Decomposing Provincial-Canada Yield Spreads: Does Fiscal Discipline Matter?

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DEFINITIONS

Basis Point
One-hundredth of a percentage point (0.01%).

Benchmark Bond
Most recently issued security used for reference or comparison. See also On-the-run.[1]

Bid-Ask Spread
The difference between the bid (price a buyer is willing to pay) and the asked price (price a seller is willing to accept) for a given security.[1]

Generic Bond (Generics)
Refers to the characteristics of a particular issuer and a particular maturity over time.

Multicollinearity
Occurs when one of the regressors is a linear function of another regressor.[2]

Nominal Bond
Fixed-coupon marketable bond. Pays interest based on a fixed (nominal) coupon, as opposed to a real return bond for which interest is adjusted for changes in the consumer price index (CPI).[3]

Primary and Secondary Market
A newly issued security is first offered on the primary market (when initially sold by the issuer). Subsequent trading occurs in the secondary market.[1]

On-the-run/Off-the-run
On-the-run bonds are the most recently issued, and often the most liquid, government bonds in a particular maturity range. Off-the-run securities are not the most recent issues and often less liquid.[1]

Stripping and Reconstituting Bonds
Separating the coupon from its principal. Stripping bonds means selling the coupon individually. Reconstituting bonds is done by buying back the two pieces (coupon and principal) individually.[4]

DISCLAIMER

EXECUTIVE SUMMARY

The market for Government of Canada securities is closely scrutinized by analysts, market participants, and government officials themselves. The market for provincial bonds generally receives less attention. However, at $642 billion in 2017 and representing 27% of capital markets in Canada, the market for provincial bonds was larger in size than that of the federal government at 23%. As some provinces will likely continue to finance important deficits by borrowing from financial markets and diversifying their borrowing methods, it is crucial to understand the dynamics at play in this segment of the market.

In this report, the Institute of Fiscal Studies and Democracy (IFSD) investigates if, and by how much, fiscal discipline matters for provincial-Canada yield differentials. To do so, we build on existing literature on subnational spreads and decompose annual provincial yield spreads by their fundamental drivers: fiscal stress, risk aversion, liquidity, transfer dependency, trade openness, and employment. We find that fiscal soundness at the provincial level consistently compresses yield spreads both at the 10- and 5-year bond maturity. Specifically, a 1 percentage point decrease in a province's net debt-to-GDP ratio decreases provincial-Canada fundamental spread by 0.5 and 0.05 basis points at the 10- and 5-year maturity, respectively. While this might seem small, considering current debt levels, this amounts to a 5 spread basis points premium for Quebec, and 7 for Newfoundland. This also is a 12, 9, and 9 spread basis point discount for Alberta, British Columbia, and Saskatchewan at the 10-year maturity, respectively. Additionally, assuming perfect liquidity in the federal bond market, a 1% increase in a province's outstanding amount of bonds relative to that of the federal government decreases its fundamental 10-year spread by 0.7 basis points. Henceforth, bigger provinces such as Ontario and Quebec, with deeper and larger markets for their bonds, benefit from a liquidity discount. It is worth emphasizing that this proxy for liquidity remains indirect.

Global risk aversion as imbedded in corporate bond spreads remains a major factor influencing provincial-Canada bond spreads. A 1-basis-point increase in Investment Grade (IG) corporate spread increases provincial spreads by 0.5 basis points. This supports the hypothesis that provincial bonds are seen by investors as substitutes for IG corporate bonds. A related finding is that, over the long-term, provincial-Canada yield spreads exhibit more variation over time than between provinces, highlighting the importance of common factors such as risk aversion in explaining yield differentials.

We also investigated whether the importance of federal transfers such as equalization payments, Canada Health Transfer, and Canada Social Transfer reduce provincial yields by providing an implicit bailout policy. We find that higher transfers-to-revenues tend to compress long-term yields, which we see as a form of risk-sharing across the country. Finally, trade openness and employment-to-population ratio, proxies for a province's capacity to attract capital and collect taxes, respectively, dampen yield spreads.

INTRODUCTION

Canada is a decentralized federation, where powers and responsibilities are divided between the federal, provincial and local governments. Among those powers, provinces have important direct taxing authority similar to those of the federal government. For example, among others, provinces are able to set up their own distinct personal income, corporate, and consumption taxes. In Canada's Constitution, the capacity to tax their citizens was given to provinces in order to allow them to meet their constitutional responsibility to deliver broad services, such as health care.

By that same token, provinces are also allowed to raise debt. Currently, six out of ten Canadian provinces, as well as the federal government, are projecting deficits for the next few years.[5] And since a deficit is by definition a shortfall of revenues over expenditures, it needs to be financed with borrowed money, meaning more debt is expected to be sold. It is in this context of debt and deficits that provinces have developed sophisticated borrowing programs for efficient debt management, effectively trying to minimize borrowing costs while managing payment volatility.

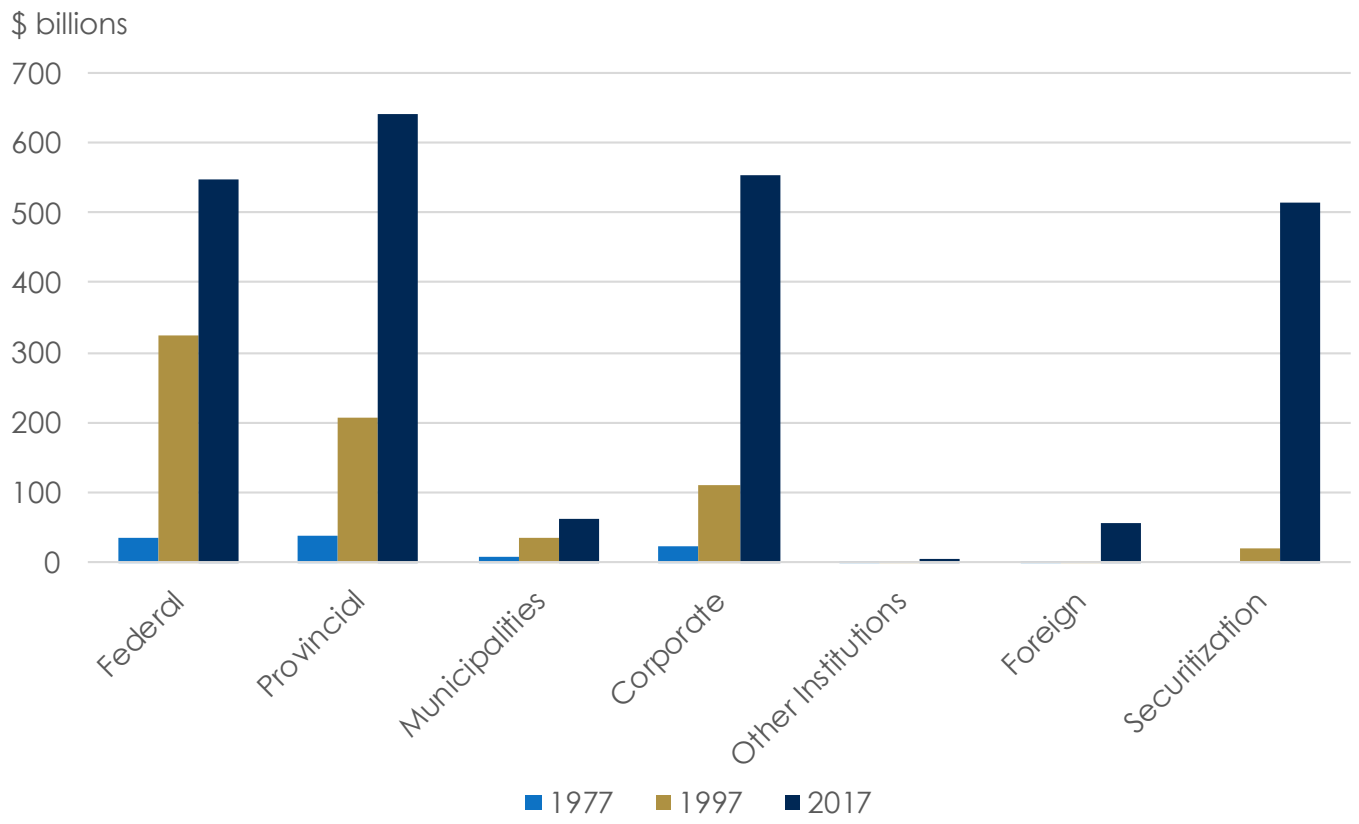
As in other advanced economies, most borrowing made by provinces are securitized and take the form of domestic nominal bonds—in Canada's case, in Canadian dollars. One salient feature of provincial bonds is their higher required rate of return both in the primary and the secondary market relative to bonds of the same maturity issued by the Government of Canada. For example, on April 6, 2018, the Province of Ontario opened its June 2028 domestic bond with a coupon rate of 2.90%. On August 16, that bond was yielding 2.92% in the secondary market. Those rates were 90 basis points and 67 basis points higher than the comparable June 2028 Government of Canada nominal bond, respectively.[6] This difference in the yields—more commonly known as the yield spread—results from many factors but the primary explanation is straightforward: Government of Canada bonds are risk-free, and provincial bonds are not. As Sola and Palomba (2015) have pointed out, many structural factors explain historically-positive subnational spreads to federal benchmarks. For instance, provinces have a more mobile tax base and cannot use monetary policy and currency play to devalue debt through inflation or exchange rate effects. Additionally, subnational governments in Canada have to share taxation powers with the central government, thereby reducing their relative taxation capacity. All of these factors, in theory, increase the default risk of provincial bonds.

However, as documented in Joffe (2012), outright defaults on provincial obligations are extremely rare in Canadian history. In fact, this has only happened once (in 1936, in Alberta) during the Great Depression. Similarly, what was then the Dominion of Canada provided financial assistance to other Western provinces in the 1930s in the form of federal loans precisely to avoid outright default. The irregularity of those episodes undeniably yields far lower default rates in the provincial debt market than in the similarly-rated corporate debt market.[7] Accordingly, some other factors must have a sustained influence on provincial bond rates, explaining systematically positive spreads relative to the Government of Canada.

In this report, we try to disentangle the long-run influence of fiscal variables on provincial bond yield spreads in the secondary market from other causes. Building on existing sovereign and sub-sovereign yield spread models, the question of fiscal discipline on the cost of borrowing for provinces can then be addressed and quantified. Understanding those dynamics is crucial to both the provinces (the issuers) and the investors. Indeed, in 2017, the provincial bond market averaged a notional value of $642 billion, representing 27% of total capital markets in Canada. In comparison, the market for federal bonds represented 23% (Chart 1).[8] Despite generating much less attention than the market for Government of Canada bonds, the market for provincial bonds is larger in size and worth watching.

Furthermore, with provinces actively diversifying their borrowings and even offering specialty bonds to retail investors, understanding the global factors that affect provincial-Canada spreads becomes essential.

Chart 1: Bonds Outstanding By Type



Sources: Bank of Canada, Statistics Canada.
Notes: In Canadian dollars. Bonds are at par value and include both direct and guaranteed securities.

The IFSD finds that an increase of 1 percentage point in the net debt-to-GDP ratio relative to the federal government increases the long-run value of provincial spreads by 0.5 basis points. We also find that liquidity and risk aversion in the secondary market have a long-run effect on provincial yield differentials, with the latter having a large impact on spreads due inherent volatility. Finally, we also cover the topic of federal bailout expectations. Indeed, a relatively large amount of literature is dedicated to the effect on subnational spreads of bailout expectations by the central government, central bank, or supranational authority. The idea is simple: if investors believe that, in a fiscally distressed situation, a national or supranational authority will provide financial assistance as a last resort to a subnational government, fiscal discipline among lower levels of government does not matter as much.

In the Theoretical Framework and Literature Review section of this report, we present the underlying theoretical model as well as a brief review of the existing literature on subnational yields spreads. The third section, Data, presents and analyzes the data. Methodology and Results follow in subsequent sections, with the conclusion ending the report.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Using portfolio theory, Bernoth et al. (2012) derive a model of yield spreads for European government bond markets.[9] That model was applied to subnational jurisdictions, including Canadian provinces, in Schuknecht et al. (2009) (1):[10]

$$\frac{r_t - r_t^*}{1 + r_t} = \left(1 - P((x_t)\right)\left(1 - \frac{\tau_t}{1 + r_t}\right) + \frac{l_t}{1 + r_t} + \phi_t \qquad (1)$$

Where:

- $0 \leq \left(1 - P((x_t)\right) \leq 1$ is the probability that the domestic (subnational) government will not be able to serve its obligations at time t.
- $\left(1 - \frac{\tau_t}{1+r_t}\right)$ is the fraction of its initial investment as a share of the promised coupon $r_t$the investor is expected not to recover in the case of partial default from the domestic government.
- $\frac{l_t}{1+r_t}$ is a liquidity premium
- ϕ_t is a variable representing risk aversion in financial markets.

Using this approach, the domestic spread is positively related to the probability of default and the expected loss given default, with the product of the two being the expected loss on investment. The relationship between credit risk and the required rate of return is well-defined, both theoretically and practically.[11] Since the expected loss is unobservable and the scarcity of credit events in Canada makes it difficult to assemble a meaningful sample, fiscal variables representing financial distress that should increase the likelihood of subnational default are used as a proxy to imbed credit risk. Namely, consistent with existing literature on national and subnational risk premia, the deficit-to-GDP and debt-to-GDP ratios are used as controls for credit risk. The relationship between fiscal distress and risk premia paid on debt securities has been demonstrated several times within the European Monetary Union (EMU). Whether European states pay risk premia relative to the benchmark (yields on German bonds) because of differences in fiscal discipline is an important and sensitive issue in that region. Moreover, the creation of the EMU in 1999 rendered better analysis possible because domestic bonds issued in the EMU do not have exchange rate risks. While the data, sample period, and methodology vary, most studies for EMU found a significant relationship between fiscal distress and risk premia imposed by sovereign debt markets; see Schuknecht, von Hagen, and Wolswijk (2009) and Bernoth et al. (2012) for a brief literature review. At the subnational level, research has focused on the effect of fiscal performance indicators on the spread over which U.S. states borrow relative to the federal government. Those studies have generally found a significant relationship between U.S. states' indebtedness and their borrowing spread.[12]

The framework also embeds an international financial market force that is likely to influence any subnational debt market: risk aversion. Indeed, as Bernoth et al. (2012) highlight, in a period of uncertainty or crisis, investors move to safer and more liquid assets to avoid potential losses. This reduces demand for subnational bonds relative to the risk-free benchmark and increases the risk premia. Indeed, Beck and Ferrucci et al. (2016), Sola and Palomba (2015), Bernoth et al. (2012), and Schuknecht, von Hagen and Wolswijk (2009) have found a consistent and positive relationship between global risk aversion and domestic risk premia.

