time below their neutral rate than above. For instance, whereas the neutral fed funds rate arguably averaged 4.75% between 1995 and today,⁴ the median (and thus normal) fed funds rate was just 3.13% over the period. Taking inspiration from this, we broaden and lower this model’s projection range to 4.00% to 5.00%.⁵

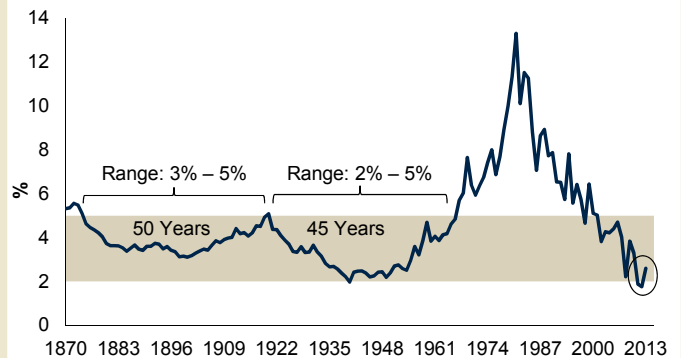
² The data is monthly, providing a clearer and smoother sense for bond market behaviour than a single annual data point could provide.

³ The reasons include greater Treasury bond buying by foreigners, but may also reflect declining economic, inflation and monetary policy uncertainty, as central banks have become more transparent and explicitly targeted inflation.

⁴ 1995 is selected as the start date since it arguably represents the beginning of the era when central banks had finally switched to inflation targeting and actually achieved normal-looking inflation rates. The historic neutral rate is higher than the future neutral rate due to a declining potential economic growth rate.

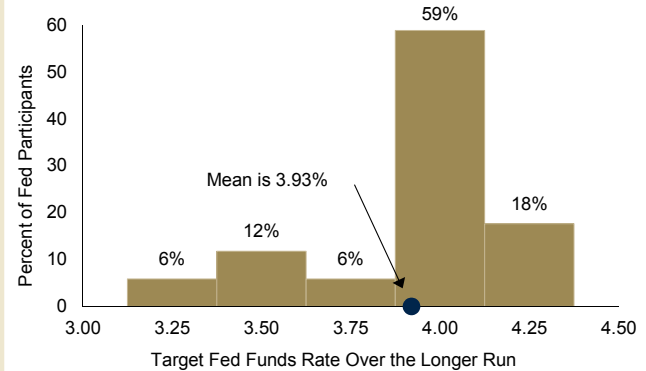
⁵ We are reluctant to push the forecast too much lower because some part of the gap between the Fed’s historic neutral and normal yield relates to the unusual conditions of the past few years.

Exhibit 4: Historical U.S. 10-year Treasury yields



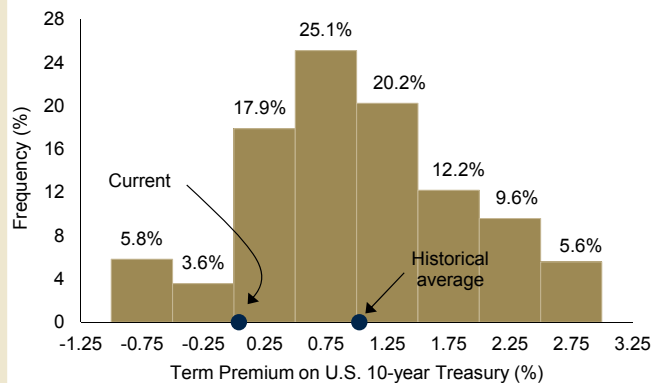
Source: RBC GAM, RBC CM

Exhibit 5: Perspective on neutral fed funds rate



Note: Based on distribution of opinions at Sept. 18, 2013 Fed meeting. Source: U.S. Federal Reserve, RBC GAM

Exhibit 6: Seeking a normal term premium



Note: Distribution of term premium since 1990. Source: Kim & Wright (2005), Federal Reserve, RBC GAM

3) Economic link: 4.00% to 4.25%

An approach near and dear to any economist's heart is to estimate bond yields by capitalizing on the historical connection between nominal economic growth and bond yields (Exhibit 7).