Further, the relatively small market size of subnational debt securities, especially for several Canadian provinces, also implies lower trading activity and therefore liquidity. This is expected to increase the risk premium for a given security because investors have less assurance that they can obtain fair value for their assets should they need to sell at any moment. However, the empirical evidence of the impact of liquidity on bond yield spreads has been mixed. Schuknecht, von Hagen and Wolswijk (2009) conclude that liquidity had been a significant factor in increasing risk premia for European countries prior to the installation of the EMU. The authors (2009) attribute this finding to the conversion of relatively small local currency debt markets into a much larger pool of Euro-denominated debt securities, which exhibits much more liquidity. However, in most other cases, the liquidity control variable has been found to be insignificant relative to subnational yield spreads in the United States, Germany, and Australia (Sola & Palomba, 2015). This lack of materiality in the liquidity effect could be partly explained by the low quality of the data available. Indeed, traditional secondary market measures of liquidity like bid-ask spreads or turnover ratios are not directly available or do not exist at the subnational level in a long-term time series format. Therefore, most studies have relied on aggregate measures of relative debt outstanding or issue sizes to measure liquidity. Unfortunately, those measures do not guarantee that the specific debt is actively traded (on-the-run) and might include illiquid series (off-the-run) that mask the underlying true liquidity in the securities market. Moreover, using aggregate outstanding debt might cause multicollinearity problems with the debt-to-GDP ratio variable that also constitutes a measure of outstanding debt, albeit a different measure.

Few studies have deconstructed provincial yield spreads over the federal government in a Canadian context. Booth et al. (2007) found that provincial fiscal stress has a significant impact on yield spreads. They also conclude that provincial bonds can be seen as substitutes to corporate bonds, especially in periods of high-risk aversion, like a recession, in which "flight to quality" is a distinct feature. Other studies have confirmed those findings. With that said, it is important to note that the quantified effects of fiscal variables on provincial yield spreads, while mostly significant, have been small and volatile. For instance, depending on the sample period, dataset, and estimation techniques used, a 1 percentage point increase in the provincial debt-to-GDP ratio relative to that of the central government has been found to increase provincial yield spreads between 0.3 (Schuknecht, von Hagen and Wolswijk, 2009) and 1.2 basis points (Beck and Ferrucci et al., 2016).[13] Similarly, a 1 percentage point increase in provincial deficit-to-GDP ratio relative to that of the central government has been found to increase yield spreads between 2.5 (Booth et al., 2007) and 4.4 basis points (Schuknecht, von Hagen and Wolswijk (2009).[14] In 2016-17, the median deficit-to-GDP ratio of Canadian provinces relative to that of the federal government was 0.40 percentage points, indicating a median provincial surplus (or smaller deficit) relative to that of the federal government.[15] Also, the median provincial debt-to-GDP ratio relative to that of the federal government was 0.2 percentage points. Combining those fiscal data to the existing literature's coefficient can therefore lead to various, and sometimes small, effects of fiscal variables on provincial spreads.

Federal transfers to provinces, determined by specific rules and formulas, have raised the question of implicit bailout expectations. For example, in the case of an emergency or a sustained fiscal crisis in one or more provinces, the federal government could increase existing transfers, or even create new ones to avoid a credit event, that could have contagion effect on all provinces' credit worthiness. Schuknecht et al. (2009) tested how implicit bailout expectations affect yield differentials by having a set of binary variables identifying equalization receiving provinces interacting with fiscal stress variables. They find that provinces that receive equalization payments "are not punished by financial markets for incurring larger deficits". When including the US, Australia, and Germany in their

sample, Sola and Palomba (2015) show results that broadly support the previous conclusion: "high transfer dependency from the central government halves the effect that budget deficits and debt have on SNGs' risk premia". That conclusion is reinforced in Beck and Ferrucci et al. (2016), who show that an implicit expectation by financial markets for the central government to provide assistance once a subnational jurisdiction enters a "danger zone" (very high level of debt) exists, but the tempering effect on spreads also depends on the central government's ability to pay.

DATA

Provincial Data Spread

Bond yields data from which provincial spreads are constructed come from the *FTSE TMX PC-Bond* database. Daily bond yields for each province and for the federal government have been available since 1989 and are averaged to construct annual series. We believe these data provides an important advantage over other yield differential measures since they are generics carefully constructed by *FTSE TMX*. They are therefore not affected by sample selection biases which could happen in a sample constructed from selected bond issuances. Indeed, the size and timing of bond issuances is inherently related to the fiscal situation, which can distort the primary market yield, e.g. provinces could stop borrowing while their fiscal situation deteriorates. Since generics are constructed as constant-maturity securities, they are not affected by the time-to-maturity of the underlying, which matters a great deal in secondary markets. Finally, using a single data source facilitates the comparison of spreads due to methodological uniformity.

Table 1 provides the average yield spread by province over four distinctive periods at the 5- and 10-year maturity. Over the whole sample (1989-2017), the average spread at the 5-year maturity runs from a low of 32 percentage points (ppts) for Alberta to Newfoundland's high of 53 ppts, just ahead of Prince Edward Island at 52 ppts and Quebec at 46 ppts. Among the provinces with the lowest spread were Alberta, British Columbia, and Ontario. The ranking is the same at the 10-year maturity but with obviously higher spreads.

Analyzing yield spreads over the 1990-99, 2000-07, and 2010-17 periods reveals patterns that are consistent with the broad regional macroeconomic dynamics of the past decades. Higher spreads were registered in the 1990s, with Newfoundland, Prince Edward Island and Quebec facing their highest average borrowing costs over the whole sample. Then, most spreads decreased significantly in the late 1990s and throughout the 2000s. While the causes of such a tightening in spreads are explored in much greater detail below, stronger economic growth coupled to a return to budgetary balance in most provinces are certainly part of the story. For example, in 2005-06 and 2006-07, all provinces and the federal government registered a budgetary surplus—quite a unique situation in recent Canadian history. Spreads increased again following the 2008-09 recession. Ontario, Quebec, British Columbia and Alberta were among the provinces which suffered the most from increasing borrowing costs over that time.

Between 1989 and 2018, most variation in provincial spreads occurred *within* each province, meaning that it occurs mostly over time for a given province (Table 2).[16] Provincial spreads both at the 5- and 10-year levels have much smaller *between* variation among provinces. That observation is important because it implies that global factors that influence all provinces could play a larger role in provincial spreads than individual factors related to the province's current fiscal situation.

TABLE 1: PROVINCIAL-FEDERAL BOND YIELD SPREAD (PERCENTAGE POINTS)								
5-Year	1989-2017		1990-1999		2000-2007		2010-2017	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
NL	53	27	63	31	31	9	58	19
PE	52	25	56	31	31	9	60	12
QC	46	20	50	22	29	8	53	10
NS	45	22	46	25	29	10	54	13
NB	42	23	38	25	26	9	56	13
SK	41	25	46	32	25	9	45	14
MB	39	22	36	23	25	9	50	13
ON	39	20	35	20	24	8	52	10
BC	34	19	29	18	24	8	43	11
AB	32	21	26	19	21	8	44	16
10-Year								
NL	77	32	79	33	47	11	99	22
PE	76	32	70	31	47	11	103	14
QC	71	27	69	23	46	8	92	14
NS	67	29	59	26	44	12	92	13
NB	63	32	48	26	39	9	97	15
SK	60	31	57	35	35	8	80	15
MB	58	30	44	24	35	8	87	14
ON	57	29	45	22	35	6	88	12
BC	51	26	38	19	34	9	76	11
AB	48	30	32	21	26	5	78	16

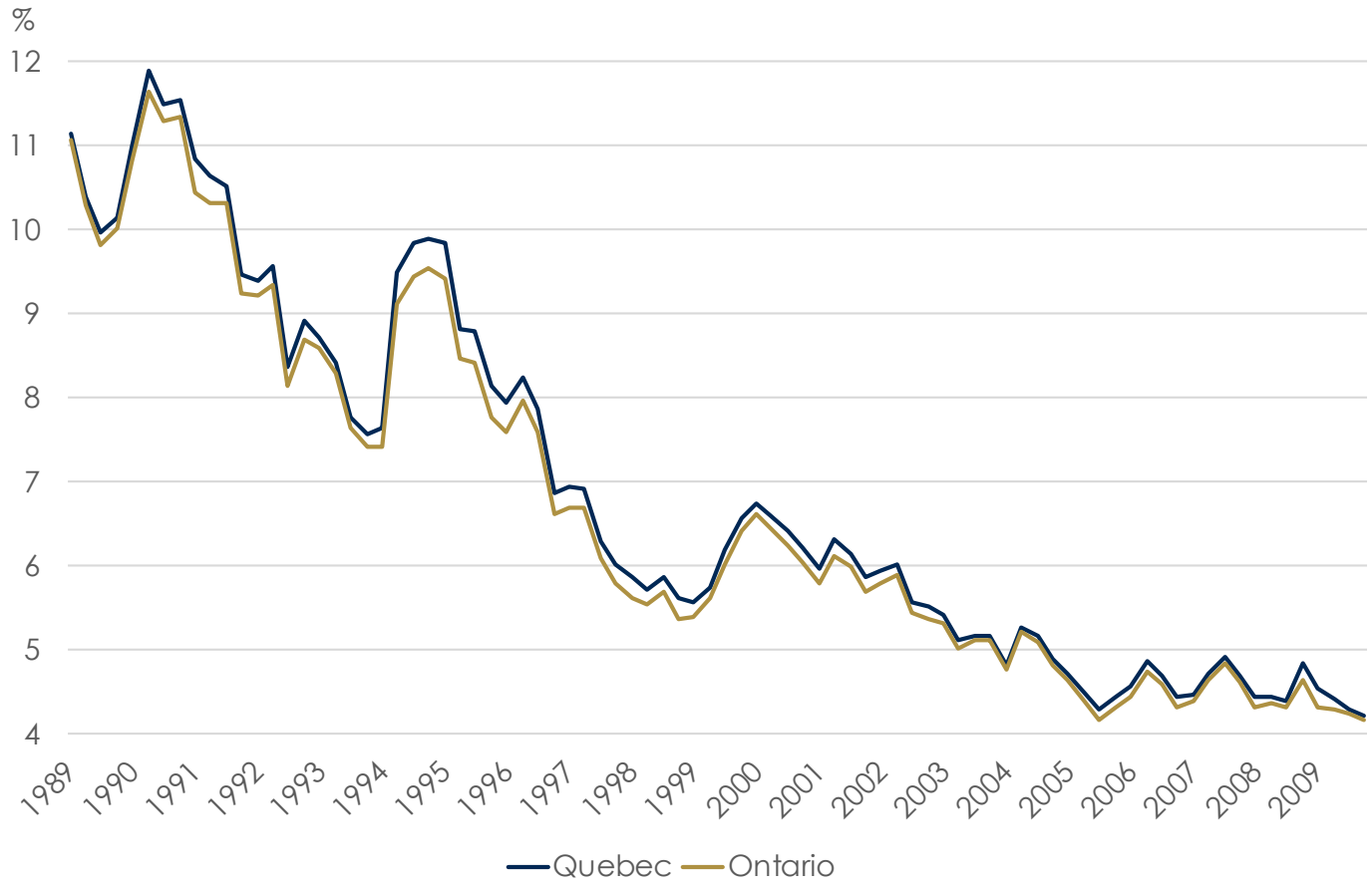
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.
Note: "S.D." is "standard deviation".

TABLE 2: AVERAGE PROVINCIAL-FEDERAL SPREAD - STATISTICS					
10-Year		Mean	Std. Dev.	Min	Max
	OVERALL	63	29	7	146
	BETWEEN		10	48	77
	WITHIN		27	14	132
5-Year		Mean	Std. Dev.	Min	Max
	OVERALL	43	21	5	103
	BETWEEN		7	33	53
	WITHIN		20	10	95

Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.
Note: Between variation represents the variation between each province and within variation represents the variation over time.

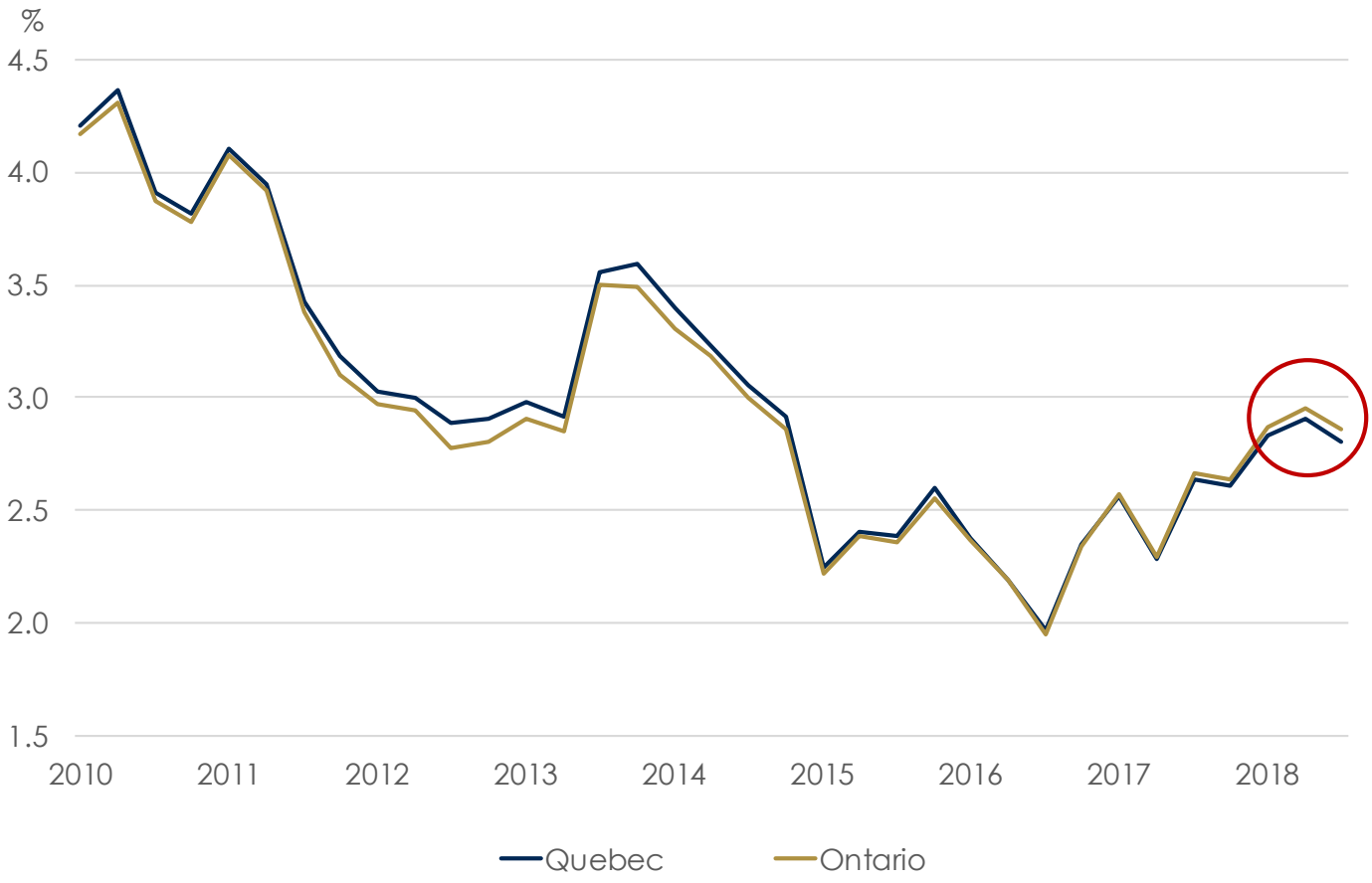
Nonetheless, some between-variation patterns are noteworthy. For instance, borrowing rates in Ontario and Quebec have evolved in a largely similar manner over the 1989-2018 period, with some important gaps. For instance, on average over the whole sample, Quebec borrowed at an 16-basis-point premium over Ontario at the 10-year maturity (Chart 2A). However, starting in the second quarter of 2016, the premium disappeared and now Quebec is borrowing at a small discount relative to Ontario (around 6 basis points at the 10-year duration (Chart 2B)). Those developments in the bond market can be related to the fiscal strength of those provinces. Indeed, after having experienced a similar overall budgetary balance-to-GDP ratio relative to the Government of Quebec since 1994, the Government of Ontario's fiscal situation became less favourable beginning with the 2009 recession (Chart 2C). In that year, Ontario's deficit reached 3.2% of GDP, while Quebec bottomed at 0.9%. It took six years for Quebec to come back to a budgetary balance while it took nine years for Ontario. Moreover, the latter is projecting further deficits in the years to come while Quebec now enjoys significant surpluses and project budgetary balances.