There is sound logic behind this. When the economy is strong, central banks hike rates and so bond yields rise. Similarly, when inflation – a part of nominal GDP – is rising, so is the inflation expectation component of the bond market. From a microeconomic perspective, bond yields naturally settle at a level where supply equals demand. If the level of yields is materially lower than the rate of GDP growth, savers will not buy bonds as they would rather invest directly in the economy itself. If yields are materially higher than growth, borrowers will not borrow as they cannot earn a sufficient return on their projects to justify the loan.

So what will constitute “normal” nominal GDP growth in 10 years' time? This can be decomposed into the outlook for inflation plus real GDP. Real GDP growth, in turn, comes from the application of some combination of more workers and higher productivity (Exhibit 8).

Inflation

The Fed currently targets a 2.0% inflation rate. However, U.S. inflation has averaged a slightly higher 2.25% since 1870; there may be some temptation to inflate away a sliver of public debt; and the dual mandate of the Fed – to balance occasionally competing inflation and unemployment goals – exposes the possibility of higher-than-targeted inflation, especially over the next several years.⁶ On the other hand, inflation has lately been stuck below 2.0%, aging populations generally agitate for lower inflation⁷ and long-discussed alternate inflation-targeting regimes⁸ could theoretically lock in a 2.0% or lower inflation rate. In the end, a 2.0% inflation forecast in a decade's time seems an innocuous compromise.

Demographics

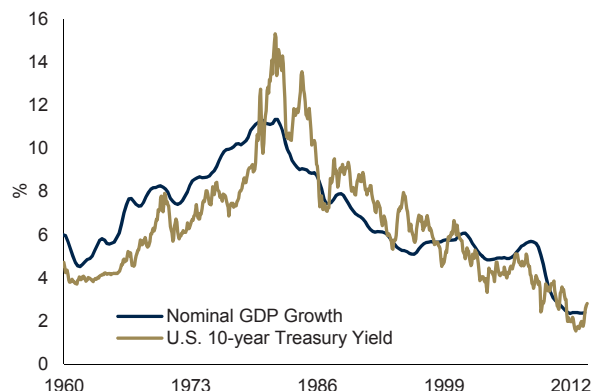
Economic growth comes in part from the application of additional workers. Usually, the anticipated growth rate of the working-age population is used as a proxy for growth in the workforce itself. But we can do better than this. Output is not merely regulated by the supply of workers. It is also determined by the demands of

⁶ The risk is particularly higher over the next several years because central banks are juggling large balance sheets and appear more focused on elevated unemployment rates. Indeed, the Fed has explicitly said it would tolerate an inflation rate up to 2.5% if it had to.

⁷ Older populations generally prefer lower inflation since they must rely upon their savings for income. Japan's experience with low inflation provides some support for this thesis (though there are other important factors that help to explain Japan's struggles with deflation).

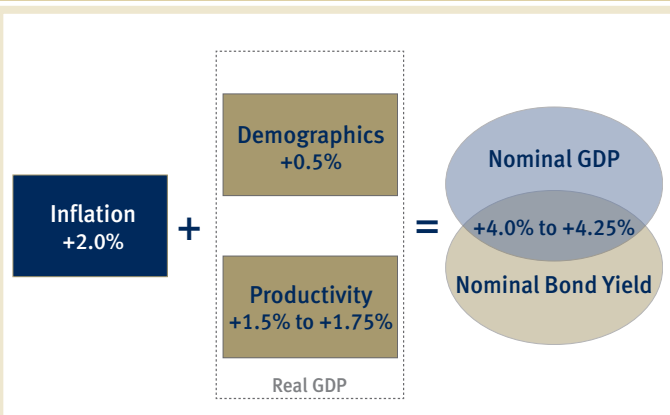
⁸ Such as pursuing a lower inflation target or price-level targeting (which would eliminate any persistent slippage from target).

Exhibit 7: U.S. nominal GDP and 10-year yield in tandem



Note: 5-year moving average of year-over-year nominal GDP growth.
Source: BEA, Haver Analytics, RBC GAM

Exhibit 8: Economic add-up



Source: RBC GAM

consumers, as reflected by growth in the overall population. After all, retirees and children eat food and buy things, too.