Chart 2A: 10-Year Provincial Bond Yield



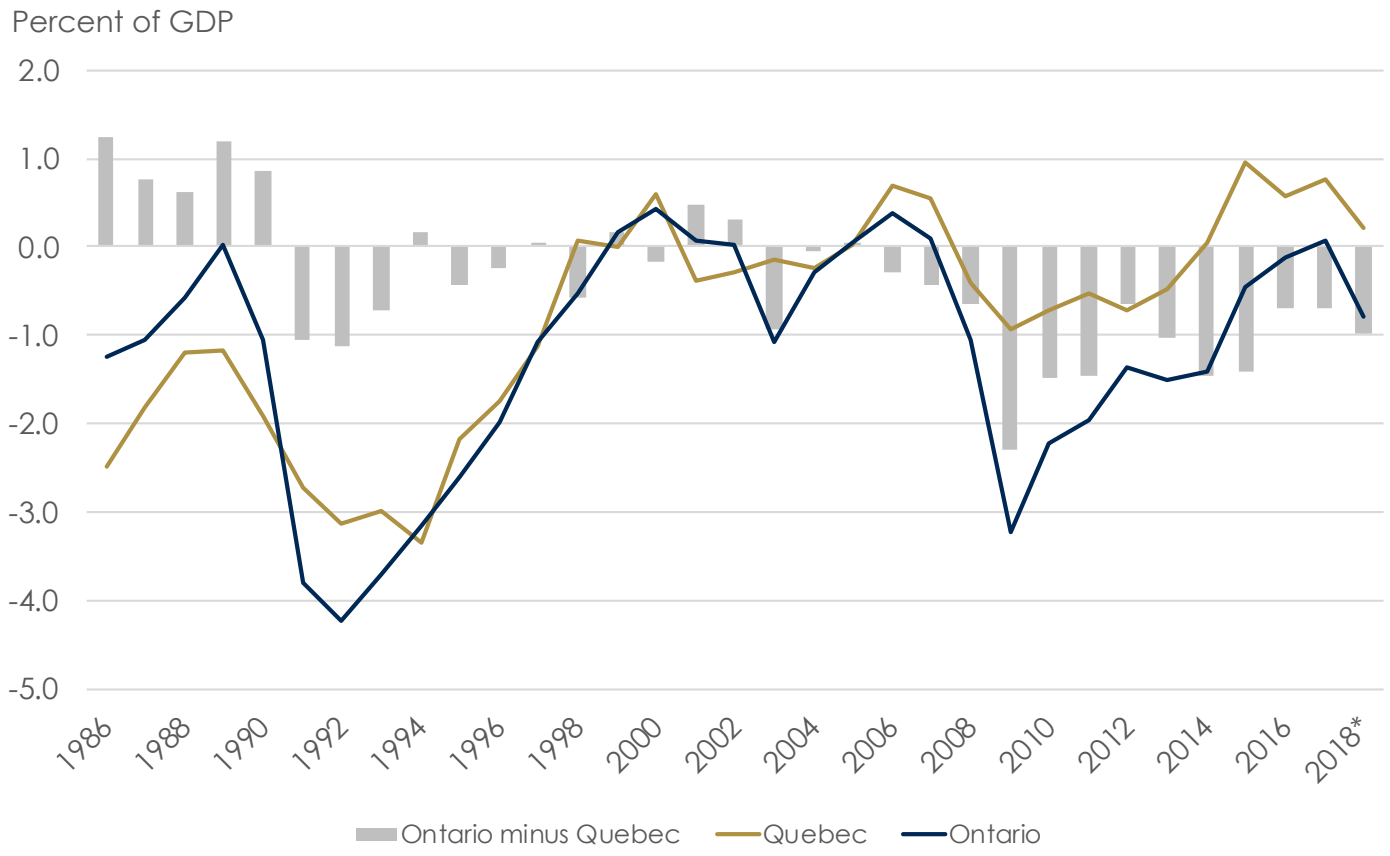
Source: FTSE TMX Global Debt Capital Markets Inc.
Note: Quarterly average.

Chart 2B: 10-Year Provincial Bond Yield



Source: FTSE TMX Global Debt Capital Markets Inc.
Notes: Quarterly average. 2018Q3 data is as of July 31.

Chart 2C: Budgetary Balance



* Estimated
Sources: Government of Canada and provincial budget estimates.

Fiscal and Economic Indicators

Consistent with the existing literature, budgetary balance-to-GDP and debt-to-GDP from the Government of Canada Fiscal Reference Tables are used as fiscal indicators in the model. For 2017 and 2018, provincial and federal budget forecasts are used.[17] However, contrary to (most) studies, we elected to use the primary balance-to-GDP to measure the fiscal balance instead of the overall budgetary balance.[18] With the difference being gross public debt charges that result from the current stock of interest-bearing debt, we believe that using the primary balance can avoid collinearity problem between the debt and the fiscal balance variables. Also, we elected to use the net debt-to-GDP as a measure of indebtedness. While its usefulness as a "true" measure of debt relative to gross, marketable, or interest-bearing debt is debatable, net debt availability since 1986 for all provinces in the Fiscal Reference Tables makes it an independent variable of choice.[19] Importantly, the fiscal indicators are shown as a deviation from the federal government's equivalent ratios.

In 2017-18, the Government of Canada estimates that it has delivered $70.5 billion to provinces and territories in the form of various transfers. Those consisted of the Canada Health Transfer ($37.1 billion), equalization ($18.3 billion), the Canada Social Transfer ($13.7 billion), and other net transfers ($1.4 billion).[20] Those transfers make a up a large portion of provincial revenues (26% on average for all provinces and all years in the sample). Since the formulas determining major transfers have changed over the years, at times benefiting some provinces over others, we tested for an implicit linear relationship between federal total transfers and yield premia. Hence, we used total federal

transfers received by one province in a year as a share of revenue, aggregated in the Fiscal Reference Tables. Again, provincial budget forecasts are used for 2017 and 2018.

Next, some economic variables are used as control for other circumstances that can affect risks as perceived by bond investors. Similar to Booth et al. (2007), we use the employment-to-population ratio and the trade openness measured as the sum of international exports and imports divided by GDP as additional control variables. Historical employment and international trade data were retrieved from Statistics Canada and employment level forecasts from the Conference Board of Canada Spring 2018 Provincial Outlook Economic Forecast for 2018.

Since the model is organized as a panel of time series, the stationarity of the data needs to be addressed. Hence, the data are tested for the presence of unit-root using two different tests applicable to time series panel.[21] We find that the net debt-to-GDP, transfer-to-revenue, employment-to-population, and trade openness contain a unit root on average across panels. The dependant variable, the 10- or 5-year provincial bond spread, is found to be stationary, as is trade openness (exports plus imports as a share of GDP) and the primary account-to-GDP.

Liquidity Premium

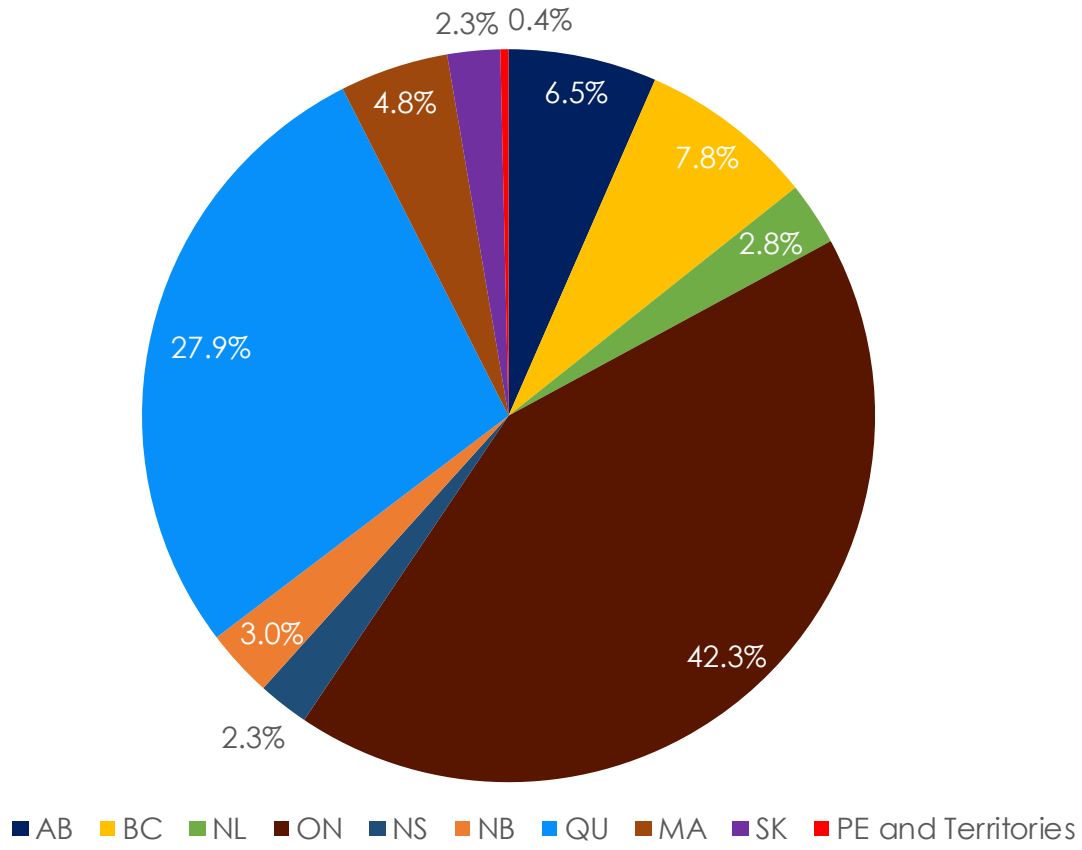
In Theoretical Framework and Literature Review and Equation 1, we referenced a liquidity premium in the market. That is, it is assumed that smaller issue size, cash flows and therefore provincial bond markets trade less. In this case, investors should command a higher rate of return for holding bonds from a smaller, illiquid market. Additionally, some provinces re-enter existing series in order to build benchmarks. Those operations facilitate the stripping and reconstitution of bonds, which augments liquidity (Booth et al, 2007). For large national bond markets and for individual securities, liquidity can be easily measured by using either trade volumes or bid-ask spreads available from financial data providers. As far as this report could verify, no trading volumes and bid-ask spreads exist or are compiled for long-term provincial bond generics. While it would be possible to re-create such an index using a series of provincial bond benchmarks, most provinces have only recently started to build benchmark bonds and therefore such a long-term series could not be built. Similarly, one could compare the turnover ratio on selected securities to assess liquidity.[22] But again, in the Canadian context, creating a series of turnover ratios using comparable bonds across each province and across time is not possible due to data limitations (see the Box on page 16 for a brief overview of provincial liquidity using turnover ratios).

To control for liquidity, Booth et al. (2007) simply used the debt-to-GDP ratio. The authors (2007) interpret a positive coefficient on the net debt-to-GDP ratio as an indication that the positive risk effect on spreads from a higher debt burden overstep the negative effect from higher liquidity stemming for a larger debt market. And, indeed, that is what they concluded. To directly measure liquidity, we elected instead to use the stock of outstanding debt for each province, the measure of liquidity used in Sola and Palomba (2015). Using Statistics Canada data, we use outstanding provincial direct and guaranteed bonds in Canadian dollars to remove the effect of exchange rate fluctuations on the size of the provincial bond market.[23]

Chart 3 presents each province's share of the provincial bond market in 2017. Overall, the provincial bond market in Canada amounted to $642 billion. In general, the size of each province's debt market is correlated to the size of its economy. For instance, more than 40% of outstanding provincial bonds in Canada were issued by Ontario, followed by Quebec at a little less than 30%. However, significant differences exist depending on the province's indebtedness level. For instance, Alberta—with a GDP worth 16% of Canada's—represents only 7% of the provincial bond market due to its much lower

indebtedness level. In fact, until 2016-17, Alberta had a negative net debt-to-GDP ratio, representing a net asset position—a situation that is quite unique in Canada. Meanwhile, the rest of the provinces are scattered at 2 to 5% share each, except for Prince Edward Island and the Territories, which together account for less than 1.0% of the total. Nevertheless, even though a 5% share might seem like a small number, for 2017, this still amounted to $31 billion (for Manitoba, for example).

Chart 3: The Provincial Bond Market



Sources: Bank of Canada, Statistics Canada.
Notes: In Canadian dollars. Include both direct and guaranteed bonds. 2017 monthly average.

To construct the liquidity variable, we assume that the federal government bond market exhibits no friction e.g. perfect liquidity. Then, we measure each provincial bond market relative to the federal government's market size to estimate a time series of liquidity for each provincial bond market. Obviously, this approach is, at best, an approximation since bonds included are both on-the-run and off-the-run, with the latter being outstanding but usually not actively traded. This could distort liquidity as we measure it. Moreover, some collinearity could exist between the liquidity measure and the debt measure since one uses total outstanding bonds and the other one uses net debt, with both being naturally correlated. As shown in Table A2-1, the liquidity variable is found non-stationary.

Measuring liquidity through the average turnover ratio

The turnover ratio is the dollar amount of a security traded as a percent of total amount outstanding in a given period of time. The higher the turnover ratio, the more transactions there are in a given market. This results in tighter bid-ask spreads and, hence, in greater liquidity. While long-term historical series for average turnover ratios in the provincial bond markets are not available, it is still possible to compare liquidity between provincial bond markets as well as the federal government by analyzing recent issuances. Table B1 presents the average turnover ratio for individual issuances that, based on our analysis, stood as the on-the-run (benchmark) 10-year bond for each province during at least some part of 2017. Since the data was gathered current to December 29, 2017 (the last business day of 2017), a 1-year turnover ratio of 1.94 for Ontario would imply that each dollar of the Ontario 2.60% 10-year bond scheduled to mature on 2 June 2027 has been traded almost twice during the year. Obviously, the longer the period of reference, the higher the turnover ratio.

Table B1 highlights some sharp contrasts. First, the federal government bond market is 5-times as liquid as are the two most liquid provincial bond markets, Ontario and Quebec, with a 1-year turnover ratio of roughly 10 versus 2. Interestingly, that federal-provincial ratio is the same for the one-month measure (a federal turnover ratio of 1 versus 0.2 for Quebec and Ontario). Provincial turnovers are more compact, but large differences also exist. New Brunswick and Nova Scotia's 10-year benchmark equivalents were only traded 0.5 times last year, fewer than larger provinces. While more work is needed to understand the liquidity dynamics in provincial bond markets, both the size of each province and the sophistication with which each places bonds and re-opens series appear to play a role. For example, Newfoundland and Labrador bonds exhibit the lowest liquidity of all provinces (0.3 turnover), but its debt market, at 3% of total provinces, is still larger than Nova Scotia with higher 1-year liquidity but a lower share of debt outstanding (0.5 turnover and 2.3% share of market debt, respectively).

TABLE B1: AVERAGE TURNOVER RATIO

10-Yeat Benchmark or Equivalent for 2017

Turnover Ratio at 29/12/2017		1-Month	2-Month	3-Month	6-Month	1-Year
CA 1.00%	01/06/2027	1.02	2.03	3.13	6.56	9.94
QC 2.75%	01/19/2027	0.22	0.50	0.70	1.17	1.94
ON 2.60%	02/06/2027	0.18	0.41	0.63	1.25	1.94
BC 2.55%	18/02/2027	0.05	0.14	0.58	0.70	1.23
MB 2.60%	02/06/2027	0.05	0.07	0.11	0.56	0.80
AB 2.55%	01/06/2027	0.04	0.22	0.24	0.47	0.76
SK 2.65%	02/06/2027	0.19	0.21	0.46	0.50	0.58
NS 2.10%	01/06/2027	0.02	0.05	0.10	0.22	0.52
NB 2.35%	14/08/2027	0.03	0.10	0.43	0.47	0.52
NL 3.00%	02/06/2027	0.01	0.04	0.06	0.11	0.30

Source: FTSE TMX Global Debt Capital Markets, Inc.

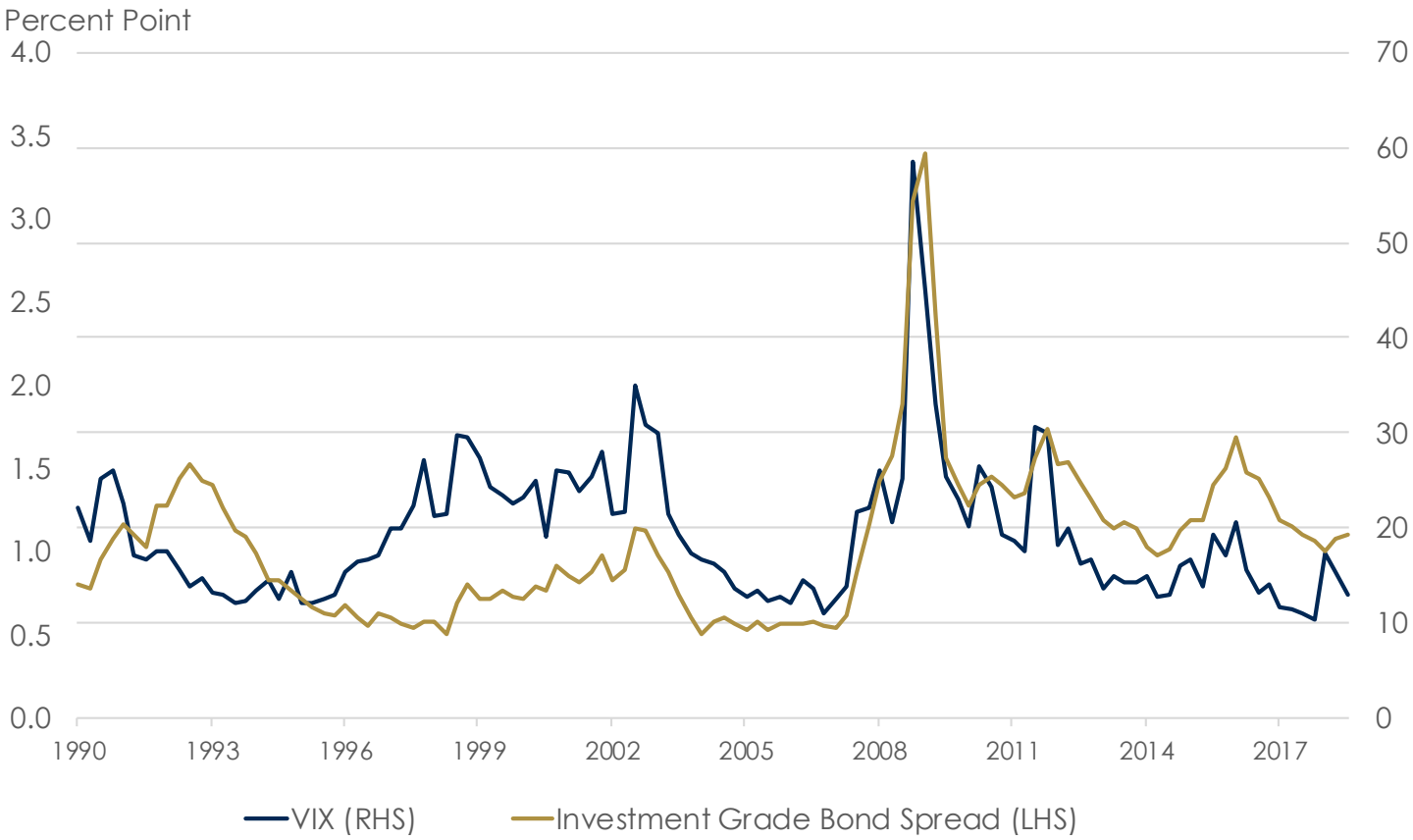
Risk Aversion

As a measure of risk aversion in the financial markets, we use the spread on the *FTSE TMX All Corporate Bond Index* relative to the *FTSE TMX Federal Index*. The former is a broad index of Canadian investment grade corporate bonds (IG) and the latter is an index of Government of Canada and Government of Canada guaranteed bonds.[24] The advantages of using the *Corporate Bond Index* as a measure of risk aversion are multiple:

- Corporate bond spreads are generally regarded as a measure of confidence in financial markets and should cyclically react to earnings expectations.
- Provincial bonds are rated A to AAA, which raises the interesting question of whether corporate bonds and provincial bonds are viewed as substitutes in financial markets.
- The *Corporate Bond Index* has a 50% positive correlation with the Chicago Board Options Exchange Volatility Index (VIX), also known as the "fear index" (Chart 4). The VIX is widely regarded in financial markets as a measure of risk aversion, and is used in Sola and Palomba (2015) for that reason.[25]
- The *Corporate Bond Index* starts in 1979 while the VIX was introduced in the early 1990s, thereby providing a longer time series.

As an alternative, we also use the *FTSE TMX BBB Bond Index* which only includes BBB rated bonds, as defined by PC-Bond.[26] As showed in Table A2-1, the risk aversion variable is found to be stationary.

Chart 4: Corporate Bond Spread and VIX



Sources: FTSE TMX Global Debt Capital Markets Inc, Bloomberg Finance L.P.
Notes: The Investment Grade Bond Spread is the difference in basis points between the FTSE TMX All Corporate Bond Index and the FTSE TMX Federal Bond index. 2018Q3 includes spread data as at July 31 2018.

METHODOLOGY

The data are organized such that each province forms a balanced panel and each year an observation. There are therefore 10 ×30=300 observations for the dependant variable.[27] The variables are first tested for stationarity. Following Booth et al. (2007), we verify whether the panels are cointegrated, meaning that there exists a stable long-run relationship between the variables that, once linearly combined, render them stationary. We also perform the Pedroni test that allows for heterogeneity across panels. At the 5% significance level, both the Phillips-Perron and modified Phillips-Perron t-stat allows us to reject the null hypothesis of no cointegration across panels.[28]

As is usually the case in previous studies, we first assume a linear relationship between the provincial spread and its determinants. Following Beck and Ferrucci et al. (2016), the data generating process is modelled as a time series with fixed effects. Indeed, each province in Canada has its own institutions, geography, culture and business environment that can affect its borrowing costs. Those hardly observable variables are captured by α_i in equation (2)[29]:

$$spread_{it} = \alpha_i + \boldsymbol{X}'_{it}\boldsymbol{\beta_i} + \varepsilon_{it} \quad (2)$$

The variable $spread_{it}$ represents the provincial yield spreads relative to the Government of Canada yield at the 5 and 10-year level for each province i at time t, $\boldsymbol{X_{it}}$ represents a vector of the independent variable and $\boldsymbol{\beta_i}$ is the corresponding estimator.[30] The model is estimated by performing OLS on mean-differenced data, thereby cancelling out the fixed effects. Hence, the resulting estimator is called the within estimator (Cameron and Trivedi, 2009). Crucially, this specification assumes that after controlling for the fixed effects α_i, the errors ε_{it} are independently and identically distributed (iid). We verify this assumption by performing the Augmented Dickey Fuller (Fisher ADF, Madala and Wu (1999) and Choi (2001)) test on the model's predicted errors. We reject the null hypothesis that all panels contain a unit root at the 5% significance level both for the 5-year and 10-year model.[31] To test the robustness of the results under the iid assumption, we also directly model the error term as a first-order autoregressive process prior to estimation.[32]

RESULTS

Fiscal Indicators

Table 3 presents the results of the baseline 10-year specification (1) as well as some alternatives using different measures of the liquidity (aggregate amount of bonds outstanding) and the risk aversion (corporate bond spreads) variables. The overall fit of the model is generally good, at 57%. Moreover, across all specifications, it is worth noting that the model seems to best explain movements within time (74%) than between provinces (58%). Table 4 presents the estimation output using the 5-year provincial spread as the dependent variable instead. Both within and between, the results are less accurate at the 5-year level. One possible reason for this discrepancy is that worries about fiscal solvencies reflected in risk premia could intensify in the long-run and not be as present in the shorter-run.

In our preferred specification (1), a 1 percentage point increase in a province's net debt-to-GDP relative to that of the federal government increases the fundamental (long-run) value of its 10-year

bond spread by 0.5 basis points. This effect increases to 0.7 in specification 3 and 4 when BBB-rated corporate bond spreads are used instead of the broader IG Index. That estimate may seem small relative to an unweighted average 10-year provincial spread of 70 basis points so far in 2018. But, for provinces that have accumulated a larger debt stock relative to that of the federal government, the impact can still be significant—5 and 7 basis points for Quebec and Newfoundland and Labrador, respectively. Three provinces in Canada are currently less indebted than the federal government: Alberta, British Columbia and Saskatchewan (Table 5). Based on the baseline specification (1), they should currently save 12, 9 and 9 basis spread points when borrowing for 10 years.[33] Using the 5-year spread as the dependant variable, the effect of net debt-to-GDP is tempered significantly.

The results found relative to the debt-to-GDP stand in sharp contrast to much weaker findings related to the deficit. In most specifications at both the 10-year and the 5-year maturity, the primary account-to-GDP estimator is very small and insignificant. When it is significant, it has the opposite sign than would be expected (positive effect on spreads instead of negative). It is possible that the effect of net debt-to-GDP already embeds all risk premia related to fiscal stress. Essentially, deficits have to be financed through borrowed money, which results in higher net debt-to-GDP. If correct, such a conclusion makes the primary account redundant in the model. Nonetheless, most studies have found a negative and significant relationship between the primary account balance (or the deficit with a positive relationship) and subnational spreads. Data measurement, methodology, jurisdictions selection and time period might explain variations in results.

Liquidity

Next, we find a significant negative relationship between the share of bonds outstanding in a given province and the total outstanding amount of Government of Canada direct and guaranteed bonds. Keeping in mind that it is assumed that the market for Government of Canada securities is frictionless (completely liquid), a 1% increase in a province's relative outstanding amount of bonds should remove 0.7 basis points of its 10-year spread. Therefore, as expected, Ontario and Quebec, having by far a larger bond market than smaller provinces, can benefit from a liquidity discount (Table 6). Besides, Ontario and Quebec use sophisticated methods to borrow and manage their debt, among others.[34] Provinces with fewer available resources to conduct analysis and technical operations could therefore not be in a position to optimize their debt management. When measuring liquidity as a province's share of the total provincial bond market (model 2 and 4 in Table 3), the liquidity effect doubles. That finding contrasts Booth et al. (2007), who find that the positive effect of deficits and debt on the spread outweigh the negative effect of greater liquidity. In our case, the liquidity effect marginally overcomes the fiscal effects.

For the following reasons, we are careful in interpreting the results related to liquidity:

1. The liquidity variable is indirectly measured. A significant portion of the outstanding amount of bonds are off-the-run, meaning not the most recent issue at its respective maturity and therefore often not traded as much as its corresponding on-the-run benchmark.
2. While methodology and measurement differ, Beck and Ferrucci et al. (2016) and Sola and Palomba (2015) also did not find a liquidity effect for Canadian provinces that is consistent and significant across provinces.