Adding a further layer of complexity, not every worker or consumer is cut from the same cloth. In particular, the mix of young and old matters. As workers gain experience over their career, their hourly output usually rises.⁹ Eventually, they scale back their working hours and then retire altogether. And they generally temper their consumption once retired, if not as severely as their output. We manage to combine these varied influences into our estimate. Given a diminished fertility rate and an aging population, it will come as little surprise that U.S. demographics are becoming less favourable. Whereas demographics

⁹ Strictly speaking, this represents a gain in productivity, which means that our demographic and productivity components are beginning to blur together. A small fraction of the diminished productivity forecast in the next section reflects this.

contributed 0.9% to GDP growth over the past decade, it is set to contribute just 0.5% in a decade's time (Exhibit 9).

Productivity

The final piece of the economic puzzle is productivity. It is also the hardest to predict. There has lately been a groundswell of opinion that the era of innovation and productivity growth is dying. The gloomy arguments generally include the following:

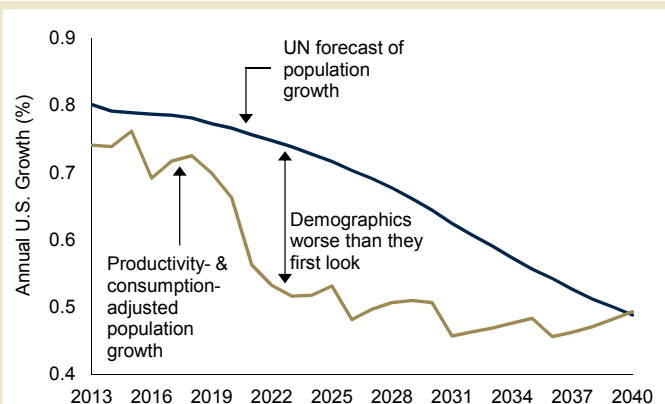
- Prior temporary tailwinds have been lost, due to the end of leveraging, false financial innovation and the three-decade decline in interest rates.
- Other tailwinds are diminishing, due to a slowdown in the rate of rising educational attainment, rising female labour force participation and urbanization.
- An absence of major breakthroughs: where's the next invention on the scale of electricity, the combustion engine or internal plumbing?

Several of these arguments have merit, and indeed productivity growth will probably slow in the future. But this perspective is rather one-sided, exaggerating the extent of the challenge. Here are some partial offsets:

- The very nature of innovation is that few see new technologies coming. Our inability to anticipate the next "big idea" doesn't invalidate its eventual emergence.
- While innovations no longer come as readily via transportation (though car and plane safety have improved massively even if their speed has not, and the self-driving car could be a game-changer) or via novel household appliances, they are still coming. Instead, the big gains occur in areas like communication and information. While the initial effect of some of these innovations has been underwhelming, new technologies take decades to fully deploy (Exhibit 10).¹⁰
- The rate of capital investment and research & development have not obviously slowed. And if the state of basic research is any guide, the future remains bright, with exciting innovations across a range of fields, including 3D printing, biotechnology, miniaturization and robotics.
- A subtle challenge-response mechanism exists whereby deteriorating demographics sometimes spur additional innovation.

¹⁰ For more detail on long-term headwinds and tailwinds for the economy, refer to *Economic Compass – Issue 13*, entitled *Sizing Up a Downshifting Economy*, released February 2012.

Exhibit 9: Demographic contribution to growth on downswing



Source: Haver Analytics, RBC GAM

Exhibit 10: The long road to productivity gains

Phase: →	Basic Research	Disruptive Innovation	Deployment
Time required	Years/Decades	Years	Decades
Excitement	Unexciting	Exciting	Less exciting
Economic value	No benefit	Small benefit	Maximal benefit

Source: Carlota Perez, Technological University of Tallinn, RBC GAM

All told, whereas U.S. productivity growth has averaged 1.9% per year over the past five years and 2.2% over the past half century, we figure it will slow to the range of 1.5% to 1.75% in the future.

Rolling inflation, demographics and productivity together, nominal GDP growth should be capable of sustaining 4.0% to 4.25% annual growth in a decade's time. In turn, bond yields should average about the same.

4) Market expectations: 4.20% to 4.45%

Lastly, we consider a radically different approach. It throws what we know about economics, monetary policy and the history of bond yields out the window, and instead simply asks Mr. Market what it thinks is a normal level for bond yields. The rational expectations hypothesis argues that this should provide a good, unbiased opinion.