Risk Aversion

We find a positive and significant effect of the IG corporate bond index spread, our proxy for risk-aversion, on the provincial yield differential. A 1 percentage point increase in our measure of risk aversion boosts provincial yield spreads by 0.5 basis point. The estimator is robust to any specification

and is also significant. It is less so when decomposing the 5-year provincial spread. This relationship has also been confirmed in all studies listed. Besides, the fact that the estimator shrinks when using BBB-rated corporate bonds instead of BBB (and higher rated) IG might be due to similar credit ratings between provincial bonds and IG securities than provincial bonds and lower-rated BBB ones. The relationship between risk aversion and provincial spreads entails that the latter might be seen in financial markets as substitutes for corporate debt (Booth et al., 2007). Moreover, it emphasizes that in periods of high global risk aversion, "flight to quality", strongly favour risk-free securities such as Government of Canada securities. It also provides evidence that provincial bonds are, at least to a certain extent, well integrated into global financial markets and thus subject to international risk aversion. Indeed, Beck and Ferrucci et al. (2016) point out that the risk aversion coefficient in the U.S. municipal bond markets is much smaller than for other subnational jurisdictions in Australia, Switzerland, Germany, and Spain, likely because the former are locally traded and therefore insulated from international events. In 2008, in the midst of the global financial crisis, risk aversion caused 10-year provincial spreads to increase sharply, by about an estimated 104 basis points. The effect was amplified further in 2009, at 114 basis points. Since then, IG spreads have been fairly compressed but have not fallen back to their historical lows reached in the mid-2000s. Besides, the model might not capture adequately the reduction in risk-aversion experienced in 2017 and measured by a record-low VIX (Chart 3) since IG spreads, at 113 basis points, were still slightly above their annual historical average since 1989.

Economic Indicators

The economic indicators used in the model both have a negative and significant effect on provincial yield differentials. We interpret those results as follow:

1. A 1 percentage point increase in a province's employment-to-population ratio lowers provincial yield differential by 1.1 basis points and 0.4 basis points at the 10- and 5-year levels, respectively. A higher level of employment leads to higher taxation revenues and a higher ability to increase taxes. It improves the province's fiscal prospects and therefore should command a tighter spread (Booth et al. 2007).
2. A 1 percentage point increase in the sum of exports and imports relative to GDP, referred to here as trade openness, decreases provincial spreads by 3.4 and 3.2 basis points, at the 10- and 5-year levels, respectively. Trade openness was used in an international context to gauge the ability to generate foreign currency. In a subnational context, higher trade openness reflects the ability to attract international business and investment. Those matter for competitiveness and therefore should command a lower yield premium (Booth et al. 2007).

The two economic indicators are the largest in size in specification (1). However, it is worth mentioning that they also have the lowest standard deviation, meaning that, despite a stronger impact on yield differentials for a 1 percentage point move, those moves occur less often. The impact on the year-over-year variation in yield spreads are therefore more muted than variables that exhibit larger variations.

Federal Transfers

The last discussion concerns the hypothesis that federal transfers represent an implicit bailout policy and therefore should lower risk premia on provincial bonds. We find a negative and significant impact of increasing transfers-to-revenue on provincial risk premia. This suggests, for example, that provinces that benefit disproportionally from the equalization program also enjoy a rebate on the price at which they can sell debt. In 2018-19, it is estimated that Atlantic provinces such as PEI (39%),

TABLE 3: ESTIMATION RESULTS (10-YEAR SPREAD)				
Variable/Specification	**1**	**2**	**3**	**4**
Primary Balance/GDP[a]	-0.04 (0.50)	-0.22 (0.49)	1.46** (0.61)	1.26** (0.59)
Net Debt/GDP[a]	0.50* (0.09)	0.47* (0.08)	0.72* (0.11)	0.74* (0.09)
Transfer/Revenue	-0.45** (0.22)	-0.50** (0.22)	-0.48*** (0.28)	-0.55** (0.28)
Employment/ Population	-1.11** (0.56)	-1.25** (0.55)	1.20* (0.68)	1.00 (0.67)
Trade Openness	-3.42* (0.55)	-3.32* (0.53)	-4.37* (0.69)	-4.48* (0.65)
Corporate Bond Spread	0.52* (0.02)	0.52* (0.02)		
BBB-Rated Bond Spread			0.25* (0.02)	0.25* (0.02)
Bonds Outstanding (share of federal market size)	-0.65** (0.31)		-0.52 (0.39)	
Bonds Outstanding (share of provincial market size)		-1.41* (0.54)		-2.35* (0.66)
Constant (fixed effects)	413.63* (57.86)	422.50* (57.65)	378.22* (72.38)	420.40* (71.03)
R^2 (Overall)	0.57	0.44	0.39	0.21
R^2 (Within)	0.74	0.74	0.59	0.61
R^2 (Between)	0.58	0.40	0.33	0.19

TABLE 4: ESTIMATION RESULTS (5-YEAR SPREAD)				
Variable/Specification	**5**	**6**	**7**	**8**
Primary Balance/GDP[a]	-0.60 (0.40)	-0.61 (0.39)	0.46 (0.47)	0.45 (0.46)
Net Debt/GDP[a]	0.05*** (0.07)	0.07*** (0.06)	0.21*** (0.08)	0.26*** (0.07)
Transfer/Revenue	0.05 (0.18)	0.03 (0.18)	0.03 (0.21)	-0.01 (0.21)
Employment/ Population	-0.42 (0.44)	-0.43 (0.44)	1.18* (0.52)	1.14* (0.51)
Trade Openness	-3.20* (0.44)	-3.28* (0.42)	-3.86* (0.52)	-4.09* (0.50)
Corporate Bond Spread	0.36* (0.02)	0.36* (0.02)		
BBB-Rated Bond Spread			0.17* (0.01)	0.17* (0.01)
Bonds Outstanding (share of federal market size)	-0.04 (0.24)	0.05* (0.29)		
Bonds Outstanding (share of provincial market size)		-0.58* (0.43)		-1.23* (0.51)
Constant (fixed effects)	321.28* (45.57)	336.48* (45.76)	297.64* (55.38)	336.17* (54.81)
R^2 (Overall)	0.48	0.38	0.28	0.18
R^2 (Within)	0.69	0.69	0.55	0.56
R^2 (Between)	0.42	0.35	0.19	0.18

TABLE 5: ESTIMATED NET DEBT-TO-GDP IN 2018-19		
	Net Debt-to-GDP	**Deviation from Fed Government**
AB	8.4	(24.4)
BC	15.3	(17.5)
SK	15.5	(17.3)
PE	32.4	(0.4)
MB	34.1	1.3
NS	34.6	1.9
ON	37.7	5.0
NB	39.5	6.7
QC	42.5	9.7
NL	46.7	14.0
Unweighted Average	30.7	(2.1)
CA	32.8	

TABLE 6: DOLLAR VALUE PROV. BOND MARKET (as a % of federal government market)	
	%
ON	49.6
QC	32.7
BC	9.1
AB	7.7
MB	5.6
NB	3.5
NL	3.3
SK	2.7
NS	2.6
PE	0.4

TABLES 3 and 4 Source: Institute of Fiscal Studies and Democracy.
Notes: Numbers in bracket represent standard deviation. Legend: *** p<.1; ** p<.05; * p<.01. [a]Deviation from the federal government.

TABLE 5 Source: Provincial budgets, Government of Canada, Institute of Fiscal Studies and Democracy.

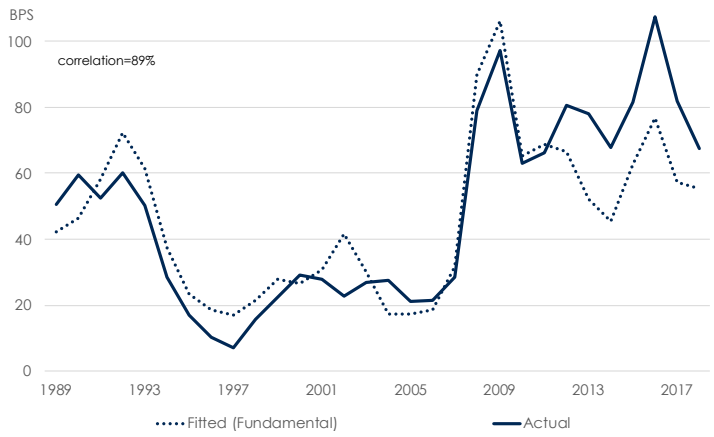
TABLE 6 Source: Statistics Canada. Notes: Average for 2017, includes direct and guaranteed bonds.

New Brunswick (34%) and Nova Scotia (33%) will the most transfers as a proportion of their revenue. It also happens that those provinces are also the ones with the largest 10-year spreads. Without those transfers, those provinces would arguably have to borrow marginally at a higher rate. In contrast, Newfoundland and Labrador, which does not qualify for the equalization program and therefore has the lowest transfers as a share of its revenue of all provinces, borrowed at the highest rate in Canada (82 basis points above the Government of Canada yield on 10-year bonds) so far in 2018. In summary, in accordance with other studies, it is possible to affirm that federal transfers are a form of risk-sharing across provinces. The federal government, who receives taxes from households and corporations in every province, redistributes them and lowers risk premia across the country.

Fitted Yields

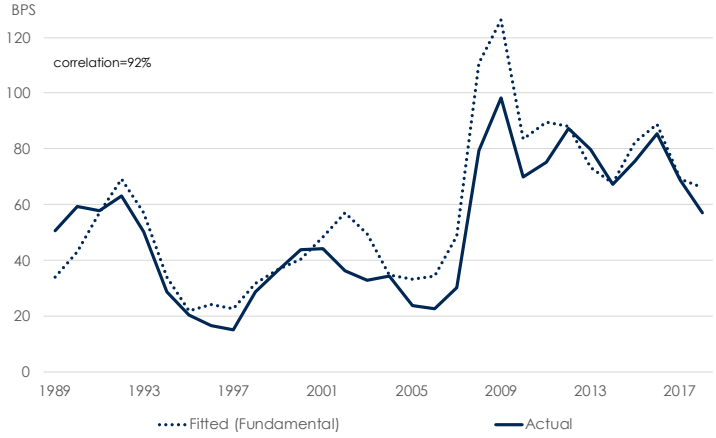
Charts 5 and 6 present for each province the model fitted values based on specification (1) in Table 3 and specification (5) in Table 4 above. Since we identified cointegration between the provincial yield differentials and the explanatory variables, the fitted values can be interpreted as fundamental values. In that context, we would expect provincial yields to converge towards their fundamental values in the long run. In general, yield spreads fluctuate around their long-term value both at the 10- and the 5-year levels. In some provinces, a decoupling of the 10-year yield differentials and their fundamentals happen after the 2008-09 recession (Alberta, Manitoba, New Brunswick, and Saskatchewan). Because spreads stay higher than their fundamentals suggest, a convergence could be expected in the future. However, a sustained gap between the actual and the fundamental yield differential is also observed in some cases. Notably, Quebec yields are lower than their fundamental throughout the sample while Ontario's are higher. This could mean that the model does not capture all factors influencing risk premia. For instance, if actual yields embed not only current but expected deficits, debt, productivity, and employment levels, then a persistent gap could occur. Contrasting Ontario and Quebec, those gaps are also explained by different long-term dynamics in both provinces. For instance, Quebec has a higher net debt-to-GDP, lower employment-to-population ratio (until recently), and fewer outstanding amount of bonds relative to the federal government. Those differences increase the province's relative yields. The gap between Ontario and Quebec's *fundamental* 10-year yield spread is however on a downward trend, from 36 basis point in 1989 to 26 basis points estimated in 2018.

Chart 5-A: Alberta 10-Year Spread



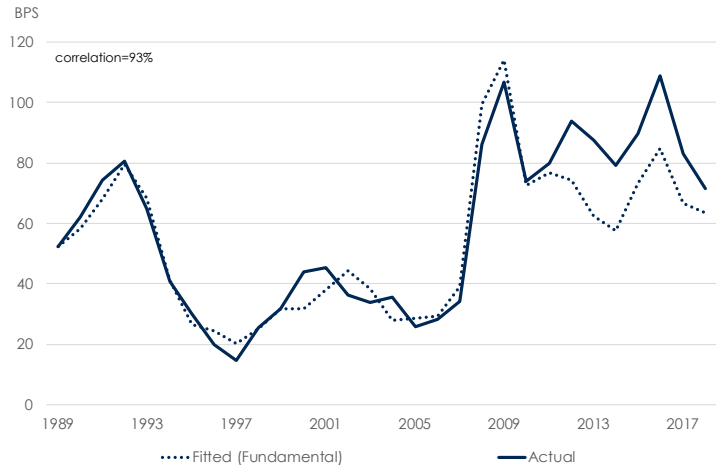
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5B: British Columbia 10-Year Spread



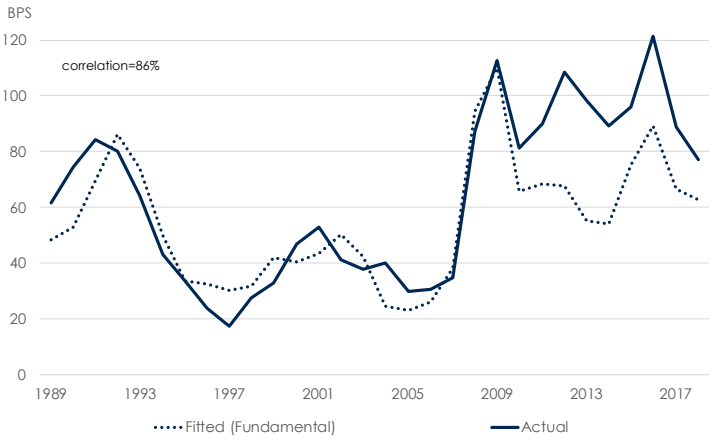
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5C: Manitoba 10-Year Spread



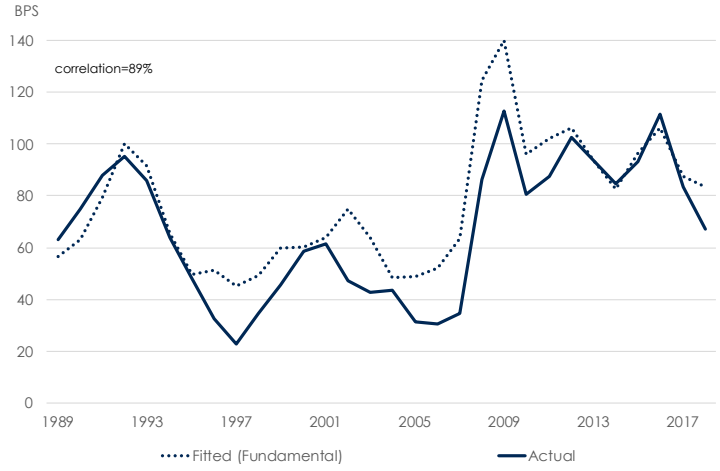
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5D: New Brunswick 10-Year Spread