We tease this information out of the market with the help of the forward curve. By comparing the level of the current 20-year yield to the level of the current 10-year yield, we can get a sense

for the expected 10-year yield in a decade's time. The current gap points to a 4.45% 10-year yield in 2023. But this neglects different 20-year and 10-year term premiums, which exaggerate the figure by up to 25 basis points. In the end, the market-expectations effect supports a 10-year yield of 4.20% to 4.45%.

Dreaded complications

Combined, these four techniques elegantly propose an average U.S. 10-year yield of 4.22%. But we aren't quite done. There are some extra considerations that need to be layered on top of this calculation.

Upward tilt

The U.S. public debt load is now quite high. Historically, there has been a positive link between the size of a nation's debt and the level of its bond yields. This is understandable: someone has to be incented to hold all of the extra bonds that finance the debt. However, we are reluctant to expect too much from this effect. The relationship between the two variables is notoriously loose, and the U.S. bond market enjoys a special dispensation to borrow without fear of reprisal due to the reserve currency status of the U.S. dollar. Certainly, there has been no sign of any punishment so far, and the experience of the pound sterling as reserve currency in the 19th and early 20th centuries provides further support (Exhibit 11).¹¹ As the U.S. deficit continues to shrink, much of the remaining pressure should ease. In short, the heavy debt load probably won't affect yields at all, though we should allow for the possibility that it could tilt them higher.

Downward tilt

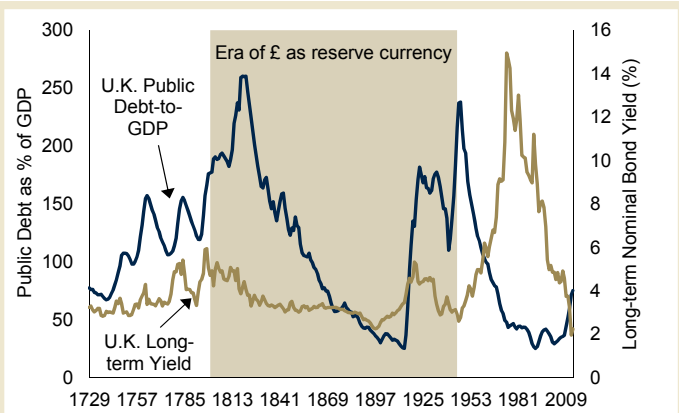
On the other hand, there are a few downward pressures. In an era of high public debt, history demonstrates that it is not unusual for policymakers to seek to subtly repress interest rates as a way of assisting in public debt reduction efforts.

Furthermore, despite all of the U.S. Treasury debt floating around, there may actually be a shortage of safe assets. On the supply side, there are fewer highly rated sovereigns (Exhibit 12), corporations (Exhibit 13) and securitized bonds than before the financial crisis. On the demand side, banks are being pressured to increase the safety of their balance sheets, and a growing horde of emerging market savers are still being forced abroad due to a lack of "risk free" domestic investments.

Meanwhile, an aging population does more than just slow economic growth. Risk tolerance also declines with age, resulting in a greater appetite for bonds. Academic studies

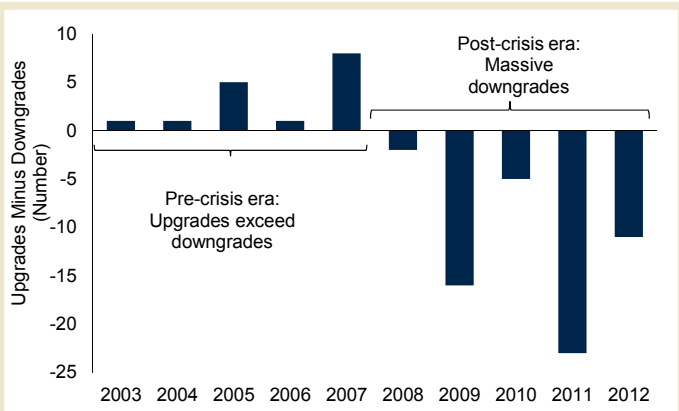
¹¹ Note further that the U.S. is decades or longer from losing its reserve currency status.

Exhibit 11: U.K. high debt went unpunished during its reign



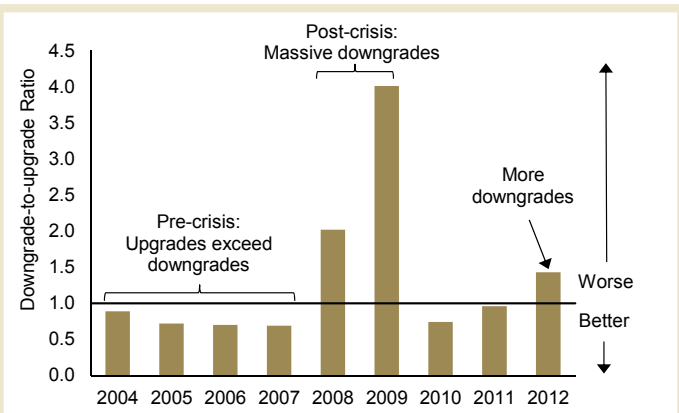
Source: Homer & Sylla, "A History of Interest Rates", U.K. Public Spending, RBC GAM

Exhibit 12: Shrinking pool of highly-rated sovereigns



Note: Upgrades and downgrades of investment-grade local-currency sovereign credit ratings. Source: S&P, RBC GAM

Exhibit 13: Shrunken pool of good corporate credit



Note: Changes of global corporate long-term local-currency credit ratings. Source: S&P, RBC GAM

estimate that this could depress the 10-year yield by up to 50 basis points.

Conservatively, we assume that these motley effects will collectively depress normal yields by 0 to 50 basis points.

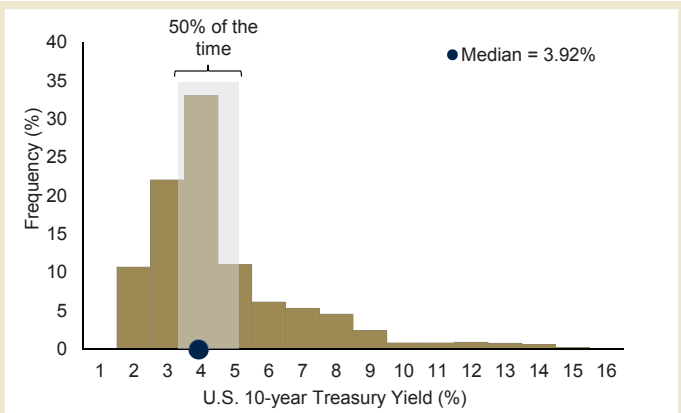
Bottom line

So, where will yields eventually settle? Our math argues that a normal U.S. 10-year yield will average 3.97% (refer again to Exhibit 2). For thoughts on Canadian rates, see Appendix A.

We stand by this number, though no one should pretend there is much precision to it. Bond yields vary hugely across the business cycle, meaning that even if they average this level over time, they will regularly depart from it. To illustrate, despite a median historic yield of 3.92%, U.S. yields have spent fully half of their time below 3.35% or above 5.15% (Exhibit 14). Providing a similar perspective, it is not uncommon for yields to temporarily deviate by multiple percentage points from the underlying economic growth rate.

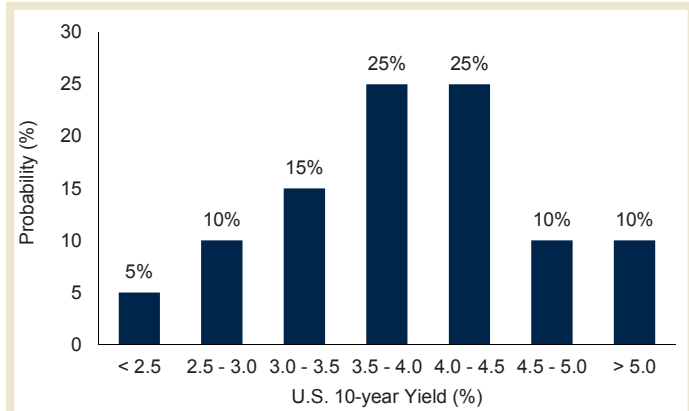
It may be wiser to think in terms of probabilities, as illustrated in Exhibit 15. A yield near 4% is indeed the most likely scenario,¹² but other possibilities exist. On the surface, it hardly seems helpful or particularly clarifying that we say there is a 25% chance that yields will average 3.5% to 4.0%, and a 25% chance they average 4.0% to 4.5%. Frankly, this means yields are just as likely to average something else altogether. Disconcerting as this may be, it usefully highlights just how mercurial the bond market can be. Perhaps some comfort can be taken from our view that the odds of yields averaging over 5.0% or less than 2.5% are collectively a mere 15%.