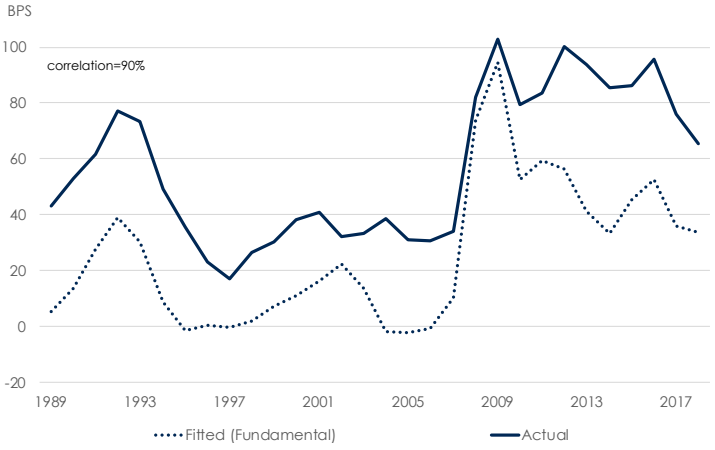
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5E: Nova Scotia 10-Year Spread



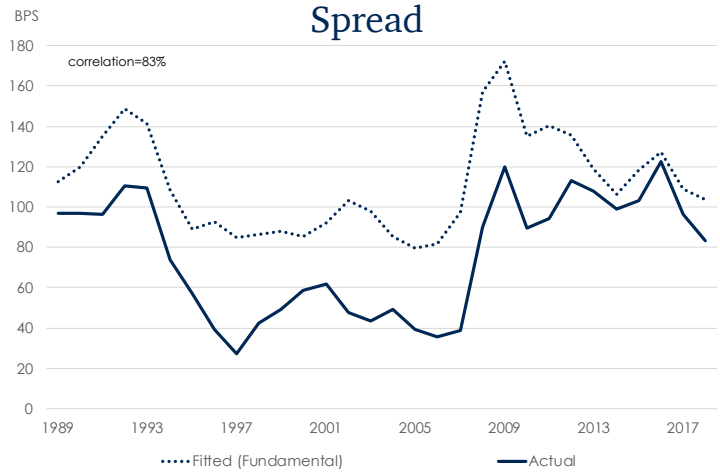
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5F: Ontario 10-Year Spread



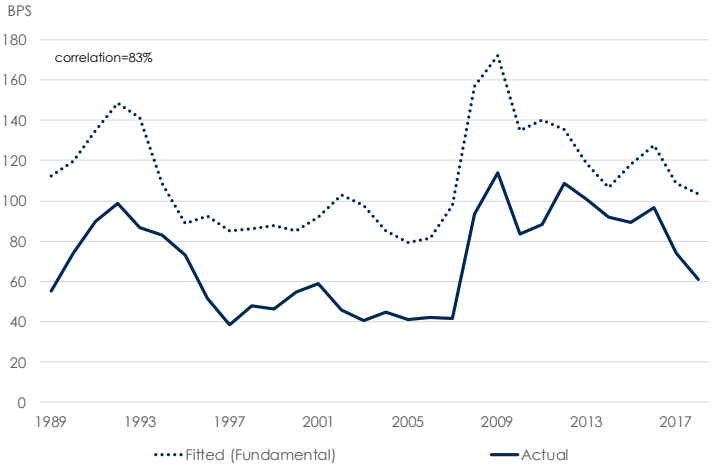
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5G: Prince Edward Island 10-Year Spread



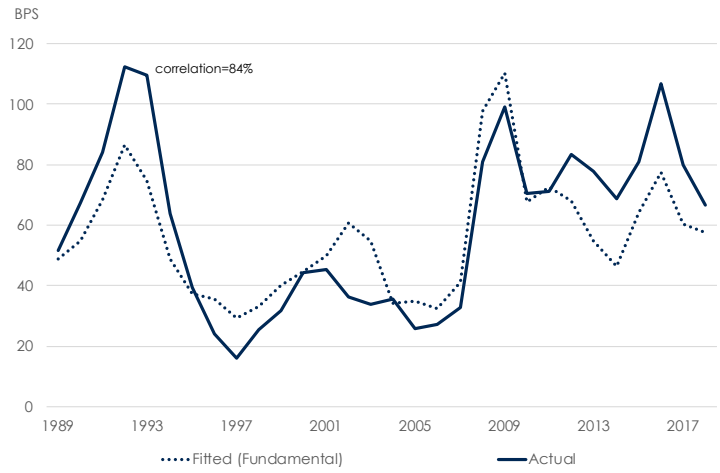
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5H: Quebec 10-Year Spread



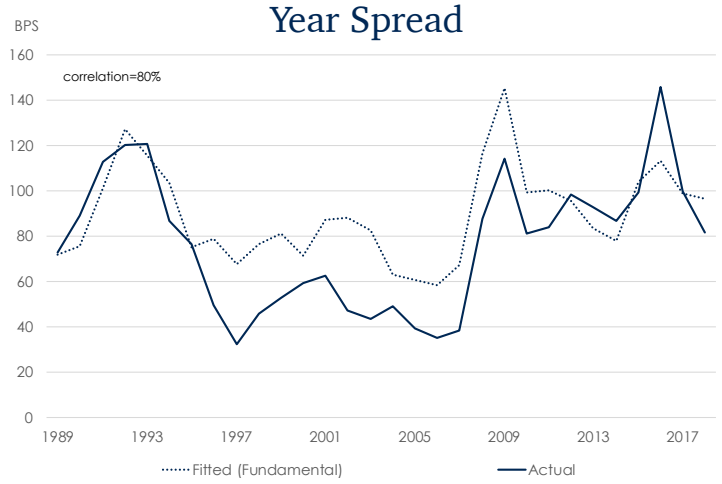
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5I: Saskatchewan 10-Year Spread



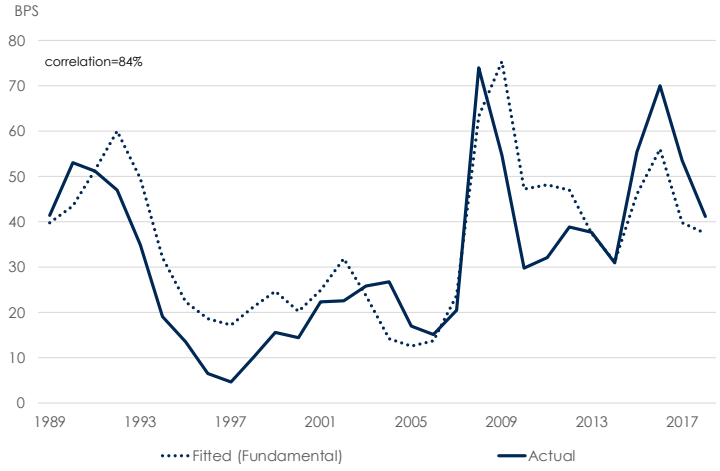
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 5J: Newfoundland and Labrador 10-Year Spread



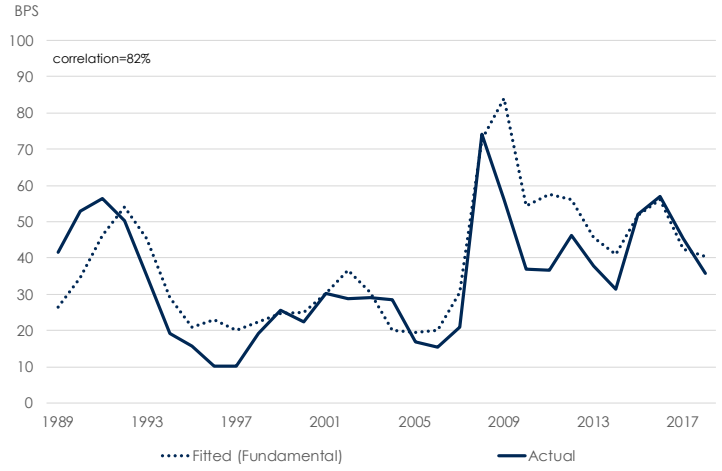
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6A: Alberta 5-Year Spread



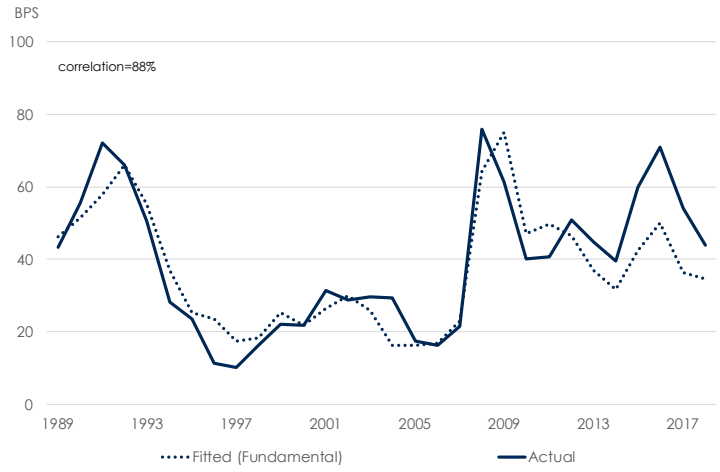
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6B: British Columbia 5-Year Spread



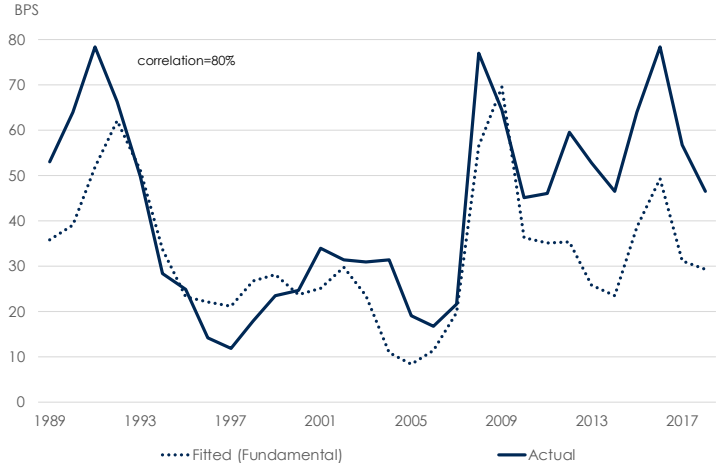
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6C: Manitoba 5-Year Spread



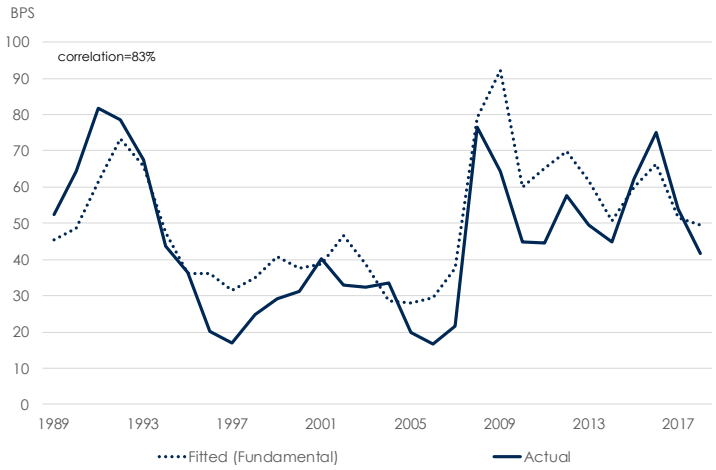
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6D: New Brunswick 5-Year Spread



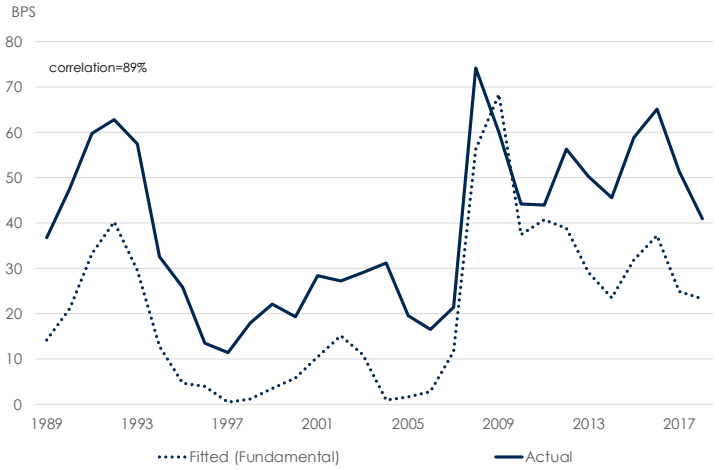
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6E: Nova Scotia 5-Year Spread



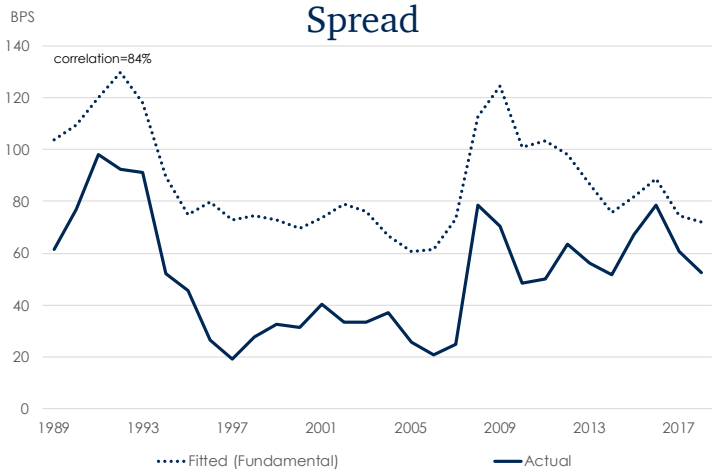
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6F: Ontario 5-Year Spread



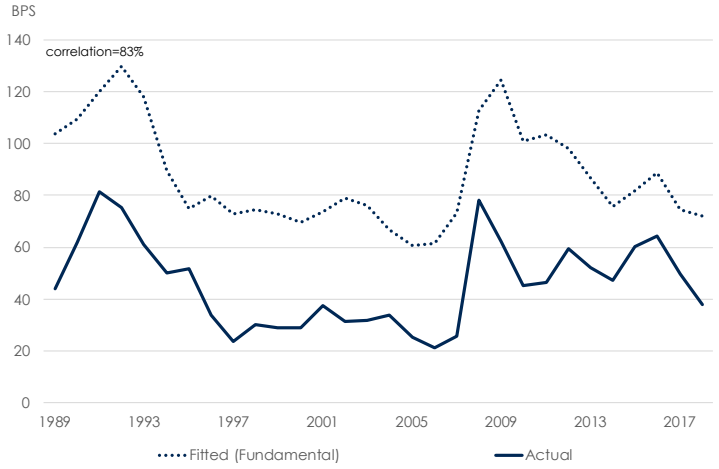
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6G: Prince Edward Island 5-Year Spread



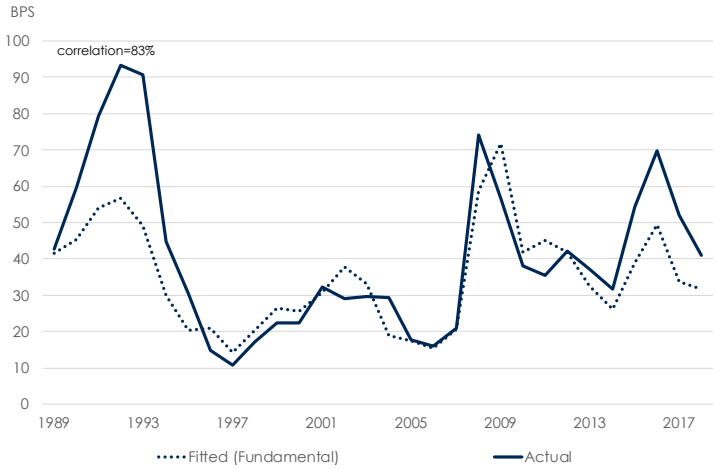
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6H: Quebec 5-Year Spread



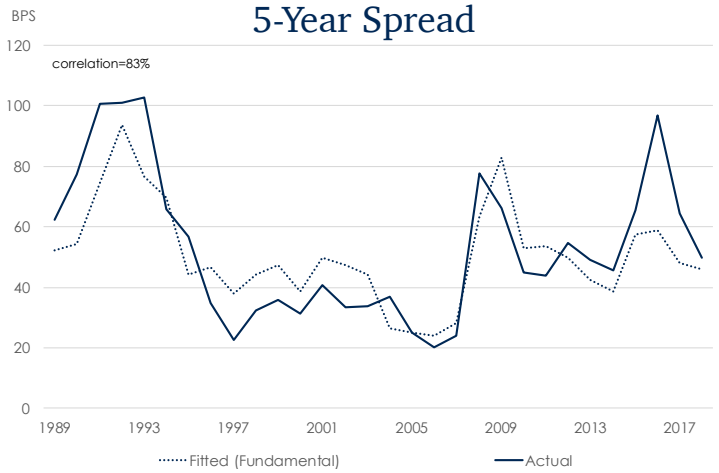
Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6I: Saskatchewan 5-Year Spread



Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

Chart 6J: Newfoundland and Labrador 5-Year Spread



Sources: FTSE TMX Global Debt Capital Markets Inc., Institute of Fiscal Studies and Democracy.

CONCLUSION

This report investigates how fiscal stress impacts provincial yield differentials with the government of Canada in the long run. To do so, we aimed at controlling for other factors that have widely been documented to have an effect on subnational spreads: liquidity, risk aversion, and various economic indicators. To the question of "Does fiscal discipline matter?" the answer is yes. Specifically, we find that fiscal discipline measured as a low net debt-to-GDP relative to the Government of Canada has a significant negative impact on provincial yield differential. One would expect that the deficit would also play a role (as supported by the literature), it does not seem to have a meaningful impact in our framework. This could be related by the fact that deficits, in essence, lead to higher debt, as latter always has an impact. Liquidity approximated by the dollar value of outstanding bonds in a given year relative to the federal government also matters and compresses yields. Therefore, as provinces continue to refine their borrowing strategy, re-enter into specific issues, and build large benchmarks, one could expect yield premia to diminish.

Another takeaway is that provincial bonds are well integrated in financial markets since they seem to be impacted by risk aversion like corporate bonds. Hence, while fiscal stress matters, it only tells one side of story. Indeed, risk aversion is an important indicator, especially in periods of financial stress like 2008-2009. Finally, individual macroeconomic characteristics are also important. In a nutshell, the capacity to collect taxes and to attract foreign capital also contributes to lower provincial spreads. We briefly investigated the role of the federal government in guaranteeing provincial fiscal soundness through the effect of transfers to provinces on yield differentials. Overall, higher transfers-to-revenues tend to compress yields, which we see as a form of risk-sharing across the country. Finally, the results were generally more robust analyzing longer-term spreads (10-year) than medium-term ones (5-year). Indeed, the market might perceive fiscal stress as a longer-term credit issue.

Endnotes

[1] Definition is based on NASDAQ.

[2] Definition is based on Stock and Watson (2012).

[3] Definition is based on Department of Finance Canada.

[4] Definition is based on Booth et al. (2007).

[5] British Columbia, Quebec, Nova Scotia and Prince Edward Island are expected to record a balanced budget in the current fiscal year (2018-19). We also acknowledge that the Auditor General of New Brunswick has recently released audited financial statements for 2017-18 that shows a $67 million in that year, as opposed to a projected $191 million deficit in the Budget. The Budget forecasts continues to assume deficits in the coming years.

[6] As will be shown below, a positive differential (spread) is very much the norm in the Canadian bond market, with a few historical exceptions.

[7] See Joffe (2012) for DBRS, Moody's and S&P Global Ratings historical default rates by corporate credit ratings and their correspondence to provincial credit ratings.

[8] See Annex 1 for a discussion of capital markets in Canada.

[9] *Sovereign Risk Premium in the European Government Bond Market* by Bernoth, von Hagen and Schuknecht was first published as a working paper in 2006, but subsequently updated and published in the *Journal of International Money and Finance* in 2012.

[10] Throughout the text, we use subnational, domestic and provincial interchangeably to characterize provincial governments.

[11] See for example Jarrow and van Deventer (2013).

[12] From Beck, Ferrucci et al. (2016): Bayoumi et al. (1995), Poterba and Rueben (1999,2001) and Johnson and Kriz (2005) show that bond spreads of U.S. states governments incorporate risk premia that reflect differences in fiscal fundamentals. Moreover, U.S. states with "sticter and self-imposed fiscal rules" benefit from lower spreads.

[13] Yield spreads definition and data varies between studies. Some use constant-maturity while some use a blend of primary market yields. Cautious is warranted when comparing results.

[14] Smaller and larger effects in various other reports have been found but often proved insignificant.

[15] The latest *actual*, audited, financial statements available in the Fiscal Reference Tables is for 2016-17. 2017-18 and 2018-19 data are estimates based on provincial and federal Budgets.

[16] Unless indicated, yield data in this report is as at July 31 2018.

[17] Nominal GDP forecasts for provinces come from the Conference Board of Canada Spring 2018 Provincial Outlook Economic Forecast. The Federal nominal GDP forecast is from Budget 2018.

[18] Of the literature covered, only Sola and Palomba (2015) uses primary balance-to-GDP.

[19] For a discussion of the use of gross versus net debt, see the IMF (2011) and S&P Global Ratings (2017).

[20] See the Department of Finance Canada for a complete description of federal transfers and their formulas.

[21] See Appendix 2 for a description of those tests and their output.

[22] The turnover ratio is defined as the volume of trading in dollar over a certain period of time divided by the size of the selected security (stock of outstanding debt). See the box on page 16.

[23] In all provinces, the vast majority of bonds are denominated in Canadian dollars.

[24] The *FTSE TMX All Corporate Bond Index* mostly includes bonds rated at, or above, BBB- by Standard and Poor's and the equivalent in other ratings agencies. The *FTSE TMX Federal Bond Index* is only comprised of AAA rated bonds.

[25] The CBOE VIX represents the implied volatility of S&P500 index options. Sola and Palomba (2015) use the CBOE VXO that uses S&P100 index options.

[26] Rated BBB- to A- by Standard and Poor's.

[27] 10 provinces and 30 years; from 1989 to 2018.

[28] See Annex 2 for detailed Pedroni (1999, 2004) test results and some important caveats related to the assumption of cointegration across panels.

[29] The individual provincial fixed effects are assumed to be time-invariant (Cameron and Trivedi, 2009).

[30] To further test the validity of the fixed effects assumption, we perform a Hausman test to identify systematic differences between a model estimated with fixed effects versus random effects. The chi-squared statistics is 32.3 and allows us to reject the null hypothesis of no systematic differences between the estimators.

[31] The corresponding inverse chi-squared statistics are 48.3 and 36.1 at the 10-year and 5-year level, respectively.

[32] See Table A3-1 in Appendix 3 for those estimation output.

[33] Those results are consistent with the existing literature. Booth et al. (2007) find a significant effect, but their estimator vary from 0.4 to 0.7 depending on the specification used. Using fixed effects, Sola and Palomba (2015) obtain an estimator of 0.3. Beck, Ferrucci et al. (2016) obtain 1.3 and Schuknecht et al. (2009) obtain 0.5, but, again, results vary with the specification.

[34] See for example, the various debt issuance programs conducted by the Ontario Financing Authority.

Bibliography

Beck, R., Ferrucci, G., Hantzsche, A., & Rau-Goehring, M. (2017). Determinants of sub-sovereign bond yield spreads–The role of fiscal fundamentals and federal bailout expectations. *Journal of International Money and Finance*, *79*, 72-98. Retrieved from https://bit.ly/2wqQZJE

Bernoth, K., Von Hagen, J., & Schuknecht, L. (2012). Sovereign risk premiums in the European government bond market. *Journal of International Money and Finance*, *31*(5), 975-995. Retrieved from https://bit.ly/2Ilbqg0

Booth, L., Georgopoulos, G., & Hejazi, W. (2007). What drives provincial-Canada yield spreads? *Canadian Journal of Economics/Revue canadienne d'économique*, *40*(3), 1008-1032. Retrieved from https://bit.ly/2KKIufU

Cameron, A. C. and K. Trivedi, Pravin (2009). *Microeconometrics using Stata* (Vol. 2). Stata Press. College Station, TX: Stata press.

Choi, I. (2001). Unit root tests for panel data. *Journal of international money and Finance*, *20*(2), 249-272. Retrieved from https://bit.ly/2FV2A3u

Conference Board of Canada (2018). *Provincial Outlook Economic Forecast: Spring 2018*. Retrieved from https://www.conferenceboard.ca/

International Monetary Fund (2011). *Fiscal Monitor September 2011: Addressing Fiscal Challenges to Reduce Economic Risks*. World Economic and Financial Surveys / IMF Multimedia Services Division. HJ101.F57. Retrieved from https://bit.ly/2LXwECu

Jarrow, R.-A., and van Deventer, D-R. (2013). *Fixed Income and Derivatives* (Vol 5). CFA Institute.

Joffe, M (2012). *Provincial Solvency and Federal Obligations*. Macdonald-Laurier Institute Publication. Retrieved from https://bit.ly/2AF5cF9

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics*, *108*(1), 1-24. Retrieved from https://bit.ly/2wjO8T0

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics*, *61*(S1), 631-652. Retrieved from https://bit.ly/2wnDGd8

Schuknecht, L., Von Hagen, J., & Wolswijk, G. (2009). Government risk premiums in the bond market: EMU and Canada. *European Journal of Political Economy*, *25*(3), 371-384. Retrieved from https://bit.ly/2jB8yxo

Sola, M. S., & Palomba, M. G. (2015). *Sub-National Government's Risk Premia: Does Fiscal Performance Matter?* (No. 15-117). International Monetary Fund. Retrieved from https://bit.ly/2rngUMR

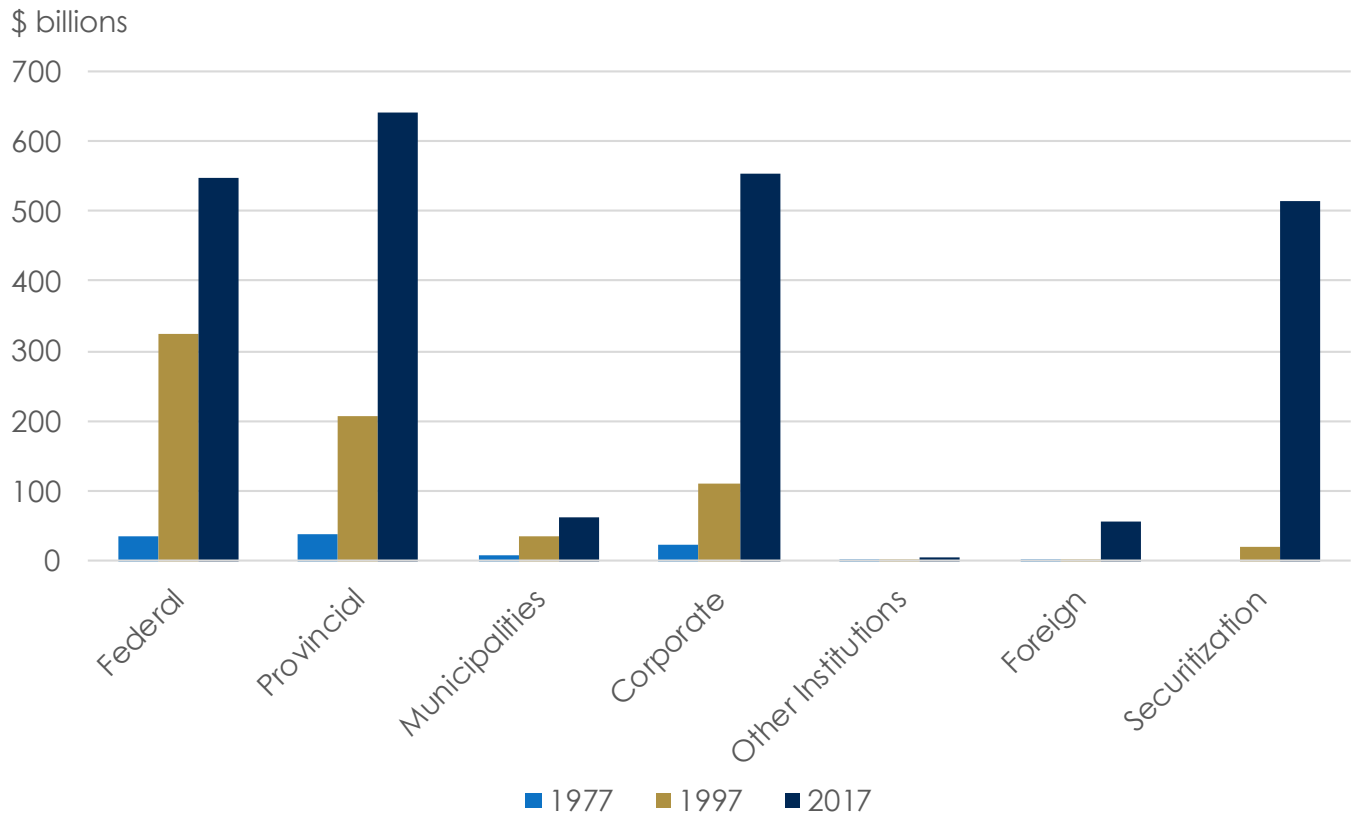
S&P Global Ratings (2017). Sovereign Rating Methodology. Standard & Poor's Financial Services LLC. Retrieved from https://bit.ly/2Mgc8tP

Stock, J. H., & Watson, M. W. (2012). *Introduction to econometrics: Global edition*. Boston, MA: Pearson Education.