Exhibit 14: Bond yields spend most of their time around 4%



Note: Distribution of monthly U.S. 10-year yield back to 1870. Source: Federal Reserve, RBC CM, RBC GAM

Exhibit 15: Where will the “normal” 10-year yield settle?



Note: Normal defined as long-term median 10-year yield. Source: RBC GAM

¹² This probability distribution does not indicate the fraction of time yields will spend in each bucket. If that were the case, the probabilities would be even more widely distributed. Instead, it reflects the likelihood that yields will average a particular level.

APPENDIX A: CANADIAN RATES

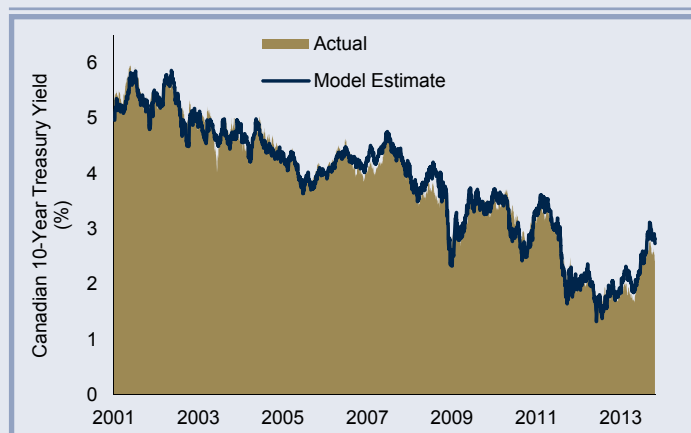
By extension, this report contains useful information about the likely end point for the Canadian 10-year yield. Helpfully, the Canadian bond market is tightly linked to its international peers. Our cross-correlation model reveals that 97% of all we need to know about the level of the Canadian 10-year yield is embedded within the yields of the world's other major bond markets (Exhibit A). Thus, economic normalization around the world and an eventual end to extraordinary stimulus will affect Canadian borrowing costs, too.

The Canadian bond market is especially closely tied to U.S. bonds. Since 1995 – when Canada solved prior chronic fiscal problems – Canadian and U.S. bonds have been joined at the hip (Exhibit B), with median yields of 4.61% and 4.52%, respectively. Thus, it is a fair bet that if the U.S. 10-year yield is set to average around 4.00%, Canada probably will too.

Domestic factors make only a small contribution to Canadian yields. Of the wedges that do exist between the two nations, most argue for Canadian yields being lower than the U.S. Depressive factors include Canada's lower public debt load, a better debt rating, a more explicit inflation target and a slower potential growth rate. Indeed, Canada's current 10-year yield is already almost 10 basis points below the U.S., despite a higher policy rate and a lack of quantitative easing.

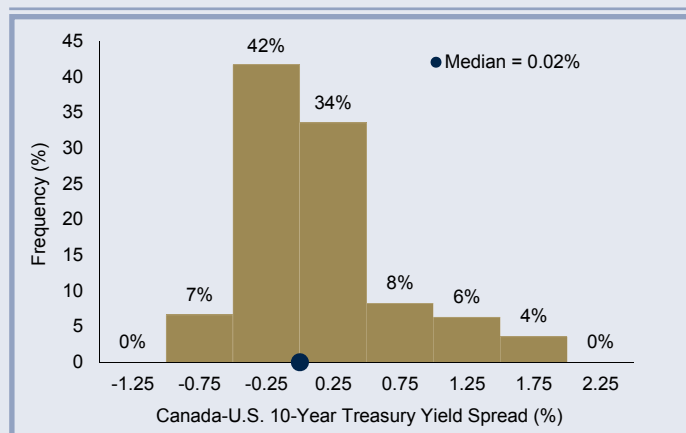
However, all of this must be pitted against an enormous advantage unique to the U.S.: status as the world's reserve currency. It isn't quite a wash: we figure Canadian yields will average 3.75% to 4.00%, a hair lower than the U.S.

Exhibit A: Global factors drive Canadian yields



Note: Estimate based on our cross-correlation econometric model using yields of 10 other developed countries to explain Canadian 10-year yield. Source: Haver Analytics, RBC GAM

Exhibit B: Canada-U.S. 10-year yield spread usually small



Note: Distribution of Canada-U.S. spreads since 1995. Source: Haver Analytics, RBC GAM

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