CAPITAL MARKETS IN CANADA

The following charts illustrate capital markets in Canada over the last forty years. The market is mainly composed of federal Government direct bonds (23% in 2017, down from as much as 47% in 1997) and provincial bonds (with a share of 27% in 2017, down from 30% in 1997). Henceforth, despite the relatively low attention that yields on provincial bond generate, they are in size currently more important than the much more scrutinized market for Government of Canada bonds.[a] The other major issuers include private corporations—23% in 2017, almost twice its relative size in 1997—and the municipalities (whose importance as a share of the total market decreased from 8% in 1977 to 3% in 2017). Finally, the remaining amount mainly consists of term securitizations which became significant in the early 2000s. With 22% of the bond market in 2017, term securitizations mainly consisted of mortgage-backed securities.

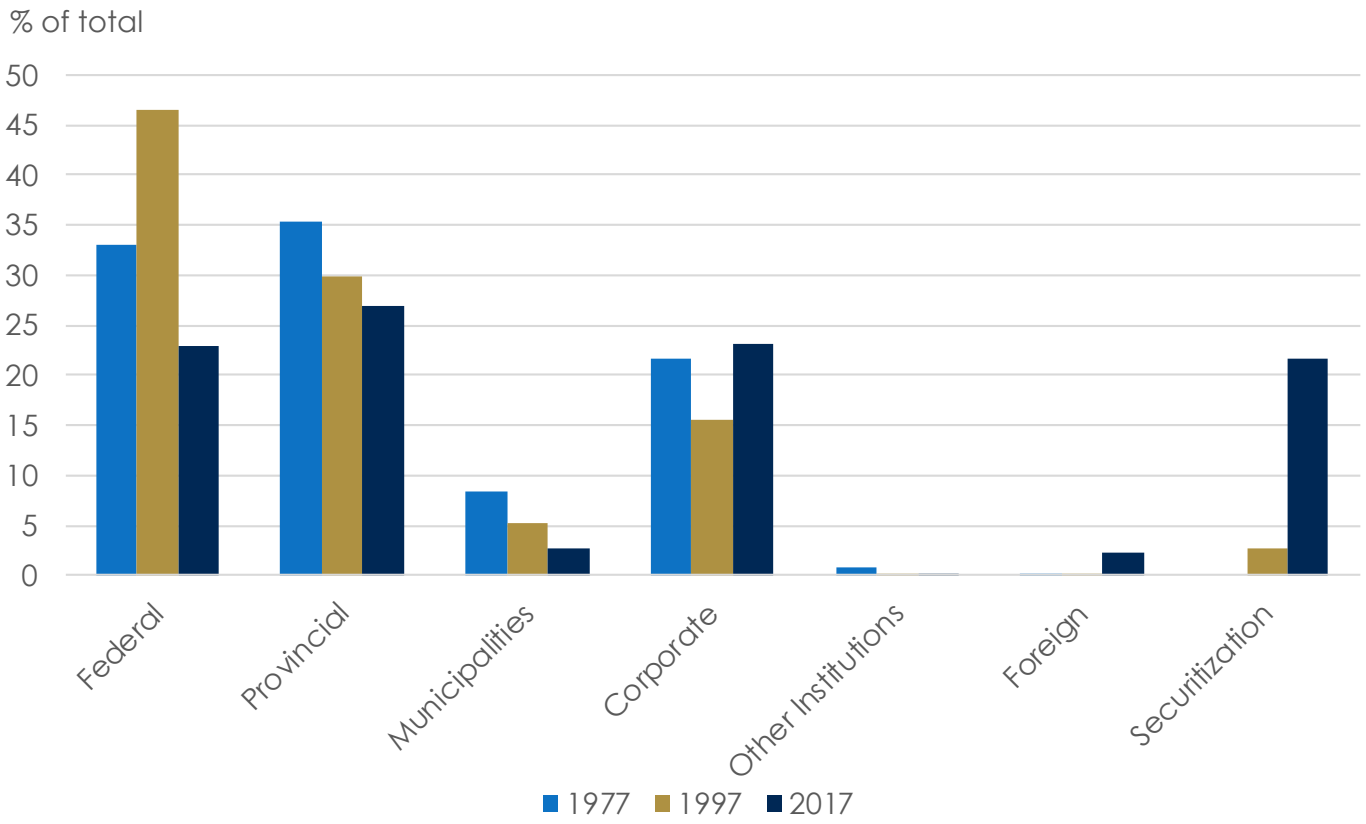
Chart A1-1: Bonds Outstanding By Type



Sources: Bank of Canada/Statistics Canada.
Notes: In Canadian dollars. Bonds are at par value and include both direct and guaranteed securities.

[a] The market for Government of Canada securities is also composed of a sizeable amount of Treasury bills and foreign debt.

Chart A1-2: Bonds Outstanding By Type



Source: Bank of Canada/Statistics Canada.
Notes: In Canadian dollars. Bonds are at par value and include both direct and guaranteed securities.

ANNEX 2

STATIONARITY AND COINTEGRATION

Since the data are organized in time series, we assess the stationarity of each variable. Since the number of panels is fixed and the number of time periods is assumed to converge to infinity, we first perform the Levin-Lin-Chu (2002) unit root test for panel data.[a] The number of differenced autoregressive (AR) terms to be included into each test is selected using the Bayesian Information Criterion (BIC). Then, because we assume heterogeneity across provincial AR terms, we perform an Augmented Dickey Fuller (Fisher ADF, Madala and Wu (1999) and Choi (2001)) test using the rounded average of the BIC lag number selected from the previous test (Table A2-1).[b]

TABLE A2-1: FISHER-TYPE AUGMENTED DICKEY-FULLER

Variable	Inversed x^2 p-Stat	t-Stat	p-value
Dependent Variable			
10-Year Prov. Bond Yield Spread*	35.9		0.02
5-Year Prov. Bond Yield Spread*	29.5		0.08
Independent Variable			
Primary Balance/GDP*	36.6		0.01
Net Debt/GDP*	13.9		0.84
Transfer/Revenue	23.8		0.25
Employment/Population*	21.6		0.36
Trade Openness*	33.7		0.03
Corporate Bond Spread**		-3.5	0.00
BBB-Rated Bond Spread**		-10.0	0.00
Bonds Outstanding (share of federal market size)	18.4		0.56
Bonds Outstanding (share of provincial market size)	33.1		0.03

Source: Institute of Fiscal Studies and Democracy.
* Shown as deviation from the federal government.
** Levin-Lin Chu (2002) Adjusted t-stat.

We find that the net debt-to-GDP, transfer-to-revenue, employment-to-population, trade openness and relative amount of bonds outstanding contain a unit root on average across panels. The dependant variable, the 10- or 5-year provincial bond spread, is found to be stationary as are trade openness (exports plus imports as a share of GDP), the primary account-to-GDP, and the corporate bond spread or the BBB-rated corporate bond spreads.[c]

[a] As recommended by Levin, Lin and Chu (2002), panel cross-sectional means are removed.

[b] Both of these tests are also recommended in Cameron and Trivedi (2009).

[c] Since corporate bond spreads do not vary across panels, it is not possible to estimate an ADF Fisher type test assuming heterogeneity across panels. In such cases, only the Levin, Lin and Chu (2002) test is used.

Following Booth et al. (2007), we also test for cointegration using the Pedroni test that allows for heterogeneity across panels. At the 5% significance level, both the Phillips-Perron and modified Phillips-Perron t-stat allows us to reject the null hypothesis of no cointegration across panels (Table A2-2 and A2-3). However, the Pedroni test states that the minimum sample size for the test statistics to reach nominal size is 250 periods and 60 panels, which is significantly larger than the sample size available for testing from provincial spreads data (29 periods and 10 provinces). We believe that one has to keep in mind this caveat when interpreting the estimation output.

TABLE A2-2: PEDRONI COINTEGRATION TEST FOR 10-YEAR SPREAD

	Statistic	p-value
Modified Phillips-Perron t	4.31	0.00
Phillips-Perron t	2.26	0.01
Augmented Dickey-Fuller t	1.16	0.12

Source: Institute of Fiscal Studies and Democracy.
Note: Include panel-specific means (fixed effects) that allows for heterogenity across panels.

TABLE A2-3: PEDRONI COINTEGRATION TEST FOR 5-YEAR SPREAD

	Statistic	p-value
Modified Phillips-Perron t	2.03	0.02
Phillips-Perron t	-2.18	0.01
Augmented Dickey-Fuller	-2.13	0.02

Source: Institute of Fiscal Studies and Democracy.
Note: Include panel-specific means (fixed effects) that allows for heterogenity across panels.

ROBUSTNESS AND ALTERNATIVE SPECIFICATIONS

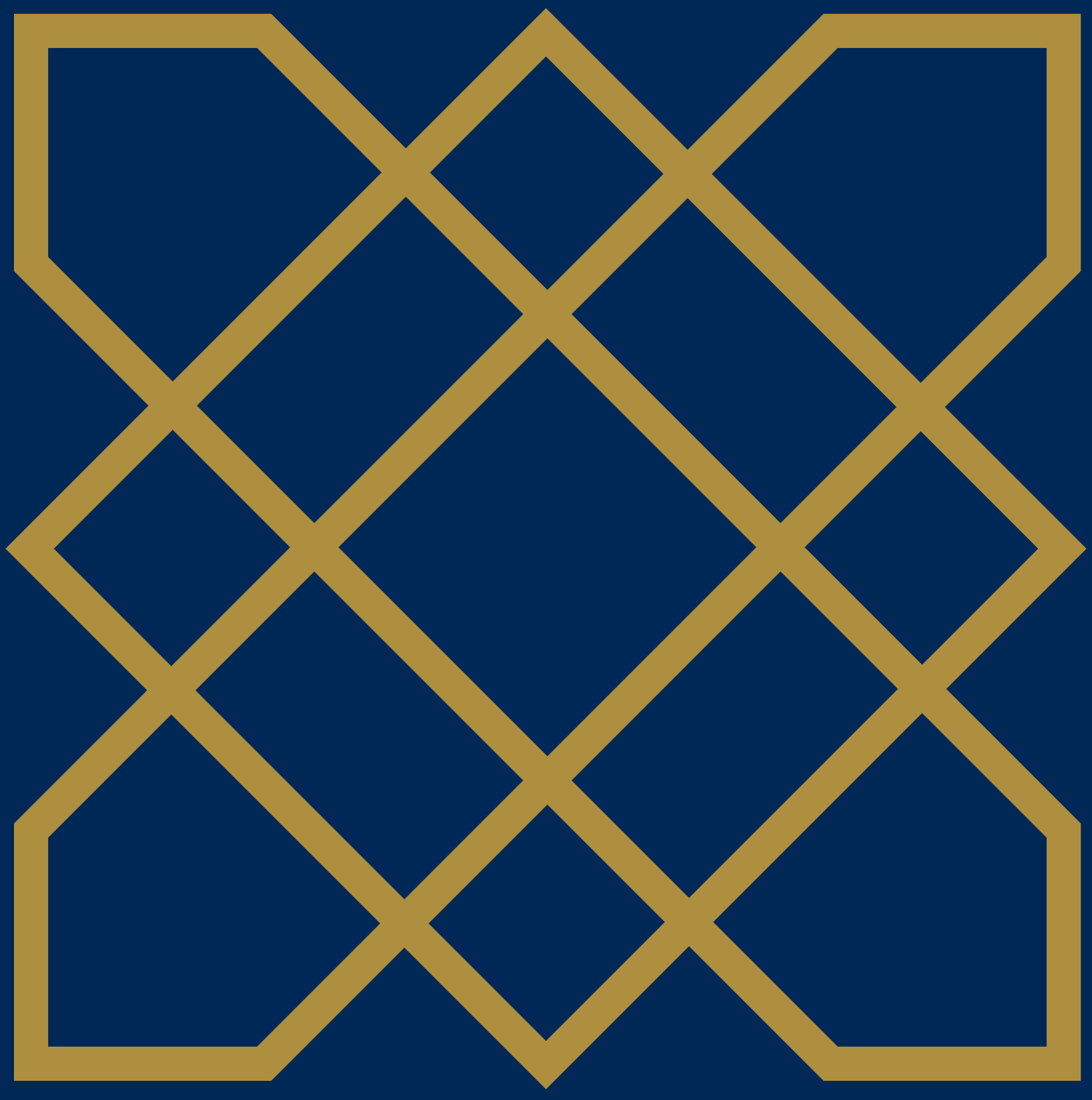
Modelling residuals as AR(1)

As a second verification on the appropriateness of assuming iid residuals after controlling for individual fixed effects, model (1) is estimated by formally modelling the regression residuals as a first order-autoregressive process (Model A3-1 in Table A3-1). The A3-1 coefficients are broadly in line with the base case model. One noticeable difference is the coefficient on the primary balance-to-GDP that becomes significant is now positive. The suggestion that a primary balance-to-GDP has a positive effect on the subnational spread is inconsistent with Equation (1), as discussed in the Results section above. Other differences include the federal transfers, the employment ratio and the liquidity variable becoming insignificant. Finally, the overall fit R^2 of the model is slightly improved due to an increased *between* R^2, partially offset by a lower *within* R^2.

TABLE A3-1: ESTIMATION RESULTS

Variable/Specification	1	A3-1
Primary Balance/GDP[a]	-0.04 (0.50)	1.17* (0.43)
Net Debt/GDP[a]	0.50* (0.09)	0.41* (0.14)
Transfer/Revenue	-0.44** (0.22)	0.28 (0.23)
Employment/ Population	-1.11** (0.56)	-0.60 (0.70)
Trade Openness	-3.42* (0.55)	-1.27** (0.58)
Corporate Bond Spread	0.52* (0.02)	0.44* (0.02)
Bonds Outstanding (share of federal market size)	-0.65** (0.31)	-0.48 (0.48)
Constant (fixed effects)	413.63* (57.86)	173.97* (12.33)
R^2 (Overall)	0.57	0.61
R^2 (Within)	0.74	0.70
R^2 (Between)	0.58	0.67

Source: Institute of Fiscal Studies and Democracy.
Notes: Numbers in bracket represent standard deviation. Legend: *** p<.1; ** p<.05; * p<.01. [a]Deviation from the federal government.



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